In addition to potential well yield, some physical chemical analysis was done on water quality from the well. The water quality issues which were analyzed indicate that the well is sufficient for domestic water purposes. Also, the hydrogeologist concluded that the wells will not be under the influence of surface water. However, additional investigation will need to be conducted when the first wells are constructed to verify this conclusion. It is opinioned by the geologists that water can be delivered from the wells directly to a transmission system for delivery to the regional water users without major treatment. The only treatment that will be required will be for disinfection. It is proposed that chlorine will be used as the disinfection medium. It is also recommended, although not required, that chemicals be added to adjust the pH of the water to reduce its corrosion potential.

Assuming the minimum yield of approximately 400 gpm per well, the well site appears to have the potential to serve the region's peak day water demand through the year 2050. That is, approximately four wells can be developed at the proposed site. Each well will have a capacity of approximately 400 to 600 gpm. Minimum yield at this site is estimated to be about 1,600 gpm. The peak day demand for the proposed regional users will be approximately 1,450 gpm.

As the AGI report suggests, we strongly recommend that the existing test well be improved to a production well including the installation of well screens and gravel packing, test pumping for a full 24-hour period, and a complete and thorough chemical and physical analysis of the water near the conclusion of the test pumping.

CHAPTER 5

PROPOSED WATER SOURCE AND IMPROVEMENTS

5.1 Proposed Water Source

The proposed water source for the Cities of Wheeler and Manzanita is recommended to be a groundwater source located at approximate River Mile 10.6 along the north bank of the Nehalem River between the river and the existing railroad tracks. The proposed site is currently owned by Mr. and Mrs. Forster. The cities should proceed with development of a legal description of the proposed property to be purchased and exercise its current option with the Forsters.

The proposed water source should initially consist of a minimum of two wells, each with a capacity of at least 400 gpm. Total groundwater capacity would then be 800 gpm, or a little over 1 mgd. The initial two wells will meet the region's projected need through the year 2010. Prior to the year 2010, the regional water system should anticipate constructing additional wells, Wells No. 3 and 4. Therefore, it is also recommended that the regional water supply authority begin negotiations with Mr. and Mrs. Forster for eventual purchase of more than the initial two acres. Approximately 15 acres may eventually be needed to serve the current proposed users, together with the future service to Rockaway Beach, Nehalem, and/or Neahkahnie. Additional hydrogeologic studies should also be undertaken to more thoroughly map the area's groundwater potential.

5.2 Proposed Improvements

Proposed improvements to develop the recommended groundwater supply will include, as a minimum, the following:

Item No.	Description
1.	Two wells
2.	Chlorine disinfection system and pH adjustment
3.	Telemetering
4.	Pipelines

A. Wells to Chlorinator System
B. Chlorinator System to Mohler
C. Mohler to Reservoirs

D. Reservoirs to Highway 101
E. Highway 101 to Manzanita
F. Highway 101 to Wheeler
G. Wheeler to Brighton

5. Reservoir (2 mg)

6. Master meters and pressure regulating valves at each service connection to Zadduck Creek, Mr. and Mrs. Forster, Tideland, Manzanita, Wheeler, Brighton, and Nehalem Bay State Park.

A schematic of the proposed Capital Improvements is shown in Figure 5.1. The proposed improvements will include several river crossings, bridge crossings at Highway 53, Highway 101, and the railroad bridge on Highway 101, boring underneath the Port of Tillamook Bay Railroad's rights-of-way, and several highway or road borings.

Where the pipeline crosses existing drainages or small streams, the pipeline will be constructed during the time frame allowed by the Oregon Department of Fish & Wildlife, or the crossings will be bored.

5.3 Pipelines

Pipelines to be constructed from the well site to Manzanita and Wheeler are shown to be located along the County road which parallels the Nehalem River on the north side. The pipeline will be routed to Mohler, Highway 53, and along Highway 53 and/or the old Mohler Highway to Highway 101. A separate pipeline will lead to a reservoir located to have an overflow elevation of about 340 feet.

The pipeline is proposed to be constructed of ductile iron. It is assumed that the majority of the pipeline route will need to be constructed with backfill of 3/4" crushed jrock to be in compliance with County jRoad and State Highway Department requirements. Ductile iron is selected primarily to resist slight movements in the ground due to natural slides and/or earhtquake potential of the area. PVC pipe is more subject to shear and pipe failure resulting from minor earth movements than is ductile iron and is, therefore, not recommended.

The pipe sizes have been selected so as to provide for water at a peak day rate to the existing water systems and existing reservoirs. A hydraulic network model was perfoemd on the computer to verify the pipe sizes.

The pipe lengths are shown to the closest 500 feet. No attempt has been made to survey the pipe routings at this time. Rather, scale dimensions have been used.

5.4 Reservoir

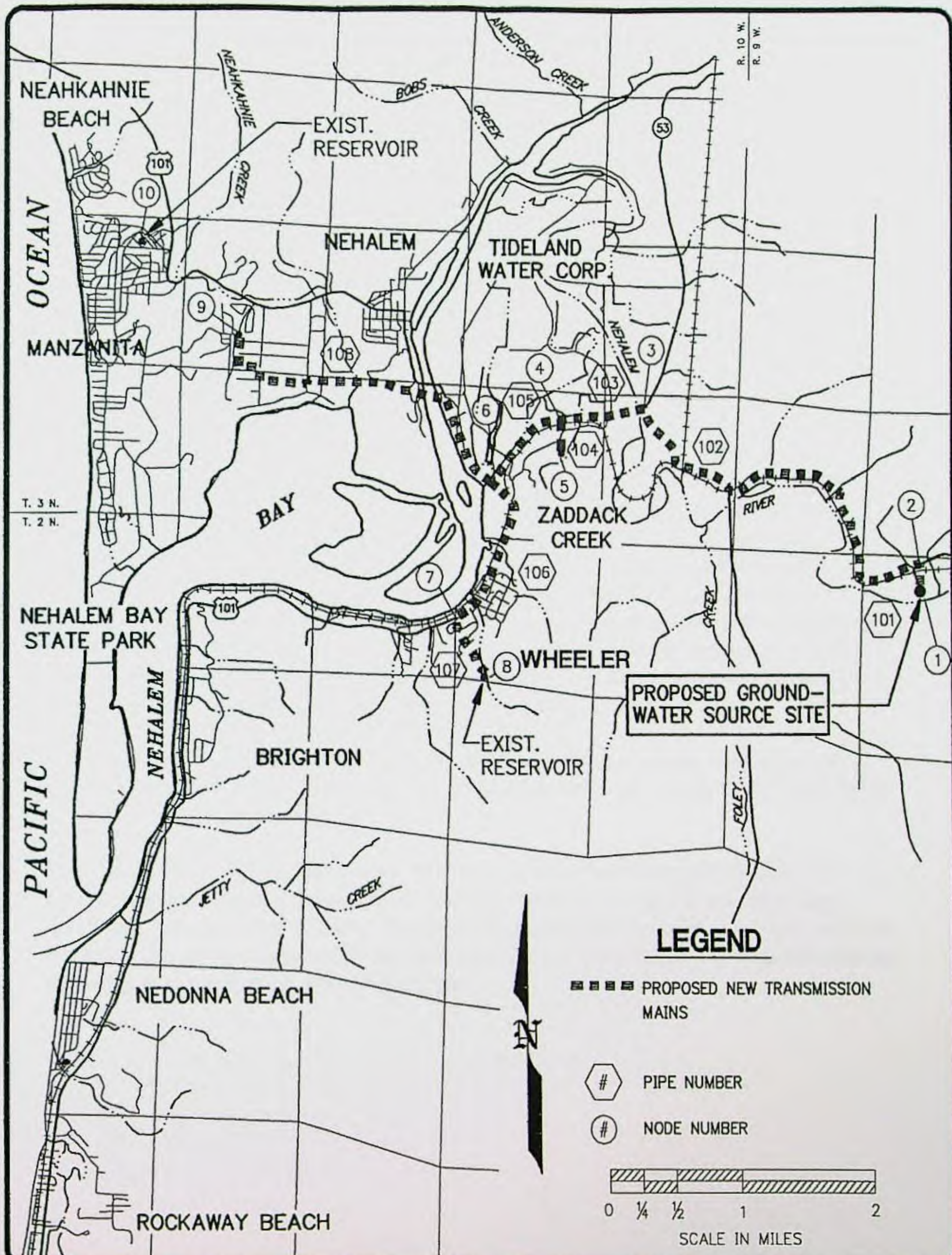
The reservoir volume has been selected to be the lesser of peak day demand or three times average day demand. For purposes of preliminary sizing, it appears that the peak day demand of a little over 2 mgd near the year 2050 controls. It is assumed that the reservoir for the regional supply, together with the reservoirs for each city, will suffice to provide a reasonable and reliable source of water during periods of minor power fialure, breaks, or other interruption of flow of water in the transmission mains, pump failures, and other emergency situations.

The reservoir is proposed to be located between Mohler and Wheeler. No specific site has been selected. However, the overflow elevation will need to be about 340 feet mean sea level. The reservoir may be constructed of either concrete or steel. However, it is recommended that the reservoir be concrete and that it be buried. The primary reason for this recommendation deals with the low maintenance costs associated with concrete and the fact that concrete reservoirs that are buried have a much better potential for resisting earthquake damage than do steel tanks constructed above ground.

5.5 Well Site Issues

The primary concern about the well site is the potential flooding of the site. The U.S. Army Corps of Engineers project that the peak 500 year storm event will cause a water level to be about 34.7 feet. The natural ground level at the site is about 24 to 26 feet. Therefore, about 8 or 9 feet of fill at the well sites will be necessary to place the well vent and other equipment above the projected 500 year floodplain. This issue must be addressed with the U.S. Army Corps of Engineers and the Division of State Lands before final details of the well construction can be determined.

The proposed well sites are not, in our opinion, located in a wetlands area or in other environmentally sensitive areas. Also, it does not appear from a brief inspection that any upstream residential housing units or other structures would be impacted by the minor hydraulic change in the potential flood levels that would occur due to the proposed construction of the wells.



OWNER: CITY OF WHEELER	LEE ENGINEERING, INC. 1300 JOHN ADAMS ST. OREGON CITY, OR. 97045		
DWG TITLE: PROPOSED WATER SOURCE	DATE: OCT '94 FILE NO: 1307P05	REVISED:	FIGURE 5.1

CHAPTER 6

COST ESTIMATES

6.1 General

In determining the capital cost estimates for the various elements of the proposed water source development, very generalized cost estimating was used. No attempt was made to develop the project to a level of preliminary engineering. Preliminary designs are beyond the scope of this report. Rather, standard cost guidelines were used when they were appropriate. In some cases, information was taken from similar projects in the Northwest Oregon region.

Since the Engineer has no control over the cost of labor, materials, equipment or services furnished by others, or the future contractor's methods for determining prices or competitive bidding or marketing conditions, the Engineer's opinion of probable total project cost and construction cost provided herein is made on the basis of the Engineer's experience and qualifications and represents the Engineer's best judgment as an experienced and qualified professional engineer familiar with the construction industry as it relates to water system improvements. The Engineer cannot and does not guarantee that proposals, bids, or actual total project or construction costs will not vary from the opinion of probable costs prepared herein. It is strongly recommended that before major financing for any of these projects is implemented, a more detailed preliminary engineering study be undertaken.

Cost estimates for Capital Improvement Programs are presented as project costs consisting of estimated construction costs, property costs, and allowances to cover for the cost of engineering, contingencies, and administration.

Construction costs will vary with time. Therefore, we have indexed the costs herein to the *Engineering News Record* Construction Cost Index, effective as of October of 1994, more specifically, an ENR Index of 5450. For future estimates of cost, the index at that time, actual or projected, should be used to update the costs form those projected herein. Construction costs are escalating at a rate of about 3% or 4% per year.

TABLE 6.1
CITY OF WHEELER AND CITY OF MANZANITA
WATER FACILITIES MASTER PLAN UPDATE
PROPOSED CAPITAL IMPROVEMENTS

ITEM	DESCRIPTION		COST ESTIMATE	
1.	Two Wells		$	175,000
	A. Land Cost		$	25,000
2.	Chlorine and pH Adjustment		$	100,000
3.	Telemetering		$	40,000
4.	Pipelines			
	A. Wells to Cl_2	1,300 12"	$	52,000
	B. Cl_2 to Mohler	17,000 12"	$	680,000
	C. Mohler to Res.	8,000 12"	$	337,000
	D. Res. to Hwy 101	1,000 12"	$	50,000
	E. Hwy 101 to Manz.	17,500 10"	$	647,500
	F. Hwy 101 to Wheeler	7,000 6"	$	224,500
	G. Wheeler to Brighton	16,000 2"	$	160,000
5.	Reservoir, 2 mg		$	650,000
	A. Land and Easement Cost		$	10,000
6.	Master Meters and PRV's			
	A. Zadduck Creek		$	1,500
	B. Forster's		$	2,500
	C. Tideland		$	3,000
	D. Manzanita		$	10,000
	E. Wheeler		$	10,000
	F. Brighton		$	3,000
	G. Nehalem Bay State Park		$	0
	SUBTOTAL:		$	3,181,000
	ENGINEERING & CONTINGENCY @ 30%		$	943,300
	TOTAL ESTIMATED PROJECT COST:		$	4,135,300
	INTERIM FINANCING & INFLATION @ 10%		$	413,530
	TOTAL PROJECT BUDGET:		$	4,548,830

CHAPTER 7

PROJECTED USER FEES

7.1 Projected User Fees

The total estimated project costs for the regional water supply is approximately $4,550,000. It is estimated that about 5,219 connections will receive benefit from the regional water supply through the year 2050. This equates to $872 per equivalent residential connection.

The unit cost of water to the future users will include the payment of debt on the capital investment, plus allowance for operation and maintenance. If the debt is assumed by the Farmers Home Administration at 5% interest rate for 30 years, the average annual cost for debt retirement will be about $60 per household. Annual power costs for a house that uses about 8,000 gallons per month is estimated at $9.20, assuming $.06 per kilowatt hour. The local Tillamook County Peoples Utility District actually charges only about $.03 to $.04 per kilowatt hour. However, it is believed that the $.06 per kilowatt hour may be more realistic in the future, and the $9.20 per year for power costs is suggested.

In addition to these costs, allowance needs to be made for general maintenance and administrative overhead.

The total estimated user cost per year is about $167, or $14 per month. This cost relates only to the wholesale cost of water. It does not include the normal operation and maintenance costs of the individual user's distribution network, including their own distribution pipelines, reservoirs, meters, and other system components. Another way of analyzing the cost of providing a regional water supply is to base the cost estimate on a unit measure of water. For example, the above estimate per month is based on a use of 8,000 gallons per month per household. Therefore, the unit cost of water would be about $1.70 per 1,000 gallons.

This approach also assumes that future users will pay for connecting with the system through System Development Charges. The System Development Charge will depend on when the new customer connects to the system. This value should be escalated each year based on the amortization schedule which is finally adopted to finance the capital improvements. This way, the existing users will not be paying for the oversizing necessary to provide service to future customers.

In order to determine the financial feasibility of the proposed project, an estimate has been made of the water rates that would be necessary to fund the annual debt service and annual O&M expenses anticipated over the next 30 years. Table 7.1 assumes that the debt service will be financed by a loan from the Farmers Home Administration at a rate of 5% per year for 30 years. Inflation is assumed to occur at 4% per year on the annual Operation and Maintenance expenses.

A brief summary of each of the columns in the table follows.

Columns 1 and 2 - The row and year beginning in 1994, concluding at the year 2024, thirty years following project inception.

Column 3 - Estimated Number of Customers - Taken from Table 3.1.

Column 4 - Estimated Water Sales in 1,000's of Gallons, beginning in 1995. Practically, water sales may not begin until 1996, but the table would remain similar, except that everything would shift one year.

Column 5 - Estimated SDC Rate. System Development Charges would be levied against each new connection, beginning in 1995 or 1996. Since the rates will include principal and interest payments for years following the date of connection, the SDC starts out at 0 and escalates to about $2,100 per year at year 30.

Column 6 - Estimated SDC Revenue, is calculated from the number of connections each year times the SDC rate in the given year.

Column 7 - Annual Debit Service, is the proposed $4.55 million debt multiplied by the capital recovery factor, giving it an annual principal and interest payment as required by Oregon statute. The annual principal and interest payment would be $296,000 per year for each of the 30-year bond schedule.

Column 8 is the Estimated Annual O&M Expenses. These expenses are escalated at the rate of about 4% per year for inflation.

Column 9 - Estimated Fees/1,000 Gallons, is essentially the annual O&M debt plus the annual operation and maintenance expense divided by the total annual sales in 1,000's of gallons. The estimated commodity charge for water will vary from about $3.28 to $1.50 at the end of 30 years. Obviously, from the table, the straight line projection of the numbers puts a heavy burden on the initial customers. Therefore, it is suggested that attempts be made to adjust the fee schedule and the debt service so that more of the debt is paid later in term. By restructuring the debt, it will be possible to keep commodity costs for water in the range of $1.70 to $2.14 over the terms of the bonds.

As can be seen from Table 7.1, both approaches to the debt payment provide equal commodity costs for water in about the year 2013. Under the straight line projection, more costs are incurred up front, and the costs are then spread out as more customers connect to the system. Under the structured debt service column, costs are kept to a minimum early on in the project, and as more customers connect, then costs are shared more equitably. This approach will require some negotiations with Farmers Home Administration and/or the bond carriers. It may also require that FmHA or OEDD provide some grants in order to keep initial costs within reason.

The March 1993 North Tillamook County Regional Water Supply Master Plan projected that water would cost about $1.03 per 1,000 gallons. The primary difference between pervious and current projections is the fact that the previous projections included service to Rockaway Beach, Nehalem, and Neahkahnie. The unit cost of production can be reduced by including more users in the system. This results from a general economy of scale. That is, the more users, the less will be the unit cost of water. The new projections also anticipate a 30-year bond term, rather than 40 years assumed in the previous report. Oregon statute limits bond terms for water authorities to 30 years.

7.2 Future Organizational Structure

In recent conversations between Wheeler and Manzanita, it is the general consensus that a water authority should be formed with the primary responsibility for delivering wholesale water to the various wholesale customers. Water authorities may be formed from existing cities, water districts, or other entities. In this case, the various entities can form a water authority as provided in ORS 450.650 through 450.700. A copy of the existing statute is enclosed in the Appendix.

It is suggested that the water authority be formed by the Cities of Wheeler and Manzanita through enacting appropriate resolutions. The resolutions shall set forth the names and boundaries of the proposed water supply authority. The boundaries need not be contiguous. The Cities of Wheeler and Manzanita should file their resolutions with the Tillamook County Board of Commissioners.

Upon receipt of the resolution, the Tillamook County Commission will need to determine that provision of potable water to the area within the proposed water authority can best be achieved by creation of a water authority rather than by water districts or cities. In making this determination, the County Commission is to consider several factors outlined in the statutes, including the ability of the proposed authority to provide water service, the effects of both long and short term rates for patrons, the impact of the proposed water authority on adjacent special districts or cities, and the consistency of the proposed water authority with the adopted Comprehensive Plan of the County within the boundaries of the proposed water authority.

Following the determination of the above informaiton, the Tillamook County Commission is to set a public hearing on the proposal. The hearing and election on the proposal and election of board members shall be conducted as provided by ORS 198.800 to 198.825.

According to the law, a water authority is a municipality and may issue revenue bonds to finance proposed construciton. ORS 450.895 limits the term on the bonds to a maximum of 30 years from the date of issue.

Another unique aspect of water authorities is the right to acquire water rights, either independently or from municipalities or districts upon its inception. Further, a water supply authority may change the points of diversion of water or move water intake sources as specified in the water rights permits or certificates of those districts or municipalities that were merged into the water authority. In general, the primary purpose of the water authority is to operate a municipal organization whose primary function is the supply of domestic water. However, the water authority may extend its jurisdiction to the transmission, distribution and operation of individual water systems.

TABLE 7.1

CITIES OF WHEELER AND MANZANITA
WATER MASTER PLAN UPDATE
PROJECTED WATER RATES WITH INFLATION AT 4% PER YEAR

ITEM	YEAR	ESTIMATED NUMBER CUSTOMERS	ESTIMATED WATER SALES 1000 GAL	ESTIMATED SDC RATE	ESTIMATED SDC REVENUE	ANNUAL DEBIT SERVICE	ANNUAL O&M EXPENSE	ESTIMATED FEES/1000 GAL	FEES WITH STRUCTURED DEBIT SERVICE
0	1994	1614	0	$0	$0	$0			
1	1995	1640	113735	$70	$1,833	$296,000	$79,428	$3.28	$1.70
2	1996	1694	117491	$140	$7,578	$296,000	$83,012	$3.16	$1.71
3	1997	1750	121314	$210	$11,572	$296,000	$86,762	$3.06	$1.72
4	1998	1806	125208	$280	$15,712	$296,000	$90,688	$2.96	$1.72
5	1999	1863	129174	$350	$20,004	$296,000	$94,798	$2.87	$1.73
6	2000	1921	133214	$420	$24,455	$296,000	$99,102	$2.78	$1.74
7	2001	1980	137331	$490	$29,072	$296,000	$103,607	$2.70	$1.75
8	2002	2041	141526	$560	$33,861	$296,000	$108,326	$2.62	$1.77
9	2003	2103	145803	$630	$38,831	$296,000	$113,268	$2.54	$1.78
10	2004	2166	150164	$700	$43,989	$296,000	$118,444	$2.47	$1.79
11	2005	2230	154610	$769	$49,344	$296,000	$123,866	$2.40	$1.80
12	2006	2295	159146	$839	$54,904	$296,000	$129,547	$2.33	$1.81
13	2007	2362	163772	$909	$60,678	$296,000	$135,499	$2.26	$1.83
14	2008	2430	168493	$979	$66,675	$296,000	$141,737	$2.20	$1.84
15	2009	2499	173311	$1,049	$72,905	$296,000	$148,274	$2.14	$1.86
16	2010	2570	178229	$1,119	$79,377	$296,000	$155,126	$2.09	$1.87
17	2011	2643	183249	$1,189	$86,103	$296,000	$162,309	$2.03	$1.89
18	2012	2717	188376	$1,259	$93,091	$296,000	$169,840	$1.98	$1.90

ITEM	YEAR	ESTIMATED NUMBER CUSTOMERS	ESTIMATED WATER SALES 1000 GAL	ESTIMATED SDC RATE	ESTIMATED SDC REVENUE	ANNUAL DEBIT SERVICE	ANNUAL O&M EXPENSE	ESTIMATED FEES/1000 GAL	FEES WITH STRUCTURED DEBIT SERVICE
19	2013	2792	193612	$1,329	$100,355	$296,000	$177,736	$1.93	$1.92
20	2014	2869	198960	$1,399	$107,905	$296,000	$186,018	$1.88	$1.93
21	2015	2948	204423	$1,469	$115,753	$296,000	$194,703	$1.83	$1.95
22	2016	3029	210007	$1,539	$123,912	$296,000	$203,815	$1.79	$1.97
23	2017	3111	215712	$1,609	$132,394	$296,000	$213,373	$1.75	$1.99
24	2018	3195	221545	$1,679	$141,213	$296,000	$223,403	$1.71	$2.01
25	2019	3281	227508	$1,749	$150,384	$296,000	$233,929	$1.67	$2.03
26	2020	3369	233605	$1,819	$159,919	$296,000	$244,977	$1.63	$2.05
27	2021	3459	239840	$1,889	$169,836	$296,000	$256,574	$1.60	$2.07
28	2022	3551	246217	$1,959	$180,148	$296,000	$268,749	$1.56	$2.09
29	2023	3645	252742	$2,029	$190,873	$296,000	$281,534	$1.53	$2.11
30	2024	3741	259417	$2,099	$202,027	$296,000	$294,960	$1.50	$2.14

CHAPTER 8

FUTURE TASKS

Several activities must be undertaken in order for the project to proceed. These tasks include, but may not be limited to, the following items.

8.1 Complete Well No. 1

It is recommended that the Cities of Wheeler and Manzanita extend the current financial request from the Oregon Department of Economic Development. A $10,000 grant has been received. The cities may borrow up to an additional $20,000 to proceed with completion of Well No. 1. This will then provide a more reliable well pumping test and a better analysis of the water chemisry and physical characteristics. This information will be invaluable during final design and will help address the issue of whether or not the wells will be under surface water influence.

8.2 Public Relations Campaign

Dr. Peter Scott of Lane Benton Community College has applied for and received a grant through RCA and EPA to undertake a public relations campaign to present to the city councils and the public at large the intent and scope of the proposed project. This campaign may be invaluable when an election is held to form the water authority and when the authority proceeds with final financing for the project. It is recommended that the two cities cooperate and enter into agreement with Dr. Scott and RCA for implementation of the proposed public relations program.

8.3 Property Purchase

It is recommended that the City of Wheeler proceed with the property purchase from Mr. and Mrs. Forster. There are still some minor issues remaining to be developed, including the arrangement for delivery of water to Mr. Forster at a stipulated rate, development of actual legal descriptions and property surveys for the property to be acquired, etc.

8.4 County Zone Change

Once the legal descriptions are completed, the cities should proceed with an application to Tillamook County for a community service zone at the proposed well sites. Application forms will need to be filled out and fees paid for the proposed zone change request.

8.5 Water Rights

The City has made application at River Mile 9.1 for a groundwater permit. This permit should be modified to apply to the proposed new well sites at River Mile 10.6. The new application should include all four proposed well sites as outlined herein.

8.6 Corps of Engineers, Division of State Lands, and DEQ Permits

In order for construction to occur within the floodplain, preliminary engineering details will need to be developed and coordinated with the Corps of Engineers, State Lands, and DEQ. There may also be some requirements under the County zoning regulations for certain conditions to be met to satisfy concerns about minor changes in the profile of the floodway. These changes will occur as a result of very small islands to be constructed at each well site and it is not anticipated that the proposed construction details will have any significant effect on the hydraulic capacity of the floodway.

8.7 Reservoir Sites and Easement

The City should immediately begin contacting potential property owners that may own sites suitable for the proposed reservoir. Ultimately, sites will need to be purchased and a pipeline easement obtained. Prior to the purchase, site surveys will need to be undertaken, legal descriptions drawn, soils and foundation studies completed, property corners set, etc.

8.8 Organizational Structure

As discussed in 7.2, the cities should undertake the formal actions necessary to form a water authority. Legal counsel will be required to assist the cities in this process.

8.9 Funding

The City of Wheeler has submitted on behalf of the regional authority a preapplication to Farmers Home Administration for funding of this project. In addition, OEDD should be contacted for grants and/or loans under the Water and Wastewater Financing Program. The FmHA application should be updated to include the new cost estimates.

The City of Wheeler should also apply for funds through the Farmers Home Administration to undertake improvements to its water system as outlined in the City's Water Facilities Master Plan.

8.10 Preliminary Design Report

Before final financing is arranged for this project, it is recommended that a preliminary design report be prepared once all of the above information is available. The preliminary design report should more accurately estimate the total costs for the project. Following preparation of the preliminary design report, a detailed financial feasibility analysis will be required prior to the sale of reveneue or general obligation bonds.

APPENDIX A

WATER SUPPLY AUTHORITIES

450.650 Board of directors; terms; qualifications. (1) The governing body of a water supply authority shall be a board of directors of seven members.

(2) The term of office of a director of a water supply authority is four years.

(3) Any elector residing within the proposed water supply authority is qualified to be a member of the board of directors of the authority.

(4) Notwithstanding subsection (3) of this section, a person who is an employee of a water supply authority is not qualified to serve as a director of the water supply authority by which the person is employed. [1987 c.863 §4; 1989 c.809 §2]

450.655 Methods of election of authority directors. (1) The directors of a water supply authority may be elected by one of the following methods:

(a) Elected by the electors of zones as nearly equal in population as feasible according to the latest federal decennial census.

(b) Elected at large by position number by the electors of the district.

(2) Candidates for election from zones shall be nominated by the electors of the zones.

(3) If the directors of the water supply authority are elected from zones, the board of the water supply authority, after each federal decennial census, shall adjust the boundaries of the zones to make them as nearly equal in population as feasible. [1987 c.863 §5]

450.658 Election of directors. (1) Seven directors of the water supply authority shall be elected at the election for formation of the authority or, if no election is held on the question of formation, at the election held under ORS 198.825.

(2) If the effective date of the formation of the water supply authority occurs in an odd-numbered year, four directors of the authority shall be elected for four-year terms and the other three directors shall be elected for two-year terms. If the effective date of the formation occurs in an even-numbered year, four directors shall be elected for three-year terms and the other three directors shall be elected for one-year terms. [1987 c.863 §6]

450.660 Water supply authority formation. A water supply authority may be formed by any of the methods provided for in ORS 450.665 to 450.680 or 450.785. [1987 c.863 §2]

450.665 Formation of authorities by special districts. A water supply authority may be formed as provided in ORS 198.800 to 198.825 except that:

(1) A petition for formation shall be signed by not less than 100 electors registered in the territory subject to the petition.

(2) In its order creating the water supply authority, the county board shall prescribe the method of election of the board of the proposed authority from among the methods described in ORS 450.655. If the county board determines that the directors of the water supply authority shall be elected from zones, the county board shall establish and describe the zones, using streets and other generally recognizable features. [1987 c.863 §3]

450.670 [1987 c.863 §9; 1989 c.809 §6; renumbered 450.987 in 1989]

450.675 Formation of authorities from areas within one or more counties. Any portion of one or more counties, including both incorporated and unincorporated areas as well as areas within domestic water supply districts, county service districts for water supply works and other districts may be formed into a water supply authority under ORS 450.650 to 450.989. Such areas need not be contiguous. [1971 c.504 §3]

450.680 Formation of authorities by cities and water districts. (1) The governing bodies of two or more cities, two or more water districts or one or more cities and one or more water districts, when they consider it necessary for the public health, safety and welfare, may initiate the formation of a water supply authority by resolution. The resolution shall set forth the name and boundaries of the proposed water supply authority. The governing bodies shall file the resolution with the governing body of the principal county, as defined in ORS 198.705. If any part of the proposed water supply authority is within a city, the resolution shall be accompanied by a certified copy of a resolution of the governing body of the city approving the resolution that initiates formation of the water supply authority.

(2) Upon receipt of the resolution, the county governing body or boundary commission shall determine that provision of potable water to the area within the proposed water authority can best be achieved by creation of a water authority rather than by water districts or cities. In making this determination, the county governing body shall consider the following factors:

(a) The ability of the proposed authority to provide water service to the area within the proposed authority;

(b) The effect on both long and short-term rates for patrons within the proposed authority;

(c) The impact, if any, of the proposed water authority on adjacent special districts and cities; and

(d) Consistency of the proposed water authority with the adopted comprehensive plan of the county within the boundaries of the proposed water authority.

(3) After the county governing body or boundary commission makes the determination under subsection (2) of this section, the county governing body shall by order provide for a public hearing on the proposal. The order shall set forth the date, time and place of the hearing. Notice of the hearing shall be given in the manner provided by ORS 198.800 except that the notice shall state that the governing bodies of the cities or water districts have filed a resolution with the county governing body declaring their intention to initiate formation. The hearing and election on the proposal, and election of board members, shall be conducted as provided by ORS 198.800 to 198.825. [1971 c.504 §4; 1983 c.740 §172; 1987 c.863 §11; 1989 c.809 §3]

450.685 Application of certain provisions to authorities. (1) Except as provided by subsection (2) of this section, ORS 450.070, 450.084, 450.085 and 450.650 to 450.989 apply to a water supply authority.

(2) ORS 450.810 (1), 450.815 (7), (8) and (9), 450.820 and 450.835 do not apply to a water supply authority.

(3) ORS 264.240, 264.250 (2), 264.300 to 264.320 and 264.505 to 264.840 are applicable to a water supply authority. [1971 c.504 §5; 1989 c.809 §4]

450.690 Purposes for which authority is municipality. A water supply authority is a municipality for the purposes of ORS 288.805 to 288.945, and revenue bonds issued by a water supply authority shall be issued in accordance with ORS 288.805 to 288.945. [1987 c.863 §8]

450.695 Acquisition of water rights; effect on priority of rights. (1) A water supply authority may acquire water rights from any municipality or any district, as defined in ORS 543.655. Upon request by the authority if the water right acquired was for municipal use, the Water Resources Commission shall issue a new water right certificate to the water supply authority preserving the previously established priority of water rights.

(2) In accordance with ORS 540.520 and 540.530, a water supply authority may change the points of diversion of water or move the water intake sources as specified in the water right permits or certificates of those districts or municipalities that were merged into the authority. [1989 c.707 §1]

Note: 450.695 and 450.700 were enacted into law by the Legislative Assembly but were not added to or made a part of ORS chapter 450 or any series therein by legislative action. See Preface to Oregon Revised Statutes for further explanation.

450.700 Acquisition of water rights; effect on prior rights. (1) A water supply authority may acquire water rights from any city or any district, as defined in ORS 543.655. Upon request by the authority, the Water Resources Commission shall issue a new water right certificate to the water supply authority preserving the previously established priority of water rights.

(2) Upon compliance with ORS 540.520 and 540.530, a water supply authority may change the points of diversion of water or move the water intake sources as specified in the water right permits of those districts that were merged into the authority. Upon the filing of notice of such changes with the Water Resources Department, the changes shall not impair any water right previously vested in those districts. [1989 c.809 §1]

Note: See note under ORS 450.695.

APPENDIX B

AGI TECHNOLOGIES

WHEELER TEST WELL REPORT
Tillamook County, Oregon

September 13, 1994

Prepared for:

Lee Engineering
1300 John Adams Street
Oregon City, Oregon 97405

AGI Project No. 15,792.001

A Report Prepared For:

Lee Engineering
1300 John Adams Street
Oregon City, Oregon 97405

WHEELER TEST WELL REPORT
Wheeler, Oregon

September 13, 1994

Douglas C. Dow
Senior Hydrogeologist

James R. Carr
Vice President

AGI Technologies
P.O. Box 1158
Gig Harbor, Washington 98335
206/851-5562

AGI Project No. 15,792.001

WHEELER TEST WELL REPORT

AGI Technologies was contracted by Lee Engineering to assist with development of a Municipal ground water supply for the City of Wheeler, Oregon. This report describes the results of investigations to select an appropriate site and conduct drilling at the selected site.

Surface Resistivity Survey

Surface resistivity profiling of property located on the north side of the Nehalem River at mile 10 showed good potential for water-bearing gravels to a depth of about 80 feet. The site map, **Figure 1**, shows the locations of the resistivity profiles. **Figures 2** and **3** show the resistivity results in cross section. After analyzing the results, we recommended installation of a test well at one of the following resistivity stations, 4, 6, 9, 10, or 13. American Drilling Company was selected to drill an 8-inch test well using the cable-tool method at Station 4. Construction and testing were conducted between August 16 and 18, 1994.

Test Well Results

The results of test drilling at Station 4 are shown in **Figure 4.** In drilling to a depth of 61 feet, two significant water-bearing zones were encountered. The first zone consists of a brown-red gravel found from 31.5 to 35 feet below ground surface. This shallow zone was tested with a centrifugal pump though the open bottom casing at 32 feet at various rates up to 62 gallons per minute (gpm) for 45 minutes. This test showed a specific capacity of 7.6 gallons per minute per foot (gpm/ft).

A second, more productive zone was encountered between depths of 45 and 60 feet. As shown in **Figure 4,** three feet of water-bearing gravel between 45 and 48 feet overlie a transition zone of gravel and cemented sand between 48 and 50 feet. A bail test was performed with the 8-inch casing shoe at a depth of 48 feet and uncased hole to a depth of 55 feet in the cemented sand. Bailing at a rate of approximately 66 gpm produced no measurable drawdown. The casing was then advanced to 50 feet in order to conduct a pumping test with the centrifugal pump. The 8-inch casing slowed its advance significantly at 50 feet, where it penetrated cemented sand.

With the casing at a depth of 50 feet, the water appeared to be shut off, and open hole drilling continued through easily drilled cemented sand, which is probably fractured and weathered sandstone bedrock, to a depth of 60 feet. The drilled materials were bailed from the hole, and water re-entered the well.

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Drilling was followed by pumping at various rates up to 150 gpm for 60 minutes. The results show a specific capacity of 17.8 gpm/ft. Recovery was nearly instantaneous, indicating an inefficient well. The quick recovery also suggests the water may have been leaking down the outside of the 8-inch casing from the 45- to 48-foot water-bearing gravel zone. This zone showed a very high specific capacity during previous bail testing. Drilling continued in hard bedrock to a depth of 60.5 feet where drilling was stopped.

Water Quality

Water samples taken from the test well, the Nehalem River, Peterson Creek, and the Nehalem Redi-mix pond were analyzed in the field for temperature, conductivity, pH, iron, manganese, and chloride. The results are shown in **Table 1.**

One additional water sample taken from the 50- to 60-foot pumping test was sent to a laboratory for analysis of iron and manganese. The results shown in **Table 1** are included in the **Appendix** and show these parameters below maximum contaminant levels, with an iron concentration of 0.13 mg/L, and a manganese concentration of 0.046 mg/L.

TABLE 1

FIELD WATER QUALITY							
Source Name	Depth of Sample (ft.)	Temperature (°C)	Conductivity (μmhos)	pH	Iron (mg/L)	Manganese (mg/L)	Chloride (mg/L)
Site #4	32	10	90.5	6.89	0.06	0.06	16
Site #4	50 - 60	10	156.9	6.28	0.19	0.06	20
Nehalem River	Surface	19	96.5	6.43	0.04	0.02	70
Peterson Creek	Surface	13	87.7	6.83	0.11	0.00	20
Nehalem Redi-mix Pond	Surface	21	110.3	6.9	0.07	0.04	20
LABORATORY ANALYSIS							
Site #4	50 - 60'	—	—	—	0.13	0.046	—

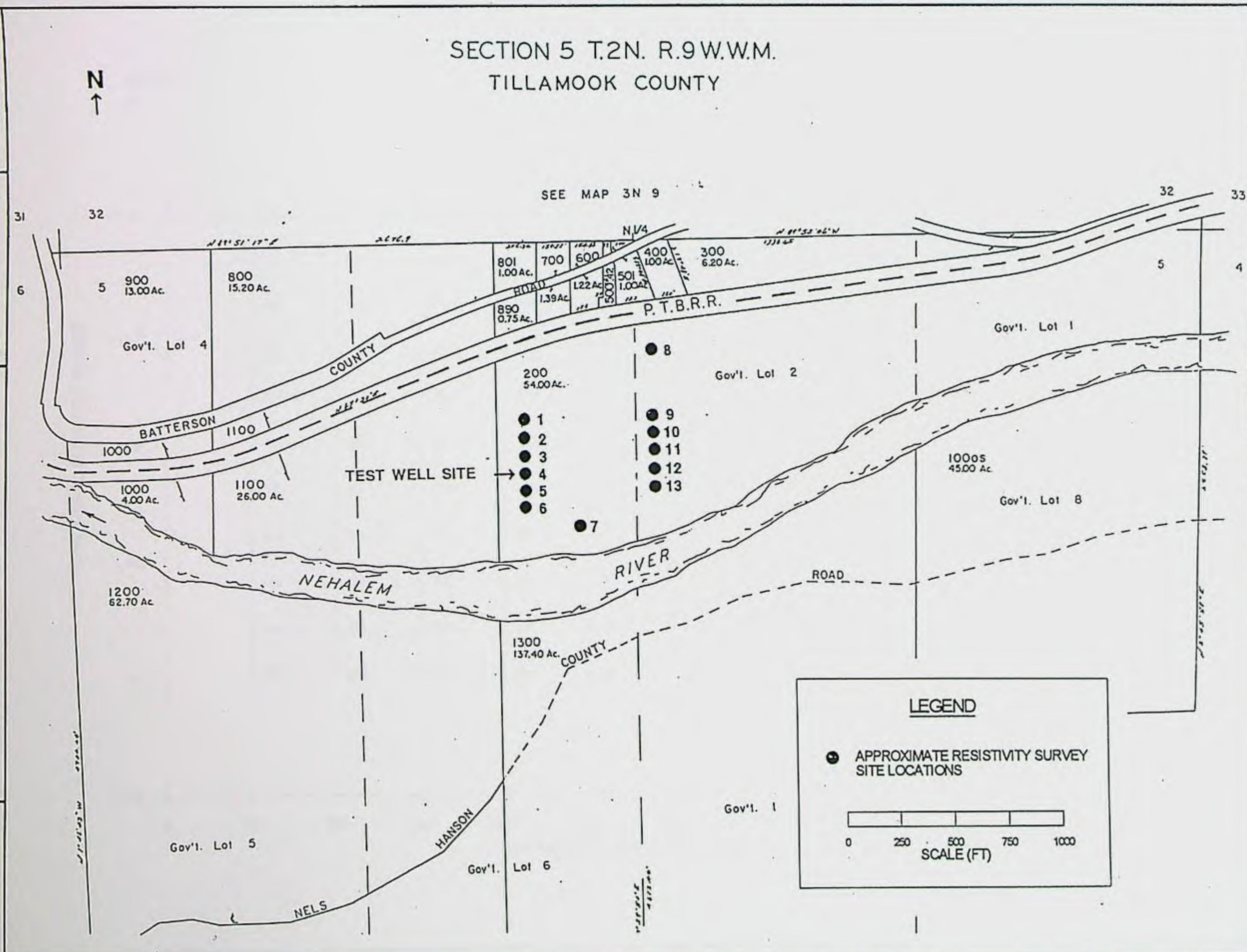
The field test results suggest the water in the lower zone is not in direct hydraulic continuity with the Nehalem River at this location. The lower water temperature, higher specific conductivity, and iron and manganese concentrations in the 45- to 60-foot zone indicate it is isolated from the river and shallow aquifer. The analyses indicate the shallow aquifer may have a more direct connection with the surface water. This aquifer's susceptibility to surface contamination is less than that of the shallow zone.

Optimum Yield

The optimum yield of a well completed in this aquifer can be estimated from the information collected during pumping and bail tests. The static water level is about 14 feet below ground surface. The top of the lower water-bearing gravel is 45 feet, leaving 31 feet of total available drawdown. A properly screened, efficient well should have a specific capacity of at least 17 to more than 20 gpm/ft. Allowing for pump submergence, seasonal water level fluctuations and interference from any additional wells, the useable drawdown is 20 feet. Therefore, the safe yield for this well, completed in the lower aquifer, is estimated to be about 400 gpm. Long-term testing is needed to establish the optimum yield of single or multiple wells completed in the lower zone of this site.

Conclusions and Recommendations

Based on these initial findings, three to four properly spaced wells producing about 400 gpm each might be constructed on this property. The subject test well is suitable for completion as the first production well. We recommend installation of 10 feet of stainless-steel well screen between 45 and 55 feet. After development, a 24-hour pumping test and complete water quality analysis will provide the information needed for design of a wellfield at this site. Better information could be obtained if at least one observation well is available during aquifer testing. If the City is ready to proceed with a wellfield, a larger diameter (12-inch) production well could be installed at one of the other recommended locations. The first test well could then be used as an observation/production well after completion, as recommended above.



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WHEELER OREGON
PROJECT: # 15782.001

TEST WELL AND RESISTIVITY SURVEY SITE LOCATION MAP

FIGURE 1

AGI TECHNOLOGIES

WHEELER OREGON
PROJECT: # 15792.001

SURFACE RESISTIVITY SURVEY RESULTS
STATIONS 1 THRU 7

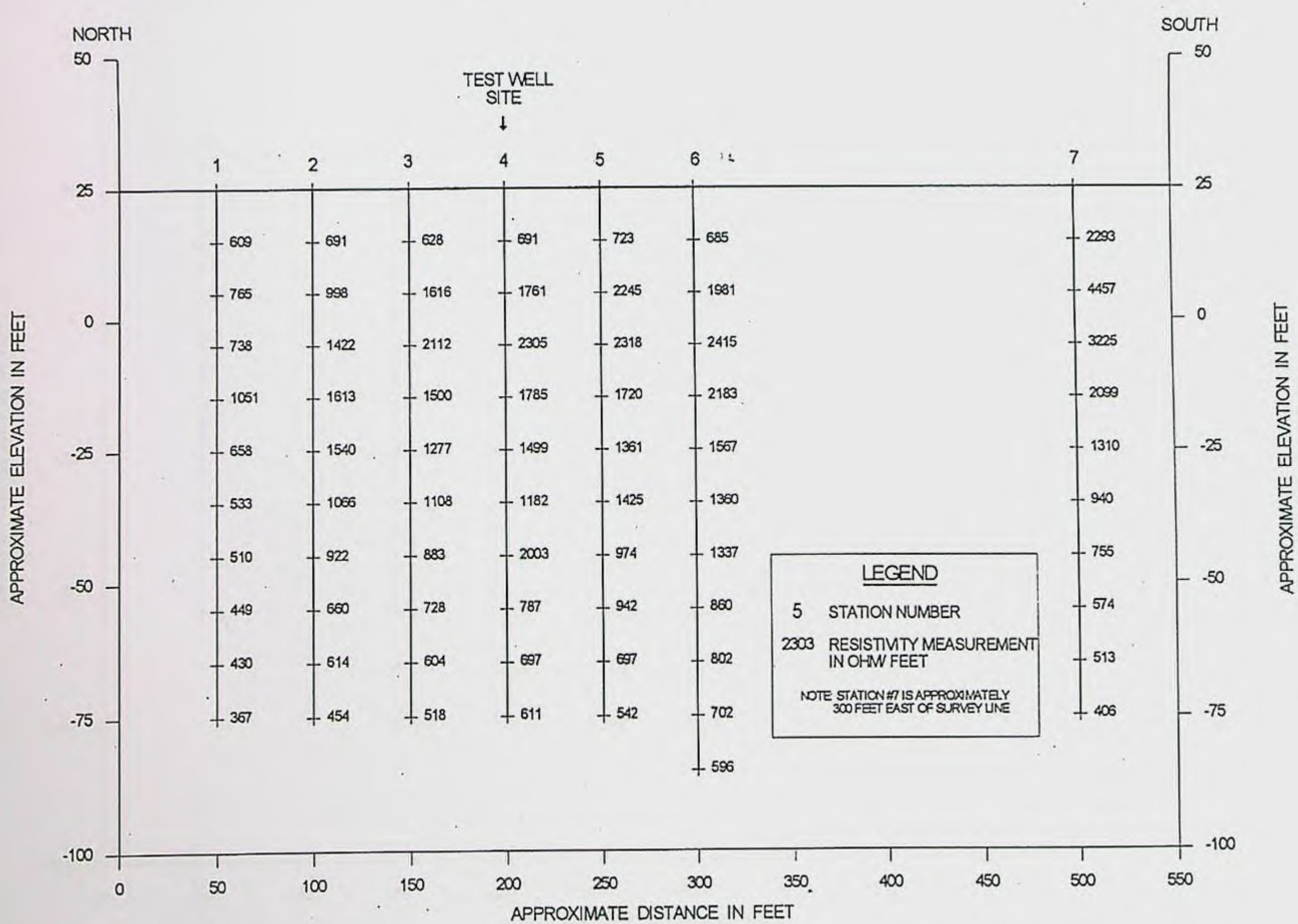


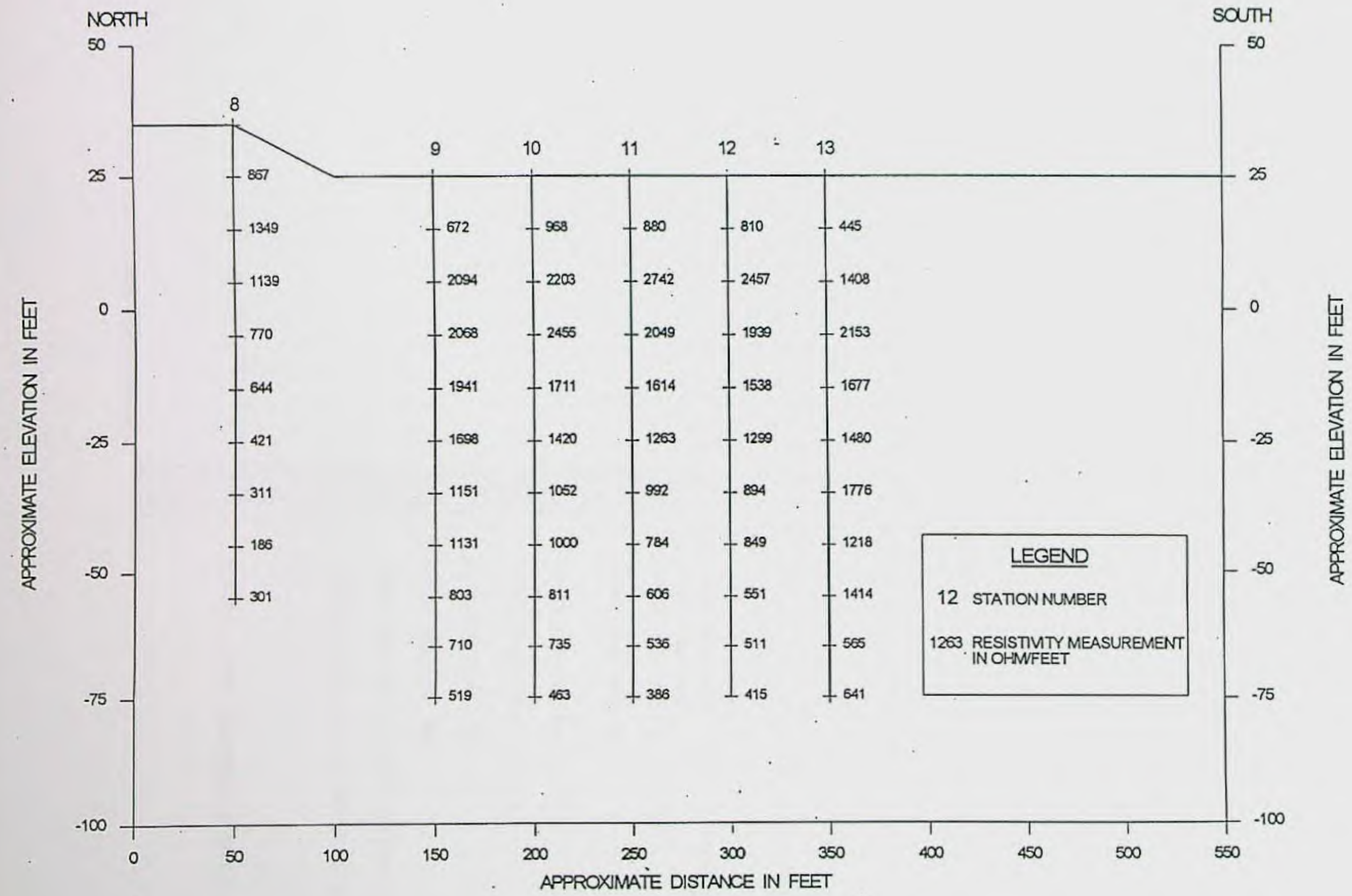
FIGURE 2

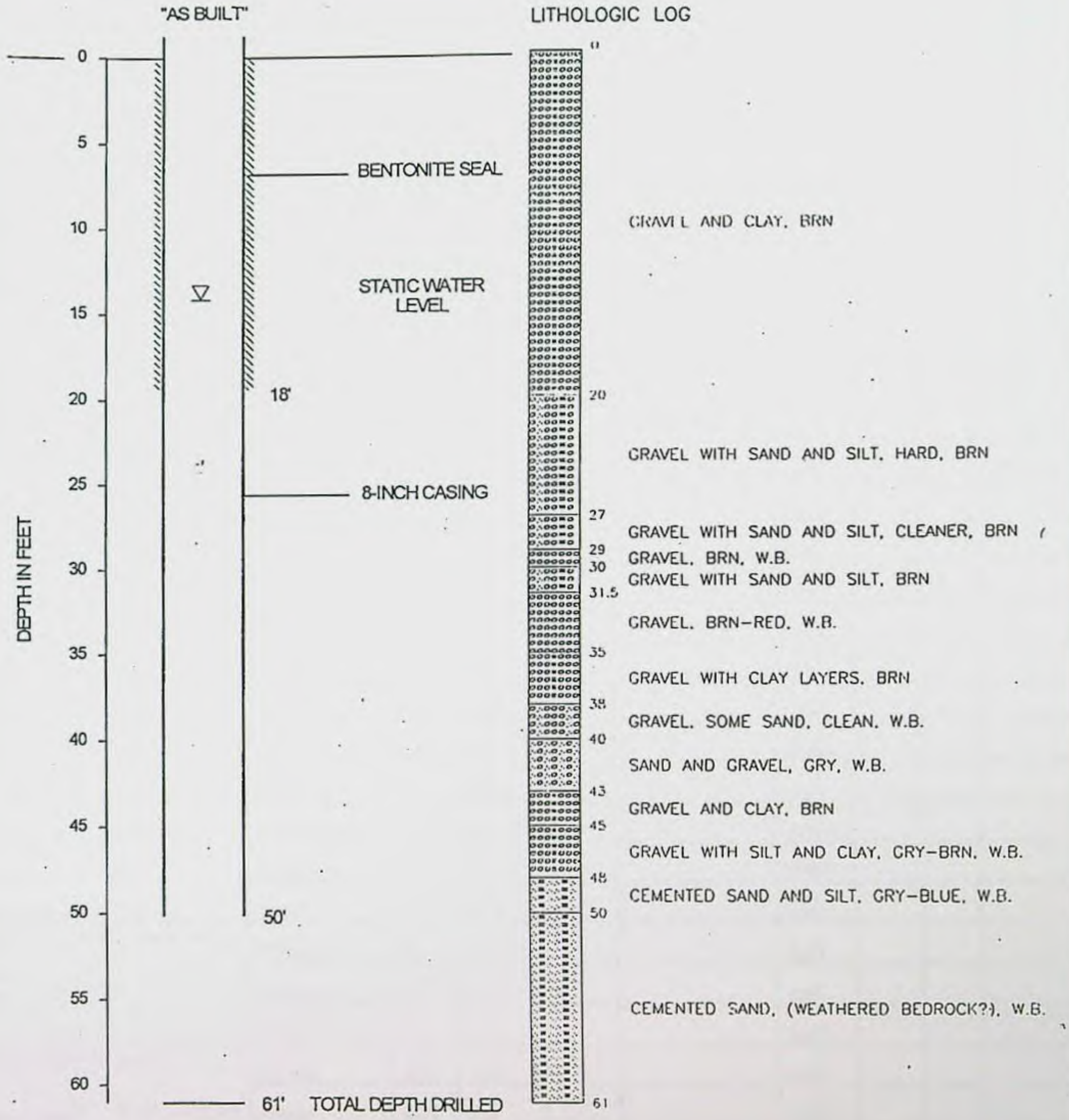
AGI TECHNOLOGIES

WHEELER OREGON
PROJECT: # 15792.001

SURFACE RESISTIVITY SURVEY RESULTS
STATIONS 8 THRU 13

FIGURE 3





AGI TECHNOLOGIES	WHEELER OREGON PROJECT: # 15792.001	LITHOLOGIC LOG AND "AS BUILT" DETAILS	FIGURE 4

SOUND ANALYTICAL SERVICES, INC.

4813 PACIFIC HIGHWAY EAST, TACOMA, WASHINGTON 98424 • TELEPHONE 206-922-2310 • FAX 206-922-5047

WATER SAMPLE INFORMATION FOR INORGANIC CHEMICAL ANALYSIS

DO NOT WRITE IN SHADED AREAS, PLEASE FILL BOXES NUMBERED 1 THRU 13, SEE BACK FOR INSTRUCTIONS

LABORATORY NUMBER: 107- 00908

DATE RECEIVED: 8-23-94

1. Date Collected: 8/18/94
2. System Name: Wheeler, OReGON
3. System ID
4. Circle Group: (A) B
5. County:
6. Source Type: (circle) Surface (Well) Spring Purchase
7. Sample Taken (circle) (Before Treatment) After Treatment
8. Source No.: Source Name: Res. site #4
10. Collected By: CR
    Telephone: (206) 851-5562
11. If taken after treatment, circle: Fluoridation Chlorination Filtration Other ________ Water Softener Type
12. If taken from distribution, indicate address
    Name:
13. Party to pay for testing:
    Name: AGF Technologies
    Address: po Box 1158 gig Harbor WA 98329
    Telephone: (206) ~~851-5562~~
14. Remarks: IRON & manganese ONly

LABORATORY REPORT
(Do Not Write Inside This Box)

Tests		MCL	Less Than <	Result	Units	Compliance Yes	Compliance No	Chemist Initials
Antimony	Sb	0.006			mg/L			
Arsenic	As	0.05			mg/L			
Barium	Ba	2.0			mg/L			
Beryllium	Be	0.004			mg/L			
Cadmium	Cd	0.005			mg/L			
Chromium	Cr	0.1			mg/L			
Copper	Cu	1.3			mg/L			
Iron	Fe	0.3		0.13	mg/L	/		SP
Lead	Pb	0.015			mg/L			
Manganese	Mn	0.05		0.046	mg/L	/		SP
Mercury	Hg	0.002			mg/L			
Nickel	Ni	0.1			mg/L			
Selenium	Se	0.050			mg/L			
Silver	Ag	0.1			mg/L			
Sodium	Na	None			mg/L			
Thallium	Tl	0.002			mg/L			
Zinc	Zn	5.0			mg/L			
Hardness		None			mg/L			
Conductivity		700			umhos			
Turbidity		1.0			NTU			
Color		15.0			Units			
Chloride	Cl	250			mg/L			
Cyanide	CN	0.2			mg/L			
Fluoride	F	2.0			mg/L			
Nitrate	as N	10.0			mg/L			
Nitrite	as N	1.0			mg/L			
Sulfate	SO_4	250			mg/L			
TDS		500			mg/L			

LABORATORY COMMENTS

42641

Laboratory Supervisor: Stan Palmquist

Date of Report: 8-25-94

MCL - Maximum Contaminant Level

Reference SOP #SAS-0513

WHITE COPY - STATE GREEN COPY - CUSTOMER BLUE COPY - LABORATORY GOLDENROD COPY - REGIONAL OFFICE

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PRODUCTION WELLS 1 AND 2
CONSTRUCTION AND TESTING REPORT
CITY OF WHEELER, OREGON

October 11, 1996

Prepared for:

Lee Engineering, Inc.
1300 John Adams
Oregon City, Oregon 97045

AGI Project No. 15,792.005.06

AGI
TECHNOLOGIES

APR 2 2 1997

March 20, 1997

MAR 24 1997

Lee Engineering, Inc.
1300 John Adams Street
Oregon City, Oregon 97045

Attention: F. Duane Lee, P.E.

Subject: City of Wheeler Ground Water Development

Dear Duane:

As you requested, we reviewed the Oregon Trout letter of February 28, 1997. This letter addresses the concerns and comments raised by Steve Hinton, the Oregon Trout "River Keeper Coordinator." Mr. Hinton's comments show a lack of familiarity with the project, resulting in a misunderstanding of the facts and misinterpretation of the benefits of the project. He indicates that after review, we are "still unable to determine the net effect on the project and water quantity in the Nehalem system." The fact is that the project should not only benefit the local population, but also should be of great benefit to the health of the Nehalem estuary and its tributaries, fish runs, and biota populations.

As you know, AGI has performed a series of progressively informative investigations to evaluate this site. The first work involved earth resistivity surveys, followed by exploratory drilling, and then production well drilling and testing. Each phase of the work has shown the site is underlain by a complex series of permeable alluvial sand and gravel, which is layered and interwoven with much less permeable sediments, resulting from changes in grain size, sorting, and compaction, which separate ground and surface water at the site.

? Logs indicate mostly sand and gravel. Specific capacity, lithology, and depositional setting all suggest an unconfined aquifer.

These low permeability layers confine water in the production aquifer. The confinement is demonstrated by a water level rise in the well of about 30 to 40 feet above the top of the aquifer. This water level rise conclusively proves that ground water flow from the aquifer to the River is severely impeded by the overlying low permeability sediments. The confinement is confirmed by the response of ground water levels to pumping, the ground water gradient at the site, and water chemistry.

Doubt it. Could have analyzed [illegible] well for S. Did not. Why not?

The impacts on water levels from pumping the production aquifer are greater than those in shallow, overlying, water-bearing zones. The pumping tests also showed no measurable impact on the surface water gages in Peterson Creek. The reported drawdown of one-half inch in R1 is from a shallow sandpoint installed about 2.0 feet below ground surface adjacent to the river. R1 measures the shallow ground water adjacent to the River, not the water level in the River.

Essentially a constant head boundary considering the amt of wtr in the river vs the maximum amt of depletion caused by pump of wells.

The ground water gradient across the site indicates a westward or southwesterly flow toward the River at a gradient steeper than the River. Direct continuity between the local surface and ground water would necessitate parallel surface and ground water gradients.

Water quality data show ground water has higher concentrations of iron and specific conductance and lower temperature, turbidity, and dissolved oxygen than the Nehalem River and Peterson Creek. These differences indicate ground water has been in contact with the sedimentary host materials and out of atmospheric contact for considerable time prior to being pumped. The unchanging measurements of temperature and conductivity of ground water during 24-hour testing show surface water infiltration was not induced.

The results of exploration and testing at the site indicate confined aquifer conditions as described under Oregon Administrative Rules, Chapter 690. Therefore, by rule, the aquifer is not hydraulically connected to local surface water and is assumed not to substantially interfere with the surface water source.

This is an incorrect interpretation of the rules.
K.C. Wozniak

Even if the aquifer were unconfined, virtually no potential measurable impact on the Nehalem River would exist at the planned rates of withdrawal. USGS data from a 57-year stream gaging record at Station #14301000, located near Foss (about three miles upstream from the wellfield), has an average annual discharge of slightly less than 2 million acre feet. The seasonal lowflow of the Nehalem generally occurs in late August and is about 70 cubic feet per second (cfs) or 31,000 gpm. The historic minimum discharge at the Foss station of 34 cfs (15,000 gpm) occurred between August 29 and 31, 1967.

The flow of the Nehalem at the well site, three miles downgradient from Foss, is likely greater than the above flow rates. If we assume similar flow at the wellfield, then the proposed 1,700 gpm average withdrawal (for full buildout) represents less than 2.5 percent of the average annual minimum flow and less than five percent of the minimum flow of record. 1700 gpm = $\frac{3.79 \text{ cfs}}{34 \text{ cfs}}$ = 11% !!!

Based on our investigation and the available data, producing ground water from this wellfield is not expected to have a measurable impact on the level or discharge of the Nehalem River during its period of low flow. This circumstance seems much more beneficial to the local fish populations which currently can be deprived of water diverted from Zaddach, Vosburg, Jarvis, and Anderson Creeks that will be restored to natural flow once the wellfield is operational.

The contribution of these tributaries to the River and estuary should greatly exceed any potential impacts which might be attributed to the planned ground water withdrawals. The proposed change in diversion points within the basin will benefit both the local population and the ecosystem.

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TECHNOLOGIES

If you have any questions or comments, please call anytime.

Sincerely,

Craig Russell

Craig A. Russell
Project Hydrogeologist

James R. Car
Vice President

CAR:JRC/dlb

cc

AGI
TECHNOLOGIES

A Report Prepared For:

Lee Engineering, Inc.
1300 John Adams
Oregon City, Oregon 97045

PRODUCTION WELLS 1 AND 2
CONSTRUCTION AND TESTING REPORT
CITY OF WHEELER, OREGON

October 11, 1996

Craig Russell

Craig A. Russell
Project Hydrogeologist

James R. Carr
Vice President/Principal Hydrogeologist

AGI Technologies
Water Resources Group
P.O. Box 1158
Gig Harbor, Washington 98335
206/851-5562

AGI Project No. 15,792.005.06

AGI TECHNOLOGIES

PRODUCTION WELLS 1 AND 2
CONSTRUCTION AND TESTING REPORT
CITY OF WHEELER, OREGON

SUMMARY

This report describes the City of Wheeler's new well field, where Production Wells 1 and 2 are located. Wells 1 and 2 are rated to provide 500 and 1,000 gpm, respectively, from a coarse gravel aquifer present between 43 and 63 feet below ground surface (bgs). The Wheeler well field is located on a point bar on the north side of the Nehalem River at river mile 10.6.

The lithology, water level response, water level gradients, and water chemistry suggest some degree of hydraulic separation between local surface waters and the Well 1 and 2 aquifer.

Tested water quality parameters indicate good water quality. Nitrate levels of 1.2 mg/L may exceed background levels but are well below the MCL of 10 mg/L.

BACKGROUND

Property owner: City of Wheeler, Oregon

Engineer: Lee Engineering, Inc.

Hydrogeologist: AGI Technologies; Craig Russell, Project Hydrogeologist

Drilling contractor: Westerberg Drilling, Inc.; Dan Stadeli

Drilling method: Cable-tool

Start date: June 17, 1996

Completion date: July 25, 1996

PERMITS AND APPLICATIONS

Westerberg Drilling worked on four wells at the Wheeler site. Well A, the first well drilled, was abandoned due to unproductive aquifer materials. A previously constructed, 8-inch test well (TW) was converted into a dual completion observation well. The completion zones of TW are designated P1 (29 to 34 feet bgs) and P2 (46 to 56 feet bgs). A copy of the State approved special standard for the dual completion is included in the **Appendix**. The two production wells are designated Wheeler Wells 1 and 2. Start cards are listed for each well along with well ID numbers.

	Well A	**TW**	**Well 1**	**Well 2**
Start card number:	89997	89999	89998	90000
Well ID number:	abandoned	L01905	L01906	L01907

DRILLING OBJECTIVE

The objective of this project was to develop two production wells capable of pumping 500 gpm each.

Desired yield:	500 gpm per well
Target aquifer:	Coarse gravel aquifer encountered in TW between 45 and 55 feet bgs
Required quality:	Potable

WELL SITE

The well site, illustrated in **Figure 1**, is located on the north side of the Nehalem River at river mile 10.6. The site is upstream of Mohler Sand and Gravel, located at 20890 Foss Road, and downstream of Forster Farms, located at 22095 Foss Road.

Map location/coordinates:	T2N/R9W/NE4NW4, Section 5
County:	Tillamook
Top of casing elevation:	Well 1 - 29.51 ft. Well 2 - 29.51 ft. TW - 28.58 ft.

Site characteristics: The site is a relatively flat lying, grassy field located on a point bar of the Nehalem River. To the north, the land surface rises into the Peterson Creek drainage. Across the river to the south, bedrock is exposed in a steep, wooded hillside.

COMPLETION RECORD

Production Wells 1 and 2 and TW are completed in accordance with Oregon Water Resources Department Administrative Rules for Well Construction & Maintenance Standards, effective August 1992.

The well completion records are illustrated in **Figures 2, 3,** and **4** and described in the Water Supply and Monitoring Well Reports in the **Appendix**.

	Well 1	**Well 2**	**TW**
Total depth drilled:	63 ft.	64 ft.	61 ft.
Completion depths:	43 to 50 ft.	45 to 60 ft.	29 to 34 ft. and 46 to 56 ft.
Depth of seals:	0 to 35 ft.	0 to 35 ft.	0 to 27 ft. and 35 to 44 ft.
Type of seal:	Cement	Cement	Bentonite grout (30% solids)/bentonite chips

Casing Record

	Casing Depth	**Diameter**	**Description**
Well 1:	+3 to 43 ft.	12-inch	Steel 0.250 in. wall
	50 to 55 ft.	12-inch	Steel 0.250 in. wall
Well 2:	+3 to 45 ft.	12-inch	Steel 0.250 in. wall
	60 to 64 ft.	12-inch	Steel 0.250 in. wall
TW:	+3 to 4 ft.	8-inch	Steel monument
	+3 to 29 ft.	2-inch	PVC, threaded
	+3 to 46 ft.	2-inch	PVC, threaded

Screen Assembly

Continuous wrap, wire-wound, welded stainless-steel well screens manufactured by Johnson Division were installed in Wells 1 and 2, and 2-inch PVC slotted screen was installed in TW as listed below:

	Screen Depth	Diameter	Description
Well 1:	43 to 50 ft.	12-inch ID	Stainless-steel 0.100-inch slot size
Well 2:	45 to 60 ft.	12-inch ID	Stainless-steel 0.100-inch slot size
TW:	29 to 34 ft. 46 to 56 ft.	2-inch ID 2-inch ID	PVC 0.020-inch slot size PVC 0.020-inch slot size

Filter Media

Filter pack: The production wells have pea gravel as a formation stabilizer around the 12-inch stainless-steel well screens. TW has Colorado Silica Sand size 8-12 as a filter pack around the 2-inch PVC screens.

HYDROGEOLOGIC LOG

The hydrogeologic logs are illustrated in **Figures 2, 3, 4,** and **5** and described in the Water supply and Monitoring Well Reports in the **Appendix**.

The general hydrogeology of the well field site consists of fluvial deposits of sand, gravel, and silt overlying an irregular basalt bedrock surface. These deposits are saturated at a depth of about 14 feet bgs or the approximate elevation of the Nehalem River.

Very productive aquifers found at this site consist of cleaner (less silt) gravels and sand that are semi-confined by silty sand and gravel layers. These clean gravels are present in narrow channels of varying thickness above the bedrock.

PUMPING TESTS

Static Water Levels

Initial water levels are measured below the measuring point at the time of testing. Static water levels are measured below ground surface.

	Well 1	Well 2
Initial water level:	16.46 ft.	16.05 ft.
Date:	July 22, 1996	July 19, 1996
Measuring point stickup:	2.94 ft.	3.25 ft.
Static water level:	13.52 ft.	12.80 ft.

Pumping Test Results

Pumping tests were conducted on Wells 1 and 2 with each well pumping for 24 consecutive hours at the maximum test rate.

	Discharge Rate	Elapsed Time	Drawdown	Specific Capacity
Well 1:	1,012 gpm	24 hrs	4.16 ft.	243 gpm/ft.
Well 2:	1,025 gpm	24 hrs	3.38 ft.	303 gpm/ft.

Transmissivity

Transmissivity is the permeability for the full aquifer thickness and is equivalent to the amount of water flowing through a vertical, one-foot wide strip of the aquifer in one day (under unit gradient). It is calculated from drawdown, recovery, and distance drawdown patterns, as illustrated in **Figures 6, 7**, and **8**. The average transmissivity in the aquifer is 500,000 gallons per day per foot (gpd/foot).

SURFACE/GROUND WATER MONITORING AND IMPACTS

To determine hydraulic connection and pumping impacts, AGI developed a surface and ground water monitoring program using the monitoring locations shown on **Figure 1**.

The three Peterson Creek monitoring stations showed no measurable impacts caused by pumping of Production Wells 1 and 2 during testing. All other stations monitored during testing were impacted to some degree by pumping.

Surface Water Monitoring

Staff gages were installed to measure surface water levels at three locations along Peterson Creek (C-1, C-2, and C-3) and in a pond (PD) excavated by Mohler Sand and Gravel. One sand point (R-1) was installed on the bank of the Nehalem River. Hydrographs of the water level data collected are shown on **Figures 9** and **10**.

Surface Water Impacts

As shown on **Figure 9**, the three Peterson Creek monitoring stations (C1, C2, C3) showed no measurable impacts caused by pumping of production Wells 1 and 2 during testing. **Figure 9** shows declining creek levels rose rapidly between July 17 and 18, 1996 due to heavy precipitation on those days. Prior to the start of the Well 2 test on July 19, 1996, creek levels were again declining and generally continued this decline throughout the monitoring period. Small creek level fluctuations were noted on July 23 and 24, 1996 during the Well 1 test. These slight fluctuations are attributed to light precipitation events on those days and do not appear to be related to pumping. These events are most discernible on the station C2 hydrograph. Station C2 tends to magnify precipitation events, because runoff from the Mohler Sand and Gravel Parking lot enters the creek near that station.

Station PD, Pond shown on **Figure 10**, is also considered a surface ? water station but reacts to both surface and ground water influences. The water level at station PD ceased to decline any further as a direct result of precipitation and runoff into the pond on July 17, 1996. Its response to precipitation differs from creek response in that its water level did not rise until the following day. This appears to be the result of rising ground water levels. It continued to rise after the creek levels began to decline, and did not decline itself until a few hours after the Well 2 test began. At the conclusion of both Well 1 and 2 pumping tests, water levels at Station PD rose in response to rising ground water levels.

Ground Water Monitoring

In addition to the two production wells, ground water levels were measure in Mohler Sand and Gravel's shallow dug well (DW) and in two piezometers (P1 and P2) installed in the dual completion test well (TW). Hydrographs of these ground water level data are shown in **Figures 10** and **11**. Water level elevations show the ground water flow direction as being predominately to the west and travelling parallel to the Nehalem River.

Ground Water Impacts

Station R1 is shown on **Figure 10**. R1 measures ground water levels on the bank of the Nehalem River. These water levels are influenced by fluctuations in river levels. Station R1 water levels were declining prior to heavy precipitation on July 17, 1996, which caused a corresponding water level rise similar to the rise in creek levels. It differs from creek response in that it continued to rise after the creek levels began to decline, and did not decline itself until a few hours after the Well 2 test began. The decline in R1 water levels after Well 2 pumping began appears to be related to both natural and pumping influences. This is demonstrated by the rapid water level rise at the conclusion of the Well 1 and 2 tests and the steepening of its natural decline curve at the start of the Well 1 test on July 22, 1996.

Stations DW and TW-P1 (**Figures 10** and **11**) showed a muted response to both precipitation and pumping. Water levels at these stations were declining prior to precipitation on July 17, 1996. Water levels here rose more slowly than either the creek or river, but more rapidly than ground water stations with deeper completions. The change in water level at these station lags behind the precipitation events by about one-half day. These stations continued to rise as a result of the precipitation until Well 2 pumping began. They were almost immediately impacted by the pumping, showing greater hydraulic connection with the pumping well than R1 or the surface water stations.

Figures 11 and **12** show hydrographs of ground water monitoring stations TW-P1 and TW-P2 and Production Wells 1 and 2. The TW hydrograph shows water levels in TW-P1 were rising, while TW-P2 water levels continued to decline. TW-P2 showed about a one day lag in response to precipitation. This hydrograph also shows less drawdown response in TW-P1 than in TW-P2 as a result of pumping, indicating that TW-P2 is in greater hydraulic connection with the pumping well than P1. Production well water level data prior to Well 2 testing are insufficient (due to well construction) to determine the lag time between the heavy precipitation of July 17, 1996 and a corresponding water level rise. However, the rise in the production well water levels is most likely equivalent to that of TW-P2, as their completion intervals and lithology are similar. Water levels in Production Wells 1 and 2 respond promptly to each other's pumping.

Figure 8 is a semi-log plot of the cone of influence around Wells 1 and 2. Drawdown measurements at each monitoring station were corrected to account for natural declines. Drawdown measurements at the conclusion of the Well 1 test ranged from a maximum of 4.16 feet in Pumping Well 1 to 0.18 feet at observation Station R1.

Drawdown measurements for the Well 2 test ranged from 3.38 feet at pumping Well 2 to 0.14 feet at observation Station R1. The amount of drawdown measured at each station is not directly proportionate to its distance from the pumped well. TW-P1 showed less drawdown than TW-P2 at an equal distance from the pumped well. Drawdown at Station DW was greater than at either station PD or R1, both of which are closer to the pumped well. This response illustrates variation in hydraulic connection. Partial penetr. effects

WATER LEVEL ELEVATIONS

Water level elevations of each of the monitoring stations and production wells on August 2, 1996 are shown on **Figure 13**. Water level elevations in Peterson Creek range from 26.11 feet above sea level upstream at Station C3 to 20.00 feet above sea level downstream at Station C2. Local ground water elevations range from 13.14 feet at Well 2 to 12.69 feet at Station PD. Surface water elevations are about 10 feet higher than local ground water elevations. The water level elevation at Station DW may be influenced by leakage from the creek.

According to the available data, the ground water gradient is about 0.0008 ft/ft. The flow direction is generally from the east to the west. There is also a slight north to south ground water gradient of about 0.0002 ft/ft. Two water surface elevations taken about 1,100 feet apart on the Nehalem River suggest its gradient is about 0.00005 ft/ft or about 16 times less than the ground water gradient. River flow is also from the east to the west.

A preliminary Wellhead Protection Model was run using the ground water gradient mentioned above and other aquifer characteristics described in this report. The model indicated that the 1-year time of travel would extend to the east about 2,000 feet. This model is not included in this report, because the data have not yet been qualified. Additional data are required to validate the results. Time of travel and stream capture are 2 different things. Red herring.

WATER QUALITY

Water samples were collected from Production Wells 1 and 2, the Nehalem River, and Peterson Creek for both field and laboratory analysis. Water samples were collected from the Mohler Sand and Gravel Pond for field analysis only.

Field Analysis

Field water quality data results are listed in **Tables 1, 2,** and **3,** and the parameters include iron, temperature, dissolved oxygen, turbidity, conductivity, and pH.

Field analysis showed both Wells 1 and 2 had similar concentrations of iron at 0.14 mg/L, which is below the state's Maximum Contaminant Level (MCL) of 0.3 mg/L. Samples for field analysis of iron were taken at TW-P1 and TW-P2 during their development on July 12, 1996. Iron concentrations of 0.44 mg/L and 1.41 mg/L, respectively, were measured. These measurements appear to have been elevated by the suspended solids in the water caused by short development periods and turbid water. Field analysis for samples taken during testing of these water-bearing zones in 1994 showed concentrations of 0.06 mg/L and 0.19 mg/L, respectively. Iron concentrations in samples collected from the Nehalem River, Peterson Creek, and the Mohler Sand and Gravel Pond in 1994 showed concentrations of 0.04, 0.11, 0.07 mg/L, respectively.

Temperatures remained constant at 50 degrees Fahrenheit in Wells 1 and 2 during testing. Temperatures measured during development of TW-P1 and TW-P2 were 54 and 58 degrees, respectively. These temperature are believed to be have been increased due to the low pumping rates and the high ambient temperatures. Temperatures of surface waters ranged from 54 degrees at Station C3 to 80 degrees at Station PD. Surface water temperatures fluctuated during the testing period as a response to precipitation events and changing ambient temperatures. In general, surface water temperatures were higher than the ground water temperatures.

Dissolved oxygen concentrations were between about 2.0 and 4.0 mg/L in Wells 1 and 2 and between about 4.0 and 10.0 mg/L in the surface waters. In general, the ground water seems to have less dissolved oxygen than the surface waters.

The turbidity of Well 1 and 2 water ranged between 0.39 and 0.08 NTU and generally declined over the testing periods, as would be expected in a newly completed well. Surface water turbidity measurements ranged from 0.56 to over 8.0 NTU. Creek and river water turbidity fluctuated significantly due the precipitation events. High turbidity levels of between 7.0 and 8.0 in the Mohler Sand and Gravel Pond are likely caused by the presence of algae in the pond.

Conductivity measurements made at Wells 1 and 2 during testing fluctuated very little and averaged about 85 uS/cm. Conductivity measurements in the Nehalem River were similar to those in production wells but increased as water levels declined after the heavy precipitation of July 17 and 18, 1996. Peterson Creek water conductivity levels were lower than those in the production wells by about 15 uS/cm, and pond water conductivity measurements of about 155 uS/cm were about 70 uS/cm higher.

Measurements of pH at Wells 1 and 2 fluctuated very little during testing and averaged about 6.5. Surface water measurements of pH fluctuated between about 6.5 and 7.5. These fluctuations appear to be associated with precipitation events. In general, pH of the local surface and ground waters appear to be similar.

Laboratory Analysis

Samples for laboratory analysis were collected after pumping Wells 1 and 2 for 24 hours at over 1,000 gpm. Analysis included bacteriological, 10 inorganic parameters, 14 metal parameters, 21 regulated volatile organic contaminants, 20 unregulated volatile organic contaminants, 39 synthetic organic compounds, and radionuclides. The same 10 inorganic and 14 metal parameters were also run on samples collected from the Nehalem River and Peterson Creek. Laboratory results for these parameters are included in the **Appendix**.

Communication uncertainty resulted in exclusion of some important water quality parameter analyses. These include the primary inorganic contaminants asbestos, copper, and lead and many secondary inorganic contaminants and physical parameters.

Bacteriological Test Results

The bacteriological analysis conducted by Applied Science Laboratory of Netarts, Oregon shows Wells 1 and 2 tested negative for coliform bacteria.

Inorganic Test Results

The results of inorganic water quality analyses, conducted by Coffey Laboratories, Inc., showed all parameters measured were below the Maximum Contaminant Levels (MCL) for drinking water. Nitrate levels of 1.2 mg/L at Wells 1 and 2 may be slightly elevated above background levels, as demonstrated by the lower nitrate levels found in the Nehalem River and Peterson Creek of 0.26 and 0.94 mg/L, respectively. The MCL for nitrate in drinking water is 10 mg/L.

Volatile and Synthetic Organic Compound Test Results

The results of inorganic water quality analyses, conducted by Coffey Laboratories, Inc., showed no detected volatile or synthetic compounds in samples taken from Production Wells 1 and 2.

Radionuclide Test Results

The analysis of radionuclides, conducted by Coffey Laboratories, Inc., showed the reported gross alpha for both Wells 1 and 2 as 1.0 pCi/L, which is well below the state MCL of 15.0 pCi/L.

HYDROGEOLOGY AND HYDRAULIC CONTINUITY

Lithology, water level response, water level gradients, and water chemistry suggest some degree of hydraulic separation between surface waters and the Well 1 and 2 aquifer.

Lithology of wells drilled at this site show a confining layer of silty, clayey sands and gravels overlies an intermediate water-bearing zone found between about 25 and 35 feet bgs. This intermediate water-bearing zone is separated from the Well 1 and 2 aquifer by a silty, clayey aquitard. Well A showed only the intermediate water-bearing zone. No productive water-bearing materials exist between this intermediate aquifer and the bedrock.

The 1994 test well showed water-bearing potential in the 25 to 35-foot zone and just above bedrock at about 48 feet bgs. Well 1 showed clean, highly productive water-bearing sediments in the intermediate zone and between about 43 and 50 feet. Well 2 showed the intermediate water-bearing zone and highly productive water-bearing sediments between 44 and 63 feet bgs. All four wells are located at a distance of less than 150 feet from each other. The varying thicknesses of coarse, clean, water-bearing materials at the various well sites indicate the presence of a cleaner, thicker subsurface channel to the south and east. Lithology also shows bedrock shallows to the north.

Water level responses to precipitation and pumping show that surface waters are not directly connected to the Production Well 1 and 2 aquifer. Lag times for precipitation impacts are progressively longer with depth, and drawdown impacts from pumping are progressively greater with depth. Vertical recharge to the intermediate water-bearing completion zone of TW-P1 (29 to 34 feet bgs) takes about one-half day. Recharge to the deeper water-bearing zone of Wells 1 and 2 and TW-P2 (43 to 60 feet bgs) takes about one day. This lag in response to precipitation is attributed to the silty, clayey sands and gravels which overlie and separate these two zones. Station DW showed a greater response to pumping than either R1 or PD, both of which are closer to the pumping well than DW. TW-P1 showed less response to pumping than did TW-P2 at a similar distance from the pumping well. These responses infer hydraulic connection though leakage.

Ground water gradients and flow directions imply that recharge to the Well 1 and 2 aquifer may be a combination of both vertical percolation from precipitation and underflow from the Nehalem River. The ground water gradient is 16 times steeper than the river water gradient, indicating that the ground and river waters are not in direct hydraulic connection.

What logic is this based on?

Water quality also shows that the ground and surface waters are not in direct hydraulic connection. Higher iron concentrations and conductivities and lower temperatures, turbidity, and dissolved oxygen suggest that the water pumped from Wells 1 and 2 had been in the ground for some period of time prior to being pumped during testing. Stable, unchanging measurements of temperature and conductivity during testing imply the same.

Confusing water pumped versus captured

OPTIMUM YIELD

Optimum yield is the maximum amount of water a well can safely produce. It is the product of the long-term specific capacity and safe drawdown. Safe drawdown allows for pump submergence requirements and seasonal and other natural water level changes, including interference from other sources.

The screen manufacturer has determined through laboratory testing that if the screen entrance velocity is equal to or less than 0.1 feet per second (fps), the following will result:

- Friction losses in the screen openings will be negligible.
- The rate of incrustation will be a minimum.
- The rate of corrosion will be a minimum.

