Appendix E

Site Engineering Technical Report

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Trendwest Properties:
Cle Elum UGA
Cle Elum, Washington

For

Trendwest Properties, Inc.
Redmond, Washington

March 2002

By

W&H Pacific, Inc.
3350 Monte Villa Parkway
Bothell, Washington 98021

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EXPIRES: DEC. 7, 2003

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Table of Contents

Section	Contents	Page
	Introduction	i – 1
1	Site Information	1-1
	Clearing, Grading and Impervious Area Information	1-1
	Project Clearing	1-1
	Site Grading	1-1
	Imported Materials Alternative	1-2
	Artificial Water Bodies – Alternative 5	1-3
2	Hydrologic Modeling	2-1
	Hydrologic Model	2-1
	Preliminary Existing Condition Models	2-2
	Land Segments	2-2
	Existing Condition Modeling Results	2-14
	Developed Condition Modeling	2-15
	Modeling Concept	2-15
	Models	2-16
	Routing	2-16
	Mitigated Developed Condition Model Results	2-22
3	Preliminary Water Plans	3-1
	System Capacity Requirements	3-1
	Treated (Domestic) Water Requirements	3-1
	Untreated Water Requirements	3-8
	Water Use Standards	3-9
	Source of Water Supply	3-10
	Proposed Joint Participation Project	3-10
	Water Intakes	3-10
	Water Treatment Alternatives	3-13
	Preliminary Water Distribution System Plan	3-13
	Pressure Zones	3-23
	Treated Water Storage	3-23
	Transmission/Distribution Lines	3-24
	Pumping Systems	3-24
	Water System Modeling	3-24
	Water Use Standards	3-25
	Indoor Water Use Standards	3-25
	Outdoor Water Use Standards	3-26
	Recommendations to Achieve Irrigation Efficiency	3-27

Contents (Cont.)

		Page
4	Preliminary Sewer Plans	4-1
	Wastewater Flow Projections	4-1
	Collection and Conveyance System	4-13
	Wastewater Treatment and Disposal	4-14
	Flows and Loadings	4-14
	Wastewater Treatment and Disposal Alternatives	4-16
	On-Site Wastewater Systems	4-18
5	Solid Wastes	5-1
	Solid Waste Sources and Classifications	5-1
	Sources of Solid Wastes	5-1
	Classifications of Solid Wastes	5-1
	Waste Stream Quantities and Management	5-3
	CDL Wastes	5-3
	Municipal and Other Wastes	5-5
	Septage Wastes	5-8
	Land Clearing Wastes	5-8
	Waste Loading Impacts	5-8

Cited References

Table

1-1	Estimated Cleared and Impervious Areas, Acres	1-1
1-2	Estimated Earthwork Quantities, Cubic Yards	1-2
2-1	Soil-Cover-Slope Complexes	2-5
2-2	Existing Subbasin Soil Types	2-13
2-3	Pre-Developed Condition Subbasin Land-Use/Land Cover	2-14
2-4	Pre-Developed Condition Annual Flow Volumes for UGA Basins at the Drainage Boundary	2-15
2-5	Pre-Developed Condition Peak Flow Analysis	2-15
2-6	Developed Condition Subbasin Land-use/Land Cover, Alternative 2	2-21
2-7	Mitigated Developed Condition Annual Flow Volumes for UGA Basins, Alternative 2	2-23
2-8	Impervious Area Summaries	2-24
2-9	Estimated Annual Runoff, Alternatives 2, 3, 4, and 5	2-25
3-1	Single Family Residences	3-1
3-2	Condominium Units	3-1

Contents (Cont.)

Page

Table

3-3	Apartment Units	3-2
3-4	Golf Course Clubhouse Users	3-3
3-5	Average Daily Treated Water Demand at Buildout Trendwest Demands, mgd	3-4
3-6	Average Daily Treated Water Demands at Buildout for Non-Trendwest Demands, mgd	3-4
3-7	Peaking Factors	3-4
3-8	Maximum Month Treated Water Demands, Trendwest Demands	3-5
3-9	Maximum Month Treated Water Demands, Non-Trendwest Demands	3-5
3-10	Monthly Net Site Lake Evaporation	3-9
3-11	Trendwest Untreated Water Demands, acre-feet/month	3-9
3-12	Non-Trendwest Untreated Water Demands, acre-feet/month	3-9
3-13	Treated Water Storage Requirements, Gallons	3-23
3-14	Allowable Irrigated Areas	3-26
3-15	Turf Irrigation Requirements	3-26
3-16	Maximum Allowable Irrigation Volumes	3-26
4-1	Wastewater Generation as a Fraction of Water Demand	4-1
4-2	Infiltration/Inflow as a Fraction of Inside Wastewater Production	4-1
4-3	Wastewater Generation – Single Family	4-2
4-4	Wastewater Generation – Condominium and Apartment Units	4-2
4-5	Monthly Wastewater Flow at Buildout, mgd	4-3
4-6	Preliminary Lift Station Design Parameters	4-13
4-7	Projected Wastewater Flows for Alternative 2, mgd	4-14
4-8	Projected Wastewater Flows for Alternative 3, mgd	4-14
4-9	Projected Wastewater Flows for Alternative 4, mgd	4-15
4-10	Projected Wastewater Flows for Alternative 5, mgd	4-15
4-11	Projected UGA Loadings for Alternatives 2, 3, 4 and 5, lb. per day	4-15
4-12	Regional Wastewater Flows at Year 30	4-16
4-13	Summary of Pollutant Loads at Year 30	4-16
5-1	Estimated Residential Building Areas, Cle Elum UGA	5-3
5-2	Estimated Non-Residential Building Areas, Cle Elum UGA	5-4
5-3	Projected CDL Generation Rates (Tons/Year) and Total Quantity at Full Buildout, Cle Elum UGA	5-4
5-4	Solid Waste Production (Tons/Year), Cle Elum UGA	5-6

Contents (Cont.)

Page

Figure

2-1	Existing Subbasins	2-3
2-2	Soil Types	2-7
2-3	Existing Vegetative Cover	2-9
2-4	Slope Map	2-11
2-5	Developed Condition Basin Boundaries	2-17
2-6	Permeable and Impermeable Area Model Schematic	2-19
3-1	Raw Water Intake and Treatment Plant Location	3-11
3-2	Preliminary Water Plan – Alternative 2	3-15
3-3	Preliminary Water Plan – Alternative 3	3-17
3-4	Preliminary Water Plan – Alternative 4	3-19
3-5	Preliminary Water Plan – Alternative 5	3-21
4-1	Preliminary Sewer Plan – Alternative 2	4-5
4-2	Preliminary Sewer Plan – Alternative 3	4-7
4-3	Preliminary Sewer Plan – Alternative 4	4-9
4-4	Preliminary Sewer Plan – Alternative 5	4-11

Introduction

This document presents information on the preliminary engineering and planning analyses performed for the Cle Elum UGA development alternatives by W&H Pacific, Inc., at the request of Trendwest Properties, Inc.

Alternatives 2, 3, and 4 were evaluated in the Draft EIS published in March 2000. Following publication of the Draft EIS and in response to public comment, a Master Site Plan Application was submitted to the City of Cle Elum in August 2001. The Master Site Plan is evaluated in the Final EIS as Alternative 5. A detailed description of Alternative 5 is included in Chapter 2 of the Final EIS, Description of Alternatives. Information on Alternatives 2, 3, 4, and 5 is presented in the Site Engineering Technical Report to facilitate a comparative impact analysis. The information includes the following:

Grading Analysis (Alternatives 2, 3, 4 and 5)
Hydrologic Modeling (Alternatives 2, 3, 4 and 5)
- Existing conditions runoff modeling
- Developed Conditions runoff modeling

Preliminary Water Plans (Alternatives 2, 3, 4 and 5)
- Water demand estimate
- Preliminary water system plan

Preliminary Sewer Plans (Alternatives 2, 3, 4 and 5)
- Wastewater flow estimate
- Preliminary sewer system plan

Clearing, Grading and Impervious Area Information

The following provides estimates of areas to be cleared during construction of the project, impervious areas, and volumes of cut and fill from project grading.

Project Clearing

In order to maintain the natural setting of the project, the extent of clearing associated with project construction would be kept to reasonable minimums through project design. Estimated areas to be cleared are presented in **Table 1-1** by type of land use category. Cleared areas for roads were assumed to be the full road right-of-way over the length of the roads. The road right-of-way was assumed to be 60 feet. Cleared areas for other land uses were taken as the assumed maximum developed area for each land use.

Impervious areas by land use category are also presented in **Table 1-1**. A width of 30 feet was used in the impervious area calculations for the roads.

Table 1-1: Estimated Cleared and Impervious Areas, Acres[a]

Land Use	UGA Alt 2		UGA Alt 3		UGA Alt 4		UGA Alt 5[b]	
	Area Cleared	Impervious Area	Area Cleared	Impervious Area	Area Cleared	Impervious Area	Area Cleared	Impervious Area
Residential	75	53	111	75	65	45	161	104
Lodging	6	5	6	5	6	5	0	0
Golf Courses	154	12	154	12	154	12	0	0
Roads	65	32	87	43	70	35	122	61
Public Facilities	5	3	5	3	5	3	23	4
Community Recreation Center	4	2	4	2	4	2	10	6
School Expansion	14	12	14	12	14	12	17	8
Cemetery Expansion	5	1	5	1	2	0	8	1
Business Park	78	60	56	44	28	22	62	63
Horse Park/RV Park	145	100	12	10	145	100	0	0
Total	550	279	453	205	492	235	403	247

[a] Note: Numbers may not sum to totals shown due to rounding
[b] Excludes Reserve Area.

Site Grading

The general considerations for grading throughout the site include the following:

- Clearing limits would be minimized as discussed previously.
- Grading will be performed to provide positive drainage.
- Grading designs would seek reasonable balances of cut and fill by development area phases.
- No excavated materials are expected to be transported off-site.

- Except as discussed in the following sections, no general borrow materials are expected to be imported from off-site sources.
- Excavated topsoil would be stockpiled and reused in golf course (Alternatives 2, 3, and 4) and landscaped areas.
- Erosion and sedimentation control measures would be implemented.

Estimated earthwork quantities are presented in **Table 1-2**. Roadway quantities to subgrade have been determined from a preliminary roadway vertical design based on the horizontal alignments presented in the proposed traffic circulation plan for each of the UGA alternatives. Quantities of cut and fill for other land uses were estimated on the basis of unit area volume procedures for each land use type. The unit area volumes were applied to the assumed maximum development areas estimated for each land use category.

Table 1-2: Estimated Earthwork Quantities, Cubic Yards

	UGA Alt 2		UGA Alt 3		UGA Alt 4		UGA Alt 5[b]	
Land Use	**Cut**	**Fill**	**Cut**	**Fill**	**Cut**	**Fill**	**Cut**	**Fill**
Residential	110,000	67,000	142,000	88,000	88,000	54,000	116,000	75,000
Lodging	22,000	18,000	22,000	18,000	22,000	18,000	0	0
Golf Courses	310,000	372,000	310,000	372,000	310,000	372,000	0	0
Roads	74,000	14,000	113,000	149,000	80,000	17,000	79,000	16,000
Public/Other Facilitiesa	4,000	3,000	4,000	3,000	4,000	3,000	82,000	15,000
Community Recreation Center	6,000	6,000	6,000	6,000	6,000	6,000	19,000	19,000
School Expansion	23,000	23,000	23,000	23,000	23,000	23,000	37,000	37,000
Cemetery Expansion	4,000	9,000	4,000	9,000	1,000	3,000	8,000	16,000
Business Park	313,000	250,000	226,000	181,000	113,000	90,000	303,000	242,000
Horse Park/RV Park	234,000	234,000	19,000	19,000	234,000	234,000	0	0
Total	1,100,000	996,000	869,000	868,000	881,000	820,000	584,000	420,000

[a] Includes maintenance area and water treatment plant.
[b] Excludes Reserve Area

Imported Materials Alternative

In the event on-site materials are not processed for construction, imported materials will be required. These materials would include: gravel base course and crushed rock base course materials for roadway, parking and paved trails; asphalt concrete; and bedding materials for pipelines. The estimated total volume of these materials is 204,000 cubic yards. This estimate is likely conservative, particularly for the Preferred Alternative (Alternative 5), as suitable materials from excavation for the artificial water bodies should provide a part of the project aggregate needs. It is assumed that material for private construction (residence driveways, etc.) would be imported whether or not on site materials were used for the public facilities.

Delivery of imported materials would follow the proposed construction schedule for the infrastructure located within the UGA, which is estimated to be 5 years. Assuming a six-month construction season for site work (May – October), approximately 6,800 cubic yards per month

would be delivered to the site. Assuming 12 cubic yard capacity trucks are used, the material importing activities would generate about 570 truck trips per month.

Some stockpiling of materials on site would be expected such as bedding materials for pipeline construction. Stockpiling would tend to increase daily truck trip volumes over the average daily truck trip volume for the construction season. However, the truck trip volume for the season would not be expected to change.

Artificial Water Bodies – Alternative 5

The conceptual site plan for Alternative 5 includes a number of artificial water bodies (small lakes or ponds) to provide landscape and recreational amenities for the community. A total surface area of 15 acres is proposed for 8 to 10 ponds and lakes. The largest lake would be about 10 acres in size, and located as a part the neighborhood clubhouse complex. The remaining lakes and ponds would average around one-half acre in size.

For the large lake, uses would include swimming, non-motorized boating and canoeing, fishing, and waterfowl viewing. A pedestrian trail system would border the lake's perimeter to allow for recreational walking and nature viewing, and perhaps locations for picnicking. The lake would be 10 to 15 feet in depth and lined to prevent leakage into the groundwater system. To protect the water quality of the lake, stormwater would not be discharged to the lake. Grading adjacent to the lake would be designed to direct shoreline runoff away from the lake.

The water in the large lake would be exchanged at least twice per year to assist in maintaining water quality and minimizing undesirable aquatic vegetation growth. The source of exchange water would be untreated water diverted from the Yakima River for irrigation of the MountainStar MPR golf courses. A portion of the water being delivered to the MPR golf courses would be diverted to the lake. The points of delivery to, and discharge from, the lake would be selected to promote the exchange effectiveness and circulation within the lake. The exchange water would be lower in temperature than the lake water. This will be beneficial to coolwater fish in the lake. The exchange water discharge from the lake would be pumped to the MPR golf course irrigation ponds. The delivery and discharge points as well as the monthly discharge rates to the lake would be determined during project design. Aeration of the lake at one or more locations may be provided to maintain desired dissolved oxygen levels.

For the smaller lakes, perimeter trail walking and nature viewing would be the principal use objectives. Some of the small lakes could have wetland components to attract waterfowl and other bird life. These lakes would also be lined. Water exchange in these smaller lakes is desirable, and could be accomplished by the method described for the large lake where the MPR untreated water transmission main was in close proximity to the lakes. Alternatively, treated water to be used for UGA common area irrigation could be routed through the smaller lakes and

the pumped to points of irrigation. Roof runoff or other stormwater (after treatment) might be discharged to the smaller lakes to assist in lake water exchange.

All lakes would have controls to maintain water surfaces at their functional design levels. Water needed to make up for evaporative losses from the lakes has been included in the water demands for Alternative 5.

A lake management and maintenance program would be necessary for all lakes. The applicable community or property owner association would operate the program for individual lakes. The program(s) would be modeled after existing volunteer lake management and monitoring programs, such as presented in the EPA's *Volunteer Lake Monitoring: A Methods Manual*. Monitoring elements suitable for volunteers include, for example, algae, aquatic plants and dissolved oxygen. For the large lake, coliform bacteria monitoring will be required to assure safe water quality conditions for swimming.

Hydrologic modeling was performed for the UGA (Alternative 2) to: (1) gain an understanding of the existing or pre-development hydrology of the site; and (2) estimate the hydrologic impacts of the proposed development for use in developing proposed mitigations. Alternative 2 represents the highest impact alternative. The results of the hydrologic modeling performed to simulate existing and developed condition flows for the project are presented below, and analyzed comparatively for Alternatives 3, 4, and 5. The simulation model is described first, followed by a summary of the data inputs to the model. The results of existing and developed conditions flow analyses are then presented for each of the UGA subbasins.

Hydrologic Model

The hydrologic simulation model used for the UGA is the same model used by W&H Pacific for the neighboring MountainStar Master Planned Resort project. The model is the Hydrologic Simulation Program – Fortran (HSPF) Release 11, (United States Environmental Protection Agency, 1996). The model continuously simulates the rainfall-runoff response of a watershed by simulating the physical process response to changing climatic conditions. HSPF is a standard hydrologic computational tool. The Washington State Department of Ecology (Ecology) notes that HSPF is relatively complex to use, and is best suited for basin plans and master drainage plans. Ecology requires the use of a continuous simulation model for basin plans. Due to the large size of the MountainStar watershed (19.5 square miles) and environmental review considerations, the HSPF model was selected for that project.

Input to the model includes land segment information such as soil parameters, elevation and vegetation parameters, as well as several continuous climatological time series for the time period being simulated. The climatological parameters required by HSPF for runoff and snow simulation are:

- Precipitation
- Evaporation
- Air temperature
- Dewpoint temperature
- Solar radiation
- Wind movement

Runoff is modeled as the combined effect of surface flow, shallow subsurface flow (interflow) and groundwater flow response to climatological conditions. The distribution of flow between runoff mechanisms is determined by land segment characteristics such as soil moisture content, infiltration rate, and interception storage. The model generates flow from pervious and impervious land segments, and routes it through the drainage network. The drainage network can include pipes, streams, vaults, detention ponds, lakes and wetlands.

Snow accumulation and melt are simulated based on energy balance equations. Snow pack conditions, including ice content, density, albedo (reflectivity of the snow) and temperature, change over time according to climate conditions. Snowmelt water is added to precipitation inputs to the land segment and is routed through the land segment runoff mechanisms before entering the drainage network.

Output from the model can include, for example: groundwater, interflow and surface flows, snow pack and snow water equivalent, and wetland or detention pond storage.

The land segments used in the model are organized into soil-cover-slope complexes. The coding used in the complexes for the site is summarized below.