The screens used in Wells 1 and 2 are 12-inch pipe size (12-inch inside diameter) with 0.100-inch slot size. This screen has a transmitting capacity of 58.8 gpm/ft of screen at an entrance velocity of 0.1 fps.

	Well 1	Well 2
Screen length:	7 ft.	15 ft.
Transmitting capacity (0.1 fps):	412 gpm	882 gpm
Safe drawdown (s):	2.1 ft.	3.3 ft.
Long-term specific capacity (SC):	240 gpm/ft.	300 gpm/ft.
Safe yield (s x SC):	500 gpm	1,000 gpm

Although both wells easily produced in excess of 1,000 gpm during testing, the additional drawdown and lower specific capacity measured in Well 1 can be attributed to increased friction losses caused by a higher entrance velocity through the screen.

Head Requirements

	Well 1	Well 2
Lift:	16 ft.	17 ft.
Discharge:	500 gpm	1,000 gpm
Intake setting:	35 ft.	40 ft.

PERMANENT EQUIPMENT RECOMMENDATIONS

Type of pump:	Submersible or line shaft turbine
Valves:	One check valve should be installed in the submersible pump drop pipe. One flow-control valve should be installed in the discharge line. One above-ground check valve should also be installed.
Depth of intake:	Well 1 - 35 ft., Well 2 - 40 ft.
Pump discharge rate:	Well 1 - 500 gpm, Well 2 - 1,000 gpm
Meter:	A totalizing flow meter should be installed in the discharge line of each well.
T to open discharge:	Should be included with valve to control discharge during periodic testing.

Sampling port: Should be a 3/4-inch hose bib located close to the wellhead.

Sounding tube: A 1-inch plastic or steel tube should be set to the top of the pump.

OTHER RECOMMENDATIONS

- To obtain the best possible service from Wells 1 and 2, the City of Wheeler should measure the static and pumping water levels at least once each month and record the results for long-term hydrologic analysis.
- Nitrate levels should be checked quarterly, recorded, and plotted for future reference.

CONCLUSIONS

- Wheeler Production Wells 1 and 2 are rated to produce 500 and 1,000 gpm, respectively from a coarse gravel aquifer found between 43 and 63 feet bgs.
- Lithologic similarities of four wells drilled on the site indicate an intermediate water-bearing zone between 25 and 35 feet bgs. This water-bearing zone is hydraulically separated from the deeper Well 1 and 2 aquifer (44 to 63 feet bgs) by a silty, clayey sand and gravel aquitard.
- Lithologic differences of four wells drilled on this site indicate the probable subsurface channel in which Wells 1 and 2 are completed is cleaner and thicker to the south and east, and that bedrock shallows to the north.
- Water level responses to precipitation and pumping show that surface waters are not directly connected to the Well 1 and 2 aquifer. Leakage occurs between local water-bearing units.
- Ground water gradients and flow directions imply that recharge to the Well 1 and 2 aquifer may be a combination of both vertical percolation from precipitation and underflow from the Nehalem River. The ground water gradient is 16 times steeper than the river water gradient, indicating that the ground and river waters are not in direct hydraulic connection.
- Differences in water quality and stable, unchanging measurements of temperature and conductivity during testing indicate the Well 1 and 2 aquifer is not in direct hydraulic connection with surface waters.

→ Proves nothing of the sort!

- Tested water quality parameters indicate good water quality. Nitrate levels of 1.2 mg/L may slightly exceed background levels but are well below the MCL of 10 mg/L. Untested primary inorganic parameters include asbestos, copper, and lead.

TABLES

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Table 1
Well 2 Field Water Quality

Date	Time	Iron (mg/L)	Temperature (degrees F°)	Dissolved Oxygen (mg/L)	YSI Dissolved Oxygen (mg/L)	Turbitity (NTU)	Conductivity (uS/cm)	pH
7/13/96	8:17	0.14	49.5	3.6			82	
7/19/96	11:37			3.6	2.6			
7/19/96	13:02			3.8	2.3			
7/19/96	14:48			3.1	2.3			
7/19/96	17:00			3.4	2.3			
7/19/96	18:00			3.1	2.4			
7/19/96	19:00			3.4	2.3			
7/19/96	20:00			3	2.4			
7/19/96	21:00			2.8	2.4			
7/19/96	22:00			3.4	2.4			
7/20/96	8:27				2.3			
7/20/96	11:28				2.3			
7/22/96	16:44	.14 ←	0.14	50		0.39	83.3	6.62
7/22/96	18:00			50		0.31		6.26
7/22/96	19:00			50		0.22		6.39
7/22/96	20:00			50		0.18		6.44
7/22/96	21:00			50		0.21		6.46
7/22/96	22:00			50				6.49
7/23/96	10:31			50		0.09	85.5	6.69
7/23/96	13:17			50		0.08	85.4	6.67

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TECHNOLOGIES

Table 2
Well 2 Field Water Quality

Date	Time	Iron (mg/L)	Temperature (degrees F°)	Dissolved Oxygen (mg/L)	Turbitity (NTU)	Conductivity (uS/cm)	pH
7/17/96	12:17	0.14	49.5	3.6		86	6.73
7/19/96	12:24	0.14	50	3.6	0.15	92.3	6.63
7/19/96	14:15		50	3.8	0.15	86.2	6.48
7/19/96	16:00		50	3.1	0.17	84.7	6.46
7/19/96	17:00		50	3.4	0.1	84.7	6.67
7/19/96	18:00		50	3.1	0.19	84.8	6.55
7/19/96	19:00		50	3.4	0.12	84.8	6.61
7/19/96	20:00		50	3	0.12	84.9	6.52
7/19/96	21:00		50	2.8	0.1	85	6.51
7/19/96	22:00		50	3.4	0.1	85	6.5
7/19/96	23:00					85	
7/20/96	0:00					85	
7/20/96	2:00					85	
7/20/96	3:00					85.1	
7/20/96	4:00					85.1	
7/20/96	5:00					85.2	
7/20/96	6:00					85.3	
7/20/96	7:00					85.3	
7/20/96	8:00					85.3	
7/20/96	8:03		50			85.3	
7/20/96	9:10		50	3.5	0.1	85.3	6.24

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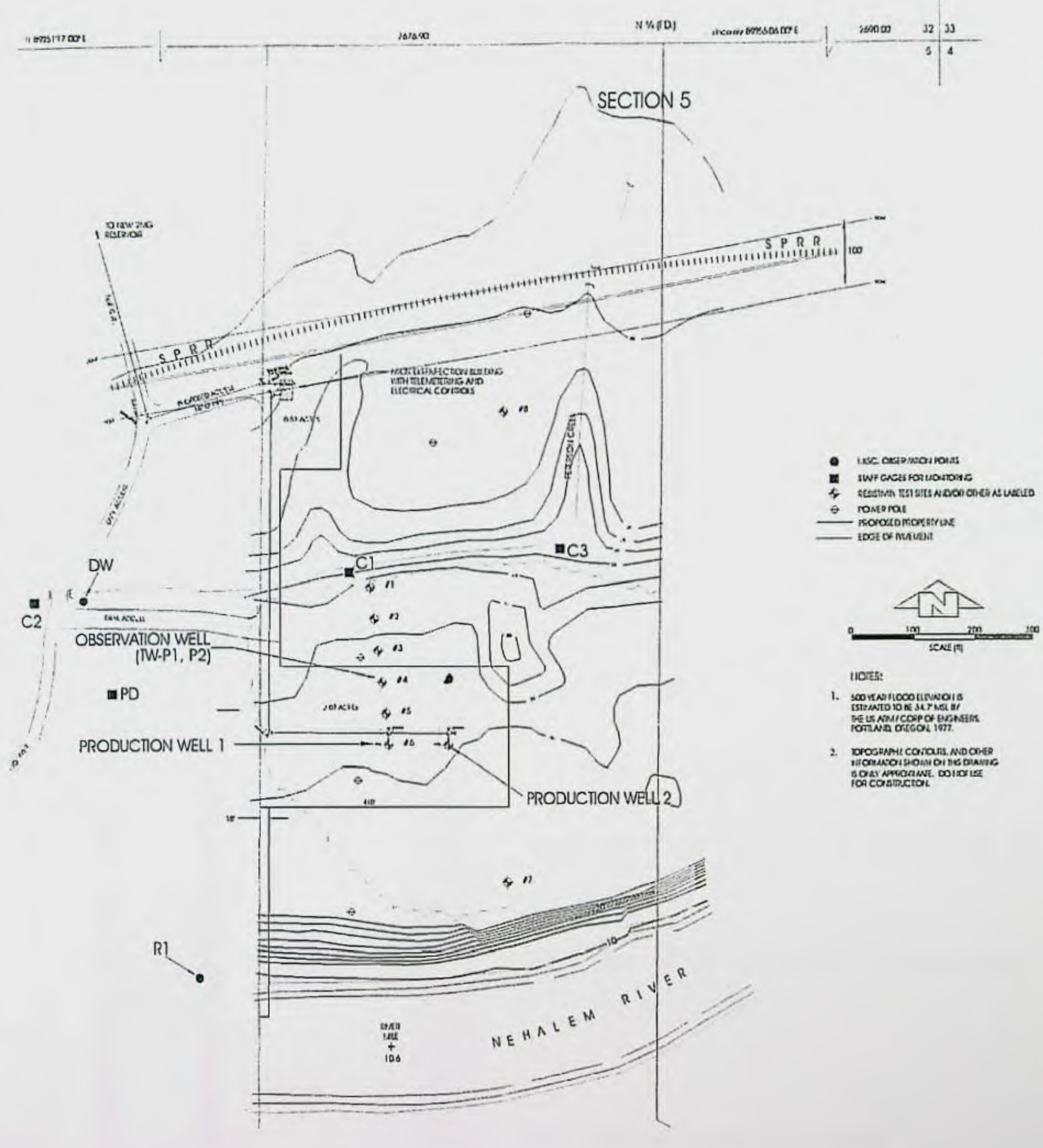
Table 3
Miscellaneous Field Water Quality

Date	Time	Location	Iron (mg/L)	Temperature (degrees F°)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Conductivity (µS/cm)	pH
7/12/96	13:35	TW-P1	0.44[1]	54[2]			79.5	
7/12/96	12:34	TW-P2	0.44[1]	58[2]		turbid	100.6	
7/16/96	11:30	C1		58	8.5		69.9	7.5
7/16/96	11:40	C2		58	8.4		71.5	7.38
7/16/96	11:20	C3		57	8.2		69.9	7.37
7/19/96	10:03	C3		54	10		65	7.6
7/20/96	9:28	C3		54	9.8	0.99	73.2	7.48
7/22/96	12:40	C3		59	8.6	1.67	72.5	6.93
7/23/96	10:43	C3		60	8.8	0.58	72	6.78
7/19/96	10:14	PD		65			152.4	7.15
7/20/96	9:45	PD		61		7.31	138.2	5.5
7/22/96	12:53	PD		80		8.36	158.3	7.02
7/23/96	11:02	PD		80		8	157.7	7.13
7/19/96	10:20	R1		62.5	8.3		69.5	7.53
7/20/96	9:54	R1		62	7.8	3.66	87.2	7.12
7/22/96	13:01	R1		66	3.7	3.77	90.1	6.42
7/23/96	11:25	R1		66	3.7	0.56	90.1	6.55

Notes:
1. Iron measurements are believed to be high due to suspended solids in sample.
2. Water temperatures may have been increased by high ambient temperatures and low flow rates.

FIG



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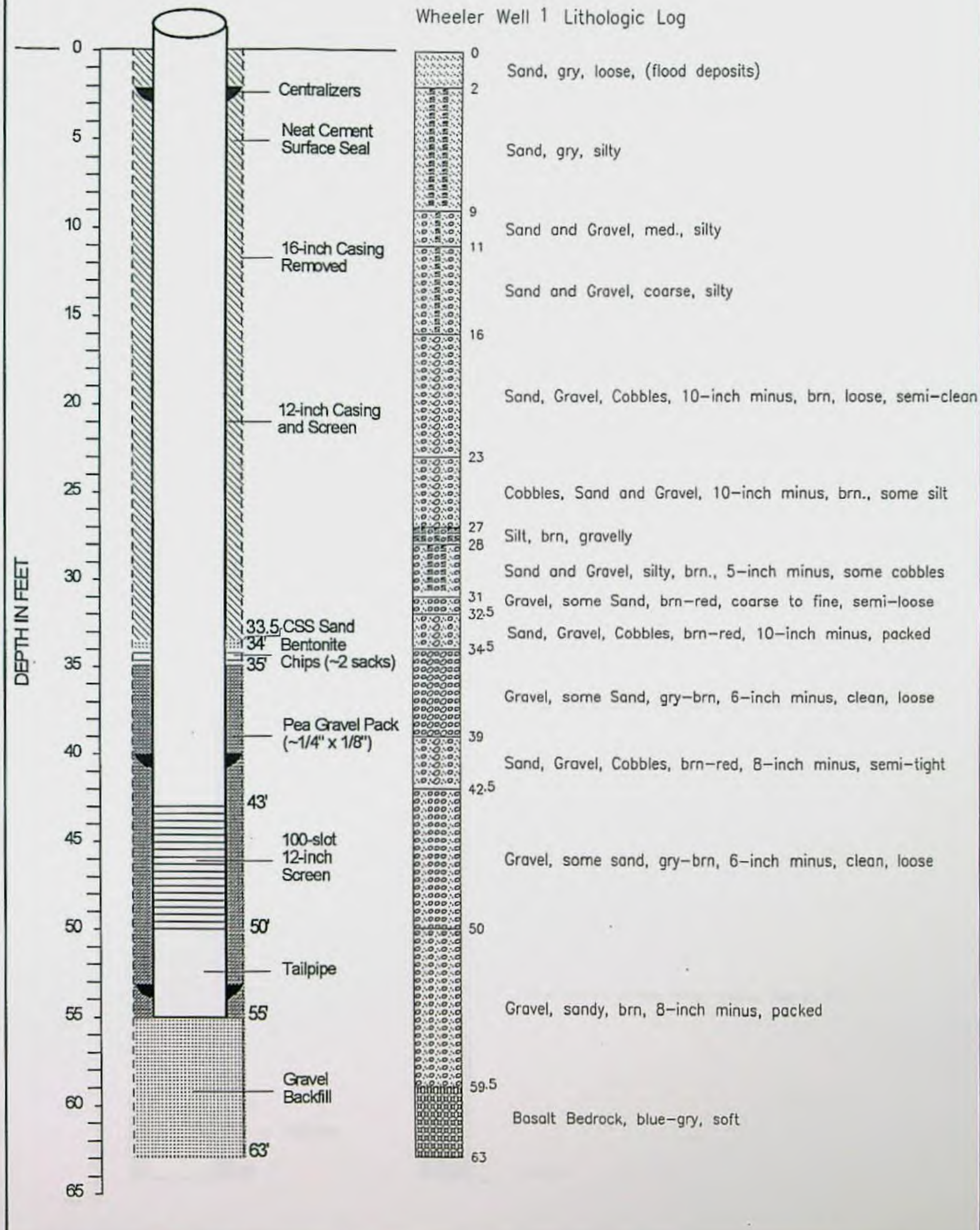
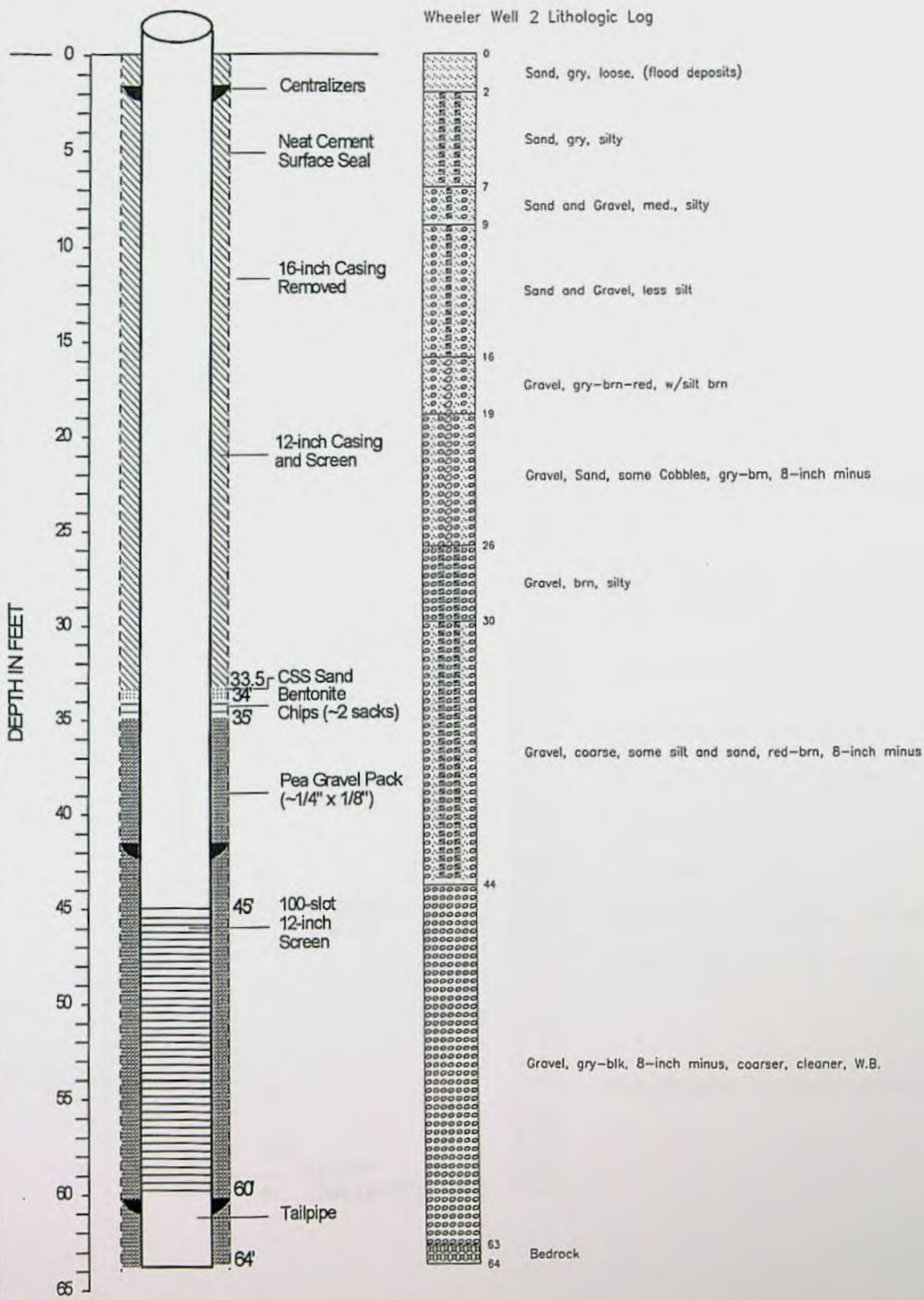
Lee Engineering
Wheeler Oregon
Project #15,792.005

Location Map

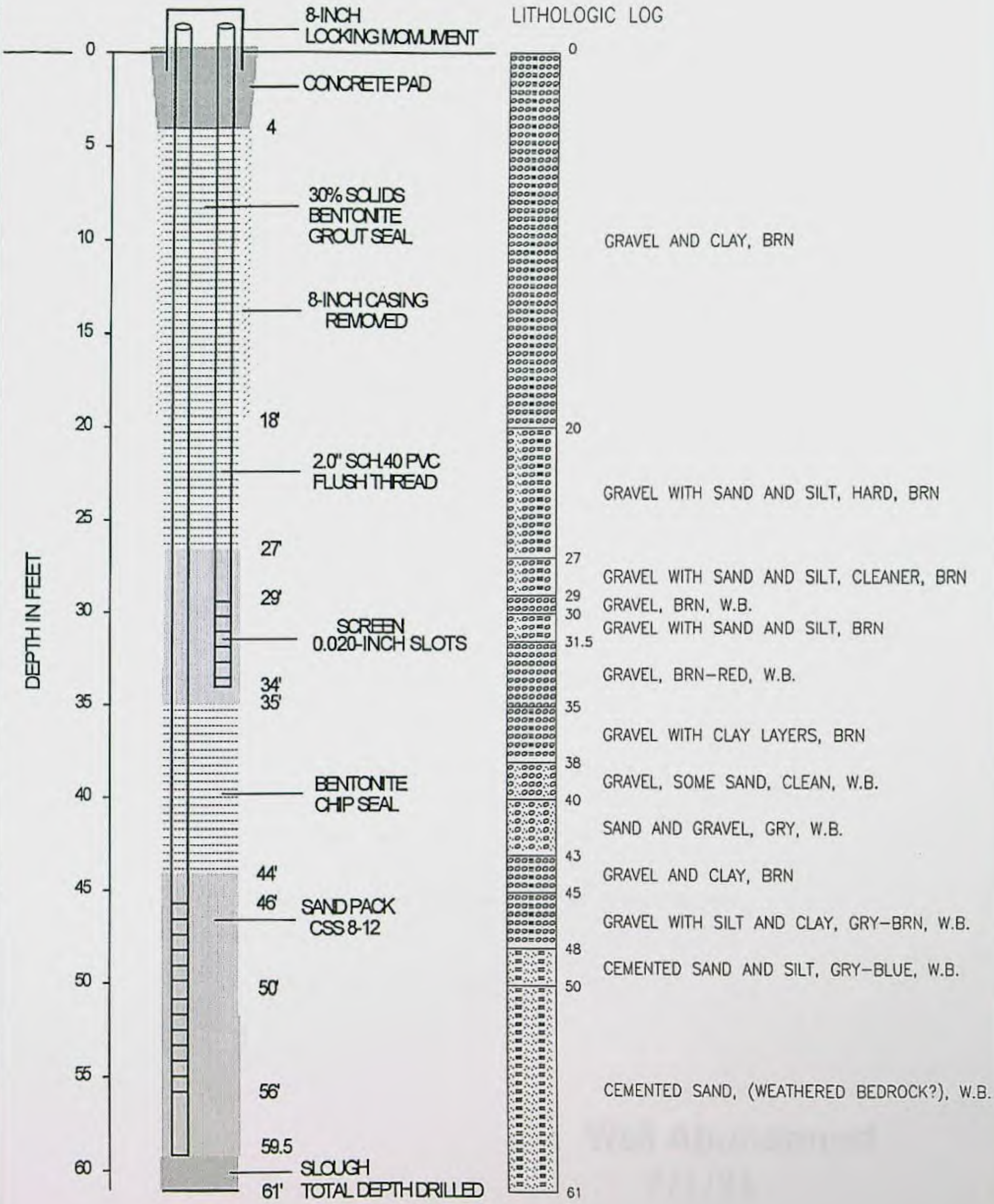
Figure 1
Date: 7/31/96



AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project #15,792.005	Well 1 Completion	Figure 2 Date: 7/31/96

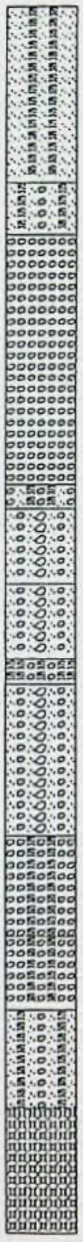


AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	Well 2 Completion	Figure 3 Date: 7/31/96



AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	Test Well Dual Completion	Figure 4 Date: 7/31/96

Wheeler – Well A
Lithologic Log



0	
	Sand, silty, gry
7	
	Sand, silty, some gravel
9	
	Gravel, med. to coarse
19	Cobbles, Gravel, Sand, 10–inch minus, silty, gry
20	
	Cobbles, Gravel, Sand, 10–inch minus, semi–loose, gry
23	
	Cobbles, Gravel, Sand, 10–inch minus, semi–loose, brn
26	Silt, gravelly, soft, brn
27	
	Cobbles, Gravel, Sand, 6–inch minus, clean, loose, gry–brn
33	
	Gravel, coarse, cemented, some silt, brn
37	
	As above, more silt
40	
	Sand and Gravel, coarse, cemented, tight, dirty, brn
44	
	Basalt, gry–blue, fractured
49	

Well Abandoned
7/1/96

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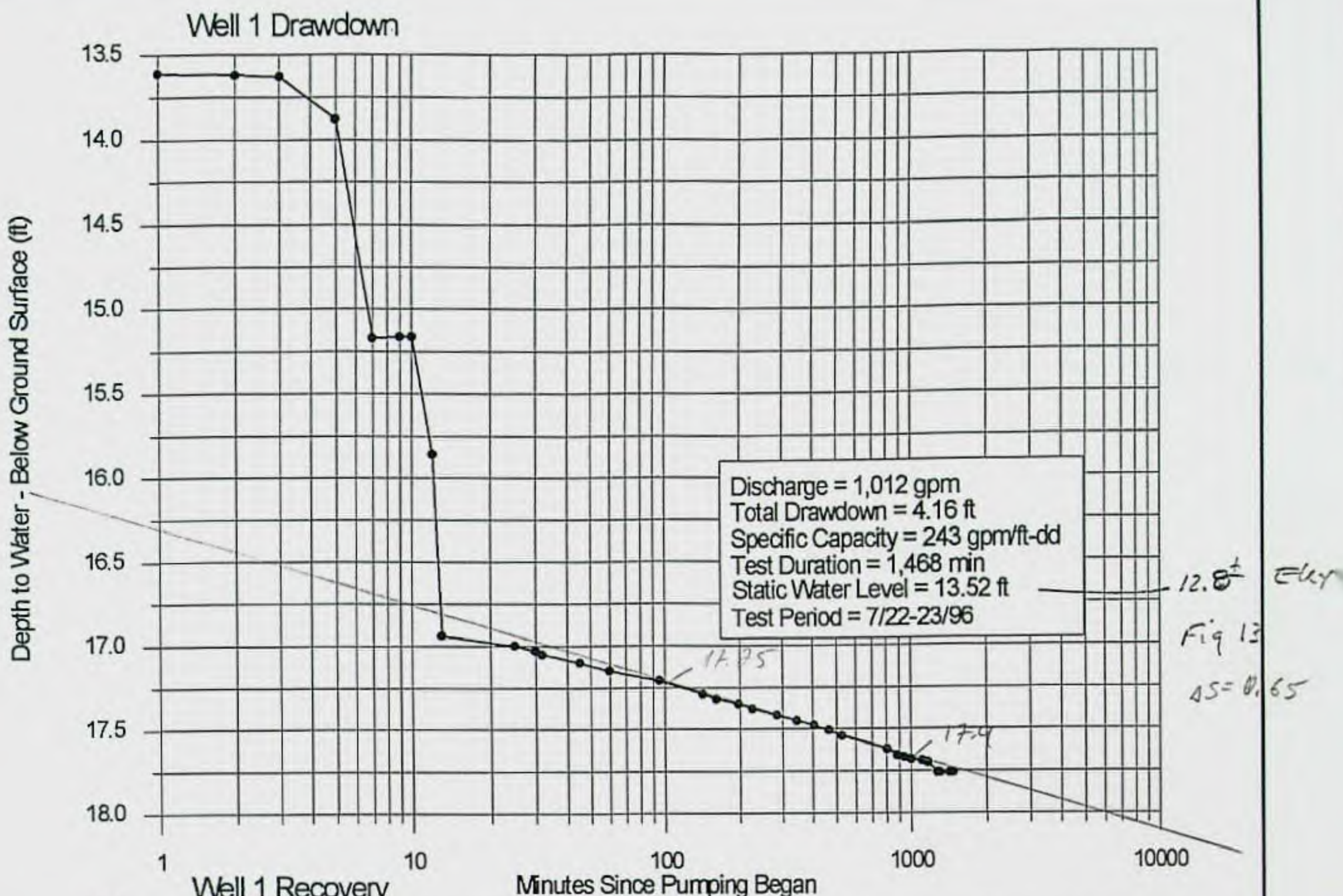
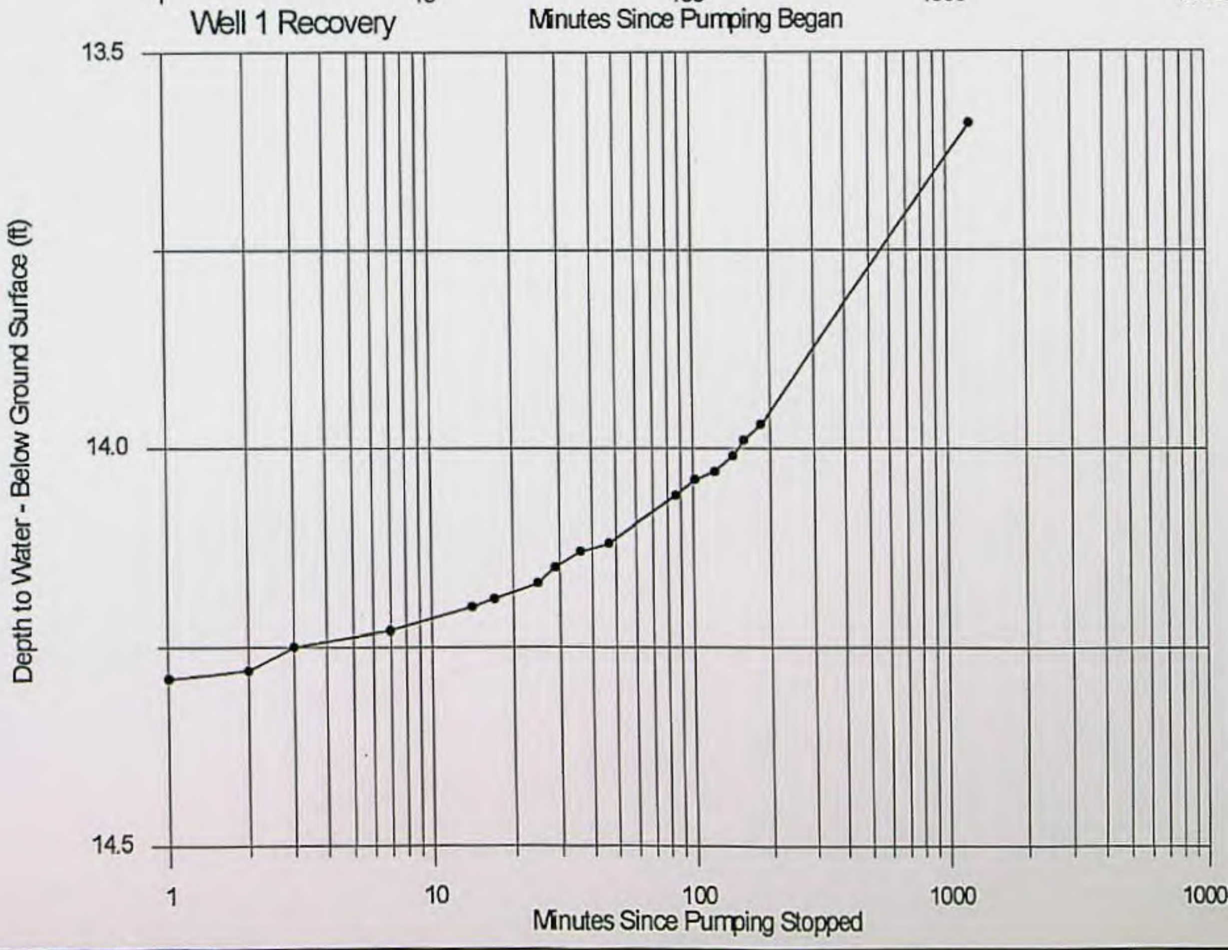
Lee Engineering
Wheeler Oregon
Project # 15,792.005

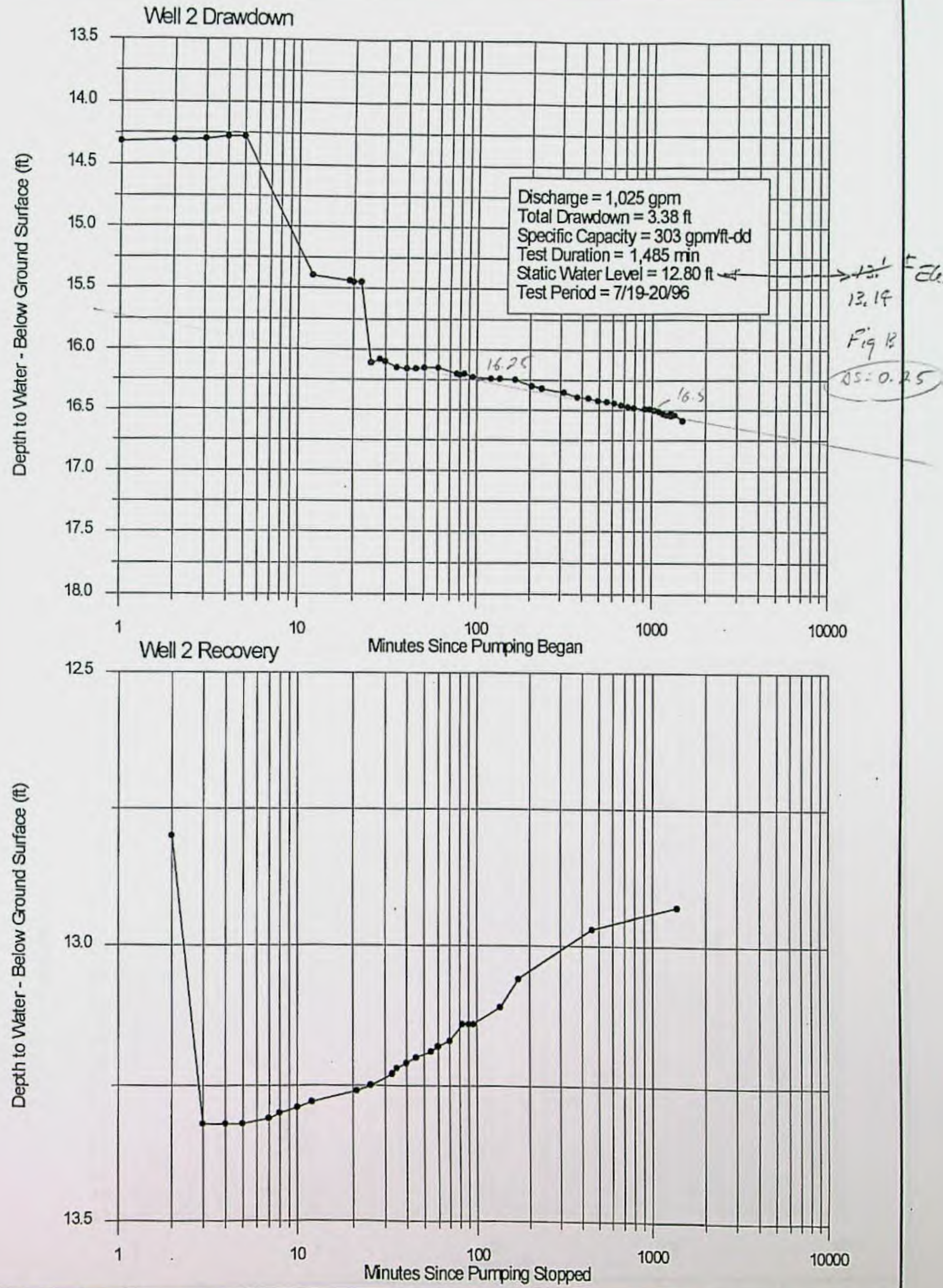
Well A Lithologic Log

Figure 5
Date: 7/31/96





AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	Well 1 Drawdown and Recovery	Figure 6 Date: 07/31/96



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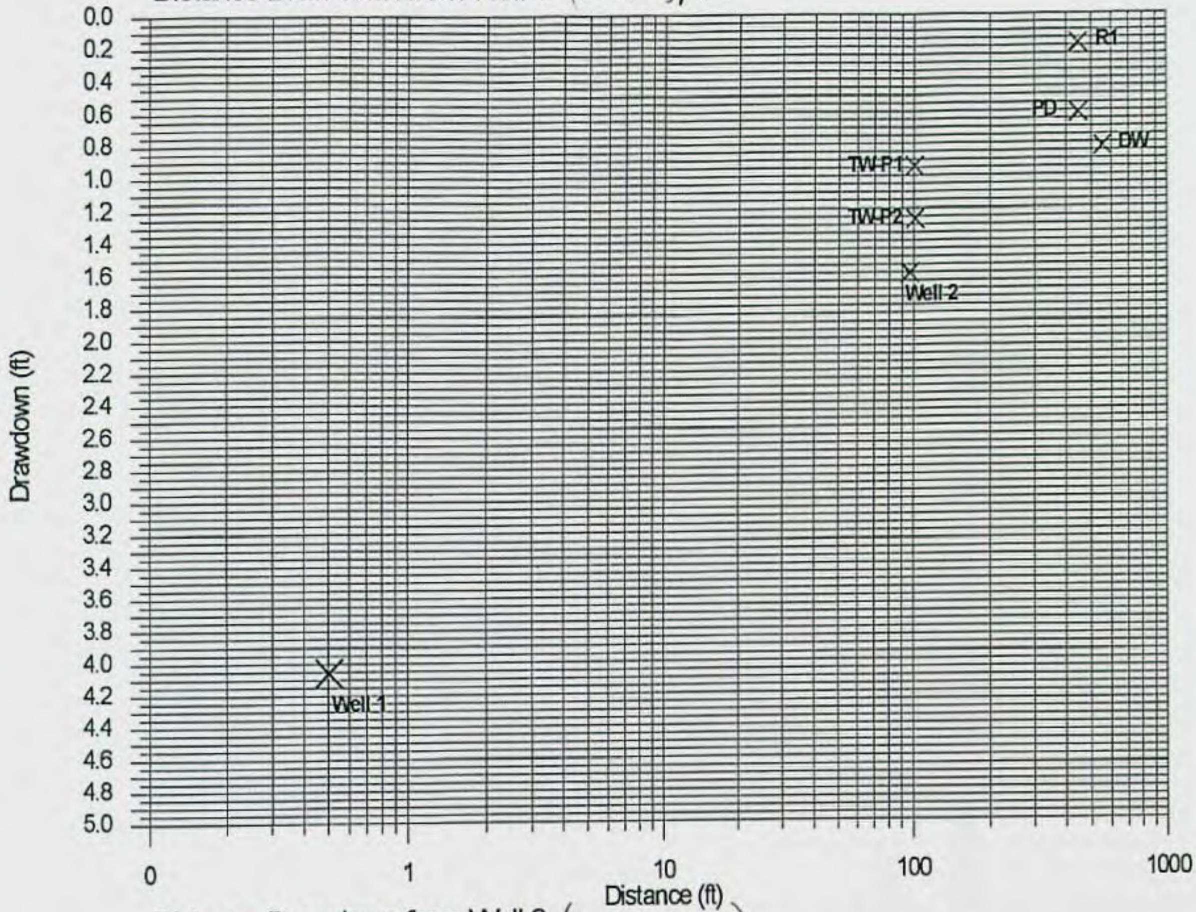
Wheeler Oregon
Project # 15,792.005

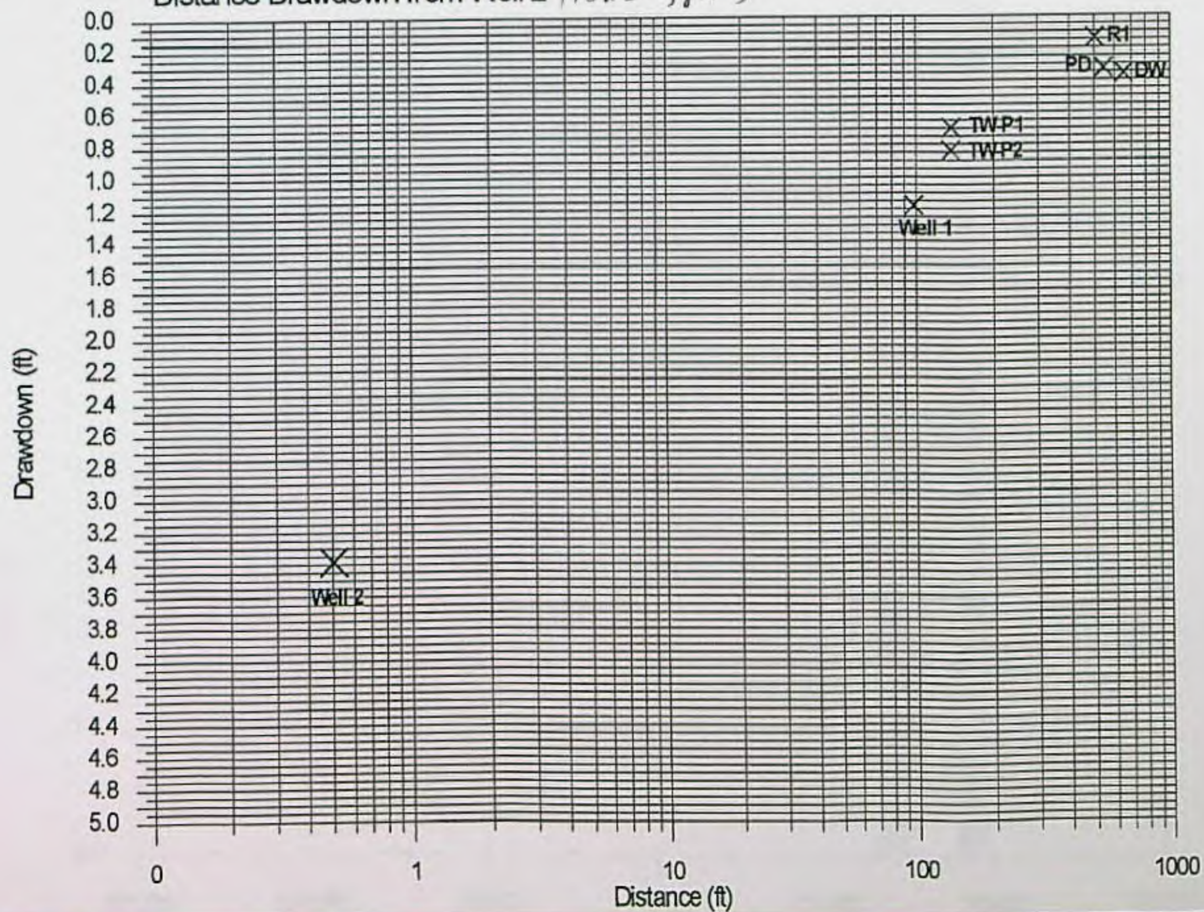
Well 2
Drawdown and Recovery

Figure 7
Date: 07/31/96

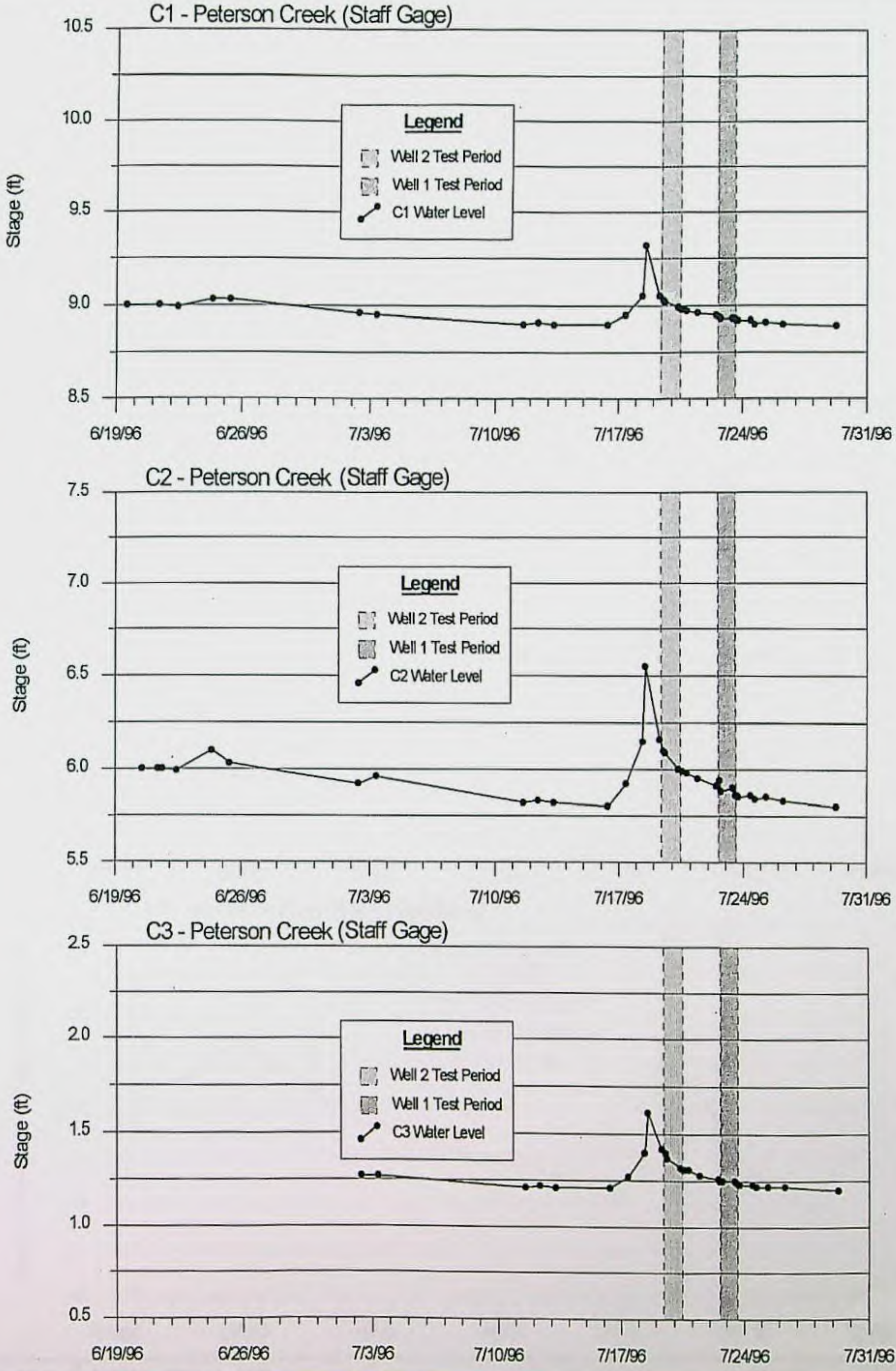
Distance Drawdown from Well 1 (1012 gpm)



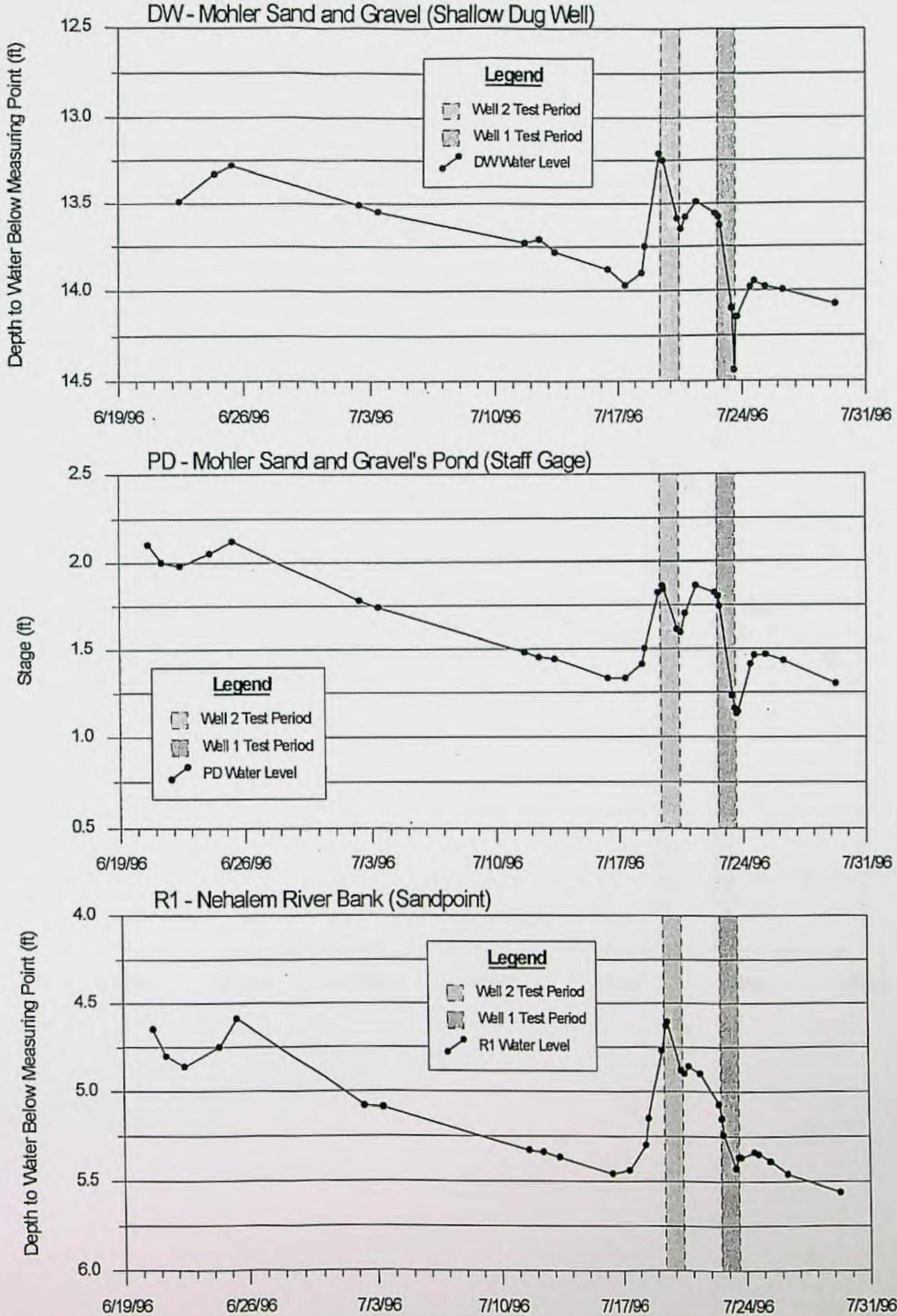
Distance Drawdown from Well 2 (1025 gpm)



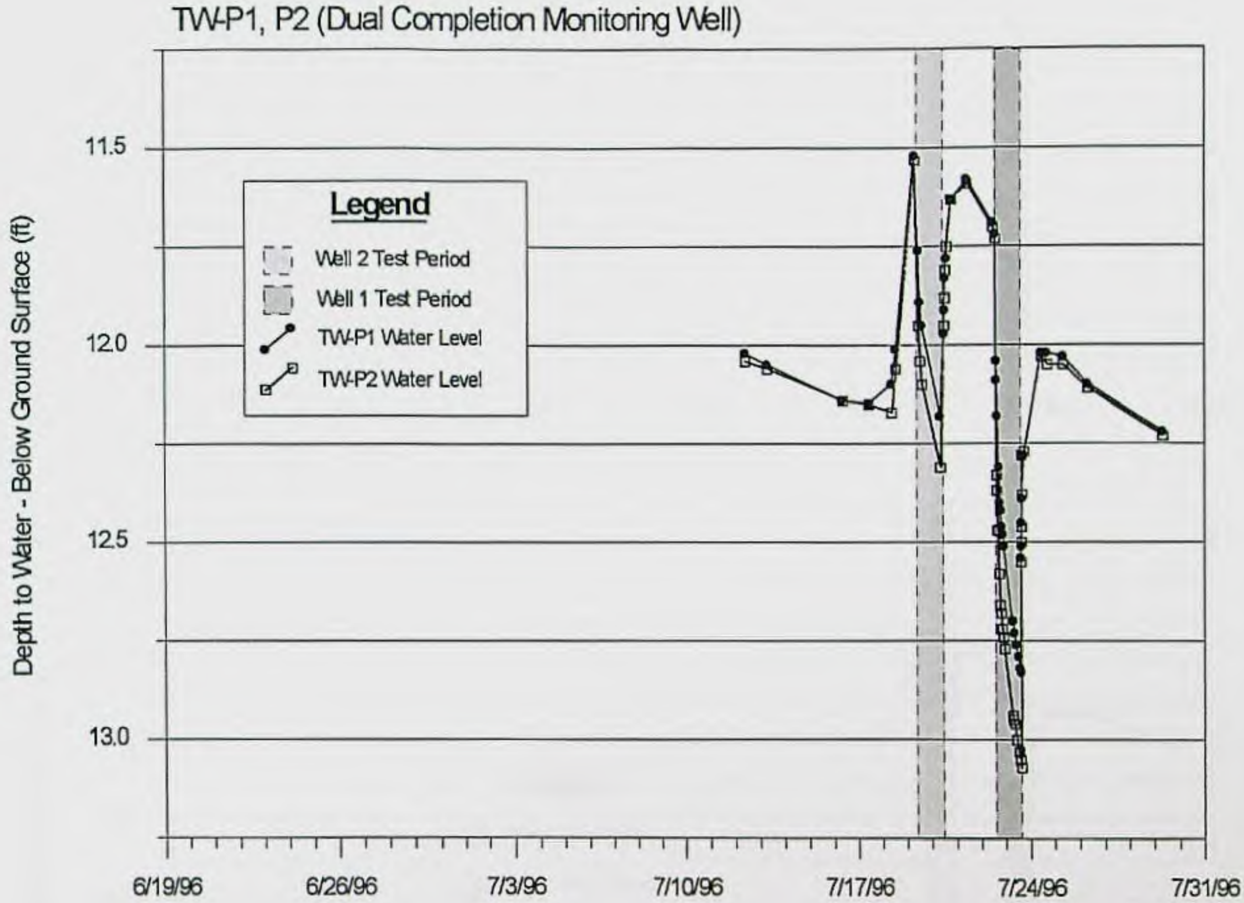
AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	Wells 1 and 2 Distance Drawdown	Figure 8 Date: 07/31/96



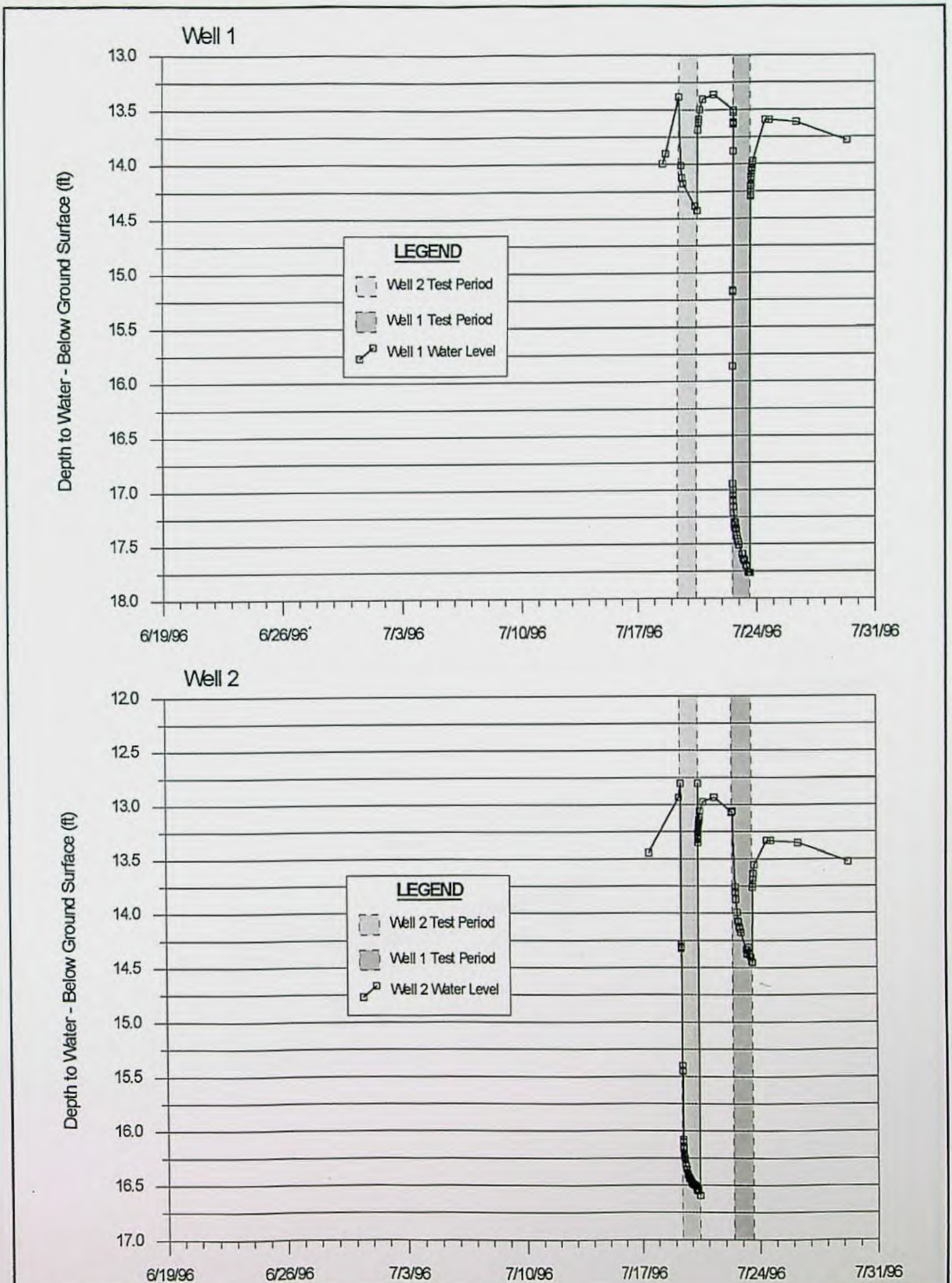
AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	Peterson Creek Monitoring Stations C1, C2, and C3 Hydrographs	Figure 9 Date: 07/31/96



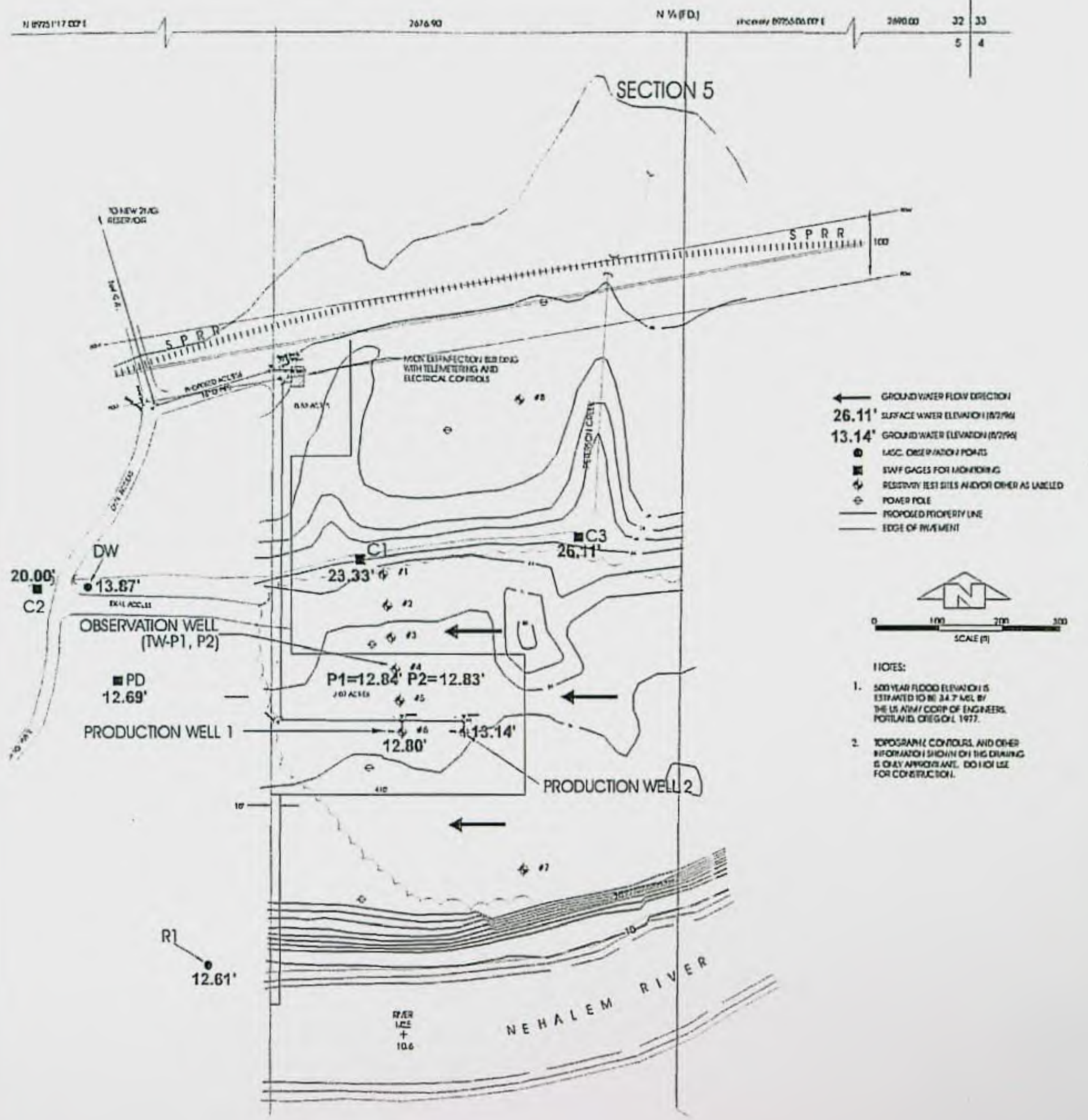
AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	Miscellaneous Monitoring Stations DW, PD, and R1 Hydrographs	Figure 10 Date: 07/31/96



AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	TW-P1, P2 Hydrograph	Figure 11 Date: 07/31/96



AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project # 15,792.005	Wells 1 and 2 Water Level Hydrographs	Figure 12 Date: 07/31/96



AGI TECHNOLOGIES	Lee Engineering Wheeler Oregon Project #15,792 005	Water Level Elevation Map	Figure 13 Date: 7/31/96

June 25, 1996

WATER
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36728 S. Kropf Road
Molalla, OR 97038

Dear Steve:

Please find enclosed a copy of the following approved special standard:

1. City of Wheeler (start card number 89999)

If you have any questions concerning this letter, please contact me by phone at (541) 396-3121 x388, by fax at (541) 396-6233 or by letter at 290 N Central Street, Coquille, OR 97423.

Sincerely,

Rob Carter
Well Construction Specialist

cc: Tracy Eichenlaub, Well Inspector

c:\wp\ws96\stadeli

Oregon Water Resources Department

REQUEST FOR WRITTEN APPROVAL TO USE CONSTRUCTION METHODS NOT INCLUDED IN OREGON ADMINISTRATIVE RULES 690-200 THROUGH 690-240

Before request can be considered, the following must be answered. Requests shall be submitted to the Well Construction Specialist, Water Resources Department. Requests may also be considered by the appropriate Regional Manager.

Date of request: 6-18-96

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

Bonded Well Constructor (name, license and mailing address): STEVE STADELI LIC. # 688

(1) Location of Well: ____ 1/4 ____ 1/4 of Section 5, Township 2N, Range 9W, Tillamook County.

Address at well site: 22095 FOSS RD. WHEELER

(2) Start Card Number(s): 89999

(3) Name and Address of Land Owner: City of WHEELER P.O. Box 177 WHEELER OR.

(4) The distance to the nearest well, septic tank or drainfield (if water supply well): 150' tOR - TO NEW PROPOSED WELL

(5) The unusual conditions which necessitate this request: THIS IS AN EXISTING 8" TEST WELL THAT THE City WISHES TO CONVERT TO A DUAL COMPLETION PIEZOMETER/MONITORING WELL

(6) The proposed construction methods that the well constructor believes will be adequate for this well (attach additional pages if needed)

SEE ATTACHED PROPOSED TEST WELL COMPLETION FIGURE 3

(7) Diagram showing the pertinent features of the proposed well design and construction (attach additional pages if needed):

SEE SAME AS # 6

THE PROPOSED SEALING MATERIAL WILL BE ALL BENTONITE PRODUCTS, NOT CEMENT/BENTONITE AS INDICATED.

PLEASE NOTE:

(1) If approved, all other phases of well construction must comply with the appropriate standards described in OAR 690-200 through 690-240.

(2) If it should be determined at some future date that the well, due to its construction, is allowing groundwater contamination, waste or loss of artesian pressure, the undersigned shall return to the site and rectify the problem.

(3) If verbal approval was granted, a written request must be submitted to the Department either within three (3) working days of the date of verbal approval or prior to the completion of the associated well work. Failure to submit a written request as described above may void prior approval.

I have read and understand the above information. I further attest that the information provided is accurate to the best of my knowledge.

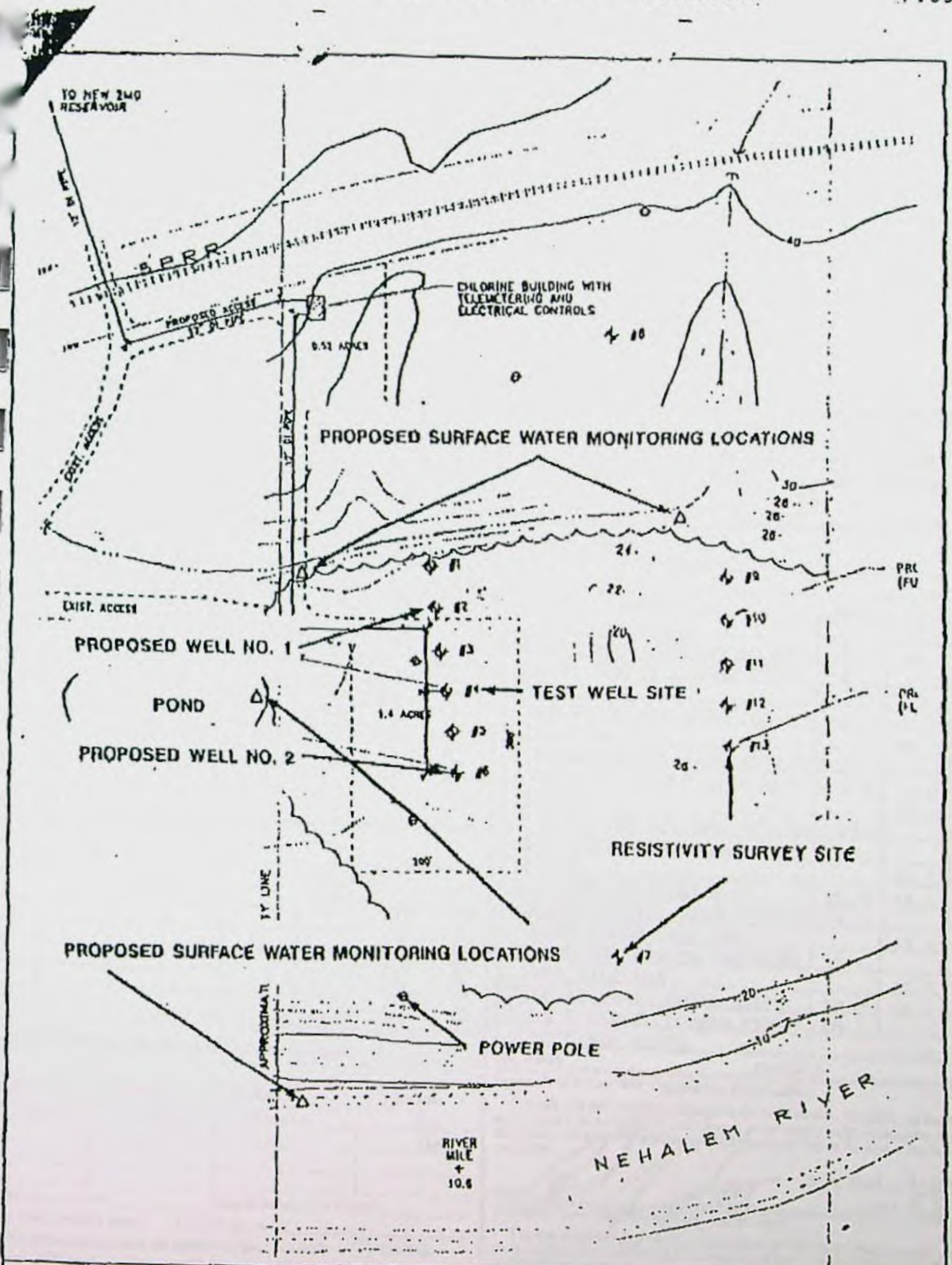
Bonded Constructor Signature: Steven H. Stadel

For Water Resources Department Use Only

Date: 6-25-96

Approved by: [signature] Denied by: ____

Remarks: ____ revised 6.96



AGI	WHEELER OREGON PROJECT:	GROUND WATER INVESTIGATION LOCATION MAP	FIGURE 1

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D.# ______

(START CARD) # 89997

(1) OWNER: Well Number Well A
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(2) TYPE OF WORK
[X] New Well [ ] Deepening [ ] Alteration (repair/recondition) [X] Abandonment

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

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

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Well 0 ft.
Explosives used [ ] Yes [X] No Type ______ Amount ______

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
18	0	8				
16	8	49				
			NEAT CEMENT	49	0	100 SACKS

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:	ALL CASING WAS REMOVED				[ ]	[ ]	[ ]	[ ]
	& WELL BORE WAS DISPLACED				[ ]	[ ]	[ ]	[ ]
	WITH NEAT CEMENT GROUT				[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s) ______

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

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]

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

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.

Temperature of water ______ 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 TILLAMOOK Latitude ______ Longitude ______
Township 2N N or S Range 9W E or W. WM.
Section 5 ______ 1/4 ______ 1/4
Tax Lot ______ Lot ______ Block ______ Subdivision ______
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
14 ft. below land surface. Date 6-28-96
Artesian pressure 0 lb. per square inch. Date ______

(11) WATER BEARING ZONES:
Depth at which water was first found 9

From	To	Estimated Flow Rate	SWL
9	19	15 GPM	
19	26.5	<100 GPM	
27.5	33.5	>100 GPM	

(12) WELL LOG:
Ground Elevation ______

Material	From	To	SWL
SAND SILTY GREY	0	7	
SAND SILTY SOME GRAVEL MED	7	9	
GRAVEL MED TO COURSE SILTY	9		
BRN		19	
COBBLES GRAVEL SAND 10"	19		
MINUS GREY		20.5	
COBBLES GRAVEL SAND 10"MINUS	20.5	23.0	
GREY VERY LITTLE SILT SEMI	23.0	23.0	
LOOSE		23.0	
COBBLES GRAVEL SAND 10"MINUS	23.0		
BRN VERY LITTLE SILT SEMI			
LOOSE		26.5	
SILT BRN SOFT GRAVELY	26.5	27.5	
COBBLES GRAVEL SAND 6"MINUS	27.5		
CLEAN LOOSE GREY BRN		33.5	
GRAVEL BRN COURSE CEMENTED	33.5		
SOME SILT BRN		37.0	
SAME AS ABOVE (MORE SILT)	37.0	40.0	
SAND & GRAVEL COURSE CMTD	40.0	44.0	
TIGHT BRN DIRTY		44.0	

Date started ______ Completed ______

(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 1487
Signed [signature] Date 7-29-96

(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. Stadel Date 7-29-96

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

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

WELL I.D.# ______

(START CARD) # 89997

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

(1) OWNER: Well Number Well A
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(2) TYPE OF WORK
[X] New Well [ ] Deepening [ ] Alteration (repair/recondition) [X] Abandonment

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

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

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

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds

How was seal placed: Method [ ] A [ ] B [ ] 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:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s) ______

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

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]

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

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

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.

Temperature of water ______ 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 TILLAMOOK Latitude ______ Longitude ______
Township 2N N or S Range 9W E or W. WM.
Section ______ ______ 1/4 ______ 1/4
Tax Lot ______ Lot ______ Block ______ Subdivision ______
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
______ ft. below land surface. Date ______
Artesian pressure ______ lb. per square inch. Date ______

(11) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Estimated Flow Rate	SWL

(12) WELL LOG:
Ground Elevation ______

Material	From	To	SWL
ROCK GREY BLUE FRACTURED	44.0		
SOFT		49.0	

Date started 6-18-96 Completed 6-29-96

(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 1487
Signed [signature] Date 7-29-96

(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 Steve N. Stoddle Date 7-29-9[illegible]

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

WELL I.D. # L01906 (START CARD) # 89998

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

(1) OWNER: Well Number 1
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(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 [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [X] Other MUNICIPAL

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Well 63 ft.
Explosives used [ ] Yes [X] No Type ______ Amount ______

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
18	0	8"				
16	8	63				
			NEAT CEMENT	33.5	0	59 SACKS

How was seal placed: Method [ ] A [ ] B [X] C [ ] D [ ] E
[ ] Other
Backfill placed from 33.5 ft. to 35 ft. Material SAND & BENT. CHIPS
Gravel placed from 35 ft. to 55 ft. Size of gravel PEA ROCK DRAIN ROCK

(6) CASING/LINER: 55 63

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+3	43	.250	[X]	[ ]	[X]	[ ]
	12	50	55		[X]	[ ]	[X]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s) NONE

(7) PERFORATIONS/SCREENS:
[ ] Perforations Method
[X] Screens Type JOHNSON V-WIRE Material SS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
43	53	100		12" p/s		[X]	[ ]

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

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

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
1012	3.5		24

Temperature of water 49 Depth Artesian Flow Found
Was a water analysis done? [X] Yes By whom AGI TECHNOLOGIES
Did any strata contain water not suitable for intended use? [ ] Too little

(9) LOCATION OF WELL by legal description:
County TILLAMOOK Latitude ______ Longitude ______
Township 2N N or S Range 9W E or W. WM.
Section 5 ___ 1/4 ___ 1/4
Tax Lot ___ Lot ___ Block ___ Subdivision ___
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
14 ft. below land surface. Date 7-24-96
Artesian pressure 0 lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 9'

From	To	Estimated Flow Rate	SWL
9	16	15	
16	23	50	14
42.5	50	500	14

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
SAND GREY LOOSE (overbank dep)	0	2	
SAND GREY SILTY	2	9	
SAND & GRAVEL MED SILTY	9	11	
SAND & GARVEL COURSE SILTY	11	16	
SAND GRAVEL COBBLES 10"MINUS	16		
BRN LOOSE (semi clean)		23	
COBBLES SAND & GRAVEL 10"	23		
MINUS PACKED BRN SOME SILT BRN		27	
SILT BROWN GRAVELY	27	28	
SAND & GRAVEL SILTY BRN 5"	28		
MINUS SOME COBBLES		31	
GRAVEL BRN COURSE TO FINE	31		
SOME SAND SEMI LOOSE		32.5	
SAND GRAVEL COBBLES 10"	32.5		
MINUS PACKED BRN		34.5	
GRAVEL & COBBLES 8" MINUS	34.5		
BROWN LESS SAND		39	
SAND GRAVEL COBBLES BRN 8"	39		
MINUS MORE SAND SEMI TIGHT		42.5	

Date started 6-21-96 Completed 7-24-96

(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 1487
Signed ______ Date 7-29-96

(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

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
WELL I.D. # L01906 (START CARD) # 89998
Instructions for completing this report are on the last page of this form.
(1) OWNER: Well Number
(9) LOCATION OF WELL by legal description:

Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(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 [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [X] Other MUNICIPAL

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

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds

How was seal placed: Method [ ] A [ ] B [ ] 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:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s)

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

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]

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

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

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.

Temperature of water ____ 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:

County TILLAMOOK Latitude ____ Longitude ____
Township 2N N or S Range 9W E or W. WM.
Section 5 ____ 1/4 ____ 1/4
Tax Lot ____ Lot ____ Block ____ Subdivision ____
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
____ ft. below land surface. Date ____
Artesian pressure ____ lb. per square inch. Date ____

(11) WATER BEARING ZONES:

Depth at which water was first found ____

From	To	Estimated Flow Rate	SWL

(12) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
GRAVEL GREY 6" MINUS CLEAN	42.5		
SOME SAND		50	
GRAVEL 8" MINUS BRN SANDY	50		
PACKED		54	
SILT BROWN GRAVELY	54	55	
GRAVEL BRN SILTY 6" MINUS	55	59.5	
BED ROCK BLUE GREY SOFT	50.5		
BROKEN WEATHERED		63	

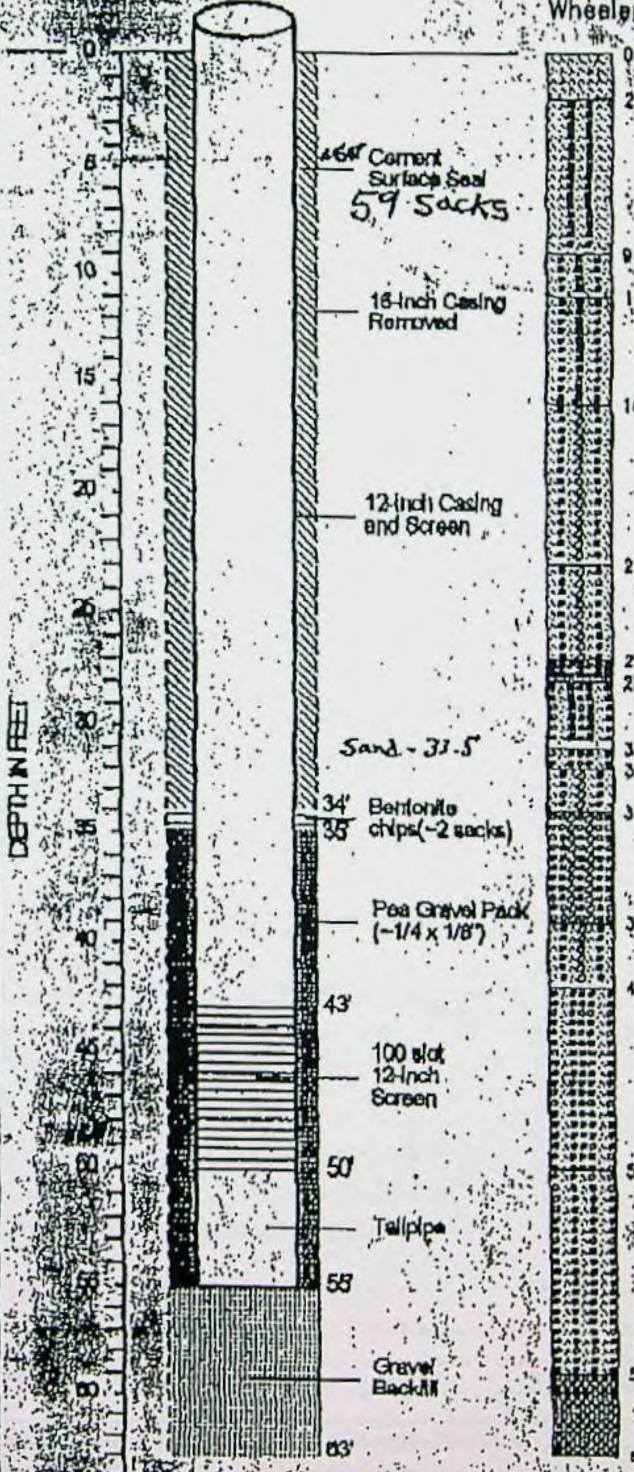
Date started 6-21-96 Completed 7-24-96

(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 1487
Signed [signature] Date 7-29-96

(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 7-29-96

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

Wheeler Well 2 Lithologic Log



0–2	Sand, gry, loose, (flood deposits)
2–9	Sand, gry, silty
9–11	Sand and Gravel, med., silty
11–16	Sand and Gravel, coarse, silty
16–23	Sand, Gravel, Cobbles, 10-Inch minus, brn, loose, semi-clean
23–27	Cobbles, Sand and Gravel, 10-inch minus, brn., some silt
27–28	Silt, brn, gravelly
28–31	Sand and Gravel, silty, brn., 5-inch minus, some cobbles
31–32.5	Gravel, some sand, brn-red, coarse to fine, semi-loose
32.5–34.5	Sand, Gravel, cobbles, brn-red, 10-inch minus, packed
34.5–39	Gravel and cobbles, 8-inch minus, brn., less sand
39–42.6	Sand, Gravel, Cobbles, brn-red, 8-inch minus, semi-tight
42.6–50	Gravel, some sand, gry-brn, 6-inch minus, clean, loose
50–58.5	Gravel, sandy, brn, 8-inch minus, packed
58.5–63	Basalt bedrock, blue-gry, soft

AGI | WHEELER OREGON | Well 2 Completion Design

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

WELL I.D.# L01907

(START CARD) # 90000

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

(1) OWNER: Well Number #2
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(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 [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [XX] Other MUNICIPAL

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Well 63 ft.
Explosives used [ ] Yes [X] No Type ______ Amount ______

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
18	0	8				
16	8	63				
			NEAT CEMENT	33.5	0	42 SACKS

How was seal placed: Method [ ] A [ ] B [X] C [ ] D [ ] E
[ ] Other
Backfill placed from 33.5 ft. to 35 ft. Material BENT. CHIPS
Gravel placed from 35 ft. to 63 ft. Size of gravel PEA ROCK

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12	+3	45	.250	[XX]	[ ]	[XX]	[ ]
	12	60	63	.250	[XX]	[ ]	[XX]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
[ ] Perforations Method
[X] Screens Type JOHNSON V-WIRE Material SS

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
45	60	100		12p/s		[XX]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]

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

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
1025	3.5		24 HOUR

Temperature of water 49° 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 TILLAMOOK Latitude ______ Longitude ______
Township 2N N or S Range 4W E or W. WM.
Section 5 ______ 1/4 ______ 1/4
Tax Lot ______ Lot ______ Block ______ Subdivision ______
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
14 ft. below land surface. Date 7-28-96
Artesian pressure ______ lb. per square inch. Date ______

(11) WATER BEARING ZONES:

Depth at which water was first found 16'

From	To	Estimated Flow Rate	SWL
16	32.5	≤15 GPM	14
32.5	44.5	≤100 GPM	14
44.5	63	≥400 GPM	14

(12) WELL LOG:
Ground Elevation ______

Material	From	To	SWL
SAND GREY LOOSE FLOOD DEPOSIT	0	2	
SAND GREY SILTY	2	7	
SAND & GRAVEL SILTY	7	9	
SAND & GRAVEL LESS SILT	9	16	
GRAVEL GREY BRN RED W/SILT	16		
BROWN		19	
GRAVEL & SAND SOME COBBLES	19	26	
GREY BRN 2" MINUS PACKED	26	[illegible]	
GRAVEL BROWN SILTY		30	
GRAVEL COURSE BRN 8" MINUS	30	[illegible]	
SOME SILT SOME SAND		32.5	
GRAVEL RED BRN SEMI CLEAN	32.5	44.5	
GRAVEL GREY BRN 6" MINUS	44.5		
CLEAN LOOSE SOME SAND		50.5	
GRAVEL GREY COURSE 10"	50.5		
MINUS CLEAN LOOSE SOME SAND		58.5	
GRAVEL GREY COURSE TRACE OF	58.5		
SILT		59.0	
GRAVEL GREY COURSE 10" MINUS	59.0		
SEMI LOOSE MORE SAND		63.0	

Date started 7-1-96 Completed 7-25-96

(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 1487
Signed [signature] Date 7-29-96

(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. Steele Date 7-29-96

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form.

WELL I.D. # L01907

(START CARD) # 90000

(1) OWNER: Well Number
Name CITY OF WHEELER
Address P.O. BOX 177
City WHEELER State OR Zip 97147

(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 [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Livestock [X] Other MUNICIPAL

(5) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [X] No Depth of Completed Well 63 ft.
Explosives used [ ] Yes [X] No Type Amount

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds

How was seal placed: Method [ ] A [ ] B [ ] 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:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Liner:					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s)

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

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]

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

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.

Temperature of water 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 TILLAMOOK Latitude Longitude
Township 2N N or S Range 4W E or W. WM.
Section 5 1/4 1/4
Tax Lot Lot Block Subdivision
Street Address of Well (or nearest address)
22095 FOSS RD., WHEELER, OR

(10) STATIC WATER LEVEL:
ft. below land surface. Date
Artesian pressure lb. per square inch. Date

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

From	To	Estimated Flow Rate	SWL

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
ROCK BROKEN WEATHERED BLUE	63		
GREY		?	