Soil Type	Cover	Slope
B = Bedrock T = Till O = Outwash S = Saturated	F = Forest G = Grassed O = Open	F = Flat (0 – 6%) G = Gradual (Moderate) (6 – 15 %) S = Steep (>15%)

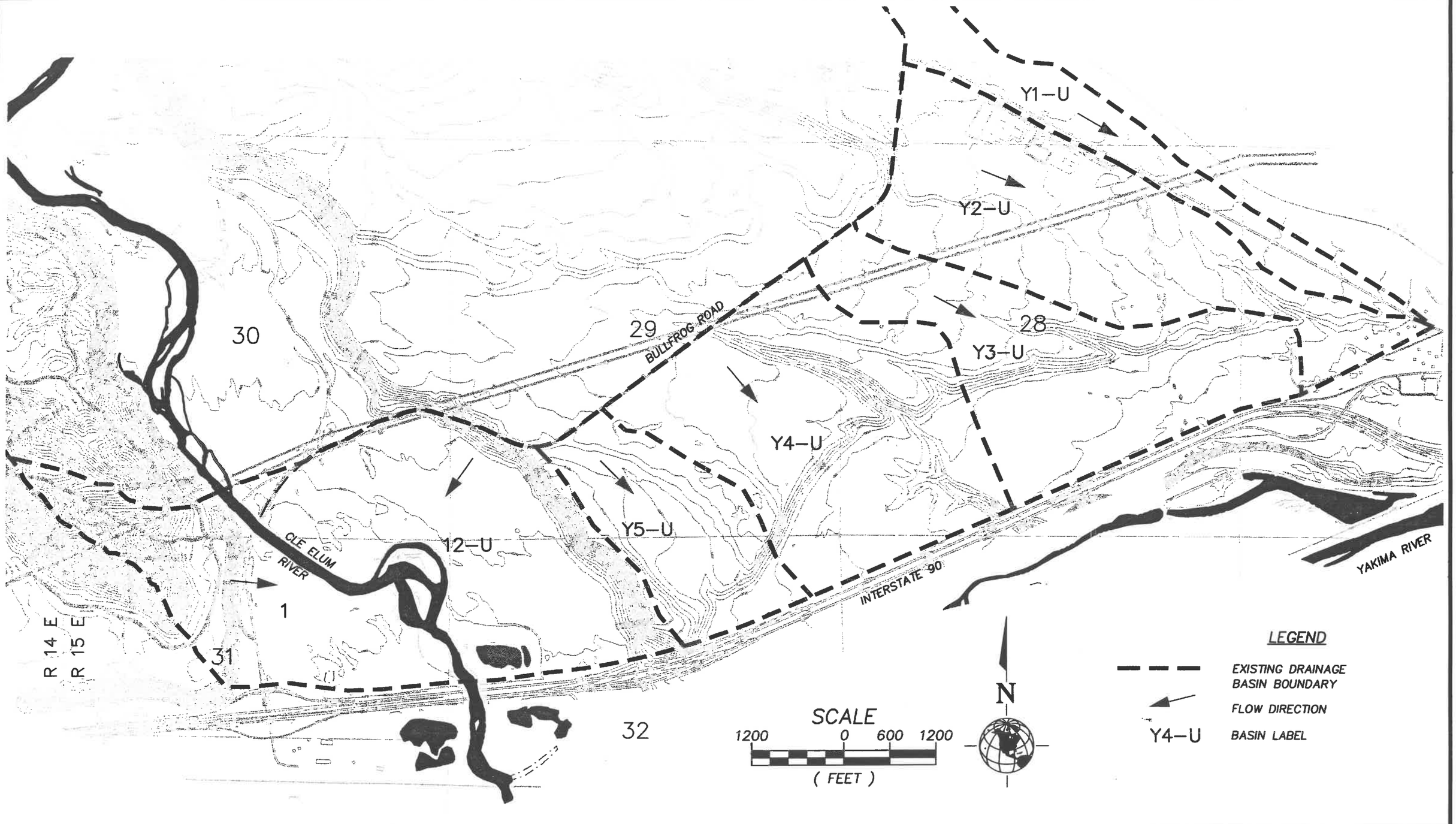
Preliminary Existing Condition Models

Preliminary existing conditions HSPF logic models have been developed for each of the UGA subbasins. Bullfrog road is the northerly limit of the subbasin. The basins are being modeled as basins without streams because of their lack of active stream systems. These include Subbasin 12-U and Subbasins Y1-U through Y5-U. Subbasins boundaries for each of the models are shown in **Figure 2-1**.

Land Segments

The drainage basins were broken into homogeneous land segments according to soil type, vegetative cover, and average slope conditions. The categories chosen for land segment classification are based on classifications by Dinicola[a]. The categories and the resulting shorthand nomenclature are contained in **Table 2-1**. The nomenclature is based on the first letter of the soil type, vegetative cover, and slope in order.

[a] Dinicola, R.S. *Characterization and Simulation of Rainfall-Runoff Relations for Headwater Basins in Western King and Snohomish Counties, Washington.* U.S. Geological Survey. 1990.



W&H PACIFIC

Cle Elum Urban Growth Area

Figure 2-1
Existing Subbasins

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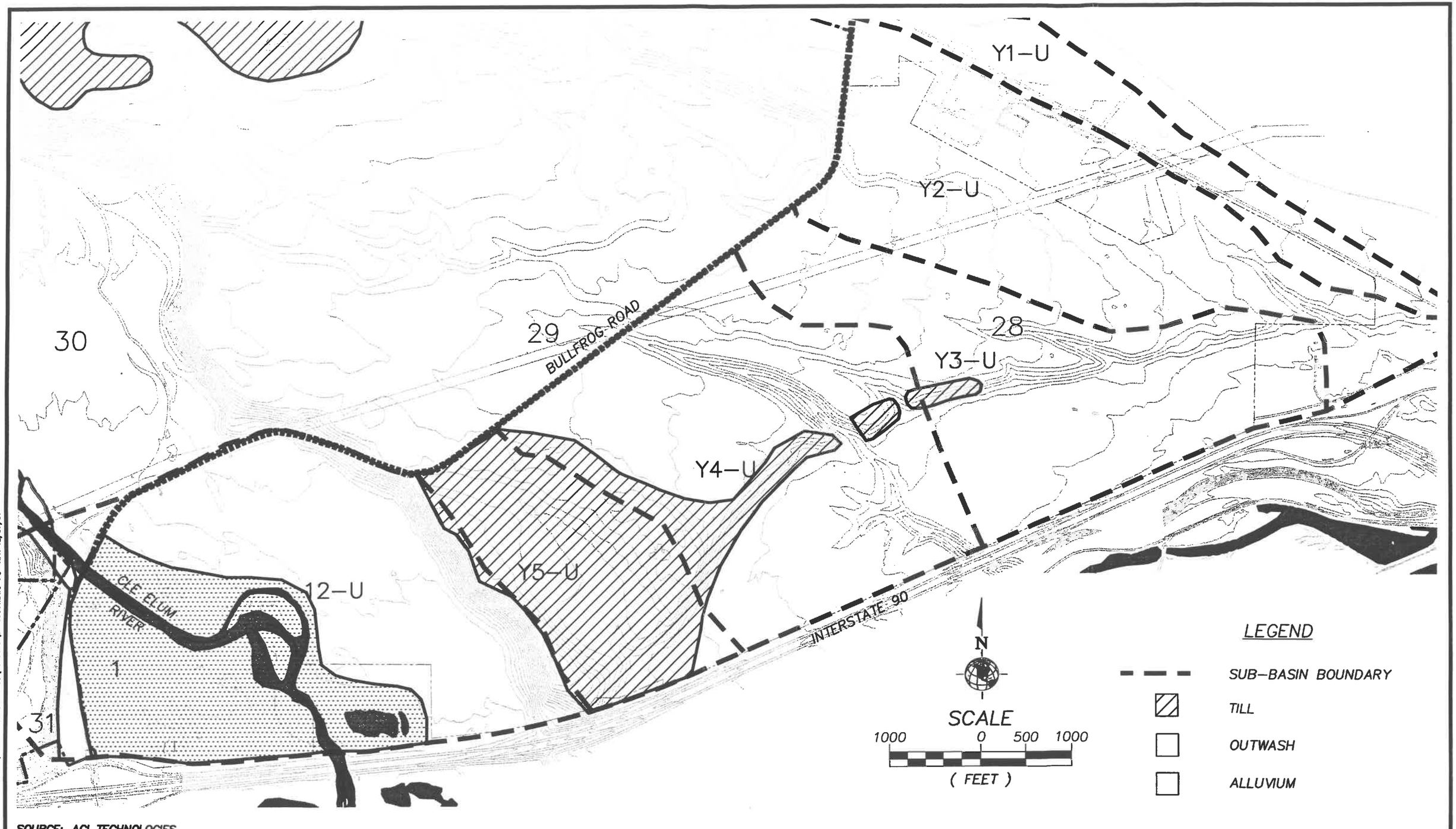
Table 2-1: Soil-Cover-Slope Complexes

Nomenclature	Soil Type	Vegetative Cover	Slope
OFF	Outwash	Forest	Flat
OFG	Outwash	Forest	Gradual
OFS	Outwash	Forest	Steep
OOF	Outwash	Successional[a]	Flat
OOG	Outwash	Successional[a]	Gradual
OOS	Outwash	Successional[a]	Steep
BFF	Bedrock	Forest	Flat
BFG	Bedrock	Forest	Gradual
BFS	Bedrock	Forest	Steep
BOG	Bedrock	Successional[a]	Gradual
BOS	Bedrock	Successional[a]	Steep
SFF	Saturated	Forest	Flat
SFG	Saturated	Forest	Gradual
SFS	Saturated	Forest	Steep
SOF	Saturated	Successional[a]	Flat
SOG	Saturated	Successional[a]	Gradual
SOS	Saturated	Successional[a]	Steep
TFF	Till	Forest	Flat
TFG	Till	Forest	Gradual
TFS	Till	Forest	Steep
TOF	Till	Successional[a]	Flat
TOG	Till	Successional[a]	Gradual
TOS	Till	Successional[a]	Steep

[a] Early Forest Successional.