Date started 7-1-96 Completed 7-25-96

(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 1487
Signed Date 7-29-96

(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 7-29-96

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

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

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

Start Card # 89999

(1) OWNER/PROJECT: WELL NO. L01905 Test/observation well

Name CITY OF WHEELER

Address P.O. BOX 177

City WHEELER State OR Zip 97147

(2) TYPE OF WORK:

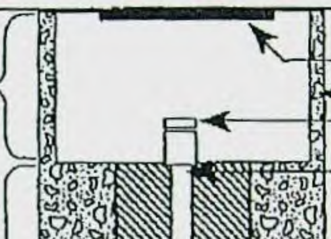
☐ New construction ☐ Alteration (Repair/Recondition)
☒ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☒ Cable
☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☒ No ☐ Depth of completed well 59.5 ft.



Vault ___ ft. TO ___ ft.

Seal ___ ft. TO ___ ft.

Filter pack ___ ft. TO ___ ft.

Land surface
Water-tight cover
Surface flush vault
Locking cap

Casing diameter 2 in.
material ______
Welded ☐ Threaded ☐ Glued ☐

Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐

Well seal:
Material ______
Amount ______
Grout weight ______
Borehole diameter ______ in.

Bentonite plug at least 3 ft. thick

Screen
material ______
interval(s):
From ____ To ____
From ____ To ____
Slot size ____ in.

Filter pack:
Material ______
Size ______ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity ______ PH ______

Temperature of water 49 °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☒ Yes ☐ No

By whom? AGI TECHNOLOGIES

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks: ______

Name of supervising Geologist/Engineer CRAIG RUSSELL

(6) LOCATION OF WELL By legal description

Well Location: County TILLAMOOK

Township 2N (N or S) Range 9W (E or W) Section 5

1. ____ 1/4 of ____ 1/4 of above section.

2. Either Street address of well location 22095 FOSS RD., WHEELER, OR

or Tax lot number of well location ______

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

14 Ft. below land surface. Date 7-11-96

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found SEE ATTACHED

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
SEE ATTACHED SHEETS FOR			
LITHOLOGY & WELL CONSTRUCTION			

Date started 7-8-96 Completed 7-11-96

(unbonded) Monitor 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. Materials used and information reported above are true to the best knowledge and belief.

MWC Number 10106

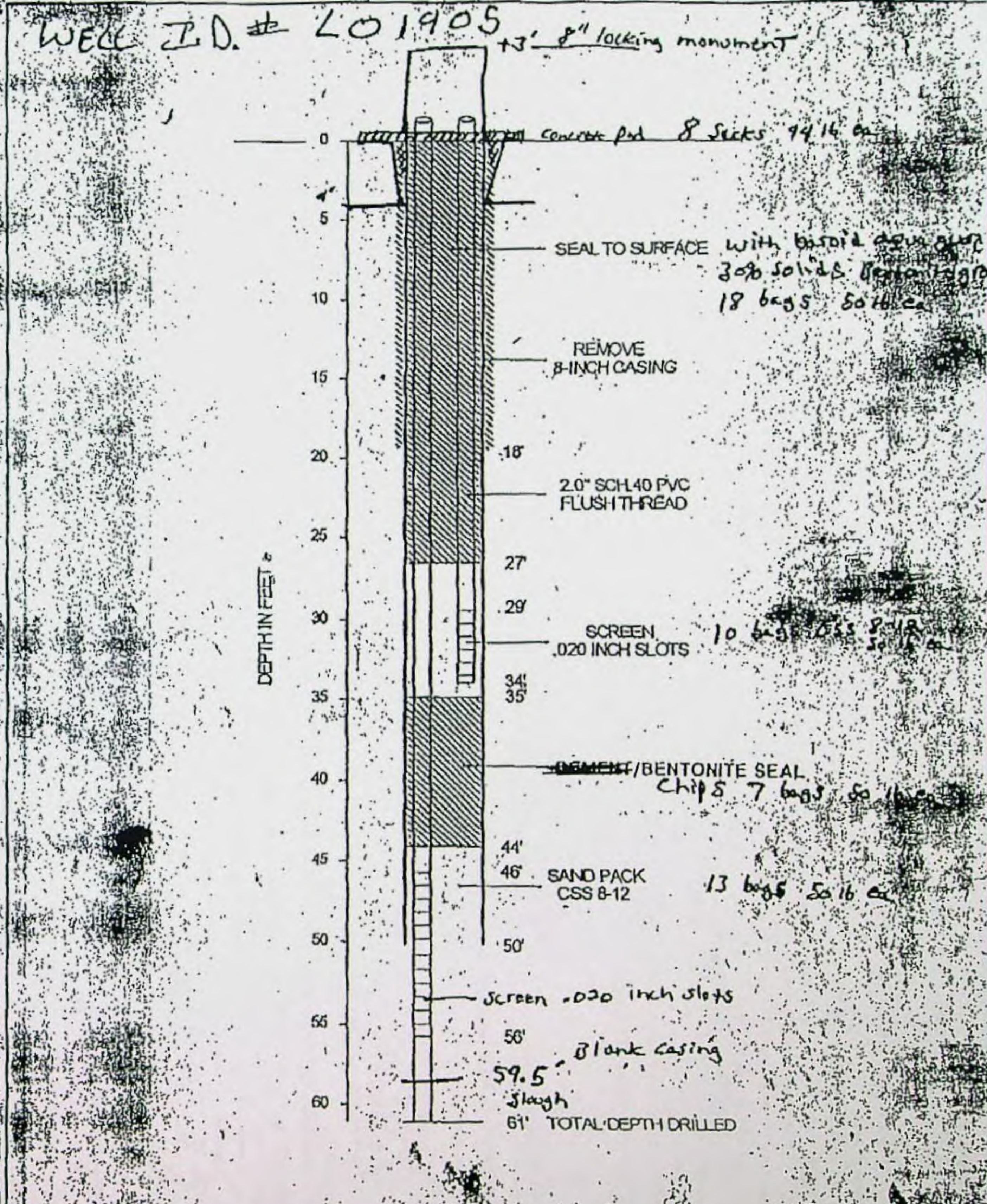
Signed [signature] Date 7-29-96

(bonded) Monitor 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.

MWC Number 10010

Signed Steven M. Stedel Date 7-29-96


WELL I.D. # L01905
+3' 8" locking monument
Concrete Pad 8 Sacks 94 lb ea
0
5
10
15
20
25
30
35
40
45
50
55
60
DEPTH IN FEET
4'
SEAL TO SURFACE with baroid aqua gard
30% solids Bentonite grout
18 bags 50 lb ea
REMOVE
8-INCH CASING
18'
2.0" SCH.40 PVC
FLUSH THREAD
27'
29'
SCREEN
.020 INCH SLOTS
34'
35'
~~CEMENT~~/BENTONITE SEAL
Chips 7 bags 50 lb ea
44'
46'
SAND PACK
CSS 8-12
13 bags 50 lb ea
50'
Screen .020 inch slots
56'
Blank casing
59.5'
Slough
61' TOTAL DEPTH DRILLED

Enter Public Water System ID # in boxes below: Project No. 1569.10

4	1						

Name of Water System: Wheeler Test Wells

Address Wheeler

City ______ County ______

Phone 368-5767

Collection date and time: 7 / 20 / 96 11 : __ a.m. (Month Day Year Hour Min)

Type of sample: ☐ Routine ☐ *Repeat ☐ Special

* If repeat, date of initial positive ______

Collected by: Gene Cox

Sample point: Test Well #2

Chlorinated? ☐ Yes ☒ No Free Chlorine mg/l ______

Return address for report:

Name Wheeler Water Dept. Attn: Gene Cox

Address P.O. Box 177

City, state, zip Wheeler, OR 97147

MICROBIOLOGICAL ANALYSIS

PUBLIC WATER SUPPLIES
DRINKING WATER PROGRAM

LABORATORY RESULTS

Total coliforms: ☐ Present* ☒ Absent

Fecal coliforms/*E. coli*: ☐ Present* ☒ Absent

*See back of pink copy for interpretation

0/10 0/5 0/5 — = <2/100ml

Test Methods: 20 Tube Total + Fecal

☒ MTF ☐ MF ☐ P-A ☐ MMO-MUG

☐ EC ☐ EC+MUG ☐ Nutrient Agar + MUG

Sample invalid: resample immediately

☐ Leaked ☐ Over 30 hr old

☐ Heavy non-coliform growth (as defined by method)

Copy Distribution:
White Lab
Yellow Health Division
Pink Water System

Form # 50-90 (Rev. 8/92)
e:\work\labslip

I 7694

110 15 15

JOHN R. GERKE, Ph.D.
APPLIED SCIENCE LAB.
P.O. BOX 195 PH: 842-5366
NETARTS, OR 97143

RECEIVED
SEP 30 1996
AGI TECHNOLOGIES

Lab Cert # 32

Sample # 7200

Bottle # No Number

Date & time received 7/20/96 1 PM

Received by: JG 1:30

Date & time analyzed: 7/20/96 2 PM

Comments:

Plate Count - 800/100ml.

Analyst: JM Date: 7/22/96

Review by: JG Date: 7/23

Send results to: Oregon Health Division, P.O. Box 14350, Portland OR 97214-0350 Phone (503) 731-4381

Enter Public Water System ID # in boxes below:

4	1						

Name of Water System: Wheeler

Address ______

City ______ County ______

Phone ______

Collection date and time: 7 / 23 / 96 2 : 15 p.m. (Month Day Year Hour Min)

Type of sample: ☐ Routine ☐ *Repeat ☒ Special

* If repeat, date of initial positive ______

Collected by: ______

Sample point: Well #1

Chlorinated? ☐ Yes ☐ No Free Chlorine mg/l ______

Return address for report:

Name Wheeler Water Dept. Attn: Gene Cox

Address P.O. Box 177

City, state, zip Wheeler, OR 97147

MICROBIOLOGICAL ANALYSIS

PUBLIC WATER SUPPLIES
DRINKING WATER PROGRAM

LABORATORY RESULTS

Total coliforms: ☐ Present* ☒ Absent

Fecal coliforms/*E. coli*: ☐ Present* ☒ Absent

*See back of pink copy for interpretation

Test Methods: 0/10 0/5 0/5 - 0/5

☒ MTF ☐ MF ☐ P-A ☐ MMO-MUG

☐ EC ☐ EC+MUG ☐ Nutrient Agar + MUG

Sample invalid: resample immediately

☐ Leaked ☐ Over 30 hr old

☐ Heavy non-coliform growth (as defined by method)

Copy Distribution:
White Lab
Yellow Health Division
Pink Water System

Form # 50-90 (Rev. 8/92)
e:\work\labslip

I 7698

<2/100 ml

Lab Cert # 32

Sample # 2401

Bottle # Clients

Date & time received 7/23/96 4 PM

Received by: JG 2413

Date & time analyzed: 7/23/96 9:30

Comments:

Analyst: JG Date: 7/26

Review by: ______ Date: ______

Send results to: Oregon Health Division, P.O. Box 14350, Portland OR 97214-0350 Phone (503) 731-4381

LEE ENGINEERING, INC.

TRANSMITTAL LETTER

DATE: 8/13/96

TO: AGI Technologies
3206 50th crt N.W. #109
Gig Harbor, WA. 98335

ATTENTION: Craig Russell

SUBJECT: Water Sample Tests - Wheeler Test Wells.

PROJECT NO: 1569.10

GENTLEMEN:

WE ARE SENDING YOU ✓ ATTACHED
____ UNDER SEPARATE COVER VIA ____

THE FOLLOWING:
____ PRINTS ____ PLANS
____ SHOP DRAWINGS ____ SPECIFICATIONS
____ CHANGE ORDER ____ COPY OF LETTER
✓ OTHER Coffey Lab Reports.

COPIES	DATE	SET NO.	DESCRIPTION

THESE ARE TRANSMITTED AS CHECKED ABOVE:

____ FOR APPROVAL ✓ FOR YOUR USE ____ FOR REVIEW AND COMMENT

____ APPROVED AS SUBMITTED ____ AS REQUESTED

____ APPROVED AS NOTED ____ RETURNED FOR CORRECTIONS

REMARKS: ____

COPY TO: ____ SIGNED F. Duane Lee

Report Date: August 13, 1996
Job Number: 960724U
PWSID: None Provided
PO Number: None Provided
Project No: LEI Project No. 1569.10
Project Name: Wheeler Test Wells

F. Duane Lee, P.E.
Lee Engineering Inc.
1300 John Adams St
Oregon City, OR 97045

Sample Information

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
960724U-1	Well No. 1	Drinking Water	07/23/96	NP

Analytical results are on the following page(s).

Sincerely,

Rona A. Klueh
Technical Director

The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

RAK/atc1

Analytical Data

Lee Engineering Inc.

Job Number: 960724U
PWSID: None Provided
Page Number: 2 of 7

Sample Information

Source ID: None provided
Sampled At: Well No. 1
Date Collected: 07/23/96
Date Received: 07/24/96
Sample Composition: None provided
Lab Sample ID: 960724U-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/24/96-08/02/96

EPA Category: Conventional Parameters

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Nitrate	1040	10.	0.01	1.2	EPA 300.0	PDB
Nitrite	1041	1.	0.01	ND	EPA 300.0	PDB
Sulfate	1055	250	0.1	2.2	EPA 300.0	PDB
Total Cyanide	1024	0.2	0.005	ND	EPA 335.2	PDB
Fluoride (Free)	1025	4.	0.2	ND	EPA 340.2	RAP
Total Alkalinity	1927	----	0.5	26.	SM 403	RAP
Phenolphthalein Alkalinity (PA)	1931	----	0.5	ND	SM 403	RAP
Carbonate Alkalinity	1929	----	0.5	ND	SM 403	RAP
Hydroxide Alkalinity	----	----	0.5	ND	SM 403	RAP
Bicarbonate Alkalinity	1928	----	0.5	26.	SM 403	RAP

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960724U
PWSID: None Provided
Page Number: 3 of 7

Sample Information

Source ID: None provided
Sampled At: Well No. 1
Date Collected: 07/23/96
Date Received: 07/24/96
Sample Composition: None provided
Lab Sample ID: 960724U-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/24/96-08/02/96

EPA Category: Metals

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Barium	1010	2.0	0.002	0.002	CFR 200.7	TTN
Beryllium	1075	0.004	0.0005	ND	CFR 200.7	TTN
Iron	1028	0.3	0.05	ND	CFR 200.7	TTN
Magnesium	1031	----	0.05	1.9	CFR 200.7	TTN
Nickel	1036	0.1	0.01	ND	CFR 200.7	TTN
Potassium	1042	----	1.	ND	CFR 200.7	TTN
Sodium	1052	----	0.1	6.0	CFR 200.7	TTN
Antimony	1074	0.006	0.0005	ND	EPA 200.8	TTN
Arsenic	1005	0.05	0.0005	ND	EPA 200.8	TTN
Cadmium	1015	0.005	0.0005	ND	EPA 200.8	TTN
Chromium	1020	0.1	0.001	ND	EPA 200.8	JEL
Selenium	1045	0.05	0.001	ND	EPA 200.8	TTN
Thallium	1085	0.002	0.0005	ND	EPA 200.8	TTN
Mercury	1035	0.002	0.0005	ND	EPA 245.1	AKH

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Coffey Laboratories, Inc.
12423 N.E. Whitaker Way • Portland, OR • 97230 • (503) 254-1794 • FAX (503) 254-1452

Analytical Data

Lee Engineering Inc.

Job Number: 960724U
PWSID: None Provided
Page Number: 4 of 7

Sample Information

Source ID:	None provided	Source Name(s):	None Provided
Sampled At:	Well No. 1	Sampled By:	Craig Russell
Date Collected:	07/23/96	Time Collected:	N/P
Date Received:	07/24/96	Date Analyzed:	07/24/96-08/02/96
Sample Composition:	None provided		
Lab Sample ID:	960724U-1		

EPA Category: Volatile Organic Contaminants - Regulated

Parameter	EPA Code	MCL (mg/L)	MDL (mg/L)	Results	Method	Analyst
Benzene	2990	0.005	0.0005	ND	EPA 524.2	DGJ
Carbon tetrachloride	2982	0.005	0.0005	ND	EPA 524.2	DGJ
Chlorobenzene	2989	0.1	0.0005	ND	EPA 524.2	DGJ
1,2-Dichlorobenzene	2968	0.6	0.0005	ND	EPA 524.2	DGJ
1,4-Dichlorobenzene	2969	0.075	0.0005	ND	EPA 524.2	DGJ
1,2-Dichloroethane	2980	0.005	0.0005	ND	EPA 524.2	DGJ
1,1-Dichloroethene	2977	0.007	0.0005	ND	EPA 524.2	DGJ
cis-1,2-Dichloroethene	2380	0.07	0.0005	ND	EPA 524.2	DGJ
trans-1,2-Dichloroethene	2979	0.1	0.0005	ND	EPA 524.2	DGJ
Dichloromethane	2964	0.005	0.0005	ND	EPA 524.2	DGJ
1,2-Dichloropropane	2983	0.005	0.0005	ND	EPA 524.2	DGJ
Ethylbenzene	2992	0.7	0.0005	ND	EPA 524.2	DGJ
Styrene	2996	0.1	0.0005	ND	EPA 524.2	DGJ
Tetrachloroethene	2987	0.005	0.0005	ND	EPA 524.2	DGJ
Toluene	2991	1.0	0.0005	ND	EPA 524.2	DGJ
1,2,4-Trichlorobenzene	2378	0.07	0.0005	ND	EPA 524.2	DGJ
1,1,1-Trichloroethane	2981	0.2	0.0005	ND	EPA 524.2	DGJ
1,1,2-Trichloroethane	2985	0.005	0.0005	ND	EPA 524.2	DGJ
Trichloroethene	2984	0.005	0.0005	ND	EPA 524.2	DGJ
Vinyl chloride	2976	0.002	0.0005	ND	EPA 524.2	DGJ
Xylenes (total)	2955	10.0	0.0005	ND	EPA 524.2	DGJ

ND means none detected at or above the detection limit.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960724U
PWSID: None Provided

Sample Information

Source ID: None provided
Sampled At: Well No. 1
Date Collected: 07/23/96
Date Received: 07/24/96
Sample Composition: None provided
Lab Sample ID: 960724U-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/24/96-08/02/96

Analysis Performed: Volatile Organic Contaminants - Unregulated

Parameter	EPA Code	MCL (mg/L)	MDL (mg/L)	Results	Method	Analyst
Bromobenzene	2993	--	0.0005	ND	EPA 524.2	DGJ
Bromodichloromethane	2943	--	0.0005	ND	EPA 524.2	DGJ
Bromoform	2942	--	0.0005	ND	EPA 524.2	DGJ
Bromomethane	2214	--	0.0005	ND	EPA 524.2	DGJ
Chloroethane	2216	--	0.0005	ND	EPA 524.2	DGJ
Chloroform	2941	--	0.0005	ND	EPA 524.2	DGJ
Chloromethane	2210	--	0.0005	ND	EPA 524.2	DGJ
2-Chlorotoluene	2965	--	0.0005	ND	EPA 524.2	DGJ
4-Chlorotoluene	2966	--	0.0005	ND	EPA 524.2	DGJ
Dibromochloromethane	2944	--	0.0005	ND	EPA 524.2	DGJ
Dibromomethane	2408	--	0.0005	ND	EPA 524.2	DGJ
1,3-Dichlorobenzene	2967	--	0.0005	ND	EPA 524.2	DGJ
1,1-Dichloroethane	2978	--	0.0005	ND	EPA 524.2	DGJ
1,3-Dichloropropane	2412	--	0.0005	ND	EPA 524.2	DGJ
2,2-Dichloropropane	2416	--	0.0005	ND	EPA 524.2	DGJ
1,1-Dichloropropene	2410	--	0.0005	ND	EPA 524.2	DGJ
1,3-Dichloropropene	2413	--	0.0005	ND	EPA 524.2	DGJ
1,1,1,2-Tetrachloroethane	2986	--	0.0005	ND	EPA 524.2	DGJ
1,1,2,2-Tetrachloroethane	2988	--	0.0005	ND	EPA 524.2	DGJ
1,2,3-Trichloropropane	2414	--	0.0005	ND	EPA 524.2	DGJ

ND means none detected at or above the detection limit.

Maximum contaminant level (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Coffey Laboratories, Inc.
12423 N.E. Whitaker Way • Portland, OR • 97230 • (503) 254-1794 • FAX (503) 254-1452

Analytical Data

Lee Engineering Inc.

Job Number: 960724U
PWSID: None Provided
Page Number: 6 of 7

Sample Information

Source ID: None provided
Sampled At: Well No. 1
Date Collected: 07/23/96
Date Received: 07/24/96
Sample Composition: None provided
Lab Sample ID: 960724U-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/24/96-08/02/96

EPA Category: Synthetic Organic Compounds

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
EDB	2946	0.00005	0.00001	ND	EPA 504	DJM
DBCP	2931	0.0002	0.00002	ND	EPA 504	DJM
Hexachlorocyclopentadiene	2042	0.050	0.00006	ND	EPA 505	DJM
Aldrin	2356	----	0.000006	ND	EPA 508	DJM
Chlordane	2959	0.002	0.000135	ND	EPA 508	DJM
Dieldrin	2070	----	0.000006	ND	EPA 508	DJM
Endrin	2005	0.0002	0.000018	ND	EPA 508	DJM
Propachlor	2077	----	0.00012	ND	EPA 508	DJM
Toxaphene	2020	0.003	0.0009	ND	EPA 508	DJM
Polychlorinated biphenyls	2383	0.0005	0.00027	ND	EPA 508	DJM
2,4-D	2105	0.07	0.001	ND	EPA 515.1	DJM
Dalapon	2031	0.2	0.002	ND	EPA 515.1	DJM
Dicamba	2440	----	0.001	ND	EPA 515.1	DJM
Dinoseb	2041	0.007	0.0002	ND	EPA 515.1	DJM
Pentachlorophenol	2326	0.001	0.0001	ND	EPA 515.1	DJM
Picloram	2040	0.5	0.0005	ND	EPA 515.1	DJM
2,4,5-TP	2110	0.05	0.0002	ND	EPA 515.1	DJM

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

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Analytical Data

Lee Engineering Inc.

Job Number: 960724U
PWSID: None Provided
Page Number: 7 of 7

Sample Information

Source ID: None provided
Sampled At: Well No. 1
Date Collected: 07/23/96
Date Received: 07/24/96
Sample Composition: None provided
Lab Sample ID: 960724U-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/24/96-08/02/96

EPA Category: Synthetic Organic Compounds

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Alachlor	2051	0.002	0.0001	ND	EPA 525.2	DGJ
Atrazine	2050	0.003	0.0001	ND	EPA 525.2	DGJ
Benzo(a)pyrene	2306	0.0002	0.0001	ND	EPA 525.2	DGJ
Di(2-ethylhexyl)phthalate	2039	0.006	0.0007	ND	EPA 525.2	DGJ
Di(2-ethylhexyl)adipate	2035	0.4	0.0001	ND	EPA 525.2	DGJ
Heptachlor	2065	0.0004	0.0001	ND	EPA 525.2	DGJ
Heptachlor epoxide	2067	0.0002	0.0001	ND	EPA 525.2	DGJ
Hexachlorobenzene	2274	0.001	0.0001	ND	EPA 525.2	DGJ
Lindane	2010	0.0002	0.0001	ND	EPA 525.2	DGJ
Methoxychlor	2015	0.04	0.0001	ND	EPA 525.2	DGJ
Simazine	2037	0.004	0.0001	ND	EPA 525.2	DGJ
Aldicarb	2047	----	0.001	ND	EPA 531.1	DJM
Aldicarb sulfone	2044	----	0.002	ND	EPA 531.1	DJM
Aldicarb sulfoxide	2043	----	0.002	ND	EPA 531.1	DJM
Carbaryl	2021	----	0.002	ND	EPA 531.1	DJM
Carbofuran	2046	0.04	0.0015	ND	EPA 531.1	DJM
3-Hydroxycarbofuran	2066	----	0.002	ND	EPA 531.1	DJM
Methomyl	2022	----	0.0005	ND	EPA 531.1	DJM
Oxamyl	2036	0.2	0.002	ND	EPA 531.1	DJM
Glyphosate	2034	0.7	0.01	ND	EPA 547	DJM
Endothall	2033	0.1	0.04	ND	EPA 548	DJM
Diquat	2032	0.02	0.002	ND	EPA 549	VB

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

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Report Date: August 13, 1996
Job Number: 960722G
PWSID: None Provided
PO Number: None Provided
Project No: LEI Proj. No. 1569.10
Project Name: Wheeler Test Wells

F. Duane Lee, P.E.
Lee Engineering Inc.
1300 John Adams St
Oregon City, OR 97045

Sample Information

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
960722G-1	Nehalem R.	Surface Water	07/20/96	NP
960722G-2	Peterson Crk.	Surface Water	07/20/96	NP
960722G-3	Well No.2	Ground Water	07/20/96	NP

Analytical results are on the following page(s).

Sincerely,

Rona A. Klueh
Technical Director

The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

RAK/atc1

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Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 2 of 11

Sample Information

Source ID: None Provided
Sampled At: Nehalem R.
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Conventional Parameters

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Nitrate	1040	10.	0.01	0.26	EPA 300.0	PDB
Nitrite	1041	1.	0.01	ND	EPA 300.0	PDB
Sulfate	1055	250	0.1	4.7	EPA 300.0	PDB
Total Cyanide	1024	0.2	0.01	ND	EPA 335.2	PDB
Fluoride (Free)	1025	4.	0.2	ND	EPA 340.2	RAP
Total Alkalinity	1927	----	0.5	22.	SM 403	RAP
Phenolphthalein Alkalinity (PA)	1931	----	0.5	ND	SM 403	RAP
Carbonate Alkalinity	1929	----	0.5	ND	SM 403	RAP
Hydroxide Alkalinity	----	----	0.5	ND	SM 403	RAP
Bicarbonate Alkalinity	1928	----	0.5	22.	SM 403	RAP

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 3 of 11

Sample Information

Source ID: None Provided
Sampled At: Nehalem R.
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Metals

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Barium	1010	2.0	0.002	0.003	CFR 200.7	TTN
Beryllium	1075	0.004	0.0005	ND	CFR 200.7	TTN
Iron	1028	0.3	0.05	0.28	CFR 200.7	TTN
Magnesium	1031	----	0.05	1.6	CFR 200.7	TTN
Nickel	1036	0.1	0.01	ND	CFR 200.7	TTN
Potassium	1042	----	1.	ND	CFR 200.7	TTN
Sodium	1052	----	0.1	6.1	CFR 200.7	TTN
Antimony	1074	0.006	0.0005	ND	EPA 200.8	JEL
Arsenic	1005	0.05	0.002	ND	EPA 200.8	JEL
Cadmium	1015	0.005	0.0005	ND	EPA 200.8	JEL
Chromium	1020	0.1	0.002	ND	EPA 200.8	JEL
Selenium	1045	0.05	0.001	ND	EPA 200.8	JEL
Thallium	1085	0.002	0.0005	ND	EPA 200.8	JEL
Mercury	1035	0.002	0.0005	ND	EPA 245.1	AKH

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 4 of 11

Sample Information

Source ID:	None Provided	Source Name(s):	None Provided
Sampled At:	Peterson Crk.	Sampled By:	Craig Russell
Date Collected:	07/20/96	Time Collected:	N/P
Date Received:	07/22/96	Date Analyzed:	07/22/96-08/02/96
Sample Composition:	None Provided		
Lab Sample ID:	960722G-2		

EPA Category: Conventional Parameters

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Nitrate	1040	10.	0.01	0.94	EPA 300.0	PDB
Nitrite	1041	1.	0.02	ND	EPA 300.0	PDB
Sulfate	1055	250	0.1	2.2	EPA 300.0	PDB
Total Cyanide	1024	0.2	0.014	ND	EPA 335.2	PDB
luoride (Free)	1025	4.	0.2	ND	EPA 340.2	RAP
Total Alkalinity	1927	----	0.5	19.	SM 403	RAP
Phenolphthalein Alkalinity (PA)	1931	----	0.5	ND	SM 403	RAP
Carbonate Alkalinity	1929	----	0.5	ND	SM 403	RAP
Hydroxide Alkalinity	----	----	0.5	ND	SM 403	RAP
Bicarbonate Alkalinity	1928	----	0.5	19.	SM 403	RAP

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 5 of 11

Sample Information

Source ID: None Provided
Sampled At: Peterson Crk.
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-2

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Metals

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Barium	1010	2.0	0.002	0.002	CFR 200.7	TTN
Beryllium	1075	0.004	0.0005	ND	CFR 200.7	TTN
Iron	1028	0.3	0.05	ND	CFR 200.7	TTN
Magnesium	1031	----	0.05	1.4	CFR 200.7	TTN
Nickel	1036	0.1	0.01	ND	CFR 200.7	TTN
Potassium	1042	----	1.	ND	CFR 200.7	TTN
Sodium	1052	----	0.1	5.4	CFR 200.7	TTN
Antimony	1074	0.006	0.0005	ND	EPA 200.8	JEL
Arsenic	1005	0.05	0.002	ND	EPA 200.8	JEL
Cadmium	1015	0.005	0.0005	ND	EPA 200.8	JEL
Chromium	1020	0.1	0.002	ND	EPA 200.8	JEL
Selenium	1045	0.05	0.001	ND	EPA 200.8	JEL
Thallium	1085	0.002	0.0005	ND	EPA 200.8	JEL
Mercury	1035	0.002	0.0005	ND	EPA 245.1	AKH

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

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Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 6 of 11

Sample Information

Source ID: None Provided
Sampled At: Well No.2
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-3

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Conventional Parameters

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Nitrate	1040	10.	0.01	1.2	EPA 300.0	PDB
Nitrite	1041	1.	0.02	ND	EPA 300.0	PDB
Sulfate	1055	250	0.1	2.2	EPA 300.0	PDB
Total Cyanide	1024	0.2	0.01	ND	EPA 335.2	PDB
Fluoride (Free)	1025	4.	0.2	ND	EPA 340.2	RAP
Total Alkalinity	1927	----	0.5	25.	SM 403	RAP
Phenolphthalein Alkalinity (PA)	1931	----	0.5	ND	SM 403	RAP
Carbonate Alkalinity	1929	----	0.5	ND	SM 403	RAP
Hydroxide Alkalinity	----	----	0.5	ND	SM 403	RAP
Bicarbonate Alkalinity	1928	----	0.5	25.	SM 403	RAP

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

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Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 7 of 11

Sample Information

Source ID: None Provided
Sampled At: Well No.2
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-3

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Metals

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Barium	1010	2.0	0.002	ND	CFR 200.7	TTN
Beryllium	1075	0.004	0.0005	ND	CFR 200.7	TTN
Iron	1028	0.3	0.05	ND	CFR 200.7	TTN
Magnesium	1031	----	0.05	1.9	CFR 200.7	TTN
Nickel	1036	0.1	0.01	ND	CFR 200.7	TTN
Potassium	1042	----	1.	ND	CFR 200.7	TTN
Sodium	1052	----	0.1	5.8	CFR 200.7	TTN
Antimony	1074	0.006	0.0005	ND	EPA 200.8	JEL
Arsenic	1005	0.05	0.002	ND	EPA 200.8	JEL
Cadmium	1015	0.005	0.0005	ND	EPA 200.8	JEL
Chromium	1020	0.1	0.002	ND	EPA 200.8	JEL
Selenium	1045	0.05	0.001	ND	EPA 200.8	JEL
Thallium	1085	0.002	0.0005	ND	EPA 200.8	JEL
Mercury	1035	0.002	0.0005	ND	EPA 245.1	AKH

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

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Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 8 of 11

Sample Information

Source ID: None Provided
Sampled At: Well No.2
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-3

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Volatile Organic Contaminants - Regulated

Parameter	EPA Code	MCL (mg/L)	MDL (mg/L)	Results	Method	Analyst
Benzene	2990	0.005	0.0005	ND	EPA 524.2	DGJ
Carbon tetrachloride	2982	0.005	0.0005	ND	EPA 524.2	DGJ
Chlorobenzene	2989	0.1	0.0005	ND	EPA 524.2	DGJ
1,2-Dichlorobenzene	2968	0.6	0.0005	ND	EPA 524.2	DGJ
1,4-Dichlorobenzene	2969	0.075	0.0005	ND	EPA 524.2	DGJ
1,2-Dichloroethane	2980	0.005	0.0005	ND	EPA 524.2	DGJ
1,1-Dichloroethene	2977	0.007	0.0005	ND	EPA 524.2	DGJ
cis-1,2-Dichloroethene	2380	0.07	0.0005	ND	EPA 524.2	DGJ
trans-1,2-Dichloroethene	2979	0.1	0.0005	ND	EPA 524.2	DGJ
Dichloromethane	2964	0.005	0.0005	ND	EPA 524.2	DGJ
1,2-Dichloropropane	2983	0.005	0.0005	ND	EPA 524.2	DGJ
Ethylbenzene	2992	0.7	0.0005	ND	EPA 524.2	DGJ
Styrene	2996	0.1	0.0005	ND	EPA 524.2	DGJ
Tetrachloroethene	2987	0.005	0.0005	ND	EPA 524.2	DGJ
Toluene	2991	1.0	0.0005	ND	EPA 524.2	DGJ
1,2,4-Trichlorobenzene	2378	0.07	0.0005	ND	EPA 524.2	DGJ
1,1,1-Trichloroethane	2981	0.2	0.0005	ND	EPA 524.2	DGJ
1,1,2-Trichloroethane	2985	0.005	0.0005	ND	EPA 524.2	DGJ
Trichloroethene	2984	0.005	0.0005	ND	EPA 524.2	DGJ
Vinyl chloride	2976	0.002	0.0005	ND	EPA 524.2	DGJ
Xylenes (total)	2955	10.0	0.0005	ND	EPA 524.2	DGJ

ND means none detected at or above the detection limit.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 9 of 11

Sample Information

Source ID: None Provided
Sampled At: Well No.2
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-3

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

Analysis Performed: Volatile Organic Contaminants - Unregulated

Parameter	EPA Code	MCL (mg/L)	MDL (mg/L)	Results	Method	Analyst
Bromobenzene	2993	--	0.0005	ND	EPA 524.2	DGJ
Bromodichloromethane	2943	--	0.0005	ND	EPA 524.2	DGJ
Bromoform	2942	--	0.0005	ND	EPA 524.2	DGJ
Bromomethane	2214	--	0.0005	ND	EPA 524.2	DGJ
Chloroethane	2216	--	0.0005	ND	EPA 524.2	DGJ
Chloroform	2941	--	0.0005	ND	EPA 524.2	DGJ
Chloromethane	2210	--	0.0005	ND	EPA 524.2	DGJ
2-Chlorotoluene	2965	--	0.0005	ND	EPA 524.2	DGJ
4-Chlorotoluene	2966	--	0.0005	ND	EPA 524.2	DGJ
Dibromochloromethane	2944	--	0.0005	ND	EPA 524.2	DGJ
Dibromomethane	2408	--	0.0005	ND	EPA 524.2	DGJ
1,3-Dichlorobenzene	2967	--	0.0005	ND	EPA 524.2	DGJ
1,1-Dichloroethane	2978	--	0.0005	ND	EPA 524.2	DGJ
1,3-Dichloropropane	2412	--	0.0005	ND	EPA 524.2	DGJ
2,2-Dichloropropane	2416	--	0.0005	ND	EPA 524.2	DGJ
1,1-Dichloropropene	2410	--	0.0005	ND	EPA 524.2	DGJ
1,3-Dichloropropene	2413	--	0.0005	ND	EPA 524.2	DGJ
1,1,1,2-Tetrachloroethane	2986	--	0.0005	ND	EPA 524.2	DGJ
1,1,2,2-Tetrachloroethane	2988	--	0.0005	ND	EPA 524.2	DGJ
1,2,3-Trichloropropane	2414	--	0.0005	ND	EPA 524.2	DGJ

ND means none detected at or above the detection limit.

Maximum contaminant level (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 10 of 11

Sample Information

Source ID: None Provided
Sampled At: Well No.2
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-3

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Synthetic Organic Compounds

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
EDB	2946	0.00005	0.00001	ND	EPA 504	DJM
DBCP	2931	0.0002	0.00002	ND	EPA 504	DJM
Hexachlorocyclopentadiene	2042	0.050	0.00006	ND	EPA 505	DJM
Aldrin	2356	----	0.000006	ND	EPA 508	DJM
Chlordane	2959	0.002	0.000135	ND	EPA 508	DJM
Dieldrin	2070	----	0.000006	ND	EPA 508	DJM
Endrin	2005	0.0002	0.000018	ND	EPA 508	DJM
Propachlor	2077	----	0.00006	ND	EPA 508	DJM
Toxaphene	2020	0.003	0.0009	ND	EPA 508	DJM
Polychlorinated biphenyls	2383	0.0005	0.00027	ND	EPA 508	DJM
2,4-D	2105	0.07	0.001	ND	EPA 515.1	DJM
Dalapon	2031	0.2	0.002	ND	EPA 515.1	DJM
Dicamba	2440	----	0.001	ND	EPA 515.1	DJM
Dinoseb	2041	0.007	0.0002	ND	EPA 515.1	DJM
Pentachlorophenol	2326	0.001	0.0001	ND	EPA 515.1	DJM
Picloram	2040	0.5	0.0005	ND	EPA 515.1	DJM
2,4,5-TP	2110	0.05	0.0002	ND	EPA 515.1	DJM

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Analytical Data

Lee Engineering Inc.

Job Number: 960722G
PWSID: None Provided
Page Number: 11 of 11

Sample Information

Source ID: None Provided
Sampled At: Well No.2
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: None Provided
Lab Sample ID: 960722G-3

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 07/22/96-08/02/96

EPA Category: Synthetic Organic Compounds

Contaminant	Code	MCL mg/L	Detection Limit	Analysis mg/L	Method	Analyst
Alachlor	2051	0.002	0.0001	ND	EPA 525.2	DGJ
Atrazine	2050	0.003	0.0001	ND	EPA 525.2	DGJ
Benzo(a)pyrene	2306	0.0002	0.0001	ND	EPA 525.2	DGJ
Di(2-ethylhexyl)phthalate	2039	0.006	0.0004	ND	EPA 525.2	DGJ
Di(2-ethylhexyl)adipate	2035	0.4	0.0001	ND	EPA 525.2	DGJ
Heptachlor	2065	0.0004	0.0001	ND	EPA 525.2	DGJ
Heptachlor epoxide	2067	0.0002	0.0001	ND	EPA 525.2	DGJ
Hexachlorobenzene	2274	0.001	0.0001	ND	EPA 525.2	DGJ
Lindane	2010	0.0002	0.0001	ND	EPA 525.2	DGJ
Methoxychlor	2015	0.04	0.0001	ND	EPA 525.2	DGJ
Simazine	2037	0.004	0.0001	ND	EPA 525.2	DGJ
Aldicarb	2047	----	0.001	ND	EPA 531.1	DJM
Aldicarb sulfone	2044	----	0.002	ND	EPA 531.1	DJM
Aldicarb sulfoxide	2043	----	0.002	ND	EPA 531.1	DJM
Carbaryl	2021	----	0.002	ND	EPA 531.1	DJM
Carbofuran	2046	0.04	0.0015	ND	EPA 531.1	DJM
3-Hydroxycarbofuran	2066	----	0.002	ND	EPA 531.1	DJM
Methomyl	2022	----	0.0005	ND	EPA 531.1	DJM
Oxamyl	2036	0.2	0.002	ND	EPA 531.1	DJM
Glyphosate	2034	0.7	0.01	ND	EPA 547	DJM
Endothall	2033	0.1	0.02	ND	EPA 548	DJM
Diquat	2032	0.02	0.0012	ND	EPA 549	DJM

ND means none detected at or above the detection limit listed.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

Coffey Laboratories, Inc.
12423 N.E. Whitaker Way • Portland, OR • 97230 • (503) 254-1794 • FAX (503) 254-1452

RECEIVED

SEP 30 1996

AGI TECHNOLOGIES

RECEIVED

SEP 27 1996

Report Date: September 25, 1996
Job Number: 960724V
PWSID: None Provided
PO Number: None Provided
Project No: LEI Project No. 1569.10
Project Name: Wheeler Test Wells

F. Duane Lee, P.E.
Lee Engineering Inc.
1300 John Adams St.
Oregon City, OR 97045

Sample Information

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
960724V-1	Well No. 1	Drinking Water	07/23/96	NP

Analytical results are on the following page(s).

Sincerely,

Rona A. Klueh
Technical Director

The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

RAK/atc1

SEP 27 1996

Analytical Data

Lee Engineering Inc.

Job Number: 960724V
PWSID: None Provided

Sample Information

Source ID: None Provided
Sampled At: Well No. 1
Date Collected: 07/23/96
Date Received: 07/24/96
Sample Composition: Drinking Water
Lab Sample ID: 960724V-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 08/16/96

EPA Category: Radiological

Contaminant	Code	MCL pCi/L	Detection Limit	Analysis pCi/L	Method	Analyst
Gross Alpha	4000	15.	1.	1.	SM 7110 C	*

* The analysis was performed by Truesdail Laboratories, Inc., Tustin, CA.

Maximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

SEP 27 1996

Report Date: September 25, 1996
Job Number: 960722K
PWSID: None Provided
PO Number: None Provided
Project No: LEI Proj. No. 1569.10
Project Name: Wheeler Test Wells

F. Duane Lee, P.E.
Lee Engineering Inc.
1300 John Adams St.
Oregon City, OR 97045

Sample Information

Laboratory Sample ID	Field Identification	Matrix	Collection Date	Collection Time
960722K-1	Well No.2	Drinking Water	07/20/96	NP

Analytical results are on the following page(s).

Sincerely,

Rona A. Klueh
Technical Director

The data submitted in this report is for the sole and exclusive use of the above-named client. All samples associated with the work order will be retained a maximum of 15 days from the report date or until the maximum holding time expires. All results pertain only to samples submitted.

Thank you for allowing Coffey Laboratories to be of service to you. If you have questions or need further assistance, please do not hesitate to call our Customer Services Department.

RAK/atc1

SEP 27 1996

Analytical Data

Lee Engineering Inc.

Job Number: 960722K
PWSID: None Provided

Sample Information

Source ID: None Provided
Sampled At: Well No.2
Date Collected: 07/20/96
Date Received: 07/22/96
Sample Composition: Drinking Water
Lab Sample ID: 960722K-1

Source Name(s): None Provided
Sampled By: Craig Russell
Time Collected: N/P
Date Analyzed: 08/16/96

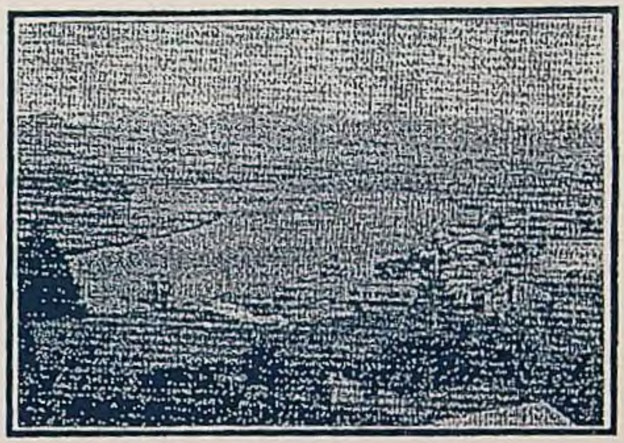
EPA Category: Radiological

Contaminant	Code	MCL pCi/L	Detection Limit	Analysis pCi/L	Method	Analyst
Gross Alpha	4000	15.	1.	1.	SM 7110 C	*

* The analysis was performed by Truesdail Laboratories, Inc., Tustin, CA.

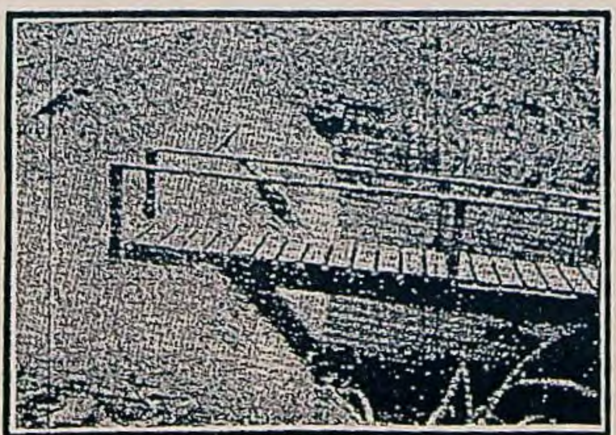
laximum contaminant (MCL) means the maximum allowable level of a contaminant in water delivered to the users of a public water system.

CITY OF WHEELER AND CITY OF MANZANITA



WATER FACILITIES MASTER PLAN UPDATE

(Draft)



Prepared By:
LEE ENGINEERING, INC.
OCTOBER 1994

LEE ENGINEERING, INC.
F. DUANE LEE, P.E.
DAVID A. LEE, P.E., P.L.S.
JAMES G. SMITH, P.E.

October 20, 1994

Mayor Walt Trandum
City of Wheeler
P.O. Box 177
Wheeler, OR 97147

Re: Cities of Wheeler and Manzanita Water Master Plan Update - Groundwater Investigation

Dear Mayor Trandum:

Lee Engineering, Inc. is pleased to transmit herewith 10 copies of our draft report for the groundwater investigation and update of your water master plan. The final report is a result of considerable effort by you and your staff and individuals at the City of Manzanita and several other parties who have been instrumental in working with you on this project. The report concludes that the best long range water supply for the Cities of Wheeler and Manzanita is the development of groundwater along the north bank of the Nehalem River at approximate River Mile 10.6. The proposed well location is on property currently owned by Mr. and Mrs. Forster.

Considerable additional work will need to be undertaken before the City can begin receiving water from the proposed new groundwater source. We look forward to working with you and the other participants in the implementation of the proposed regional water supply project.

Thank you for this opportunity to be of service to you and the many citizens of the North Tillamook County area.

Sincerely,

LEE ENGINEERING, INC.

F. Duane Lee

F. Duane Lee, P.E., W.R.E.

FDL:nj
Enclosures

1300 JOHN ADAMS STREET · OREGON CITY, OREGON 97045 · PH. 503-655-1342
1-800-848-9731 · FAX 503-655-1360

CITY OF WHEELER
AND
CITY OF MANZANITA

WATER FACILITIES

MASTER PLAN UPDATE

REGISTERED PROFESSIONAL
ENGINEER
6757
F. Duane Lee
OREGON
JULY 17, 1970
F. DUANE LEE
10/20/94

This project was funded in part with a financial award from the Special Public Works Fund administered by the State of Oregon Economic Development Department.

October 1994

Prepared by:

LEE ENGINEERING, INC.
1300 John Adams Street
Oregon City, Oregon 97045

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CITY OF WHEELER AND CITY OF MANZANITA
WATER FACILITIES MASTER PLAN UPDATE

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(continued)

ILLUSTRATIONS

CHAPTER 1

1.1 Introduction

During the past two years, including 1993 and 1994, the City of Wheeler has been actively pursuing a solution to their domestic water needs. The City currently delivers water to the citizens from two small drainages near the town of Wheeler. Water is delivered without treatment except for chlorination acting as a disinfectant. At times, the water becomes very turbid. At other times, there is barely enough water to serve the existing customers and their associated demands.

In March of 1993, a report was prepared for the City of Wheeler outlining various alternatives for improving their water supply. The recommendations were in keeping with the Oregon Department of Human Resources - Health Division, which is requiring Wheeler to upgrade its water supply or seek an alternative source. The report concluded that the most likely solution for an improved water system would be to develop a water supply on the Nehalem River.

In order to pursue this option, the City of Wheeler, together with the City of Manzanita, applied for a grant from the Oregon Department of Economic Development to drill test wells along the Nehalem River at approximately River Mile 9 to River Mile 10. The City of Manzanita elected to join the City of Wheeler in the investigation of alternative supplies since it is also under direction from the Oregon Health Division to upgrade its water source. The two cities budgeted local resources for additional funds beyond the $10,000 grant in order to accomplish the minimum objectives of groundwater investigations.

Several other smaller water systems and communities could participate in the proposed regional solution. However, the groundwater investigation was limited to the two cities, together with Nehalem Bay State Park, Zadduck Creek, Tideland, and Brighton. Other agencies which could benefit from the proposed regional water system, but did not choose to do so, were Watseco-Barview, Rockaway Beach, Nehalem, and Neahkahnie Water District. However, it is understood that these agencies may wish to participate in the regional water solution after the initial groundwater investigation or at some other future date.

1.2 Purpose of the Study

The primary purpose of this study is to provide sufficient information to determine whether or not groundwater can be developed in sufficient quantity and quality to meet the needs of a regional water supply. It is not the purpose of this study to answer all questions relating to a regional water supply. Rather, the primary focus of this study is on the potential groundwater resource.

This report also updates the previous reports entitled "North Tillamook County Regional Water Supply Master Plan" and City of Wheeler Water Facilities Master Plan." Additional information is contained within the previous studies.

1.3 Scope of the Study

The scope of this study is to include investigations of the potential of a groundwater resource and, if viable, address how the water system would be developed to provide domestic water supplies to Wheeler and Manzanita and the other participating parties. The primary tasks include:

1. Perform an electro-geophysical mapping of the potential aquifer area.

2. Construct test wells (test well) by drilling, casing and developing one or more wells.

3. Provide test pumping of the developed wells.

4. Perform water quality testing to determine if the water is suitable for domestic purposes.

5. Prepare an engineering report of findings.

1.4 Acknowledgments

Lee Engineering, Inc. expresses sincere thanks to Mayor Walt Trandum of Wheeler, Gene Cox, City Recorder/Public Works Director of Wheeler, and Randy Kugler, City Manager of Manzanita. Their assistance in collecting the information and approaching the local property owners for permission to access potential groundwater sites was invaluable. This project would not have been possible without their help.

We also wish to thank various individuals at the Oregon Economic Development Department, including Bill Campbell, and Dave Phelps at the Oregon Health Division, for his patience and encouragement throughout the project.

Finally, we thank Dr. Peter Scott of Linn Benton Community College and Vicki Goodman of the Tillamook County Economic Development Committee for their assistance in working with the North Tillamook County Water Resource Committee in coordinating various activities under this study.

CHAPTER 2

PLANNING AREA CHARACTERISTICS

2.1 Planning Area Description

The planning area for this report is the City of Wheeler Urban Growth Boundary, the City of Manzanita Urban Growth Boundary, and the existing service areas of Nehalem Bay State Park, Tideland, Zadduck Creek, and Brighton. For the areas outside of Wheeler and Manzanita, the existing land use is controlled by the Tillamook County Comprehensive Plan. The Urban Growth Boundary for Wheeler and Manzanita is outlined in the cities' respective Comprehensive Plans. Details of the planning area, potential growth, and other factors are outlined in the previous report entitled "North Tillamook County Regional Water Supply Master Plan," March 1993. The specific areas covered by projections in this report are shown on Figure 2.1.

2.2 Pending Developments

The City of Wheeler has received active inquiries concerning several recent developments. In the prior report of March 1993, four commercial developments were proposed. They included:

Proposed Development	Estimated New Jobs Created
Paradise Cove Marina and RV Park	15
Wheeler Marine Park	6
Nehalem River Marina Harbor	12
Wheeler Fishing Lodge	3
Total Estimated New Jobs:	36

In addition to these projects, residential subdivisions were proposed, including:

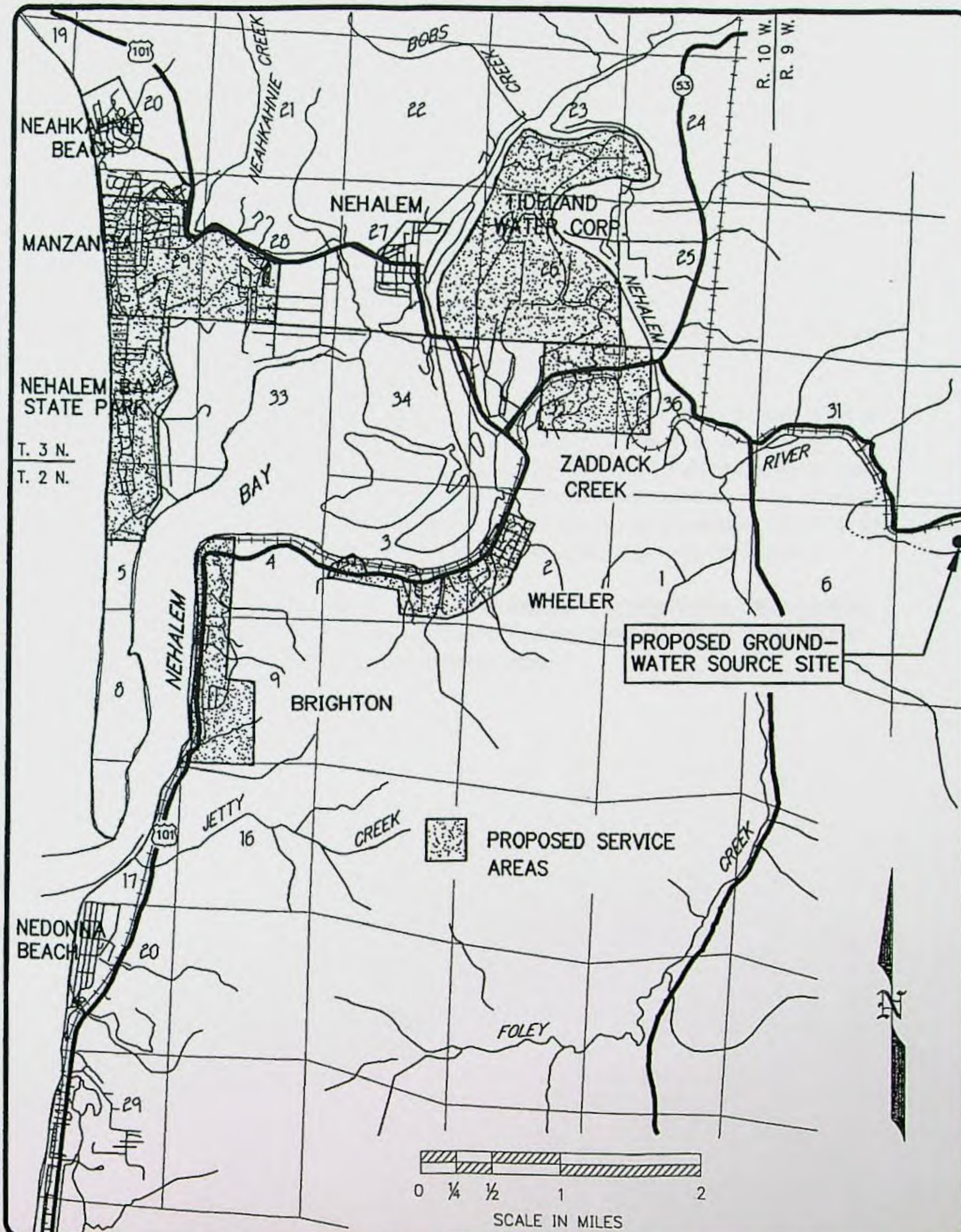
Development	Total Lots
Goins Subdivision (Bayview) Scott Goins, Developer	20
Rose Addition Vern Scobel, Developer	24

Currently, two other major developments have been added to the list for Wheeler. They include:

Development	Total Lots
Alder Ridge Subdivision Pat Williams, Developer	13
Bay View Subdivision Bob Webster, Developer	25
Alder Street Development Mr. & Mrs. Welch	4

Obviously, the City of Wheeler is expecting much more rapid growth than was originally anticipated two years ago. With the developments currently under way, the city's population is expected to increase by about 50% in the next five to ten years. These developments are presently being restricted due to the inability of the City to meet the demands and quality requirements of a public water system.

The City of Manzanita is also experiencing rapid development far in excess of the earlier projections. Currently, the City has growth at a rate of 3% to 4% per year. Most of Manzanita's development is the result of new housing on existing platted lots. There are no pending new subdivisions. However, several are anticipated in the near future.



OWNER: CITY OF WHEELER		LEE ENGINEERING, INC. 1300 JOHN ADAMS ST. OREGON CITY, OR, 97045
DWG TITLE: N. TILLAMOOK CO. REGIONAL WATER STUDY AREAS INCLUDED IN WATER RIGHTS APPLICATION	DATE: OCT '94 FILE NO: 1307P08	REVISED:

FIGURE 2.1

CHAPTER 3

WATER REQUIREMENTS

3.1 Estimated Water Demands

The current and future water demands are shown in Table 3.1. The total number of existing services connected to the proposed six jurisdictions that will be served by a regional water supply is about 1,587. Total connections are expected to increase to about 2,458 by the year 2010 and to 4,978, or approximately 5,000 connections, by the year 2050.

Currently, average water demand is a little over 400,000 gallons per day. This demand is for an average day. Peak day demands are about two to two and one-half times the average day demand. Peak day demands occur in August and January of each year. Future average day and peak day demands are tabulated in Table 3.1. Peak day demands will approach about 2.2 million gallons per day by the year 2050. This is a rate of about 1,526 gallons per minute. Average day is estimated to be about 913,000 gallons per day, or a little over 630 gallons per minute.

In addition to the future water needs of Wheeler, Manzanita, and neighboring water systems, future service may be provided to Rockaway Beach, Nehalem, and Neahkahnie. Estimates of those systems' demands are outlined in the previous reports.

TABLE 3.1

CITIES OF WHEELER AND MANZANITA
WATER MASTER PLAN UPDATE
ESTIMATED WATER DEMAND PROJECTIONS
FOR YEARS 2010 AND 2050

Jurisdiction	No. Services 1994	Average Demand 1994 (GPD)	ESTIMATED VALUES					
			2010			2050		
			No. Services.	Avg. Day Demand GPD	Peak Day Demand GPD	No. Services	Avg. Day Demand GPD	Peak Day Demand GPD
Wheeler	185*	163,655**	300	72,000	144,000	662	165,600	330,000
Manzanita	1,058	183,636	1,697	294,682	766,172	3,747	650,700	1,700,000
Nehalem Bay St. Park	302	24,000	378	30,000	75,000	456	36,200	90,600
Tideland	20	25,000	25	31,250	62,500	30	37,500	75,000
Zadduck Creek	10	2,400	13	3,120	6,240	15	3,600	7,200
Brighton	12	3,000	15	3,750	7,500	18	4,500	9,000
Misc.	0	0	30	9,000	18,000	50	15,000	30,000
TOTALS	1,587	401,691	2,458	443,802	1,079,412	4,978	913,100	2,241,500

*Paradise Cove not included.

** Paradise Cove use is included plus unnaccounted water use.

CHAPTER 4

TEST WELLS

4.1 Test Wells

The initial test well site was proposed to be at River Mile 9.1 on property owned by Don Smith. The City attempted to negotiate an option to purchase Mr. Smith's property while electrogeophysical investigations were under way and while surveys were being performed. However, the negotiations with Mr. Smith were not concluded and, therefore, no test wells were constructed on this site.

Following the failure to arrive at a reasonable option to purchase Mr. Smith's property, the City of Wheeler undertook steps to secure alternative sites for further groundwater investigation. Properties upstream and downstream of Mr. Smith's property were investigated. Land owners were contacted. The majority of the landowners were not interested in selling property to the Cities of Wheeler and Manzanita for a regional water supply. However, Mr. Forster, who owns property along the north bank of the Nehalem River upstream of approximate River Mile 10.5, was willing to discuss groundwater development on his property. Eventually, the City and Mr. Forster entered into an option for the purchase of about two acres for the initial development of groundwater. Following those negotiations, Lee Engineering, Inc. and AGI Technologies proceeded with electro-geophysical investigations at approximate River Mile 10.6.

The results of the electrogeophysical work are enclosed in the Appendix, together with the test well results. The report is entitled: "Wheeler Test Well Report," September 13, 1994.

The initial intent was to drill a test well and two observation wells. However, a pond exists near the well site and the Nehalem River is sufficiently close to provide for the observation that was necessary to give reasonable conclusions as to the potential yield of the one test well that was eventually drilled. Other test wells and/or observation wells were not drilled due to financial constraints that resulted from the initial investigations undertaken at the Smith property and the failure to conclude the investigations at that site. Although electro-resistivity work was done and may provide valuable information for a future well site on the Smith property, only the one test well was eventually constructed.

The test well was constructed in conformance with Oregon Water Resource Department requirements and was drilled by American Drilling Company. Again, due to financial constraints, the well was not developed to its full potential. Each water-bearing zone was independently tested as the casing was advanced. However, a well screen was not placed, nor was the casing perforated to yield the maximum potential from the well. The geologist projects that each well located at this site will likely have a yield of at least 400 gpm. The yield may prove to be higher once the well is fully developed.

In addition to potential well yield, some physical and chemical analysis was done on water quality from the well. The water quality issues which were analyzed indicate that the well is sufficient for domestic water purposes. Also, the hydrogeologist concluded that the wells will not be under the influence of surface water. Therefore, water can be delivered from the wells directly to a transmission system for delivery to the regional water users. The only treatment that will be required will be for disinfection. It is proposed that chlorine will be used as the disinfection medium. It is also recommended, although not required, that chemicals be added to adjust the pH of the water to reduce its corrosion potential.

Assuming the minimum yield of approximately 400 gpm per well, the well site appears to have the potential to serve the region's peak day water demand through the year 2050. That is, approximately four wells can be developed at the proposed site. Each well will have a capacity of approximately 400 to 600 gpm. Minimum yield at this site is estimated to be about 1,600 gpm. The peak day demand for the proposed regional users will be approximately 1,550 gpm in the year 2050.

As the AGI report suggests, we strongly recommend that the existing test well be improved to a production well including the installation of well screens and gravel packing, test pumping for a full 24-hour period, and a complete and thorough chemical and physical analysis of the water near the conclusion of the test pumping.

CHAPTER 5

PROPOSED WATER SOURCE AND IMPROVEMENTS

5.1 Proposed Water Source

The proposed water source for the Cities of Wheeler and Manzanita is recommended to be a groundwater source located at approximate River Mile 10.6 along the north bank of the Nehalem River between the river and the existing railroad tracks. The proposed site is currently owned by Mr. and Mrs. Forster. The cities should proceed with development of a legal description of the proposed property to be purchased and exercise its current option with the Forsters.

The proposed water source should initially consist of a minimum of two wells, each with a capacity of at least 400 gpm. Total groundwater capacity would then be 800 gpm, or a little over 1 mgd. The initial two wells will meet the region's projected need through the year 2010. Prior to the year 2010, the regional water system should anticipate constructing additional wells, Wells No. 3 and 4. Therefore, it is also recommended that the regional water supply authority begin negotiations with Mr. and Mrs. Forster for eventual purchase of more than the initial two acres. Approximately 15 acres may eventually be needed to serve the current proposed users, together with the future service to Rockaway Beach, Nehalem, and/or Neahkahnie. Additional hydrogeologic studies should also be undertaken to more thoroughly map the area's groundwater potential.

5.2 Proposed Improvements

Proposed improvements to develop the recommended groundwater supply will include, as a minimum, the following:

Item No.	Description
1.	Two wells
2.	Chlorine disinfection system and pH adjustment
3.	Telemetering
4.	Pipelines

A. Wells to Chlorinator System
B. Chlorinator System to Mohler
C. Mohler to Reservoirs

D. Reservoirs to Highway 101
E. Highway 101 to Manzanita
F. Highway 101 to Wheeler
G. Wheeler to Brighton

5. Reservoir (2 mg)

6. Master meters and pressure regulating valves at each service connection to Zadduck Creek, Mr. and Mrs. Forster, Tideland, Manzanita, Wheeler, Brighton, and Nehalem Bay State Park.

A schematic of the proposed Capital Improvements is shown in Figure 5.1. The proposed improvements will include several river crossings, bridge crossings at Highway 53, Highway 101, and the railroad bridge on Highway 101, boring underneath the Port of Tillamook Bay Railroad's rights-of-way, and several highway or road borings.

Where the pipeline crosses existing drainages or small streams, the pipeline will be constructed during the time frame allowed by the Oregon Department of Fish & Wildlife, or the crossings will be bored.

5.3 Pipelines

Pipelines to be constructed from the well site to Manzanita and Wheeler are shown to be located along the County road which parallels the Nehalem River on the north side. The pipeline will be routed to Mohler, Highway 53, and along Highway 53 and/or the old Mohler Highway to Highway 101. A separate pipeline will lead to a reservoir located to have an overflow elevation of about 340 feet.

The pipeline is proposed to be constructed of ductile iron. It is assumed that the majority of the pipeline route will need to be constructed with backfill of 3/4" crushed rock to be in compliance with County Road and State Highway Department requirements. Ductile iron is selected primarily to resist slight movements in the ground due to natural slides and/or earthquake potential of the area. PVC pipe is more subject to shear and pipe failure resulting from minor earth movements than is ductile iron and is, therefore, not recommended..

The pipe sizes have been selected so as to provide for water at a peak day rate to the existing water systems and existing reservoirs. A hydraulic network model was performed on the computer to verify the pipe sizes.

The pipe lengths are shown to the closest 500 feet. No attempt has been made to survey the pipe routings at this time. Rather, scale dimensions have been used.

5.4 Reservoir

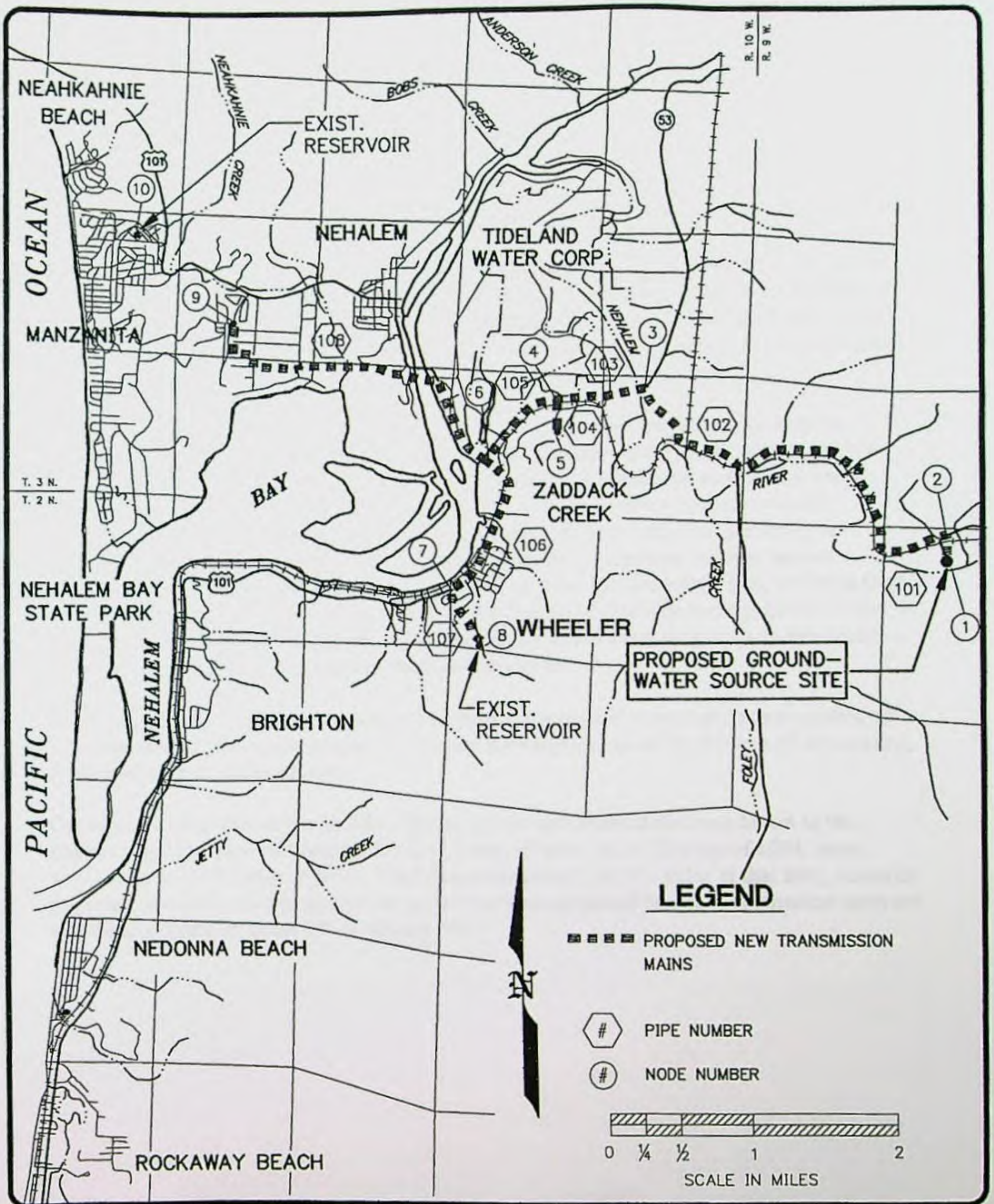
The reservoir volume has been selected to be the lesser of peak day demand or three times average day demand. For purposes of preliminary sizing, it appears that the peak day demand of a little over 2 mgd near the year 2050 controls. It is assumed that the reservoir for the regional supply, together with the reservoirs for each city, will suffice to provide a reasonable and reliable source of water during periods of minor power failure, breaks, or other interruption of transmission of water in the transmission mains, and other emergency situations.

The reservoir is proposed to be located between Mohler and Wheeler. No specific site has been selected. However, the overflow elevation will need to be about 340 feet mean sea level. The reservoir may be constructed of either concrete or steel. However, it is recommended that the reservoir be concrete and that it be buried. The primary reason for this recommendation deals with the low maintenance costs associated with concrete and the fact that concrete reservoirs that are buried have a much better potential for resisting earthquake damage than do steel tanks constructed above ground.

5.5 Well Site Issues

The primary concern about the well site is the potential flooding of the site. The U.S. Army Corps of Engineers project that the peak 500 year storm event will cause a water level to be about 34.7 feet. The natural ground level at the site is about 24 to 26 feet. Therefore, about 8 or 9 feet of fill at the well sites will be necessary to place the well vent and other equipment above the projected 500 year floodplain. This issue must be addressed with the U.S. Army Corps of Engineers and the Division of State Lands before final details of the well construction can be determined.

The proposed well sites are not, in our opinion, located in a wetlands area or in other environmentally sensitive areas. Also, it does not appear from a brief inspection that any residential housing units would be impacted by the minor hydraulic change in the potential flood levels that would occur in the natural floodway so as to preclude some minor construction activity at the well sites.



OWNER: **CITY OF WHEELER**	**LEE ENGINEERING, INC.** 1300 JOHN ADAMS ST. OREGON CITY, OR. 97045
DWG TITLE: **PROPOSED WATER SOURCE**	DATE: OCT '94 FILE NO: 1307P05 · REVISED: · **FIGURE 5.1**

CHAPTER 6

COST ESTIMATES

6.1 General

In determining the capital cost estimates for the various elements of the proposed water source development, very generalized cost estimating was used. No attempt was made to develop the project to a level of preliminary engineering. Preliminary designs are beyond the scope of this report. Rather, standard cost guidelines were used when they were appropriate. In some cases, information was taken from similar projects in the Northwest Oregon region.

Since the Engineer has no control over the cost of labor, materials, equipment or services furnished by others, or the future contractor's methods for determining prices, or competitive bidding or marketing conditions, the Engineer's opinion of probable total project cost and construction cost provided herein is made on the basis of the Engineer's experience and qualifications and represents the Engineer's best judgment as an experienced and qualified professional engineer familiar with the construction industry as it relates to water system improvements. The Engineer cannot and does not guarantee that proposals, bids, or actual total project or construction costs will not vary from the opinion of probable costs prepared herein. It is strongly recommended that before major financing for any of these projects is implemented, a more detailed preliminary engineering study be undertaken.

Costs estimates for Capital Improvement Programs are presented as project costs consisting of estimated construction costs, property costs, and allowances to cover for the cost of engineering, contingencies, and administration.

Construction costs will vary with time. Therefore, we have indexed the costs herein to the *Engineering News Record* Construction Cost Index, effective as of October of 1994, more specifically, an ENR Index of 5450. For future estimates of cost, the index at that time, actual or projected, should be used to update the costs from those projected herein. Construction costs are escalating at a rate of about 3% or 4% per year.

TABLE 6.1
CITY OF WHEELER AND CITY OF MANZANITA
WATER FACILITIES MASTER PLAN UPDATE
PROPOSED CAPITAL IMPROVEMENTS

ITEM	DESCRIPTION		COST ESTIMATE	
1.	Two Wells		$	175,000
	A. Land Cost		$	25,000
2.	Chlorine and pH Adjustment		$	100,000
3.	Telemetering		$	40,000
4.	Pipelines			
	A. Wells to Cl_2	1,300 12"	$	52,000
	B. Cl_2 to Mohler	17,000 12"	$	680,000
	C. Mohler to Res.	8,000 12"	$	337,000
	D. Res. to Hwy 101	1,000 12"	$	50,000
	E. Hwy 101 to Manz.	17,500 10"	$	647,500
	F. Hwy 101 to Wheeler	7,000 6"	$	224,500
	G. Wheeler to Brighton	16,000 2"	$	160,000
5.	Reservoir, 2 mg		$	650,000
	A. Land and Easement Cost		$	10,000
6.	Master Meters and PRV's			
	A. Zadduck Creek		$	1,500
	B. Forster's		$	2,500
	C. Tideland		$	3,000
	D. Manzanita		$	10,000
	E. Wheeler		$	10,000
	F. Brighton		$	3,000
	G. Nehalem Bay State Park		$	0
	SUBTOTAL:		$	3,181,000
	ENGINEERING & CONTINGENCY @ 30%		$	943,300
	TOTAL ESTIMATED PROJECT COST:		$	4,135,300
	INTERIM FINANCING & INFLATION @ 10%		$	413,530
	TOTAL PROJECT BUDGET:		$	4,548,830

CHAPTER 7

PROJECTED USER FEES

7.1 Projected User Fees

The total estimated project costs for the regional water supply is approximately $4,550,000. It is estimated that about 4,978 connections will receive benefit from the regional water supply through the year 2050. This equates to $910 per equivalent residential connection.

The unit cost of water to the future users will include the payment of debt on the capital investment, plus allowance for operation and maintenance. If the debt is assumed by the Farmers Home Administration at 5% interest rate for 30 years, the average annual cost for debt retirement will be about $60 per household. Annual power costs for a house that uses about 8,000 gallons per month is estimated at $9.20, assuming $.06 per kilowatt hour. The local Tillamook County Peoples Utility District actually charges only about $.03 to $.04 per kilowatt hour. However, it is believed that the $.06 per kilowatt hour may be more realistic in the future, and the $9.20 per year for power costs is suggested.

In addition to these costs, allowance needs to be made for general maintenance and administrative overhead.

The total estimated user cost per year is about $167, or $14 per month. This cost relates only to the wholesale cost of water. It does not include the normal operation and maintenance costs of the individual user's distribution network, including their own distribution pipelines, reservoirs, meters, and other system components. Another way of analyzing the cost of providing a regional water supply is to base the cost estimate on a unit measure of water. For example, the above estimate per month is based on a use of 8,000 gallons per month per household. Therefore, the unit cost of water would be about $1.74 per 1,000 gallons.

This approach also assumes that future users will pay for connecting with the system through System Development Charges. The System Development Charge will depend on when the new customer conencts to the system. This value should be escalated each year based on the amortization schedule which is finally adopted to finance the capital improvements. This way, the existing users will not be paying for the oversizing necessary to provide service to future customers.

The March 1993 North Tillamook County Regional Water Supply Master Plan projected that water would cost about $1.03 per 1,000 gallons. The primary difference between previous and current projections is the fact that the previous projections included service to Rockaway Beach, Nehalem, and Neahkahnie. The unit cost of production can be reduced by including more users in the system. This results from a general economy of scale. That is, the more users, the less will be the unit cost of water. The new projections also anticipate a 30-year bond term, rather than 40 years assumed in the previous report. Oregon statute limits bond terms for water authorities to 30 years.

7.2 Future Organizational Structure

In recent conversations between Wheeler and Manzanita, it is the general consensus that a water authority should be formed with the primary responsibility for delivering wholesale water to the various wholesale customers. Water authorities may be formed from existing cities, water districts, or other entities. In this case, the various entities can form a water authority as provided in ORS 450.650 through 450.700. A copy of the existing statute is enclosed in the Appendix.

It is suggested that the water authority be formed by the Cities of Wheeler and Manzanita through enacting appropriate resolutions. The resolutions shall set forth the names and boundaries of the proposed water supply authority. The boundaries need not be contiguous. The Cities of Wheeler and Manzanita should file their resolutions with the Tillamook County Board of Commissioners.

Upon receipt of the resolution, the Tillamook County Commission shall determine that provision of potable water to the area within the proposed water authority can best be achieved by creation of a water authority rather than by water districts or cities. In making this determination, the County Commission shall consider several factors outlined in the statutes, including the ability of the proposed authority to provide water service, the effects of both long and short term rates for patrons, the impact of the proposed water authority on adjacent special districts or cities, and the consistency of the proposed water authority with the adopted Comprehensive Plan of the County within the boundaries of the proposed water authority.

Following the determination of the above information, the Tillamook County Commission is to set a public hearing on the proposal. The hearing and election on the proposal and election of board members shall be conducted as provided by ORS 198.800 to 198.825.

According to the law, a water authority is a municipality and may issue revenue bonds to finance proposed construction.

Another unique aspect of water authorities is the right to acquire water rights, either independently or from municipalities or districts upon its inception. Further, a water supply authority may change the points of diversion of water or move water intake sources as specified in the water rights permits or certificates of those districts or municipalities that were merged into the water authority. In general, the primary purpose of the water authority is to operate a municipal organization whose primary function is the supply of domestic water. However, the water authority may extend its jurisdiction to the transmission, distribution and operation of individual water systems.

CHAPTER 8

FUTURE TASKS

Several activities must be undertaken in order for the project to proceed. These tasks include, but may not be limited to, the following items.

8.1 Complete Well No. 1

It is recommended that the Cities of Wheeler and Manzanita extend the current financial request from the Oregon Department of Economic Development. A $10,000 grant has been received. The cities may borrow up to an additional $20,000 to proceed with completion of Well No. 1. This will then provide a more reliable well pumping test and a better analysis of the water chemistry and physical characteristics. This information will be invaluable during final design.

8.2 Public Relations Campaign

Dr. Peter Scott of Lane Benton Community College has applied for and received a grant through RCA and EPA to undertake a public relations campaign to present to the city councils and the public at large the intent and scope of the proposed project. This campaign may be invaluable when an election is held to form the water authority and when the authority proceeds with final financing for the project. It is recommended that the two cities cooperate and enter into agreement with Dr. Scott and RCA for implementation of the proposed public relations program.

8.3 Property Purchase

It is recommended that the City of Wheeler proceed with the property purchase from Mr. and Mrs. Forster. There are still some minor issues remaining to be developed, including the arrangement for delivery of water to Mr. Forster at a stipulated rate, development of actual legal descriptions and property surveys for the property to be acquired, etc.

8.4 County Zone Change

Once the legal descriptions are completed, the cities should proceed with an application to Tillamook County for a community service zone at the proposed well sites. Application forms will need to be filled out and fees paid for the proposed zone change request.

8.5 Water Rights

The City has made application at River Mile 9.1 for a groundwater permit. This permit should be modified to apply to the proposed new well sites at River Mile 10.6. The new application should include all four proposed well sites as outlined herein.

8.6 Corps of Engineers, Division of State Lands, and DEQ Permits

In order for construction to occur within the floodplain, preliminary engineering details will need to be developed and coordinated with the Corps of Engineers, State Lands, and DEQ. There may also be some requirements under the County zoning regulations for certain conditions to be met to satisfy concerns about minor changes in the profile of the floodway. These changes will occur as very small islands at each well site and it is not anticipated that the proposed construction details will have any significant effect on the hydraulic capacity of the floodway. However, these issues will need to be addressed with the Corps and DEQ and/or the Division of State Lands.

8.7 Reservoir Sites and Easement

The City should immediately begin contacting potential property owners that may own sites suitable for the proposed reservoir. Ultimately, sites will need to be purchased and a pipeline easement obtained. Prior to the purchase, site surveys will need to be undertaken, legal descriptions drawn, property corners set, etc.

8.8 Organizational Structure

As discussed in 7.2, the cities should undertake the formal actions necessary to form a water authority. Legal counsel will be required to assist the cities in this process.

8.9 Funding

The City of Wheeler has submitted on behalf of the regional authority a preapplication to Farmers Home Administration for funding of this project. In addition, OEDD should be contacted for grants and/or loans under the Water and Wastewater Financing Program. The FmHA application should be updated to include the new cost estimates.

The City of Wheeler should also apply for funds through the Farmers Home Administration to undertake improvements to its water system as outlined in the City's Water Facilities Master Plan.

8.10 Preliminary Design Report

Before final financing is arranged for this project, it is recommended that a preliminary design report be prepared once all of the above information is available. The preliminary design report should more accurately estimate the total costs for the project. Following preparation of the preliminary design report, a detailed financial feasibility analysis will be required prior to the sale of revenue or general obligation bonds.

APPENDIX A

WATER SUPPLY AUTHORITIES

450.650 Board of directors; terms; qualifications. (1) The governing body of a water supply authority shall be a board of directors of seven members.

(2) The term of office of a director of a water supply authority is four years.

(3) Any elector residing within the proposed water supply authority is qualified to be a member of the board of directors of the authority.

(4) Notwithstanding subsection (3) of this section, a person who is an employee of a water supply authority is not qualified to serve as a director of the water supply authority by which the person is employed. [1987 c.863 §4; 1989 c.809 §2]

450.655 Methods of election of authority directors. (1) The directors of a water supply authority may be elected by one of the following methods:

(a) Elected by the electors of zones as nearly equal in population as feasible according to the latest federal decennial census.

(b) Elected at large by position number by the electors of the district.

(2) Candidates for election from zones shall be nominated by the electors of the zones.

(3) If the directors of the water supply authority are elected from zones, the board of the water supply authority, after each federal decennial census, shall adjust the boundaries of the zones to make them as nearly equal in population as feasible. [1987 c.863 §5]

450.658 Election of directors. (1) Seven directors of the water supply authority shall be elected at the election for formation of the authority or, if no election is held on the question of formation, at the election held under ORS 198.825.

(2) If the effective date of the formation of the water supply authority occurs in an odd-numbered year, four directors of the authority shall be elected for four-year terms and the other three directors shall be elected for two-year terms. If the effective date of the formation occurs in an even-numbered year, four directors shall be elected for three-year terms and the other three directors shall be elected for one-year terms. [1987 c.863 §6]

450.660 Water supply authority formation. A water supply authority may be formed by any of the methods provided for in ORS 450.665 to 450.680 or 450.785. [1987 c.863 §2]

450.665 Formation of authorities by special districts. A water supply authority may be formed as provided in ORS 198.800 to 198.825 except that:

(1) A petition for formation shall be signed by not less than 100 electors registered in the territory subject to the petition.

(2) In its order creating the water supply authority, the county board shall prescribe the method of election of the board of the proposed authority from among the methods described in ORS 450.655. If the county board determines that the directors of the water supply authority shall be elected from zones, the county board shall establish and describe the zones, using streets and other generally recognizable features. [1987 c.863 §3]

450.670 [1987 c.863 §9; 1989 c.809 §6; renumbered 450.987 in 1989]

450.675 Formation of authorities from areas within one or more counties. Any portion of one or more counties, including both incorporated and unincorporated areas as well as areas within domestic water supply districts, county service districts for water supply works and other districts may be formed into a water supply authority under ORS 450.650 to 450.989. Such areas need not be contiguous. [1971 c.504 §3]

450.680 Formation of authorities by cities and water districts. (1) The governing bodies of two or more cities, two or more water districts or one or more cities and one or more water districts, when they consider it necessary for the public health, safety and welfare, may initiate the formation of a water supply authority by resolution. The resolution shall set forth the name and boundaries of the proposed water supply authority. The governing bodies shall file the resolution with the governing body of the principal county, as defined in ORS 198.705. If any part of the proposed water supply authority is within a city, the resolution shall be accompanied by a certified copy of a resolution of the governing body of the city approving the resolution that initiates formation of the water supply authority.

(2) Upon receipt of the resolution, the county governing body or boundary commission shall determine that provision of potable water to the area within the proposed water authority can best be achieved by creation of a water authority rather than by water districts or cities. In making this determination, the county governing body shall consider the following factors:

(a) The ability of the proposed authority to provide water service to the area within the proposed authority;

(b) The effect on both long and short-term rates for patrons within the proposed authority;

(c) The impact, if any, of the proposed water authority on adjacent special districts and cities; and

(d) Consistency of the proposed water authority with the adopted comprehensive plan of the county within the boundaries of the proposed water authority.

(3) After the county governing body or boundary commission makes the determination under subsection (2) of this section, the county governing body shall by order provide for a public hearing on the proposal. The order shall set forth the date, time and place of the hearing. Notice of the hearing shall be given in the manner provided by ORS 198.800 except that the notice shall state that the governing bodies of the cities or water districts have filed a resolution with the county governing body declaring their intention to initiate formation. The hearing and election on the proposal, and election of board members, shall be conducted as provided by ORS 198.800 to 198.825. [1971 c.504 §4; 1983 c.740 §172; 1987 c.863 §11; 1989 c.809 §3]

450.685 Application of certain provisions to authorities. (1) Except as provided by subsection (2) of this section, ORS 450.070, 450.084, 450.085 and 450.650 to 450.989 apply to a water supply authority.

(2) ORS 450.810 (1), 450.815 (7), (8) and (9), 450.820 and 450.835 do not apply to a water supply authority.

(3) ORS 264.240, 264.250 (2), 264.300 to 264.320 and 264.505 to 264.840 are applicable to a water supply authority. [1971 c.504 §5; 1989 c.809 §4]

450.690 Purposes for which authority is municipality. A water supply authority is a municipality for the purposes of ORS 288.805 to 288.945, and revenue bonds issued by a water supply authority shall be issued in accordance with ORS 288.805 to 288.945. [1987 c.863 §8]

450.695 Acquisition of water rights; effect on priority of rights. (1) A water supply authority may acquire water rights from any municipality or any district, as defined in ORS 543.655. Upon request by the authority if the water right acquired was for municipal use, the Water Resources Commission shall issue a new water right certificate to the water supply authority preserving the previously established priority of water rights.

(2) In accordance with ORS 540.520 and 540.530, a water supply authority may change the points of diversion of water or move the water intake sources as specified in the water right permits or certificates of those districts or municipalities that were merged into the authority. [1989 c.707 §1]

Note: 450.695 and 450.700 were enacted into law by the Legislative Assembly but were not added to or made a part of ORS chapter 450 or any series therein by legislative action. See Preface to Oregon Revised Statutes for further explanation.

450.700 Acquisition of water rights; effect on prior rights. (1) A water supply authority may acquire water rights from any city or any district, as defined in ORS 543.655. Upon request by the authority, the Water Resources Commission shall issue a new water right certificate to the water supply authority preserving the previously established priority of water rights.

(2) Upon compliance with ORS 540.520 and 540.530, a water supply authority may change the points of diversion of water or move the water intake sources as specified in the water right permits of those districts that were merged into the authority. Upon the filing of notice of such changes with the Water Resources Department, the changes shall not impair any water right previously vested in those districts. [1989 c.809 §1]

Note: See note under ORS 450.695

APPENDIX B

AGI

TECHNOLOGIES

WHEELER TEST WELL REPORT
Tillamook County, Oregon

September 13, 1994

Prepared for:

Lee Engineering
1300 John Adams Street
Oregon City, Oregon 97405

AGI Project No. 15,792.001

A Report Prepared For:

Lee Engineering
1300 John Adams Street
Oregon City, Oregon 97405

WHEELER TEST WELL REPORT
Wheeler, Oregon

September 13, 1994

Douglas C. Dow
Senior Hydrogeologist

James R. Carr
Vice President

AGI Technologies
P.O. Box 1158
Gig Harbor, Washington 98335
206/851-5562

AGI Project No. 15,792.001

AGI TECHNOLOGIES

WHEELER TEST WELL REPORT

AGI Technologies was contracted by Lee Engineering to assist with development of a Municipal ground water supply for the City of Wheeler, Oregon. This report describes the results of investigations to select an appropriate site and conduct drilling at the selected site.

Surface Resistivity Survey

Surface resistivity profiling of property located on the north side of the Nehalem River at mile 10 showed good potential for water-bearing gravels to a depth of about 80 feet. The site map, **Figure 1**, shows the locations of the resistivity profiles. **Figures 2** and **3** show the resistivity results in cross section. After analyzing the results, we recommended installation of a test well at one of the following resistivity stations, 4, 6, 9, 10, or 13. American Drilling Company was selected to drill an 8-inch test well using the cable-tool method at Station 4. Construction and testing were conducted between August 16 and 18, 1994.

Test Well Results

The results of test drilling at Station 4 are shown in **Figure 4**. In drilling to a depth of 61 feet, two significant water-bearing zones were encountered. The first zone consists of a brown-red gravel found from 31.5 to 35 feet below ground surface. This shallow zone was tested with a centrifugal pump though the open bottom casing at 32 feet at various rates up to 62 gallons per minute (gpm) for 45 minutes. This test showed a specific capacity of 7.6 gallons per minute per foot (gpm/ft).

A second, more productive zone was encountered between depths of 45 and 60 feet. As shown in **Figure 4**, three feet of water-bearing gravel between 45 and 48 feet overlie a transition zone of gravel and cemented sand between 48 and 50 feet. A bail test was performed with the 8-inch casing shoe at a depth of 48 feet and uncased hole to a depth of 55 feet in the cemented sand. Bailing at a rate of approximately 66 gpm produced no measurable drawdown. The casing was then advanced to 50 feet in order to conduct a pumping test with the centrifugal pump. The 8-inch casing slowed its advance significantly at 50 feet, where it penetrated cemented sand.

With the casing at a depth of 50 feet, the water appeared to be shut off, and open hole drilling continued through easily drilled cemented sand, which is probably fractured and weathered sandstone bedrock, to a depth of 60 feet. The drilled materials were bailed from the hole, and water re-entered the well.

Drilling was followed by pumping at various rates up to 150 gpm for 60 minutes. The results show a specific capacity of 17.8 gpm/ft. Recovery was nearly instantaneous, indicating an inefficient well. The quick recovery also suggests the water may have been leaking down the outside of the 8-inch casing from the 45- to 48-foot water-bearing gravel zone. This zone showed a very high specific capacity during previous bail testing. Drilling continued in hard bedrock to a depth of 60.5 feet where drilling was stopped.

Water Quality

Water samples taken from the test well, the Nehalem River, Peterson Creek, and the Nehalem Redi-mix pond were analyzed in the field for temperature, conductivity, pH, iron, manganese, and chloride. The results are shown in **Table 1.**

One additional water sample taken from the 50- to 60-foot pumping test was sent to a laboratory for analysis of iron and manganese. The results shown in **Table 1** are included in the **Appendix** and show these parameters below maximum contaminant levels, with an iron concentration of 0.13 mg/L, and a manganese concentration of 0.046 mg/L.

TABLE 1

FIELD WATER QUALITY							
Source Name	Depth of Sample (ft.)	Temperature (°C)	Conductivity (μmhos)	pH	Iron (mg/L)	Manganese (mg/L)	Chloride (mg/L)
Site #4	32	10	90.5	6.89	0.06	0.06	16
Site #4	50 - 60	10	156.9	6.28	0.19	0.06	20
Nehalem River	Surface	19	96.5	6.43	0.04	0.02	70
Peterson Creek	Surface	13	87.7	6.83	0.11	0.00	20
Nehalem Redi-mix Pond	Surface	21	110.3	6.9	0.07	0.04	20
LABORATORY ANALYSIS							
Site #4	50 - 60'	—	—	—	0.13	0.046	—

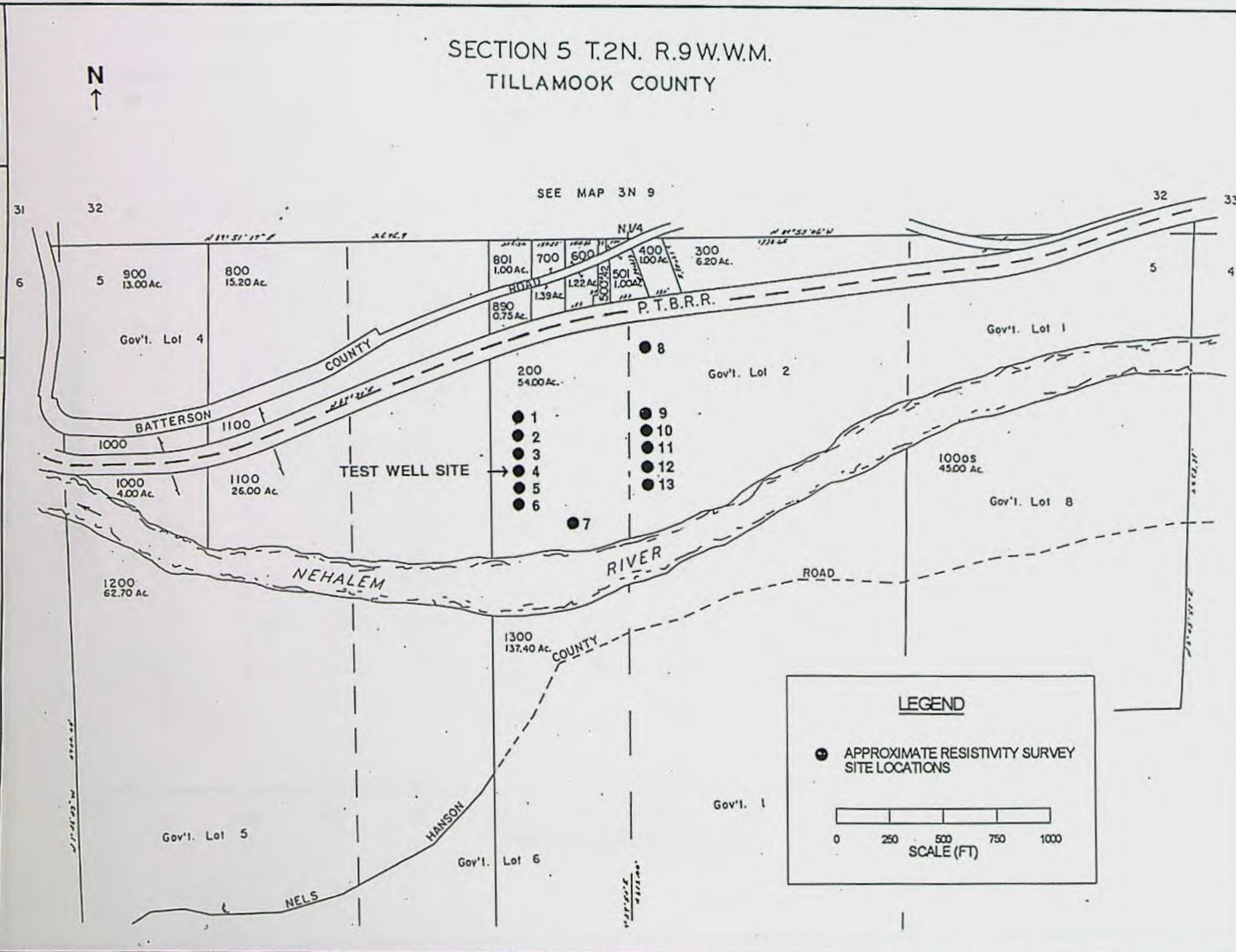
The field test results suggest the water in the lower zone is not in direct hydraulic continuity with the Nehalem River at this location. The lower water temperature, higher specific conductivity, and iron and manganese concentrations in the 45- to 60-foot zone indicate it is isolated from the river and shallow aquifer. The analyses indicate the shallow aquifer may have a more direct connection with the surface water. This aquifer's susceptibility to surface contamination is less than that of the shallow zone.

Optimum Yield

The optimum yield of a well completed in this aquifer can be estimated from the information collected during pumping and bail tests. The static water level is about 14 feet below ground surface. The top of the lower water-bearing gravel is 45 feet, leaving 31 feet of total available drawdown. A properly screened, efficient well should have a specific capacity of at least 17 to more than 20 gpm/ft. Allowing for pump submergence, seasonal water level fluctuations and interference from any additional wells, the useable drawdown is 20 feet. Therefore, the safe yield for this well, completed in the lower aquifer, is estimated to be about 400 gpm. Long-term testing is needed to establish the optimum yield of single or multiple wells completed in the lower zone of this site.

Conclusions and Recommendations

Based on these initial findings, three to four properly spaced wells producing about 400 gpm each might be constructed on this property. The subject test well is suitable for completion as the first production well. We recommend installation of 10 feet of stainless-steel well screen between 45 and 55 feet. After development, a 24-hour pumping test and complete water quality analysis will provide the information needed for design of a wellfield at this site. Better information could be obtained if at least one observation well is available during aquifer testing. If the City is ready to proceed with a wellfield, a larger diameter (12-inch) production well could be installed at one of the other recommended locations. The first test well could then be used as an observation/production well after completion, as recommended above.

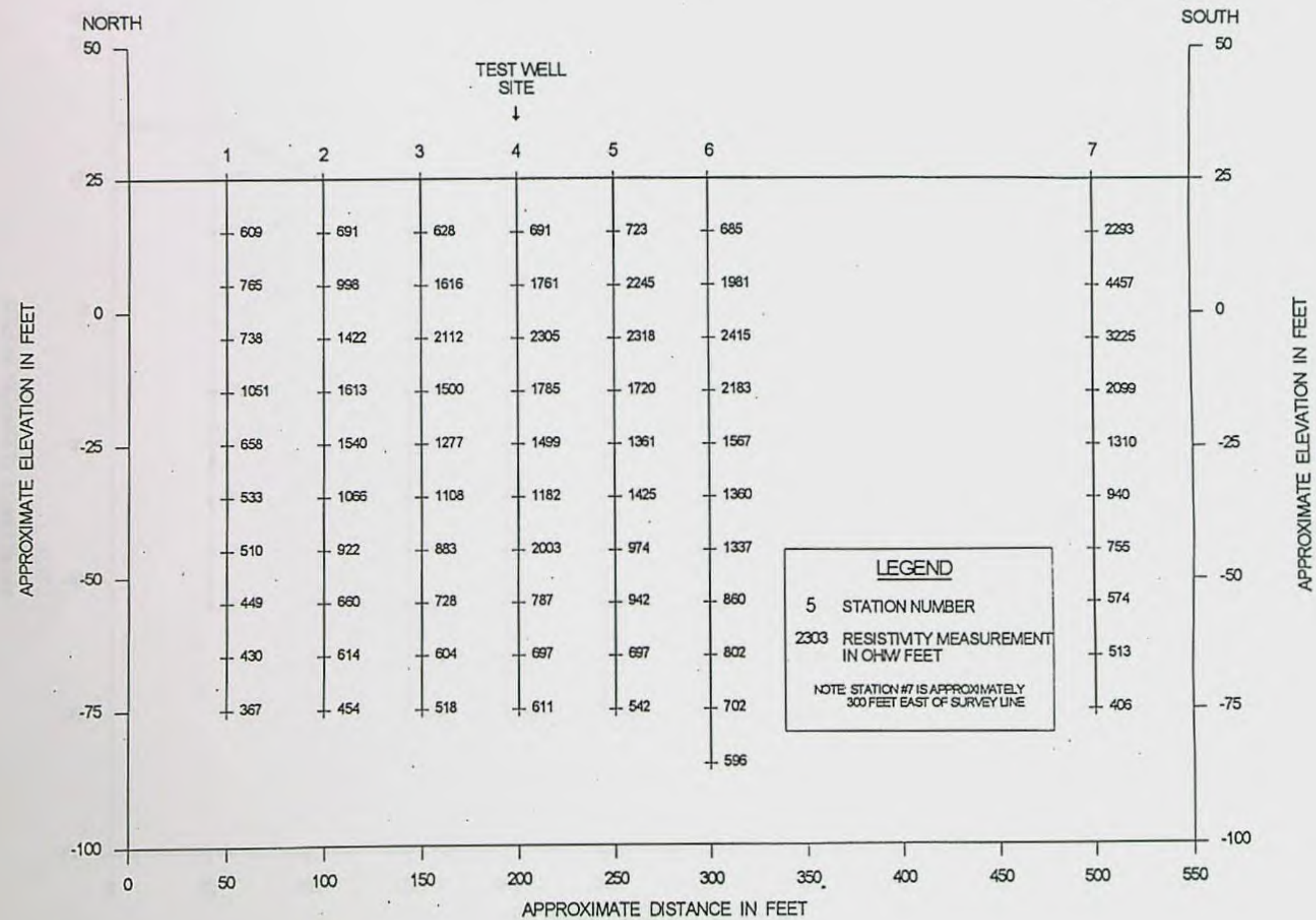


AGI TECHNOLOGIES

WHEELER OREGON
PROJECT: # 15792.001

TEST WELL AND RESISTIVITY SURVEY SITE LOCATION MAP

FIGURE 1

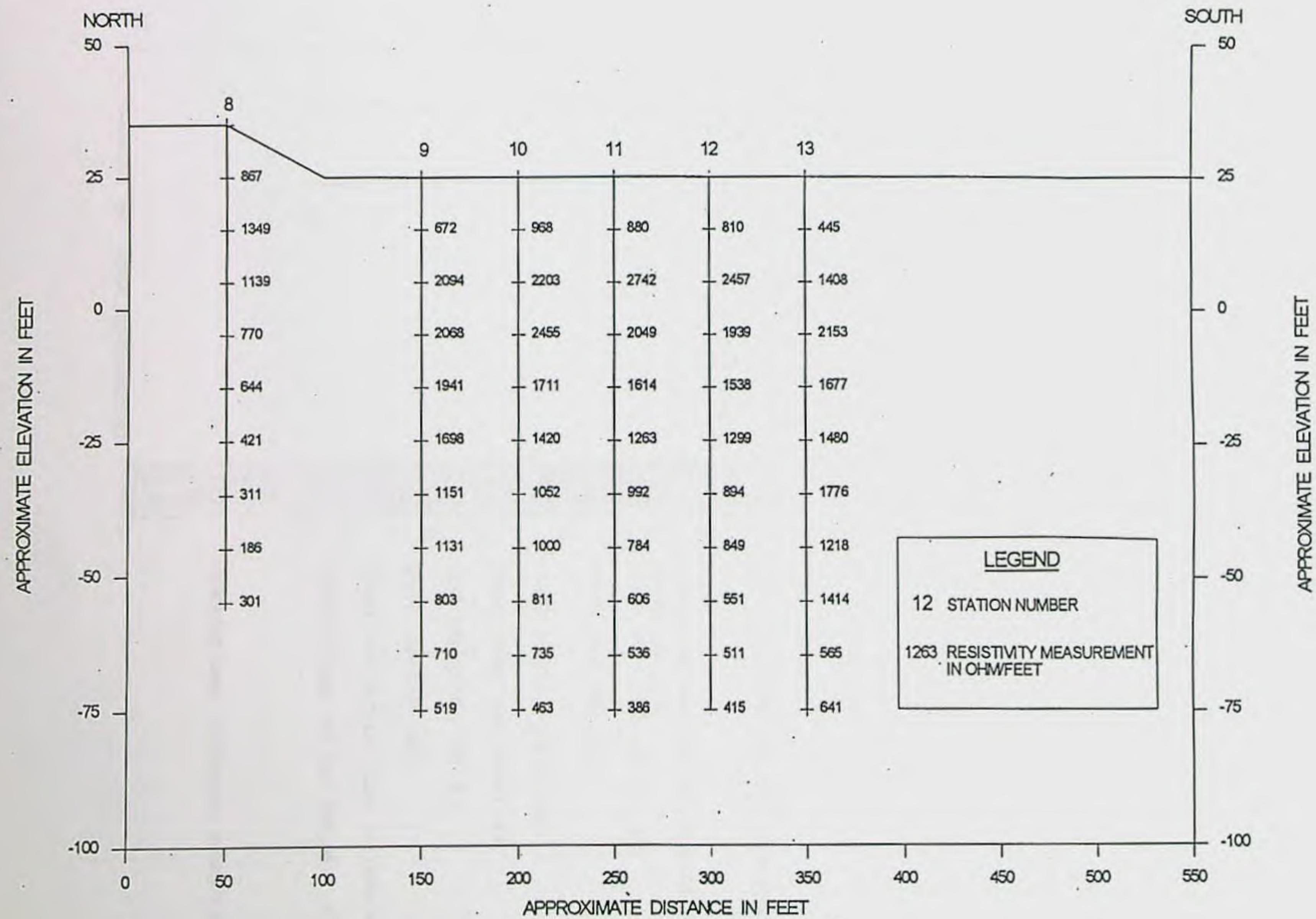


AGI TECHNOLOGIES

WHEELER OREGON
PROJECT: #15792.001

SURFACE RESISTIVITY SURVEY RESULTS
STATIONS 1 THRU 7

FIGURE 2

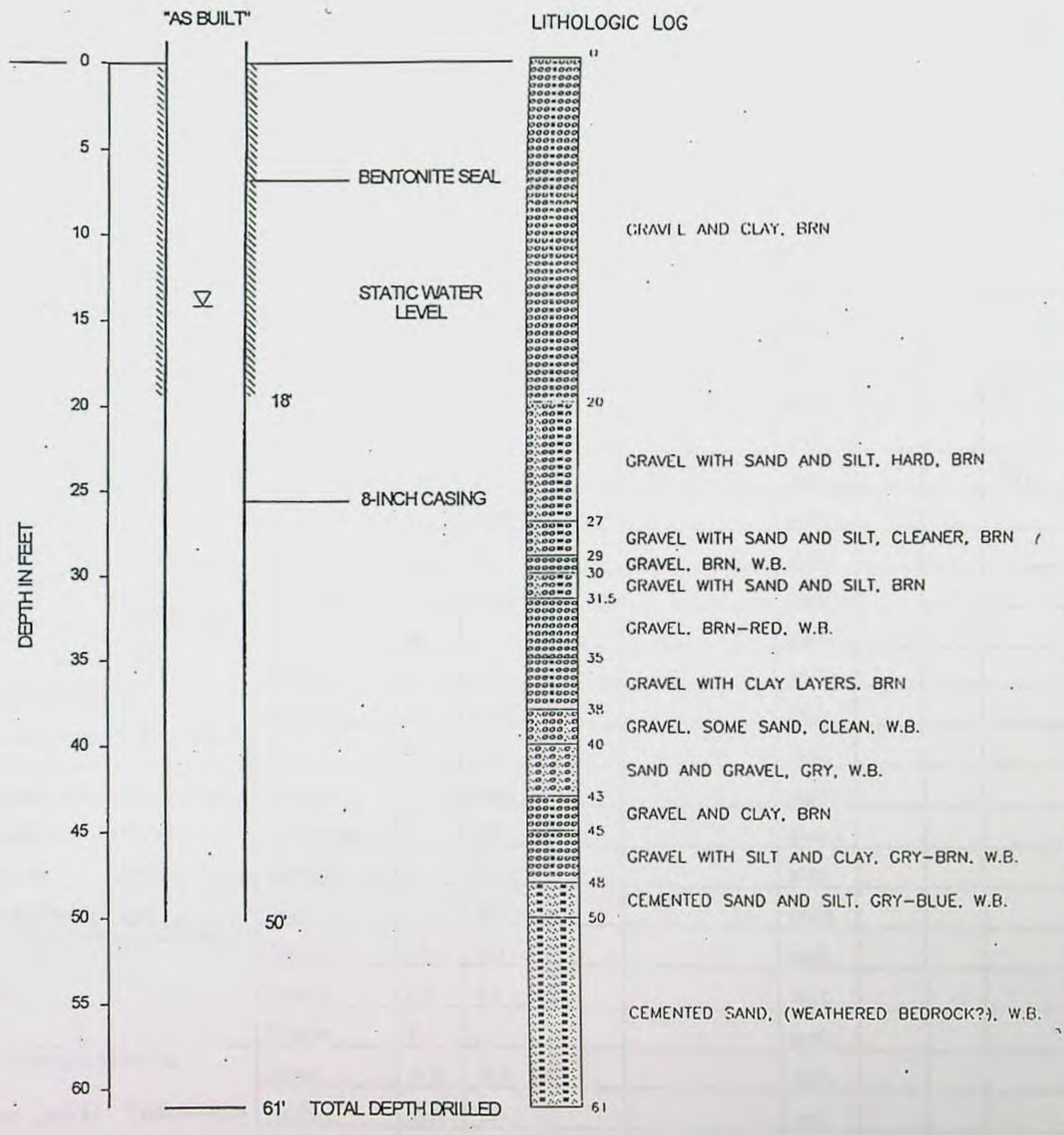


AGI TECHNOLOGIES

WHEELER OREGON
PROJECT: #15792.001

SURFACE RESISTIVITY SURVEY RESULTS
STATIONS 8 THRU 13

FIGURE 3



AGI TECHNOLOGIES	WHEELER OREGON PROJECT: # 15792.001	LITHOLOGIC LOG AND "AS BUILT" DETAILS	FIGURE 4

SOUND ANALYTICAL SERVICES, INC.

4813 PACIFIC HIGHWAY EAST, TACOMA, WASHINGTON 98424 • TELEPHONE 206-922-2310 • FAX 206-922-5047

WATER SAMPLE INFORMATION FOR INORGANIC CHEMICAL ANALYSIS

DO NOT WRITE IN SHADED AREAS, PLEASE FILL BOXES NUMBERED 1 THRU 13, SEE BACK FOR INSTRUCTIONS

LABORATORY NUMBER: 107- 00908

DATE RECEIVED: 8-23-94

1. Date Collected: 8/18/94
2. System Name: Wheeler, Oregon
3. System ID
4. Circle Group: (A) B
5. County:
6. Source Type: (circle) Surface (Well) Spring Purchase
7. Sample Taken (circle) (Before Treatment) After Treatment
8. Source No.: Source Name: Res. site #4
10. Collected By: CR
Telephone: (206) 851-5562
11. If taken after treatment, circle: Fluoridation Chlorination Filtration Other ______ Water Softener Type ______
12. If taken from distribution, indicate address
Name:
13. Party to pay for testing:
Name: AGF Technologes
Address: po Box 1158 gig Harbor WA 98329
Telephone: (206) ~~851-5562~~
14. Remarks: IRON & manganese only

LABORATORY REPORT (Do Not Write Inside This Box)

Tests		MCL	Less Than <	Result	Units	Compliance Yes	Compliance No	Chemist Initials
Antimony	Sb	0.006			mg/L			
Arsenic	As	0.05			mg/L			
Barium	Ba	2.0			mg/L			
Beryllium	Be	0.004			mg/L			
Cadmium	Cd	0.005			mg/L			
Chromium	Cr	0.1			mg/L			
Copper	Cu	1.3			mg/L			
Iron	Fe	0.3		0.13	mg/L	/		SP
Lead	Pb	0.015			mg/L			
Manganese	Mn	0.05		0.046	mg/L	/		SP
Mercury	Hg	0.002			mg/L			
Nickel	Ni	0.1			mg/L			
Selenium	Se	0.050			mg/L			
Silver	Ag	0.1			mg/L			
Sodium	Na	None			mg/L			
Thallium	Tl	0.002			mg/L			
Zinc	Zn	5.0			mg/L			
Hardness		None			mg/L			
Conductivity		700			umhos			
Turbidity		1.0			NTU			
Color		15.0			Units			
Chloride	Cl	250			mg/L			
Cyanide	CN	0.2			mg/L			
Fluoride	F	2.0			mg/L			
Nitrate	as N	10.0			mg/L			
Nitrite	as N	1.0			mg/L			
Sulfate	SO_4	250			mg/L			
TDS		500			mg/L			

LABORATORY COMMENTS

42641

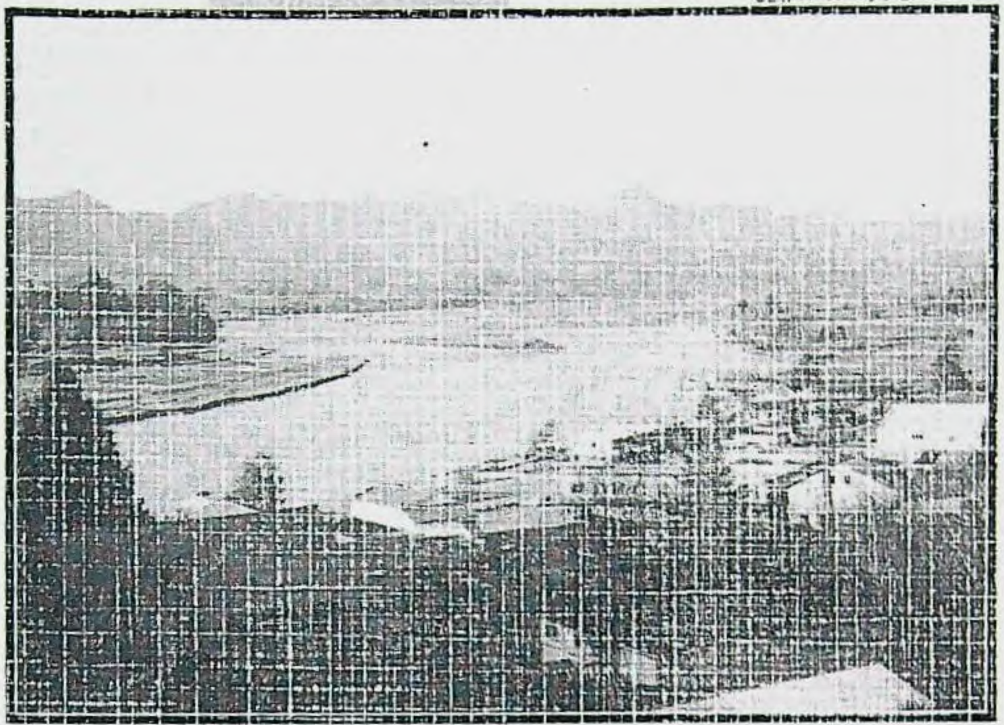
Laboratory Supervisor: Stan Palmquist

Date of Report: 8-25-94

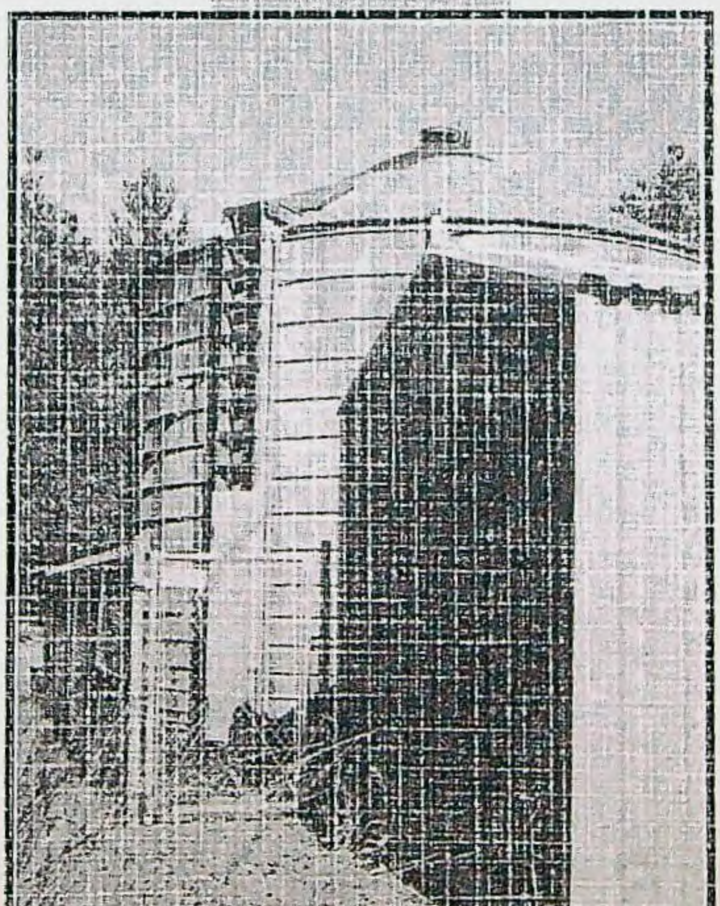
MCL - Maximum Contaminant Level

Reference SOP #SAS-0513

WHITE COPY - STATE GREEN COPY - CUSTOMER BLUE COPY - LABORATORY GOLDENROD COPY - REGIONAL OFFICE



Lee Engineering, Inc.
1300 John Adams Street
Oregon City, OR 97045



North Tillamook County

REGIONAL WATER SUPPLY MASTER PLAN

Prepared for the City of Wheeler

BY:

LEE ENGINEERING, INC.

MARCH 1993

NORTH TILLAMOOK COUNTY

REGIONAL WATER SUPPLY

MASTER PLAN

PREPARED FOR THE

CITY OF WHEELER

March 1993

Prepared by:

LEE ENGINEERING, INC.
1300 John Adams Street
Oregon City, Oregon 97045

LEE ENGINEERING, INC.

F. DUANE LEE, P.E.
DAVID A. LEE, P.E., P.L.S.
JAMES G. SMITH, P.E.

March 25, 1993

North Tillamook County
Water Resource Committee
c/o City of Wheeler
P.O. Box 177
Wheeler, Oregon 97147

Re: North Tillamook County Regional Water Supply Master Plan

Gentlemen:

We are pleased to transmit herewith 20 copies of the final report for the North Tillamook County Regional Water Supply Master Plan. The final report is a result of considerable effort by the Committee, representatives of the Tillamook County Economic Development Committee, the Rural Community Assistance Corporation, the Oregon Health Division, and Lee Engineering, Inc. You will recall that we have had several meetings with the Water Resource Committee, during which we have discussed many of the preliminary findings of this report. Most of the concerns that have been expressed by the Committee are addressed herein.

The report outlines several options for the development of adequate public water supplies within the study area. The report concludes that most, if not all, of the existing water supplies are inadequate in capacity or water quality. The alternative water supply that addresses future needs at the least possible cost appears to be groundwater development on the Nehalem River. However, future studies concerning the available groundwater and groundwater quality need to be undertaken before final decisions can be made on the regional water supply.

Communities such as Watseco/Barview, Rockaway Beach and Neahkahnie need to undertake additional studies of their water systems before deciding to join with the regional supply. However, the regional supply should anticipate that these communities will also join the regional water system as demands continue to exceed available water resources.

In order to continue with the regional option, it is suggested that the Cities of Wheeler, Nehalem and Manzanita enter into an interim intergovernmental agreement to address several key critical issues. These issues are enumerated in the Summary of Conclusions and Recommendations, Chapter 8. Also, each of the three cities under order from the Oregon Health Division to treat their existing supplies must respond to the Health Division with proposed programs for continuing with funding, scheduling, interim operation of their water supplies, and implementation of the recommended alternatives.

1300 JOHN ADAMS STREET • OREGON CITY, OREGON 97045 • PH. 503-655-1342
1-800-848-9731 • FAX 503-655-1360

We sincerely appreciate working with each of the representatives of the various jurisdictions who participated in this study effort. We look forward to working with each of you as you begin to implement various phases of the recommended projects. Also, we look forward to working with many of you in answering many of the unanswered questions developed during the preparation of this master plan.

Thank you for this opportunity to be of service to you and the many citizens of the North Tillamook County area.

Sincerely,

LEE ENGINEERING, INC.

F. Duane Lee

F. Duane Lee, P.E., WRE

FDL:nj

Enclosure

TABLE OF CONTENTS
NORTH TILLAMOOK COUNTY
REGIONAL WATER MASTER PLAN

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ILLUSTRATIONS

CHAPTER 1

CHAPTER 1

INTRODUCTION

1.1 PROJECT HISTORY

In January of 1992, the City of Wheeler met with representatives of the Oregon Economic Development Department (OEDD) for the purpose of obtaining a special public works fund technical assistance grant to undertake a study of the City of Wheeler's water system. The City of Wheeler at that time agreed with OEDD to take a proactive role in working with surrounding jurisdictions to participate in a feasibility study to coordinate an area-wide approach to the water supply and quality issues. As a result, a detailed scope of work was developed to analyze not only the City of Wheeler's water needs, but also to analyze a regional water supply of one or more sources to meet the needs of the majority of the public and private water systems north of Tillamook Bay to and including all developable area south of Neahkahnie Mountain.

Also in January of 1992, the Oregon Department of Human Resources - Health Division issued formal schedules to 47 communities in Oregon requiring them to improve treatment of their drinking water supplies obtained from lakes, streams and river sources. The schedule required that the communities either install filtration by June, 1993, or develop an alternative source of water such as wells or purchase water from other communities. The Cities of Manzanita, Nehalem and Wheeler are among those required to filter their surface water supplies or connect to approved alternative sources.

Throughout the Pacific Northwest, concerns about the use of unfiltered water sources have been high for many reasons. First, there have been several documented cases in the past decade of water borne disease outbreaks in Oregon community water systems, especially due to the parasite giardia. A second reason is the implementation in Oregon of new federal water requirements for increased levels of treatment to reduce the risk of water borne diseases. These new requirements were established under the federal Safe Drinking Water Act of 1986, and the requirements of this act have taken effect as of January 1, 1991. In addition, there are concerns about the cost of meeting the new regulations for small water systems. The requirements for testing, control, availability of water, certified operation, and many other factors will affect the cost of operating and maintaining existing, alternative, or modified water systems.

In addition to the requirements for meeting new regulations, many of the jurisdictions in the proposed planning area have experienced water shortages during low stream flow periods. The recent drought, coupled with increased population and demands for water supplies, has caused storage reservoirs to drop significantly in the communities of Neahkahnie, Manzanita, Nehalem, Wheeler and Rockaway Beach. These communities take water from springs or small streams near each jurisdiction. Typically, the drainage area of each of the existing water sources is less than one to two square miles. Stream flows have dropped well below demand at various times during the months of July, August and early September. Therefore, in addition to meeting the requirements for improved water quality, each jurisdiction must improve its existing water sources for more capacity or seek alternative supplies.

During the summer and spring of 1992, negotiations were entered into with 10 separate water jurisdictions in the North Tillamook County area to undertake a regional water supply study. With assistance from Vicki Goodman of the Tillamook County Development Committee and Dr. Peter Scott, Dean of Science and Industry, Linn-Benton Community College, representing the Rural Community Assistance Program, individuals were gathered who represent 10 water providers. The jurisdiction, contact person, and mailing address of those agencies are as follows:

Water System	Technical Contact Person	Address & Phone No.
Manzanita	Randy Kugler City Manager	Manzanita City Hall P.O. Box C Manzanita, OR 97130 368-5343
Nehalem	Merlin Brown City Manager	City of Nehalem 35900 8th Street Nehalem, OR 97131 368-5627
Rockaway Beach	Jim Gohring Public Works Supt.	Rockaway Beach Public Works P.O. Box 5 Rockaway Beach, OR 97136 355-2982
Wheeler	Gene Cox Public Works Supt.	City of Wheeler P.O. Box 177 Wheeler, OR 97147 368-5767
Zaddack Creek Water Co-op	Daryl Johnston	16115 Old Mohler Rd. Nehalem, OR 97131 368-5819
Brighton Water Co.	Archie Buchanan	29285 Bayview Blvd. Rockaway Beach, OR 97136 368-6683

Water System	Technical Contact Person	Address & Phone No.
Neah-Kah-Nie Water District	Tom Bender Chairman	Neah-Kah-Nie Water Dist. P.O. Box 172 Manzanita, OR 97130 368-7309 or 368-6294
Nehalem Bay State Park	Dennis Davidson Superintendent	8300 3rd St. Neah-Kah-Nie City Nehalem, OR 97131 368-5943
Watseco-Barview Water District	Clayton McCormick Chairman	Watseco-Barview Water District Box 295 Rockaway Beach, OR 97136 355-2556
Tideland Water Co-op	Jack Thayer	Tideland Water Co-op 14650 Tideland Road Nehalem, OR 97131 368-6908

Following the formation of the Water Resource Committee, the various jurisdictions agreed to an intergovernmental agreement and a financing plan to move forward with the proposed water study. The City of Wheeler took the lead role in this effort, and by a written agreement dated April 16, 1992 authorized Lee Engineering, Inc. to proceed with two water studies. One would address the needs of the City of Wheeler's distribution and storage requirements. The other would deal with water supplies of Wheeler and the other participating parties, including a regional water supply. A detailed scope of work was developed and submitted to the committee for their review and modification.

1.2 OBJECTIVES AND GUIDELINES

The primary objective of this report is to address the concerns of the water purveyors in North Tillamook County that deal with meeting the requirements of Oregon Revised Statutes Chapter 448 and Oregon Administrative Rule Chapter 333 that deal with the implementation of the federal Surface Water Treatment Rules enacted by Congress in 1986. Questions must be answered as to whether or not existing systems can continue to operate or whether additional treatment facilities and/or new sources will be required. The communities of Manzanita, Nehalem, and Wheeler are under State Order to comply with the "Treatment requirements and performance standards" and must submit plans for construction of filtration systems or development of alternative sources as soon as possible.

In general, facilities are to be operational by June 29, 1993, or a request must be made for time extensions which shows that progress is being made, applications have been made for funding, and the water system is meeting or will meet an approved interim operational plan.

Because of the limited scope and time frame for completion, this report will not address many issues which may have an impact on the ultimate solutions. For example, the report will basically be limited to source options including:

1. Single source/merge system
2. Multiple source/decentralized system
3. Operation and maintenance of existing systems

Although some of the systems may elect not to participate in a regional supply, all of the systems have some deficiency with regard to quality standards and/or adequacy of supply. No attempt will be made in this study to contest or modify existing administrative rules or regulations.

1.3 SCOPE OF WORK

A general scope of work agreed to by the North Tillamook County Water Resource Committee consists of the major tasks described below:

A. Gather and review existing data concerning city area characteristics such as climate and rainfall patterns, topography, soils and geology, land use characteristics, population trends and local employment.

B. Collect and review existing data on the present water systems and problem areas. Analyze existing data for the existing water supply sources, including volume and quality characteristics. Review the water use patterns of the existing systems, including total annual water sales, peaking factors, existing water rights, and whether or not the water supplies meet current water quality regulations.

C. Based on existing information, make projections for future service areas, future development, water demand projections, and develop criteria for cost estimating procedures.

D. Prepare a system analysis including a computer model which will provide for analysis of connecting the existing systems into one regional system or otherwise providing additional capacity to existing systems.

E. Evaluate alternative water supplies and compare the various alternatives with improvements of existing water systems.

F. Analyze the operation and maintenance considerations of existing systems versus the regional supplies.

G. Outline in brief form the various financial considerations and organizational issues related to the regional supply.

1.4 ACKNOWLEDGMENTS

Lee Engineering, Inc. expresses its sincere thanks to members of the Water Resource Committee for their assistance in collecting existing information, attending various meetings, correcting erroneous information, and otherwise providing help that was necessary and critical to preparing this document. Credit for this effort can be shared by all.

Special thanks goes to Vicki Goodman of the Tillamook County Economic Development Committee, Dr. Pete Scott of Linn-Benton Community College, and Dave Phelps and Mike Grimm of the Oregon Health Division for their valuable assistance in encouraging progress on this important project.

CHAPTER 2

CHAPTER 2

STUDY AREA CHARACTERISTICS

2.1 STUDY AREA

The study area includes North Tillamook County from Neahkahnie Beach on the north, continuing south around Nehalem Bay and along the beach to the north jetty of Tillamook Bay. The various cities, water districts and private water companies that have participated in this study include:

1. Neahkahnie Water District
2. Manzanita
3. Nehalem Bay State Park
4. Nehalem
5. Tideland Water Co-op
6. Zaddack Creek Water Co-op
7. Wheeler
8. Brighton Water Company
9. Rockaway Beach
10. Watseco-Barview Water District

The study area includes the existing Urban Growth Boundaries of the cities and those areas of the county outlined by the Comprehensive Plan that allows for existing and future development. See Figure 2.1 for a graphic representation of the study area.

2.2 CLIMATE AND RAINFALL PATTERNS

The area along the North Tillamook County coastal zone has a temperate, humid climate. This results from the moderating influence of the Pacific Ocean and from the rainfall induced by the Coastal Range mountain barrier. Rainfall is significantly influenced by elevation, increasing from 60 to 90 inches per year along the sea shore to a high of about 180 to 200 inches per year in the higher elevations of the coast and mountain range.

Approximately 80% of the precipitation occurs between October and March. Average precipitation varies from 8" to 12" per month during this period and can be over 20" per month in the mountain areas. Summer rainfall is only 1" to 2" per month and consists primarily of occasional light rain storms, drizzle and heavy coastal fog.

Within the study area and the mountainous areas to the east, little infiltration to groundwater occurs from rainfall. The soil is relatively thin and overlies impervious rock. Most of the rainfall moves directly to stream channels. Stream flows rise beginning in the rainy season in October, reach a maximum during mid-winter, and then taper off with minimum flows occurring in August and September. Only about 3% of the rainfall occurs during the July through September. (Reference: Freshwater Resources of the Oregon Coastal Zone, State Water Resources Board, December, 1974.)

As a result of these characteristics, stream flows can vary by a factor of 1,000:1. For example, the peak discharge recorded on the Nehalem River was approximately 34,300 cubic feet per second on April 5, 1991, but has been recorded as high as 53,400 cubic feet per second on January 9, 1990 for a brief period. A minimum discharge was approximately 34 cubic feet per second on August 29 through 31, 1967. This information was recorded by the USGS at River Mile 13.5 near Foss, Oregon. Stream flows for small drainages fronting directly on north Oregon beaches have been measured to be as low as 0.2 to 0.36 cfs per square mile (i.e., Johnson Creek near Newport and Jetty Creek north of Rockaway Beach).

2.3 TOPOGRAPHY, SOILS AND GEOLOGY

The topography within the planning area varies from flat tidal land to steep rocky hillsides with slopes 25% to 35%. Tidal areas typically contain standing water throughout the year, whereas in the hilly, mountainous areas directly away from the beach, water runs off rapidly. Soil types vary from coarse sands and gravels to fine muds and clays. Much of the landscape immediately away from the beach area is too steep for residential and commercial development.

With continuing geologic studies, there is now abundance of evidence showing a series of recent geologic movement and severe local earthquakes. Recent discoveries in several bays of Oregon and Washington and in offshore drilling activities appear to confirm a history of as many as 13 major earthquakes occurring in the past 7,000 to 8,000 years. Most of these major earthquakes appear to have been accompanied by widespread underwater sliding on the continental slope and abrupt subsidence of the coastline by several inches to several feet. These massive earth movements have caused large ocean waves that have buried marsh lands, prehistoric human occupation sites, and coastal cedar forests under wave-deposited sands. (Paul D. See, Geologist; Letter to Handforth, Larson & Barrett, May 5, 1990.)

Strong seismic accelerations are expected to precipitate widespread landslides in the coast range. Future tsunami impacts or tidal waves will vary with coastal topography. Estimates indicate that the average height for possible tsunami encroachment on higher land areas is about 22 feet to 25 feet above tide level, and could be higher. It has been estimated by See, Cornforth, and Nadin, that there is a 20% chance of a magnitude 8 earthquake in the next 50 years.

2.4 LAND USE

Enacted in 1913, the Oswald West Act declared all of the west sand beaches of Oregon as public highways. Later, the threatened loss of public use and access to Oregon's beaches prompted Oregonians to press successfully in 1967 for legislation providing for public use of the ocean shore in perpetuity. This "Beach Bill" provides that the entire ocean shore from low water to the line of vegetation be for public use, recreation, and enjoyment.

As a part of statewide concern for land use, Oregon and various municipal jurisdictions, including cities and counties, have developed a comprehensive management program for its coastal resources. In 1969, the Oregon legislature took the first step toward statewide land use management by passing a law (Senate Bill 10) requiring that all lands of the state be subject to local government comprehensive land use plans and zoning ordinances.

In 1973, the Oregon Land Use Act (ORS 197, commonly referred to as Senate Bill 100) was passed. This act was prompted by accelerated growth throughout Oregon, particularly along the Oregon coast, which was causing damage to fragile coastal ecosystems as well as aesthetically displeasing conditions. Conditions of concern included filling of estuaries, dredging of harbors and rivers, and haphazard placement of vacation homes and tourist facilities. Private development and state and federal agencies were proposing projects which could significantly affect the natural environment of the coastal area.

In 1973, the Oregon Coastal Management Program was put in place. It was designed to comply with requirements of the federal Coastal Zone Management Act of 1972.

Currently, the land use jurisdiction within the North Tillamook County area is administered by Tillamook County and the Cities of Manzanita, Nehalem, Wheeler and Rockaway Beach. For purposes of this study, the existing land use plans in the above jurisdictions were heavily relied upon for predicting future population, employment and related water demands. No attempt has been made to reproduce the summaries of the existing comprehensive plans. The reader is referred to those plans for specific details. (Reference to above: Oregon Coastal Management Program, 1976, Oregon LCDC, 1976.)

2.5 POPULATION TRENDS AND ECONOMIC DEVELOPMENT

The state land use programs have been designed in part to facilitate economic development and to provide for adequate housing for current and future citizens in the planning area. In North Tillamook County, the shortage of available housing, either to purchase or rent, is a growing concern. This is particularly true for low and moderate income people. Much of the housing that has been built is second or retirement homes for those who have acquired ample resources working elsewhere. It is assumed, however, that with adequate planning and the availability of public facilities, including water and sewer systems, development can and will occur. In order to project future growth in North Tillamook County, historical records concerning population, employment, housing and other factors were reviewed.

Information on population and other factors is gathered periodically by the U.S. Bureau of Census. That information is readily available at the Department of Urban and Public Affairs, Portland State University. Census data was reviewed from 1960 through 1990. That information is shown in the census data tabulated in Table 2.1 - Long Range Population Estimate.

From the historical information, various techniques can be used by planners and engineers to estimate long range population growth. The graphical method can be used to get an informal estimate of population growth by fitting a curve on a graph of census data using an approximate method. The logistic curve method fits a logarithmically decreasing curve to census data that approaches a theoretical saturation population. This method only works if the census data increases over time. Since the Tillamook area data does not in all cases increase over time, the logistic curve method cannot be used. The ratio and correlation methods use an estimate of population growth for a large area, such as Tillamook County, to establish the growth of a smaller area within the larger. This data also does not fit the necessary assumptions, so these two methods were not used. The only mathematical method that is available for the information that exists is the regression method. Regression is a statistical technique in which an equation is found that minimizes the deviations between observed data and equation values. Four types of equations can be used: linear, logarithmic, exponential and power functions. The regression computer program determines which one of the four equations best fits the available data. For purposes of this study, the estimated populations for the years 2010 and 2050 were developed using our computer programs. The method which fit the available data best is also listed in Table 2.1.

2.5.1 SATURATION POPULATION ESTIMATES

In determining available water resources that can be used to serve existing and future populations, some estimate of saturation population is appropriate. The long term water resources to be developed for domestic water purposes should be capable of serving the ultimate saturation population of the planning area.

A four-part method was used to establish the ultimate saturation population:

1. The first step was to gather land use planning maps from Tillamook County and the local cities.

2. The second step was to measure the area within each jurisdiction corresponding to different land use zones using graphic techniques. Measurements of area were approximate, within plus or minus 10%. The area was measured and converted to units of acres.

3. The third step was to research each jurisdiction's land use ordinances for the allowed minimum lot sizes and to calculate the average number of persons per household from census data.

4. The fourth and final step was to input the gathered data into a spreadsheet for analysis. See Table 2.2. The available gross area for each zone was

multiplied by 0.7 to reduce the area to the probable buildable area. The result gives an estimate of the maximum number of housing units allowed by the land use ordinance. This number has been multiplied by the average number of persons per household from historical information to get the total equivalent number of persons for each zone.

For this analysis, the Urban Growth Boundary is assumed to remain constant. Also, no projections were made for possible land use changes. Therefore, the area remains fixed over time. The numbers which were generated are shown in the following tables and represent an estimate of the worst case scenario, not necessarily the most practical case which may result. Again, this exercise was used primarily to give an estimate for the ultimate water resource development that may be needed to serve the domestic needs of the planning area.

In order to check this approach, the County Assessor's records as of January 1992 were reviewed. According to the County Assessor, approximately 18,000 parcels are zoned for residential development in the County, 7,000 of which currently do not contain dwellings. Moreover, many of these parcels can be further divided to provide additional building sites. A conservative estimate indicates that current zoning provides at least 12,000 to 15,000 potential additional building sites, enough to provide for more than twice the County's population. The existing County population according to 1990 census data is about 21,570 people living inside and outside of incorporated areas. According to our projections for population saturation, this could grow to about 52,000. Although the different approaches vary, the long term saturation population in the study area (equivalent population including residents and recreational units such as hotels, motels and camp sites) is estimated at about 47,000 people.

TABLE 2.1

LONG RANGE POPULATION ESTIMATE

DISTRICT	CENSUS DATA				ESTIMATED		EST.
	1960	1970	1980	1990	2010	2050	METHOD
TILLAMOOK CO.*	18,955	18,034	21,164	21,570	23,772	28,162	LINEAR
MANZANITA	363	365	443	513	641	1,049	EXP.
NEHALEM	233	241	258	232	246	252	LOG.
ROCKAWAY BEACH	771	665	906	970	1121**	1,457	LINEAR
WHEELER	244	262	319	335	428	670	POWER

* INSIDE AND OUTSIDE OF THE STUDY AREA

** ROCKAWAY BEACH COMPREHENSIVE PLAN BACKGROUND REPORT, JUNE, 1990, ESTIMATES 2028 POPULATION BY THE YEAR 2010.

TABLE 2.2

SATURATION POPULATION
N. TILLAMOOK CO. REGIONAL WATER STUDY

NE'AH-KAH-NIE BEACH

ZONE CODE	ZONE AREA (ACRES)	MIN. H.U. SIZE (SQ. FT.)	MAX. H.U. ALLOW.	AVERAGE PERS/H.U.*	TOTAL EQ. PERS.
R-1	438.60	7,500	1,783	2.44	4,351
RR	90.00	20,000	137	2.44	335
SATURATION POPULATION ESTIMATE***					4,686

MANZANITA (URBAN GROWTH BOUNDARY, UGB)

ZONE CODE	ZONE AREA (ACRES)	MIN. H.U. SIZE (SQ. FT.)	MAX. H.U. ALLOW.	AVERAGE PERS/H.U.	TOTAL EQ. PERS.
R-2	672.20	5,000	4,099	2.01	8,240
RMH	98.62	2,500	1,203	2.01	2,418
SRR	GOLF COURSE	N.A.	200	2.01	402
SATURATION POPULATION ESTIMATE					11,060

NEHALEM (UGB)**

ZONE CODE	ZONE AREA (ACRES)	MIN. H.U. SIZE (SQ. FT.)	MAX. H.U. ALLOW.	AVERAGE PERS/H.U.	TOTAL EQ. PERS.
A-1	7.13	20,000	11	2.41	26
R-1	171.97	5,000	1,049	2.41	2,527
R-2	328.77	5,000	2,005	2.41	4,832
R-3	59.06	5,000	360	2.41	868
R-L	14.60	10,000	45	2.41	107
MR	46.30	5,000	282	2.41	680
C	46.30	5,000	282	2.41	680
P	3.95	0	0	2.41	0
SATURATION POPULATION ESTIMATE					9,720

* TILLAMOOK COUNTY AVERAGE FROM CENSUS DATA USED

** MINOR AREAS OF ZONE CODES RT, RM, AND SA ARE INCLUDED IN ADJOINING ZONES.

*** MUCH DEBATE IS UNDERWAY WITHIN THE NE'AH-KAH-NIE AREA ABOUT SATURATION POPULATION. ESTIMATES AS LOW AS 3000 HAVE BEEN DEVELOPED.

TABLE 2.2 (CON'T)

WHEELER (UGB)

ZONE CODE	ZONE AREA (ACRES)	MIN. H.U. SIZE (SQ. FT.)	MAX. H.U. ALLOW.	AVERAGE PERS/H.U.	TOTAL EQ. PERS.
R-1	213.42	5,000	1,302	2.42	3,150
R-2	35.89	5,000	219	2.42	530
ED	48.56	0	0	2.42	0
EN	13.43	0	0	2.42	0
IND	6.91	5,000	42	2.42	102
WRC	35.34	5,000	216	2.42	522
P	9.07	0	0	2.42	0
GC	43.56	5,000	266	2.42	643
SATURATION POPULATION ESTIMATE					4,947

ROCKAWAY BEACH (UGB)

ZONE CODE	ZONE AREA (ACRES)	MIN. H.U. SIZE (SQ. FT.)	MAX. H.U. ALLOW.	AVERAGE PERS/H.U.	TOTAL EQ. PERS.
R-1	65.00	5,000	396	1.98	785
R-2	100.00	5,000	610	1.98	1,207
R-3	118.00	5,000	720	1.98	1,425
RMH	6.69	3,500	58	1.98	115
RMD	0.00	3,500	0	1.98	0
C-1	97.31	5,000	593	1.98	1,175
OS	27.31	0	0	N.A.	0
SA	246.06	0	0	N.A.	0
WD	5.84	5,000	36	1.98	71
SRR	5.18	5,000	32	1.98	63
RR	1.50	N.A.	80	1.98	158
SATURATION POPULATION ESTIMATE					4,999

TABLE 2.2 (CON'T)

BARVIEW-WATSECO

ZONE CODE	ZONE AREA (ACRES)	MIN. H.U. SIZE (SQ. FT.)	MAX. H.U. ALLOW.	AVERAGE PERS/H.U.*	TOTAL EQ. PERS.
R-1	51.28	5,000	313	2.44	763
R-2	85.39	5,000	521	2.44	1,271
R-3	4.59	5,000	28	2.44	68
RM	393.45	5,000	2,399	2.44	5,855
RR	70.00	5,000	427	2.44	1,042
M-1	20.90	5,000	127	2.44	311
C-1	6.36	5,000	39	2.44	95
C-2	6.94	5,000	42	2.44	103
ES	24.76	0	0	2.44	0
SATURATION POPULATION ESTIMATE					9,507

* TILLAMOOK COUNTY AVERAGE FROM CENSUS DATA USED

TIDEWATER, ZADDACK CRK, BRIGHTON, NBSP, & OTHERS

ZONE CODE	ZONE AREA (ACRES)	MIN. H.U. SIZE (SQ. FT.)	MAX. H.U. ALLOW.	AVERAGE PERS/H.U.	TOTAL EQ. PERS.
N.A.	N.A.	N.A.	860*	2.50	2,150
SATURATION POPULATION ESTIMATE					2,150

* EQUIVALANT HOUSING UNITS

TOTAL SERVICE AREA SATURATION POPULATION (ROUNDED): 47,000

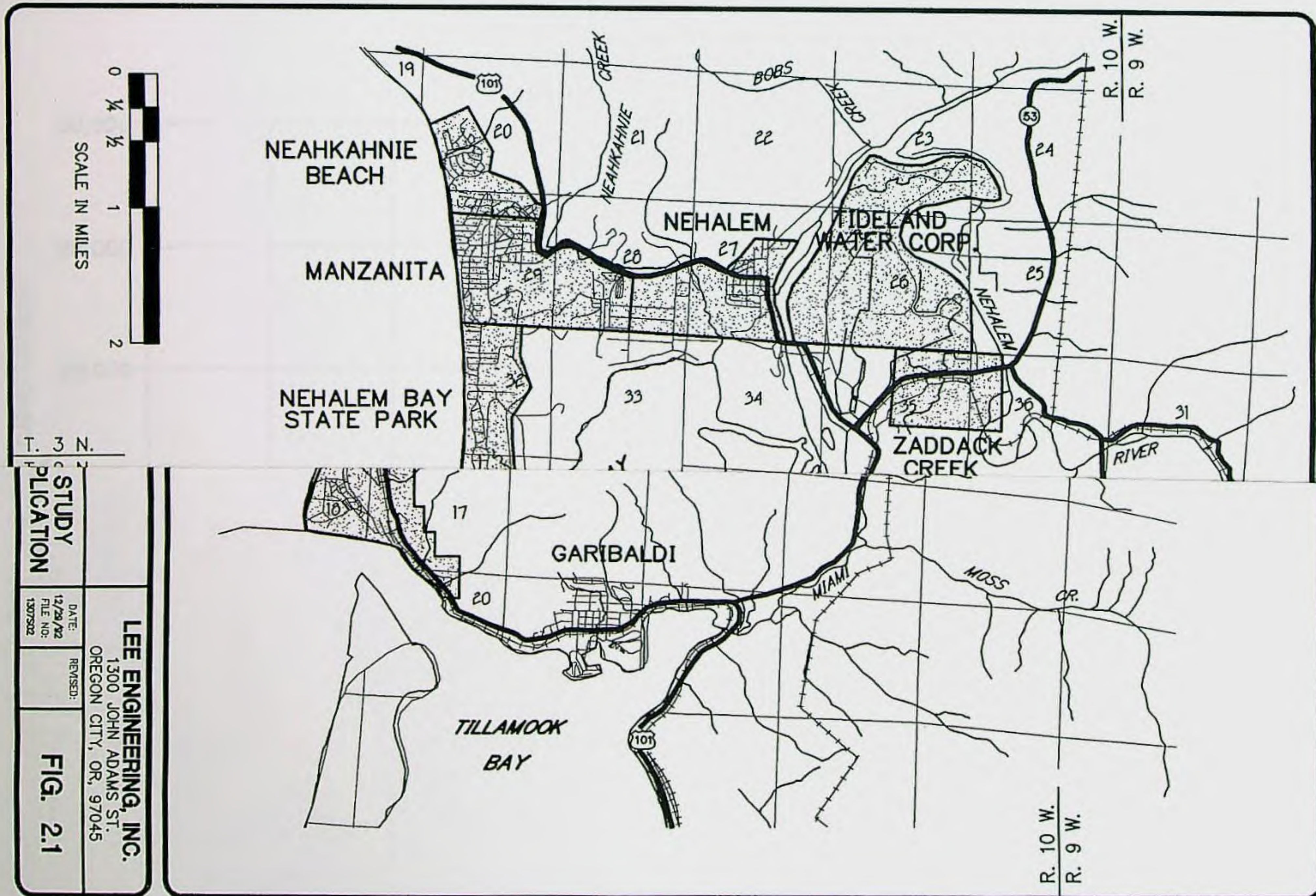
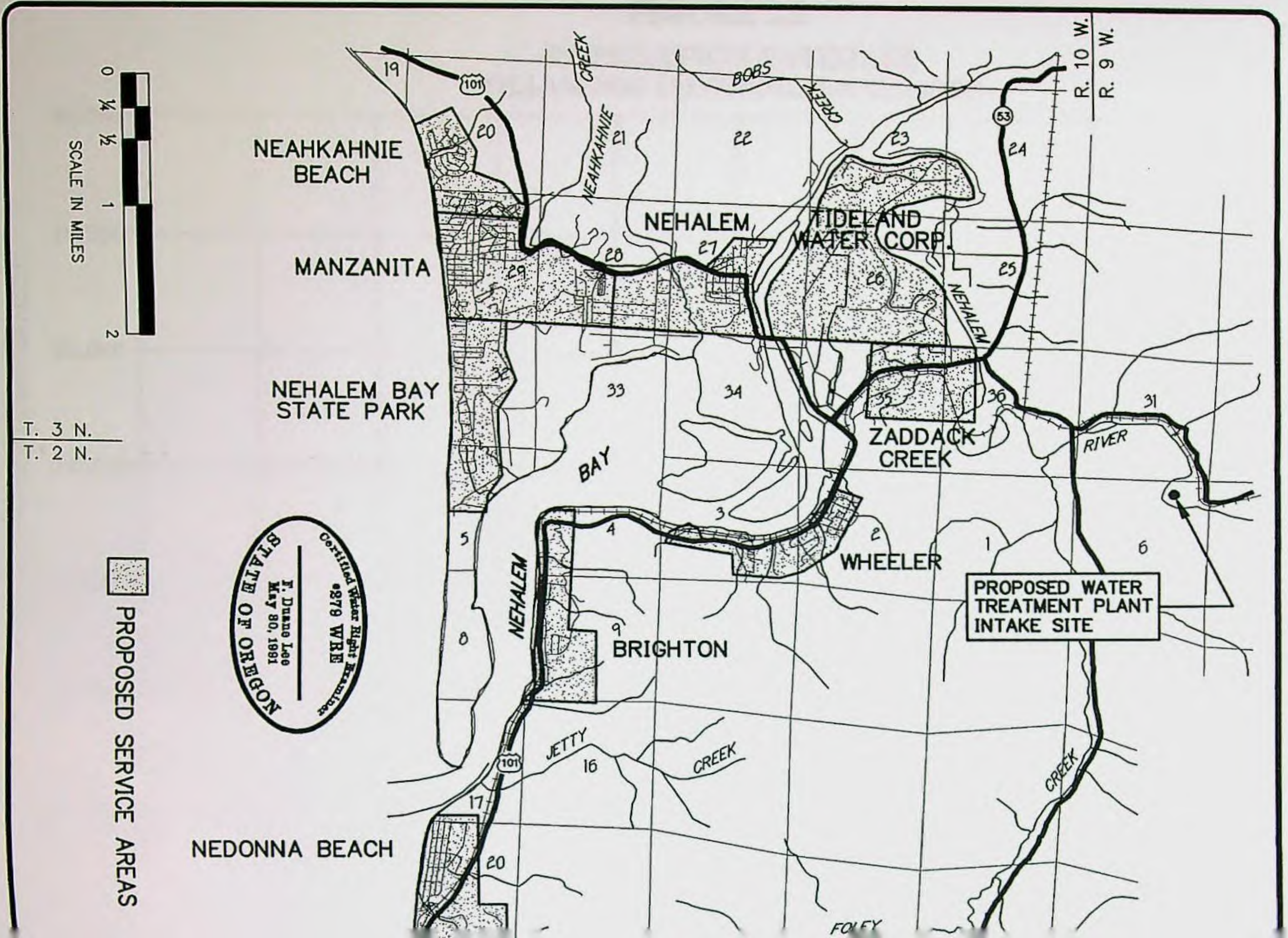

NEAHKAHNIE BEACH
MANZANITA
NEHALEM
TIDELAND WATER CORP.
NEHALEM BAY STATE PARK
ZADDACK CREEK
GARIBALDI
TILLAMOOK BAY
NEAHKAHNIE CREEK
BOBS CREEK
NEHALEM
RIVER
MIAMI
MOSS CR.
101
53
R. 10 W.
R. 9 W.
T. 3 N.
0 ¼ ½ 1 2
SCALE IN MILES
STUDY
PLICATION
LEE ENGINEERING, INC.
1300 JOHN ADAMS ST.
OREGON CITY, OR, 97045
DATE: 12/28/92
FILE NO: 1307S02
REVISED:

FIG. 2.1


NEAHKAHNIE BEACH
MANZANITA
NEHALEM BAY STATE PARK
NEHALEM
TIDELAND WATER CORP.
ZADDACK CREEK
WHEELER
BRIGHTON
NEDONNA BEACH
PROPOSED WATER TREATMENT PLANT INTAKE SITE
PROPOSED SERVICE AREAS
SCALE IN MILES
0
¼
½
1
2
T. 3 N.
T. 2 N.
R. 10 W.
R. 9 W.
101
53
BOBS CREEK
NEAHKAHNIE CREEK
NEHALEM
BAY
RIVER
NEHALEM
JETTY CREEK
CREEK
FOLEY
19
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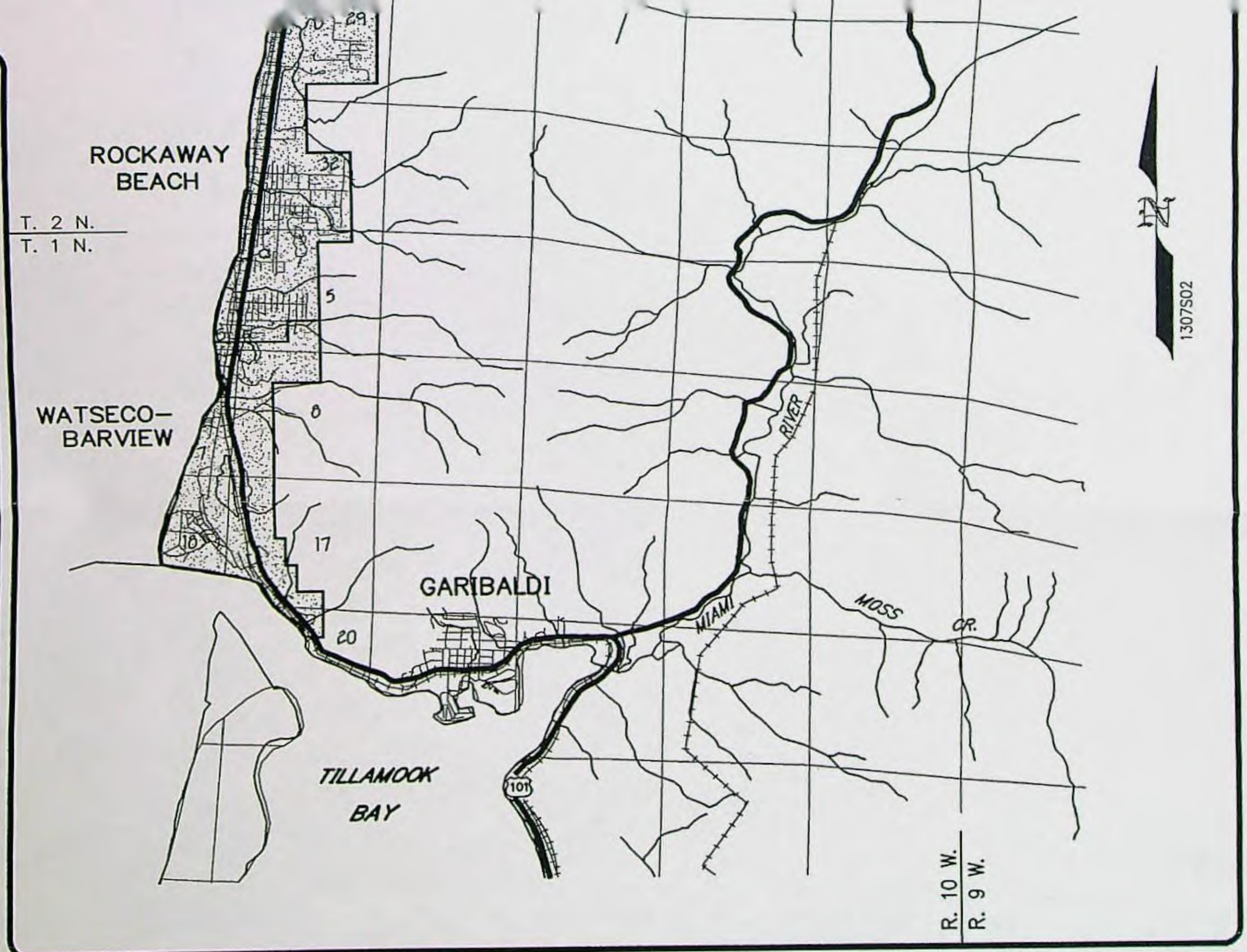
17
20
Certified Water Right Examiner
#279 WRE
F. Duane Lee
May 30, 1991
STATE OF OREGON



OWNER: CITY OF WHEELER

LEE ENGINEERING, INC.
1300 JOHN ADAMS ST.
OREGON CITY, OR, 97045

DWG TITLE: N. TILLAMOOK CO. REGIONAL WATER STUDY AREAS INCLUDED IN WATER RIGHTS APPLICATION

DATE: 12/29/92
FILE NO: 1307S02
REVISED:

FIG. 2.1

FIGURE 2.2

POPULATION ESTIMATE

TILLAMOOK CO.-TOTAL POPULATION

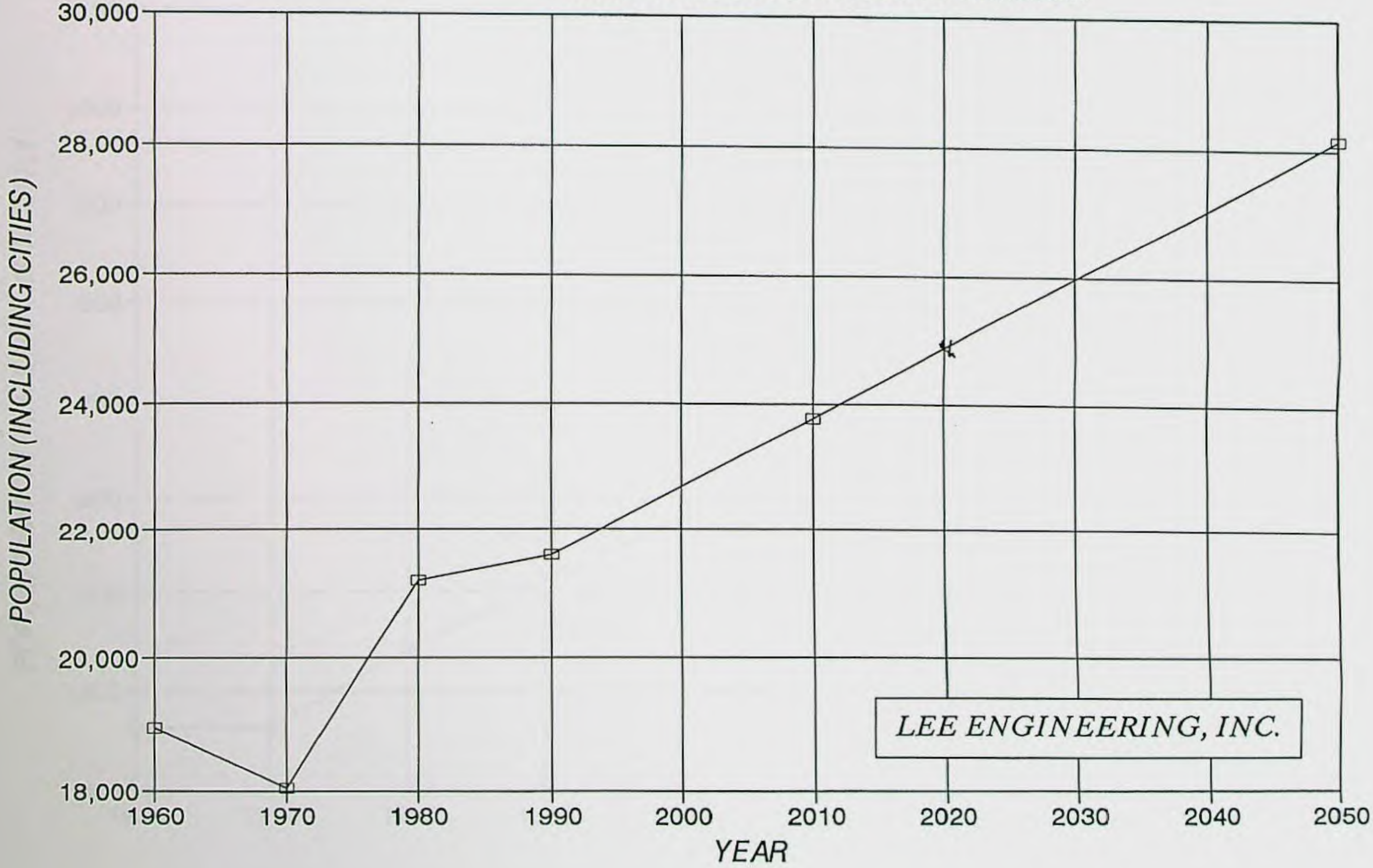


FIGURE 2.3
POPULATION ESTIMATE
MANZANITA

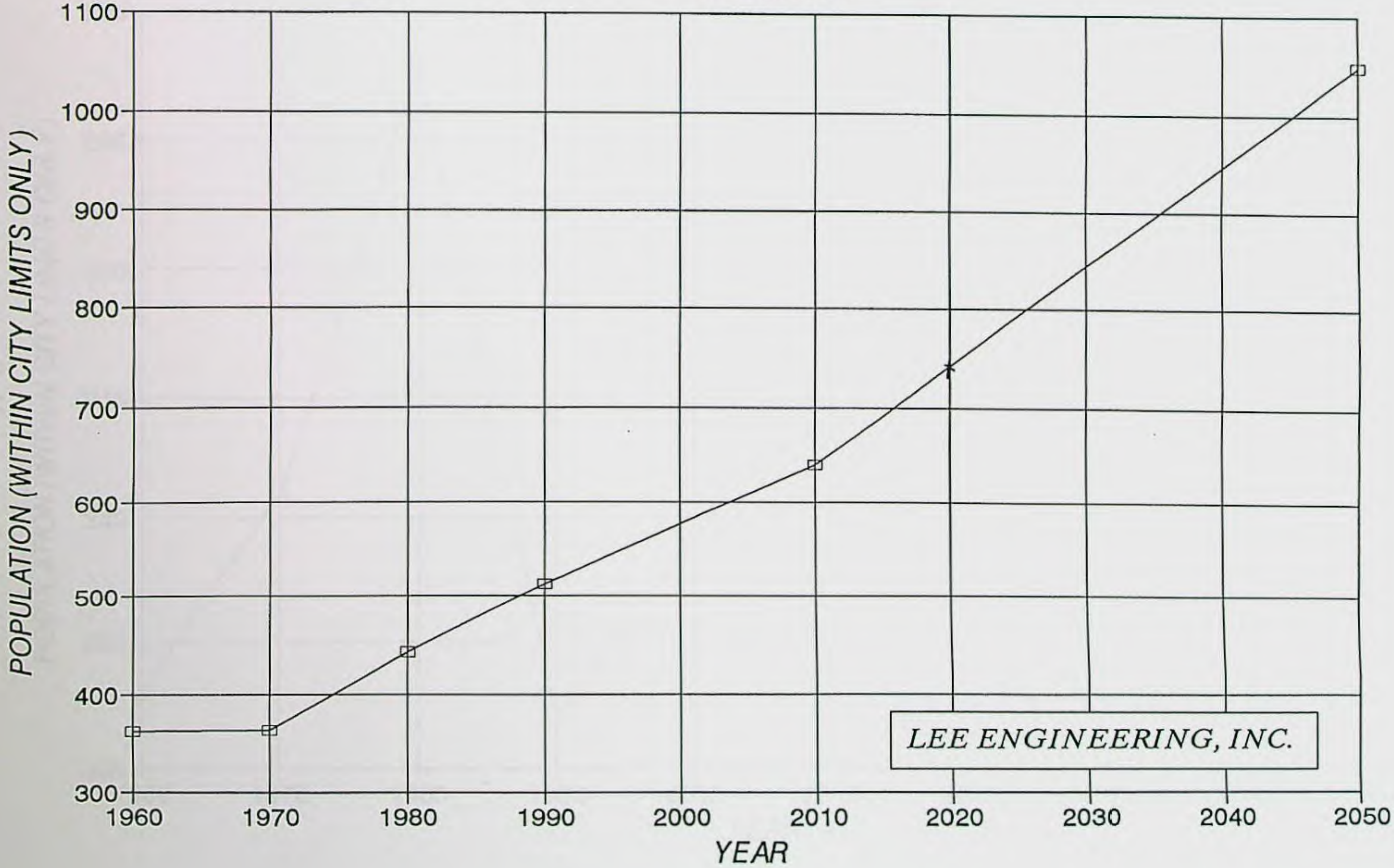


FIGURE 2.4
POPULATION ESTIMATE
NEHALEM

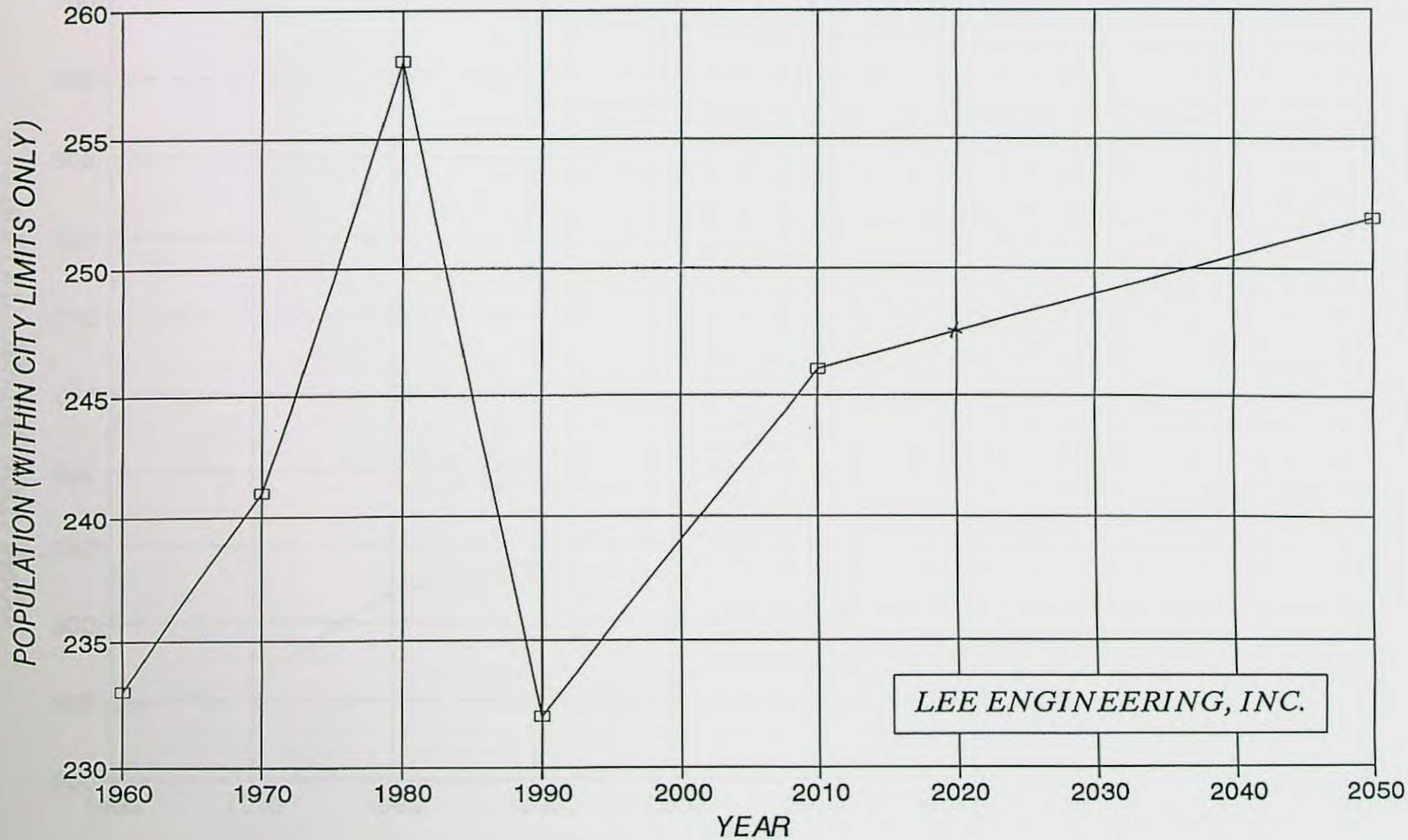


FIGURE 2.5
POPULATION ESTIMATE
WHEELER

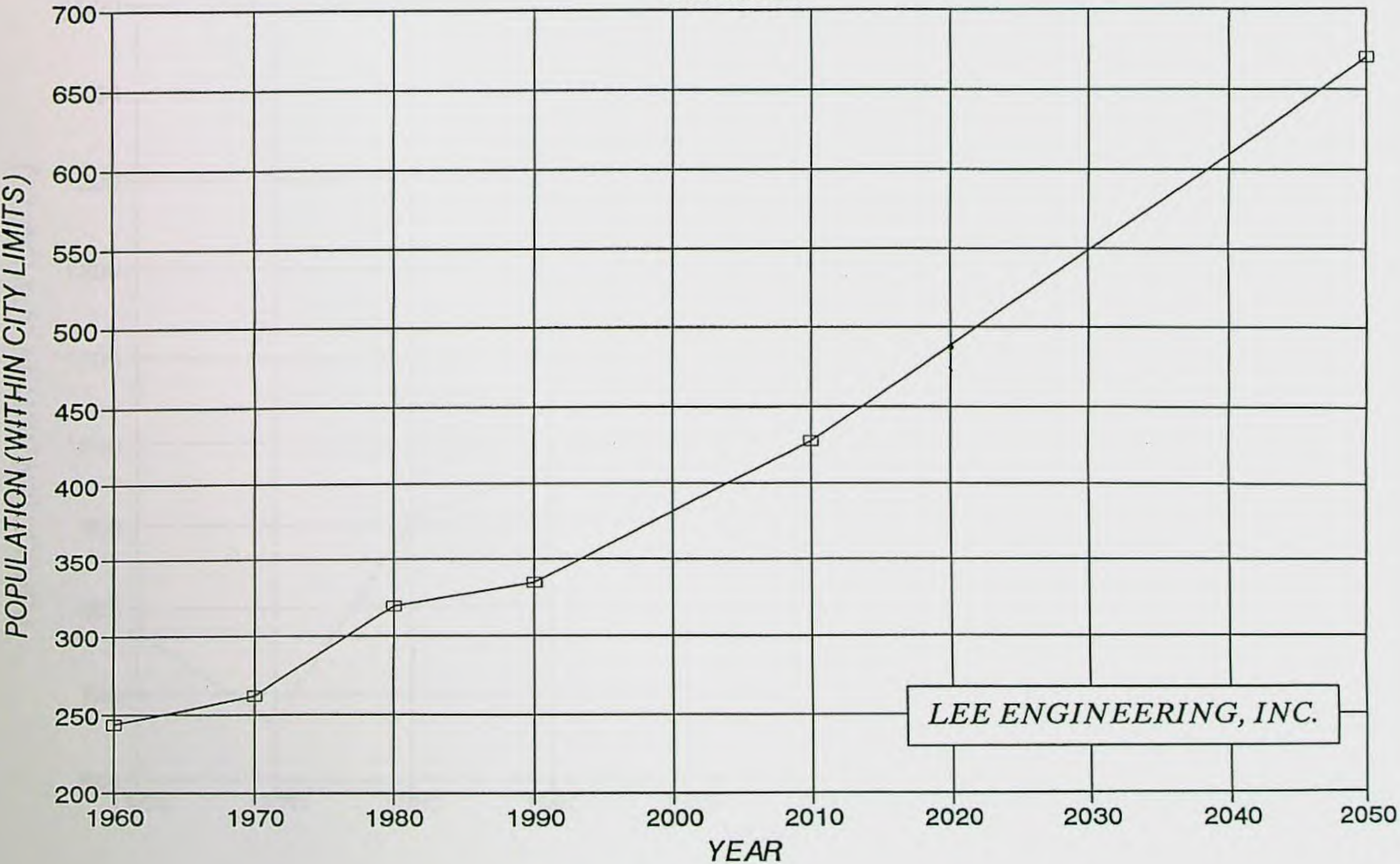
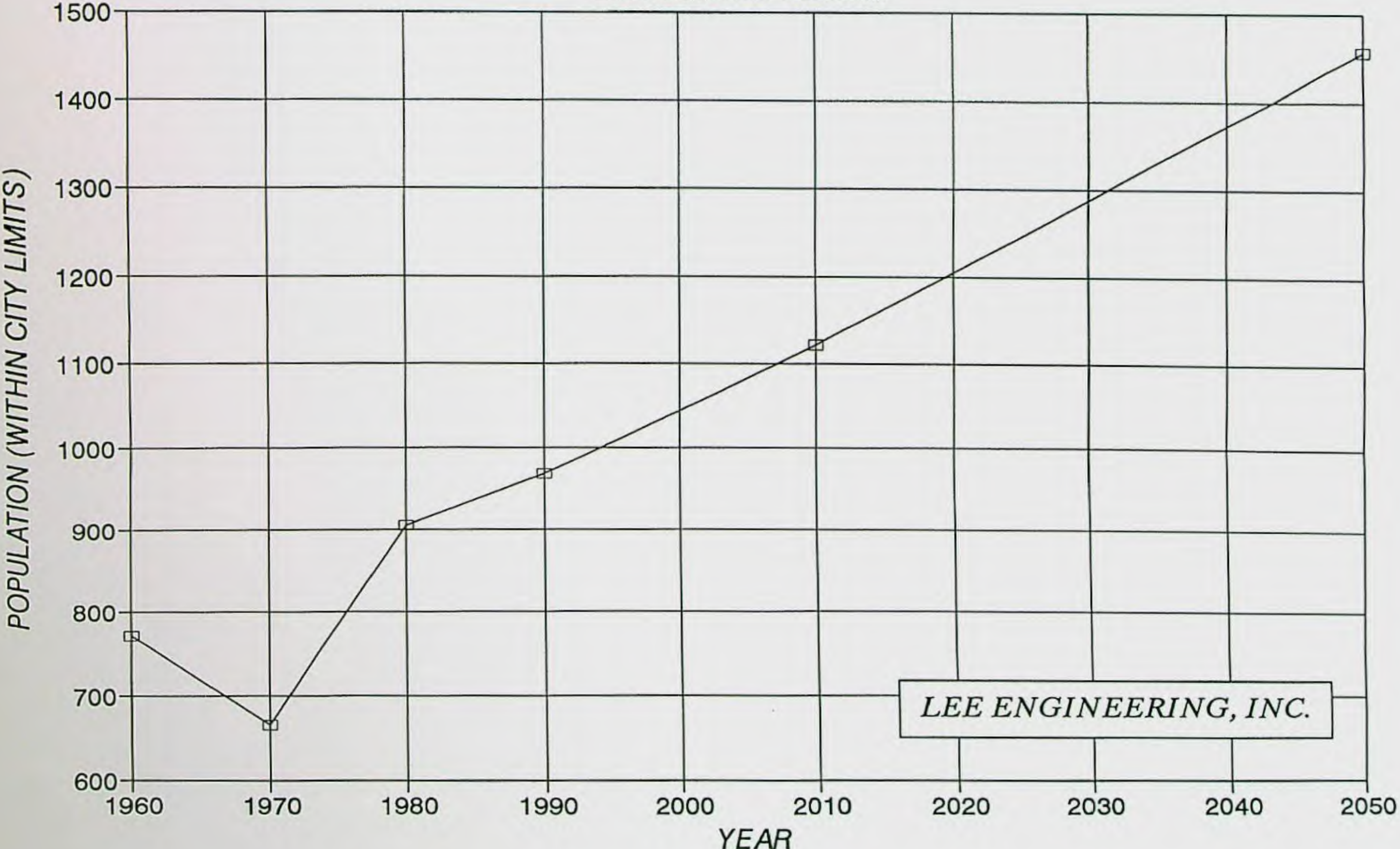


FIGURE 2.6
POPULATION ESTIMATE
ROCKAWAY BEACH



CHAPTER 3

CHAPTER 3

EXISTING WATER SYSTEMS

3.1 GENERAL INFORMATION

In mid-July, 1992, a list of information that would be helpful in analyzing existing water systems was prepared and disseminated to the various participants. The information that was requested included:

1. Population data
2. Copies of land use plans, zoning maps and zone descriptions.
3. Water use records, including average day demands, peak day demands, unaccounted-for water, etc.
4. Water source information, including capacity, type, existing treatment, raw water quality reports, pumping data, etc.
5. Copies of state sanitary surveys.
6. Maps showing supply, storage and distribution.
7. Reservoir and pump information.
8. Copies of previous engineering reports.
9. Copies of water rights permits and/or certificates.
10. Water rates ordinances and/or resolutions.
11. Policy statements.
12. Detailed description of pipes 6" and larger, including pipe diameter, type, age, etc.
13. Copies of the 1991 and 1992 audits.
14. Copies of agreements existing with local private forest companies, Division of State Lands, and easements.
15. Information on metered services.
16. List of wholesale connections and/or annual water sales to wholesale customers.
17. List of industrial and large commercial accounts larger than 1-1/2" meter size.
18. Adopted Capital Improvement Programs.
19. Copies of the 1992-1993 budgets showing water enterprise accounts only.
20. Local fire protection requirements.
21. Watershed management plans and/or well head protection plans.
22. Stream and spring flow monitoring records, if any.