Soil Type. CDM (formerly AGI Technologies) characterized soil types throughout the UGA site. These soil types were aggregated by American Engineering Corporation into four general soil types for the hydrologic model. The four model soil types are bedrock, till, outwash and saturated. **Table 2-2** summarizes the soil types present in each of the subbasins. The soil types for the UGA watershed are shown in **Figure 2-2**.

Cover. Vegetative cover information obtained from aerial photos was field verified and analyzed by Raedeke Associates, Inc. The cover classes identified by Raedeke were reduced to two general cover classes for the hydrologic model. W&H Pacific, Inc., performed aggregation. The two classes were early forest successional and forested. The early forest successional class is composed of grassland, bare ground, shrubs, riparian shrubs, forest harvest and sections of forest early secessional cover classes identified by Raedeke Associates, Inc. The forest cover class is composed of mixed, coniferous, thinned coniferous, and deciduous forest classes identified by Raedeke Associates, Inc. The vegetative cover types for the UGA watershed are shown in **Figure 2-3**.



SOURCE: AGI TECHNOLOGIES

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Cle Elum Urban Growth Area

Figure 2-2
Soil Types

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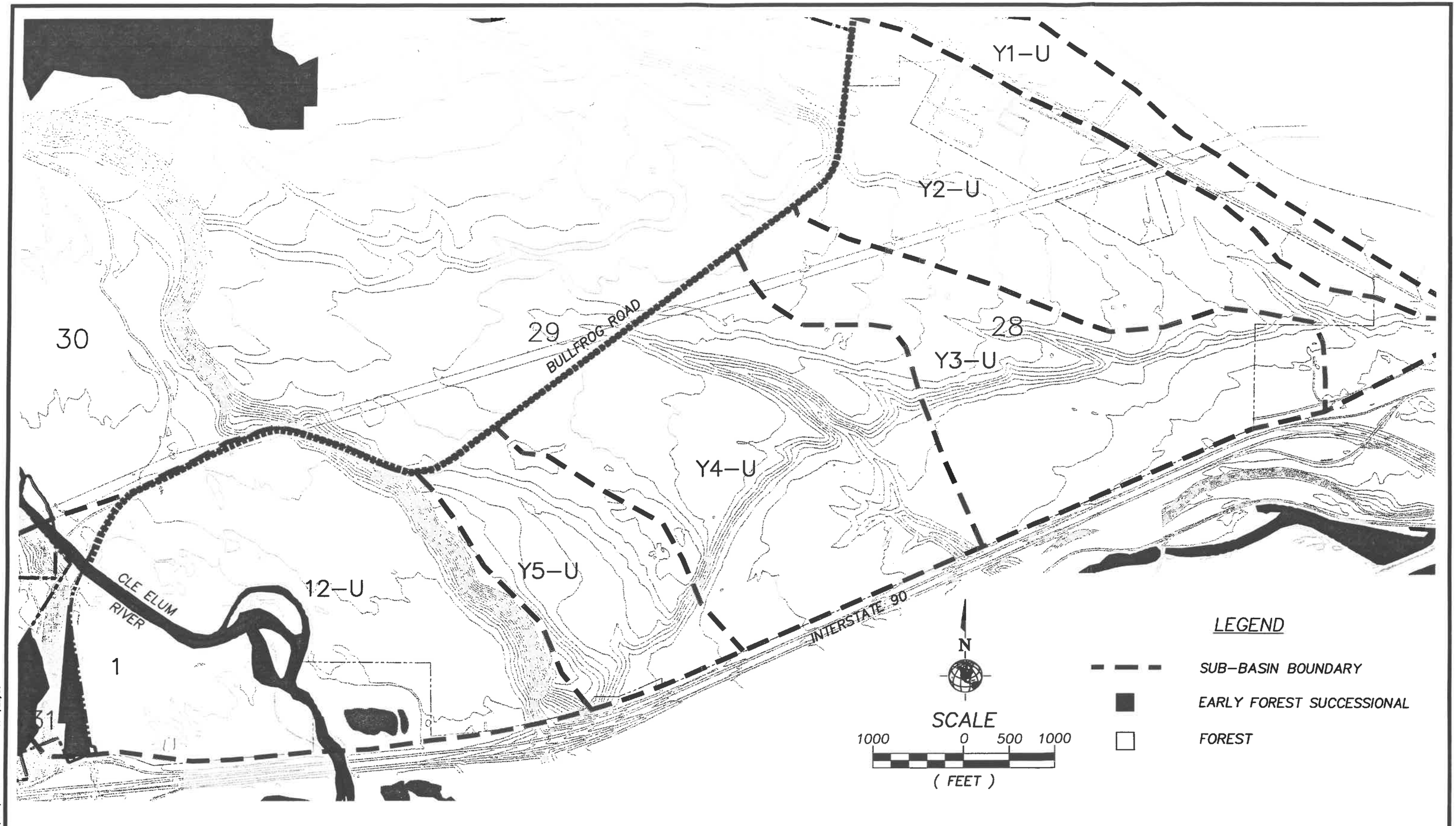

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Cle Elum Urban Growth Area

Figure 2-3
Existing Vegetative Cover

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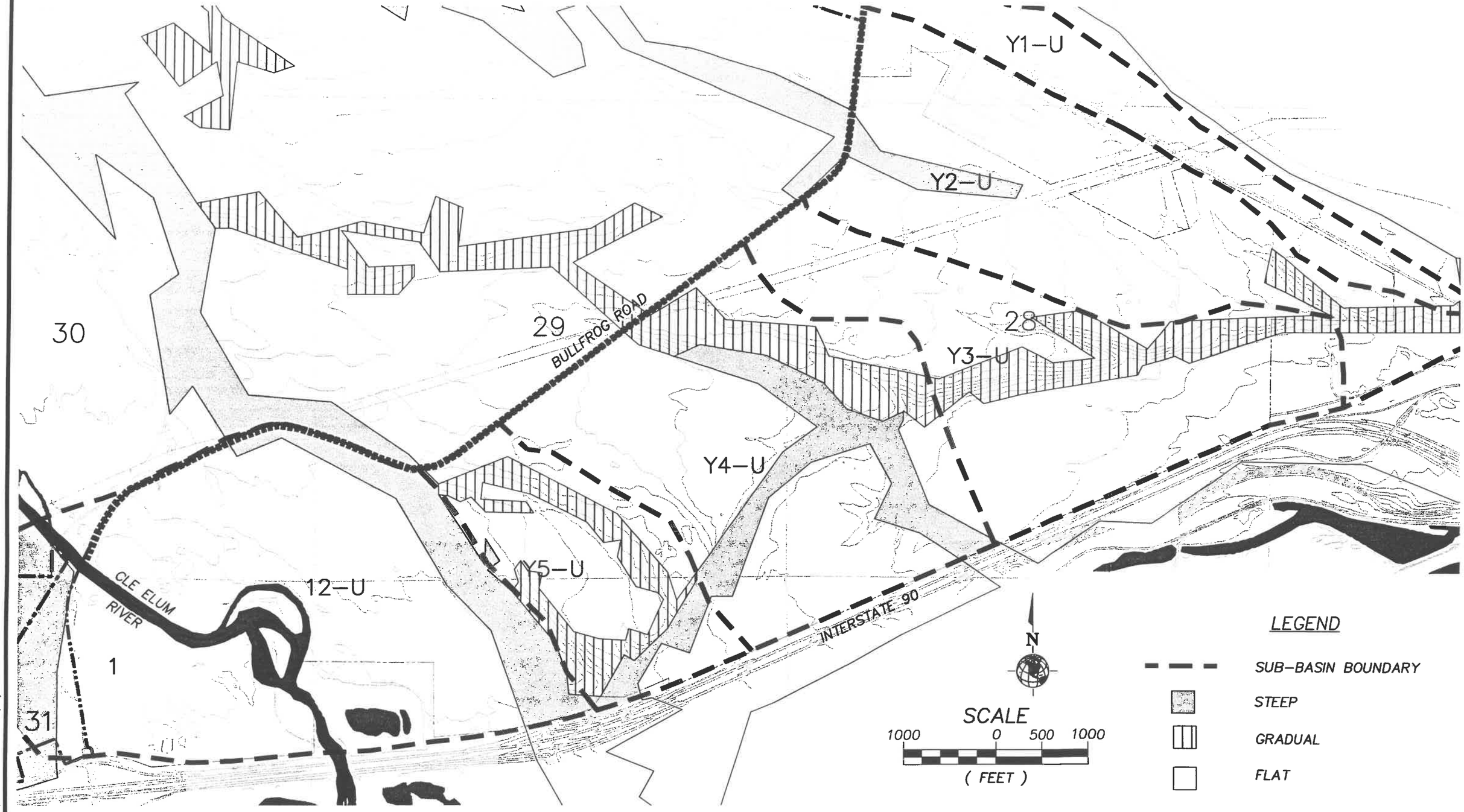