Obviously, this listed information is extensive and it took some time for various agencies to produce what was available. In most cases, not all of the information was pertinent or available.

Following receipt of the information in late summer and early fall, a personal inspection was made of the key sources. In some cases, memorandums were developed of the inspections and some pictures were taken. A brief summary of each system's characteristics was developed as follows.

3.2 NEAHKAHNIE WATER DISTRICT

The boundaries of the Neahkahnie Water District encompass all of Section 20 and the northeast corner of Section 19, Township 3 North, Range 10 West, Willamette Meridian, and is generally that area north of Manzanita and south of Oswald West State Park. U.S. Highway 101 passes through the water district. Forestry lands exist on the eastern boundary and the Pacific Ocean on the western boundary.

Generally, the County Comprehensive Plan has zoned the area south of Highway 101 as R-1, allowing for 7,500 square foot residential lots, and has zoned approximately 90 acres north of Highway 101 as RR-2, which will convert to 20,000 square foot lots once the area is sewered.

The water system of Neahkahnie receives its water from four springs. Spring No. 1 serves the upper level and feeds to an existing 20,000 gallon steel reservoir with overflow elevation of 616 feet. A second spring exists at elevation 544 feet and is connected by pipelines to Spring No. 3 at elevation 404 feet. These two springs drain into two separate reservoirs. The 30,000 gallon Hillcrest Reservoir is at elevation 307 and the Reservoir Park Reservoir is a 38,000 gallon concrete tank, also at elevation 307. A fourth spring, Pirate Spring, at elevation 141 feet, is currently not in use. However, a pumphouse has been built and a pump ordered, and it will soon be operational to pump water to the Reservoir Park Reservoir.

All of the springs are being chlorinated via various means. Spring No. 1 is chlorinated with tablets. Springs No. 2 and 3 are chlorinated at the Hillcrest Reservoir site with a mechanical chlorinator feeding hypochloride solution. When Pirate Spring is put in service, it is intended that a metering pump will feed hypchloride solution to the waters of this spring.

The Neahkahnie Water District has recently begun metering its system. They have also begun to meter their spring supply within the past few years. The meters are read manually and there is no continuous recording. Recent information indicates that the springs have a total capacity of approximately 110 gallons per minute. Average daily demand within the system is approximately 54,000 gallons per day, or 38 gpm, but peak day demands approach 100,000 gallons per day, just slightly less than existing dry weather spring capacity. Because Pirate Spring has not yet been connected to the system, there have been periods when water use has had to be restricted.

A review of the District's Capital Improvement Plan indicates that recent work has focused on storage, piping and installation of meters. However, the existing planning information does not indicate the immediate intent to address many of the new regulations dealing with such issues as well head protection programs, conservation, disinfection byproducts, testing for volatile organic chemicals and synthetic organic chemicals, classifications of water sources (groundwater versus surface water), and many other issues. Board members and operation personnel indicate their intent to address these issues in the near future, where and when they are applicable.

3.3 MANZANITA

The City of Manzanita's water system serves primarily the area within its Urban Growth Boundary, but also serves some areas surrounding the city and serves water, on an emergency basis, to Nehalem Bay State Park.

The source for Manzanita is Anderson Creek, located approximately four miles northeast of the city. Water is collected at three different forks of Anderson Creek and is transmitted to the city's 500,000 gallon Classic Ridge Reservoir site through various 6" and 8" diameter pipes, all by gravity.

The water supply is untreated except for chlorination. The dry weather flow on Anderson Creek is estimated to be 167 gpm. The existing peak day demand is estimated to be 224 gpm, indicating that during dry weather flow periods, the existing supply is unable to keep pace with system demand.

The city has prepared a Master Water Plan dated December, 1990, by Hanforth Larson & Barrett, Inc. which outlines the Capital Improvement Program including improvements to piping, storage and treatment through the year 2000. The plan comments that development of additional surface water supply should be the first alternative investigated, with local groundwater sources a second alternative. Existing storage is approximately 612,000 gallons short of the needs by the year 2001. Further, several improvements to the distribution system and fire hydrants are recommended.

Again, the plan does not make mention of several other concerns under current regulations. These items need to be addressed, and it is the city's intent to do so.

3.4 NEHALEM BAY STATE PARK

The water supply for Nehalem Bay State Park is a well drilled through the sand dunes at a location on the north edge of the park approximately 500 ft. east of Necarney Road just north of Ninth Street. The well was initially drilled in 1980 and was redrilled in 1983. The well was test pumped at a rate of between 20 and 45 gpm and appears to have been constructed in conformance with applicable regulations.

The well water contains a high level of iron, estimated at more than 12 parts per million. Therefore, treatment is provided by the addition of chemicals which oxidize and flocculate the iron, and the water is then filtered through pressure filters before entering a 50,000 gallon redwood tank. Downstream of the tank, two 3 hp booster pumps deliver water to the camping and picnic areas within the State Park. Chlorine disinfection of the water supply is not provided.

From historical information, the average daily demand during the months of July and August is 24,000 gpd. Peak day demands are estimated to be about 46,000 gpd during the Fourth of July holiday. The park estimates that it uses approximately 3,000,000 gallons per year.

The park superintendent, Dennis Davidson, indicates that the cost of treating water is extremely high. Also, the quality control on the treatment process is not sufficient to assure good quality water consistently. The park would prefer to buy water from Manzanita or a regional water supply. Because of the recent restrictions upon water use, Manzanita has not had surplus water to sell to Nehalem Bay State Park.

3.5 NEHALEM

The City of Nehalem provides water to its citizens plus water to several areas outside of its boundaries. Those areas include the Tideland Water Co-op, the local sanitary authority, and housing west and northeast of the city. Approximately two-thirds of the water service is outside the city limits. For the most part, maximum water use appears to occur in August and September, which coincides with low stream flows from its source.

The source of water for Nehalem is Bob's Creek about two miles north of the city. A 6" gravity transmission line delivers water to two uncovered concrete reservoirs totaling 300,000 gallons.

Chlorine is the only current means of treatment. The reservoirs are piped and operated so as to provide some settling of solids before water is disinfected and delivered to town. The chlorinator is a hypochlorinator driven by a master meter which records total water usage. A report prepared in 1973 entitled: "A Comprehensive Development Program for Water System Improvements - City of Nehalem" indicates that present chlorine contact time is only 10 minutes prior to the first water service.

The distribution system is in generally good condition, although several major water leaks have been noted in the recent past. The pipeline is constructed primarily of asbestos cement pipe. A portion of the town is placed in a high level service area and is delivered water through a booster pump. No reservoir storage exists in this service area.

Water is delivered through a master meter to the local sanitary authority and Tideland Water Co-op.

Nehalem currently serves 450 customers with an average daily demand of 135,000 gpd. Maximum water use was 318,000 gpd on August 2, 1992. Approximately 400,000 gpd was used on December 25, 1990. This high water use was estimated to result from a cold weather period during that time. These peak day flows include water delivered to Tideland Water Co-op.

Existing supply from Bob's Creek is estimated to have a minimum capacity of 175 gpm during dry weather conditions, or about 250,000 gpd. It appears that the capacity of the Nehalem system's source is marginally sufficient for the current peak day demands, but is not adequate to meet projected future peak day demands. Also, treatment will be required on the existing and/or future surface sources. The Comprehensive Development Program prepared in 1973 also envisions additional storage and pipeline improvements.

3.6 TIDELAND WATER CO-OP

The Tideland Water Co-op serves water to 20 connections in an area which is east of the City of Nehalem, and north of Nehalem junction and west of Mohler. Water service is received from Nehalem. Water is served from Nehalem to the Nehalem Bay Wastewater Agency which in turn submeters service to Tideland. Tideland has no independent source or storage. Tideland operates as a water co-op and has a total of 18 meters which it reads, primarily on a quarterly basis. Several of the meters serve more than one residence and/or dairy. Three large dairies are served, together with eight separate homes.

All of the pipeline in the system is relatively new. The 4" main line was installed approximately seven years ago and two 2" main lines have been installed within the last two years. All of the new pipe is PVC pipe.

The average water demand for Tideland was estimated at 24,500 gpd in 1992 and had a peak day demand of 48,500 gallons. The normal operating pressure in the system is about 80 psi.

3.7 ZADDACK CREEK

Zaddack Creek serves an area in the general vicinity of Mohler along Highway 53 just north of Wheeler and east of Nehalem. Zaddack Creek receives its water from its namesake in the hills just south of Mohler. No surveys have been made of the diversion location, but it is estimated to occur at approximate elevation 200. This information was calculated from the pressures within the system. Approximately 1,600 gallons of storage are provided at the intake. The system serves 10 single-family residences and has an average daily demand of 2,400 gpd. No other information has been provided on Zaddack Creek.

3.8 WHEELER

The City of Wheeler receives its water from two small drainages east and southeast of the town. The Jarvis Creek Diversion has an overflow elevation of 316 feet, from which water flows by gravity to a chlorinator and a separate 3,600 gallon holding tank. The holding tank has an overflow elevation of 285.25 feet. From there, water is regulated into the tank through a float-operated control valve. Water flows from the tank by gravity to an upper pressure zone within the city, serving several homes and the local nursing home.

Water is diverted in Vosberg Creek at an earthen dam with an overflow elevation of 290.5 feet. Water flows from the dam by gravity to a 10,000 gallon holding tank where the Vosberg supply is chlorinated. Water flows from this tank by gravity to the lower pressure zone of the city. The overflow of this tank is 219.16 feet.

The City of Wheeler has 180 connections serving a population of 350, plus the local nursing home, the commercial area along Highway 101, the area along the waterfront, and the Paradise Cove RV Park. The average water demand is approximately 74,000 gpd, with a peak water demand of approximately 147,000 gpd. During the past few summers, water shortages have occurred, particularly in the Jarvis Creek Drainage. In order to provide adequate service to the nursing home and upper pressure zone, it has been occasionally necessary to modify the operation of the system to force water from the Vosburg Diversion Structure directly to the high pressure zone. This activity has caused excessive pressures in the low pressure system and some difficulty with meeting adequate chlorine contact time from the Vosberg supply. The existing water supplies for Wheeler are not sufficient to meet the current demands.

The pipelines in Wheeler are in the process of being upgraded. This past summer a major length of old wood stave pipe was replaced with PVC pipe. A water system feasibility study was prepared by Hanforth and Larson in 1981 and has provided some guidelines for the city's upgrading of its water system. However, the city has also recently undertaken efforts to upgrade that report in light of new regulations. Lee Enginering, Inc. is preparing a water study for Wheeler in conjunction with this report, which may be referenced for more details on the City of Wheeler's water system.

3.9 BRIGHTON

The small community of Brighton serves 12 services along Highway 101 midway between the City of Wheeler and the City of Rockaway Beach. Diversion is from a small stream in the southwest corner of Section 9, Township 2 North, Range 10 West, Willamette Meridian. The water rights certificate from this stream is dated August 14, 1946. The community has been granted the right to divert approximately 0.05 cfs, or about 22-1/2 gpm.

In 1992, the Brighton Water Company entered into an agreement with Simpson Timber Company for a license to operate the diversion structure, pumping system and pipeline. It is assumed that prior to this time the water company was operating as trespassers. The license term is for a period of one year unless renewed in writing. Special conditions of the license require that in the event a municipal or public water supply becomes available to replace the water being conveyed under the agreement, the Brighton Water Company agrees to terminate the agreement.

The water system provides no treatment except chlorination. Bacteriological analysis indicates that the finished water supply is free of coliform bacteria, but the raw water supply at times shows very high counts of coliform, up to 40,000 per 100 ml. In general, the existing water supply does not meet current standards and will require additional treatment.

3.10 ROCKAWAY BEACH

The water system operated by Rockaway Beach serves an area from the Nedonna Beach south of the South Jetty of Nehalem Bay to Twin Rocks, near Spring Lake, approximately a mile and a half north of the North Jetty of Tillamook Bay. The area encompasses a four-mile stretch along Highway 101.

The source of water for this area is primarily Jetty Creek. The City operates a 1,000,000 gallon per day water treatment plant which diverts water from Jetty Creek about 1,000 ft. upstream from Highway 101 and provides for full treatment including chemical addition, flocculation, sedimentation, filtration and disinfection. Following treatment, water enters a clearwell from which it is pumped to the distribution system.

In addition to the Jetty Creek supply, the city operates two wells on an emergency basis. The wells have been designed for a capacity of 175 gpm each and are located in the north area of Nedonna Beach.

The distribution system consists of a series of pipelines varying in size from 6" to 12" along Highway 101, the beach, and the foothills. Two major reservoirs are connected to the distribution system, including the Third Street Reservoir with an overflow elevation of 241 feet and the Scenic View Reservoir with an overflow elevation of 155 feet. The reservoir capacities are 1,000,000 and 1,250,000 gallons, respectively.

In general, the Rockaway Beach water system meets the requirements of current regulations, but growth, development, and recreational activities tax the water system in terms of demand versus capacity each summer. Summertime flows on Jetty Creek have been recorded as low as 360 gpm, whereas peak day demands have approached 770 gpm. If the wells are used, then the supply closely approximates peak day demands. However, the city is reluctant to use the wells, except in an emergency.

In addition to the Jetty Creek supply, the city owns water rights of 0.5 cfs on Heitmiller Creek and 0.5 cfs on McMillan Creek. The city also holds a Certificate of Right on Jetty Creek of 1.0 cfs and an additional permit of 1.0 cfs. In addition, the water use from Jetty Creek is further restricted by a license agreement with Publishers Paper Company dated May 15, 1981. The city has serious concerns about its ability to meet future peak day demands. The supplies from Heitmiller Creek and McMillan Creek are reserved for emergency purposes only since they are untreated. Although the waters from McMillan Creek and Heitmiller Creek could be joined together in a separate treatment facility, low stream flows in these drainages do not provide for a large additional capacity to the city's water supply. The city's existing Public Facilities Plan comments that: "It is important that an additional source of water supply be developed."

3.11 WATSECO-BARVIEW

The Watseco-Barview Water District serves 130 connections in an area along Highway 101 from the North Jetty of Tillamook Bay north to Spring Lake. The water supply is a well located in one of the old camp sites at the Barview County Park which is towards the southern end of the service area. The well has an existing capacity of approximately 140 gpm, with two centrifugal pumps. Water is delivered directly to the distribution system. A reservoir is connected to the system with an overflow elevation of approximately 184 feet located on the hillside east of the Barview Store.

The well water has recently been tested and meets standards for physical and chemical parameters, except for high iron content, which has been measured in the well at 2.5 ppm. Water users frequently complain of "red water" which results from oxidization of the iron in the water which precipitates and settles in the mains during low flow periods. During periods of higher demand, the oxidized iron is resuspended and appears in the individual plumbing systems, including the bath water, toilets, sinks, and washing machines. The water can discolor laundry and/or fixtures under certain circumstances.

The existing pumps are centrifugal pumps with suction lifts. The suction from the well limits the existing capacity. The well as originally test pumped has a capacity of somewhere between 150 and 200 gpm. It is satisfactory to meet current and future projected uses, provided it is outfitted with a different pumping system, probably a submersible pump. Also, the iron issue needs to be addressed. The Board of Directors have recently authorized the installation of a chemical feed system to add a sequestering agent, Calgon product C-9, at a dosage rate of approximately 3 mg/l. The sequestering agent will help hold the iron in suspension so that it does not oxidize and create the red water problem. In addition, the water was analyzed for corrosive characteristics. The water has a Langelier index of -2.13 indicating that it is corrosive. The addition of the sequestering agent will help minimize corrosion problems of pipelines and/or plumbing fixtures.

The water piping and reservoir system appear adequate to meet existing domestic demands and fire protection. However, there are some problems related to the security at the well site, the iron problem, and future testing and wellhead protection program requirements under the new state and federal regulations. In the immediate future, the Board of the water district anticipates a new trailer park development and possibly a new subdivision which will add to their water demands. With proposed modifications to the well and the addition of chemicals, short-term problems should be adequately addressed. However, planning should be undertaken to analyze the long-term capacity of the aquifer, protection of that aquifer, and future testing for VOC's, SOC's, disinfection byproducts, and other concerns.

3.12 WATER SUPPLY REGULATIONS

Regulations which apply to the proposed water supplies for the North Tillamook County area will determine whether supplies remain as they are or whether new supplies are developed.

3.12.1 SURFACE WATER TREATMENT RULES (SWTR)

The Surface Water Treatment Rules were enacted on June 29, 1989 and defined the criteria for adequate treatment of surface water supplies to insure that contaminants of giardia lamblia, viruses, heterotrophic plate count bacteria, Legionella and turbidity were properly removed from domestic water supplies. The rules required that various treatment processes must provide for the removal of at least 99.9% of giardia cysts and a removal of at least 99.99% of viruses. The rules allow for compliance by disinfection alone if several criteria, including source water quality compliance, compliance with existing trihalomethane regulations, and compliance with existing limits on bacteria in the distribution system, are met. In all cases where water supplies may contain giardia cysts, filtration is required to remove the majority of the cysts, usually a 2 to 2.5 log reduction (more than 99 of every 100 cysts). Disinfection is required with filtration to insure that any cysts and viruses which may pass through the filtration system are adequately immobilized.

3.12.2 TURBIDITY RULE

Maximum contaminant levels for turbidity are applicable to all public water supply systems using surface water or groundwater sources under the direct influence of surface water in whole or in part. In general, turbidity levels measured in NTU's should be less than one turbidity unit. Provisions are made to allow for turbidity levels as high as five NTU's on an average of two consecutive days. However, the general trend with regard to turbidity is likely to require that turbidity levels be kept, on average, less than 0.1 NTU.

3.12.3 COLIFORM RULE

This rule requires that coliform bacteria be absent in 95% of the samples taken from the distribution system and recommends a measurable amount of disinfectant be present throughout the distribution system. The normal test for the bacteriological compliance is a presence or absence of total coliform bacteria. For most surface water supplies, it is nearly impossible to meet the coliform rule without some form of treatment, including filtration and disinfection.

3.12.4 DISINFECTION

All common disinfectants are chemical oxidants that tend to react with naturally occurring organic material in water. The organic and inorganic products of these reactions are referred to as disinfection byproducts. The disinfection and disinfection byproduct rule is still under development. The proposed implementation schedule has been changed so that the planned effective date has been delayed until June 1995. However, the current rules do require the continued use of chlorine as a disinfectant and have set construction standards, particularly CT requirements (contact time) that must be met. Currently, it is uncertain as to which disinfection products would be regulated in addition to trihalomethanes (THM) which are currently regulated at a total concentration of 0.1 mg/l. There is some discussion about decreasing the THM limit to 0.025 or 0.050 mg/l. Other disinfection byproducts which are considered to be under scrutiny for regulation include the Haloacetic acids (HAA's), aldehydes, and cyanogen chloride. This rule, and its uncertainty due to delays in the implementation of proposed regulations, may have a major influence on decisions as to whether or not Neahkahnie and/or Watseco-Barview will be impacted by these regulations. It is assumed from experience that the other systems will need to address disinfection byproducts.

3.12.5 LEAD AND COPPER RULE

The lead and copper rule requires that the level of these elements be minimized in their presence at the consumer's tap. Allowed concentrations on first draw after six hours detention in the customer's plumbing for concentrations of lead and copper are 0.015 and 1.3 mg/l, respectively. Corrosion control treatment would be required to minimize contributions of lead and copper from the source water and from corrosion in their distribution and plumbing pipelines and fixtures. This rule may have significant impact on all options for water sources. Typically, surface waters and groundwaters along the northern Oregon coast are slightly acidic and the Langelier index is typically such that corrosion is a strong potential. Therefore, each water supply is assumed to require some form of corrosion control.

3.12.6 MONITORING REQUIREMENTS

Oregon Administrative Rules require that each water supply be monitored for maximum contaminant levels under seven major headings. Various headings and the frequency of sampling follow:

Item	Description	Typical Frequency of Testing (May Vary)
1.	Inorganic chemicals	Annually
2.	Organic chemicals	
	a. Chlorinated hydrocarbons	Annually or every three years
	b. Trihalomethanes	Quarterly
	c. Volatile organic chemicals	Annually (Quarterly for first year)
3.	Turbidity	Daily
4.	Bacteriological	
	a. Presence or absence	Monthly
	b. Fecal coliform	Monthly
5.	Radionuclides	Every three years
6.	Secondary physical/chemical MCL's	Annually
7.	SOC's, Phase II and IV	Quarterly

For water supplies such as Neahkahnie, tests will need to be run on each spring source. For supplies such as Manzanita, testing and monitoring may be applied to the combined flow from the various streams and may be sampled at a point prior to various supplies entering the distribution system. Frequency of testing may vary with population and source. See OAR 333-61-036 and/or Appendix G for details.

3.12.7 PUBLIC NOTICE AND REPORTING

The owner or operator of a public water supply which fails to comply with an applicable MCL or treatment technique published by the Oregon Administrative Rules or which fails to comply with the requirements of any schedule prescribed pursuant to a variance or permit of these rules shall notify their users as provided by the Rules. The requirements for notification are extensive, and no attempt is made herein to replicate the Rules. Needless to say, this reporting and public notification process can be burdensome and can result in major consequences, politically and economically. Response to public inquiry after notification can consume considerable time and manpower.

3.12.8 CONSTRUCTION STANDARDS

The construction standards outlined under Oregon Administrative Rules apply to all new construction of public water systems and to major additions or modifications of existing public water systems. They are intended to insure that the system facilities will be free of public health hazards and will be capable of producing water which consistently complies with the maximum contaminant levels. A review of all of the water systems investigated under this report clearly shows that, with the exception of the Rockaway Beach Water Filtration Plant, none of the systems currently meet new construction standards. The reader is referred to Chapter 333-61-050 for specific details concerning new construction requirements.

3.13 PROBLEM AREAS

3.13.1 EXISTING PROBLEMS

Tabulated in Table 3.1 is a summary of the compliance issues observed during the review of the existing sources. The Table lists each source and whether or not, in the opinion of the author, the source complies with new or proposed rules. In addition to the rules described above, requirements for watershed management and/or wellhead protection plans are also listed. In some cases, it is not known whether or not the source or its administration complies with the rules. In those instances, a question mark is shown in the tabulation. Where the existing sources, treatment, or operations do not comply, an X is shown, and where the rules do not appear to comply, the acronym representing Not Applicable is entered. Where a blank space shows in the tabulation, it is assumed that the source complies or the treatment on the source is in compliance.

Where systems do not appear to be in compliance, a general discussion to bring the source in compliance can be found in Chapter 6 - Formulation and Evaluation of Alternative Water Supplies.

3.13.2 FUTURE PROBLEM AREAS

The major problem with existing water supplies is their capacity to meet future demand. A near equal problem deals with the cost associated with upgrading the existing supplies to meet current and future standards. Ultimately, the question needs to be raised whether or not it makes sense to improve existing supplies when they fail to meet long term capacity needs of the local jurisdictions. In other words, will vacant property be allowed to develop and will existing densities be allowed to expand, if allowed under the zoning ordinances, or will growth be curtailed in relation to existing water supplies or other limits?

Another future problem deals with disinfection of drinking water using chlorine. The advantages of chlorine disinfection are well known, since chlorine provides a high degree of protection against many common diseases such as dysentary, salmonella, cholera, typhoid, and other illnesses which one seldom hears about. Chlorine is also relatively simple and inexpensive to use.

Despite these advantages, there are concerns about disinfection byproducts. Trihalomethanes are suspected to be cancer-forming when ingested in sufficient quantities. USEPA's proposed disinfection byproduct rules become effective after June 1995, and will impose a level of acceptable THM's that all systems will be required to meet. The rule could also regulate haloacetic acids that result from using chlorine for pre-oxidation or disinfection purposes. As a result of these concerns, alternative disinfection means may be required.

Finally, the most difficult issue facing the regional supply question deals with the organizational structure that will need to be formed to implement the requirements of the regional supply. The solution to this issue will need to be addressed by all of the governmental entities and private water users. A brief discussion on these issues is included in Chapter 7.

3.14 EXISTING WATER RIGHTS SUMMARY

There are two basic systems of controlling the use of surface drainages in the United States. The riparian doctrine prevails in the eastern part of the United States and allows any property adjoining natural waterways to use the available water. The appropriation doctrine prevails in the West. Concerning groundwater, allocation procedures vary from state to state and can include a rule of absolute ownership, the rule of reasonable use, the rule of correlative rights, or the permit system. In Oregon, the permit system for both surface waters and groundwaters is used.

The appropriation doctrine is generally referred to as "first in time, first in right," and was subsequently confirmed in law by express recognition through court decisions, constitutional provisions, and state statutes. The nature of a water right acquired by appropriation is a right of use, or usufructuary right, to take water and apply it to beneficial use for a certain property and a right of preference over the rights of subsequent appropriators during times of water shortage. Although appropriative water rights arise by application of water to beneficial use, state administrative and judicial systems are in place for determining the nature and extent of these water rights and their relative priorities, and for the administration of such rights to assure that such waters are made available to appropriators in accordance with their determined rights.

An aspect of appropriative water rights is the right to change the point of diversion, place of use, and the nature of use in a manner that will not injure the rights of other appropriators. There are several potential causes of possible adverse effect or injury to junior appropriators in a stream, such as an expansion in time or volume of the water use, increased consumptive use, altered location, and timing of return flows. No attempt will be made in this report to elaborate on these issues. See "Water Rights of the Fifty States and Territories," published by the American Water Association.

Municipal water suppliers must often compete with other water users for a water resource. The Water Utility Manager and municipal governing board will on occasion be required to make policy decisions to insure an adequate supply of water.

The more knowledgeable they are on the consequences of their decisions, the better those decisions will be.

The appropriation doctrine is generally considered to have started during the Gold Rush days in California. Large volumes of water were necessary to wash placer deposits, and miners often found themselves short of the necessary water because of upstream diversions. To settle the issues, the miners applied the same rule as they applied to gold: first in time, first in right. As time progressed, legal recognition was given by western courts, and the issues were later codified by western legislatures. As development occurred and agriculture began to replace mining activities, the doctrine has generally been applied to irrigation.

The word "appropriation" means: "to take for one's own or exclusive use." The appropriation doctrine is essentially a rule of capture, similar to the rule that common law applied to wild animals. Rather than belonging to land owners, as is the case under riparian doctrine, water was viewed as belonging to nobody, and as the property of all. Oregon, as well as all other western states, rely in part on state ownership for authority, and have enacted extensive statutory codes regulating appropriation.

The appropriation doctrine rests on two basic principles: priority and beneficial use. When the flow of a stream is insufficient to meet demand, its use is regulated by priority and time. The most recent uses are curtailed in order to provide water for the earlier uses. The effect of the rule is clear: water shortages fall entirely on those who last began using water. This is in contrast to the riparian doctrine under which shortages are shared by all.

Municipal water rights, long held in reserve, are now being developed to serve a growing population. Water districts and municipalities have the legal ability to interconnect systems and serve other entities, even out-of-basin. Municipal water rights generally represent a senior claim to the water, and are a potential threat to the public instream values that depend on river flows. For purposes of information, tabulated in Table 3.2 are the names of the various municipal and private water jurisdictions that hold water rights in the areas of this study for municipal or domestic use.

TABLE 3.1
SUMMARY OF COMPLIANCE ISSUES
EXISTING SOURCES

EXISTING SOURCE	RULES									
	SWTR	Turbidity	Coliform	D/DBP	Lead & Copper	Monitoring	Reporting	Constr. Std.	Watershed Mgmt.	Well Head Protection
1. Neahkahnie Springs	?	?	?	?	?	X	?	X		X
2. Anderson Creek	X	X	X	?	?	X	?	X	X	
3. Bob's Creek	X	X	X	?	?	X	?	X	X	
4. Jarvis & Vosberg	X	X	X	?	?	X	?	X	X	
5. Jetty Creek				?	?		?		X	
6. Rockaway Beach Wells	N.A.		?	?	?	X	?	?		X
7. Barview Well	N.A.		?	?	?	X	?	X		X
8. Nehalem Bay State Park	N.A.			?	?	X	?			X
9. Zaddack Creek	X	X	X	?	?	X	?	X	X	
10. Brighton	X	X	X	?	?	X	?	X	X	

LEGEND AND NOTES

? = Information lacking or insufficient to discern compliance or noncompliance.
X = Information or lack of information suggests compliance with new or proposed rules is unlikely unless specific issues are addressed.
Blank = Probably in compliance.
N.A. = Not Applicable.
SWTR = Surface Water Treatment Rules.
D/DBP = Disinfection and Disinfection By-Product Rule
Constr. Std. = Construction Standard per OAR Chapter 333-61-050, 1991.

TABLE 3.2

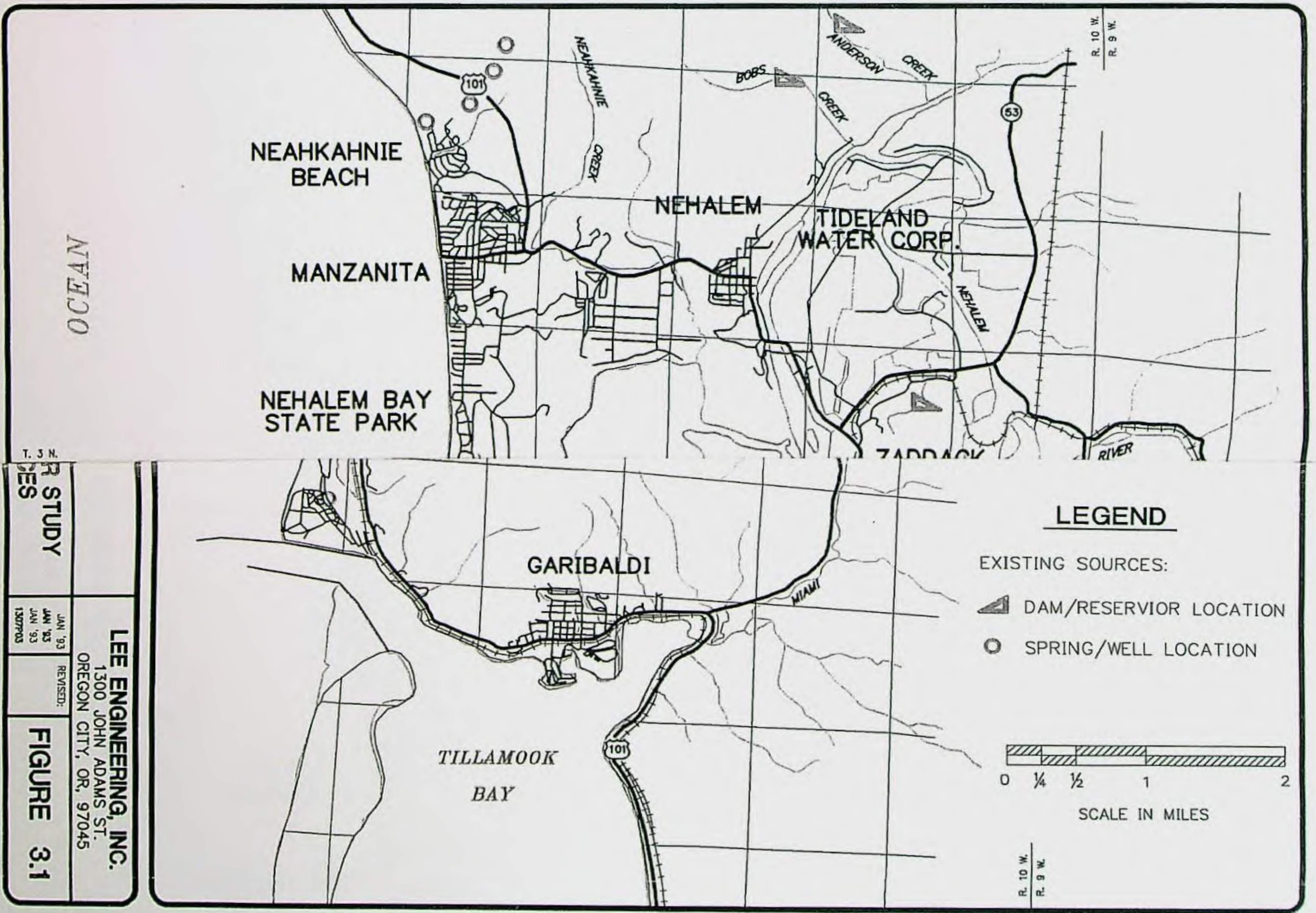
NORTH TILLAMOOK COUNTY
REGIONAL WATER MASTER PLAN

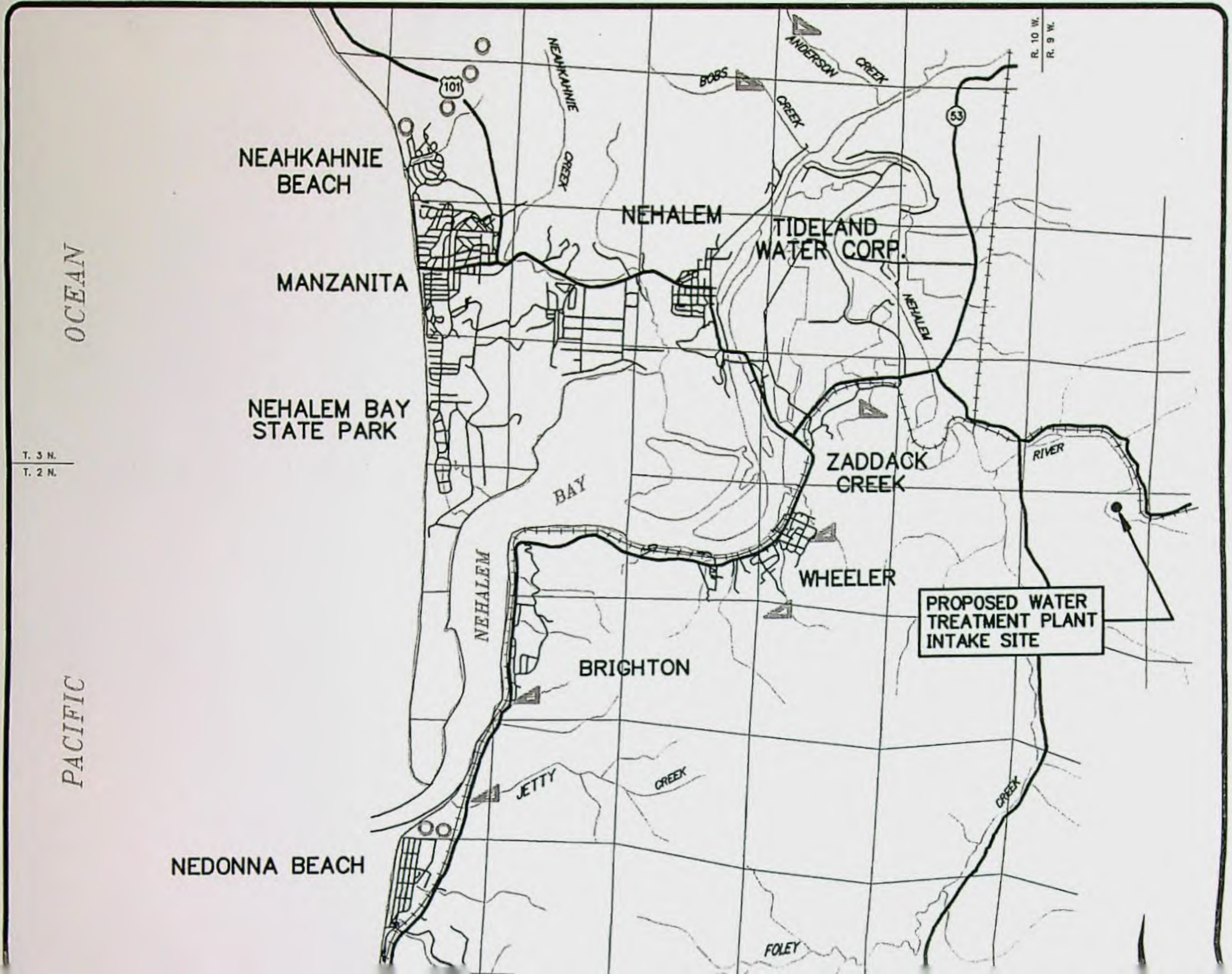
SUMMARY OF EXISTING WATER RIGHTS

Jurisdiction and Source	Permit Date	Water Rights cfs.	Totals cfs.
Neahkahnie Water District			
1. Spring 1	12/7/70	0.01	
2. Spring 2	12/7/70	0.01	
3. Spring 3	12/7/70	0.15	
4. Pirate Spring	12/9/68	0.45	
			0.62
5. Spring 1	4/7/92	0.06	
6. Spring 2	4/7/92	0.06	
7. Spring 3	4/7/92	0.20	
			0.32
Neahkahnie Water Co.			
1. Spring 1	4/30/29	0.01	
2. Spring 2	4/30/29	0.01	
3. Spring 3	4/30/29	0.15	
			0.17
Manzanita			
1. W. Fork Anderson Creek	12/15/78	0.50	
2. Middle Fork Anderson Creek	12/10/45	0.50	
3. N. Fork Anderson Creek	12/10/45	0.50	
4. Neahkahnie Creek	8/14/50	0.87	
5. Alder Creek	9/14/48	0.50	
			2.87
Nehalem Bay State Park			
1. Well	6/5/86	0.06	
			0.06

SUMMARY OF EXISTING WATER RIGHTS
(Continued)

Jurisdiction and Source	Permit Date	Water Rights cfs.	Totals cfs.
Nehalem			
1. Bob's Creek		2.0	
2. Coal Creek, West Branch	10/22/79	1.5	
3. Coal Creek, Main Branch	10/22/79	1.5	
			5.0
Tidewater - None			
Zaddack Creek - None			
Wheeler			
1. Jarvis Creek	1/24/13	3.00	
2. Jarvis Creek	3/14/30	0.28	
3. Vosberg	8/15/74	4.00	
			7.28
Brighton			
1. W. T. Edwards - Unnamed creek	8/14/46	0.05	
			0.05
Rockaway Beach			
1. Heitmiller Creek	2/16/62	0.50	
2. Heitmiller Creek	10/18/11	2.50	
3. Jetty Creek	12/8/69	1.00	
4. Jetty Creek	6/24/81	1.00	
5. Well No. 1	6/10/81	0.39	
6. Well No. 2	6/10/81	0.39	
7. McMillian Creek	3/17/58	0.26	
8. McMillian Creek	7/31/46	0.26	
9. McMillian Creek	7/30/59	0.50	
			6.80
Watseco-Barview - None			


NEAHKAHNIE BEACH
MANZANITA
NEHALEM BAY STATE PARK
OCEAN
NEHALEM
TIDELAND WATER CORP.
NEAHKAHNIE CREEK
BOBS CREEK
ANDERSON CREEK
NEHALEM RIVER
GARIBALDI
MIAMI
TILLAMOOK BAY
101
53
R. 10 W.
R. 9 W.
T. 3 N.
LEGEND
EXISTING SOURCES:
DAM/RESERVIOR LOCATION
SPRING/WELL LOCATION
0 ¼ ½ 1 2
SCALE IN MILES
LEE ENGINEERING, INC.
1300 JOHN ADAMS ST.
OREGON CITY, OR, 97045
JAN '93
REVISED:
FIGURE 3.1


NEAHKAHNIE BEACH
MANZANITA
NEHALEM BAY STATE PARK
NEDONNA BEACH
NEHALEM
TIDELAND WATER CORP.
ZADDACK CREEK
WHEELER
BRIGHTON
PROPOSED WATER TREATMENT PLANT INTAKE SITE
PACIFIC
OCEAN
BAY
NEHALEM
RIVER
NEAHKAHNIE
CREEK
BOBS
CREEK
ANDERSON
CREEK
JETTY
CREEK
CREEK
FOLEY
101
53
R. 10 W.
R. 9 W.
T. 3 N.
T. 2 N.

OWNER:

CITY OF WHEELER

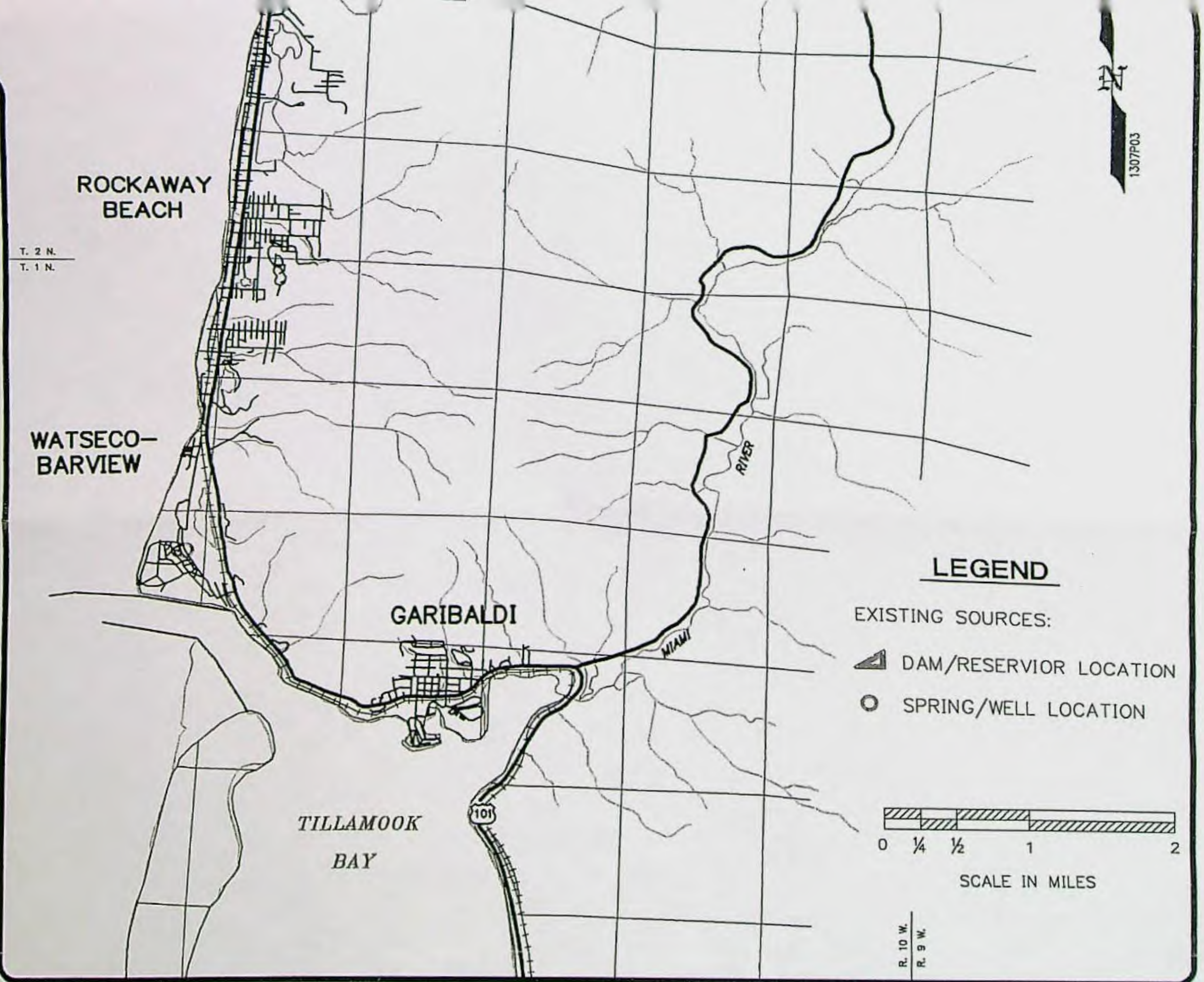
DWG TITLE:
N. TILLAMOOK CO. REGIONAL WATER STUDY
LOCATION OF EXISTING SOURCES

LEE ENGINEERING, INC.
1300 JOHN ADAMS ST.
OREGON CITY, OR, 97045

JAN '93
JAN '93
JAN '93
1307P03

REVISED:

FIGURE 3.1



CHAPTER 4

CHAPTER 4

PLANNING CRITERIA

4.1 WATER DEMAND PROJECTIONS

4.1.1 WATER USE CHARACTERISTICS

Most of the community water systems read master meters on a daily basis. However, some read weekly and others read monthly. The information that was provided was reviewed and analyzed to try to predict water use characteristics and trends, daily and seasonally. Daily readings were provided by Nehalem. Most of the other water systems provided information on a monthly basis, similar to the information submitted to the Health Division and Water Resources Department. Many of the systems show marked seasonal trends in water use caused primarily from recreational impacts during the summer months. Few of the systems show any significant impact of water use resulting from industry or yard and landscape irrigation.

Water use information from Neahkahnie is somewhat incomplete since master meters have only recently been installed and are read manually. Manzanita has detailed monthly records, but provided insufficient information to analyze their peak day or peak hourly demands. In general, Manzanita's water use, on a monthly average, indicates variations in water use being minimal in the fall, winter and spring months and peaking in July and August. Water use variations from 1989 to 1992 go from as low as 100,000 gpd in February of 1992 to a high of about 280,000 gpd in August of 1990. See Figure 4.1.

Water use at Nehalem Bay State Park varies widely, as one would expect. Their average peak use is about 24,000 gpd during July and August and as low as 2,000 gpd during December. Peak day use in July and August is not known, but undoubtedly exceeds 46,000 gpd.

Water use in the City of Nehalem is similar to that in Manzanita. Water use varies from a low of 120,000 gpd in April of 1990 and has been as high as 210,000 gpd in August of 1990. See Figure 4.2.

A review of the information from Tideland and the City of Wheeler indicates that these two jurisdictions do not experience the impact of summer recreation as do other users. For example, Wheeler's variation in water use during 1992 shows average daily use varying from 100,000 to 130,000 gpd. Their summertime use increases only approximately 30,000 gpd versus their wintertime use. See Figure 4.3. This trend in part is also related to the available water in the two drainage basins. In other words, the summer demand may be higher if sufficient water was available.

Flows in Rockaway Beach vary significantly, based on summertime use, which is more than twice average wintertime use, going from approximately 400,000 gpd in the winter to over a million gpd during peak summer events.

Table 4.1 tabulates information on the existing and proposed future demands for the year 2010 and 2050. Average daily demand and peak day demand projections are both shown. For the 10 existing water systems, average day and peak day demands are shown to be about 1.2 million gpd and 3.0 million gpd in the year 2010, respectively, and approximately 1.4 and 3.6 million gpd by the year 2050, respectively.

4.1.2 WATER LOSS AND LEAKAGE

A review of the various projections and historical data concerning water loss and leakage shows that most systems appear to be relatively free of major leaks. The City of Wheeler had considerable water loss during 1990, but has recently replaced several old wood stave pipes which has significantly reduced their water consumption. Also, the City of Nehalem frequently experiences water leaks but because of their daily review of water use, they normally repair leaks as they occur. No significant reduction in water use is anticipated with additional improvements in replacing old and worn out pipes. Some reduction will occur, but it is not expected to be significant.

4.1.3 PEAKING FACTORS

Peaking factors vary widely from a low of about 1.7 at Watseco-Barview to a high of about 2.5 for Rockaway Beach. The average peaking factor used in projecting ultimate peak day demands are shown in the tabulations at the bottom of the system schematics, Figure 6.1.

Peaking factors were determined, where possible, by analyzing the peak day demand with the average annual demand for each water system. It is assumed that existing reservoir capacity will accommodate the peak hour demand which is higher than the peak day demand. However, future water supply systems should be capable of meeting peak day demand without major reliance on in-system storage, which should be reserved to meet peak hour demands, fire flows, and emergencies.

4.1.4 FIRE FLOW REQUIREMENTS

Fire flow requirements are taken from the Insurance Services Office "Fire Suppression Rating Schedule," Edition 6-80. Section 604 FIREFLOW AND DURATION reads that: "The fire flow duration should be two hours for needed fire flows up to 2,500 gpm and three hours for needed fire flows of 3,500 gpm." Requirements for needed fire flows are shown in Section 304 of the schedule. Needed fire flows vary from 500 gpm where building spacings exceed 100 feet to as much as 1,500 gpm that are spaced 10 feet or closer together. These figures are for single-family and multiple-family dwellings. For larger structures such as schools, hospitals, motels, and other commercial establishments, fire flow requirements can be considerably greater, approaching 3,500 gpm maximum for other occupied buildings. For some schools and other structures, needed fire flows can be considerably higher, approaching 5,000 gpm.

For purposes of this report, it is assumed that fire flows would be met by the capacity of the in-system storage and distribution network of each individual system. Credit can be given for the regional water supply to the volume available in the pipe distribution system. In addition, it is recommended that some storage be provided in the regional supply for emergency purposes which could be used in part for meeting required fire flows. This available flow from the transmission pipeline can reduce the total required volume of storage within the distribution networks. This volume reduction in storage should be credited against the cost of the regional water supply to appropriately review the net cost of the regional water system. However, to the extent that existing supply sources also are credited against required distribution storage, the net flow difference between the capacity of the regional water supply and the existing minimum flow in each source should be the volume used in the credit analysis.

4.1.5 REGIONAL WATER SUPPLY STORAGE

The regional water supply source should have sufficient storage to meet the requirements for CT, backwashing of filters, and emergency storage. Emergency storage should be sized to at least account for power outages and the time necessary to fix major repairs such as broken mains, failed pumps, and other emergency situations. It is recommended that a minimum of storage volume be provided equivalent to the peak day demand estimated for the year 2010 plus CT and backwash water requirements.

4.1.6 CONSERVATION

Conservation means, according to ORS 537.455, the reduction of the amount of water consumed or irretrievably lost in the process of satisfying an existing beneficial use achieved either by improving the technology or method for diverting, transporting, applying or recovering the water or by implementing other approved conservation measures. In general, the Oregon Legislative Assembly declared that the policy of the State of Oregon is to: (a) aggressively promote conservation; and (b) encourage the highest and best use of water by allowing the sale or lease of the right to the use of conserved water. In general, all existing water rights holders and future water rights applications must have a conservation plan. Each of the existing water users, if they continue to operate independently, can anticipate the need to develop a conservation plan. The plan will need to address such issues as lost water, unaccounted-for water, revisions to building codes to encourage use of water conservation fixtures, retrofitting existing fixtures with water conservation apparatus such as flow volume restricters, and other matters.

Although conservation will be required to some extent, it is not anticipated that significant results will accrue in the study area. About half of the water consumption will be related to recreational use. Users of motels, campsites, and other recreation facilities are not likely to voluntarily reduce their water consumption. Rather, water consumption will more likely be reduced by providing such devices as shower flow restricters, toilets with revised flow control, and other features.

Other means to reduce water use can involve water rate structures which penalize customers for use of high volumes of water during critical months of the year. However, recent studies by the City of Portland and others indicate that the probable reduction of future demands can only be affected by approximately 10% to 15% of existing demands. For purposes of this report, it is not assumed that conservation will have a major impact on the size and capacity of a regional water supply. Rather, the impact will be on the average daily use, which may in turn affect the rates for each unit of volume of water used by the customers. It will take some time to implement any conservation measures within the study area. Once measures are implemented, it will take more time before the conservation effort results in water use reduction. The end result will be an extension of the time frame in which future expansion may be needed to the supply system.

4.2 COST ESTIMATING PROCEDURES

4.2.1 GENERAL

In determining the capital cost for each of the various possible projects, very generalized cost estimating was used. No attempt was made to develop the project to a level of preliminary engineering. Preliminary designs are beyond the scope of this report. Rather, standard cost guidelines were used when they were appropriate. In some cases, information was taken from similar projects in the Northwest Oregon region.

Since the engineer has no control over the cost of labor, materials, equipment or services furnished by others or the future contractor's methods for determining prices or competitive bidding or marketing conditions, the engineer's opinion of probable "total project cost and construction cost" provided herein is made on the basis of the engineer's experience and qualifications and represents the engineer's best judgment as an experienced and qualified professional engineer familiar with the construction industry as it relates to water system improvements. The engineer cannot and does not guarantee that proposals, bids, or actual total project or construction costs will not vary from the opinions of probable cost prepared herein. It is strongly recommended that before major financing for any of these projects is implemented, a more detailed preliminary engineering study be undertaken.

Cost estimates for capital improvement programs are presented as project costs consisting of estimated construction costs, property costs, and allowances to cover for the cost of engineering, contingencies and administration.

Since construction costs vary with time and local economic conditions, a method of indexing current construction costs to future construction costs may be necessary. For purposes of this report, the index used is the Engineering News Record's "Construction Cost Index." This index monitors material and labor cost in specific markets and is generally tabulated in the Engineering News Record periodical on a weekly basis. In this report, it is assumed that the Construction Cost Index is approximately 5,100. This index relates to the cost of construction anticipated in June, 1993. For future estimates of cost, the index at that time, actual or projected, can be divided by the Construction Cost Index of 5,100 to estimate a multiplier to which future costs can be approximated. For example, if a Construction Cost Index is projected at time of construction to be about 6,000, then the costs herein should be multiplied by the ratio of 6,000 divided by 5,100, or 1.18, to project estimated future costs.

It is acknowledged that the use of the Construction Cost Index does not necessarily apply to the specific projects outlined herein. Other indexes published by the Environmental Protection Agency and by McGraw-Hill Publishing Company can better predict cost variations with time by using appropriate indexes for treatment plants, pipelines, concrete or steel construction, specific labor markets, etc. However, such approaches are time consuming and beyond the scope of this report. Rather, the more generalized ENR Construction Cost Index has been used.

4.2.2 PIPELINE COSTS

Costs for pipelines have been estimated on a lineal foot basis. Cost estimates have been developed from historical records of previous pipeline construction projects in Northwest Oregon. The cost per foot includes trench excavation and backfill, furnishing and installing pipelines, fittings, valves and other appurtenances, surface restoration consisting of native backfill and/or asphalt replacement as appropriate, allowances for engineering, and contractor's expenses related to profit and overhead. The summary of the estimates for various sizes of pipes ranging from 4" through 42" is shown in Figure 4.4.

It is assumed that all the pipelines will be constructed within highway and County road rights-of-way and will be constructed, for the most part, within shoulder areas.

4.2.3 RESERVOIR COSTS

Several types of construction are possible for in-system storage. They include prestressed concrete reservoirs, reinforced concrete reservoirs, and ground level steel reservoirs. Foundation preparation, the distance between the transmission main and the reservoir site, subsurface soil conditions, aesthetic considerations, and other factors affect the cost of reservoirs.

For the North Tillamook County Regional Water Supply, it is anticipated that the reservoir will be constructed of steel above grade. However, in the final design analysis, consideration should be given to buried concrete structures which resist earthquakes with little or no structural damage. Primary damage occurring from major earthquakes has to do with superstructures, pipelines and mechanical equipment more than with buried structures. Therefore, the additional cost of a buried concrete reservoir may be justified, depending upon the characteristics of the site and anticipated earthquake intensities.

Reservoirs can be constructed on grade at the proposed water source site or elevated tanks can be constructed on the hillsides south or east of Mohler. A ground level storage tank at the source site will require repumping of well or river water. If this option is selected, standby pumping facilities should be provided so that water can be pumped during periods of lost power. If elevated sites are used, then no additional pumping would be required beyond that which causes a rise in the hydraulic grade line at the source site.

For purposes of comparison, total project cost estimates for the various sizes and types of construction of reservoir are shown on Figure 4.5. Curves for the cost projections for prestressed concrete tanks and ground level steel reservoirs are shown. In general, steel reservoirs have a lower first cost, but are more difficult to design for resistance to earthquakes and have a lower service life. Concrete reservoirs generally are anticipated to have a 100 year service life. Steel reservoirs have a service life in the range of 50 to 60 years. At the end of the service life, the reservoirs will need major rehabilitation and/or replacement.

There is also concern for corrosion protection. For proposed water from the Nehalem River, concrete reservoirs resist corrosion without protective coatings and/or cathodic protection. Steel reservoirs, on the contrary, will need extensive coatings and recoatings on about 10-year cycles and/or cathodic protection on the interior surface. Adjustment in water chemistry to comply with the Lead/Copper Rule may minimize the concern.

4.2.4 COST ESTIMATES FOR GROUNDWATER DEVELOPMENT

At least three options exist for the development of groundwater in the North Tillamook County area. They are the development of vertical wells in the gravel alluvium along the Nehalem River, the development of Ranney Collectors, which are horizontal wells in the same location, or the development of water from sand dunes within the Nehalem Bay State Park, near the existing Rockaway Beach wells south of the South Jetty of Nehalem Bay, and near the existing well for Watseco-Barview near Barview County Park. Other areas within sand dunes along Rockaway Beach may also be possible. However, each of these options have risk and certainty of development cannot be known without further study. However, for purposes of future comparison, cost estimates for these various alternatives have been developed. The cost to develop vertical wells depends upon the depth of the well and well yield. Information has been collected from various sources, including wells drilled in Tillamook. It is anticipated that the average well yield for vertical wells will range from about 200 gpm up to 1,000 gpm. The yield will be dependent upon the particular gravel formations which are encountered. It is assumed that the wells would be constructed along the Nehalem River near River Mile 9.

If well water requires treatment for removal of volatile organic chemicals (VOC's) such as trichloroethylenes or tetrachloroethylenes, then additional costs would be incurred. To remove these constituents, it is anticipated that air stripping will be required of the volatile organic chemicals. Additional costs of approximately \$350,000 to \$400,000 per well would be required. In addition, annual operation and maintenance costs would be another \$200,000 per well. This could amount to approximately \$.25 per 1,000 gallons of water produced from the well in addition to the other costs of well development and well pumping. (Reference: EPA/625/4-89/023, p. 120)

A potential for developing groundwater through a Ranney collector is projected to be high. However, before this option can be developed at least four phases of additional investigation will be necessary. Those four phases include a study of the general geologic data and superficial examination of the proposed sites, test wells, analysis of pump testing information, and finally, an analysis of the cost of the proposed Ranney collectors versus other treatment or water source options. Before proceeding with further analysis of the Ranney collector option, the option for developing vertical wells should be pursued.

Development of wells in the sand dunes is likely to be available to primarily meet the high summer demands. Water available from the sand dunes is primarily water which percolates through the sands during the winter and spring months. Analysis of existing water within available areas indicates high concentrations of iron which will probably require treatment for removal. Cost estimates for development of water from the sand dunes includes the development of the well plus treatment of well water to remove iron at concentrations of from .3 to as high as 30 ppm.

4.2.5 SURFACE WATER TREATMENT

Treatment of surface waters from the Nehalem River will likely require conventional treatment plus provisions to eliminate concerns about disinfection byproducts and to adjust water chemistry so that the water supply is in conformance with the Lead and Copper Rule. Conventional water treatment includes processes of chemical addition, coagulation, flocculation, sedimentation, filtration and disinfection.

Costs for conventional water treatment were developed from various technical sources. They include "Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities," EPA/4-89/023. Additional information was taken from "Estimated Cost of Treatment Plant Construction," Syed R. Quasim, et al., American Water Works Journal, August, 1992 and from an analysis of existing or proposed future treatment plants along the northern Oregon coast. A graph of anticipated project costs for water treatment plants at various capacities was developed and is shown in Figure 4.6.

A potential exists to reduce the capital cost of surface water treatment by using direct filtration in lieu of conventional treatment. Savings of 20% to 40% of estimated costs are possible. However, pilot studies will be needed prior to final design to justify this option. The Health Division must be involved in the pilot plant protocol and in approving direct filtration.

4.3 OPERATION AND MAINTENANCE COST ESTIMATES

Cost estimates to analyze the cost of operation and maintenance are based on data which has been documented in various EPA manuals, the actual experience of operating and maintaining water treatment plants in Oregon, and on the Engineer's judgment. For operation and maintenance of package treatment plants, EPA guidelines were heavily relied upon. For the operation and maintenance of pumping stations, pipelines, and reservoirs, a typical value of 0.5% of capitalized costs of long lived components such as pipelines and concrete was assumed. Three percent of capitalized costs were assumed for pumps and mechanical equipment. The actual costs of power as published by Tillamook P.U.D. was used for power costs. For labor, it was assumed that the various operators will be certified according to the requirements of Oregon Administrative Rule and that salaries will generally range between $20,000 and $30,000 per year plus an allowance of 40% for direct salary overhead. It is also assumed that because of the requirements for vacations, holidays, sick leave, training and other factors, that the effective utilization of any employee is approximately 1,600 hours per year.

Package plant operation is simplified by automated features, and maintenance requirements and costs are well documented in the manuals. Common automated devices found in package plants include effluent turbidimeters and chemical feed controls. These devices are assumed to be built into the various future plants to ensure that the finished water does not exceed the required turbidity levels. Automated chemical feed systems are to be provided so that the plants can operate without full time operators, but it is assumed that operation will occur at least 8 hours for each day.

According to extensive manufacturer evaluations, system performance in general is improving because of better equipment, more highly skilled operators, and greater surveillance by the regulatory officials. The EPA manual entitled "Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities" contains the summary results of package plants at Corvallis, Rainier, and Newport, Oregon. Cost estimates have also been developed for these operations and others in the Pacific Northwest and across the country. Operation and maintenance costs for package treatment plants range from about \$.52 to a high of about \$9.44 per 1,000 gallons, calculated in 1978 dollars. These costs were upgraded using Engineering News Record and EPA indexes to provide estimates for operation and maintenance of package plants in 1993 dollars. Curves were developed representing the unit cost of operation and maintenance per 1,000 gallons of water produced based on the average annual estimate of water production for each plant.

See Figure 4.7.

In addition, average unit cost of production in dollars per 1,000 gallons versus average daily production, including the cost of capital amortised at 8% and 6-1/2% interest rates was also prepared. See Figure 4.8. These figures were used where estimates for annual operation and maintenance expenses are necessary to operate proposed package treatment plants.

4.4 DEVELOPMENT OF ISSUES LIST

A preliminary list of major issues was developed by the consultants based on anticipation of future environmental, social, engineering and legal issues. See Table 4.2. The issues address problems and concerns that may be encountered during the technical, public, legal and permitting reviews required for future development of one or more of the water source options. The preliminary issues were not incorporated in the final development of alternatives. However, where obvious concerns exist and where, in the judgment of the engineer, such issues may be insurmountable, the issues would play a major impact on the final selection of alternatives. Therefore, where issues such as availability of stream flow information and/or projected stream flow quantities would jeopardize future water needs, such information would obviously dictate that such alternative source not be considered.

It is recommended that the list developed be further reviewed by the Water Resource Committee and that these issues be addressed in a formal fashion through development of ranking criteria, public information programs, and other action as the committee might develop.

Many of the issues and final evaluation of the concerns are beyond the scope of this report. Additional research and effort will be necessary to adequately address them. The primary emphasis herein is to address engineering concerns, but at the same time where major environmental, social or institutional concerns exist with options, they were taken into consideration in the final engineering analysis.

TABLE 4.1
N. TILLAMOOK CO. REGIONAL WATER SUPPLY MASTER PLAN
ESTIMATED PEAK WATER DEMAND PROJECTIONS - YEARS 2010 AND 2050

Jurisdiction	No. Services in 1992	Ave. Demand 1992 (GPD)	Demand per Service	Estimated Values for 2010			Estimated Values for 2050		
				Services	Average Demand (GPD)	Peak Demand (GPD)	Services	Average Demand (GPD)	Peak Demand (GPD)
Ne'ah-kah-nie	225	54,000	240	281	67,500	168,750	340	81,540	203,850
Manzanita (UGB)*	1002	162,300	162	1,253	202,875	507,187	1,513	245,073	612,682
Nehalem Bay (Park)	302	24,000	79	378	30,000	75,000	456	36,240	90,600
Nehalem (UGB)*	450	135,100	300	563	168,875	422,188	680	204,001	510,003
Tideland Wat. Corp	20	24,500	1,225	25	30,625	76,563	30	36,995	92,488
Zaddack Creek	10	2,400	240	13	3,000	7,500	15	3,624	9,060
Wheeler (UGB)*	175	73,560	420	219	91,950	229,875	264	111,076	277,689
Brighton	12	3,000	250	15	3,750	9,375	18	4,530	11,325
Rockaway Beach (UGB)	1660	445,000	268	2,075	556,250	1,390,625	2,507	671,950	1,679,875
Watseco/Barview	129	24,945	193	161	31,181	77,953	195	37,667	94,167
TOTAL	3,985	948,805		4,981	1,186,006	2,965,016	6,017	1,432,696	3,581,739

UGB* URGAN GROWTH BOUNDARY OR SERVIVE AREA, NOT JUST EXISTING CITY LIMITS.