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Cle Elum Urban Growth Area

Figure 2-4
Slope Map

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Table 2-2: Existing Subbasin Soil Types

Subbasin	Basin Area (acres)	Till (acres)	Outwash (acres)	Bedrock Area (acres)	Saturated (acres)	Impervious (acres)
Basin 1-1U	90	-	90	-	-	-
Basin 1-2U	85	-	40	45	-	-
Basin 12-U	248	2	246	-	-	-
Basin Y1-U	100	-	94	-	-	6
Basin Y2-U1	97	-	97	-	-	-
Basin Y2-U2	57	-	57	-	-	-
Basin Y2-U3	28	-	28	-	-	-
Basin Y2-U4	102	-	93	-	-	9
Basin Y3-U1	70	-	70	-	-	-
Basin Y3-U2	15	-	15	-	-	-
Basin Y3-U3	61	2	59	-	-	-
Basin Y3-U4	65	-	65	-	-	-
Basin Y3-U5	20	-	20	-	-	-
Basin Y4-U1	105	26	79	-	-	-
Basin Y4-U2	93	11	82	-	-	-
Basin Y4-U3	64	1	63	-	-	-
Basin Y4-U4	26	1	25	-	-	-
Basin Y5-U1	96	96	-	-	-	-
Basin Y5-U2	31	26	5	-	-	-

Slope. Three slope categories were used for the analysis: Flat (0-6 percent), Gradual (Moderate) (6-15 percent) and Steep (+15 percent). Average slope was analyzed in SoftDesk v.8 using 10-ft contours for the project site. W&H Pacific, Inc. performed the slope analysis. The results of the slope category delineation for the project watershed are shown in **Figure 2-4**.

Soil-Cover-Slope-Complex Summary. The dominate soil-cover-slope class is OFF. Other classes occupying more than 3 percent of the site include OFG, OFS, TFF and TFS.

A summary of the existing conditions land use for the site is contained in **Table 2-3**.

Table 2-3: Pre-Development Condition Subbasin Land-Use/Land Cover

Subbasin	Basin Area (acres)	Undisturbed Area (acres)	Total Converted (acres)	Landscape Area (acres)	Impervious Roads (acres)	Impervious Other (acres)
Basin 1-1U	90.0	90.0	-	-	-	-
Basin 1-2U	85.0	85.0	-	-	-	-
Basin 12-U	248.0	248.0	-	-	-	-
Basin Y1-U	100.0	94.0	6.0	-	-	6.0
Basin Y2-U1	97.0	97.0	-	-	-	-
Basin Y2-U2	57.0	57.0	-	-	-	-
Basin Y2-U3	28.0	28.0	-	-	-	-
Basin Y2-U4	102.0	93.0	9.0	-	-	9.0
Basin Y3-U1	70.0	70.0	-	-	-	-
Basin Y3-U2	15.0	15.0	-	-	-	-
Basin Y3-U3	61.0	61.0	-	-	-	-
Basin Y3-U4	65.0	65.0	-	-	-	-
Basin Y3-U5	20.0	20.0	-	-	-	-
Basin Y4-U1	105.0	109.0	-	-	-	-
Basin Y4-U2	93.0	93.0	-	-	-	-
Basin Y4-U3	64.0	64.0	-	-	-	-
Basin Y4-U4	26.0	26.0	-	-	-	-
Basin Y5-U1	96.0	96.0	-	-	-	-
Basin Y5-U2	31.0	31.0	-	-	-	-

Existing Condition Modeling Results

Model output consists of 29 water years of hourly runoff data for each drainage basin (October 1961 through December 1990). This period was governed by the availability of solar radiation data, a required input to the model. The runoff data were used to perform an annual flood frequency and flow duration analysis. Peak flows were developed according to the procedures outlined in U.S. Water Resources Council Bulletin 17B.

Annual flow and peak flow summaries for each subbasin, are presented in **Tables 2-4** and **2-5**, respectively. Peak flow for these subbasins, which do not contain streams, is the sum of groundwater, shallow surface, and surface flow for all land segments within the basin. This flow can be thought of, potentially, as the subbasin's contribution to either the Cle Elum River or the Yakima River depending on location.

Table 2-4: Pre-Developed Condition Annual Flow Volumes for UGA Basins at the Drainage Boundary

Drainage Basin	Total Basin Area (ac)	Average Annual Flow					Flow Distribution (as percentage of total flow)		
		Total Flow (ac-ft)	Total Flow/ Unit Area (ac-ft/ac)	Surface Flow (ac-ft)	Interflow (ac-ft)	Groundwater Flow (ac-ft)	Surface	Interflow	Groundwater
Basin 1	175	323.2	1.9	0.5	9.1	313.7	0%	3%	97%
Basin 12	248	310.7	1.3	18.8	0.0	292.0	6%	0%	94%
BSN Y1-U	100	110.6	1.1	12.5	0.0	98.2	11%	0%	89%
BSN Y2-U	284	311.2	1.1	18.8	0.0	292.4	6%	0%	94%
BSN Y3-U	231	240.5	1.0	0.2	0.7	239.7	0%	0%	100%
BSN Y4-U	288	299.6	1.0	0.6	13.7	285.3	0%	5%	95%
BSN Y5-U	127	184.3	1.4	2.9	73.5	107.9	2%	40%	59%

Note: Percentages may not add up to 100 percent due to rounding.

Table 2-5: Pre-Developed Condition Peak Flow Analysis

	Flow from Melt and Rain Events: January 1 – December 31 (cfs)					
	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
Basin 1	1.70	2.46	2.91	3.43	3.77	4.09
Basin 12	1.51	2.22	2.80	3.66	4.40	5.25
BSN Y1-U	1.37	1.84	2.18	2.63	2.99	3.36
BSN Y2-U	2.43	3.21	3.75	4.45	5.00	5.56
BSN Y3-U	0.90	1.38	1.77	2.36	2.87	3.46
BSN Y4-U	1.19	1.81	2.30	3.00	3.60	4.27
BSN Y5-U	1.47	2.36	3.06	4.05	4.88	5.77

Developed Condition Modeling

Modeling Concept

The developed condition drainage concept includes collection and conveyance facilities, water quality treatment facilities, infiltration basins, and detention basins. The HSPF developed condition models include basin area reaches, routing protocols (describing locations to where stormwater is routed), detention basins, and infiltration basins. The water quality facilities do not significantly alter the peak flows or flow volumes and, therefore, are not constructed in the modeling. To be conservative the interflow and surface flow of the subbasin area upstream of the roadside ditches is routed to the subbasin stormwater facility. This is a conservative approach because the roadside ditches are not modeled as losing reaches, whereas in reality some of the upslope basin interflow and surface flow would infiltrate prior to reaching the infiltration basins. Groundwater discharges are routed to the outlet of the basin in which they are generated.

A typical HSPF model includes the basin area containing slope, vegetation, soil, and climate characteristics; a routing description indicating the detention facility, stream, or wetland to which the contributing area is routed; and the detention or infiltration facility (for mitigated developed condition models).

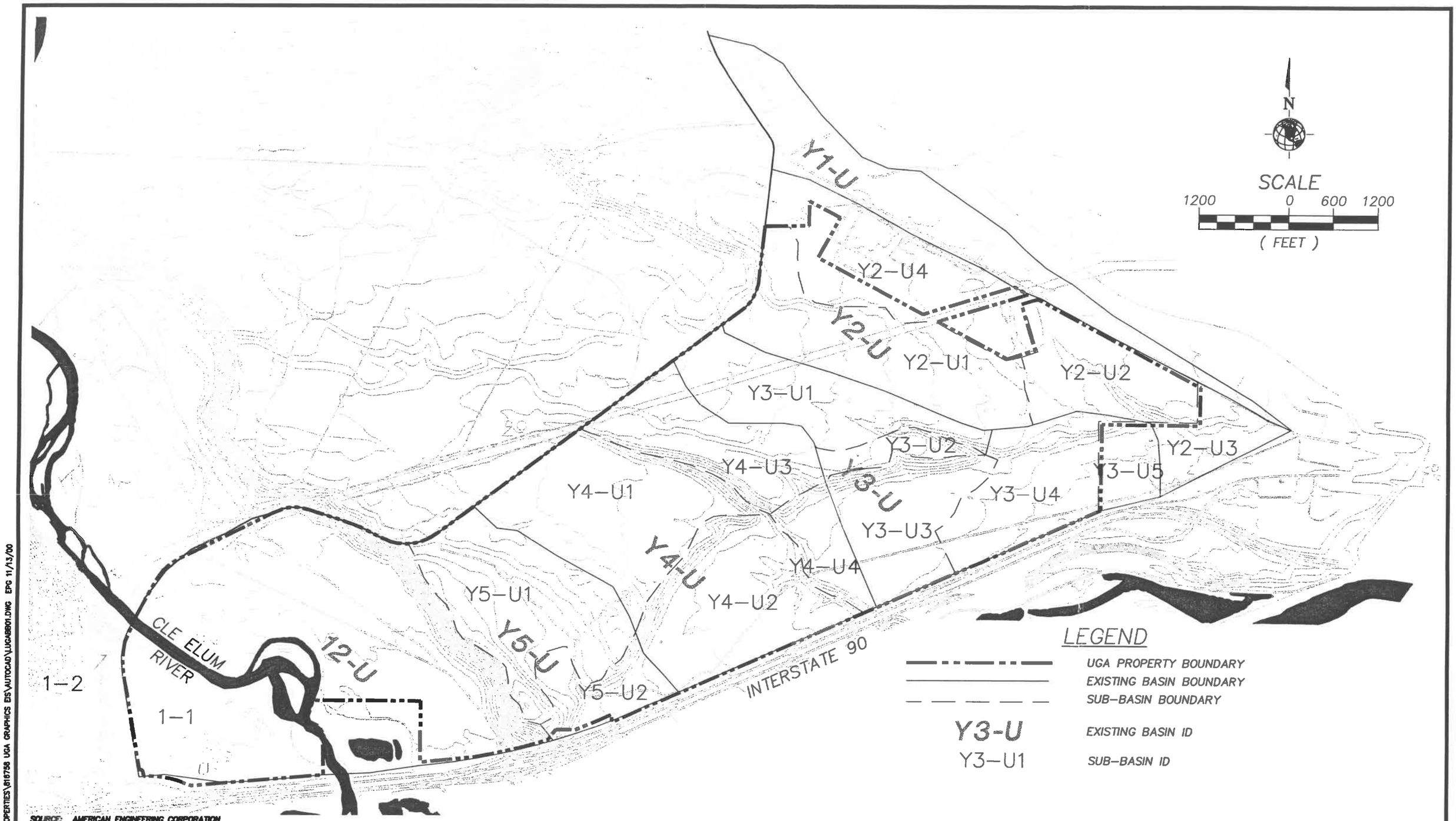
Models

To estimate the developed site runoff volumes and runoff rates, developed condition models were generated. These models contain developed land use/land cover characteristics, developed basin conveyance systems, and infiltration and detention ponds. The purpose of these models is to evaluate the effectiveness of the proposed stormwater detention facilities to provide developed condition runoff characteristics equivalent to existing basins stormwater runoff characteristics. **Table 2-6** provides a summary of land use/land cover for developed conditions. The runoff volumes at both the existing drainage basin boundaries and the discharge from the stormwater facilities were determined. The HSPF model results will be used to evaluate the effect of the development on stream flow volumes.

Routing

The stormwater routing for the developed condition modeling was developed based on two different sets of tributary areas: pond tributary areas and undisturbed existing basins. Developed condition basin boundaries are shown in **Figure 2-5**. Pond tributary areas include all areas that are tributary to an infiltration or detention pond. Pond tributary areas consist of pervious land segments representing landscaping and undisturbed areas that are upstream of interceptor swales and impervious land segments representing roads, parking lots, roofs, and driveways. The pond tributary areas are labeled sequentially according to the existing basin in which they discharge. For example, pond Y4-U4 is the fourth pond discharging to the existing drainage basin Y4-U. Only one pond is modeled for each tributary area in order to compute total storage necessary. In practice, the total storage may be divided into multiple ponds. Undisturbed existing basins consist of the portions of the existing condition basins that are not tributary to a pond. Undisturbed existing basins contain mostly pervious land segments.

HSPF models three different types of runoff for pervious land: surface flow, interflow, and groundwater flow. Runoff from impervious land occurs only as surface flow. Each of these runoff types can be routed independently for each land segment. The stormwater routing for developed basins and pond tributary areas is shown in **Figure 2-6** and is explained in further detail in the following paragraphs.



SOURCE: AMERICAN ENGINEERING CORPORATION

W&H PACIFIC

Cle Elum Urban Growth Area

Figure 2-5
Developed Condition Basin Boundaries

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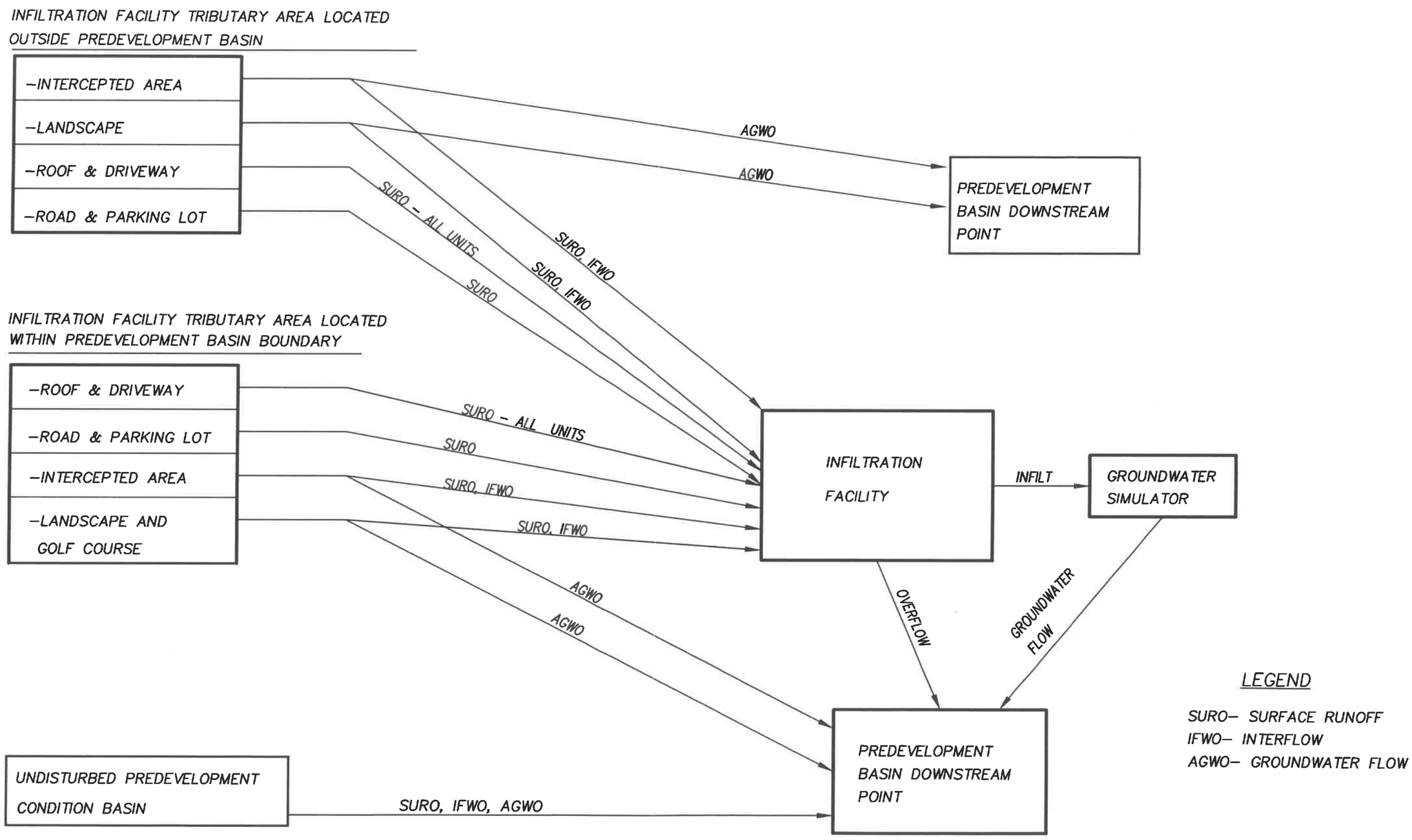

W&H PACIFIC

Cle Elum Urban Growth Area

Figure 2-6
Permeable and Impermeable Area Model Schematic

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Table 2-6: Developed Condition Subbasin Land-use/Land Cover, Alternative 2[a]

Subbasin	Basin Area (acres)	Undisturbed Area (acres)	Total Converted (acres)	Landscape Area (acres)	Impervious Roads (acres)	Impervious Other (acres)
Basin 1-1U	90.0	42.8	47.2	36.5	6.0	4.7
Basin 1-2U	85.0	85.0	0.0	0.0	0.0	0.0
Basin 12-U	248.0	210.2	37.8	15.6	8.5	13.7
Basin Y1-U	100.0	94.0	6.0	0.0	0.0	6.0
Basin Y2-U1	97.0	19.0	78.0	39.0	19.5	19.5
Basin Y2-U2	57.0	17.0	40.0	23.0	7.0	10.0
Basin Y2-U3	28.0	28.0	0.0	0.0	0.0	0.0
Basin Y2-U4	102.0	93.0	9.0	0.0	0.0	9.0
Basin Y3-U1	70.0	14.0	56.0	28.0	14.0	14.0
Basin Y3-U2	15.0	0.0	15.0	8.0	1.7	5.3
Basin Y3-U3	61.0	13.0	48.0	36.0	3.1	8.9
Basin Y3-U4	65.0	7.0	58.0	15.0	30.0	13.0
Basin Y3-U5	20.0	20.0	0.0	0.0	0.0	0.0
Basin Y4-U1	105.0	4.0	101.0	85.5	3.9	11.6
Basin Y4-U2	93.0	14.0	79.0	76.0	3.0	0.0
Basin Y4-U3	64.0	8.0	56.0	48.0	2.6	5.4
Basin Y4-U4	26.0	3.0	23.0	22.0	0.9	0.1
Basin Y5-U1	96.0	10.0	86.0	71.0	3.8	11.2
Basin Y5-U2	31.0	10.0	21.0	20.5	0.0	0.5
	1453.0	692.0	761.0	524.1	104.0	132.9

a. Based on November 1999 land use/cover definition.