1307WR2

TABLE 4.2

ISSUES LIST - EVALUATION CONCERNS

ENVIRONMENTAL PROTECTION

A. Fish, reptiles, amphibians, wildlife, and aquatic resources
B. Protection of wetlands
C. Protection of sensitive, threatened, or endangered species and their habitats
D. Water quality
E. Stream flows

SOCIAL

A. Protection of recreation uses
B. Protection of aesthetic resources
C. Conservation of resources
D. Land use compatibility
E. Protection of historic and cultural resources
F. Avoidance of conflicting uses
G. Avoidance of excessively controversial or unacceptable options

ENGINEERING

A. Reliability of supply
B. Minimize operation and maintenance
C. Reasonable water rates
D. Safe potable water
E. Avoidance of hazards - earthquakes and hazardous wastes
F. Avoidance of wetlands
G. Impacts on current users
H. Availability of surface water and groundwater
I. Efficient delivery systems
J. Engineering flexibility
K. Innovation, such as new technologies for source development or storage
L. Watershed or well head protection from contamination

INSTITUTIONAL/LEGAL

A. Water rights
B. Regional planning and management of water
C. Coordination between providers and local government
D. Instream water rights
E. Consistency with land use
F. Avoidance of designated scenic rivers
G. Cooperative development of sources
H. Compliance with regulations

FIGURE 4.1
CITY OF MANZANITA
AVERAGE MONTHLY WATER USAGE

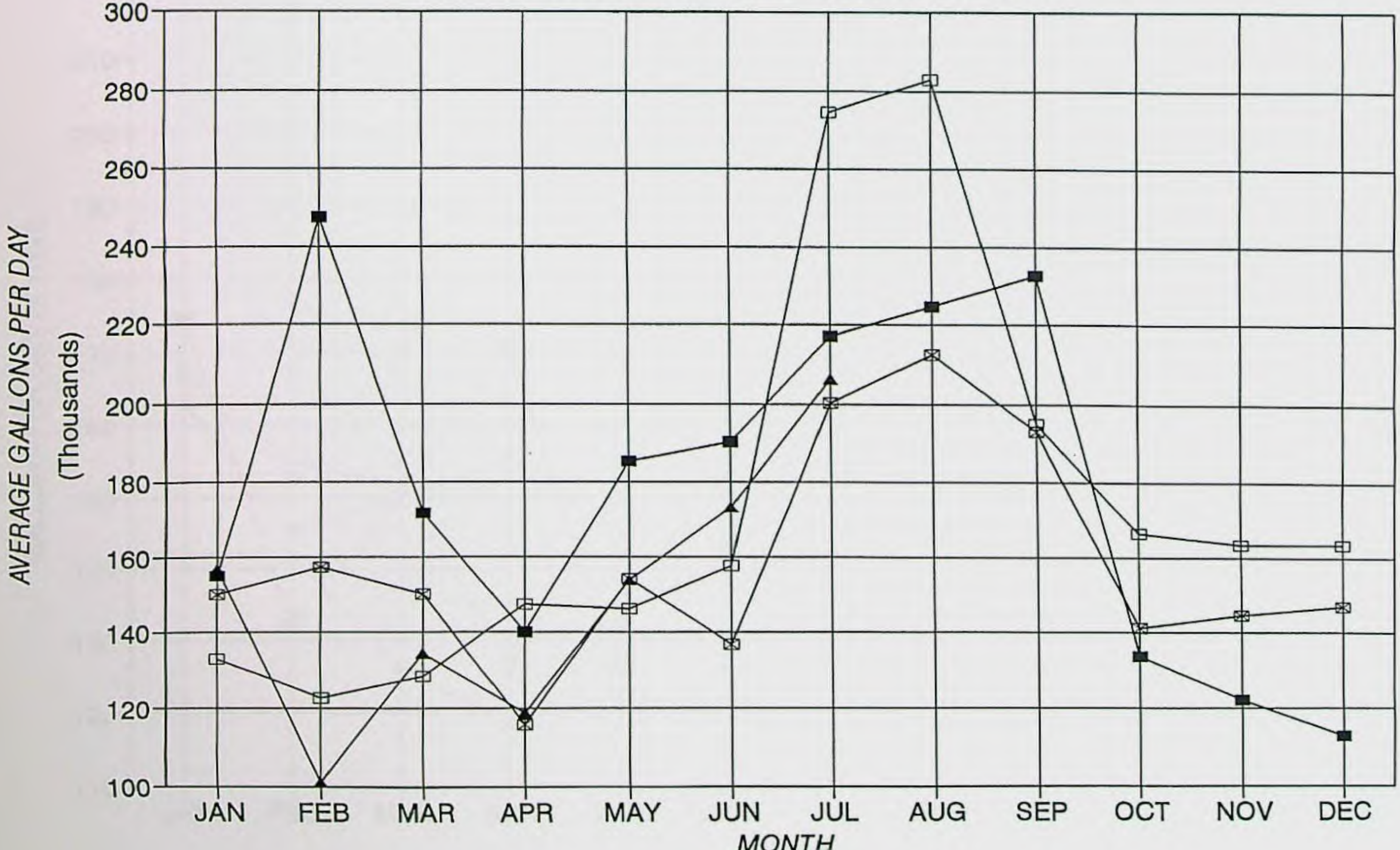


FIGURE 4.2
CITY OF NEHALEM
METERED WATER PRODUCTION SUMMARY

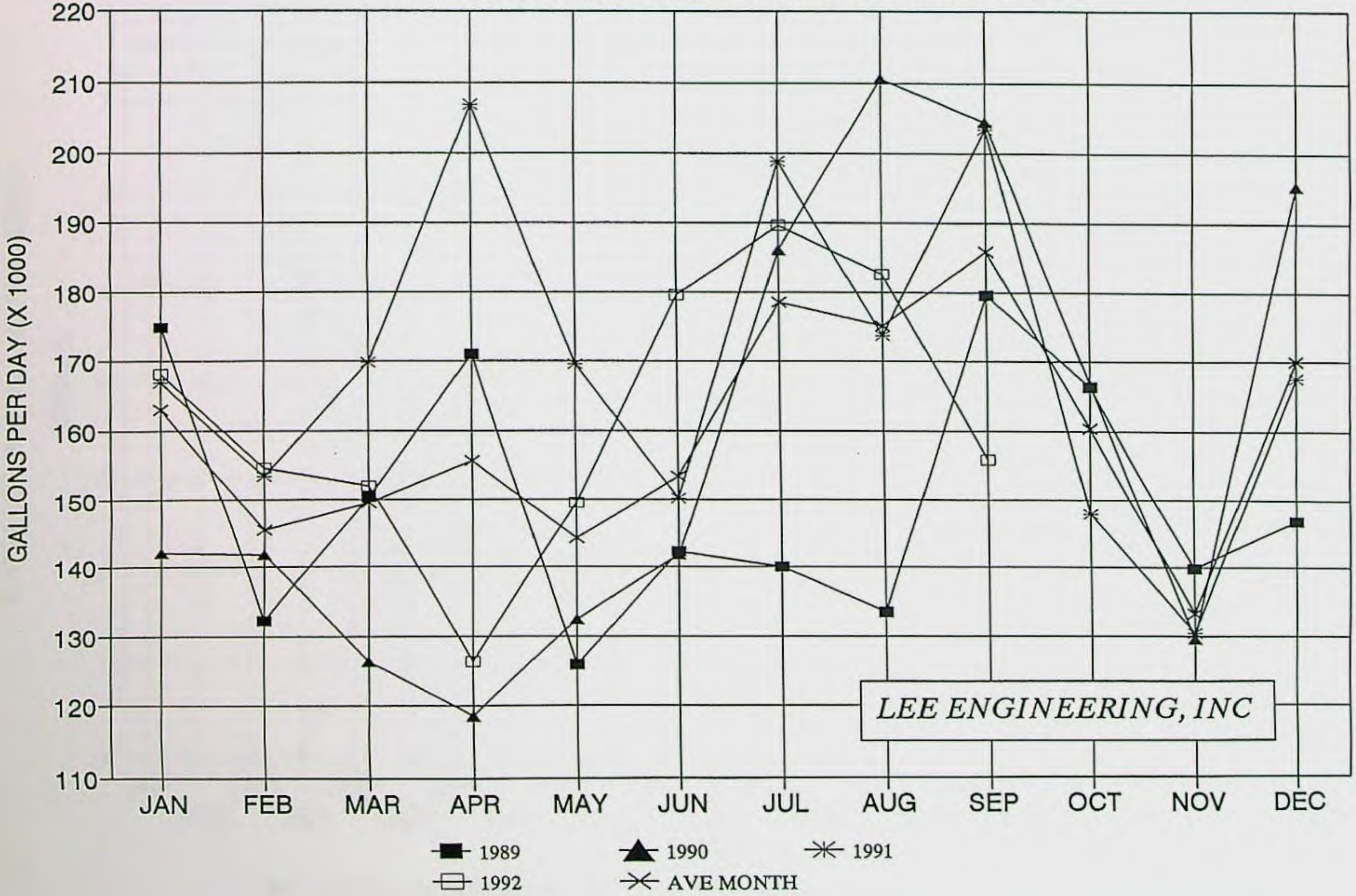


FIGURE 4.3
CITY OF WHEELER
METERED WATER PRODUCTION SUMMARY

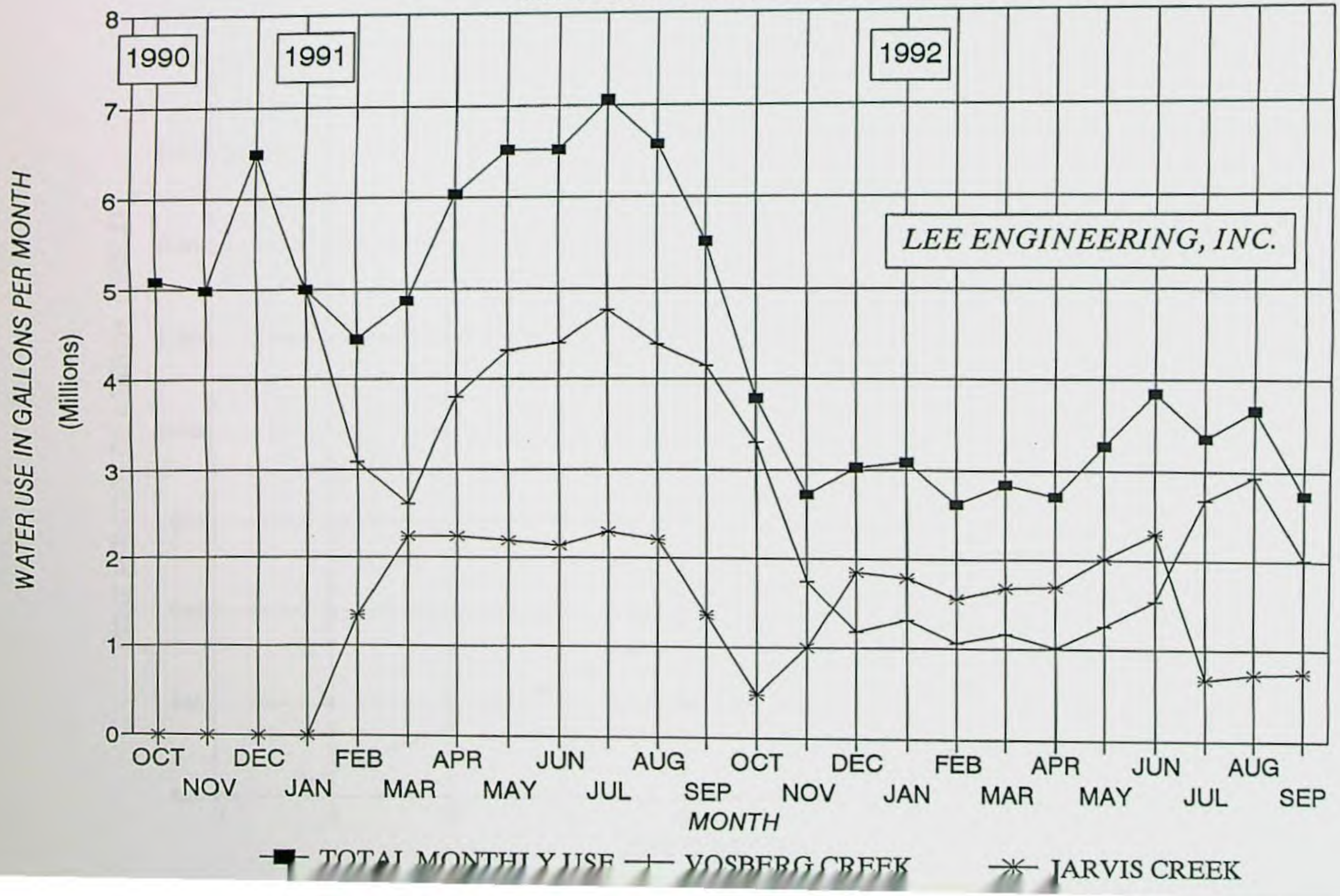


FIGURE 4.4
WATERLINE COST ESTIMATE PER FOOT OF LENGTH

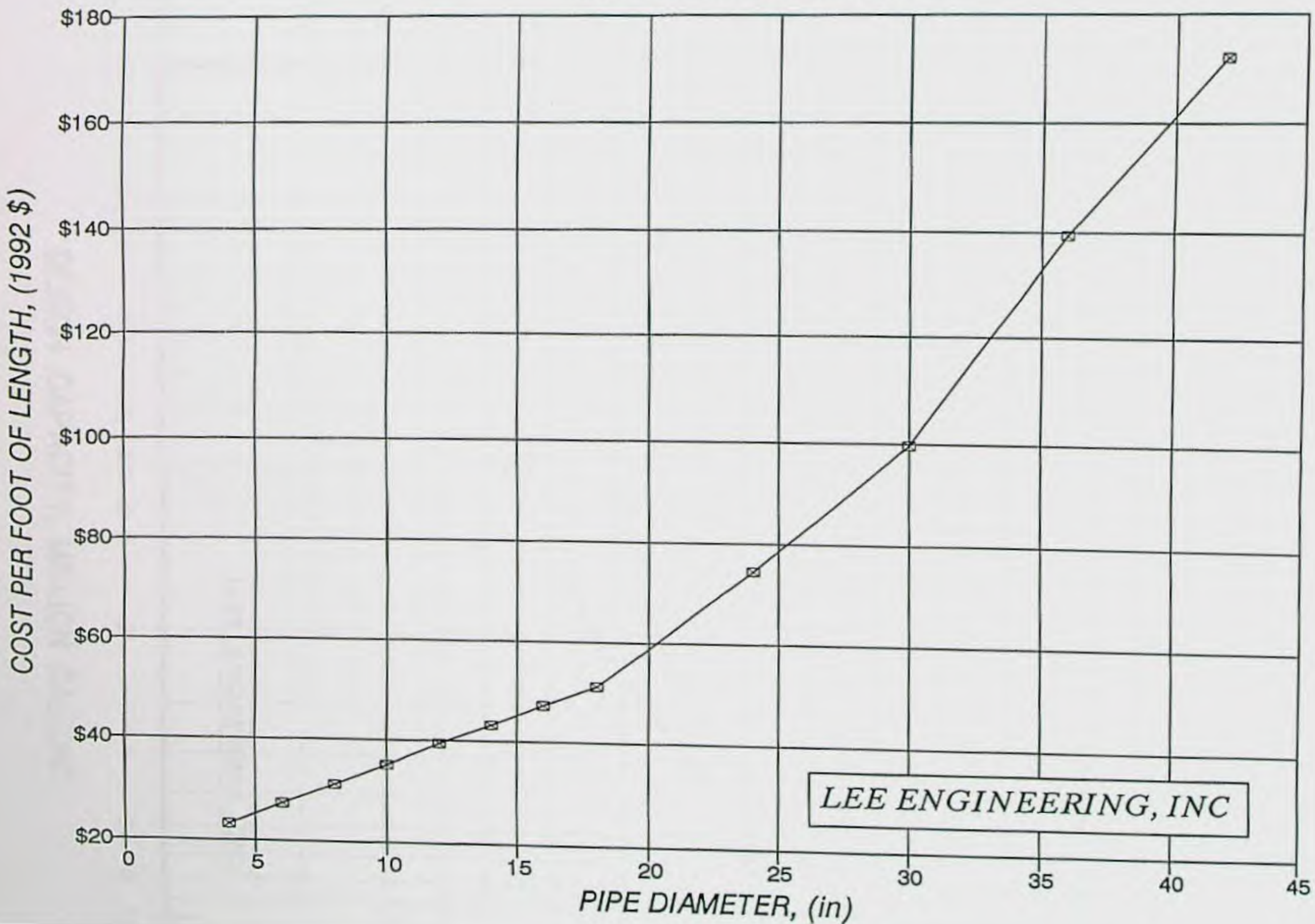
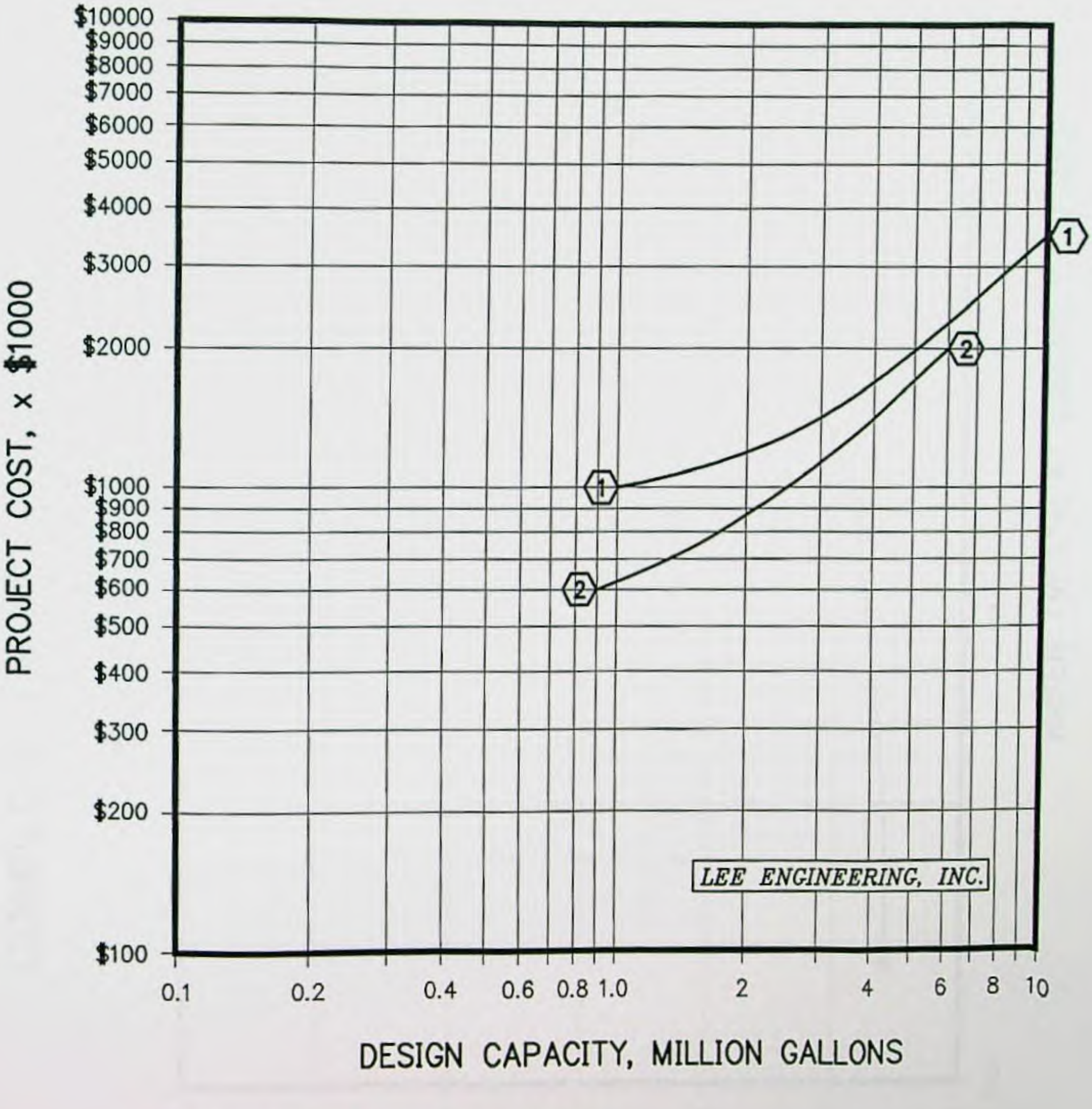


FIGURE 4.5

RESERVOIR PROJECT COST VS. DESIGN CAPACITY



(1) PRESTRESSED CONCRETE RESERVOIR

(2) GROUND LEVEL STEEL RESERVOIR

FIGURE 4.6

COMPLETE TREATMENT CAPITAL COST ESTIMATE VS. TREATMENT CAPACITY IN MGD

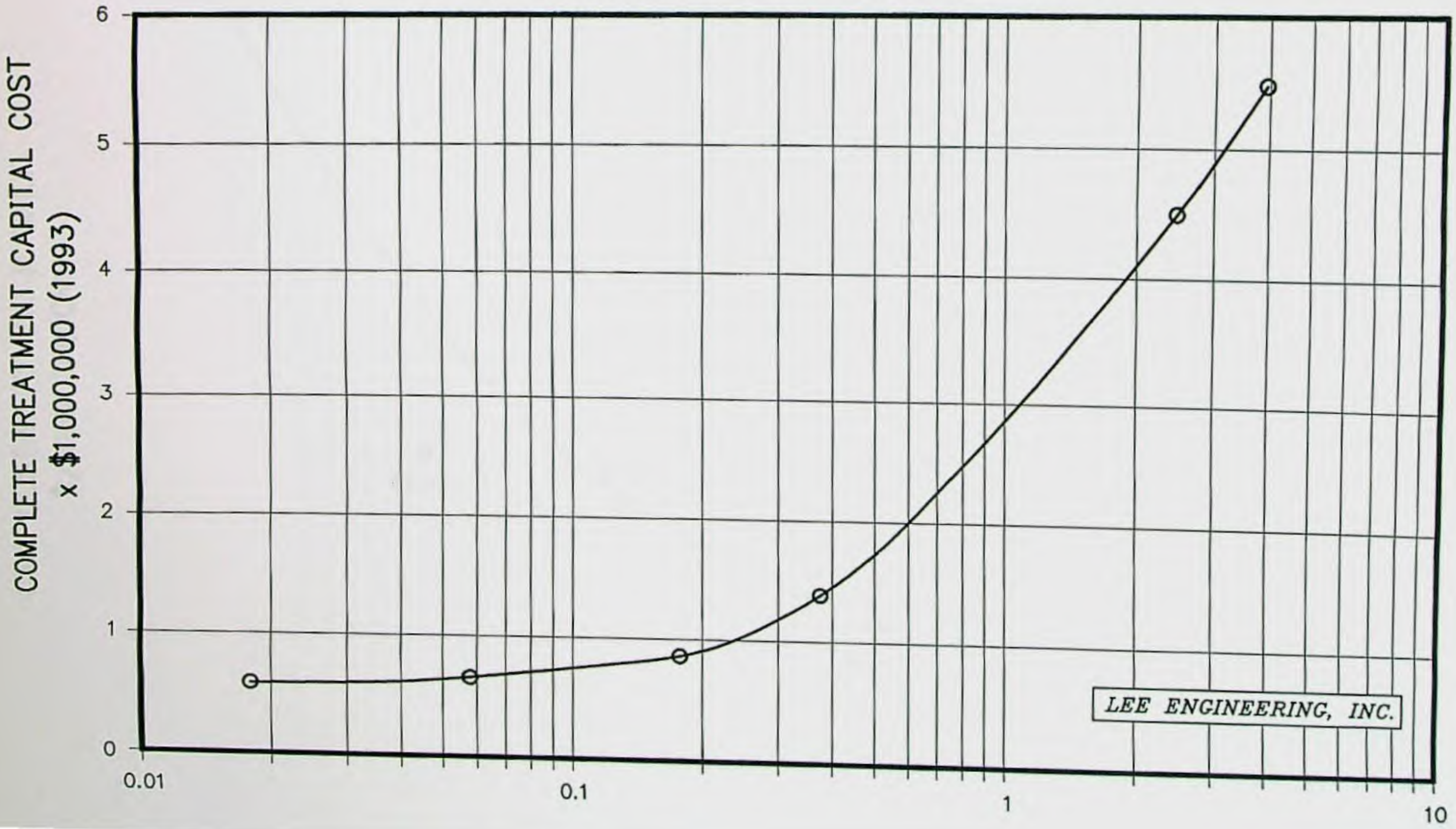


FIGURE 4.7

AVERAGE ANNUAL PRODUCTION
VS.
COST OF O AND M

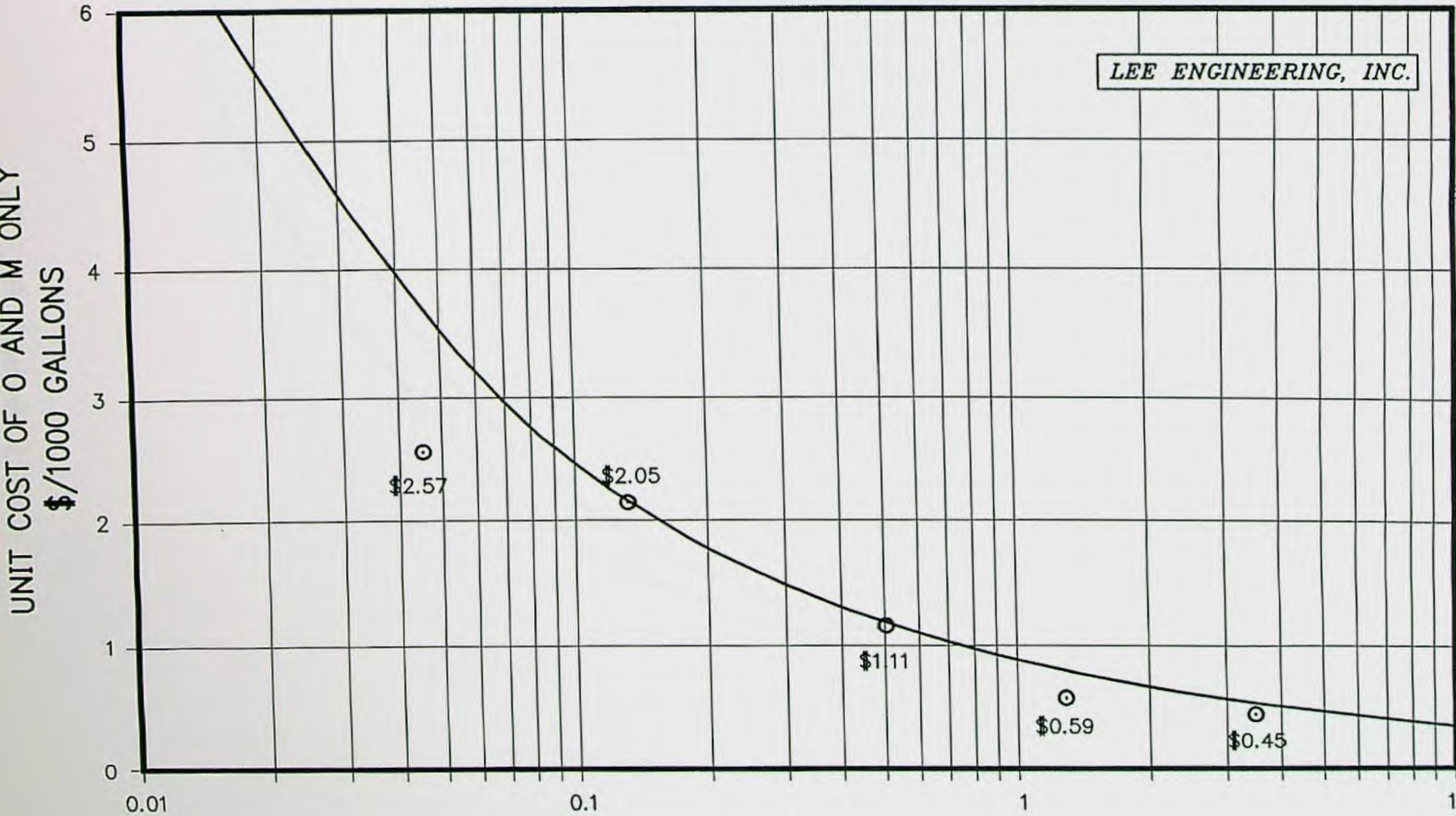
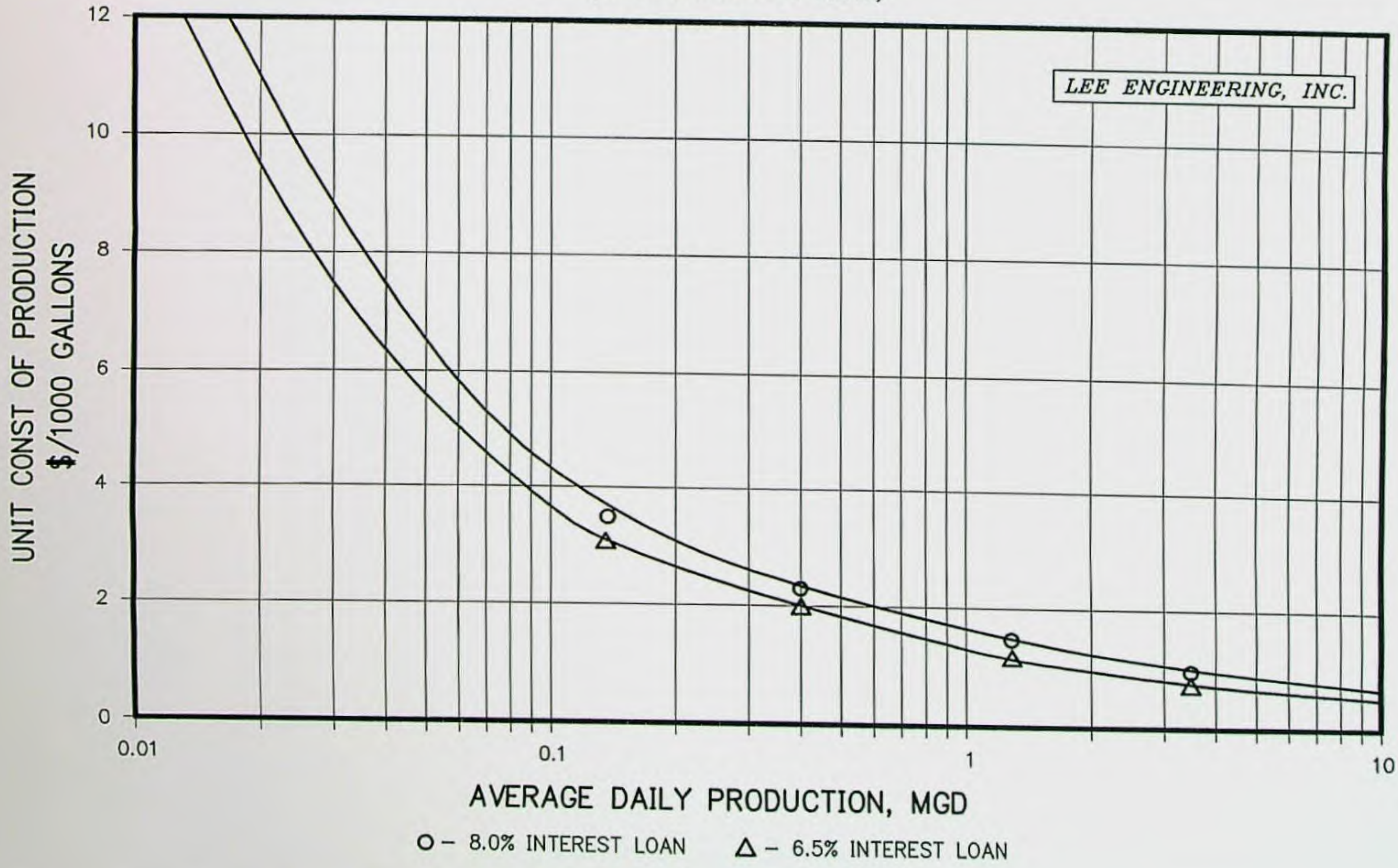


FIGURE 4.8
AVERAGE DAILY PRODUCTION
VS.
COST OF PRODUCTION
(INCLUDING CAPITOL COSTS)



CHAPTER 5

CHAPTER 5

DESCRIPTION OF WATER SOURCE AND TREATMENT OPTIONS

The list of new source options was created by considering general criteria such as hydrologic conditions, water quality, and distance to existing water users. Consideration of these general concepts helped to define the source options and provided the initial listing of sources to be evaluated.

Hydrologic conditions deal with the capacity of the source to meet ultimate demands. Watersheds should be large enough in size to provide significant runoff during low stream flow periods to provide domestic water as well as added reserves to protect downstream environments, particularly fish and wildlife habitats.

Water quality and the ability to treat the water source to meet drinking water quality standards is of the utmost concern. Lesser treatment requirements can correspond to a lower annualized cost for development of the water source.

Delivery of water from long distances requires considerable investment in conveyance or piping systems. The cost to convey water along the 12-mile reach of the coast within the study area is a major part of the cost of the regional system. The closer the source is to the center of the demand area, the less expensive the conveyance is likely to be.

5.1 DESCRIPTION OF WATER SOURCE OPTIONS

5.1.1 OPTION 1 - EXISTING SOURCES

Existing water sources include a combination of surface waters, springs and wells. These sources are described more fully in Chapter 3. In some cases, the existing sources may be combined with a part of the regional source. However, most of the existing sources do not have adequate treatment to meet the Safe Drinking Water Act requirements. Each of the sources do not currently meet the capacity needs of the present systems, let alone the needs of a regional supply.

The major advantage for the continued use of the existing supplies is the relatively small size of the interconnecting pipelines between the various users and an auxiliary regional supply.

The main disadvantage would be that the supplies will need to be improved with regard to meeting water quality criteria, therefore requiring several different treatment plants. Operation of several plants will require more manpower and will likely be less efficient and reliable.

5.1.2 JETTY CREEK

Jetty Creek currently supplies the Rockaway Beach area. It is treated through a package treatment plant including flocculation, sedimentation, filtration and disinfection.

The primary advantage of the Jetty Creek supply is that it currently exists and the treatment plant is in good shape and functioning in conformance with current regulations. The Jetty Creek could continue to provide water to Rockaway Beach and the general area up to a capacity of 1 mgd (700 gpm).

The main disadvantage of Jetty Creek is that the minimum stream flows during dry weather periods have been measured at about 360 gpm. This capacity is not sufficient to serve Rockaway Beach or the region. Also, existing water rights are limited and Jetty Creek's drainage is within the reserve of a private timber holding. Continued administration of the license agreement would need to be maintained.

5.1.3 COAL CREEK

Coal Creek is a small drainage north of Nehalem and is a tributary to the North Fork of the Nehalem River. No stream flow information exists on minimum stream flows. However, calculations of the drainage area indicate that the minimum stream flows probably do not exceed 700 gpm. This capacity is also not sufficient to meet the needs of the region.

The primary advantage of Coal Creek is its close proximity to the City of Nehalem and the existing pipeline network extended by Nehalem in anticipation of developing this as its future source of supply.

The main disadvantage of this source is its low yield and potential environmental problems associated with: maintaining downstream water quality; water temperatures; aquatic life; drainage of adjoining wetlands during low stream flow periods; interruption of aquatic growth along the stream; fish and wildlife concerns; and many other factors. Environmental concerns may preclude this source from being a future water source for Nehalem and the region as a whole.

5.1.4 ROY CREEK

Roy Creek is a tributary to the Nehalem River about one mile upstream from Mohler. A quick review of Roy Creek indicates that the drainage area is insufficient to provide adequate flows during minimum stream flow periods to meet the region's needs. Therefore, no future consideration is given to Roy Creek.

5.1.5 FOLEY CREEK

Foley Creek is also a tributary to the Nehalem River, draining from the south and connecting to the Nehalem River at River Mile 7.4. The relatively low summertime stream flows and a significant amount of development along Foley Creek give concern about possible pollution of the creek with high concentrations of coliform and other potential contaminants from failed septic tanks, farming and logging operations. Diversion of water from Foley Creek could also create significant impacts on the environment. For these and other reasons, further consideration of Foley Creek is not recommended.

5.1.6 MIAMI RIVER - GARIBALDI

The Miami River is a tributary to Tillamook Bay approximately one mile upstream from the City of Garibaldi. Garibaldi currently has a well tapped into the alluvium of the Miami River. However, the well is relatively low yielding, approximately 250 gpm, and low stream flows on the Miami River are similar to those on Foley Creek. Sufficient water is not available to meet the region's needs and water quality problems are negatively impacted by existing development, farming and logging operations.

The Miami River has a drainage area of about 36 square miles. Assuming a yield of about 0.2 cfs per square mile, the minimum flow in the Miami River is expected to be about 7.2 cfs, or about 4.6 MGD. Again, the Miami River's flows are not sufficient without impoundment to meet the region's needs. Therefore, no future consideration is given to Miami River.

5.1.7 KILCHIS RIVER

The Kilchis River is a tributary to Tillamook Bay near Bay City, Oregon. Bay City and several other water systems obtain water from a well field about four miles east of U.S. Highway 101. The source of existing supply consists of two wells each with a capacity of approximately 600 gpm. The well water generally meets water quality except for iron and turbidity. Iron levels are about 0.7 ppm; whereas the recommended secondary contaminant level is about 0.3 ppm. Turbidity frequently exceeds 0.1 NTUs.

In order to use the Kilchis water for the North Tillamook County area, agreement would have to be entered into with Bay City, additional source capacity would have to be developed in the way of added wells and/or treatment, and a transmission pipeline would have to be constructed from the well water source through Bay City to the North Tillamook County area. Because of the long distance involved and well development and/or treatment is likely to be necessary, it is projected that such costs would be greater than developing similar sources along the Nehalem River. Also, in order to provide adequate pressures in the North Tillamook area, several booster stations would need to be constructed along the pipeline route.

Flows on the Kilchis River have been monitored to be as low as 13.4 cfs, or approximately 8.5 MGD. Since the North Tillamook region's water needs are about 9.2 MGD, ultimately, the Kilchis, without reservoir storage, is not sufficient to meet projected peak day demands. In addition, the development of water on the Kilchis including the drilling of wells or raw water intake, treatment, and transporting the water from Bay City would be considerably more expensive than other solutions. Therefore, no further consideration was given to the Kilchis.

5.1.8 NEHALEM RIVER

The Nehalem River discharges to Nehalem Bay. A significant amount of information exists on the various characteristics of the Nehalem drainage. The City of Portland has also considered the Nehalem River and a possible reservoir and diversion system on the upper reaches of the river about 10 miles upstream of Vernonia. However, Portland has discontinued further interest in the river since a major reservoir would need to be constructed and approximately 2,000 acres of existing farmland and forest land would be inundated.

Water discharge records are available on the Nehalem since October, 1939. The average discharge on the river has been about 2,670 cubic feet per second, or about 2 million acre feet per year. The minimum discharge in the Nehalem has been recorded at 36 cfs on August 29, 1967. More than adequate water exists through most of the year to serve the region's water needs. The minimum stream flows on the Nehalem River generally occur in September, well beyond the time when the region's maximum water needs occur.

Water quality information is also collected by the USGS on the lower reaches of the Nehalem River. Water quality data indicates that the water from the Nehalem meets water quality standards except for turbidity and coliform. A standard water treatment facility or possibly a direct filtration plant can effectively remove these constituents and provide safe, potable water supplies.

Water resources can be developed from the Nehalem River without significantly impacting fish, wildlife, other aquatic plants and animals, etc. Little if any impact will occur on wetlands and no significant impact is expected on aesthetic values. Therefore, the Nehalem River is sufficient to meet the long term needs of the region.

In addition to providing sufficient quantities of surface water, the potential exists for development of groundwater in the alluvium of the lower reaches of the Nehalem. Such potential water sources need to be located sufficiently above maximum head of tidewater to minimize the potential for drawing saltwater into the aquifer. It is possible that vertical wells could be installed along the Nehalem River at a location that would reduce or minimize iron which may exist in the alluvium. Iron bacteria typically grow in reaches of the alluvium where flows and dissolved oxygen are very high. If areas can be located in the alluvium where water flows through the gravel formations and is routinely recharged from the surface waters in the river, then the wells may contain little or no iron. However, this location may also result in surface water influence on the groundwater, requiring some form of treatment such as additional chlorination or turbidity removal. The exact conditions of the alluvium are not known and test wells should be constructed to verify the quality of the groundwater in the vicinity of the Nehalem River.

5.1.9 SEA WATER

A regional water supply could be developed by treating sea water to remove the salt and other matter. The process involves reverse osmosis which is a high pressure system that forces water through permeable membranes, removing the plankton, diatoms, and various ions from the sea water. It is assumed that the plant would be located near the Jetty Creek treatment plant. Sea water would be pumped from the vicinity of the Nehalem Jetties to this location. An alternative may be to drill additional wells near the Rockaway Beach wells, recognizing that development of such wells would cause an intrusion of salt water. However, the preferred method would be to construct an intake just downstream of the Jetty Marina and pump water to a treatment facility in that area.

Several nations around the world, including many Middle East countries and small islands, use this process to develop supplies of domestic water. In addition, most of the naval fleets around the world desalt sea water for on-board ship use, and recent drought conditions in Southern California have brought desalinization of sea water to the United States.

Increasing costs of water supplies by conventional processes and the reduced costs being developed for desalting sea water are bringing the two processes closer together in terms of price competitiveness. Desalting processes would provide a stable new water source for the coastal region that would probably have the least impact on the environment.

However, there are several disadvantages to the sea water option. Sea water collection in large volumes by various means could impact marine life. Byproducts of the desalinization process, including brine, filtered backwash solids, and heated waste water, would need further treatment before these wastes were disposed of. In addition, a substantial energy source would be required for the desalting process. It is estimated that the cost of desalting, including capital and operation and maintenance expenses, would be approximately three to four times greater than conventional processes in this area of the Oregon coast. Therefore, no additional consideration will be given to this option.

5.2 WATER TREATMENT OPTIONS

Several available technologies exist for the treatment of surface waters and groundwaters to meet the requirements of the Safe Drinking Water Act. Filtration is one of the most important elements in traditional water treatment systems and can play an important role in controlling organic contaminants.

For surface water supplies, various treatment concepts include:

- Conventional treatment and direct filtration;
- Direct filtration (gravity and pressure filters);
- Slow sand filtration;
- Package plants;
- Diatomaceous earth filtration;
- Membrane filters;
- Cartridge filters

In the Pacific Northwest, the most common treatment scheme is conventional treatment. Slow sand filters have been installed in some locations, but recent pilot tests in Astoria, Manzanita and Tillamook indicate that they do not work adequately in the Northwest coastal region. In general, slow sand filters do not have an established record of performance with a large number of water systems in this country or with systems that have rather large water demands. Membrane and cartridge filtration systems are considered an emerging technology because they show promise, but have not generally been used for treatment of drinking water. Package plants, diatomaceous earth, and membrane filters are considered best suited for small systems less than 5 mgd.

Filtration systems are regarded as effective for removal of turbidity and microbial contaminants, including coliform bacteria, giardia lamblia, cryptosporidium, enterovirus, and Legionella.

The Surface Water Treatment Rules require that filters achieve turbidities of less than 0.5 NTU's in 95% of the finished water samples. Turbidity is a measure of suspended particles, which can include organic solids, viruses, bacteria and other substances. Turbidity particles range in size from less than 1 micron to 100 microns (micron = 1 millionth of a meter).

In this report, it is assumed that surface waters will be treated using package treatment plants. Package plants consist of a combination of chemical addition, flocculation, settling, filtering and disinfection, all included in one large steel or aluminum tank.

For groundwater, it is assumed that iron will be the primary constituent needing to be removed. Pressure filters using green sand or the addition of potassium permanganate will be used.

Significant savings on the order of 20% to 40% can be realized using direct filtration, which is only applicable for systems with high quality and seasonally consistent influent supplies. The influent should have a turbidity of less than 5 to 10 NTU's and colors of less than 20 to 30 units. The Nehalem is considered to be within this range except for brief periods during major storms. During such times, either groundwater can be realized or systems can be served through existing and future storage.

However, before direct filtration can be used, it will be necessary to perform pilot studies to prove their effectiveness. Because of the rather large savings in capital costs, it is recommended that a pilot study be performed on the waters of the Nehalem River beginning as soon as possible. The study should run for a period of at least 6 to 12 months.

CHAPTER 6

CHAPTER 6

FORMULATION AND EVALUATION OF ALTERNATIVE WATER SUPPLIES

6.1 INTRODUCTION

As indicated above, with the exception of Neahkahnie, Nehalem Bay State Park, and Watseco-Barview, all of the existing systems have major deficiencies in terms of the water available to meet current and future demands. Based on estimations of minimum stream flows and the capacity of existing wells and/or treatment systems, no combination of existing water supplies can meet the long range water needs of the North Tillamook County region. Therefore, a new source of supply must be developed for the majority of the water users. Some cities, such as Nehalem, can develop alternative surface water sources to meet their projected needs over the next 20 years. However, Neahkahnie Water District, Manzanita, Wheeler, Rockaway Beach and even Nehalem and the smaller users must eventually develop additional water supplies to meet their long range (saturation) peak day demands.

As a result of this finding, emphasis will be placed on developing a water supply which can meet the long range needs. The only water supply investigated that is capable of doing this at a reasonable cost is development of groundwater and/or surface waters from the Nehalem River, just above the head of tidewater. Three alternatives have been investigated for a raw water source. They include surface water treatment, a Ranney collector, and/or several deep wells in the alluvium.

Because difficulties may arise in attempts to form and fund a regional water supply, an analysis was made of each individual supply and its need to upgrade existing sources to meet current regulations and present demands. These details are also discussed below.

Finally, there are several sub-options which might be investigated which could affect the capacity of the regional water supply. For example, Rockaway Beach could develop an independent groundwater source from the vicinity of the South Jetty of Nehalem Bay or near the North Jetty of Tillamook Bay. However, additional water treatment would be required of these alternative sources, including removal of iron and disinfection. A brief review of these options is also discussed.

Also, various jurisdictions could negotiate agreements for regional services to operate and maintain existing and/or future water systems. This issue is highly complex and no attempt is made herein to analyze all the options under this scenario. In general, if qualified people exist and smaller systems utilize individuals for more than one position in their organization, it is doubtful that a regional organization for operation and maintenance would be any more or less expensive than individual operation and maintenance. However, reliability of service might be improved with regional operation and maintenance, and services for major maintenance and laboratory work might be minimized. The details of this option, however, are left for the water resource committee to debate and analyze.

6.2 WATER SYSTEM IMPROVEMENT PROJECTS

6.2.1 IMPROVEMENTS PLANNED AND DESIGNED

Several plans have been put forth to improve the systems in Neahkahnie, Manzanita, and Nehalem. The City of Wheeler is, simultaneously with this study, preparing a water master plan to look at its independent options, and Rockaway Beach is intending to undertake additional plans if the regional water issue does not meet its needs. In addition, Watseco-Barview is projecting improvements for its well water supply to meet immediate expansion needs and to address the concerns about "red water." However, none of these plans take into consideration minimum stream flows and the ability of existing supplies to meet long range peak day demands.

In general, all of the existing plans need to be revised and updated to address concerns under the Surface Water Treatment Rules and other issues discussed in Chapter 3 concerning compliance with regulations. None of the present plans thoroughly address all of the current issues, such as the rules for coliform, turbidity, lead and copper, disinfection byproducts, and several others. Many of these rules will become effective prior to 1995. Therefore, if the regional water supply does not satisfactorily meet the needs and requirements of the various jurisdictions, then additional planning should be undertaken before any system proceeds on its own to improve its water supplies.

6.2.2 IMPROVEMENTS TO RELIEVE EXISTING SYSTEM DEFICIENCIES

A partial listing of the anticipated improvements necessary to comply with current regulations is given for each system below. Also tabulated is an estimate of the operation and maintenance expense and/or capital cost for each improvement. Capital costs are shown in anticipated 1993 dollars. Operation and maintenance expenses are shown for annual expenses.

Cost estimates envision that projects will be designed under the direction of a registered engineer in compliance with current rules. Operation and maintenance expenses are anticipated to be incurred by current staff or staff added to existing jurisdictions. It is assumed that all jurisdictions will pay prevailing wage rates, provide ordinary benefits, and other payroll-related expenses totaling approximately 40% of basic salary. Laboratory expenses are assumed to be provided, for the most part, by outside certified laboratories.

6.2.2.1 NEAHKAHNIE WATER DISTRICT

SUGGESTED SOURCE IMPROVEMENTS

	Capital Cost Est. $1993	Annual O&M Cost Estimate
A. Improve disinfection (OAR 333-61-050(6)); two each	$60,000	
B. Monitor sources (Spring 3 & Pirate) if surface water influence		
1. pH		$1,50
2. Temperature		1,50
3. Turbidity		
4. Chlorine residual		
5. CT calculations		
6. Flow recording (spring & system)		
C. Particle analysis - each source, 2 ea.	4,000	
D. CT reservoirs (separate from storage) (2 ea.); if surface water influence	20,000	
E. Divert waters from Springs 1 & 2 to Spring 3	5,000	
F. Pump water from CT tank or Reservoir Park to higher elevations. (Existing piping and 20,000 gal. tank near Spring 1)	10,000	5
G. Develop well head protection plan for all springs (1, 2, 3 & Pirate)	40,000	
H. Routine testing for physical, chemical, VOC's, SOC's, radionuclides, Cl_2, coliform, etc.		
I. Depending on results of coliform and turbidity monitoring, install treatment (or connect to alternative source) as required.	855,000	18
J. Install corrosion control for lead & copper rule at each source. (1993) 2 ea.	6,000	1
K. Monitor for and revise disinfection for disinfection byproduct issues.	Unknown	Unkn
L. Acquire control of land and land use within 50 feet of springs (no sewers, drains, etc.)	10,000	N
M. Conduct vulnerability assessment with respect to SOC's at each source.	8,000	N.
N. Connect emergency piping, meter and pumping with Manzanita.	53,000	
TOTALS:	$1,381,000	$50,60

The decision as to whether or not the improvements suggested above will be required will depend on whether or not the springs can continue to be classified as groundwater or whether future testing and monitoring indicates surface water influence. Therefore, it is suggested that the District proceed immediately with performing particle analysis on each source. This involves a process in which 500 to 1,000 gallons of water are pumped through a fine micro filter membrane system which is then sent to a lab. The lab will then analyze particles collected in the micro filter and render opinions as to whether or not there is any surface water influence. The sample should be collected during a rainy period this winter. Another test that can be performed is a tracer test to check the probability of surface water influence. Recent data provided for review in March, 1993, indicates possible surface water influence.

Because of the pending requirements for a variety of new tests and concerns for future problems with disinfection byproducts, the Lead/Copper Rule, and other issues, it is suggested that Springs 1 and 2 be piped to Spring 3 and that the waters from the three springs be combined into one source. This will eliminate the need to provide additional testing on Springs 1 and 2. The District already intends to pump water from Reservoir Park Reservoir to the higher pressure zone and the existing 20,000 gallon tank. The tank can and should remain in service. Whether or not Springs 1 and 2 should be plumbed at this time to Spring 3 is at the discretion of the District. With the bringing on line of Pirate Spring, there may not be an immediate need for the water from Springs 1 and 2.

The District needs to address concerns for the Lead/Copper Rule and possibly adjusting water pH and/or the Langelier Index so the water is not corrosive. It is expected that the water will be slightly acid and that the Langelier Index will be slightly negative. However, no tests of these parameters have been brought to the author's attention.

Improvements to the existing disinfection systems are recommended. In addition to simply adding sodium hypochlorite solution to the water, the District should monitor for pH, temperature, turbidity, and chlorine residual at each source. It is also suggested that improvements be made to flow monitoring to measure the flows from the springs as well as the flow delivered to the water system. Samples of raw spring water from each source should be regularly tested for the presence or absence of coliform and turbidity.

The volume of storage needs to be revised in accordance with required fire flow and possible future CT requirements. Part of this issue revolve around whether or not an emergency piping connection is made to Manzanita and whether this can be counted as an additional source. It is recommended that the District eventually consider the emergency piping connection to Manzanita.

Another shortcoming of the existing springs is that the District does not have legal control of all of the land within 50 feet of the springs. This is required by Oregon Administrative Rule (OAR 333-61-050(2)(a)(A). This may present a problem, particularly with Pirate Springs.

As a worst case scenario, the springs may be classified as surface water influence and may require future treatment. In such a case, the District should look at a regional supply or anticipate the installation of a package membrane filtration plant. If this treatment is required, it is suggested that the water from each spring be pumped to a central facility at Spring 3 and that the water be treated in one treatment plant.

In addition to these requirements, it will also be necessary for the District to conduct in the near future a vulnerability assessment with respect to synthetic organic chemicals at each source. Also, the District will be required to develop a well head protection plan for each source.

The cost estimates above are very general and may be higher or lower, depending on the detailed scope of work developed for each task. In most cases, it will be necessary to retain the services of a registered professional engineer, or geologist, to conduct the necessary studies. Some of the testing, however, can be performed by water district personnel. Other testing will have to be done by certified laboratories.

6.2.2.2 MANZANITA

SUGGESTED SOURCE IMPROVEMENTS

		Estimated Capital Costs $1993	Annual O&M Cost Est.
A. Package treatment with clearwell, electric, instrumentation, controls, sludge lagoon, building, etc. (0.35 MGD)		$1,200,000	$102,200[2]
B. Well water supply		81,000[1]	6,000
C. Treatment of well water (100 gpm) (Iron removal with potassium permanganate and pressure filter.)		300,000	10,000
D. Develop watershed management plan		20,000	500
E. Lead/Copper Rule		6,000	1,000
F. Well Head Protection Plan for Proposed new well		10,000	500
	TOTALS:	$1,617,000	$120,200

[1]From Handforth, Larson & Barrett, 1990, pp 5-23. Updated to 1993 cost estimate.

[2]Includes monitoring, testing and reporting.

The City of Manzanita has already investigated some of its needs with regard to upgrading its raw water supply to meet current Safe Drinking Water Act requirements. However, there are three additional items which need to be considered. First, the well water supply proposed to add to the existing surface water source to meet peak day demands does not indicate a requirement for treatment. It is highly likely that the groundwater supply will contain high levels of iron and the city will need to remove iron from the new well water. Further, the city will need to develop a watershed management plan on its existing raw water source and a well head protection plan for the new well when it is brought on line. Finally, the city will have to address the Lead/Copper Rule in the near future as well as concerns about VOC's, SOC's, and other requirements for water testing. Estimates for this additional testing is included in the operation and maintenance of the proposed package treatment plant for treating their raw water supplies. Finally, future requirements for disinfection byproducts will need to be addressed.

6.2.2.3 NEHALEM

SUGGESTED SOURCE IMPROVEMENTS

		Estimated Capital Costs $1993	Annual O&M Cost Est.
A. Develop new source with package treatment (0.35 MGD)			
1. Intake with fish screens & fish passage		300,000	Incl. below
2. Water treatment plant		1,200,000	100,000[1]
3. Interconnecting pipeline		372,000	N.A.
B. Lead/Copper Rule - corrosion control		6,000	1,000
C. Watershed Management Plan		20,000	500
	TOTALS:	$1,898,000	$101,500

[1]Includes monitoring and testing.

The City of Nehalem's existing water source, Bob's Creek, does not have sufficient volume to meet its current as well as future needs. Therefore, the city must consider either encouraging and participating in a regional water supply or developing a new source on Coal Creek.

A new source on Coal Creek would require a new intake structure. Several environmental issues must be addressed, including fish and wildlife, wetlands, minimum stream flow requirements, and several others. Assuming that the environmental issues can be adequately addressed, a new intake on Coal Creek will be required together with the necessary fish screens and fish passage facilities. A new water treatment plant of approximately 0.35 mgd should be constructed. The new plant will need to be connected to the existing piping system near the confluence of the North Nehalem River and the main stem of the Nehalem River.

In addition to improvements to a new source, the Lead and Copper Rule will need to be addressed and a watershed management plan prepared. Future concerns for disinfection byproducts should be anticipated.

There is some opportunity because of the anticipated available flows in Coal Creek that Nehalem could provide some water to the City of Wheeler and/or the City of Manzanita. However, this would require the development of an intergovernmental agreement as provided under ORS 190.

Although this may be to the advantage of Nehalem, it may not suit the desires of Manzanita or Wheeler. Another alternative might be to develop a water authority to encompass all three jurisdictions. However, these options are beyond the scope of this report and are left to the various jurisdictions to discuss. Ultimately, however, Coal Creek does not have enough water to satisfy Nehalem's needs alone.

6.2.2.4 WHEELER

SUGGESTED SOURCE IMPROVEMENTS

		Estimated Capital Costs $1993	Annual O&M Cost Est.
A. New well at R.M. 9 Nehalem River (100 gpm)		$75,000	$2,500
B. Disinfection, CT, pumps and motors, Building, equipment and reservoir		100,000	14,500
C. Pipelines to Wheeler		1,003,600	Incl.
D. Wellhead Protection Plan		10,000	500
E. Corrosion Control - Lead/Copper Rule		6,000	1,000
F. Land Acquisition		35,000	N.A.
G. Annual monitoring, testing & reporting		________	5,000
	TOTALS:	$1,229,600	$23,500

The City of Wheeler's existing water supply is not sufficient in volume to meet current peak day demands. Development in Wheeler has been curtailed, pending resolution of its future water source. The above tabulation assumes that a new well can be constructed somewhere along the Nehalem River at approximate River Mile 9. The new well would have sufficient volume, approximately 100 gpm, to provide water service to Wheeler and Zaddack Creek and Brighton. Other than disinfection, it is assumed that the well would not need additional treatment. If iron is present, it will likely be in low concentrations and sequestering can be added at minimal cost.

A pipeline would be constructed from the well site along the existing County road right-of-way to Highway 53, then continue through Mohler to U.S. 101 and along Highway 101 to Wheeler. Alternative routes may be along the old highway through Nehalem Junction.

In addition to the basic source and transmission systems, the city will need to develop a well head protection plan, address the Lead/Copper Rule, and acquire the land for the new well site. Also, annual monitoring, testing and reporting of the water's physical and chemical characteristics, including SOC's, VOC's and ultimately, disinfection byproducts, will be needed.

It is assumed that Zaddack Creek would be served from the transmission line with a master meter and interconnecting pipeline that would connect to the existing water system. The current intake on Zaddack Creek would be discontinued.

In addition, service could be provided to Brighton via a small diameter pipeline as discussed below.

As well as requiring a new source, Wheeler will need to have additional improvements to their water system, including more pipes and reservoirs.

An alternative could involve arrangements with Nehalem for water supply, which is discussed in a separate report.

6.2.2.5 BRIGHTON

SUGGESTED SOURCE IMPROVEMENTS

		Estimated Capital Costs $1993	Annual O&M Cost Est.
A. Option I - Pipeline to Wheeler (Paradise Cove) with booster pump. 14,500' 2" dia., meter, etc.		55,000	2,00
B. Option II - Treat existing supply		-or-	-o
1. Treatment and disinfection		60,000	5,0
2. Corrosion control		3,000	6
3. Watershed management plan		10,000	
4. Annual testing and reporting			5,0
	TOTALS:	$73,000	$11,1

[1]Add cost of water from Wheeler.

Two alternative solutions for source improvements to Brighton were considered. First, an option of connecting to the City of Wheeler with a booster pump and approximately 14,500 feet of 2" diameter PVC pipe was considered. Second, the option of treating the existing water supply was considered. If Brighton treats its own water supply, it will also have to deal with corrosion control, a watershed management plan, and annual testing and reporting of various chemical and physical characteristics of their water supply.

In general, the option of connecting to the City of Wheeler is the least expensive. In addition to the annual cost shown in the tabulation above, the residents would have to pay about $3.50 per 1,000 gallons of water received from Wheeler. Brighton could operate its own booster pump station and pipeline or contract with Wheeler. However, Wheeler would need to address the issue of providing water service to areas outside of its jurisdiction. Similar arrangements would have to be made with Zaddack Creek.

Alternative routing for the pipeline from Wheeler to Brighton should consider a route east of U.S. Highway 101 through the existing Brighton platted development. With an adequate water supply this area of Brighton may be available for future development according to the County's Comprehensive Plan. Routing of the pipeline through Brighton might also eliminate some of the geological hazards along Highway 101 near Nehalem Bay.

6.2.2.6 ROCKAWAY BEACH

SUGGESTED SOURCE IMPROVEMENTS

	Capital Cost Est. $1993	Annual O&M Cost Estimate
A. Four wells at 200 gpm each	$33,300	$ 2,000
B. Pumps and Piping	244,000	5,000
C. Fencing and Security	16,000	500
D. Land	50,000	
E. Well Head Protection Plan	10,000	500
F. Corrosion Control	10,000	500
G. Annual Monitoring & Testing		6,000
H. Treatment - including site work, lagoons, filters and equipment, concrete, labor, building, electrical and instrumentation, eng. & cont. @ 30%	1,151,700	25,000
I. Clearwell Storage	100,000	N.A.
J. Pipe to Spring Lake Connection	240,000	1,000
K. Disinfection	20,000	1,000
L. Finish Water Pumps	35,000	
M. Jetty Creek Improvements		
1. Corrosion Control	10,000	
2. Added Testing & Reporting		5,000
3. Watershed Management Plan	20,000	500
TOTALS:	$1,940,600	$48,000

Several options were investigated to provide the additional supply to Rockaway that it needs in order to meet existing as well as future peak day demands through the year 2010. The options, including the regional supply option, included collecting waters from existing drainages east of Rockaway Beach, development of additional supplies from groundwaters at Nedonna Beach, and Barview, and connecting to supplies from Garibaldi and/or Bay City.

The most likely option appears to be development of additional groundwaters near Barview. Garibaldi's existing supply does not appear to be sufficient to meet Rockaway Beach's needs. The cost of the pipeline, source development and treatment, and other issues relative to Bay City does not appear feasible. Further, collecting of existing waters from drainages east of Rockaway Beach is relatively expensive and there are several environmental issues that would have to be addressed. There is also some question as to whether or not the drainages contain enough water to meet Rockaway Beach's needs. If sufficient water was available, it is anticipated that they would be piped back to Jetty Creek for treatment.

The development of groundwater at Barview involves a number of items, including the development of wells, pumping and piping the groundwater to a central treatment facility, treating the water for removal of iron and manganese, etc. A well head protection plan would have to be developed for the well field. Testing and monitoring would need to be done on the raw well water supplies. An interconnecting pipeline would need to be constructed from the treatment facility to the existing Rockaway pipeline just north of Spring Lake. An alternative to this would be to connect to Watseco-Barview's existing 8" line and connect their 8" line to the city's system. However, this would require an intergovernmental agreement or the annexation of Watseco-Barview.

The well field would be constructed just south of Camp McGruder or possibly along the old access road on the west side of Smith Lake.

In addition to developing an alternative water supply, Rockaway Beach will need to address corrosion control, additional testing and reporting, and a watershed management plan for its Jetty Creek supply.

Various previous reports have projected significant quantities of groundwater in the sand dune areas of North Tillamook County. (Reference: CH_2M/Comprehensive Water and Sewerage Planning Study, p. 83.) It is estimated that an annual water yield of about 1 mgd is potentially possible from the dunes south of Manzanita. Other studies (Noble) have indicated similar yield potentials for the area near Barview. However, each of these estimates are based on the assumption that water is withdrawn only in the summertime months to meet peak day demands and that the areas are allowed to recharge during the winter months.

6.2.2.7 WATSECO-BARVIEW

SUGGESTED SOURCE IMPROVEMENTS

	Estimated Capital Costs $1993	Annual O&M Cost Est.
A. Acquire additional land	$10,000	N.A.
B. File for water rights	2,000	100
C. Address Red Water & Corrosion Control Problem. Sequester Iron (work in progress)	3,000	1,000
D. Improve Disinfection Control - Residual Monitoring & Alarms	5,000	500
E. Improve Source Metering	5,000	500
F. Modify Pumping	18,000	No Change
G. Wellhead Protection Plan	10,000	500
H. Added Testing, Monitoring & Reporting		5,000
TOTALS:	$50,000	$7,600

The well water supply for Watseco-Barview appears to be adequate in quantity to serve their needs through the year 2010. However, there are several shortcomings which were noted with the existing supply. The District does not maintain legal control of the required area around the well. Additional negotiation should be entered into with the County to give the District control of all lands within 50 feet of the well. Further, the District does not have water rights on the well and should retain a certified water rights examiner to prepare the necessary maps and documents to file for water rights.

The District has had several complaints about red water and is in the process of constructing improvements to the well to add a sequestering agent to hold the iron in solution. Iron concentrations at the well were measured at 2.5 ppm. By adding this chemical to the well, the Lead/Copper Rule concerns will also probably be met. However, additional testing will be necessary to verify this assumption.

Improvements to the existing disinfection control equipment are needed. Alarms indicating loss of residual and residual monitoring should be constructed. Also, additional equipment is needed for the metering arrangement. Continuous recording of the well operation should be provided.

Another concern of the District is that the existing pumping arrangement does not provide for full utilization of the water yield capability of the well. The centrifugal pumps are mounted away from the well. Water must be suction lifted from the well; therefore, the water level cannot drop more than about 15 to 20 feet below the pumps. The well has been test pumped and is capable of yielding more water than the present pumps can produce. Therefore, it is recommended that either a submersible pump or vertical turbine pump be constructed to replace the centrifugal pumps.

Finally, a wellhead protection plan must be implemented and additional testing, monitoring and reporting of well water quality is needed.

6.2.3 LONG RANGE IMPROVEMENTS TO MEET ANTICIPATED GROWTH

The improvements outlined in Section 6.2.2 deal primarily with those improvements to meet current demand as well as demand through the year 2010. However, beyond the year 2010 additional water supplies will need to be developed. In all cases, the existing supplies and/or water rights applications are not sufficient to serve the North Tillamook County region's predicted saturation population. Therefore, a regional water supply will eventually have to be developed or growth will need to be restricted.

A tabulation of the ultimate saturation population and projections for long term water needs shows that the ultimate peak day demand will be in the range of 9.2 MGD. The current capacity is a little less than 3 MGD. This leaves a long term deficit of about 6 MGD. Long range planning appears to demand that a rather large water source be developed to meet the long term needs of the North Tillamook County area. (See Table 6.1).

6.3 REGIONAL WATER SOURCE ALTERNATIVES

With the abundance of rain and the many streams in the North Tillamook County area, it would appear that there would be more than adequate water to serve the domestic needs of the region. However, minimum stream flows, particularly during drought years, are insufficient to meet water demands. Other concerns with surface water sources, particularly the maintenance of wetlands, fish and wildlife, and other environmental and aesthetic values, makes it difficult to envision continued use of existing sources, let alone improvement of those sources to meet long range needs. It may be possible to store water on some drainages for release during minimum stream flow periods. However, the development of storage impoundments is expensive, and environmental issues related to inundating existing landscapes are considered to be beyond the scope of this report.

Briefly, several surface waters were investigated as possible regional supplies. They include Jetty Creek, the Kilchis River, Miami River, Foley Creek, the Nehalem River, Roy Creek and Coal Creek. See Chapter 5 for general discussion.

Several groundwater sources were also investigated, including those at Bay City and sand spits at the mouth of the Nehalem Bay and the mouth of Tillamook Bay. The Bay City facility is not large enough in capacity to serve the long range regional needs of the North Tillamook County area. The sand spits are only able to produce water during drought times and are not recommended for long term use, which would likely result in encroachment of salt water which would preclude their use from that point forward. Therefore, except to meet peak day demands during critical times of each summer, it is not recommended that groundwater (except along the Nehalem) be considered as a long term solution.

6.3.1 WATER RIGHTS

Water rights were filed by the City of Wheeler on December 31, 1992, in the amount of 6 cfs to appropriate water from the Nehalem River. That application is pending with the Water Resources Department and public hearings are anticipated sometime during the spring of 1993. These rights were filed to preserve water for the regional water supply system, if it is developed, through the year 2010. Additional water rights should be filed following completion of the current permit to reserve additional waters of 8.3 cfs, totalling 14.3 cfs.

6.4 SOURCE RECOMMENDATION

Only one raw water source appears to be adequate to meet the long term needs of the study area. That source is the Nehalem River.

The development of the Nehalem River may involve several approaches. The first recommended approach is the attempt to develop groundwater in the alluvium just above the head of tidewater near River Mile 9. If groundwater can be developed, it will represent the least expensive alternative. Alternative developments include Ranney collectors and/or surface water diversion and complete treatment. Therefore, efforts should begin as soon as possible to acquire land and drill test wells to clarify the availability of existing groundwater.

In addition to source development, transmission pipelines will need to be constructed throughout the region as shown in Figure 6.1 and 6.2. It is proposed that a pipeline be constructed from the water source site along the County road on the north side of the Nehalem River to Highway 53, thence along Highway 53 to Highway 101. Water would be delivered from the regional supply to Zaddack Creek and Tidewater in the vicinity of Mohler. At Highway 101, a 12" pipeline would be constructed north through Nehalem, then reduced to an 8" pipeline to Manzanita. At both Nehalem and Manzanita, master meters would be constructed, together with pressure regulating features, to control water delivery to the existing distribution systems and reservoirs. In each case, new reservoirs and improvements to the distribution system are anticipated, but are not necessary for the regional water supply. They are, however, necessary for the need to meet peak day demands and fire flows within each jurisdiction. Ultimately, a connection between Manzanita and Neahkahnie will be necessary in order to meet Neahkahnie's long term needs. An additional booster pump and master meters will be required. It is anticipated that water will flow through Manzanita to Neahkahnie. An intergovernmental agreement between Neahkahnie and Manzanita will be necessary to allow this pass through arrangement.

At the intersection of Highway 101 and Highway 53, a 12" pipeline would continue south along Highway 101 through Wheeler. From Wheeler, a 12" or 10" pipeline will continue past Brighton and connect to the Rockaway Beach system at Jetty Creek. The pipeline south of Wheeler may be a 10" pipeline, if it is assumed that the Rockaway Beach treatment facility at Jetty Creek will remain in service. An economic analysis indicates that by maintaining the Jetty Creek treatment facility, pipe size from Wheeler to Rockaway Beach can be reduced and savings in the amount of about $400,000 in capital investment can be realized through the year 2010. However, beyond 2010, it may be necessary to lay parallel pipes south of Highway 53, and add to source, storage and pumping.

If Watseco-Barview elects to connect to the regional water supply, about 800 feet of pipe together with a booster pump and master meter would need to be constructed near Spring Lake. The booster pump would need to be controlled from a level float control on the existing Watseco-Barview Reservoir near the Barview Store.

The cost for the regional supply will vary from about $9.5 million to a low of $5.7 million, depending on whether or not groundwater can be developed along the Nehalem River. If the Jetty Creek treatment facility remains on line, costs can be reduced to about $8.3 million instead of $9.6 million, assuming full treatment of Nehalem River water. A further discussion of the alternatives is presented below.

6.5 COMPARISON OF ALTERNATIVE WATER SUPPLIES

6.5.1 GENERAL

A review of the saturation population information developed in Chapter 2 indicates that the ultimate density of the study area is approximately 47,000 people. It is unlikely that this full density will be realized, but population densities of up to 90% to 95% of saturation are possible.

With saturation population, estimates can be made as to the ultimate water demand for the area. Assuming approximately 200 gpd per resident for the city areas, 60 gpd for the population equivalent at Nehalem Bay State Park, and 500 gpd for the Tideland and Zadduck Creek areas, total water projections are estimated to be 9.2 mgd. The high estimate for peak day demand is based on the assumption that projections for population only indicate part of the user group which impacts peak day demands. A large portion of the service area contains motels and hotels which are not a part of the population projections. The total number of people in Rockaway Beach during major holidays far exceeds the existing population. Rockaway Beach's Public Facilities Plan indicates that the population impact in Rockaway is approximately two seasonal residents for every one permanent resident.

Whether this ratio will continue into the next century is not know. However, the obvious impact of seasonal contributors to the water demand is significant. The State Park does not have the same type of facilities in the way of showers and kitchens that are provided in many motel rooms, recreation developments, or most homes. Tidewater and Zadduck Creek have dairies attached to their systems and the water use in the dairies tends to distort the per capita estimate assumptions.

The information shown in Table 6.1 indicates a total deficiency in existing sources of approximately 6.3 mgd.

Table 6.2 is a summary of existing sources, demands and deficiencies through the year 2050. The next to the last column predicts the year 2050 peak day demand deficiency in gpm for each system. The total deficiency in the year 2050 of all of the systems is approximately 1,150 gpm, or about 1.6 mgd.

6.5.2 COST VARIABLES

Several cost factors can affect the ultimate price for water service. It is assumed for this report that the power costs from the Tillamook Peoples Utility District will be in accordance with Schedule G-1B which establishes a base charge of $16 per month, power cost at $.0385 for the first 12,000 kilowatt hours, and $.0197 per kilowatt hour for everything over 12,000 kilowatt hours. Demand charge will be $3.90 for everything over 50 kilowatt hours per month. For purposes of this study, it has been assumed that power costs will average about $.03 per kilowatt hour.

Labor rates may vary, but they have been assumed to be approximately $10 to $14 per hour plus 40% for direct salary overhead.

Interest rates will depend upon the source of financing. Financing is available through the State of Oregon at 6-1/2%. The term is negotiable and can be as much as 20 to 30 years. Monies are also available from the Farmers Home Administration in the way of loans at interest rates of about 5% over 40 years. These various interest rates and terms were analyzed and will be discussed later, indicating significant variation on costs, depending upon the source of loan funds.

Obviously, source options and location play a large part. It is assumed that the source will be the Nehalem River for the regional water supply, sufficiently upstream from the head of tidewater so as not to develop potential problems with brackish water, but far enough downstream so as to have minimum impact on the lower reach of the Nehalem River during minimum stream flows.

6.5.3 SEPARATE SOURCE DEVELOPMENT

The cost for the various alternatives of separate source development has been tabulated in Table 6.3 (A,B and C). The headings across the top of the table indicate:

- Item: A numerical reference

- Jurisdiction: City, Water Districts, Owner or Regional Agency

- Recommended Capacity: Size of existing source minimum flows or year 2110 peak day demand, whichever is less, rounded to standard package WTP sizes.

- Estimated Capital Cost, 1993: See Section 6.2.

- Source Annual Operation & Maintenance Cost Estimate: For Rockaway Beach, add cost to operate Jetty Creek at $1.11 per 1,000 gallons. See Section 4.3 for general discussion.

- 1992 Average Daily Water Production, gpm: See Table 4.1, third column.

- 1993 Unit Operation and Maintenance Cost $/1,000 gallons: Total annual operation and maintenance cost divided by annual water production. Or: Annual operation and maintenance, 1993, divided by 1.02 (water production, gpm)(1,140)(365)/1,000.

  Or: Col. 5 divided by [1.02 * Col.6 * 1,140 min./day * 365 days/yr. ÷ 1,000].

- Projected 1993 Annual Operation and Maintenance Cost including Capital = (Col. 4 * CRF) + Col. 5.

- Projected 1993 Unit Cost with Capital, $/1,000 gal. = Col. 8 divided by (1.02 * Col. 6 * 1,440 * 365 ÷ 1,000).

In summary, the total estimated capital investment necessary to improve the existing water supplies to their ultimate capacity is about $8.15 million. Unit costs of production will vary from a low of about $.33 for the Nehalem Bay State Park to as high as $4.21 per 1,000 gallons for Nehalem. Again, these improvements will satisfy the immediate needs for upgrading the quality and capacity of existing systems, but ultimately, additional sources will have to be developed. The costs assume Farmers Home Administration funds borrowed at 5% interest for 40 years. (See Table 6.3B.) Items 1A through 10A assume that oversizing of some improvements to serve future customers will be funded through system development charges.

6.5.4 REGIONAL SUPPLY - COMPLETE TREATMENT

Item 11 on Table 6.2 summarizes the expected cost to develop a regional supply and treat river water from the Nehalem River. Total capital costs are expected to be about $9.5 million. Annual operating expenses are projected to be about $0.9 million with a projected unit cost of production of $2.33 per 1,000 gallons.

An alternative to this solution was developed assuming that future users will connect to the water system and pay system development charges. The existing base (existing customers) would bear costs of about $6.3 million, have an annual operating expense of $715,510, and pay about $1.85 per 1,000 gallons of water consumed. Under this scenario, most of the water systems would be paying less for a regional water supply than is estimated to develop their own independent supplies. The exceptions are Watseco-Barview, Nehalem Bay State Park, Rockaway Beach, and possibly Neahkahnie. However, the regional water supply is not dependent upon these participants and could be developed with or without their participation. Their lack of participation is not anticipated to significantly affect the average cost of water from a regional source.

6.5.5 REGIONAL WATER SUPPLY WITH JETTY CREEK - OPTION 1

Another alternative was to analyze the regional water supply assuming that the Jetty Creek Treatment Facility remains on line through its service life. The transmission system would be sized to ultimately provide water to Rockaway Beach through the new transmission facilities and an enlarged regional supply to be constructed with an additional capacity when the Jetty Creek supply is abandoned. The estimated capital cost for this alternative is about $8.8 million with an average annual cost for operation and maintenance and debt retirement of about $717,000. Unit cost for water production is estimated at about $3.05 per 1,000 gallons. This amount can be reduced by implementing the proposed system development charge option. However, this option causes a significantly higher cost to the regional water users, other than Rockaway. This issue needs further discussion by the water resource committee.

6.5.6 REGIONAL WATER SUPPLY WITH JETTY CREEK - OPTION 2

Item No. 13 in Figure 6.2 analyzes the cost of water production, assuming that Jetty Creek remains on supply and the pipelines are sized only to handle the capacity to serve Rockaway's needs beyond the 1 mgd capacity of the Jetty Creek Treatment Facility. This option in essence down sizes the transmission pipeline from the supply source to Rockaway Beach in anticipation that approximately 1 mgd would always be served by the Jetty Creek source.

This option results in a higher per unit cost for production since the participation by Rockaway Beach is significantly reduced and is not recommended.

6.5.7 REGIONAL SUPPLY - WELLS

Item 14 on Table 6.2 analyzes the regional water supply assuming that wells can be developed along the Nehalem River without major treatment. Treatment is assumed to be minimal, consisting of disinfection and/or sequestering of iron if found in minute quantities. The capital cost for this option is approximately $5.7 million, with an annual operating cost of approximately $508,000. The unit cost of water would be about $1.31 per 1,000 gallons.

The option exists for this alternative to implement system development charges also. Assuming that the base (existing customers) pays for about two-thirds of the capital investments and that future customers pay the other one-third, the capital cost to the existing base would be about $3.8 million with an annual operating cost of about $397,000, resulting in a unit cost of production of about $1.03 per 1,000 gallons.

The regional water supply with wells holds great promise to reduce the cost of water to the region. Therefore, it is highly recommended that investigation begins immediately on the potential for development of wells along the Nehalem River. This investigation should include a geological study, drilling test wells, and testing the wells for yield and water quality.

6.5.8 EFFECTS OF INTEREST AND LOAN TERM FOR BORROWED FUNDS

Tables 6.3A, 6.3B and 6.3C were developed to show the impact of interest rates and terms on the annual cost and unit costs for water production. Three alternatives were investigated, including interest rates at 6-1/2% for 30 years, 5.0% for 40 years, and 6-1/2% over 20 years. In Option 11 for the regional water supply using water treatment, the unit costs of production are projected to be $2.24, $1.85, and $2.38 per 1,000 gallons, respectively. For the well option, including system development charges, the unit costs of production are, respectively, $1.26, $1.03, and $1.35.

Obviously, the lower the interest rates and the longer the term, the less the unit cost of water. However, the overall financing cost will be greater for the interest charges for the longer terms.

6.6 RECOMMENDATIONS

Throughout the course of this study, various references were accessed for information. Existing reports all have a common theme. The HGE report for Nehalem, published in 1973, cautions about the shortage of water. Tillamook County's Department of Community Development stated in their 1991-1992 Annual Report that: "Limitations in water availability have restricted growth in Neahkahnie." The Manzanita Water Master Plan, published in 1990, points out the need to develop alternative surface water supplies and/or wells. The City of Rockaway Beach Public Facilities Plan, 1981, states: "Although, at the present time, Jetty Creek is sufficient as a source of supply for the service area, it is vulnerable to a potential drought, or a major fire, which may radically change the quality and quantity of water. For these reasons, it is important that an additional source of water supply be developed." The City of Wheeler has recently had to curtail additional development until the issues with regard to alternative water supplies are resolved. In 1969, CH_2M Hill reported: "With few exceptions, existing water sources are incapable of supplying future water requirements." That study further suggested that future water service plans should consider consolidation of individual utilities into a single utility serving a general area instead of an individual community. The conclusions of this report are not different. A regional water supply will ultimately be required.

The primary purpose of this initial study effort was to evaluate numerous potential water supply options to determine preferred options, or a package of options, to be carried into further study and analysis.

It is recommended that additional studies be undertaken to include a more thorough, site-specific, study to determine the feasibility of developing a regional water supply on the Nehalem River. The study would include on-site field investigations including geologic and environmental studies, development and analysis of test wells, and economic studies to provide a reasonable assurance that the source option package can, in fact, be implemented to meet the region's water demand. Further, issues regarding conservation, endangered species, water rights, land availability, and fish and wildlife concerns need to be thoroughly addressed.

It is suggested that the water resource committee thoroughly analyze these and other matters and develop a detailed work program with appropriate time frames to implement the development of a regional water supply.

As a part of this effort, it is suggested that the water resource committee begin discussions with their respective boards and city councils to solicit their support of the recommended program. In addition, public hearings should begin soon to inform the general public of the committee's findings.

Finally, issues must be addressed on what type of governmental organization will own and operate the required water system. Several options along these lines are discussed in Chapter 7.

TABLE 6.1

NORTH TILLAMOOK COUNTY
REGIONAL WATER STUDY

SATURATION POPULATION SUMMARY
PROJECTION OF PEAK DAY DEMANDS
AND SOURCE DEFICIENCIES

JURISDICTION	City/Co. 1992 Population	UGB Saturation Population	Assumed Peak Day Demand per Person, Gallons	Saturation Water Demand Peak Day, Gal./Day	Existing Source Capacity Min. Flow, Gal./Day	Deficiency of Source Gallons per Day
Neahkahnie	540	4,685[3]	200	937,000	160,000	777,000
Manzanita	513	10,657	200	2,131,400	240,000	1,891,400
Nehalem Bay State Park	350[1]	1,000[1]	60	60,000	35,000	25,000
Nehalem	232	9,722	200	1,944,400	1,000,000	944,400
Wheeler	335	4,946	200	989,200	81,000	908,200
Tideland	45	100	500	50,000	N.A.	50,000
Zaddack Creek	24	51	500	25,500	N.A.	25,500
Brighton	30	1,000	200	200,000	144,000	56,000
Rockaway Beach	970	4,889	200	977,800	1,000,000[2]	-0-
Watseco/Barview	310	9,507	200	1,901,400	230,000	1,671,400
TOTALS:	3,349	58,900		9,216,700	2,890,000	6,348,900

[1]Equivalent Population
[2]Assumes existing emergency wells are satisfactory.
[3]See notes on Table 2.2.

TABLE 6.2
NORTH TILLAMOOK COUNTY REGIONAL WATER MASTER PLAN
SUMMARY OF EXISTING SOURCES, DEMANDS, AND DEFICIENCIES

CITY/DISTRICT	Drainage Area Sq. Miles	Min. Flow gpm	Existing Water Rights gpm	2050 ADD gpm	2050 PDD gpm	2050 PDD Deficient gpm	Existing ADD/PDD gpm
Neahkanie							
A. Spring 1	N.A.	5	36				
B. Spring 2	N.A.	6	36				
C. Spring 3	N.A.	54	224				
D. Pirate Spring	N.A.	46	202.5				
TOTALS:		111	498.5	57	142	31	37.5/75
Manzanita							
A. West Fork		167	225				
B. Middle Fork		Incl.	225				
C. North Fork		Incl.	225				
D. Neahkahnie Creek		208	390				
E. Alder Creek		75	225				
TOTALS:	1.45	550	1,290	170	425	0[1]	112/224
Nehalem							
A. Bobs Creek	0.7	175		142	354	179	94/188
B. Coal Creek	7.65	700±	1,800	142	354	0[1]	
Wheeler							
A. Jarvis Creek	0.23	21	126				
B. Vosberg Creek	0.38	35	1,800				
TOTALS:		56		77	193	137	51/102

[1] Assumes development of new sources and treatment.

TABLE 6.2 (CONT'D.)

NORTH TILLAMOOK COUNTY REGIONAL WATER MASTER PLAN
SUMMARY OF EXISTING SOURCES, DEMANDS, AND DEFICIENCIES

CITY/DISTRICT	Drainage Area Sq. Miles	Min. Flow gpm	Existing Water Rights	2050 ADD gpm	2050 PDD gpm	2050 PDD Deficient gpm	Existing ADD/PDD gpm
Rockaway Beach							
A. Jetty Creek	1.86	360	450				
B. Well 1	N.A.	175	175				
C. Well 2	N.A.	175	175				
TOTALS:		600-700		467	1,167	600±	309/773
Watseco/Barview/Well		200 gpm	None	26	65	None	17/30

TABLE 6.3A
ALTERNATIVE WATER SUPPLY COST ESTIMATES

ASSUMED CAPITAL RECOVERY FACTOR (6.5% AT 30 YEARS): 0.08198

JURISDICTION	RECOMMENDED CAPACITY(GPM)	ESTIMATED CAPITAL COST, 1993	SOURCE ANNUAL O&M COST EST.	1992 AVERAGE DAILY WATER PRODUCTION(GPM)	1993 UNIT O&M COST $/1000 GAL	PROJECTED 1993 ANNUAL O&M COST INCLUDING CAPITAL	PROJECTED 1993 UNIT COST WITH CAPITAL $/1000 GAL
1 NEAHKAHNIE	111	$1,381,000	$60,600	38	$2.97	UNKNOWN	UNKNOWN
2 MANZANITA	350	$1,607,000	$119,700	112	$1.99	$251,442	$4.19
3 NEHALEM	350	$1,898,000	$101,500	94	$2.01	$257,098	$5.10
4 WHEELER	100	$1,229,600	$23,500	51	$0.86	$124,303	$4.55
5 ROCKAWAY BEACH	1400	$1,907,600	$228,276 (1)	309	$1.38	$384,661	$2.32 (2)
6 WATSECO/BARVIEW	200	$50,000	$12,600	17	$1.38	$16,699	$1.83
SUBTOTALS		$8,073,200	$546,176			$1,034,202	
7 NBSP	24	N.A.	$3,000	17	$0.33	$3,000	$0.33
8 BRIGHTON	10	$55,000	$2,000	2	$1.87	$6,509	$6.07
9 ZADDACK CREEK	10	$20,000	N.A.	2	UNKNOWN	$1,640	$1.53
10 TIDELAND	35	NEHALEM	N.A.	17	$2.10	$0	$5.10
TOTALS		$8,148,200		659		$1,045,351	
SEPARATE SOURCE DEVELOPMENT WITH SDC'S:							
1A NEAHKAHNIE	111	$933,108	$60,600	38	$2.97	UNKNOWN	UNKNOWN
2A MANZANITA	350	$1,028,480	$119,700	112	$1.99	$204,015	$3.40
3A NEHALEM	350	$1,019,497	$101,500	94	$2.01	$185,078	$3.67
4A WHEELER	100	$1,229,600	$23,500	51	$0.86	$124,303	$4.55
5A ROCKAWAY BEACH	1400	$1,053,268	$228,276	309	$1.38	$314,622	$1.90
6A WATSECO/BARVIEW	200	$7,500	$12,600	17	$1.38	$13,215	$1.45
7A NBSP	24	N.A.	$3,000	17	$0.33	$3,000	$0.33
8A BRIGHTON	10	$23,571	$2,000	2	$1.87	$3,932	$3.67
9A ZADDACK CREEK	10	N.A.	N.A.	2	UNKNOWN	N.A.	N.A.
10A TIDELAND	35	NEHALEM	N.A.	17	$2.01	$0	$3.67
TOTALS		$5,295,024				$848,165	

(1) INCLUDES EXISTING WATER PRODUCTION COSTS AT $1.11 PER 1000 GALLONS.

(2) INCLUDES O&M AT JETTY CREEK BUT NOT CAPITAL AMORITIZATION OF JETTY CREEK.

TABLE 6.3A (CON'T)

JURISDICTION	RECOMMENDED CAPACITY(GPM)	ESTIMATED CAPITAL COST, 1993	SOURCE ANNUAL O&M COST EST.	1992 AVERAGE DAILY WATER PRODUCTION(GPM)	1993 UNIT O&M COST $/1000 GAL	PROJECTED 1993 ANNUAL O&M COST INCLUDING CAPITAL	PROJECTED 1993 UNIT COST WITH CAPITAL $/1000 GAL
11 REGIONAL SUPPLY	2100			700			
A. RIVER SOURCE WITH TREATMENT		$4,800,000	$312,732	700	$0.85	$706,236	$1.83
B. TRASMISSION, STORAGE AND PUMPING		$4,694,190	$33,773	700	$0.09	$418,602	$1.08
SUBTOTALS		**$9,494,190**	**$346,505**			**$1,124,838**	**$2.91**
DEDUCT FOR SYSTEM DEVELOPMENT CHARGES NET EXPENSE TO EXISTING BASE		$6,332,625	$346,505	700	$0.94	$865,653	$2.24
12 REGIONAL SUPPLY WITH JETTY CREEK TO REMAIN AND TRANS. MAIN SIZED FOR ULTIMATE FLOW							
A. RIVER SOURCE WITH TREATMENT	1400	$4,100,000	$173,448	330	$1.00	$509,566	$2.80
B. TRANSMISSION, STORAGE AND PUMPING	2100	$4,694,190	$30,756	700	$0.08	$415,585	$1.08
SUBTOTALS		**$8,794,190**	**$204,204**			**$925,151**	**$3.87**
13 REGIONAL SUPPLY WITH JETTY CREEK PART OF SOURCE, DOWNSIZED TRANS. MAIN							
A. RIVER SOURCE WITH TREATMENT	1400	$4,100,000	$173,448	330	$1.00	$509,566	$2.80
B. TRANSMISSION, STORAGE AND PUMPING	1400	$4,212,730	$28,348	330	$0.16	$373,708	$2.05
SUBTOTALS		**$8,312,730**	**$201,796**			**$883,274**	**$4.85**
14 REGIONAL SUPPLY WITH WELLS							
A. WELLS	2100	$1,000,000	$136,937	700	$0.37	$218,917	$0.57
B. TRANSMISSION, STORAGE AND PUMPING	2100	$4,694,190	$38,924	700	$0.11	$423,753	$1.10
SUBTOTALS		**$5,694,190**	**$175,861**			**$642,670**	**$1.66**
DEDUCT FOR SYSTEM DEVELOPMENT CHARGES NET EXPENSE TO BASE		$3,796,146	$175,861	700	$0.44	$487,069	$1.26

1307Q08.WQ1

TABLE 6.3B

ALTERNATIVE WATER SUPPLY COST ESTIMATES

ASSUMED CAPITAL RECOVERY FACTOR (5.0% AT 40 YEARS): 0.05828

JURISDICTION	RECOMMENDED CAPACITY(GPM)	ESTIMATED CAPITAL COST, 1993	SOURCE ANNUAL O&M COST EST.	1992 AVERAGE DAILY WATER PRODUCTION(GPM)	1993 UNIT O&M COST $/1000 GAL	PROJECTED 1993 ANNUAL O&M COST INCLUDING CAPITAL	PROJECTED 1993 UNIT COST WITH CAPITAL $/1000 GAL
1 NEAHKAHNIE	111	$1,381,000	$60,600	38	$2.97	UNKNOWN	UNKNOWN
2 MANZANITA	350	$1,607,000	$119,700	112	$1.99	$213,356	$3.55
3 NEHALEM	350	$1,898,000	$101,500	94	$2.01	$212,115	$4.21
4 WHEELER	100	$1,229,600	$23,500	51	$0.86	$95,161	$3.48
5 ROCKAWAY BEACH	1400	$1,907,600	$228,276 (1)	309	$1.38	$339,450	$2.05 (2)
6 WATSECO/BARVIEW	200	$50,000	$12,600	17	$1.38	$15,514	$1.70
SUBTOTALS		$8,073,200	$546,176			$875,597	
7 NBSP	24	N.A.	$3,000	17	$0.33	$3,000	$0.33
8 BRIGHTON	10	$55,000	$2,000	2	$1.87	$5,205	$4.85
9 ZADDACK CREEK	10	$20,000	N.A.	2	UNKNOWN	$1,166	$1.09
10 TIDELAND	35	NEHALEM	N.A.	17	$2.10	$0	$4.21
TOTALS		$8,148,200		659		$884,968	
SEPARATE SOURCE DEVELOPMENT WITH SDC'S:							
1A NEAHKAHNIE	111	$933,108	$60,600	38	$2.97	UNKNOWN	UNKNOWN
2A MANZANITA	350	$1,028,480	$119,700	112	$1.99	$179,640	$2.99
3A NEHALEM	350	$1,019,497	$101,500	94	$2.01	$160,916	$3.19
4A WHEELER	100	$1,229,600	$23,500	51	$0.86	$95,161	$3.48
5A ROCKAWAY BEACH	1400	$1,053,268	$228,276	309	$1.38	$289,660	$1.75
6A WATSECO/BARVIEW	200	$7,500	$12,600	17	$1.38	$13,037	$1.43
7A NBSP	24	N.A.	$3,000	17	$0.33	$3,000	$0.33
8A BRIGHTON	10	$23,571	$2,000	2	$1.87	$3,374	$3.15
9A ZADDACK CREEK	10	N.A.	N.A.	2	UNKNOWN	N.A.	N.A.
10A TIDELAND	35	NEHALEM	N.A.	17	$2.01	$0	$3.19
TOTALS		$5,295,024				$744,788	

(1) INCLUDES EXISTING WATER PRODUCTION COSTS AT $1.11 PER 1000 GALLONS.

(2) INCLUDES O&M AT JETTY CREEK BUT NOT CAPITAL AMORITIZATION OF JETTY CREEK.