Existing Basin Routing. The routing for the undisturbed portion of existing basins is straightforward - all runoff (surface flow, interflow, and groundwater flow) originating within the basin is routed to the existing basin downstream point.

Pond Tributary Area Routing. Pervious undisturbed, impervious, and landscape areas as provided by American Engineering were used to model the tributary pond areas.

Pond tributary area runoff is the sum of runoff from development areas and from intercepted upslope undeveloped areas. The roadside ditches alter the existing drainage path for the surface runoff and interflow. The groundwater flow from the intercepted upslope area, pervious area, and landscape area is routed to the existing basin downstream point. Groundwater flow from intercepted areas in other basins is routed to the existing downstream point of the basin in which it originated. Surface flow and interflow runoff from golf course areas in the modeled Alternative 2 are routed to the developed basin infiltration ponds. Groundwater flow from the golf course areas is routed to the existing basin downstream point of the basin in which that portion of the golf course is located. Golf course runoff may be modified in the future depending on choice of mitigation techniques.

The roadside ditches are expected to intercept the surface flow and interflow from basin developed and undeveloped areas. Thus, the surface runoff from pervious areas, roads, parking

lots, other impervious surfaces, landscape, intercepted area within the basin, and intercepted area from adjacent basins is routed to the basin infiltration pond. Interflow from pervious areas, landscape area, intercepted area within the basin, and intercepted area from adjacent basins is also routed to the infiltration pond.

Surface runoff from driveways and commercial roofs will be routed to the developed basin infiltration pond. Infiltrated stormwater from infiltration ponds will be routed to the existing basin groundwater.

A groundwater simulator is used to simulate the behavior of water infiltrated from infiltration ponds. The groundwater simulator is different from groundwater flow simulation of HSPFs. The groundwater simulator is used to extend the ability of HSPF to model surface flows that are returned to the ground through infiltration. The groundwater simulator is a reservoir with a large storage capacity. It simulates a groundwater recession curve using a linear relationship between storage and discharge. The slope of the recession curve is set equal to the HSPF recession parameter for the surrounding soil type. For purposes of hydrologic modeling of the UGA basins, it has been assumed that each subbasin will have multiple infiltration facilities. Therefore, runoff infiltrated to groundwater will be attenuated as assumed with the use of the groundwater simulator. For basins without streams, volumes calculated are compared only on an annual basis. This is because the groundwater simulator is used on the developed condition models and not on the existing condition models.

Mitigated Developed Condition Model Results

Developed mitigated condition annual flow volumes at basin boundaries is provided in **Table 2-7**. The comparison between existing and developed annual runoff volumes is provided as a percentage of existing flow in the table. The mitigated volumes were based on fully infiltrating surface flows in infiltration ponds. The exception is runoff from existing impervious areas not modified by project development or captured by project stormwater management facilities. These ponds had preliminary design rates of 2 to 10 inches per hour.

It should be noted that the modeling described in this section is based on the November 1999 land use/cover definitions for Alternative 2. Due to the evolving nature of conceptual land use plans, modifications have occurred since that time. However, HSPF modeling for the latest revision of the UGA project description has not been performed. This is because stormwater runoff volumes can be reasonably estimated for impact purposes based on the original modeling effort and the current proposed site plan.

Table 2-7: Mitigated Developed Condition Annual Flow Volumes for UGA Basins, Alternative 2

Drainage Basin	Total Basin Area (Ac.)	Average Annual Flow					Flow Distribution (as percentage of total flow)			Comparison to Existing Conditions	
		Total Flow (ac-ft)	Total Flow/Unit Area (ac-ft/ac)	Surface (ac-ft)	Interflow (ac-ft)	Groundwater (ac-ft)	Surface	Interflow	Groundwater	Percent Increase in Annual Flow	Percent Decrease in Surface Flow
Basin 1	175	348.5	2.0	0.3	9.1	339.2	0%	3%	97%	8%	40%
Basin 12	248	353.6	1.4	0.1	0.0	353.6	0%	0%	100%	14%	100%
BSN Y1	100	110.6	1.1	12.5	0.0	98.2	11%[1]	0%	89%	0%	0%
BSN Y2	284	376.1	1.3	18.7	0.0	357.4	5%[1]	0%	95%	21%	1%
BSN Y3	231	348.3	1.5	0.0	0.0	348.2	0%	0%	100%	45%	92%
BSN Y4	288	375.4	1.3	0.0	0.0	375.4	0%	0%	100%	25%	99%
BSN Y5	127	229.8	1.8	0.0	0.0	229.8	0%	0%	100%	25%	100%

1. Positive values reflect runoff from existing impervious areas not modified by project development or captured by project stormwater management facilities.
2. Based on November 1999 land use/cover definition.

Impervious and landscaped areas for Alternatives 2, 3, 4, and 5 are summarized in Table 2-8. The development alternatives have similar impervious area to that modeled and would, therefore, be expected to generate comparable stormwater volume for infiltration.

Table 2-8: Impervious and Landscape Area Summaries[b]

Surface Type, Acres	Project Alternative							
	2		3		4		5[c]	
	Impervious Area	Landscape Area	Impervious Area	Landscape Area	Impervious Area	Landscape Area	Impervious Area	Landscape Area
Roadways	32	32	43	43	35	35	61	61
Residential	53	21	75	36	45	21	104	50
Lodging	5	1	5	1	5	1	0	0
Golf Course	12	142	12	142	12	142	0	0
Public Facilities [a]	17	11	17	11	16	8	19	22
Business Park	60	18	44	12	22	6	63	7
Horse Park	90	43	0	0	90	43	0	0
RV Park	10	2	10	2	10	2	0	0
Total	279	271	205	247	235	257	247	140

[a] Maintenance area, water treatment plant, Community Recreation Center, School Expansion, and Cemetery Expansion.
[b] Note: Numbers may not sum to totals shown due to rounding.
[c] Excludes Reserve Area.

As previously described, modeling was performed based on November 1999 conceptual land use cover assumptions for Alternative 2. Alternative 2, as modeled, had 524 acres of landscape and 237 acres of impervious surface. Subsequent site planning modifications resulted in changes in impervious and landscape areas that are shown in Table 2-8. Landscaped area ranges from 140 acres (Alternative 5) to between 247 and 271 acres for Alternatives 2, 3, and 4. Impervious surface under Alternatives 2, 3, 4, and 5 ranges from 205 to 279 acres.

Based on the HSPF model used to model runoff, outwash landscape generates an average of about one-tenth the runoff of impervious surface per year. Using this approximation, the total runoff can be estimated using an equivalent impervious area. For the modeled Alternative 2, the equivalent impervious area is about 289 acres. The average annual surface flow and interflow components of runoff were estimated at 2,142 acre-feet for the modeled Alternative 2. This equates to an average of 7.40 acre-feet per acre of equivalent impervious area.

Using this estimated runoff per acre the stormwater runoff for the currently proposed alternatives 2, 3, 4 and 5 can be estimated. The equivalent impervious area and estimated runoff for each alternative are summarized in **Table 2-9**.

Table 2-9: Estimated Annual Runoff, Alternatives 2, 3, 4 and 5

Alternative	Equivalent Impervious Area, Acres	Estimated Average Runoff (Surface and Interflow), Ac-Ft
2	306	2,264
3	230	1,702
4	261	1,931
5	263	1,946

As can be noted from the table above, the estimated stormwater runoff for Alternative 2, as analyzed in the Draft EIS, is about 6 percent greater than the runoff estimated for the November 1999 Alternative 2. Alternatives 3, 4, and 5 are expected to generate less runoff than was estimated for the November 1999 Alternative 2.

A variation in stormwater runoff estimates for a particular drainage basin would be addressed with fewer or more stormwater quality and runoff control facilities depending on whether the estimated runoff for that basin increased or decreased.

The purpose of this section is to provide information on the preliminary water system concepts for Alternatives 2, 3 4, and 5. The information presented is intended for use in EIS-related evaluations and analyses.

System Capacity Requirements

Two water systems are proposed for the UGA area - a treated water system and an untreated water system. The treated water system is a standard potable water system providing water to all dwelling units and commercial uses in the area. Under Alternatives 2, 3, or 4, the untreated water system would provide irrigation water to the golf courses, recreational fields, Washington State Horse Park irrigated areas, and the larger public landscape areas. Under Alternative 5, the untreated water system would provide irrigation water to public landscape areas and evaporation make-up water to the artificial water bodies.

Treated (Domestic) Water Requirements

Water demands for the development were based on Washington State Department of Health standard unit demands. Unit interior water demands for each unit type proposed for the UGA under Alternatives 2, 3, 4, or 5 are described below.

Single Family, Multi-Family and Condominiums. Unit interior demands for single family residences, condominium units, and multi-family unit accommodations are summarized in **Tables 3-1, 3-2**, and **3-3**, respectively.