TABLE 6.3B (CON'T)

JURISDICTION	RECOMMENDED CAPACITY(GPM)	ESTIMATED CAPITAL COST, 1993	SOURCE ANNUAL O&M COST EST.	1992 AVERAGE DAILY WATER PRODUCTION(GPM)	1993 UNIT O&M COST $/1000 GAL	PROJECTED 1993 ANNUAL O&M COST INCLUDING CAPITAL	PROJECTED 1993 UNIT COST WITH CAPITAL $/1000 GAL
11 REGIONAL SUPPLY	2100			700			
A. RIVER SOURCE WITH TREATMENT		$4,800,000	$312,732	700	$0.85	$592,476	$1.53
B. TRASMISSION, STORAGE AND PUMPING		$4,694,190	$33,773	700	$0.09	$307,350	$0.80
SUBTOTALS		**$9,494,190**	**$346,505**			**$899,826**	**$2.33**
DEDUCT FOR SYSTEM DEVELOPMENT CHARGES NET EXPENSE TO EXISTING BASE		$6,332,625	$346,505	700	$0.94	$715,570	$1.85
12 REGIONAL SUPPLY WITH JETTY CREEK TO REMAIN AND TRANS. MAIN SIZED FOR ULTIMATE FLOW							
A. RIVER SOURCE WITH TREATMENT	1400	$4,100,000	$173,448	330	$1.00	$412,396	$2.26
B. TRANSMISSION, STORAGE AND PUMPING	2100	$4,694,190	$30,756	700	$0.08	$304,333	$0.79
SUBTOTALS		**$8,794,190**	**$204,204**			**$716,729**	**$3.05**
13 REGIONAL SUPPLY WITH JETTY CREEK PART OF SOURCE, DOWNSIZED TRANS. MAIN							
A. RIVER SOURCE WITH TREATMENT	1400	$4,100,000	$173,448	330	$1.00	$412,396	$2.26
B. TRANSMISSION, STORAGE AND PUMPING	1400	$4,212,730	$28,348	330	$0.16	$273,866	$1.50
SUBTOTALS		**$8,312,730**	**$201,796**			**$686,262**	**$3.77**
14 REGIONAL SUPPLY WITH WELLS							
A. WELLS	2100	$1,000,000	$136,937	700	$0.37	$195,217	$0.51
B. TRANSMISSION, STORAGE AND PUMPING	2100	$4,694,190	$38,924	700	$0.11	$312,501	$0.81
SUBTOTALS		**$5,694,190**	**$175,861**			**$507,718**	**$1.31**
DEDUCT FOR SYSTEM DEVELOPMENT CHARGES NET EXPENSE TO BASE		$3,796,146	$175,861	700	$0.44	$397,100	$1.03

1307Q08.WQ1

TABLE 6.3C

ALTERNATIVE WATER SUPPLY COST ESTIMATES

ASSUMED CAPITAL RECOVERY FACTOR (6.5% AT 20 YEARS): 0.09076

	JURISDICTION	RECOMMENDED CAPACITY(GPM)	ESTIMATED CAPITAL COST, 1993	SOURCE ANNUAL O&M COST EST.	1992 AVERAGE DAILY WATER PRODUCTION(GPM)	1993 UNIT O&M COST $/1000 GAL	PROJECTED 1993 ANNUAL O&M COST INCLUDING CAPITAL	PROJECTED 1993 UNIT COST WITH CAPITAL $/1000 GAL
1	NEAHKAHNIE	111	$1,381,000	$60,600	38	$2.97	UNKNOWN	UNKNOWN
2	MANZANITA	350	$1,607,000	$119,700	112	$1.99	$265,551	$4.42
3	NEHALEM	350	$1,898,000	$101,500	94	$2.01	$273,762	$5.43
4	WHEELER	100	$1,229,600	$23,500	51	$0.86	$135,098	$4.94
5	ROCKAWAY BEACH	1400	$1,907,600	$228,276 (1)	309	$1.38	$401,409	$2.42 (2)
6	WATSECO/BARVIEW	200	$50,000	$12,600	17	$1.38	$17,138	$1.88
	SUBTOTALS		$8,073,200	$546,176			$1,092,960	
7	NBSP	24	N.A.	$3,000	17	$0.33	$3,000	$0.33
8	BRIGHTON	10	$55,000	$2,000	2	$1.87	$6,992	$6.52
9	ZADDACK CREEK	10	$20,000	N.A.	2	UNKNOWN	$1,815	$1.69
10	TIDELAND	35	NEHALEM	N.A.	17	$2.10	$0	$5.43
	TOTALS		$8,148,200		659		$1,104,767	
	SEPARATE SOURCE DEVELOPMENT WITH SDC'S:							
1A	NEAHKAHNIE	111	$933,108	$60,600	38	$2.97	UNKNOWN	UNKNOWN
2A	MANZANITA	350	$1,028,480	$119,700	112	$1.99	$213,045	$3.55
3A	NEHALEM	350	$1,019,497	$101,500	94	$2.01	$194,030	$3.85
4A	WHEELER	100	$1,229,600	$23,500	51	$0.86	$135,098	$4.94
5A	ROCKAWAY BEACH	1400	$1,053,268	$228,276	309	$1.38	$323,870	$1.96
6A	WATSECO/BARVIEW	200	$7,500	$12,600	17	$1.38	$13,281	$1.46
7A	NBSP	24	N.A.	$3,000	17	$0.33	$3,000	$0.33
8A	BRIGHTON	10	$23,571	$2,000	2	$1.87	$4,139	$3.86
9A	ZADDACK CREEK	10	N.A.	N.A.	2	UNKNOWN	N.A.	N.A.
10A	TIDELAND	35	NEHALEM	N.A.	17	$2.01	$0	$3.85
	TOTALS		$5,295,024				$886,463	

(1) INCLUDES EXISTING WATER PRODUCTION COSTS AT $1.11 PER 1000 GALLONS.

(2) INCLUDES O&M AT JETTY CREEK BUT NOT CAPITAL AMORITIZATION OF JETTY CREEK.

TABLE 6.3C (CON'T)

JURISDICTION	RECOMMENDED CAPACITY(GPM)	ESTIMATED CAPITAL COST, 1993	SOURCE ANNUAL O&M COST EST.	1992 AVERAGE DAILY WATER PRODUCTION(GPM)	1993 UNIT O&M COST $/1000 GAL	PROJECTED 1993 ANNUAL O&M COST INCLUDING CAPITAL	PROJECTED 1993 UNIT COST WITH CAPITAL $/1000 GAL
11 REGIONAL SUPPLY	2100			700			
A. RIVER SOURCE WITH TREATMENT		$4,800,000	$312,732	700	$0.85	$748,380	$1.94
B. TRASMISSION, STORAGE AND PUMPING		$4,694,190	$33,773	700	$0.09	$459,817	$1.19
SUBTOTALS		$9,494,190	$346,505			$1,208,197	$3.13
DEDUCT FOR SYSTEM DEVELOPMENT CHARGES NET EXPENSE TO EXISTING BASE		$6,332,625	$346,505	700	$0.94	$921,254	$2.38
12 REGIONAL SUPPLY WITH JETTY CREEK TO REMAIN AND TRANS. MAIN SIZED FOR ULTIMATE FLOW							
A. RIVER SOURCE WITH TREATMENT	1400	$4,100,000	$173,448	330	$1.00	$545,564	$3.00
B. TRANSMISSION, STORAGE AND PUMPING	2100	$4,694,190	$30,756	700	$0.08	$456,800	$1.18
SUBTOTALS		$8,794,190	$204,204			$1,002,364	$4.18
13 REGIONAL SUPPLY WITH JETTY CREEK PART OF SOURCE, DOWNSIZED TRANS. MAIN							
A. RIVER SOURCE WITH TREATMENT	1400	$4,100,000	$173,448	330	$1.00	$545,564	$3.00
B. TRANSMISSION, STORAGE AND PUMPING	1400	$4,212,730	$28,348	330	$0.16	$410,696	$2.26
SUBTOTALS		$8,312,730	$201,796			$956,260	$5.25
14 REGIONAL SUPPLY WITH WELLS							
A. WELLS	2100	$1,000,000	$136,937	700	$0.37	$227,697	$0.59
B. TRANSMISSION, STORAGE AND PUMPING	2100	$4,694,190	$38,924	700	$0.11	$464,968	$1.20
SUBTOTALS		$5,694,190	$175,861			$692,665	$1.79
DEDUCT FOR SYSTEM DEVELOPMENT CHARGES NET EXPENSE TO BASE		$3,796,146	$175,861	700	$0.44	$520,399	$1.35

1307Q08.WQ1

TABLE 6.4

NEW TRANSMISSION MAIN COST COMPARISION

TRANSMISSION MAIN SIZES FOR 2050 PEAK DEMAND

PIPE #	LENGTH (FT)	DIA. (IN)	COST $/FT	PIPE COST
101	13,000	16	$43.12	$560,560
102	1,000	16	$43.12	$43,120
103	5,000	16	$43.12	$215,600
104	9,000	12	$35.88	$322,920
105	5,000	8	$28.27	$141,350
106	4,000	12	$35.88	$143,520
107	18,000	12	$35.88	$645,840
108	6,000	12	$35.88	$215,280
			TOTAL	$2,288,190

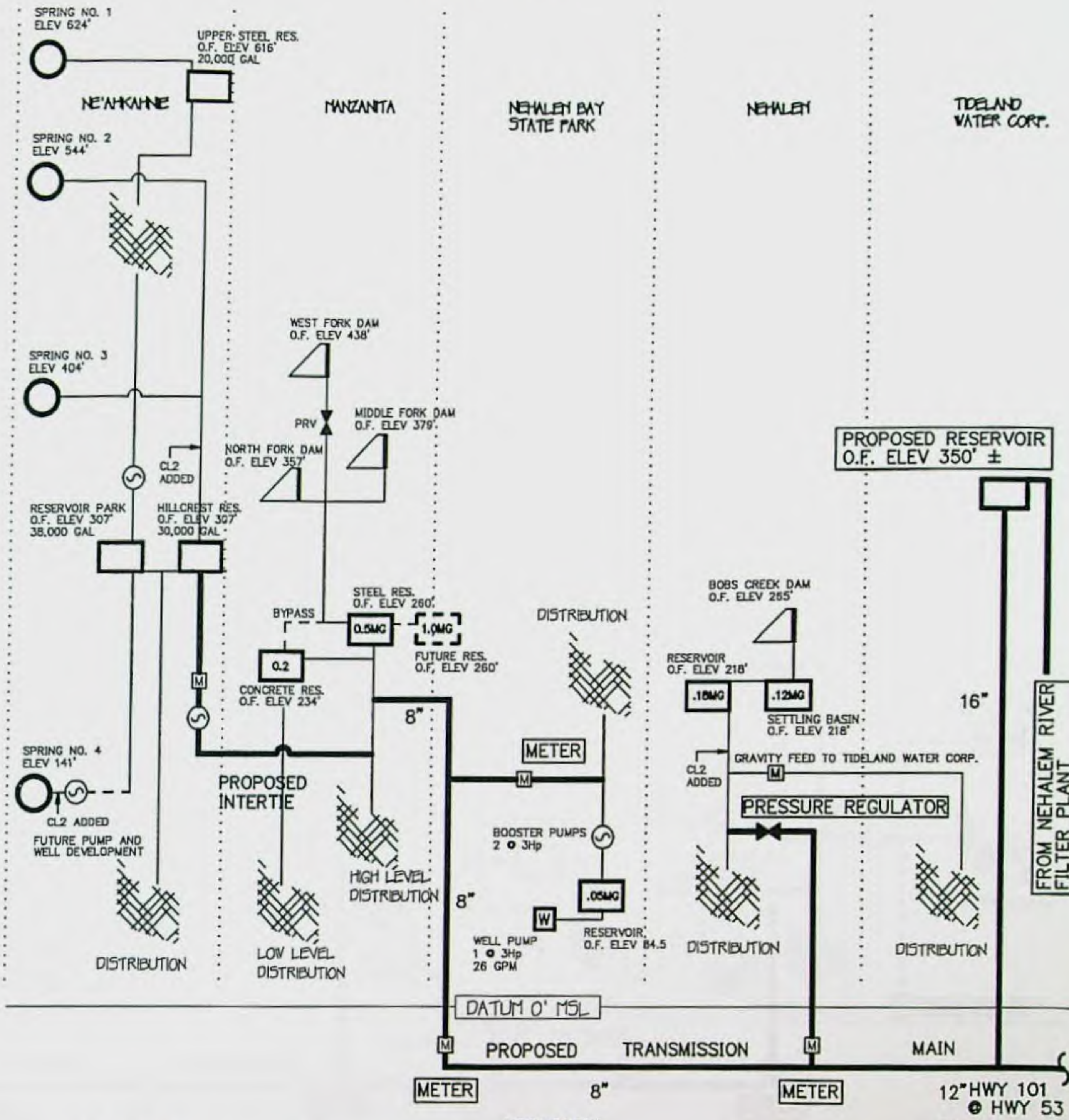
TRANSMISSION MAIN SIZES FOR 2050 PEAK DEMAND

WITH 1MGD FROM JETTY CREEK

PIPE #	LENGTH (FT)	DIA. (IN)	COST $/FT	PIPE COST
101	13,000	16	$43.12	$560,560
102	1,000	16	$43.12	$43,120
103	5,000	16	$43.12	$215,600
104	9,000	12	$35.88	$322,920
105	5,000	8	$28.27	$141,350
106	4,000	10	$31.98	$127,920
107	18,000	10	$31.98	$575,640
108	6,000	8	$28.27	$169,620
			TOTAL	$2,156,730

COST DIFFERENCE ***$131,460***

FIGURE 6.1-1



	NE'AH KAH NIE	MANZANITA	NEHALEM BAY STATE PARK	NEHALEM	TIDELAND WATER CORP.
POPULATION	540 ±	513 ±	N.A.	232 ±	45 ±
. SERVICES	1992 – 260	1002	302	450	20
VE. DEMAND	1992 – 54,000 GPD	1992 – 162,300 GPD	1992 – 24,000 GPD	1992 – 135,100 GPD	1992 – 24,500 GPD
PEAK DEMAND	1992 – 97,700 GPD/PF=1.8	1992 – 350,000 GPD/PF=2.2	1992 – 46,000 GPD / PF=1.9	1992 – 270,200 GPD / PF=2	1992 – 48,500 GPD / PF=2
RESSURE	20 psi TO 125 psi ±	UPPER: 65psi/LOWER: 90psi ±	40 psi ±	94 psi ±	80 psi ±

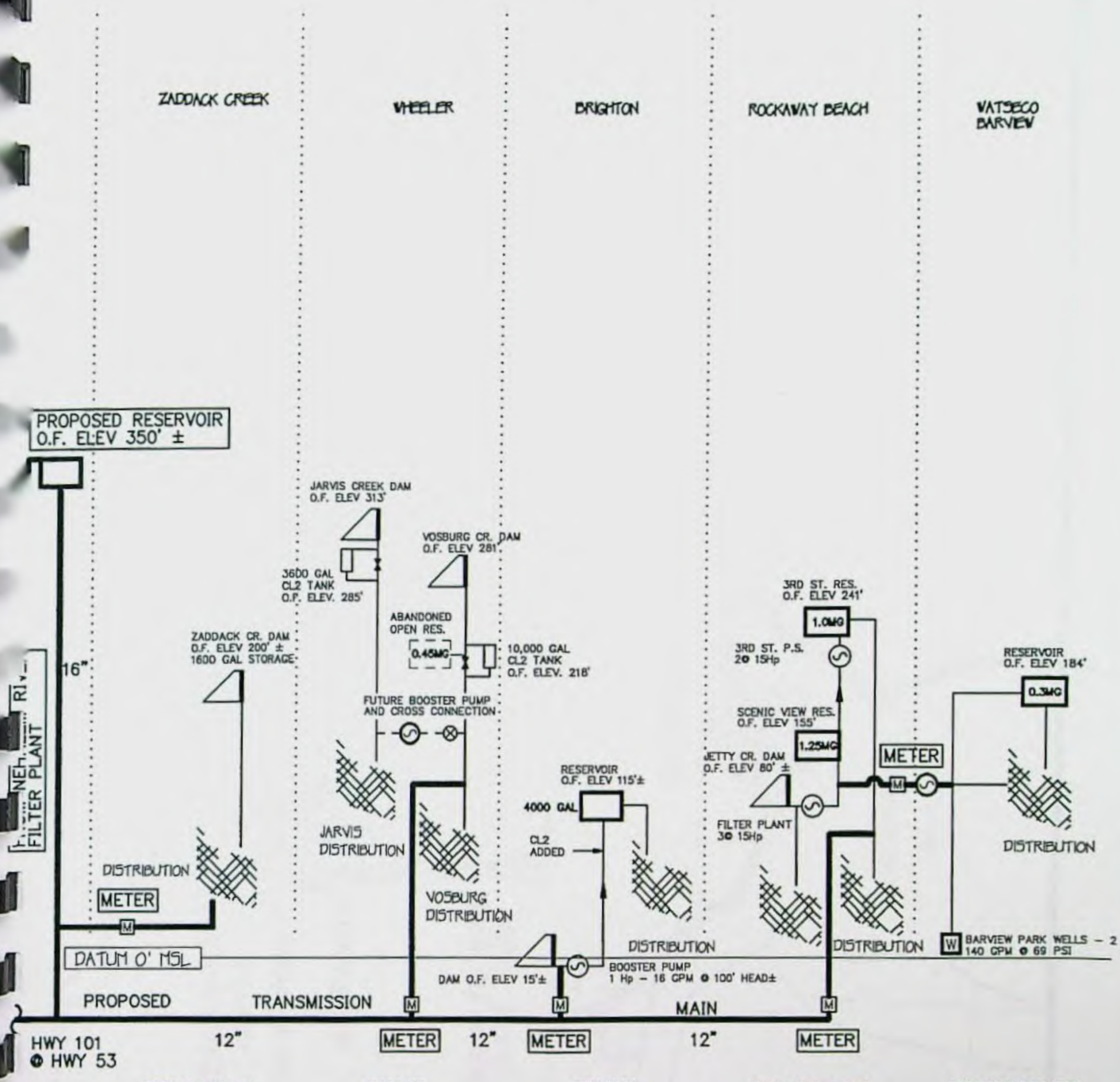
N. TILLAMOOK CO. REGIONAL WATER STUDY

SYSTEM SCHEMATICS

2/15/93
1307S01

LEE ENGINEERING, INC. 1300 JOHN ADAMS, OREGON CITY, OREGON 97045

FIGURE 6.1-2



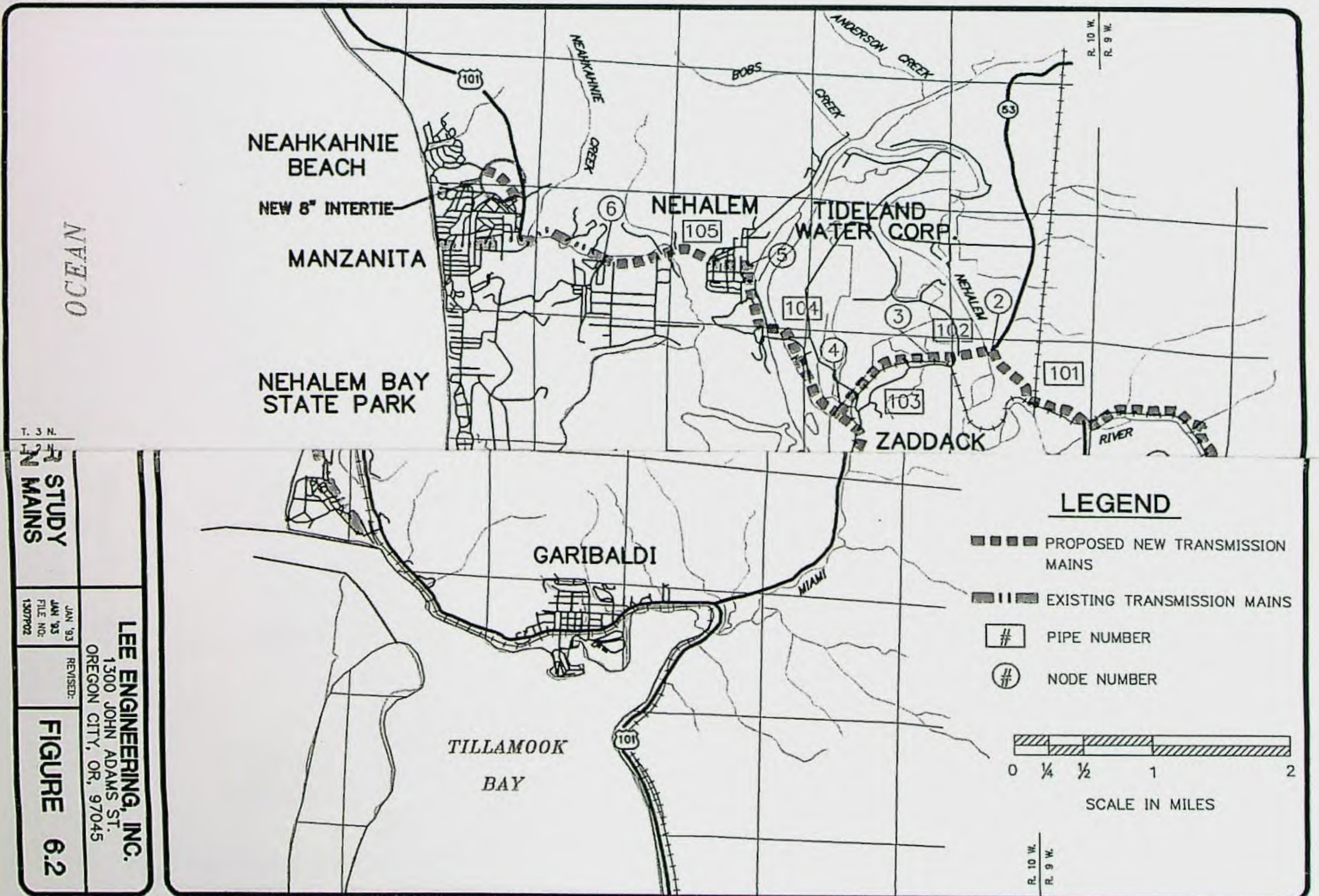
	ZADDACK CREEK	WHEELER	BRIGHTON	ROCKAWAY BEACH	WATSECO/BARVIEW
POPULATION	24 ±	335 ±	30 ±	970 ±	310 ±
SERVICES	10 CURRENT/15 ULTIMATE	180	12	1660	129
AVE. DEMAND	1992 – 2400 GPD	1992 – 73,560 GPD	1992 – 3,000 GPD	1992 – 445,000 GPD	1992 – 24,945 GPD
PEAK DEMAND	1992 – 4800 GPD / PF=2	1992 – 147,120 GPD / PF=2	1992 – 6,000 GPD / PF=2	1992 – 1.12 MGD / PF=2.5	1992 – 43,600 GPD/PF=1.7
PRESSURE	40 psi ±	JARVIS: 62/VOSBURG: 74 psi ±	43 psi ±	35 psi TO 65 psi ±	100 psi ±

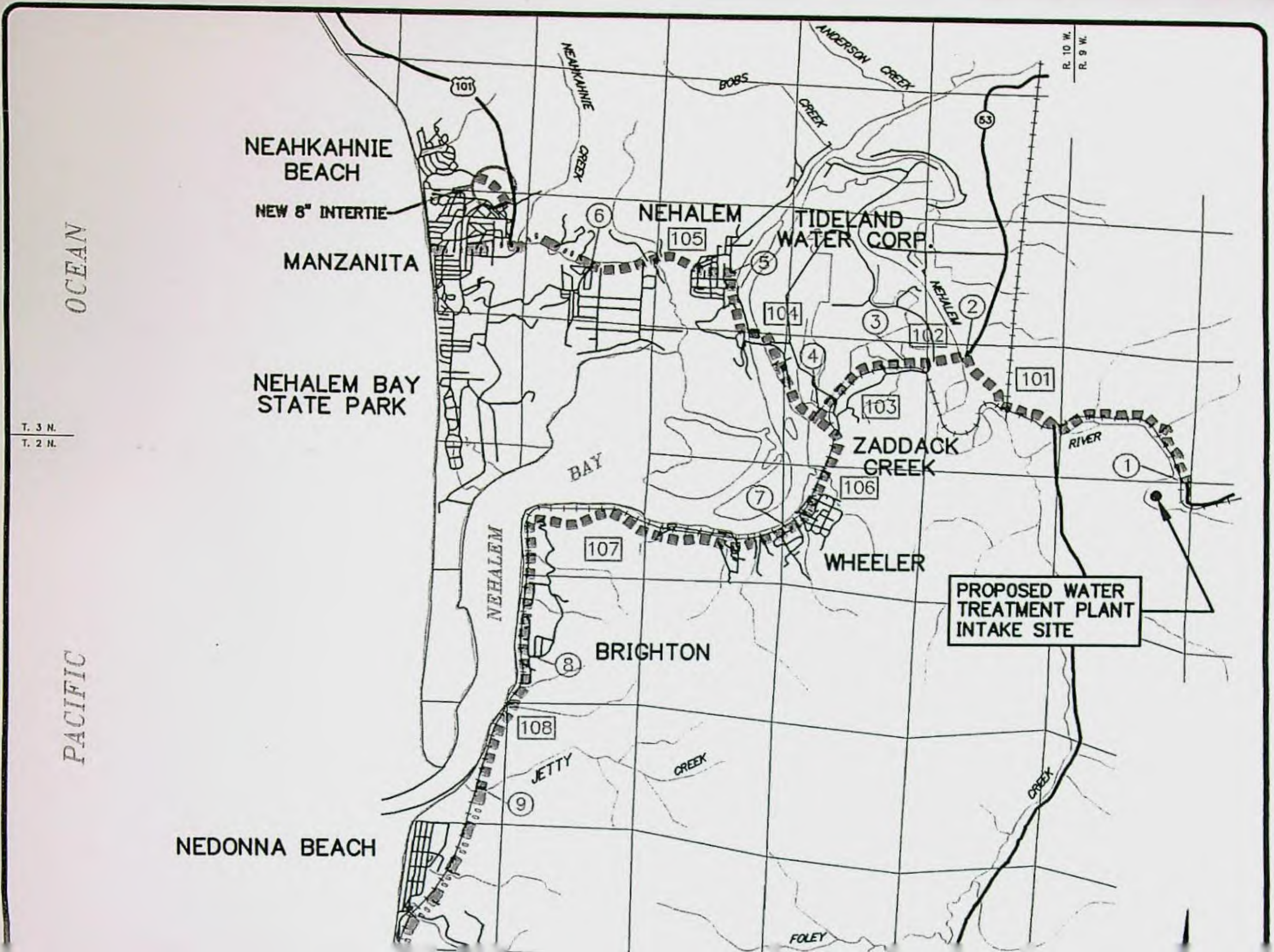
N. TILLAMOOK CO. REGIONAL WATER STUDY

SYSTEM SCHEMATICS

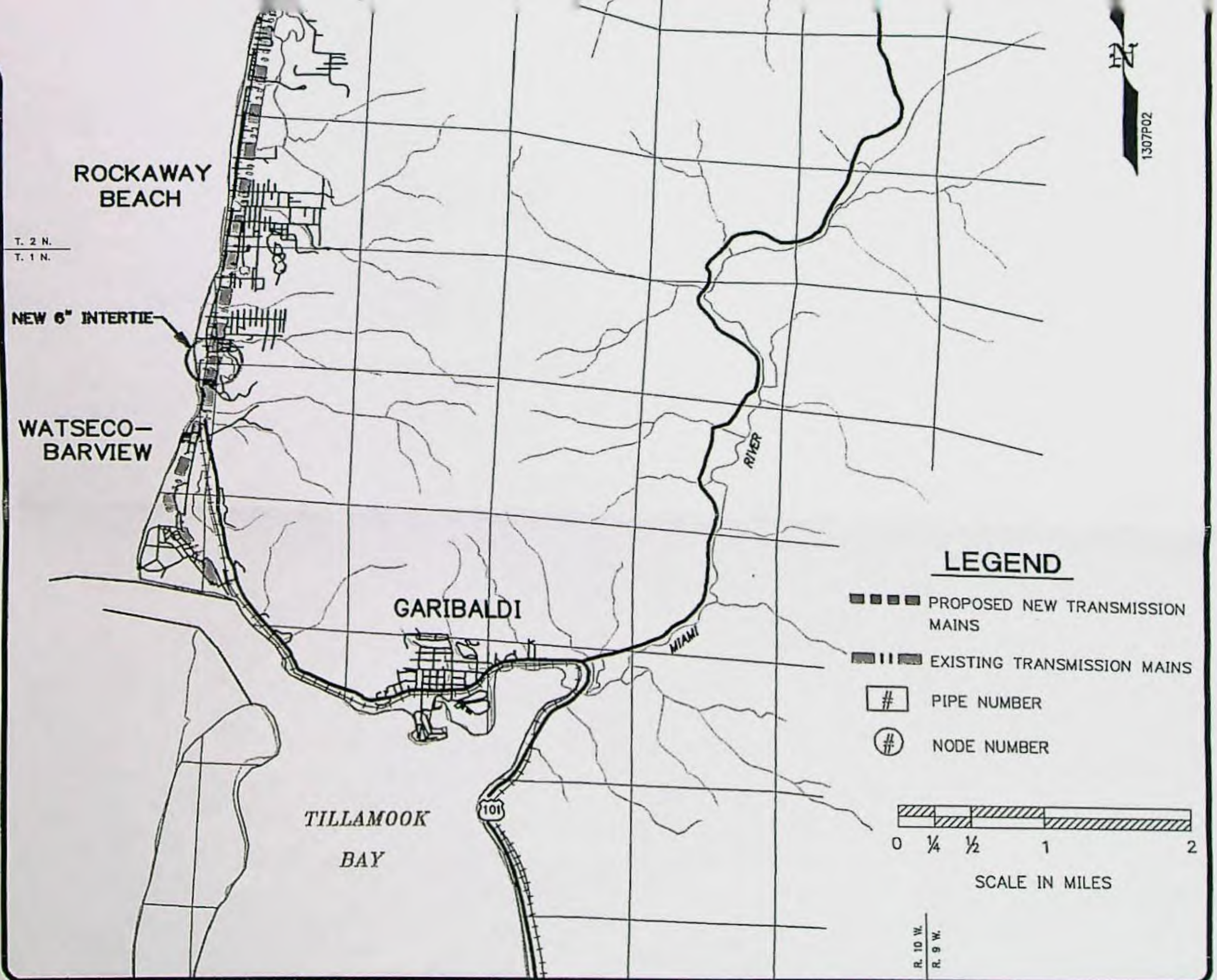
2/15/93

1307S01


NEAHKAHNIE BEACH
NEW 8" INTERTIE
MANZANITA
NEHALEM BAY STATE PARK
OCEAN
NEHALEM
TIDELAND WATER CORP.
ZADDACK
NEAHKAHNIE CREEK
BOBS CREEK
ANDERSON CREEK
NEHALEM RIVER
MIAMI
GARIBALDI
TILLAMOOK BAY
101
53
105
104
102
103
101
2
3
4
5
6
R. 10 W.
R. 9 W.
T. 3 N.
T. 2 N.
LEGEND
PROPOSED NEW TRANSMISSION MAINS
EXISTING TRANSMISSION MAINS
PIPE NUMBER
NODE NUMBER
0 ¼ ½ 1 2
SCALE IN MILES
R STUDY
N MAINS
JAN '93
JAN '93
FILE NO:
1307P02
REVISED:
LEE ENGINEERING, INC.
1300 JOHN ADAMS ST.
OREGON CITY, OR, 97045
FIGURE 6.2



R. 10 W.
R. 9 W.
ANDERSON CREEK
BOBS CREEK
NEAHKAHNIE CREEK
101
53
NEAHKAHNIE BEACH
NEW 8" INTERTIE
MANZANITA
OCEAN
6
NEHALEM
105
TIDELAND WATER CORP.
5
104
3
NEHALEM
2
102
4
NEHALEM BAY STATE PARK
101
103
T. 3 N.
T. 2 N.
ZADDACK CREEK
RIVER
1
BAY
106
7
107
WHEELER
NEHALEM
PROPOSED WATER TREATMENT PLANT INTAKE SITE
BRIGHTON
8
PACIFIC
108
JETTY
CREEK
CREEK
9
NEDONNA BEACH
FOLEY



OWNER:
CITY OF WHEELER

DWG TITLE:
N. TILLAMOOK CO. REGIONAL WATER STUDY
PROPOSED REGIONAL TRANSMISSION MAINS

LEE ENGINEERING, INC.
1300 JOHN ADAMS ST.
OREGON CITY, OR, 97045

JAN '93
JAN '93
FILE NO:
1307P02

REVISED:

FIGURE 6.2

CHAPTER 7

CHAPTER 7

OPTIONAL WATER SUPPLY ORGANIZATIONS

The State Constitution and Oregon Revised Statutes provide for various forms of government that can be set up to operate water supply systems and provide for their financing. Several, but not all, of the options are listed below. Options not discussed include water control districts, irrigation districts, small drainage districts, district improvement companies, private corporations, nonprofit corporations and cooperatives. These options are unlikely considering the existing organizational structures of cities and water districts currently in place within the study area.

A more detailed description of the various organizational structures can be found in the appropriate statutes at most of the County law libraries.

7.1 CITIES

Statutory authority is provided for cities to supply water inside and outside their corporate limits, depending on how the city charter is drafted. Public water supply systems can be developed by cities in cooperation with other cities, water districts, private utilities or water associations. Cities may use their powers to acquire property, finance improvements, and perform other water work functions. They may purchase, own, hold, appropriate and condemn lands, rights-of-way, water permits or water rights, all for their specific needs. Typically, cities may issue revenue bonds or general obligation bonds to finance the construction of water system facilities.

Unique to cities is the authority for local government to make intergovernmental agreements. A unit of local government may enter into a written agreement with any other unit or units of local government for the performance of any or all functions and activities that the parties to the agreement have authority to perform. The agreement may provide for the performance of a function or activity by:

1. A consolidated department;

2. Jointly providing for administrative officers;

3. Means of facilities or equipment jointly constructed, owned, leased or operated such as water supply facilities;

4. One of the parties for any other party;

5. An intergovernmental entity created by the agreement and governed by a board or commission appointed by or responsible to and acting on behalf of the units of local government that are parties to the agreement; or

6. A combination of the methods described above.

A more detailed description of the cooperative arrangement of governmental units is covered under Chapter 190, ORS.

7.2 WATER DISTRICTS

ORS 264 authorizes the formation of water districts as municipal corporations. Communities may be incorporated for the purpose of supplying their inhabitants with water for domestic purposes as provided by this chapter. The district may supply, furnish or sell for any use any surplus water over and above the domestic needs of its inhabitants to any other persons, corporations or associations either within or without the district or to other communities, water districts or municipal corporations. The water district is typically formed as a separate intergovernmental agreement having its own elected officials. Like cities, the water districts have the power to borrow money and to issue general obligation and revenue bonds to finance improvements. The district also has the power of tax assessment, levy and collection in the event it elects to use property taxes, in lieu of revenues, to finance certain portions of its improvements. In general, Bancroft assessment procedures are not available to water districts as they are to cities and sanitary districts. Adjoining districts may be consolidated to form a single domestic supply corporation under ORS 264.575, by voters of the districts involved.

7.3 PEOPLES UTILITY DISTRICTS

Peoples utility districts exist under ORS 261. The Oregon Constitution includes authorization for the establishment of PUD's to develop the water and energy resources of this state for the benefit of the people and to supply public utility service, including water, water power and electric energy for all uses and users. PUD's may supply water both inside and outside of their boundaries. As with cities and water districts, they are authorized to acquire and hold real property, exercise the power of eminent domain, borrow money and incur indebtedness, levy taxes, and enter into contracts with any municipality or utility district for supplying and distributing water. The existing Tillamook PUD could perform the services recommended herein.

7.4 COUNTY SERVICE DISTRICTS

State law concerning statutory powers for Oregon counties do not include authority to retail water or distribute water as permitted to cities and water districts. However, ORS 451 does provide that county service districts may be created within a county for providing sewage service and water supply developments. However, in Tillamook County, the County has recently had experience with this issue and elected not to become politically involved at this time.

For home rule counties, the law does permit the county to develop water supplies and construct, maintain and operate complete water systems including distribution and service to customers.

A limit on home rule provisions provides that the bonded indebtedness of a county may not exceed 2% of the true cash value of all taxable property within the county. Whether or not this applies in Tillamook County needs further review. Also, the County Commission would be the governing body under this provision.

7.5 WATER AUTHORITIES

Recent legislation has enacted the powers for water supply authorities under ORS 450.650. A separate governing board of directors may be elected separate from other governing bodies. The board is to consist of seven members. The term of the board is four years, and any elector residing within the boundaries of the water authority may be qualified as a board member. The only restriction is that the board of directors shall not consist of any member who is employed by the water supply authority.

Water authorities may be formed from existing cities, water districts, or other entities. Any portion of one or more counties, including both incorporated and unincorporated areas as well as areas within domestic water supply districts, county service districts, and other districts may be formed into a water supply authority under the Act. Such areas need not be contiguous.

According to the law, a water supply authority is a municipality and may issue revenue bonds to finance proposed construction.

Another unique aspect of water authorities is the right to acquire water rights from any municipality or district upon its inception. Further, a water supply authority may change the points of diversion of water or move the water intake sources as specified in the water rights permit or certificates of those districts or municipalities that were merged into the water authority. In general, the primary purpose of the water authority is to operate a municipal organization whose primary function is the supply of domestic water. However, the water authority may extend its jurisdiction to the transmission, distribution and operation of individual water systems.

CHAPTER 8

CHAPTER 8

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Throughout the course of this study, several conclusions and recommendations have been brought forward by the Water Resource Committee and the Engineers. A summary of those conclusions and recommendations follows.

8.1 SUMMARY OF CONCLUSIONS

8.1.1 New regulations promulgated under the Federal Safe Drinking Water Act will require all domestic water systems in the planning area to improve their water supply sources.

8.1.2 The potential for future development in the planning area is dependent upon adequate supplies of domestic water. None of the existing supplies are adequate in capacity to meet potential growth demands. Further, most of the systems will have to address serious deficiencies in meeting future water quality criteria.

8.1.3 Growth in population will be severe in most of the existing cities, commensurate with adequate facilities, including water supplies. Total population in the planning area may approach 47,000 at saturation under the existing Comprehensive Plans.

8.1.4 Although adequate water rights exist for the various purveyors, except possibly Watseco/Barview, minimum stream flows during drought conditions are much less than the existing water rights.

8.1.5 Minimum stream flows are not sufficient to meet most of the existing demands during July and August, particularly during drought years.

8.1.6 The scope of this report was limited primarily to engineering issues. Environmental, social and institutional issues need to be addressed before proceeding with any long term alternative water supply.

8.1.7 Several source options were reviewed. The only existing source of sufficient capacity of fresh water to serve the region is the Nehalem River.

8.1.8 The most reliable option for treating surface waters is complete treatment using package filter plants.

8.1.9 Groundwater development in the gravel alluvium of the Nehalem River is the least cost alternative for a regional water supply. Further studies of the groundwater availability and water quality are necessary before a final decision on the regional supply can be made.

8.1.10 It is estimated that the cost of future water supplies will add somewhere between $1.00 and $5.00 per 1,000 gallons to the cost of water. This is about $6.00 to $30.00 a month per customer, on average, above what is currently being paid.

8.2 SUMMARY OF RECOMMENDATIONS

8.2.1 Water rights for the proposed regional supply have been filed for by the City of Wheeler. Public hearings on the permit application are scheduled for this spring. Resources must be developed to proceed with this process.

8.2.2 A public information program should be developed on the regional water supply option. The findings of this report should be presented to each of the affected jurisdictions and their support should be encouraged. Financial support for the public information program should be solicited from EPA and the Rural Community Assistance Corporation (RCAC) through Linn Benton Community College.

8.2.3 It is recommended that two or more of the existing jurisdictions form a water authority to proceed with development of the regional supply from the Nehalem River. Wheeler, Nehalem, Manzanita and several of the smaller water purveyors are the obvious beneficiaries of a new water source.

8.2.4 It is recommended that Neahkahnie, Rockaway Beach and Watseco/Barview undertake additional studies of their water needs before joining a regional supply in the near future. However, a regional water supply should anticipate providing future service to these areas.

8.2.5 A program of tasks, interim operation, organization and funding should be developed as soon as possible. Those communities under Administrative Order from the Oregon Health Division to treat their water supplies must submit such a program to the Health Division for approval.

8.2.6 An interim intergovernmental agreement should be entered into as soon as possible to proceed with key critical issues such as:

- Land acquisition
- Hydrogeologic and geologic studies of groundwater on the Nehalem.
- Water rights
- Environmental studies

- Legal and administrative issues for formation of a water authority
- Funding
- Public information programs
- Continued engineering assistance
- Permits
- Land use issues

APPENDIX A

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APPENDIX B

GLOSSARY

DEFINITION OF TERMS

Alluvium. Clay, silt, sand, gravel or similar detrital material deposited by running water.

Annual Average Demand. The total gallonage of water delivered to the system in a year, divided by 365 days.

Aquifer. Porous water bearing formation of permeable rock, sand, or gravel capable of yielding significant amounts of water.

Average Daily Flow (ADF) or Average Daily Demand (ADD). A measurement of the amount of water treated by a plant or delivered to a pipe system each day. It is the average of the actual daily flows that occur within a period of time, such as a week, a month, or a year. Mathematically, it is the sum of all daily flows divided by the total number of daily flows used.

Average flow rate. The average of the instantaneous flow rates over a given period of time, such as a day.

Census Zone. A geographic area used by the Bureau of Census to survey and analyze population trends and characteristics.

Coliform. Relating to, resembling, or being the colon bacillus.

Concentration. In chemistry, a measurement of how much solute is contained in a given amount of solution. concentrations are commonly measured in parts per million (ppm), milligrams per litre (mg/L), or grains per gallon (gpg).

Daily Flow. The volume of water that passes through a plant in one day (24 hr.) More precisely called "daily flow volume."

DEQ. Oregon Department of Environmental Quality.

Detention time. The average length of time a drop of water or a suspended particle remains in a tank or chamber. Mathematically, it is the volume of water in the tank divided by the flow rate through the tank. The unit of flow rate used in the calculation (gpm, gph, or gpd) is dependent on whether the detention time is to be calculated in minutes, hours, or days.

EPA. Federal Environmental Protection Agency.

Flow rate. A measure of the volume of water moving past a given point in a given period of time. Compare instantaneous flow rate and average flow rate.

Gallons per capita per day. A measurement of the average number of gallons of water used by the average person each day in a water system. The calculation is made by dividing the total gallons of water used each day by the total number of people using the water system.

Hardness. A characteristic of water, caused primarily by the salts of calcium and magnesium. Causes deposition of scale in boilers, damage in some industrial processes, and sometimes objectionable taste. May also decrease the effectiveness of soap.

Hydraulic Connection. The ability of water to flow between two areas, such as between two water-bearing zones.

Hydraulic Network. A series of interconnecting pipelines.

Hydraulic Capacity. The amount of a fluid that a conduit can deliver.

Hydraulic Grade Line. A line (hydraulic profile) indicating the piezometric level of water at all points along a conduit, open channel, or stream. In an open channel, the HGL is the free water surface.

Instantaneous Flow Rate. A flow rate of water measured at one particular instant, such as by a metering device or by a calculation ($Q = AV$) involving the cross sectional area of the channel or pipe and the velocity of the water at one instant.

Maximum Daily Demand. The maximum gallonage of water delivered to the system in any single day, divided by 1 day.

NPDES. National Pollution Discharge Elimination System.

Organic compounds. Generally, compounds containing carbon that result from decay or reduction of molecules from plants and animals.

Parts per million (ppm). A measure of the concentration of a solution. One part of solute in every million parts of solution. Generally interchangeable with milligrams per litre in water treatment calculations.

Peak Day Demand (PDD). The maximum amount of water used (demanded) in a 24-hour period.

Peaking Factor. The ratio between maximum daily demand and average daily demand.

Percent. The fraction of the whole expressed as parts per one hundred.

Pilot Plant. A small-scale water treatment plant designed and operated to simulate a full-scale water treatment plant.

Pressure. The force pushing on a unit area. Normally pressure can be measured in pounds per square inch (psi), feet of head, or Pascals (Pa).

Prestressed Concrete. Concrete which is preloaded to resist cracking.

Radionuclides. Radioactive elements, usually radon, radium-226, radium 228, uranium, and alpha and beta emitters.

Ratio. A relationship between two numbers. A ratio may be expressed using colons.

Regression. A mathematical or statistical procedure to predict a trend line or trend curve.

Saturation Population. The maximum possible population of a study area given the current zoning regulations.

SOC. Synthetic organic chemicals.

Solvent. The liquid used to dissolve a substance. See Solution.

Tetrachloroethylene. A volatile organic chemical used as an industrial solvent.

Traffic Zones. A geographic area used by planners and highway engineers to analyze traffic volumes.

Transmissibility. a measure of the ability of a geologic formation to transmit water.

Transmission System. A large pipe to transmit water as opposed to distribution system.

Trichloroethylene. A volatile organic chemical used as an industrial solvent.

Trihalomethanes (THMs). Certain organic compounds, sometimes formed when water containing natural organics is chlorinated. Some THMs, in large enough concentrations, may be carcinogenic.

Turbidity. The light scattering properties of water such as clay, algae, etc.

UBC. Urban Growth Boundary.

VOC. Volatile Organic Chemicals.

Well Yield. The volume of water that is discharged from a well during a specified time period (usually minutes). Mathematically, it is the total number of gallons discharged, divided by the minutes during which the discharge was monitored.

CONVERSION FACTORS

1 gallon per minute	= 60 gallons per hour (GPH)
	= 1,440 gallons per day (GPD)
	= 193 cubic feet per day
1 million gallons per day (mgd)	= 695 gallons per minute (gpm)
	= 1.55 cubic feet per second (cfs)
1 cubic foot per second (cfs)	= 450 gallons per minute (gpm)
	= 0.648 million gallons per day (mgd)

Volumetric conversions are as follows:

1 cubic feet	= 7.48 gallons
1 gallon	= 0.134 cubic feet

ABBREVIATIONS

GPM	=gallons per minute
mg/l	=milligrams per liter
MG	=million gallons
MGD	=million gallons per day
NTU	=measure of turbid or cloudy water in Nephelometric Turbidity Units.
WTP	=water treatment plant

APPENDIX C

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Oregon

DEPARTMENT OF HUMAN RESOURCES

HEALTH DIVISION

"OREGON COMMUNITIES TO FILTER WATER SUPPLIES"
Fact Sheet - January 1992
Drinking Water Program
Oregon Health Division

The Health Division issued formal schedules to 47 communities requiring them to improve treatment for their drinking water supplies obtained from lakes, streams, and river sources. The schedules require the communities to either install filtration by June, 1993, or develop an alternate source of water, such as wells or purchasing from another community. These water system improvements will improve the safety of drinking water supplies for nearly 100,000 Oregonians. The Division estimates that upgrading of these water systems will cost about $20M.

In Oregon, as well as the rest of the Pacific Northwest, concern about use of unfiltered water sources has been high for two reasons. The first is the recent history of documented waterborne disease outbreaks in Oregon community water systems, especially due to the parasite *Giardia*. The second reason is the implementation in Oregon of new federal requirements for increased levels of treatment for water systems using surface water sources to reduce the risk of waterborne disease. These new requirements, established under the federal Safe Drinking Water Act Amendments of 1986, took effect January 1, 1991.

Who is Affected?

In Oregon, 50 communities currently use open surface water supplies treated with chlorination but without filtration treatment. A listing of these systems is attached. Most of these systems are small, for example, 29 of the 50 unfiltered systems serve less than 1,000 people. Forty-seven will have to install filtration or an alternate source under the surface water treatment rules; three now meet or will be able to meet requirements to remain unfiltered. In contrast, 105 Oregon community systems currently have filtration treatment in place for each surface water source used..

Background

During the early and middle 1980s, Oregon experienced a number of waterborne giardiasis outbreaks in municipal and large community water systems. The larger outbreaks are described in the attached table. Several of these outbreaks occurred in areas dependent on tourism and as a result these outbreaks had a high degree of public visibility. In each of these outbreaks, unfiltered and inadequately disinfected water sources were used. Boil notices or high levels of chlorination were necessary as temporary measures to control the outbreaks. Final solutions included development of

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24-26 (Rev. 1-91)

alternate water sources, such as ground water or purchased sources, or installation of filtration treatment.

Water systems in United States which use surface water sources for drinking water supplies have generally practiced "multiple barrier" treatment. This means using **both** filtration **and** disinfection, usually using chlorine, to assure that harmful microorganisms are killed. In the Northeastern and Northwestern regions of the U.S., however, many water systems have historically used very high quality surface water sources from isolated high mountain forested watersheds. Many of these water sources could easily meet earlier federal and state water quality standards with disinfection treatment alone. Many Oregon water systems provided additional protection for users by obtaining or negotiating strict controls over access and activities in their watersheds, rather than installing filtration treatment.

As a reult of waterborne disease outbreaks that occurred around the country during the 1970s and 1980s, national research was undertaken to establish the minimum levels of treatment needed to prevent waterborne disease from occurring in water systems using surface waters. This research and experience resulted in the establishment of new federal treatment standards by the U.S. Environmental Protection Agency, which took effect January 1, 1991. The federal requirements have been administered in Oregon by the Health Division's Drinking Water Program since 1986.

Progress Already Made

Oregon communities, the Health Division, and the USEPA have been working since 1978 to improve treatment facilities and operations for surface water supplies. Much progress has already been made. Between 1978 and 1991, 50 communities serving nearly 75,000 Oregonians either installed filtration, connected to other communities, or developed well water sources. In addition, many of the remaining unfiltered communities have already made significant progress toward complying with the new requirements (see attached table). For example, the City of Hillsboro has a $1.4M slow sand filter plant already under construction for their supplemental supply from the upper Tualatin River. The main supply from the lower Tualatin River is already filtered, and has been in operation since 1976.

Three Communities Can Remain Unfiltered

Two communities, the City of Portland and the City of Bend, have demonstrated to the Division that their water supply meets strict requirements under the rules and can remain unfiltered. This is primarily because of the uniquely high quality of the water supply source (Portland's Bull Run and Bend's Tumalo Falls/Bridge Creek watersheds). In addition, the Portland Water Bureau is now completing a major improvement of the disinfection treatment system in order to meet the new treatment requirements, a project that cost $3M and took a year to design and complete. The City of Bend has shifted to city wells to reduce use of the surface supply until disinfection improvements costing $0.7M are completed. A third community, the City of Baker City, will be able to remain unfiltered after installation of $3.4M in improved disinfection and watershed facilities later in 1992.

What is the Health Risk?

Meeting the new standards will reduce the last remaining risks from waterborne disease at unfiltered water supplies. EPA estimates a **maximum** of 455 cases per year of waterborne illness could occur in Oregon from these systems. The Division and Oregon communities are working together to reduce this risk in the short term by implementing higher standards for operating existing systems through operator training and certification, and for the long term by improving and installing treatment for unfiltered supplies. There have been no major outbreaks of illness traced to Oregon water systems in recent years, however, small numbers of illness cases could go undetected.

What Must Communities Do?

As of January 1, 1992, each community water system using a surface water source for drinking water must meet the requirements of the rule, either by filtering the water, or by demonstrating that the water system meets the criteria to remain unfiltered as outlined in the rule. All systems not meeting these requirements must install filtration or obtain an alternate water source by June 29, 1993. The Division is issuing an Administrative Order to each system containing a schedule for achieving compliance with these requirements. The Orders contain information on interim operations and procedures for obtaining extensions to the June 29, 1993 deadline. Extensions are available for communities who need additional time to arrange financing or to complete construction projects.

How Will Improvements be Paid For?

The Division recommends that affected communities complete their plans and cost estimates for water system improvements as soon as possible so that funding can be located and arranged. The 1991 Legislative Assembly created the Safe Drinking Water Funding Program which provides for the state to sell bonds on behalf of water systems and make loans directly to communities for safe drinking water projects. This program is operated by the Oregon Economic Development Department, Community Development Program. Funding assistance is also available from several other state and federal agencies.

For Further Information Contact:

Dave Leland, Manager, Drinking Water Program, 229-6302

Funding Assistance Information:

Dave Phelps, Drinking Water Program, 229-6302
Betty Pongracz, Assistant Manager, Special Public Works Fund Program, Oregon Community Development Programs, Oregon Economic Development Department, ph. 378-3732

Oregon Giardiasis Outbreaks

Water System	Year	Pop.	Cases	Resolution
Lady Creek Water System	1979	1200	66	Drill Wells
Government Camp	1979	125	27	Construct Spring
City of Rockaway	1980	2000	44	Filtration Plant
Corbett Water District	1982	2100	19	Filtration Plant

Status of Unfiltered Community Systems

Currently, there are 155 community water systems using surface water sources. Of those 155, 50 remain unfiltered. The progress of the 50 systems is shown below:

# of Systems	Stage
3	Filter plant construction underway
4	Pilot treatment study completed
8	Pilot treatment study in progress
2	Pilot treatment study proposed
9	Consultant/engineer hired
4	Seeking new groundwater source
2	Redeveloping existing source as groundwater
3	Abandoning surface source
3	Meet requirements to remain unfiltered
12	No plans known to OHD
50	Total unfiltered community systems

Unfiltered Community Public Water Systems:

Alderwood Water Development Co.
City of Baker City
City of Banks
Bear Creek Hideout Water System
City of Bend
City of Cannon Beach
City of Cascade Locks
Cedar Water Association
City of Dufur
Elderberry - Nehalem Water System
Evergreen Acres Water System
City of Falls City
Forest Grove Transmission Line
Galice Subdivision
Glascow Water Co-op
Heceta Water District
Hillsboro - Cherry Grove W.D.
City of Idanha
City of Joseph
Kernville, Gleneden Beach W.D.
Kilchis Water District
Knappa Water Association
Lakeshore Trailer Court
Lyons - Mehama Water District
City of Manzanita
City of Nehalem
Pacific City Water District
Panther Creek Water District
PGE -Three Lynx Water System
Portland Water Bureau
City of Powers
City of Prescott
Rainbow Rock Village
City of Reedsport
Rhododendron Summer Home Assoc.
Riddle/Russell Ck. Water System
Rock Creek Hideout Water System
S.W. Lincoln County Water Dist.
City of Seaside
Siltcoos Heights Water System
City of Sisters
Tierra Del Mar Water System
Tillamook Water Commission
Upper Farm Tracts Water System
City of Warrenton
Westport Water Association
City of Wheeler
Wickiup Water District
City of Yachats
Youngs R. - Lewis & Clark Water District

APPENDIX D

WATER POLLUTION

DIVISION 41

STATE-WIDE WATER QUALITY MANAGEMENT PLAN; BENEFICIAL USES, POLICIES, STANDARDS, AND TREATMENT CRITERIA FOR OREGON

[ED. NOTE: The Tables and Figures referred to within the text of this division may be found at the end of this division.]

Preface

340-41-001 The rules which follow, together with the applicable laws of the State of Oregon and the applicable regulations of the Environmental Quality Commission, set forth Oregon's plans for management of the quality of public waters within the State of Oregon.

Under this plan, the Department of Environmental Quality will continue to manage water quality by evaluating each discharge and activity, whether existing or a new proposal, on a case-by-case basis, based on best information currently available and within the limiting framework of minimum standards, treatment criteria, and policies which are set forth in the plan.

The EQC recognizes that the deadlines for adoption of this plan prevented thorough involvement by local government in the development and review of the plan. Accordingly, the Department will review the contents of this plan with affected local governments and will use their comments and suggestions in preparing amendments for consideration by the EQC not later than December, 1977. At a minimum, the processes of coordination with local governments will consist of the following elements:

(1) Work with county coordinators to set up meetings to explain the plan to groups of local governments and solicit their comments.

(2) Provide copies of the plan and supporting documents to any affected local governments who have not already received them.

(3) Seek input from councils of governments.

(4) Upon request, visit local level governments to discuss the plan.

(5) Work with statewide associations of local governments and others to inform local governments of the plan.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77

Definitions

340-41-005 [SA 26, f. 6-1-67; Repealed by DEQ 128, f. & ef. 1-21-77]

Definitions

340-41-006 Definitions applicable to all basins unless context requires otherwise:

(1) "BOD" means 5-day 20° C. Biochemical Oxygen Demand.

(2) "DEQ" or "Department" means the Oregon State Department of Environmental Quality.

(3) "DO" means dissolved oxygen.

(4) "EQC" means the Oregon State Environmental Quality Commission.

(5) "Estuarine waters" means all mixed fresh and oceanic waters in estuaries or bays from the point of oceanic water intrusion inland to a line connecting the outermost points of the headlands or protective jetties.

(6) "Industrial waste" means any liquid, gaseous, radioactive, or solid waste substance or a combination thereof resulting from any process of industry, manufacturing, trade, or business, or from the development or recovery of any natural resources.

(7) "Marine waters" means all oceanic, offshore waters outside of estuaries or bays and within the territorial limits of the State of Oregon.

(8) "mg/l" means milligrams per liter.

(9) "Pollution" means such contamination or other alteration of the physical, chemical, or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt, or odor of the waters, or such radioactive or other substance into any waters of the state which either by itself or in connection with any other substance present, will or can reasonably be expected to create a public nuisance or render such waters harmful, detrimental, or injurious to public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life, or the habitat thereof.

(10) "Public water" means the same as "waters of the state".

(11) "Sewage" means the water-carried human or animal waste from residences, buildings, industrial establishments, or other places together with such groundwater infiltration and surface water as may be present. The admixture with sewage as herein defined of industrial wastes or wastes, as defined in sections (6) and (13) of this rule, shall also be considered "sewage" within the meaning of this division.

(12) "SS" means suspended solids.

(13) "Wastes" means sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive, or other substances which will or may cause pollution or tend to cause pollution of any water of the state.

(14) "Waters of the state" include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or effect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

(15) "Low flow period" means the flows in a stream resulting from primarily groundwater discharge or baseflows augmented from lakes and storage projects during the driest period of the year. The dry weather period varies across the state according to climate and topography. Wherever the low flow period is indicated in the Water Quality Management Plans, this period has been approximated by the inclusive

months. Where applicable in a waste discharge permit, the low flow period may be further defined.

(16) "Secondary treatment" as the following context may require for:

(a) "Sewage wastes" means the minimum level of treatment mandated by EPA regulations pursuant to Public Law 92-500.

(b) "Industrial and other waste sources" imply control equivalent to best practicable treatment (BPT).

(17) "Nonpoint Sources" refers to diffuse or unconfined sources of pollution where wastes can either enter into – or be conveyed by the movement of water to – public waters.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 24-1981, f. & ef. 9-8-81

Highest and Best Practicable Treatment and Control Required

340-41-010 [SA 26, f. 6-1-67;
Repealed by DEQ 128,
f, & ef. 1-21-77]

Restriction on the Discharge of Sewage and Industrial Wastes and Human Activities Which Affect Water Quality in the Waters of the State

340-41-015 [SA 26, f. 6-1-67;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Maintenance of Standards of Quality

340-41-020 [SA 26, f. 6-1-67;
DEQ 28, f. 5-24-71, ef. 6-25-71;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Implementation of Treatment Requirements and Water Quality Standards

340-41-022 [DEQ 28, f. 5-24-71, ef. 6-25-71;
DEQ 46, f. 6-15-72, ef. 7-1-72;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Mixing Zones

340-41-023 [DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Testing Methods

340-41-024 [DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

General Water Quality Standards

340-41-025 [SA 26, f. 6-1-67;
DEQ 39, f. 4-5-72, ef. 4-15-72;
DEQ 55, f. 7-2-73, ef, 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Policies and Guidelines Generally Applicable to All Basins

340-41-026 (1)(a) Existing high quality waters which exceed those levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water shall be maintained and protected unless the Environmental Quality Commission chooses, after full satisfaction of the intergovernmental coordination and public participation provisions of the continuing planning process, to lower water quality for necessary and justifiable economic or social development. The Director or his designee may allow lower water quality on a short-term basis in order to respond to emergencies or to otherwise protect public health and welfare. In no event, however, may degradation of water quality interfere with or become injurious to the beneficial uses of water within surface waters of the following areas:

(A) National Parks;

(B) National Wild and Scenic Rivers;

(C) National Wildlife Refuges;

(D) State Parks.

(b) Point source discharges shall follow policies and guidelines (2), (3), and (4), and nonpoint source activities shall follow guidelines (5), (6), (7), (8), and (9).

(2) In order to maintain the quality of waters in the State of Oregon, it is the policy of the EQC to require that growth and development be accommodated by increased efficiency and effectiveness of waste treatment and control such that measurable future discharged waste loads from existing sources do not exceed presently allowed discharged loads unless otherwise specifically approved by the EQC.

(3) For any new waste sources, alternatives which utilize reuse or disposal with no discharge to public waters shall be given highest priority for use wherever practicable. New source discharges may be approved by the Department if no measurable adverse impact on water quality or beneficial uses will occur. Significant or large new sources must be approved by the Environmental Quality Commission.

(4) No discharges of wastes to lakes or reservoirs shall be allowed without specific approval of the EQC.

(5) Log handling in public waters shall conform to current EQC policies and guidelines.

(6) Sand and gravel removal operations shall be conducted pursuant to a permit from the Division of State Lands and separated from the active flowing stream by a water-tight berm wherever physically practicable. Recirculation and reuse of process water shall be required wherever practicable. Discharges, when allowed, or seepage or leakage losses to public waters shall not cause a violation of water quality standards or adversely affect legitimate beneficial uses.

(7) Logging and forest management activities shall be conducted in accordance with the Oregon Forest Practices Act so as to minimize adverse effects on water quality.

(8) Road building and maintenance activities shall be conducted in a manner so as to keep waste materials out of public waters and minimize erosion of cut banks, fills, and road surfaces.

(9) In order to improve controls over nonpoint sources of pollution, federal, state, and local resource management agencies will be encouraged and assisted to coordinate planning and implementation of programs to regulate or control runoff, erosion, turbidity, stream temperature, stream flow, and the withdrawal and use of irrigation water on a basin-wide approach so as to protect the quality and beneficial uses

of water and related resources. Such programs may include, but not be limited to, the following:

(a) Development of projects for storage and release of suitable quality waters to augment low stream flow;

(b) Urban runoff control to reduce erosion;

(c) Possible modification of irrigation practices to reduce or minimize adverse impacts from irrigation return flows;

(d) Stream bank erosion reduction projects.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 1-1980, f. & ef. 1-9-80

General Groundwater Quality Protection Policy

340-41-029 The following statements of policy are intended to guide federal agencies and state agencies, cities, counties, industries, citizens, and the Department of Environmental Quality staff in their efforts to protect the quality of groundwater:

(1) General Policies:

(a) It is the responsibility of the EQC to regulate and control waste sources so that impairment of the natural quality of groundwater is minimized to assure beneficial uses of these resources by future generations.

(b) In order to assure maximum reasonable protection of public health, the public should be informed that groundwater – and most particularly local flow systems or water table aquifers – should not be assumed to be safe for domestic use unless quality testing demonstrates a safe supply. Domestic water drawn from water table aquifers should be tested frequently to assure its continued safety for use.

(c) For the purpose of making the best use of limited staff resources, the Department will concentrate its control strategy development and implementation efforts in areas where waste disposal practices and activities regulated by the Department have the greatest potential for degrading groundwater quality. These areas will be delineated from a statewide map outlining the boundaries of major water table aquifers prepared in 1980 by Sweet, Edwards & Associates, Inc. This map may be revised periodically by the Water Resources Department.

(d) The Department will seek the assistance and cooperation of the Water Resources Department to design an ambient monitoring program adequate to determine long-term quality trends for significant groundwater flow systems. The Department will assist and cooperate with the Water Resources Department in their groundwater studies. The Department will also seek the advice, assistance, and cooperation of local, state, and federal agencies to identify and resolve groundwater quality problems.

(e) The EQC recognizes and supports the authority and responsibilities of the Water Resources Department and Water Policy Review Board in the management of groundwater and protection of groundwater quality. In particular, existing programs to regulate well construction and to control the withdrawal of groundwater provide important quality protective opportunities. These policies are intended to complement and not duplicate the programs of the Water Resources Department.

(2) Source Control Policies:

(a) Consistent with general policies for protection of surface water, highest and best practicable treatment and control of sewage, industrial wastes, and landfill leachates, shall be required so as to minimize potential pollutant loading to groundwater. Among other factors, energy, economics, public health protection, potential value of the groundwater resource to present and future generations, and time required for recovery of quality after elimination of pollutant loadings may be considered in arriving at a case-by-case determination of highest and best practicable treatment and control. For areas where urban density development is planned or is occurring and where rapidly draining soils overlay local groundwater flow systems and their associated water table aquifers, the collection, treatment and disposal of sewage, industrial wastes and leachates from landfills will be deemed highest and best practicable treatment and control unless otherwise approved by the EQC pursuant to subsections (b) or (c) of this section.

(b) Establishment of controls more stringent than those identified in subsection (a) of this section may be required by the EQC in situations where:

(A) DEQ demonstrates such controls are needed to assure protection of beneficial uses;

(B) The Water Resources Director declares a critical groundwater area for reasons of quality; or

(C) EPA designates a sole source aquifer pursuant to the Federal Safe Drinking Water Act.

(c) Less stringent controls than those identified in subsection (a) of this section may be approved by the EQC for a specific area if a request, including technical studies showing that lesser controls will adequately protect beneficial uses is made by representatives of the area and if the request is consistent with other state laws and regulations.

(d) Disposal of wastes onto or into the ground in a manner which allows potential movement to groundwater shall be authorized and regulated by the existing rules of the Department's Water Pollution Control Facility (WPCF) Permit, Solid Waste Disposal Facility Permit, or On-Site (Subsurface) Sewage Disposal System Construction Permit, whichever is appropriate:

(A) WPCF permits shall specify appropriate groundwater quality protection requirements and monitoring and reporting requirements. Such permits shall be used in all cases other than for those covered by Solid Waste Disposal Facility Permit or On-site (subsurface) disposal permits.

(B) Solid Waste Disposal Facility Permits shall be used for landfills and sludge disposal not covered by NPDES or WPCF permits. Such permits shall specify appropriate groundwater quality protection requirements and monitoring and reporting requirements.

(C) On-site Sewage Disposal System Construction permits shall be issued in accordance with adopted rules. It is recognized that existing rules may not be adequate in all cases to protect groundwater quality. Therefore, as deficiencies are documented, the Department shall propose rule amendments to correct the deficiencies.

(e) In order to minimize groundwater quality degradation potentially resulting from nonpoint sources, it is the policy of the EQC that activities associated with land and animal management, chemical application and handling, and spill prevention be conducted using the appropriate state of the art management practices ("Best Management Practices").

(3) Problem Abatement Policies:

(a) It is the intent of the EQC to see that groundwater roblem abatement plans are developed and implemented in timely fashion. In order to accomplish this all available and propriate statutory and administrative authorities will be lized, including but not limited to: permits, special permit nditions, penalties, fines, Commission orders, compliance hedules, moratoriums, Department orders, and geographic les. It is recognized, however, that in some cases the entification, evaluation and implementation of abatement easures may take time and that continued degradation may ur while the plan is being developed and implemented. e EQC will allow short-term continued degradation only if beneficial uses, public health, and groundwater resources not significantly affected, and only if the approved ement plan is being implemented on schedule.

(b) In areas where groundwater quality is being degraded result of existing individual source activities or waste al practices the Department may establish the neces- ontrol and abatement schedule requirements to be nented by the individual sources to modify or elimi- ate their activities or waste disposal practices through xisting permit authorities, Department orders, or Commis- on orders issued pursuant to ORS Chapter 183.

(c) In urban areas where groundwater is being degraded s a result of on-site sewage disposal practices and an reawide solution is necessay, the Department may propose rule for adoption by the Commission and incorporation nto the appropriate basin section of the State Water Quality Management Plan (OAR Division 41) which will achieve the ollowing:

(A) Recite the findings describing the problem;

(B) Define the area where corrective action is required;

(C) Describe the problem correction and prevention measures to be ordered;

(D) Establish the schedule for required major increments of progress;

(E) Identify conditions under which new, modified, or repaired on-site sewage disposal systems may be installed in the interim while the area correction program is being implemented and is on schedule;

(F) Identify the conditions under which enforcement measures will be pursued if adequate progress to implement the corrective actions is not made. These measures may include but are not limited to the measures authorized in ORS 454.235(2), 454.685, 454.645 and 454.317;

(G) Identify all known affected local governing bodies which the Department will notify by certified mail of the final rule adoption; and

(H) Any other items declared to be necessary by the Commission.

(d) The Department shall notify all known impacted or potentially affected local units of government of the opportunity to comment on the proposed rule at a scheduled public hearing and of their right to request a contested case hearing pursuant to ORS Chapter 183 prior to the Commission's final order adopting the rule.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 24-1981, f. & ef. 9-8-81; DEQ 13-1984, f. & ef. 7-13-84

Beneficial Uses of Waters to be Protected by Special Water Quality Standards

340-41-030 [SA 26, f. 6-1-67; Repealed by DEQ 128, f. & ef. 1-21-77]

Policy on Sewerage Works Planning and Construction

340-41-034 (1) Oregon's publicly owned sewerage utilities have since 1956 developed an increasing reliance on federal sewerage works construction grant funds to meet a major portion of the cost of their sewerage works construction needs. This reliance did not appear unreasonable based on federal legislation passed up through 1978. Indeed, the Environmental Quality Commission (EQC) has routinely approved compliance schedules with deadlines contingent on federal funding. This reliance no longer appears reasonable based on recent and proposed legislative actions and appropriations and the general state of the nation's economy.

(2) The federal funds expected for future years will address a small percentage of Oregon's sewerage works construction needs. Thus, continued reliance by DEQ and public agencies on federal funding for sewerage works construction will not assure that sewage from a growing Oregon population will be adequately treated and disposed of so that health hazards and nuisance conditions are prevented and beneficial uses of public waters are not threatened or impaired by quality degradation.

(3) Therefore, the following statements of policy are established to guide future sewerage works planning and construction:

(a) The EQC remains strongly committed to its historic program of preventing water quality problems by requiring control facilities to be provided prior to the connection of new or increased waste loads.

(b) The EQC urges each sewerage utility in Oregon to develop, as soon as practicable, a financing plan which will assure that future sewerage works construction, operation, maintenance and replacement needs can be met in a timely manner. Such financing plans will be a prerequisite to Department issuance of permits for new or significantly modified sewerage facilities, for approval of plans for new or significantly modified sewerage facilities, or for access to funding assistance from the state pollution control bond fund. The Department may accept assurance of development of such financing plan if necessary to prevent delay in projects already planned and in the process of implementation. The Department will work with the League of Oregon Cities and others as necessary to aid in the development of financing plans.

(c) No sewerage utility should assume that it will receive grant assistance to aid in addressing its planning and construction needs.

(d) Existing sewerage facility plans which are awaiting design and construction should be updated where necessary to include:

(A) Evaluation of additional alternatives where appropriate, and re-evaluation of costs of existing alternatives;

(B) Identification and delineation of phased construction alternatives; and

(C) A financing plan which will assure ability to construct facilities over an appropriate time span with locally derived funds.

(e) New sewerage works facility planning initiated after October 1, 1981 should not be approved without adequate consideration of alternatives and phased construction options, and without a financing plan which assures adequate funding for construction, operation, maintenance and replacement of sewerage facilities:

(A) The EQC recognizes that many cities in need of immediate sewerage works construction have completed planning and are awaiting design or construction funding. These cities have developed their program relying on 75% federal grants. They will have difficulty developing and implementing alternatives to fund immediate construction needs. Many are, or will be, under moratoriums on new connections because existing facilities are at, or near, capacity. The EQC will consider the following interim measures as a means of assisting these cities to get on a self-supporting basis provided that an approvable long-range program is presented:

(i) Temporary increases in waste discharge loading may be approved provided a minimum of secondary treatment, or equivalent control is maintained and beneficial uses of the receiving waterway are not impaired.

(ii) Installation and operation of temporary treatment works may be approved providing:

(I) The area served is inside an approved urban growth boundary and the proposal is consistent with State Land Use Planning laws.

(II) A master sewerage plan is adopted which shows how and when the temporary facilities will be phased out.

(III) The public agency responsible for implementing the master plan is the owner and operator of the temporary facilities.

(IV) Sewerage service to the area served by the temporary facility is necessary as part of the financing program for master plan implementation and no other option for service is practicably available.

(V) An acceptable receiving stream or method of effluent disposal is available for the temporary facility.

(B) Compliance schedules and other permit requirements may be modified to incorporate an approved interim program. Compliance with a permit so modified will be required at all times.

(f) Sewerage Construction programs should be designed to eliminate raw sewage bypassing during the summer recreation season (except for a storm event greater than the 1 in 10 year 24 hour storm) as soon as practicable. A program and timetable should be developed through negotiation with each affected source. Bypasses which occur during the remainder of the year should be eliminated in accordance with an approved longer term maintenance based correction program. More stringent schedules may be imposed as necessary to protect drinking water supplies and shellfish growing areas.

(g) Any sewerage utility that is presently in compliance and forsees a need to plan for future expansion to accommodate growth but elects to wait for federal funds for planning and construction will make such election with full knowledge that if existing facilities reach capacity before new facilities are completed, a moratorium on new connections will be imposed. Such moratorium will not qualify them for any special consideration since its presence is deemed a matter of their choice.

(h) The Department will continue to assist cities to develop interim and long-range programs, and construction schedules and to secure financing for essential construction.

Stat. Auth.: ORS Ch. 183
Hist.: DEQ 29-1981, f. & ef. 10-19-81

Special Water Quality Standards For Public Waters of Goose Lake in Lake County

340-41-035 [SA 26, f. 6-1-67;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Special Water Quality Standards For Public Waters of the Main Stem Klamath River

340-41-040 [SA 26, f. 6-1-67;
DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128, f. & ef. 1-21-77]

Special Water Quality Standards For the Public Waters of Multnomah Channel and the Main Stem Willamette River

340-41-045 [SA 26, f. 6-1-67;
DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Special Water Quality Standards For the Public Waters of the Main Stem of the Columbia River From the Eastern Oregon-Washington Border Westward to the Pacific Ocean

340-41-050 [SA 26, f. 6-1-67;
DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Special Water Quality Standards For the Public Waters of the Main Stem of the Grande Ronde River

340-41-055 [SA 26, f. 6-1-67;
DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Water Quality Standards For the Public Waters of the Main Stem of the Walla Walla River

340-41-060 [SA 26, f. 6-1-67;
DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Water Quality Standards For the Main Stem of the Snake River in and Adjacent to Oregon

340-41-065 [SA 26, f. 6-1-67;
DEQ 55, f. 7-2-73, ef. 7-15-73;
Repealed by DEQ 128,
f. & ef. 1-21-77]

Water Quality Standards For the Marine and Estuarine Waters of Oregon

340-41-070 [SA 26, f. 6-1-67;
Repealed by DEQ 128,
f. & ef. 1-21-77]

plementation and Enforcement Plan

340-41-075 [SA 27, f. 6-19-67; DEQ 38, f. 4-5-72, ef. 4-15-72; Repealed by DEQ 128, f. & ef. 1-21-77]

ecial Water Quality and Waste Treatment Standards For : Rogue River Basin

340-41-080 [SA 94, f. 10-29-69; DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

cial Water Quality and Waste Treatment Standards For Umpqua River Basin

340-41-085 [SA 50, f. 10-29-69; DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

ecial Water Quality and Waste Treatment Standards For : Clackamas River Basin, Molalla River Basin, and Sandy ver Basin

340-41-090 [SA 51, f. 10-29-69; DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

pecial Water Quality and Waste Treatment Standards For e Tualatin River Basin

340-41-095 [DEQ 2, f. 3-3-70, ef. 3-25-70; DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

pecial Water Quality and Waste Treatment Standards For ae McKenzie River Basin and the Santiam River Basin

340-41-100 [DEQ 3, f. 3-3-70, ef. 3-25-70; DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

Special Water Quality and Waste Treatment Standards For he Deschutes River Basin

340-41-105 [DEQ 4, f. 3-3-70, ef. 3-25-70; DEQ 55, f. 7-2-73, ef. 7-15-73; Repealed by DEQ 128, f. & ef. 1-21-77]

Implementation Program Applicable to All Basins

340-41-120 (1) No waste treatment and disposal facilities shall be constructed or operated and no wastes shall be discharged to public waters without obtaining a permit from the Department as required by ORS 468.740.

(2) Plans for all sewage and industrial waste treatment, control, and disposal facilities shall be submitted to the Department for review and approval prior to construction as required by ORS 468.742.

(3) Minimum design criteria for waste treatment and control facilities prescribed under this plan and such other waste treatment and controls as may be necessary to insure compliance with the water quality standards contained in this plan shall be provided in accordance with specific permit conditions for those sources or activities for which permits are required and the following implementation program:

(a) For new or expanded waste loads or activities, fully approved treatment or control facilities, or both shall be provided prior to discharge of any wastes from the new or expanded facility or conduct of the new or expanded activity.

(b) For existing waste loads or activities, additional treatment or control facilities necessary to correct specific unacceptable water quality conditions shall be provided in accordance with a specific program and timetable incorporated into the waste discharge permit for the individual discharger or activity. In developing treatment requirements and implementation schedules for existing installations or activities, consideration shall be given to the impact upon the overall environmental quality including air, water, land use, and aesthetics.

(c) Wherever minimum design criteria for waste treatment and control facilities set forth in this plan are more stringent than applicable federal standards and treatment levels currently being provided, upgrading to the more stringent requirements will be deferred until it is necessary to expand or otherwise modify or replace the existing treatment facilities. Such deferral will be acknowledged in the permit for the source.

(d) Where planning or design or construction of new or modified waste treatment and controls to meet prior applicable state or federal requirements is underway at the time this plan is adopted, such plans, design, or construction may be completed under the requirements in effect when the project was initiated. Timing for upgrading to meet more stringent future requirements will be as provided in section (3) of this rule.

(4) Confined animal feeding operations shall be regulated pursuant to rules 340-51-005 through 340-51-080 in order to minimize potential adverse effect on water quality.

(5) Programs for control of pollution from non-point sources when developed by the Department, or by other agencies pursuant to Section 208 of Public Law 92-500 and approved by the Department, shall as applicable, be incorporated into this plan by amendment via the same process used to adopt the plan unless other procedures are established by law.

(6) Where minimum requirements of federal law or enforceable regulations are more stringent than specific provisions of this plan, the federal requirements shall prevail.

(7) Within a framework of state-wide priority and available resources, the Department will monitor water quality within the basin for the purposes of evaluating conformance with the plan and developing information for future additions or updating.

(8) The EQC recognizes that the potential exists for conflicts between water quality management plans and the land use plans and resource management plans which local governments and other agencies must develop pursuant to law. In the event any such conflicts develop, it is the intent of the Department to meet with the local government or responsible agency to formulate proposed revisions to one or

both so as to resolve the conflict. Revisions will be presented for adoption via the same process used to adopt the plan unless other specific procedures are established by law.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77

Nuisance Phytoplankton Growth

340-41-150 The following values and implementation program shall be applied to lakes, reservoirs, estuaries and streams, except for ponds and reservoirs less than 10 acres in surface area, marshes and saline lakes:

(1) The following average Chlorophyll *a* values shall be used to identify water bodies where phytoplankton may impair the recognized beneficial uses:

(a) Natural lakes which thermally stratify: 0.01 mg/l;

(b) Natural lakes which do not thermally stratify, reservoirs, rivers and estuaries: 0.015 mg/l.

Average Chlorophyll *a* values shall be based on the following methodology (or other methods approved by the Department): a minimum of three (3) samples collected over any three consecutive months at a minimum of one representative location (e.g., above the deepest point of a lake or reservoir or at a point mid-flow of a river) from samples integrated from the surface to a depth equal to twice the secchi depth or the bottom (the lesser of the two depths); analytical and quality assurance methods shall be in accordance with the most recent edition of **Standard Methods for the Examination of Water and Wastewater.**

(2) Upon determination by the Department that the values in section (1) of this rule are exceeded, the Department shall:

(a) In accordance with a schedule approved by the Commission, conduct such studies as are necessary to describe present water quality; determine the impacts on beneficial uses; determine the probable causes of the exceedance and beneficial use impact; and develop a proposed control strategy for attaining compliance where technically and economically practicable. Proposed strategies could include standards for additional pollutant parameters, pollutant discharge load limitations, and other such provisions as may be appropriate.

Where natural conditions are responsible for exceedance of the values in section (1) of this rule or beneficial uses are not impaired, the values in section (1) of this rule may be modified to an appropriate values for that water body;

(b) Conduct necessary public hearings preliminary to adoption of a control strategy, standards or modified values after obtaining Commission authorization;

(c) Implement the strategy upon adoption by the Commission.

(3) In cases where waters exceed the values in section (1) of this rule and the necessary studies are not completed, the Department may approve new activities (which require Department approval), new or additional (above currently approved permit limits) discharge loadings from point sources provided that it is determined that beneficial uses would not be significantly impaired by the new activity or discharge.

[Publications: The publication(s) referred to or incorporated by reference in this rule are available from the office of the Department of Environmental Quality.]

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 7-1986, f. & ef. 3-26-86

North Coast-Lower Columbia Basin

Beneficial Water Uses to be Protected

340-41-202 Water quality in the North Coast-Lower Columbia River Basin (see Figures 1 and 2) shall be managed to protect the recognized beneficial uses as indicated in Table 1.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 9-1985, f. & ef. 8-6-85

Water Quality Standards Not to be Exceeded (To be adopted pursuant to ORS 468.735 and enforceable pursuant to ORS 468.720, 468.990, and 468.992.)

340-41-205 (1) Notwithstanding the water quality standards contained below, the highest and best practicable treatment and/or control of wastes, activities, and flows shall in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor, and other deleterious factors at the lowest possible levels.

(2) No wastes shall be discharged and no activities shall be conducted which either alone or in combination with other wastes or activities will cause violation of the following standards in the waters of the North Coast – Lower Columbia River Basin:

(a) Dissolved oxygen (DO):

(A) Fresh waters: DO concentrations shall not be less than 90 percent of saturation at the seasonal low, or less than 95 percent of saturation in spawning areas during spawning, incubation, hatching, and fry stages of salmonid fishes.

(B) Marine and estuarine waters (outside of zones of upwelled marine waters naturally deficient in DO): DO concentrations shall not be less than 6 mg/l for estuarine waters, or less than saturation concentrations for marine waters.

(C) Columbia River: DO concentrations shall not be less than 90 percent of saturation.

(b) Temperature:

(A) Columbia River: No measurable increases shall be allowed outside of the assigned mixing zone, as measured relative to a control point immediately upstream from a discharge when stream temperatures are 68° F. or greater; or more than 0.5° F. increase due to a single-source discharge when receiving water temperatures are 67.5° F. or less; or more than 2° F. increase due to all sources combined when stream temperatures are 66° F. or less, except for specifically limited duration activities which may be authorized by DEQ under such conditions as DEQ and the Department of Fish and Wildlife may prescribe and which are necessary to accommodate legitimate uses or activities where temperatures in excess of this standard are unavoidable and all practical preventive techniques have been applied to minimize temperature rises. The Director shall hold a public hearing when a request for an exception to the temperature standard for a planned activity or discharge will in all probability adversely affect the beneficial uses.

(B) All other freshwater streams and tributaries thereto: No measurable increases shall be allowed outside of the assigned mixing zone, as measured relative to a control point immediately upstream from a discharge when stream temperatures are 58° F. or greater; or more than 0.5° F. increase due to a single-source discharge when receiving water temperatures are 57.5° F. or less; or more than 2° F. increase due to all sources combined when stream temperatures are 56° F. or less, except for specifically limited duration activities which may be authorized by DEQ under such conditions as DEQ and the Department of Fish and Wildlife may prescribe and which are necessary to accommodate legitimate uses or activities where temperatures in excess of this standard are unavoidable and all practical preventive techniques have been applied to minimize temperature rises. The Director shall hold a public hearing when a request for an exception to the temperature standard for a planned activity or discharge will in all probability adversely affect the beneficial uses.

(C) Marine and estuarine waters: No significant increase above natural background temperatures shall be allowed, and water temperatures shall not be altered to a degree which creates or can reasonably be expected to create an adverse effect on fish or other aquatic life.

(c) Turbidity (Jackson Turbidity Units, JTU): No more than a 10 percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. However, limited duration activities necessary to address an emergency or to accommodate essential dredging, construction or other legitimate activities and which cause the standard to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and one of the following has been granted:

(A) Emergency activities: Approval coordinated by DEQ with the Department of Fish and Wildlife under conditions they may prescribe to accommodate response to emergencies or to protect public health and welfare.

(B) Dredging, Construction or other Legitimate Activities: Permit or certification authorized under terms of Section 401 or 404 (Permits and Licenses, Federal Water Pollution Control Act) or OAR 141-85-100 et seq. (Removal and Fill Permits, Division of State Lands), with limitations and conditions governing the activity set forth in the permit or certificate.

(d) pH (hydrogen ion concentration): pH values shall not fall outside the following ranges:

(A) Marine waters: 7.0 – 8.5.

(B) Estuarine and fresh waters: 6.5 – 8.5.

(e) Organisms of the coliform group where associated with fecal sources (MPN or equivalent MF using a representative number of samples):

(A) Columbia River from the Highway 5 bridge between Vancouver and Portland to the mouth: A log mean of 200 fecal coliform per 100 milliliters based on a minimum of 5 samples in a 30-day period with no more than 10 percent of the samples in the 30-day period exceeding 400 per 100 ml.

(B) Marine waters and estuarine shellfish growing waters: A fecal coliform median concentration of 14 organisms per 100 milliliters, with not more than 10 percent of the samples exceeding 43 organisms per 100 ml.

(C) Estuarine waters other than shellfish growing waters: A log mean of 200 fecal coliform per 100 milliliters based on a minimum of 5 samples in a 30-day period with no more than 10 percent of the samples in the 30-day period exceeding 400 per 100 ml.

(f) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or shellfish propagation, or otherwise injurious to public health shall not be allowed.

(g) The liberation of dissolved gases, such as carbon-dioxide, hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses made of such waters shall not be allowed.

(h) The development of fungi or other growths having a deleterious effect on stream bottoms, fish or other aquatic life, or which are injurious to health, recreation, or industry shall not be allowed.

(i) The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish shall not be allowed.

(j) The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed.

(k) Objectionable discoloration, scum, oily sleek, or floating solids, or coating of aquatic life with oil film shall not be allowed.

(l) Aesthetic conditions offensive to the human senses of sight, taste, smell, or touch shall not be allowed.

(m) Radioisotope concentrations shall not exceed maximum permissible concentrations (MCP's) in drinking water, edible fishes or shellfishes, wildlife, irrigated crops, livestock and dairy products, or pose an external radiation hazard.

(n) The concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection shall not exceed one hundred and ten percent (110%) of saturation, except when stream flow exceeds the 10-year, 7-day average flood. However, for Hatchery receiving waters and waters of less than 2 feet in depth, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection shall not exceed one hundred and five percent (105%) of saturation.

(o) Total Dissolved Solids: Guide concentrations listed below shall not be exceeded unless otherwise specifically authorized by DEQ upon such conditions as it may deem necessary to carry out the general intent of this plan and to protect the beneficial uses set forth in rule 340-41-202:

(A) Columbia River – 500.0 mg/l;

(B) All other Fresh Water Streams and Tributaries – 100.0 mg/l;

(p) Toxic Substances:

(A) Toxic substances shall not be introduced above natural background levels in the waters of the state in amounts, concentrations, or combinations which may be harmful, may chemically change to harmful forms in the environment, or may bioaccumulate to levels that adversely affect public health, safety, or welfare; adquatic life; or other designated beneficial uses.

(B) Levels of toxic substances shall not exceed the most recent criteria values for organic and inorganic pollutants established by EPA and published in Quality Criteria for Water (1986). A list of the criteria is presented in Table 20.

(C) The criteria in paragraph (B) of this subsection shall apply unless data from scientifically valid studies demonstrate that the most sensitive designated beneficial uses will not be adversely affected by exceeding a criterion or that a more restrictive criterion is warranted to protect beneficial uses, as accepted by the Department on a site specific basis. Where no published EPA criteria exist for a toxic substance, public health advisories and other published scientific literature may be considered and used, if appropriate, to set guidance values.

(D) Bio-assessment studies such as laboratory bioassays or instream measurements of indigenous biological communities, shall be conducted, as the Department deems necessary, to monitor the toxicity of complex effluents, other suspected discharges or chemical substances without numeric criteria, to aquatic life. These studies, properly conducted in accordance with standard testing procedures, may be considered as scientifically valid data for the purposes of paragraph (C) of this subsection. If toxicity occurs, the Department shall evaluate and implement measures necessary to reduce toxicity on a case-by-case basis.

(3) Where the natural quality parameters of water of the North Coast – Lower Columbia River Basin are outside the numerical limits of the above assigned water quality standards, the natural water quality shall be the standard.

(4) Mixing zones:

(a) The Department may allow a designated portion of a receiving water to serve as a zone of initial dilution for waste water and receiving waters to mix thoroughly and this zone will be defined as a mixing zone.

(b) The Department may suspend all or part of the water quality standards, or set less restrictive standards, in the defined mixing zone, provided that the following conditions are met:

(A) The water within the mixing zone shall be free of:

(i) Materials in concentrations that will cause acute (96HLC50) toxicity to aquatic life. Acute toxicity is measured as the lethal concentration that causes 50 percent mortality of organisms within a 96-hour test period.

(ii) Materials that will settle to form objectionable deposits.

(iii) Floating debris, oil, scum, or other materials that cause nuisance conditions.

(iv) Substances in concentrations that produce deleterious amounts of fungal or bacterial growths.

(B) The water outside the boundary of the mixing zone shall:

(i) Be free of materials in concentrations that will cause chronic (sublethal) toxicity. Chronic toxicity is measured as the concentration that causes long-term sublethal effects, such as significantly impaired growth or reproduction in aquatic organisms, during a testing period based on test species life cycle. Procedures and end points will be specified by the Department in waste water discharge permits.

(ii) Meet all other water quality standards under normal annual low flow conditions.

(c) The limits of the mixing zone shall be described in the waste water discharge permit. In determining the location, surface area, and volume of a mixing zone area, the Department may use appropriate mixing zone guidelines to assess the biological, physical, and chemical character of receiving waters, and effluent, and the most appropriate placement of the outfall, to protect instream water quality, public health, and other beneficial uses. Based on receiving water and effluent characteristics, the Department shall define a mixing zone in the immediate area of a waste water discharge to:

(A) Be as small as feasible;

(B) Avoid overlap with any other mixing zones to the extent possible and be less than the total stream width as necessary to allow passage of fish and other aquatic organisms;

(C) Minimize adverse effects on the indigenous biological community especially when species are present that warrant special protection for their economic importance, tribal significance, ecological uniqueness, or for other similar reasons as determined by the Department;

(D) Not threaten public health;

(E) Minimize adverse effects on other designated beneficial uses outside the mixing zone.

(d) The Department may request the applicant of a permitted discharge for which a mixing zone is required, to submit all information necessary to define a mixing zone, such as:

(A) Type of operation to be conducted;

(B) Characteristics of effluent flow rates and composition;

(C) Characteristics of low flows of receiving waters:

(D) Description of potential environmental effects:

(E) Proposed design for outfall structures.

(e) The Department may, as necessary, require mixing zone monitoring studies and/or bioassays to be conducted to evaluate water quality or biological status within and outside the mixing zone boundary.

(f) The Department may change mixing zone limits or require the relocation of an outfall if it determines that the water quality within the mixing zone adversely affects any existing beneficial uses in the receiving waters.

(5) Testing methods: The analytical testing methods for determining compliance with the water quality standards contained in this rule shall be in accordance with the most recent edition of **Standard Methods for the Examination of Water and Waste Water published jointly by the American Public Health Association, American Water Works Association, and Water Pollution Control Federation**, unless the Department has published an applicable superseding method, in which case testing shall be in accordance with the superseding method; provided, however, that testing in accordance with an alternative method shall comply with this rule if the Department has published the method or has approved the method in writing.

[**Publications:** The publication(s) referred to or incorporated by reference in this rule are available from the office of the Department of Environmental Quality.]

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 1-1980, f. & ef. 1-9-80; DEQ 18-1987, f. & ef. 9-4-87

Minimum Design Criteria for Treatment and Control of Wastes

340-41-215 Subject to the implementation program set forth in rule 340-41-120, prior to discharge of any wastes from any new or modified facility to any waters of the North Coast – Lower Columbia River Basin, such wastes shall be treated and controlled in facilities designed in accordance with the following minimum criteria (In designing treatment facilities, average conditions and a normal range of variability are generally used in establishing design criteria. A facility once completed and placed in operation should operate at or near the design limit most of the time but may operate below the design criteria limit at times due to variables which are unpredictable or uncontrollable. This is particularly true for biological treatment facilities. The actual operating limits are intended to be established by permit pursuant to ORS 468.740 and recognize that the actual performance level may at times be less than the design criteria.):

(1) Sewage wastes:

(a) During periods of low stream flows (approximately May 1 to October 31): Treatment resulting in monthly average effluent concentrations not to exceed 20 mg/l of BOD and 20 mg/l of SS or equivalent control.

(b) During the period of high stream flows (approximately November 1 to April 30) and for direct ocean discharges: A minimum of secondary treatment or equivalent control and unless otherwise specifically authorized by the Department, operation of all waste treatment and control facilities at maximum practicable efficiency and effectiveness so as to minimize waste discharges to public waters.

(c) Effluent BOD concentrations in mg/l, divided by the dilution factor (ratio of receiving stream flow to effluent flow) shall not exceed one (1) unless otherwise approved by the EQC.

(d) Sewage wastes shall be disinfected, after treatment, equivalent to thorough mixing with sufficient chlorine to provide a residual of at least 1 part per million after 60 minutes of contact time unless otherwise specifically authorized by permit.

(e) Positive protection shall be provided to prevent bypassing raw or inadequately treated sewage to public waters unless otherwise approved by the Department where elimination of inflow and infiltration would be necessary but not presently practicable.

(f) More stringent waste treatment and control requirements may be imposed where special conditions may require.

(2) Industrial wastes:

(a) After maximum practicable inplant control, a minimum of secondary treatment or equivalent control (reduction of suspended solids and organic material where present in significant quantities, effective disinfection where bacterial organisms of public health significance are present, and control of toxic or other deleterious substances).

(b) Specific industrial waste treatment requirements shall be determined on an individual basis in accordance with the provisions of this plan, applicable federal requirements, and the following:

(A) The uses which are or may likely be made of the receiving stream;

(B) The size and nature of flow of the receiving stream;

(C) The quantity and quality of wastes to be treated; and

(D) The presence or absence of other sources of pollution on the same watershed.

(c) Where industrial, commercial, or agricultural effluents contain significant quantities of potentially toxic elements, treatment requirements shall be determined utilizing appropriate bioassays.

(d) Industrial cooling waters containing significant heat loads shall be subjected to offstream cooling or heat recovery prior to discharge to public waters.

(e) Positive protection shall be provided to prevent bypassing of raw or inadequately treated industrial wastes to any public waters.

(f) Facilities shall be provided to prevent and contain spills of potentially toxic or hazardous materials and a positive program for containment and cleanup of such spills should they occur shall be developed and maintained.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77

Mid Coast Basin

Beneficial Water Uses to be Protected

340-41-242 Water quality in the Mid Coast Basin (see Figures 1 and 3) shall be managed to protect the recognized beneficial uses as indicated in Table 2.

Stat. Auth.: ORS Ch. 468
Hist.: DEQ 128, f. & ef. 1-21-77; DEQ 9-1985, f. & ef. 8-6-85

Water Quality Standards Not to be Exceeded (To be adopted pursuant to ORS 468.735 and enforceable pursuant to ORS 468.720, 468.990, and 468.992.)

340-41-245 (1) Notwithstanding the water quality standards contained below, the highest and best practicable treatment and/or control of wastes, activities, and flows shall in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and water temperatures, coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor, and other deleterious factors at the lowest possible levels.

(2) No wastes shall be discharged and no activities shall be conducted which either alone or in combination with other wastes or activities will cause violation of the following standards in the waters of the Mid Coast Basin:

(a) Dissolved oxygen (DO):

(A) Fresh waters: DO concentrations shall not be less than 90 percent of saturation at the seasonal low, or less than 95 percent of saturation in spawning areas during spawning, incubation, hatching, and fry stages of salmonid fishes.

(B) Marine and estuarine waters (outside of zones of upwelled marine waters naturally deficient in DO): DO concentrations shall not be less than 6 mg/l for estuarine waters, or less than saturation concentrations for marine waters.

(b) Temperature:

(A) Fresh waters: No measurable increases shall be allowed outside of the assigned mixing zone, as measured relative to a control point immediately upstream from a discharge when stream temperatures are 64° F. or greater; or more than 0.5° F. increase due to a single-source discharge when receiving water temperatures are 63.5° F. or less; or more than 2° F. increase due to all sources combined when stream temperatures are 62° F. or less, except for specifically limited duration activities which may be authorized by DEQ under such conditions as DEQ and the Department of Fish and Wildlife may prescribe and which are necessary to accommodate legitimate uses or activities where temperatures in excess of this standard are unavoidable and all practical preventive techniques have been applied to minimize temperature rises. The Director shall hold a public hearing when a request for an exception to the temperature standard for a planned activity or discharge will in all probability adversely affect the beneficial uses.

FIGURE 1

BASIN INDEX MAP

Basin No.	Basin	Rule Number
11-21	North Coast - Lower Columbia	340-41-202
12	Mid Coast	340-41-242
13	Umpqua	340-41-282
14	South Coast	340-41-322
15	Rogue	340-41-362
22	Willamette	340-41-442
23	Sandy	340-41-482
24	Hood	340-41-522
25	Deschutes	340-41-562
26	John Day	340-41-602
27	Umatilla	340-41-642
28	Walla Walla	340-41-682
31	Grande Ronde	340-41-722
32	Powder	340-41-762
33	Malheur River	340-41-802
34	Owyhee	340-41-842
41	Malheur Lake	340-41-882
42	Goose & Summer Lakes	340-41-922
43	Klamath	340-41-962

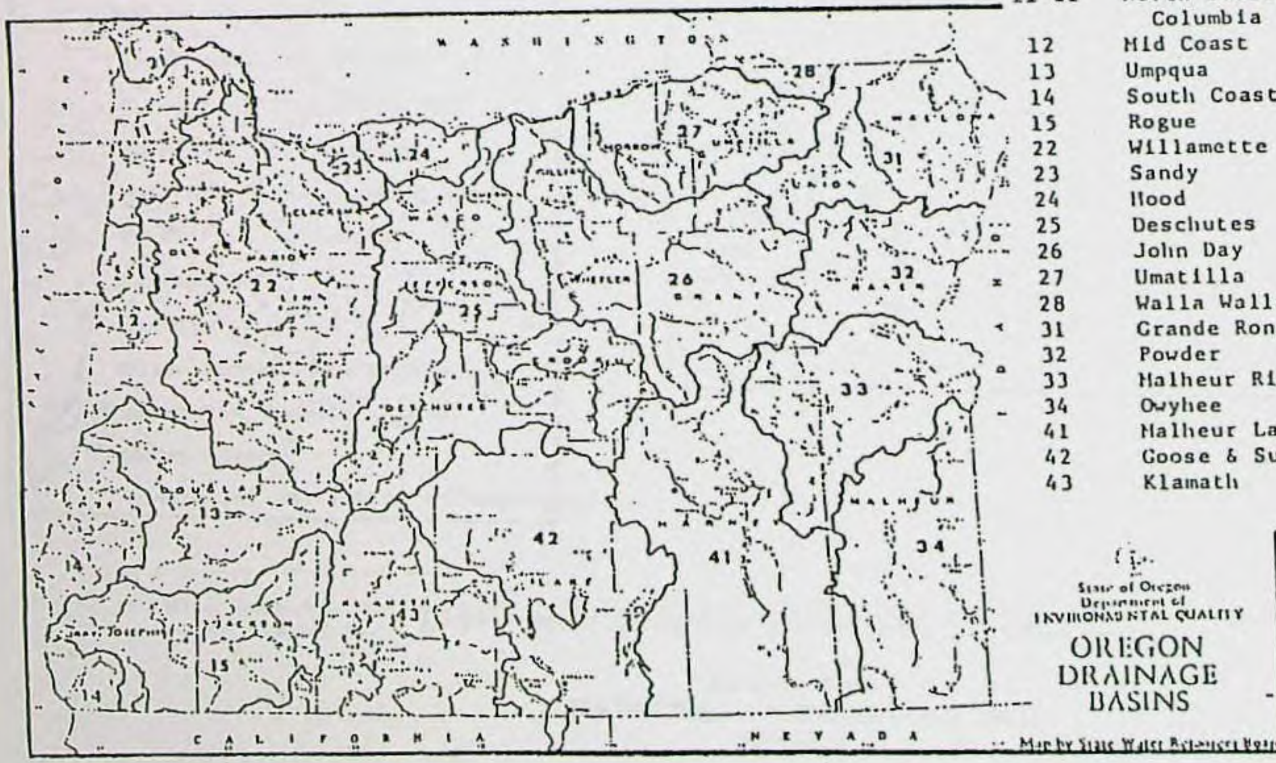


Figure 2
NORTH COAST - LOWER COLUMBIA BASIN
(340-41-202)

(Note: Basin Boundaries are as shown in figure below.)

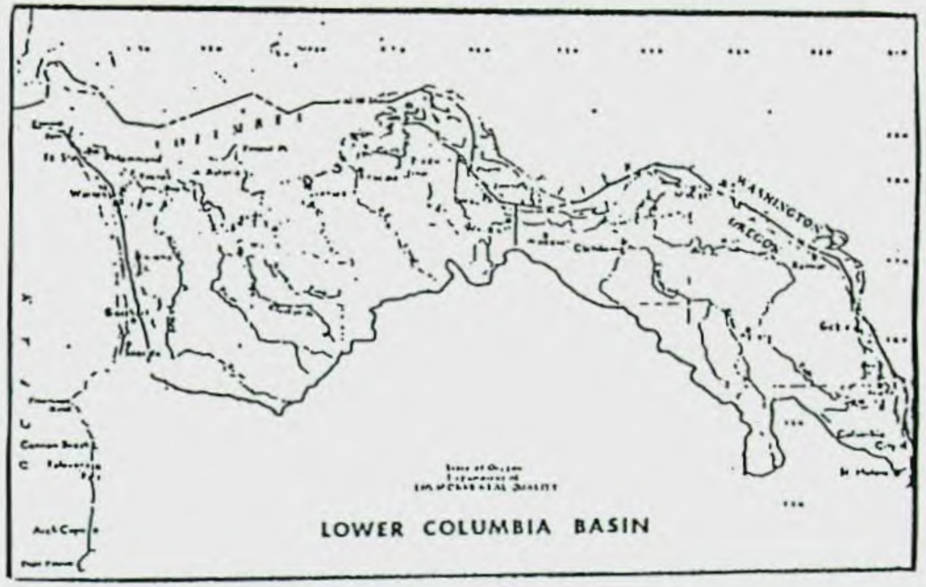


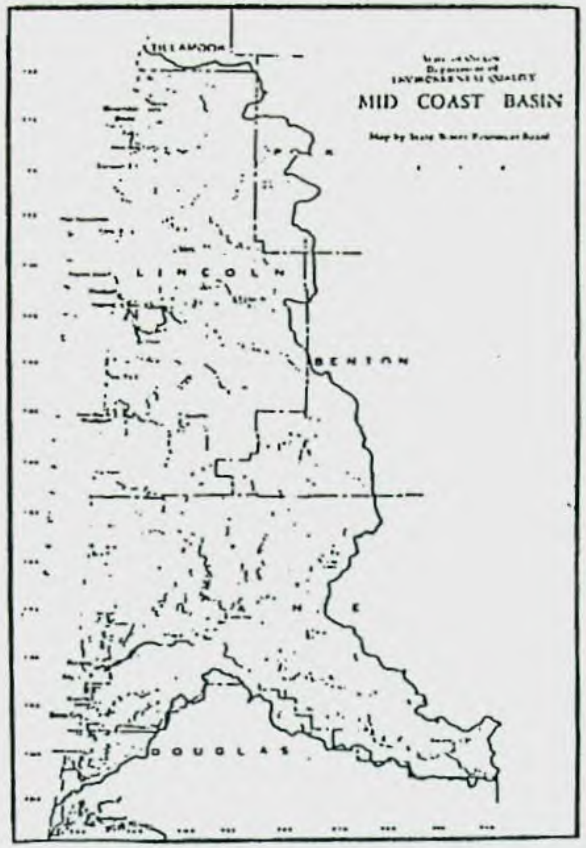
TABLE 1
(340-41-202)

Beneficial Uses	Estuary and Adjacent Marine Waters	Columbia River Mouth to RM 86	All Other Streams and Tributaries Thereto
Public Domestic Water Supply[1]		X	X
Private Domestic Water Supply[1]		X	X
Industrial Water Supply	X	X	X
Irrigation		X	X
Livestock Watering		X	X
Anadromous Fish Passage	X	X	X
Salmonid Fish Rearing	X	X	X
Salmonid Fish Spawning	X	X	X
Resident Fish & Aquatic Life	X	X	X
Wildlife & Hunting	X	X	X
Fishing	X	X	X
Boating	X	X	X
Water Contact Recreation	X	X	X
Aesthetic Quality	X	X	X
Hydro Power			
Commercial Navigation & Transportation	X	X	

1 With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.

Figure 3
MID COAST BASIN
(340-41-242)

(Note: Basin boundaries are as shown in figure below)



filed 6-14-89
EQC 6-2-89

OREGON ADMINISTRATIVE RULES 340-41-026
(As Amended 6/2/89)

NOTE: The underlined portions of text represent proposed additions made to the rules.

The [~~bracketed~~] portions of text represent proposed deletions made to the rules.

POLICIES AND GUIDELINES GENERALLY APPLICABLE TO ALL BASINS

340-41-026

(1) (a) Existing high quality waters which exceed those levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water shall be maintained and protected unless the Environmental Quality Commission chooses, after full satisfaction of the intergovernmental coordination and public participation provisions of the continuing planning process, to lower water quality for necessary and justifiable economic or social development. The Director or his designee may allow lower water quality on a short-term basis in order to respond to emergencies or to otherwise protect public health and welfare. In no event, however, may degradation of water quality interfere with or become injurious to the beneficial uses of water within surface waters of the following areas:

(A) National Parks;
(B) National Wild and Scenic Rivers;
(C) National Wildlife Refuges;
(D) State Parks.

(b) Point source discharges shall follow policies and guidelines (2), (4) [~~(3)~~], and (5) [~~(4)~~], and nonpoint source activities shall follow guidelines (6), (7), (8), (9), and (10). [~~(5), (6), (7), (8), and (9).~~]

(2) In order to maintain the quality of waters in the State of Oregon, it is the general policy of the EQC to require that growth and development be accommodated by increased efficiency and effectiveness of waste treatment and control such that measurable future discharged waste loads from existing sources do not exceed presently allowed discharged loads except as provided in section (3). [~~unless otherwise specifically approved by the EQC.~~]

(3) The Commission or Director may grant exceptions to sections (2) and (5) and approvals to section (4) for major dischargers and other dischargers, respectively. Major dischargers include those industrial and domestic sources that are classified as major sources for permit fee purposes in OAR 340-45-075(2).

(a) In allowing new or increased discharged loads, the Commission or Director shall make the following findings:

(A) The new or increased discharged load would not cause water quality standards to be violated;

(B) The new or increased discharged load would not threaten or impair any recognized beneficial uses;

(C) The new or increased discharged load shall not be granted if the receiving stream is classified as being water quality limited unless the pollutant parameters associated with the proposed discharge are unrelated either directly or indirectly to the parameter(s) causing the receiving stream to be water quality limited; and

(D) The activity, expansion, or growth necessitating a new or increased discharge load is consistent with the acknowledged local land use plans as evidenced by a statement of land use compatibility from the appropriate local planning agency.

(b) Oregon's water quality management policies and programs recognize that Oregon's water bodies have a finite capacity to assimilate waste. The strategy that has been followed in stream management has hastened the development and application of treatment technology that would not have otherwise occurred. As a result, some waters in Oregon have assimilative capacity above that which would exist if only the minimum level of waste treatment was achieved. This unused assimilative capacity is an exceedingly valuable resource that enhances in-stream values specifically, and environmental quality generally. Allocation of any unused assimilative capacity should be based on explicit criteria. In addition to the conditions in subsection (a) of this section, the Commission or Director shall consider the following:

(A) Environmental Effects Criteria.

(i) Adverse Out-of-Stream Effects. There may be instances where the nondischarge or limited discharge alternatives may cause greater adverse environmental effects than the increased discharge alternative. An example may be the potential degradation of groundwater from land application of wastes.

(ii) Instream Effects. Total stream loading may be reduced through elimination or reduction of other source discharges or through a reduction in seasonal discharge. A source that replaces other sources, accepts additional waste from less efficient treatment units or systems, or reduces discharge loadings during periods of low stream flow may be permitted an increased discharge load year-round or during seasons of high flow, as appropriate.

(iii) Beneficial Effects. Land application, upland wetlands application, or other non-discharge alternatives for appropriately treated wastewater may replenish groundwater levels and increase streamflow and assimilative capacity during otherwise low streamflow periods.

(B) Economic Effects Criteria. When assimilative capacity exists in a stream, and when it is judged that increased loadings will not have significantly greater adverse environmental effects than other alternatives to increased discharge, the economic effect of increased loading will be considered. Economic effects will be of two general types:

(i) Value of Assimilative Capacity. The assimilative capacity of Oregon's streams are finite, but the potential uses of this capacity are virtually unlimited. Thus it is important that priority be given to those beneficial uses that promise the greatest return (beneficial use) relative to the unused assimilative capacity that might be utilized. In-stream uses that will benefit from reserve assimilative capacity, as well as potential future beneficial use, will be weighed against the economic benefit associated with increased loading.

(ii) Cost of Treatment Technology. The cost of improved treatment technology, nondischarge and limited discharge alternatives shall be evaluated.

(4) [~~(3)~~] For any new waste sources, alternatives which utilize reuse or disposal with no discharge to public waters shall be given highest priority for use wherever practicable. New source discharges may be approved subject to the criteria in Section 3 of this rule. [~~by the Department if no measurable adverse impact on water quality or beneficial uses will occur. Significant or large new sources must be approved by the Environmental Quality Commission.~~]

(5) [~~(4)~~] No discharges of wastes to lakes or reservoirs shall be allowed except as provided in Section 3. [~~without specific approval of the EQC.~~]

(6) [~~(5)~~] Log handling in public waters shall conform to current EQC policies and guidelines.

(7) [~~(6)~~] Sand and gravel removal operations shall be conducted pursuant to a permit from the Division of State Lands and separated from the active flowing stream by a water-tight berm wherever physically practicable. Recirculation and reuse of process water shall be required wherever practicable. Discharges, when allowed, or seepage or leakage losses to public waters shall not cause a violation of water quality standards or adversely affect legitimate beneficial uses.

(8) [(7)] Logging and forest management activities shall be conducted in accordance with the Oregon Forest Practices Act so as to minimize adverse effects on water quality.

(9) [(8)] Road building and maintenance activities shall be conducted in a manner so as to keep waste materials out of public waters and minimize erosion of cut banks, fills, and road surfaces.

(10) [(9)] In order to improve controls over nonpoint sources of pollution, federal, state, and local resource management agencies will be encouraged and assisted to coordinate planning and implementation of programs to regulate or control runoff, erosion, turbidity, stream temperature, stream flow, and the withdrawal and use of irrigation water on a basin-wide approach so as to protect the quality and beneficial uses of water and related resources. Such programs may include, but not be limited to, the following:

(a) Development of projects for storage and release of suitable quality waters to augment low stream flow.

(b) Urban runoff control to reduce erosion.

(c) Possible modification of irrigation practices to reduce or minimize adverse impacts from irrigation return flows.

(d) Stream bank erosion reduction projects.

APPENDIX E

14301000 NEHALEM RIVER NEAR FOSS, OR--Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.-- Water years 1975 to current year.

PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: August 1980 to September 1981.
WATER TEMPERATURE: December 1974 to September 1981.

REMARKS.--Some samples were analyzed by different methods and may have data with different levels of detection.

WATER QUALITY DATA, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND	SPE-CIFIC CON-DUCT-ANCE (US/CM)	PH (STAND-ARD UNITS)	TEMPER-ATURE WATER (DEG C)	TUR-BID-ITY (NTU)	OXYGEN, DIS-SOLVED (MG/L)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./100 ML)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML)	HARD-NESS (MG/L AS CACO3)	CALCIUM, DIS-SOLVED (MG/L AS CA)
NOV 1990 19...	1345	2050	58	7.1	7.0	2.0	12.2	102	--	--	17	4.7
MAR 1991 12...	1150	5250	50	7.4	6.0	5.6	12.6	102	28	28	14	4.0
JUN 25...	1330	745	65	7.8	13.5	1.5	10.7	102	20	K18	19	5.3
AUG 15...	1105	163	83	8.1	20.5	1.9	8.6	96	K5	K810	25	7.0

DATE	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)	SODIUM PERCENT	SODIUM, AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	ALKA-LINITY, DIS IT FIELD (MG/L AS CACO3)	BICAR-BONATE, DIS IT FIELD (MG/L AS HCO3)	CAR-BONATE, DIS IT FIELD (MG/L AS CO3)	SULFATE, DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SILICA, DIS-SOLVED (MG/L AS SIO2)
NOV 1990 19...	1.2	4.9	38	0.5	0.7	15	18	0	2.9	4.3	0.1	14
MAR 1991 12...	1.0	4.4	39	0.5	0.5	13	15	0	2.5	3.7	<0.1	13
JUN 25...	1.3	5.6	38	0.6	0.7	20	24	0	3.4	5.1	0.2	14
AUG 15...	1.7	7.1	38	0.6	0.8	26	32	0	3.6	6.4	<0.1	14

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SOLIDS, DIS-SOLVED (TONS PER AC-FT)	SOLIDS, DIS-SOLVED (TONS PER DAY)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N)	PHOS-PHORUS, TOTAL (MG/L AS P)	PHOS-PHORUS, DIS-SOLVED (MG/L AS P)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P)	ALUM-INUM, DIS-SOLVED (UG/L AS AL)
NOV 1990 19...	32	46	0.04	177	<0.01	0.90	0.04	<0.2	0.02	<0.01	<0.01	40
MAR 1991 12...	43	40	0.06	610	<0.01	0.68	0.01	0.3	0.02	0.01	<0.01	40
JUN 25...	45	49	0.06	90.5	<0.01	0.35	0.02	<0.2	0.01	<0.01	<0.01	20
AUG 15...	43	57	0.06	18.9	<0.01	0.22	<0.01	0.9	0.03	<0.01	<0.01	<10

DATE	ARSENIC, DIS-SOLVED (UG/L AS AS)	BARIUM, DIS-SOLVED (UG/L AS BA)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE)	CADMIUM, DIS-SOLVED (UG/L AS CD)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR)	COBALT, DIS-SOLVED (UG/L AS CO)	COPPER, DIS-SOLVED (UG/L AS CU)	IRON, DIS-SOLVED (UG/L AS FE)	LEAD, DIS-SOLVED (UG/L AS PB)	LITHIUM, DIS-SOLVED (UG/L AS LI)	MANGA-NESE, DIS-SOLVED (UG/L AS MN)
NOV 1990 19...	<1	4	<0.5	<1	<1	<3	2	110	<1	<4	4
MAR 1991 12...	<1	3	<0.5	<1	<1	<3	1	71	<1	<4	4
JUN 25...	<1	4	0.5	1	1	3	1	150	<1	<4	2
AUG 15...	<1	4	<0.5	<1	<1	<3	<1	120	<1	<4	1

DATE	MERCURY, DIS-SOLVED (UG/L AS HG)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO)	NICKEL, DIS-SOLVED (UG/L AS NI)	SELE-NIUM, DIS-SOLVED (UG/L AS SE)	SILVER, DIS-SOLVED (UG/L AS AG)	STRON-TIUM, DIS-SOLVED (UG/L AS SR)	VANA-DIUM, DIS-SOLVED (UG/L AS V)	ZINC, DIS-SOLVED (UG/L AS ZN)	SEDI-MENT, SUS-PENDED (MG/L)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM
NOV 1990 19...	<0.1	<10	2	<2	<1	30	<6	<3	5	28	83
MAR 1991 12...	<0.1	<10	<1	1	<1	27	<6	7	15	213	68
JUN 25...	<0.1	<10	<1	<1	<1	35	<6	4	3	6.0	--
AUG 15...	<0.1	<10	<1	<1	<1	47	<6	17	6	2.6	--

K - Results based on colony count outside acceptable range (non-ideal colony count).

Reference: Water Resources Data Oregon Water Year 1991, US Geological Survey, 1991.

NEHALEM RIVER BASIN

14301000 NEHALEM RIVER NEAR FOSS, OR
(National stream quality accounting network station)

LOCATION.--Lat 45°42′15", long 123°45′15", in NW 1/4 sec.35, T.3 N., R.9 W., Tillamook County, Hydrologic Unit 17100202, on right bank 0.2 mi upstream from Cook Creek, 2.2 mi northeast of Foss, and at mile 13.5.

DRAINAGE AREA.--667 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--October 1939 to current year.

GAGE.--Water-stage recorder. Datum of gage is 32.60 ft above National Geodetic Vertical Datum of 1929 (State Highway Department bench mark). Prior to Nov. 11, 1939, nonrecording gage.

REMARKS.--Records good except for estimated daily discharges, which are fair. No regulation. Several small diversions for irrigation and domestic use upstream from station.

AVERAGE DISCHARGE.--52 years, 2,670 ft^3/s, 54.36 in/yr, 1,934,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 53,400 ft^3/s Jan. 9, 1990, gage height, 25.07 ft; minimum discharge, 34 ft^3/s Aug. 29-31, 1967.

EXTREMES FOR CURRENT YEAR.--Peak discharge greater than base discharge of 19,000 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 5	0930	*34,300	*19.17	No other peak greater than base discharge.			

Minimum discharge, 73 ft^3/s Oct. 1, Sept. 25, 26.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1990 TO SEPTEMBER 1991
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	76	1820	7840	2220	1450	1920	1330	1320	1010	558	220	220
2	85	1420	8510	2070	4190	2970	1300	1240	930	530	214	223
3	144	1220	7690	1920	5760	5310	2290	1150	869	501	210	200
4	223	1340	9300	1780	8100	7810	14800	1080	825	471	206	180
5	297	1370	9300	1640	9770	8070	31000	1020	789	449	202	162
6	264	1380	7700	1520	8330	6780	24800	981	759	432	202	145
7	232	1350	6020	2330	6360	5650	18000	1070	747	422	202	133
8	208	1490	4820	3420	4950	4770	10600	1460	729	406	198	126
9	184	1580	4060	4030	4010	4180	10300	1490	693	395	195	122
10	166	1860	3530	5070	3320	3810	9860	1440	663	392	194	118
11	153	1870	3340	7530	2910	3610	8620	1350	635	380	188	114
12	164	1590	3170	14100	3280	5120	7150	1270	625	366	179	113
13	192	3450	2990	13300	5010	5410	5780	1200	643	356	171	120
14	230	4970	2770	10200	4870	4820	4730	1140	648	350	169	115
15	469	4380	2570	12300	4260	4180	3970	1080	625	342	164	111
16	574	3480	2370	10300	3750	3640	3370	1000	691	345	157	108
17	494	2880	2320	7830	3340	3180	2890	1120	727	347	152	104
18	616	2380	3160	6060	3000	2780	2530	1290	663	342	149	101
19	662	2070	3160	4800	3500	2490	2260	1320	624	333	145	98
20	534	2180	2920	3900	8090	2270	2030	1280	635	320	140	93
21	1300	2840	2550	3240	7780	2240	1830	1200	871	308	135	88
22	1830	4790	2260	2720	6030	2170	1640	1110	963	295	129	84
23	1280	5690	e2100	2360	4730	2030	1520	1020	879	284	124	81
24	836	10800	e1920	2080	3860	1960	1620	972	791	286	123	77
25	655	15100	e1750	1850	3210	1930	1630	1050	738	288	121	75
26	641	9860	1760	1640	2710	1890	1550	1080	695	285	120	73
27	574	7460	2200	1460	2350	1800	1670	1020	662	272	122	75
28	772	5910	2630	1350	2080	1690	1670	962	637	265	142	78
29	1100	5600	2500	1260	---	1580	1550	938	607	256	204	80
30	2320	6450	2160	1170	---	1470	1430	1070	580	242	225	78
31	2150	---	2080	1260	---	1390	---	1090	---	230	218	---
TOTAL	19425	118580	121450	136710	131000	108920	183720	35813	21953	11048	5320	3495
MEAN	627	3953	3918	4410	4679	3514	6124	1155	732	356	172	116
MAX	2320	15100	9300	14100	9770	8070	31000	1490	1010	558	225	223
MIN	76	1220	1750	1170	1450	1390	1300	938	580	230	120	73
AC-FT	38530	235200	240900	271200	259800	216000	364400	71040	43540	21910	10550	6930
CFSM	.94	5.93	5.87	6.61	7.01	5.27	9.18	1.73	1.10	.53	.26	.17
IN.	1.08	6.61	6.77	7.62	7.31	6.07	10.25	2.00	1.22	.62	.30	.19

e Estimated

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1940 - 1991, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	806	3707	6070	6270	5826	4356	2698	1240	605	271	148	213
MAX	2948	9256	11390	12450	12490	8696	6124	3028	1591	747	314	877
(WY)	1948	1974	1956	1971	1949	1956	1991	1948	1968	1983	1968	1959
MIN	69.9	197	599	596	1066	1518	1149	520	284	137	62.5	63.6
(WY)	1953	1953	1977	1977	1977	1941	1941	1989	1989	1967	1967	1967

SUMMARY STATISTICS	FOR 1990 CALENDAR YEAR		FOR 1991 WATER YEAR		WATER YEARS 1940 - 1991	
ANNUAL TOTAL	1074561		897434			
ANNUAL MEAN	2944		2459		2670	
HIGHEST ANNUAL MEAN					4235	1974
LOWEST ANNUAL MEAN					1063	1977
HIGHEST DAILY MEAN	42400	Jan 9	31000	Apr 5	42400	Jan 9 1990
LOWEST DAILY MEAN	73	Sep 29	73	Sep 26	36	Aug 29 1967
ANNUAL SEVEN-DAY MINIMUM	75	Sep 25	77	Sep 24	38	Aug 26 1967
ANNUAL RUNOFF (AC-FT)	2131000		1780000		1934000	
ANNUAL RUNOFF (CFSM)	4.41		3.69		4.00	
ANNUAL RUNOFF (INCHES)	59.93		50.05		54.39	
10 PERCENT EXCEEDS	7690		6180		7260	
50 PERCENT EXCEEDS	1110		1330		1130	
90 PERCENT EXCEEDS	125		145		128	

Reference: Water Resources Data Oregon Water Year 1991, US Geological Survey, 1991.

APPENDIX F

Filename: 1307H03.WK1
First: N. TILLAMOOK COUNTY
Second: REGIONAL WATER STUDY
Third: 2050 - HYDRAULIC MODEL USING EXISTING PIPES
Fourth: TRANSMISSION MAINS W/ 1 MGD FROM JETTY CREEK

PIPE TABLE

Input						Output			Input
Pipe	UpNode	DnNode	Length	Diameter	Roughness	Flow	Velocity	HeadLoss	Status
			ft	in		US mgd	ft/sec	ft	Open
101	1	2	13000.00	16.00	150.00	2.582	2.86	18.44	
102	2	3	1000.00	16.00	150.00	2.489	2.76	1.33	
103	3	4	5000.00	16.00	150.00	2.480	2.75	6.58	
104	4	5	9000.00	12.00	150.00	1.417	2.79	17.06	
105	5	6	5000.00	8.00	150.00	0.907	4.02	29.90	
106	4	7	4000.00	10.00	150.00	1.063	3.02	10.82	
107	7	8	18000.00	10.00	150.00	0.785	2.23	27.80	
108	8	9	6000.00	8.00	150.00	0.774	3.43	26.74	

NODE TABLE

Input			Output		Optional		Input
Node	Elevation	Demand	Pressure	HGL	XCoord	YCoord	Status
	ft	US mgd	psi	ft			ON
1	350.00		0.00	350.00			
2	27.00	0.0925	131.85	331.56			
3	28.00	0.0091	130.84	330.24			
4	20.00		131.45	323.65			
5	20.00	0.5100	124.07	306.59			
6	45.00	0.9071	100.30	276.69			
7	18.00	0.2777	127.63	312.83			
8	23.00	0.0113	113.43	285.03			
9	55.00	0.7740	88.00	258.29			
		2.58					

Filename: 1307H02.WK1
First: N. TILLAMOOK COUNTY
Second: REGIONAL WATER STUDY
Third: 2050 - HYDRAULIC MODEL USING EXISTING PIPES
Fourth: TRANSMISSION MAINS

PIPE TABLE

Input						Output			Input
Pipe	UpNode	DnNode	Length	Diameter	Roughness	Flow	Velocity	HeadLoss	Status
			ft	in		US mgd	ft/sec	ft	Open
101	1	2	13000.00	16.00	150.00	3.582	3.97	33.80	
102	2	3	1000.00	16.00	150.00	3.489	3.87	2.48	
103	3	4	5000.00	16.00	150.00	3.480	3.86	12.33	
104	4	5	9000.00	12.00	150.00	1.417	2.79	17.06	
105	5	6	5000.00	8.00	150.00	0.907	4.02	29.90	
106	4	7	4000.00	12.00	150.00	2.063	4.06	15.20	
107	7	8	18000.00	12.00	150.00	1.785	3.52	52.34	
108	8	9	6000.00	12.00	150.00	1.774	3.50	17.24	

NODE TABLE

Input		Output			Optional		Input
Node	Elevation	Demand	Pressure	HGL	XCoord	YCoord	Status
	ft	US mgd	psi	ft			ON
1	350.00		0.00	350.00			
2	27.00	0.0925	125.19	316.20			
3	28.00	0.0091	123.69	313.72			
4	20.00		121.81	301.39			
5	20.00	0.5100	114.43	284.33			
6	45.00	0.9071	90.66	254.43			
7	18.00	0.2777	116.10	286.19			
8	23.00	0.0113	91.27	233.84			
9	55.00	1.7740	69.96	216.60			
		3.58					

APPENDIX G

(503)731-4381
FAX (503)731-4077
onvoice (503) 731-4031

Oregon

DEPARTMENT OF
HUMAN
RESOURCES

HEALTH DIVISION

March 10, 1993

All Certified Laboratories

Clarification Of New Monitoring and Reporting Issues

Please make sure everyone involved in Drinking Water sampling and analysis reads this letter. It is intended to clarify questions and concerns we have been hearing from you on the new rules and reporting requirements. It summarizes our current understanding of the federal rules and provides interpretation on some issues. Not all questions have an easy answer and sometimes even we can not find the definitive answer. Please understand we will try to get an answer to a specific question but it may take time and patience on your part. Issues on lab methods should be addressed to Dr. Ronning at the Public Health Lab at 229-5505.

Dioxin

Most systems in the state have been given a waiver from having to do Dioxin testing. The Drinking Water Section will notify those systems that are at risk and only those few will be required to do Dioxin.

Asbestos

Only those systems who are in the targeted areas need to test for Asbestos at *source* unless they have a waiver.
Testing of Asbestos at the *distribution* system because of Asbestos–Cement pipe will be required of community and nontransient systems unless they have a waiver.
Target areas are: SW Oregon – any system west of the Willamette meridian (R1E) and south of township 25 (T25S); NE Oregon – any system south of township 6 (T6S) and north of township 17 (T17S), east of Grant / Wheeler county line and west of the Snake River.

Nitrate

All systems are required to begin Nitrate sampling this year. Community and nontransient noncommunity systems using surface water sources must sample quarterly, all other systems must sample annually.

Compositing

Compositing is now recommended *only* for Volatile Organic Chemicals. It is not technically feasible to composite Synthetic Organic And Inorganic chemical samples. Systems have the option to have samples composited if they wish.The Drinking Water Section does not recommend compositing samples.

Barbara Roberts
Governor

800 NE Oregon Street # 21
Portland, OR 97232
(503) 731-4030 Emergency
(503) 252-7978 TDD
Emergency

Composite samples that have a detection need to have a complete analysis performed for each source in the composite. The rationale is that compositing may have diluted other contaminants below the detection level.

Waivers

If a system does not present a waiver document from the Drinking Water Section (see attached) they must test for everything except for Dioxin. Waivers only reduce future monitoring they do not eliminate monitoring. Basically all community systems are required to do a complete analysis of all chemicals for their first sample.

Small Systems under 3,300

Community systems under 3,300 population and Nontransient Noncommunity systems need only take one sample for SOCs, VOCs, and unregulated SOCs and VOCs. This sample must be collected before October 1st, 1993.

Nontransient Noncommunity

These systems are now on a regular monitoring cycle for inorganic and organic chemicals. They are not required to sample for Antimony, Beryllium, Cyanide, Nickel, and Thallium until January 1996. They must sample for the remaining inorganic according to their population and schedule during 1993-95.

They do not need to test for unregulated VOCs.

They do not need to test for unregulated SOCs if they asked for a waiver. We encourage them to do the unregulated SOCs now since the cost is not that much more and it *may* reduce future sampling.

Noncommunity Systems

Noncommunity systems do not need to repeat the inorganic if they have already done one in the past and reported it. Systems that have not done an inorganic, new systems, and systems with new sources must do a complete inorganic analysis.

All noncommunity systems must do a yearly Nitrate.

Nitrite must be sampled before December, 1995 and we recommend they do it with the first Nitrate test.

Confused Systems

Systems that don't have a clue and seem lost should call their local county health department or the Drinking Water program. A mistake made early on can have serious repercussions later.

Reporting Form

New Form

We request you use the attached forms to submit new SOC, VOC and Inorganic test results. Our data entry system is geared to accepting data in the order on the forms. The new data is required by EPA.

You may modify the form to meet your own requirements but we ask that all the sample collection and system data be at the head of the form and that the chemicals be listed exactly as the are.

[s]ample Composition

[W]e need information on Sample Composition completed on the report forms so we can accurately report the results to EPA.
[T]he choices are:

Raw/Treated — Raw is just that raw water without any treatment, no chlorination, no softening, no treatment of any kind. Everything else is treated.

Source/Distribution — Source is collected from any point between the well/intake and the first user. Distribution is collected from the first user onward.

Single/Combined — Single is a sample from only one source. Combined would be a sample after two or more sources are blended or mixed.

A sample cannot be raw and treated, nor single and combined. They can be raw/source/combined, or treated/distribution/single, etc.

"Sampled at" must be filled in and descriptive of exactly where the sample was collected. This is extremely important if the sample is and *Entry Point sample*. An *Entry Point sample* is a sample taken after treatment or combining of sources.

Please make sure that the sampler provides this information. Lab reports without this information will be returned to have it added. This is very important to the Drinking Water Program, EPA and for the system.

Detection Limits
Contaminants that were not analyzed to the method detection limit should be marked/notated/asterixed on the form. An example would be Adipates that on this day were analyzed to a .005 mg/l level instead of the required .0006 mg/l. The Adipate result would be marked in some method to alert the reader.

Detection limits for Lead and Copper are set by CFR 136 appendix B. A copy is attached. The detection limit is variable according to your equipment and method used. We do not have specific limits for each method at this time.

Patrick Meyer, MPH
Monitoring and Compliance
Drinking Water Section

Sample

INITIAL SOC WAIVER **MONITORING REQUIREMENTS** **WAIVER APPLICATION** **SUMMARY**

GENERAL INFORMATION	
SYSTEM NAME:	ID#: 41
ADDRESS:	
CITY, STATE, ZIP:	
SAMPLING POINT IDENTIFICATION	
SAMPLING POINT LOCATION:	
SOURCE(S) REPRESENTED:	
USE WAIVER APPLICATION SUBMITTAL CHECKLIST	
REQUEST LETTER:	
TOPOGRAPHIC MAP(S) WITH LOCATOR LEGEND:	
WF-1 FORM(RINEHOLD/WITT SUMMARY, COUNTY):	
WF-2 FORM(ACTIVITY SOURCE CONTACTS):	
WF-3 FORM(BASE USE LIST):	
SUBMITTED BY:	DATE:
REVIEWED BY:	DATE:
SUSCEPTIBILITY APPLICATION SUBMITTAL CHECKLIST	
APPLICATION RECEIVED:	
COMPLETE WF-7 FORM SUBMITTED:	
SUBMITTED BY:	DATE:
REGISTERED GEOLOGIST:	
REVIEWED BY:	DATE:

Sample

COMMENTS:

SOC WAIVERS BASED ON WAIVER EVALUATION YEAR 199_						
Y/N (USED)	CONTAMINANT	CODE	QT* 1	QT 2	QT 3	QT 4
	2,4-D	2105				
	2,4,5-TP(SILVEX)	2110				
	3-HYDROXYCARBOFURAN	2066				
	DI(2-ETHHEX)ADIPATE	2035				
	ALACHLOR	2051				
	ALDICARB	2047				
	ALDICARB SULFOXIDE	2043				
	ALDICARB SULFONE	2044				
	ALDRIN	2356				
	ATRAZINE	2050				
	BENZO(A)PYRENE	2306				
	BHC-g(LINDANE)	2010				
	BUTACHLOR	2076				
	CARBOFURAN	2046				
	CARBARYL	2021				
	CHLORDANE	2959				
	DALAPON	2031				
	DIBROMOCHLOROPROPANE	2931				
	DICAMBA	2440				
	DIELDRIN	2070				
	DINOSEB	2041				

Sample

Y/N (USED)	CONTAMINANT	CODE	QT* 1	QT 2	QT 3	QT 4
	DIOXIN(2,3,7,8-TCDD)	2063				
	DIQUAT	2032				
	ENDOTHALL	2033				
	ENDRIN	2005				
	ETHYLENE DIBROMIDE	2946				
	GLYPHOSATE	2034				
	HEPTACHLOR	2065				
	HEPTACHLOR EPOXIDE	2067				
	HEXACHLOROBENZENE	2274				
	HEXACHLOROCYCLO-PENTADIENE	2042				
	METHOMYL	2022				
	METHOXYCHLOR	2015				
	METOLACHLOR	2045				
	METRIBUZIN	2595				
	PENTACHLOROPHENOL	2326				
	DI(2-ETHHEX)PHTHALATE	2039				
	PICLORAM	2040				
	PCBs	2383				
	PROPACHLOR	2077				
	SIMAZINE	2037				
	TOXAPHENE	2020				
	VYDATE(OXAMYL)	2036				

home\fs\putnam\waivdata.sum 11-4-92 * W= WAIVED, G= GRANDFATHERED

Sample

Inorganic Waivers and Grandfathering

System:				PWS Id: 41	
Source: □Surface □Ground	Sample Point:			For 199	
Contaminant	Code	Qrtly	Yearly	1/3 Yrs	1/9 Yrs
ANTIMONY	1074				
ARSENIC	1005				
ASBESTOS: SOURCE	1094				
ASBESTOS: AC PIPE	1094				
BARIUM	1010				
BERYLLIUM	1075				
CADMIUM	1015				
CHROMIUM	1020				
CYANIDE	1024				
FLUORIDE	1025				
MERCURY	1035				
NICKEL	1036				
NITRATE	1040				
NITRITE	1041				
SELENIUM	1045				
SODIUM	1052				
SULFATE	1055				
THALLIUM	1085				
Reviewed by:				Date:	

Organic Chemical Detection Limits

Contaminant	Code	DL mg/l
Synthetics		
2,4-D	2105	.0001
2,4,5-TP Silvex	2110	.0002
Adipates	2035	.0006
Alachlor (Lasso)	2051	.0002
Atrazine	2050	.0001
Benzo(A)Pyrene	2306	.00002
BHC-gamma (Lindane)	2010	.00002
Carbofuran	2046	.0009
Chlordane	2959	.0002
Dalapon	2031	.001
Dibromochloropropane	2931	.00002
Dinoseb	2041	.0002
Dioxin	2063	$5x10^{-9}$
Diquat	2032	.0004
Endothall	2033	.009
Endrin	2005	.00001
Ethylene Dibromide (EDB)	2946	.00001
Glyphosate	2034	.006
Heptachlor Epoxide	2067	.00002
Heptachlor	2065	.00004
Hexachlorobenzene (HCB)	2274	.0001
Hexachlorocyclopentadiene	2042	.0001
Methoxychlor	2015	.0001
Pentachlorophenol	2326	.00004
Phthalates	2039	.0006
Picloram	2040	.0001
Polychlorinated Biphenyls	2383	.0001
Simazine	2037	.00007
Toxaphene	2020	.001
Vydate	2036	.002
Volatiles		
All		.0005

Inorganic Chemical Detection Limits		
Contaminant	Method	DL mg/l
Antimony	AA-furnace	.003 .0008[1]
	ICP-Mass spec.	.0004
	Hydride-AA	.001
Asbestos	TEM	.01 MFL
Barium	AA-furnace	.002
	AA-direct	.1
	ICP	.002 .001[2]
Beryllium	AA-furnace	.0002
	AA-direct	.00002
	ICP	.0003
	ICP-Mass spec.	.0003
Cadmium	AA-furnace	.0001
	ICP	.001
Chromium	AA-furnace	.001
	ICP	.007 .001[2]
Cyanide	Spectrometric	.02
	Automated Spec.	.005
	Selective Electrode	.05
	Amenable Spectro.	.02
Mercury	Cold Vapor	.0002
	Automated Cold Vapor	.0002
Nickel	AA-furnace	.001 .0006[1]
	ICP	.005
	ICP-Mass spec.	.0005
Nitrate	Cd Reduction	.01
	Automated Hydrazine	.01
	Automated Cd	.05
	Selective Electrode	1
	Ion Chromatography	.01

Inorganic Chemical Detection Limits		
Contaminant	Method	DL mg/l
Nitrite	Spectrophotometric Automated Cd Cd Reduction Ion Chromatography	.01 .05 .01 .004
Selenium	AA-furnace AA-Hydride	.002 .002
Thallium	AA-furnace ICP-Mass spec.	.001 .0007[1] .0003
Lead	AA-furnace ICP-Mass spec. AA-platform furnace	see CFR 136 App. B
Copper	AA-furnace AA-direct ICP ICP-Mass spec. AA-platform furnace	see CFR 136 App. B

[1] Lower MDLs using stabilized graphite furnace atomic absorption

[2] Using concentration technique in EPA method 200.7

Lab Name, Logo, ...

Pws ID #: 41	Source ID:	Source name:
System		
Address		
City, Sate, Zip		

Sample Identification	
Sampled at:	Sampled by:
Date Collected:	Time collected:
Date recieved:	Date analyzed:
Sample Composition: Raw / Treated | Source / Distribution | Single / Combined	
Lab sample ID #:	Sample Composited

Volatile Organic Chemicals

Regulated VOCs

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
1,1-Dichloroethylene	2977	0.007			
1,1,1-Trichloroethane	2981	0.2			
1,1,2-Trichloroethane	2985	0.005			
1,2 Dichloroethane	2980	0.005			
1,2 Dichloropropane	2983	0.005			
1,2,4-Trichlorobenzene	2378	0.07			
Benzene	2990	0.005			
Carbon Tetrachloride	2982	0.005			
Cis-1,2-Dichloroethylene	2380	0.07			
Dichloromethane	2964	0.005			
Ethylbenzene	2992	0.7			
Monochlorobenzene	2989	0.1			
O-Dichlorobenzene	2968	0.6			
P-Dichlorobenzene	2969	0.075			
Styrene	2996	0.1			
Tetrachloroethylene	2987	0.005			
Toluene	2991	1.0			
Total Xylenes	2955	10.0			
Trans-1,2-Dichloroethylene	2979	0.1			
Trichloroethylene	2984	0.005			
Vinyl Chloride	2976	0.002			

Unregulated				
Contaminant	Code	Analysis mg/l	Method	Analyst
1,1-Dichloroethane	2978			
1,1-Dichloropropene	2410			
1,1,1,2-Tetrachloroethane	2986			
1,1,2,2,-Tetrachloroethane	2988			
1,2,3,-Trichloropropane	2414			
1,3-Dichloropropane	2412			
1,3-Dichloropropene	2413			
2,2-Dichloropropane	2416			
Bromobenzene	2993			
Bromodichloromethane	2943			
Bromoform	2942			
Bromomethane	2214			
Chloroethane	2216			
Chloroform	2941			
Chloromethane	2210			
Dibromochloromethane	2944			
Dibromomethane	2408			
M-Dichlorobenzene	2967			
O-Chlorotoluene	2965			
P-Chlorotoluene	2966			

Lab Name, Logo, ...

Pws ID #: 41	Source ID:	Source name:
System		
Address		
City, Sate, Zip		

Sample Identification	
Sampled at:	Sampled by:
Date Collected:	Time collected:
Date recieved:	Date analyzed:
Sample Composition: Raw / Treated | Source / Distribution | Single / Combined	
Lab sample ID #:	Composite Sample:

Inorganic Chemicals

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
Antimony Total[1]	1074	0.006			
Arsenic	1005	0.05			
Asbestos	1094	7 MF/l[3]			
Barium	1010	2			
Berylium Total[1]	1075	0.004			
Cadmium	1015	0.005			
Chromium	1020	0.1			
Cyanide[1]	1024	0.2			
Fluoride	1025	4.0			
Lead	1030	0.015			
Mercury	1035	0.002			
Nickel[1]	1036	0.1			
Nitrate	1040	10.			
Nitrate-Nitrite	1038	10.			
Nitrite	1041	1.0			
Selenium	1045	0.05			
Sodium[2]	1052				
Sulfate	1055				
Thallium Total[1]	1085	0.002			

[1] Unregulated for systems less 150 connection until 1/1/96. [2] Community systems only

[3] Million Fibers/liter > 10um

Lab Name, Logo, ...

Pws ID #: 41	Source ID:	Source name:
System		
Address		
City, Sate, Zip		

Sample Identification

Sampled at:	Sampled by:
Date Collected:	Time collected:
Date recieved:	Date analyzed:
Sample Composition: Raw / Treated | Source / Distribution | Single / Combined	
Lab sample ID #:	Sample Composited

Synthetic Organic Chemicals

Regulated

Contaminant	Code	MCL mg/l	Analysis mg/l	Method	Analyst
2,4-D	2105	0.07			
2,4,5-TP Silvex	2110	0.05			
Adipates	2035	0.5			
Alachlor (Lasso)	2051	0.002			
Atrazine	2050	0.003			
Benzo(A)Pyrene	2306	0.0002			
BHC-gamma (Lindane)	2010	0.0002			
Carbofuran	2046	0.04			
Chlordane	2959	0.002			
Dalapon	2031	0.2			
Dibromochloropropane	2931	0.0002			
Dinoseb	2041	0.007			
Dioxin	2063	$3x10^{-8}$			
Diquat	2032	0.02			
Endothall	2033	0.1			
Endrin	2005	0.0002			
Ethylene Dibromide (EDB)	2946	0.00005			
Glyphosate	2034	0.7			
Heptachlor Epoxide	2067	0.0002			
Heptachlor	2065	0.0004			
Hexachlorobenzene (HCB)	2274	0.001			

Hexachlorocyclopentadiene	2042	0.05
Methoxychlor	2015	0.04
Pentachlorophenol	2326	0.001
Phthalates	2039	0.006
Picloram	2040	0.5
Polychlorinated Biphenyls	2383	0.0005
Simazine	2037	0.004
Toxaphene	2020	0.003
Vydate	2036	0.2

Unregulated

Contaminant	Code	Analysis mg/l	Method	Analyst
3-Hydroxycarbofuran	2066			
Aldicarb	2047			
Aldicarb Sulfoxide	2043			
Aldicarb Sulfone	2044			
Aldrin	2356			
Butachlor	2076			
Carbaryl	2021			
Dicamba	2440			
Dieldrin	2070			
Methomyl	2022			
Metolachlor	2045			
Metribuzin	2595			
Propachlor	2077			

Oregon Health Division
Drinking Water Section
731-4381

Simplified Chemical Monitoring for Community WS*

For Jan. 1993 to Dec. 1995

Chemicals		Surface Water	Ground Water
Inorganics		Yearly	One
Sodium		Yearly	One
Nitrate (Testing starts 1/93)		Quarterly	Yearly
Nitrite		One	
Asbestos	AC Pipe	One	
	Source	Yearly	One
Synthetic Organics		4 quarters	
Unregulated SOC		4 quarters	
Volatile Organic		4 quarters	
Unregulated VOC		4 quarters	One
Trihalomethane		Quarterly	Quarterly
Radiological		every 4 years	every 4 years
Lead and Copper Rule		Semi Annually	

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

Beginning monitoring: You must begin monitoring between Jan. 93 and Dec. 93 if your population is greater than 299; between Jan. 94 and Dec. 94 if your population is 100-299; and between Jan. 95 and Dec. 95 if your population is 25-99.

Beginning Lead & Copper monitoring: You must start Lead and Copper Rule monitoring by Jan. 92 if your population is 50,000 or over; by July 92 if your population is 3,300 or over; and by July 93 if your population is 25 or over.

Monitoring 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.

Testing for SOCs, Unregulated SOCs, VOCs, and Unregulated VOCs: Systems having a population smaller than 3,300 may take 1 sample for SOCs, Unregulated SOCs, VOCs, and Unregulated VOCs to satisfy monitoring requirements. If there are detections of any chemicals further sampling will be required. Sample must be collected before Oct. 1993.

4 Quarters: test on a quarterly schedule for one year for a total of 4 tests.

This table supersedes previous editions. Rev 2/23/93

Contaminants and Maximum Levels

Inorganic

Contaminant	mg/l
Antimony Total†	0.006
Arsenic	0.05
Asbestos	7 MFL[1]
Barium	2
Berylium Total†	0.004
Cadmium	0.005
Chromium	0.1
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	
Sulfate	
Thallium Total†	0.002

Volatile Organics

Contaminant	mg/l
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

Contaminant	mg/l
2,4-D	0.07
2,4,5-TP Silvex	0.05
3-Hydroxycarbofuran‡	
Adipates†	0.5
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†	0.0002
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 for systems with less than 150 connections until 1/1/96 (Phase 5).
‡ Unregulated organics.
[1] Million Fibers per Liter

Oregon Health Division
Drinking Water Section
731-4381

Simplified Monitoring for Noncommunity WS*

Chemicals	Sample
Inorganics (*Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cyanide, Fluoride, Lead, Mercury, Nickel, Selenium, Thallium*)	Once
Nitrate (Testing starts 1/93)	Yearly
Nitrite (Testing starts 1/93)	Once

Turbidity for Surface Water only	1 Reading Every 4 Hours[1]

<table>
<tr><td rowspan="5">Coliform Bacteria</td><td colspan="3">Source</td></tr>
<tr><td colspan="2">Ground Water</td><td>Surface Water</td></tr>
<tr><td colspan="2">Average Daily Population Served</td><td rowspan="3">Monthly Sampling</td></tr>
<tr><td>≤1000</td><td>> 1000</td></tr>
<tr><td>Quarterly Sampling</td><td>Monthly Sampling</td></tr>
</table>

Quarterly Sampling	Collect Sample Between:		
1st Quarter ...	January 1	and	March 31
2nd Quarter ...	April 1	and	June 30
3rd Quarter ...	July 1	and	September 30
4th Quarter ...	October 1	and	December 31

* This table reflects base line monitoring. Waivers, reductions, or detections will affect sampling requirements.

[1] A system using a Slow Sand Filter can reduce monitoring to once a day upon Division approval.

This chart supersedes previous editions 2/23/93

Contaminants and Maximum Levels

Inorganic	mg/l
Antimony Total	0.006
Arsenic	0.05
Barium	2
Beryllium Total	0.004
Cadmium	0.005
Chromium	0.1
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
Thallium Total	0.002

Coliform Bacteria .... None Present

Turbidity[1]	Maximum Level
Conventional / Direct Filtration	0.5 NTU
Slow Sand Filter	1.0 NTU
Diatomaceous Earth Filter	1.0 NTU

[1] Can never exceed 5.0 NTU at any time, and no more 5% of readings can be over maximum level.

Oregon Health Division
Drinking Water Section
731-4381

Simplified Chemical Monitoring for Non Transient WS*
For Jan. 1993 to Dec. 1995

Chemicals		Surface Water	Ground Water
Inorganics		Yearly	One
Sodium		Yearly	One
Nitrate (Testing starts 1/93)		Quarterly	Yearly
Nitrite		One	
Asbestos	AC Pipe	One	
	Source	Yearly	One
Synthetic Organics		4 quarters	
Unregulated SOCs		4 quarters	
Volatile Organics		4 quarters	
Lead and Copper Rule		Semi Annually	

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

Beginning monitoring: You must begin monitoring between Jan. 93 and Dec. 93 if your population is greater than 299; between Jan. 94 and Dec. 94 if your population is 100-299; and between Jan. 95 and Dec. 95 if your population is 25-99.

Beginning Lead & Copper monitoring: You must start Lead and Copper Rule monitoring by Jan. 92 if your population is 50,000 or over; by July 92 if your population is 3,300 or over; and by July 93 if your population is 25 or over.

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

Testing for SOCs, Unregulated SOCs, VOCs: Systems having a population smaller than 3,300 may take 1 sample for SOCs, Unregulated SOCs, and VOCs to satisfy monitoring requirements. If there are detections of any chemicals further sampling will be required. Sample must be collected before Oct. 1993.

4 quarters: test on a quarterly schedule for one year for a total of 4 tests.

This table supercedes previous editions. rev 2/23/93

Contaminants and Maximum Levels

norganic	mg/l
ntimony Total†	0.006
rsenic	0.05
sbestos	7 MFL[1]
arium	2
erylium Total†	0.004
admium	0.005
hromium	0.1
yanide†	0.2
luoride	4.0
ead	0.015
fercury	0.002
lickel†	0.1
litrate	10
litrate-Nitrite	10
litrite	1
elenium	0.05
odium	
ulfate	
hallium Total†	0.002

olatile Organics	
,1-Dichloroethane‡	
,1-Dichloroethylene	0.007
,1-Dichloropropene‡	
,1,1-Trichloroethane	0.2
,1,1,2-Tetrachloroethane‡	
,1,2-Trichloroethane†	0.005
,1,2,2-Tetrachloroethane‡	
,2-Dichloropropane	0.005
,2-Dichloroethane	0.005
,2,3-Trichloropropane‡	
,2,4-Trichlorobenzene†	0.07
,3-Dichloropropane‡	
,3-Dichloropropene‡	
,2-Dichloropropane‡	
enzene	0.005
romobenzene‡	
romodichloromethane‡	
romoform‡	
romomethane‡	
arbon Tetrachloride	0.005
hlorodibromomethane ‡	
hloroethane‡	
hloroform‡	
hloromethane‡	
-Chlorotoluene‡	
-Chlorotoluene‡	
is-1,2-Dichloroethylene	0.07
ibromomethane‡	
1-Dichlorobenzene‡	
ichloromethane†	0.005
thylbenzene	0.7
lonochlorobenzene	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†	0.5
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†	0.0002
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 for systems with less than 150 connections until 1/1/96 (Phase 5).
‡ Unregulated organics.
[1] Million Fibers per Liter

Appendix B to Part 136—Definition and Procedure for the Determination of the Method Detection Limit—Revision 1.11

Definition

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

Scope and Application

This procedure is designed for applicability to a wide variety of sample types ranging from reagent (blank) water containing analyte to wastewater containing analyte. The MDL for an analytical procedure may vary as a function of sample type. The procedure requires a complete, specific, and well defined analytical method. It is essential that all sample processing steps of the analytical method be included in the determination of the method detection limit.

The MDL obtained by this procedure is used to judge the significance of a single measurement of a future sample.

The MDL procedure was designed for applicability to a broad variety of physical and chemical methods. To accomplish this, the procedure was made device- or instrument-independent.

Procedure

1. Make an estimate of the detection limit using one of the following:

(a) The concentration value that corresponds to an instrument signal/noise in the range of 2.5 to 5.

(b) The concentration equivalent of three times the standard deviation of replicate instrumental measurements of the analyte in reagent water.

(c) That region of the standard curve where there is a significant change in sensitivity, i.e., a break in the slope of the standard curve.

(d) Instrumental limitations.

It is recognized that the experience of the analyst is important to this process. However, the analyst must include the above considerations in the initial estimate of the detection limit.

2. Prepare reagent (blank) water that is as free of analyte as possible. Reagent or interference free water is defined as a water sample in which analyte and interferent concentrations are not detected at the method detection limit of each analyte of interest. Interferences are defined as systematic errors in the measured analytical signal of an established procedure caused by the presence of interfering species (interferent). The interferent concentration is presupposed to be normally distributed in representative samples of a given matrix.

3. (a) If the MDL is to be determined in reagent (blank) water, prepare a laboratory standard (analyte in reagent water) at a concentration which is at least equal to or in the same concentration range as the estimated method detection limit. (Recommend between 1 and 5 times the estimated method detection limit.) Proceed to Step 4.

(b) If the MDL is to be determined in another sample matrix, analyze the sample. If the measured level of the analyte is in the recommended range of one to five times the estimated detection limit, proceed to Step 4.

If the measured level of analyte is less than the estimated detection limit, add a known amount of analyte to bring the level of analyte between one and five times the estimated detection limit.

If the measured level of analyte is greater than five times the estimated detection limit, there are two options.

(1) Obtain another sample with a lower level of analyte in the same matrix if possible.

(2) The sample may be used as is for determining the method detection limit if the analyte level does not exceed 10 times the MDL of the analyte in reagent water. The variance of the analytical method changes as the analyte concentration increases from the MDL, hence the MDL determined under these circumstances may not truly reflect method variance at lower analyte concentrations.

4. (a) Take a minimum of seven aliquots of the sample to be used to calculate the method detection limit and process each through the entire analytical method. Make all computations according to the defined method with final results in the method reporting units. If a blank measurement is required to calculate the measured level of analyte, obtain a separate blank measurement for each sample aliquot analyzed. The average blank measurement is subtracted from the respective sample measurements.

(b) It may be economically and technically desirable to evaluate the estimated method detection limit before proceeding with 4a. This will: (1) Prevent repeating this entire procedure when the costs of analyses are high and (2) insure that the procedure is being conducted at the correct concentration. It is quite possible that an inflated MDL will be calculated from data obtained at many times the real MDL even though the level of analyte is less than five times the calculated method detection limit. To insure that the estimate of the method detection limit is a good estimate, it is necessary to determine that a lower concentration of analyte will not result in a significantly lower method detection limit. Take two aliquots of the sample to be used to calculate the method detection limit and process each through the entire method, including blank measurements as described above in 4a. Evaluate these data:

(1) If these measurements indicate the sample is in desirable range for determination of the MDL, take five additional aliquots and proceed. Use all seven measurements for calculation of the MDL.

(2) If these measurements indicate the sample is not in correct range, reestimate the MDL, obtain new sample as in 3 and repeat either 4a or 4b.

5. Calculate the variance (S^2) and standard deviation (S) of the replicate measurements, as follows:

$$S^2 = \frac{1}{n-1}\left[\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i\right)^2 \Big/ n\right]$$

$$S = (S^2)^{1/2}$$

where:

X_i; i=1 to n, are the analytical results in the final method reporting units obtained from the n sample aliquots and Σ refers to the sum of the X values from i=1 to n.

6. (a) Compute the MDL as follows:

$$MDL = t_{(n-1,1-\alpha=0.99)}\ (S)$$

where:

MDL = the method detection limit

$t_{(n-1,1-\alpha=.99)}$ = the students' t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom. See Table.

S = standard deviation of the replicate analyses.

(b) The 95% confidence interval estimates for the MDL derived in 6a are computed according to the following equations derived from percentiles of the chi square over degrees of freedom distribution (χ^2/df).

LCL = 0.64 MDL

UCL = 2.20 MDL

where: LCL and UCL are the lower and upper 95% confidence limits respectively based on seven aliquots.

7. Optional iterative procedure to verify the reasonableness of the estimate of the MDL and subsequent MDL determinations.

(a) If this is the initial attempt to compute MDL based on the estimate of MDL formulated in Step 1, take the MDL as calculated in Step 6, spike the matrix at this calculated MDL and proceed through the procedure starting with Step 4.

(b) If this is the second or later iteration of the MDL calculation, use S^2 from the current MDL calculation and S^2 from the previous MDL calculation to compute the F-ratio. The F-ratio is calculated by substituting the larger S^2 into the numerator S^2_A and the other into the denominator S^2_B. The computed F-ratio is then compared with the F-ratio found in the table which is 3.05 as follows: if $S^2_A/S^2_B<3.05$, then compute the pooled standard deviation by the following equation:

$$S_{pooled} = \left[\frac{6S^2_A+6S^2_B}{12}\right]^{1/2}$$

if $S^2_A/S^2_B>3.05$, respike at the most recent calculated MDL and process the samples through the procedure starting with Step 4. If the most recent calculated MDL does not permit qualitative identification when samples are spiked at that level, report the MDL as a concentration between the current and previous MDL which permits qualitative identification.

(c) Use the S_{pooled} as calculated in 7b, to compute the final MDL according to the following equation:

$$MDL = 2.681\ (S_{pooled})$$

where 2.681 is equal to $t_{(12,1-\alpha=.99)}$.

(d) The 95% confidence limits for MDL derived in 7c are computed according to the following equations derived from precentiles of the chi-squared over degrees of freedom distribution.

LCL=0.72 MDL

UCL=1.65 MDL

where LCL and UCL are the lower and upper 95% confidence limits respectively based on 14 aliquots.

TABLES OF STUDENTS' t VALUES AT THE 99 PERCENT CONFIDENCE LEVEL

Number of replicates	Degrees of freedom (n-1)	$t_{(n-1,.99)}$
7	6	3.143
8	7	2.998
9	8	2.896
10	9	2.821
11	10	2.764
16	15	2.602
21	20	2.528
26	25	2.485
31	30	2.457
61	60	2.390
∞	∞	2.326

Reporting

The analytical method used must be specifically identified by number or title and the MDL for each analyte expressed in the appropriate method reporting units. If the analytical method permits options which affect the method detection limit, these conditions must be specified with the MDL value. The sample matrix used to determine the MDL must also be identified with MDL value. Report the mean analyte level with the MDL and indicate if the MDL procedure was iterated. If a laboratory standard or a sample that contained a known amount analyte was used for this determination, also report the mean recovery.

If the level of analyte in the sample was below the determined MDL or exceeds 10 times the MDL of the analyte in reagent water, do not report a value for the MDL.

[49 FR 43430, Oct. 26, 1984; 50 FR 694, 696, Jan. 4, 1985, as amended at 51 FR 23703, June 30, 1986]

Important News

New changes in Drinking Water rules now require all noncommunity water systems to:

- Test for Nitrate yearly starting January of this year, and
- Test once for Nitrite before December 1995.

You are not required to test for the five new inorganic chemicals for your current source of water as the January 1993 Pipeline article may have suggested. Only new sources of water must be tested at this time.

If you have any questions please contact your lab, county health department, or the Drinking Water Section at 731-4381.

Please keep this chart for future reference. The chart in the January Pipeline had some errors in it.

Monitoring for Noncommunity Water Systems

Chemicals	Sample
Inorganics (*Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cyanide, Fluoride, Lead, Mercury, Nickel, Selenium, Thallium*)	Once
Nitrate (Testing starts 1/93)	Yearly
Nitrite (Testing starts 1/93)	Once
Turbidity for Surface Water only	1 Reading Every 4 Hours[1]

<table>
<tr><td rowspan="5">Coliform Bacteria</td><td colspan="3">Source</td></tr>
<tr><td colspan="2">Ground Water</td><td>Surface Water</td></tr>
<tr><td colspan="2">Average Daily Population Served</td><td rowspan="3">Monthly Sampling</td></tr>
<tr><td>≤1000</td><td>> 1000</td></tr>
<tr><td>Quarterly Sampling</td><td>Monthly Sampling</td></tr>
</table>

1 Systems using Slow Sand filters may reduce Turbidity readings to once a day upon approval from the Drinking Water Section.

Feb. 22, 1993

PHASE II & V PRESERVATIVE/HOLDING TIME TABLE

	Method	Container	Preservative	Extraction Holding Time*	Analysis Holding Time**
VOLATILE ORGANICS	EPA 502.2	2(40ml)Vials	HCl	---	14
SYNTHETIC ORGANICS	EPA 504	2(40ml)Vials	HCl	---	28
	EPA 506	1L Glass Amber	---	14	14
	EPA 507	1L Glass Amber	$HgCl_2$	14	14
	EPA 508	1L Glass Amber	$HgCl_2$	7	14
	EPA 508A	1L Glass Amber	---	14	30
	EPA 515.1	1L Glass Amber	$HgCl_2$	14	28
	EPA 531.1	100ml Glass Amber	Acid Buffer	---	28
	EPA 547	100ml Glass Amber	---	---	14
	EPA 548	100ml Glass Amber	---	7	1
	EPA 549	250ml Nalgene	H_2SO_4	7	21
	EPA 550	1L Glass Amber	HCl	7	40
METALS	Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Lead Nickel Selenium Sodium Thallium	250ml Plastic	HNO_3	---	180
	Mercury			---	28
ASBESTOS	EPA 600/4-83	250ml Plastic	---	---	---
MISC. INORGANICS	Cyanide	1L Plastic	NaOH	---	14
	Fluoride Sulfate	250ml Plastic	---	---	28
	Nitrate Nitrite			--- ---	2 2

* Holding Times expressed as days unless otherwise noted.

** Analysis holding time is expressed as days after extraction where applicable.

Volatile Organics

Compound	EPA Code	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Method	R/U	Phase
Benzene	2990	0.0005		0.005	EPA 502.2	R	I
Bromobenzene	2993	0.0005		—	EPA 502.2	U	I
Bromodichloromethane	2943	0.0005		—	EPA 502.2	U	I
Bromoform	2942	0.0005		—	EPA 502.2	U	I
Bromomethane	2214	0.001		—	EPA 502.2	U	I
Carbon tetrachloride	2982	0.0005		0.005	EPA 502.2	R	I
Chlorobenzene	2989	0.0005		0.1	EPA 502.2	R	II
Chloroethane	2216	0.003		—	EPA 502.2	U	I
Chloroform	2941	0.0005		—	EPA 502.2	U	I
Chloromethane	2214	0.0005		—	EPA 502.2	U	I
1,2-Chlorotoluene	2965	0.0005		—	EPA 502.2	U	I
1,4-Chlorotoluene	2966	0.0005		—	EPA 502.2	U	I
Dibromochloromethane	2944	0.0005		—	EPA 502.2	U	I
1,2-Dichlorobenzene	2968	0.0005		0.6	EPA 502.2	R	II
1,3-Dichlorobenzene	2967	0.0005		—	EPA 502.2	U	I
1,4-Dichlorobenzene	2969	0.0005		0.075	EPA 502.2	R	I
1,1-Dichloroethane	2978	0.0005		—	EPA 502.2	U	I
1,2-Dichloroethane	2980	0.0005		0.005	EPA 502.2	R	I
1,1-Dichloroethene	2977	0.0005		0.007	EPA 502.2	R	I
cis-1,2-Dichloroethene	2380	0.0005		0.07	EPA 502.2	R	II
trans-1,2-Dichloroethene	2979	0.0005		0.1	EPA 502.2	R	II
Dichloromethane	2964	0.0005	0.005	0.005	EPA 502.2	U	V
1,2-Dichloropropane	2983	0.0005		0.005	EPA 502.2	R	II
1,3-Dichloropropane	2412	0.0005		—	EPA 502.2	U	I
2,2-Dichloropropane	2416	0.0005		—	EPA 502.2	U	I
1,1-Dichloropropene	2410	0.0005		—	EPA 502.2	U	I
1,3-Dichloropropene	2413	0.0005		—	EPA 502.2	U	I
Ethylbenzene	2992	0.0005		0.7	EPA 502.2	R	II
Styrene	2996	0.0005		0.1	EPA 502.2	R	II
1,1,1,2-Tetrachloroethane	2986	0.0005		—	EPA 502.2	U	I
1,1,2,2-Tetrachloroethane	2988	0.0005		—	EPA 502.2	U	I
Tetrachloroethene	2987	0.0005		0.005	EPA 502.2	R	II
Toluene	2991	0.0005		1.0	EPA 502.2	R	II
1,2,4-Trichlorobenzene	2378	0.0005	0.005	0.07	EPA 502.2	R	V
1,1,1-Trichloroethane	2981	0.0005		0.2	EPA 502.2	R	I
1,1,2-Trichloroethane	2985	0.0005	0.005	0.005	EPA 502.2	R	V
Trichloroethene	2984	0.0005		0.005	EPA 502.2	R	I
1,2,3-Trichloropropane	2414	0.0005		—	EPA 502.2	U	I
Vinyl chloride	2976	0.001		0.002	EPA 502.2	R	I
Total Xylenes	2955	0.0005		10.0	EPA 502.2	R	II

Synthetic Organics

Compound	EPA Code	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Method	R/U	Phase
DBCP	2931	*0.00002*		0.0002	EPA 504	R	II
EDB	2946	*0.00001*		0.00005	EPA 504	R	II
Di(ethylhexyl)adipate	—		0.006	0.4	EPA 506	R	V
Di(ethylhexyl)phthalate	—		0.006	0.006	EPA 506	R	V
Atrazine	2050	*0.0001*		0.003	EPA 507	R	II
Butachlor	2076			—	EPA 507	U	II
Metolachlor	2045			—	EPA 507	U	II
Metribuzine	2595			—	EPA 507	U	II
Propachlor	2077			—	EPA 507	U	II
Simazine	2037		0.0007	0.004	EPA 507	R	V
Alachlor	2051	*0.0002*		0.002	EPA 508	R	II
Aldrin	2356			—	EPA 508	U	II
Chlordane	2959	*0.0002*		0.002	EPA 508	R	II
Dieldrin	2070			—	EPA 508	U	II
Endrin	2005	0.00001	0.001	0.0002	EPA 508	R	V
Heptachlor	2065	*0.00004*		0.0004	EPA 508	R	II
Heptachlor epoxide	2067	*0.00002*		0.0002	EPA 508	R	II
Hexachlorobenzene	2274		0.001	0.001	EPA 508	R	V
Hexachlorocyclopentadiene	2042		0.001	0.05	EPA 508	R	V
Lindane	2010	*0.00002*		0.0002	EPA 508	R	II
Methoxychlor	2015	*0.0001*		0.04	EPA 508	R	II
Toxaphene	2020	*0.001*		0.003	EPA 508	R	II
Decachlorobiphenyl	—	*0.0001*		0.0005	EPA 508A	R	II
2,4-D	2105	*0.0001*		0.07	EPA 515.1	R	II
Dalapon	2031	0.001	0.01	0.2	EPA 515.1	R	V
Dicamba	2440			—	EPA 515.1	U	II
Dinoseb	2041	0.0002	0.002	0.007	EPA 515.1	R	V
Pentachlorophenol	2326	*0.00004*		0.001	EPA 515.1	R	II
Picloram	2040	0.0001	0.001	0.5	EPA 515.1	R	V
2,4,5-TP	2110	*0.0002*		0.05	EPA 515.1	R	II
Aldicarb	2047	0.0005		0.003	EPA 531.1	U	II
Aldicarb sulfone	2044	0.0008		0.003	EPA 531.1	U	II
Aldicarb sulfoxide	2043	0.0005		0.003	EPA 531.1	U	II
Carbaryl	2021			—	EPA 531.1	U	II
Carbofuran	2046	*0.0009*		0.04	EPA 531.1	R	II
3-Hydroxycarbofuran	2066			—	EPA 531.1	U	II
Methyomyl	2022			—	EPA 531.1	U	II
Vydate (Oxymyl)	2036		0.02	0.2	EPA 531.1	R	V
Glyphosate	2034	0.006	0.06	0.7	EPA 547	R	V
Endothall	2033	0.009	0.09	0.1	EPA 548	R	V
Diquat	2032	0.0004	0.004	0.02	EPA 549	R	V
Benzo(a)pyrene	2306	0.00002	0.0002	0.0002	EPA 550	R	V

Inorganics
Metals

Compound	EPA Code	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Method	R/U	Phase
Antimony	1074	0.003		0.006	EPA 204.2	R	V
Arsenic	1005			0.05	EPA 206.2	R	II
Barium	1010	*0.002*		2	EPA 200.7	R	II
Beryllium	1075	0.0003		0.004	EPA 200.7	U	V
Cadmium	1015	*0.0001*		0.005	EPA 213.2	R	II
Chromium	1020	*0.001*		0.1	EPA 218.2	R	II
Copper	1022			1.3	EPA 220.1	R	III
Lead	1030			0.015	EPA 239.2	R	III
Mercury	1035	*0.0002*		0.002	EPA 245.1	R	II
Nickel	1036	0.005		0.1	EPA 200.7	U	V
Selenium	1045	*0.002*		0.05	EPA 270.2	R	II
Sodium	1052			—	EPA 200.7	U	II
Thallium	1035	0.001		0.002	EPA 279.2	U	V

Asbestos

Compound	EPA Code	MDL (mg/L)	PQL (mg/L)	MCL	Method	R/U	Phase
Asbestos	1097	*0.01*		7 MF/L	EPA-600/4-83	R	II

Miscellaneous Inorganics

Compound	EPA Code	MDL (mg/L)	PQL (mg/L)	MCL (mg/L)	Method	R/U	Phase
Cyanide	1024	0.02		0.2	EPA 335.2	U	V
Fluoride	1025			4.0	EPA 340.2	R	II
Nitrate	1040	*0.01*		10.	EPA 300.0	R	II
Nitrite	1041	*0.01*		1.0	EPA 354.1	R	II
Sulfate	1055			—	EPA 300.0	U	II

References: EPA 40 CFR Parts 141 and 142.
OAR, Chapter 333.