Table 3-1: Single Family Residences

	Primary Residences
Party Size	2.4
Unit Demand (gpdpc)	100
Total Interior Unit Demand (gpd)	240
Average Annual Occupancy	92%

Table 3-2: Condominium Units

	Timeshare[a] Condominiums	Wholly-owned Primary Condominiums
Party Size	2.5	2.4
Unit Demand (gpdpc)	100	100
Total Interior Unit Demand (gpd)	250	240
Average Annual Occupancy	70%	92%

[a] Timeshare condominiums apply to Alternatives 2, 3, and 4 only.

Table 3-3: Apartment Units

	Primary Residences
Party Size	2.4
Unit Demand (gpdpc)	100
Total Interior Unit Demand (gpd)	210
Average Annual Occupancy	92%

Unit outside water use was based on 800 to 1,200 square feet for single family units, 500 to 1,000 square feet for condominiums, and 400 square feet for multi-family units.

Project Components - Alternatives 2, 3, and 4. Unit demands for project components specific to Alternatives 2, 3, and 4 are provided in the following.

- **Business Park**. Potable water use for the business center was based on 0.085 gpd/square-foot of office space. Irrigated landscaped area was provided by Kent Berryman & Associates.

- **Lodge.** Inside water use was based on 1.5 persons per unit and a unit demand of 50 gpd/person/unit. Non-guest room demands, including restaurant and bar, are taken as 30 gpd/person/unit. The total daily demand is 120 gpd per unit. Average annual occupancy was assumed to be 60 percent (Hobson Johnson Associates, 1999).

- **Campground Guests.** Campsite water use was based on 3.2 persons per unit and a unit demand of 50 gpd/person/unit. The total daily unit demand is 160 gpd per unit. Outside water use was assumed at 1.5 acres of irrigated landscaped areas throughout the campground site. Average annual occupancy was assumed to be 43 percent (Hobson Johnson Associates, 1999).

- **Horse Park Visitors, Employees, and Horses**. Water use per employee and equestrian visitor was estimated at 20 gpd/person. Water use per horse was estimated at 40 gpd/horse. Monthly variation in equestrian park users, boarded horses, event horses, and horse park employees was provided by Atelier PS Landscape Architects.

- **Community Recreation Center**. The community recreation center demand was based on 20 gallons per day per community center visitor. Visitor estimates are estimated to be 50 persons/day during the winter, spring, and fall months and 75 persons/day during the summer months.

- **Employees.** Employees would be individuals employed at the golf course clubhouse, maintenance personal, etc. The number of employees is estimated to be 50 persons.

- **Golf Course Club House**. The golf course clubhouse demand is estimated to be 12 gpd/person. User estimates are provided in **Table 3-4**.

Table 3-4: Golf Course Clubhouse Users

Month	Weekday Persons (person/day)	Weekend Persons (persons/day)
January	40	80
February	40	80
March	40	80
April	40	80
May	50	150
June	100	200
July	100	200
August	100	200
September	100	200
October	50	150
November	40	80
December	40	80

The ultimate water system demands are based on full buildout of all proposed units and occupancy projections provided by Hobson Johnson Associates, Inc. Monthly water demands have been generated for the UGA for each year of the project through buildout.

Residential water demands were estimated based on inside and outside (irrigation) water demands. Monthly inside water demands were calculated as the number of occupied units for the month times the unit demands. Hobson Johnson Associates also provided monthly occupancy estimates for each unit type throughout the buildout of the UGA. The occupancy estimates provided the information needed to generate seasonally varying water demands. Outside water demands were calculated as the number of units times the landscape areas times the unit landscape water demands. Unit irrigation demands for residential landscape, lawns and the campground landscaping were based on the Washington State Irrigation Guide (WSIG) average annual net irrigation demands for pasture/turf at Cle Elum (18.1 inches/year). An irrigation efficiency of 60 percent was used to calculate total demands. A factor of 10 percent was added to the demands to account for system losses, maintenance demands, and miscellaneous public uses.

The water demands within each development area of the alternatives were determined based on the preliminary land use plans.

The monthly treated water demands at buildout are separated into Trendwest and non-Trendwest demands for water rights purposes. Monthly treated water demands at buildout for Alternatives 2, 3, 4 and 5 for Trendwest and non-Trendwest are presented in **Tables 3-5** and **3-6**, respectively. Non-Trendwest demands include the cemetery expansion area, business park, school expansion area, and Community Recreation Center.

Table 3-5: Average Daily Treated Water Demands at Buildout Trendwest Demands,[a] mgd

Alternative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Total (ac-ft)
Alternative 2[b]	0.24	0.24	0.27	0.29	0.32	0.43	0.53	0.49	0.43	0.29	0.26	0.26	0.34	379
Alternative 3	0.31	0.31	0.33	0.34	0.36	0.50	0.63	0.56	0.51	0.34	0.32	0.33	0.40	452
Alternative 4[b]	0.21	0.21	0.22	0.23	0.24	0.34	0.42	0.38	0.34	0.23	0.22	0.22	0.27	304
Alternative 5[c]	0.33	0.33	0.33	0.33	0.33	0.47	0.60	0.53	0.48	0.33	0.33	0.33	0.39	442

[a] Includes system loss allowance.
[b] Includes demands for Washington State Horse Park.
[c] Excludes Reserve Area.

Table 3-6: Average Daily Treated Water Demands at Buildout for Non-Trendwest Demands,[a, b] mgd

Alternative	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average	Total (ac-ft)
Alternative 2	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	100
Alternative 3	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06	63
Alternative 4	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	32
Alternative 5[c]	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	100

[a] Includes system loss allowance.
[b] Non-Trendwest treated water demands include the Business Park and Community Recreation Center.
[c] Excludes Reserve Area.

Peaking factors used for the UGA water system design are presented in **Table 3-7,** and are applied to maximum month average daily demands. Equalizing storage will be provided to accommodate hourly peak requirements. These peaking factors are applicable only to the treated water demands.

Table 3-7: Peaking Factors

Ratio	Peaking Factor
Maximum Daily to Average Daily (Maximum Month)	1.5
Maximum Hourly to Average Daily (Maximum Month)	2.2

Using the above average daily water demands and peaking factors, the maximum month design demands (at buildout) for the Trendwest demands are given in **Table 3-8.** The maximum month design demands (at buildout) for non-Trendwest demands are given in **Table 3-9.**

Table 3-8: Maximum Month Treated Water Demands, Trendwest Demands

	Average Daily Demand (ADD)[a,b]	Maximum Day Demand (MDD)[a,c]	Peak Hour Demand (PHD)[a,d]
Alternative 2	0.53 mgd (370 gpm)	0.78 mgd (540 gpm)	1.13 mgd (780 gpm)
Alternative 3	0.63 mgd (440 gpm)	0.92 mgd (640 gpm)	1.34 mgd (930 gpm)
Alternative 4	0.42 mgd (290 gpm)	0.61 mgd (420 gpm)	0.88 mgd (610 gpm)
Alternative 5[e]	0.60 mgd (417 gpm)	0.88 mgd (611 gpm)	1.27 mgd (882 gpm)

[a] For treated water the daily system loss is calculated as total annual demand x 10% / 365 = 31,000gpd (UGA, Alt 2), 36,700 gpd (UGA, Alt 3), 24,700 gpd (UGA, Alt 4), 35,800 gpd (UGA, Alt 5).
[b] ADD is calculated as maximum month estimated demand + system loss.
[c] MDD is calculated as maximum month estimated demand x 1.5 + system loss.
[d] PHD is calculated as maximum month estimated demand x 2.2 + system loss.
[e] Excludes Reserve Area.

Table 3-9: Maximum Month Treated Water Demands, Non-Trendwest Demands

	Average Daily Demand (ADD)[a,b]	Maximum Day Demand (MDD)[a,c]	Peak Hour Demand (PHD)[a,d]
Alternative 2	0.09 mgd (60 gpm)	0.13 mgd (90 gpm)	0.19 mgd (130 gpm)
Alternative 3	0.06 mgd (40 gpm)	0.08 mgd (60 gpm)	0.12 mgd (80 gpm)
Alternative 4	0.03 mgd (20 gpm)	0.04 mgd (30 gpm)	0.06 mgd 40 gpm)
Alternative 5[e]	0.09 mgd (60 gpm)	0.13 mgd (90 gpm)	0.19 mgd (130 gpm)

[a] For treated water the daily system loss is calculated as total annual demand x 10% / 365 = 8,100 gpd (UGA, Alt 2), 5,100 gpd (UGA, Alt 3), 2,600 gpd (UGA, Alt 4), 8,100 gpd (UGA Alt 5).
[b] ADD is calculated as maximum month estimated demand + system loss.
[c] MDD is calculated as maximum month estimated demand x 1.5 + system loss.
[d] PHD is calculated as maximum month estimated demand x 2.2 + system loss.
[e] Excludes Reserve Area.

Equivalent Residential Unit (ERU) Demands. The Washington State Department of Health uses the concept of ERUs to equate non-residential or multi-family water usage to a specific number of single family residences. As this is a customary way of expressing demands, an ERU value has been developed for the UGA.

The June 1999 publication, *Water System Design Manual*, by DOH, contains guidance for establishing water demands. The suggested methods (in order of preference) include:

1. Reliable metered water use records;
2. Comparable metered water use data from analogous water systems; and
3. Criteria as presented in the DOH design manual.

As there is not a water system in the UGA at present, there are no system meter records from the UGA service area available for use. The existing City meter records could be used if the City system qualified as an analogous system. The DOH Design Manual defines analogous systems as:

> *Analogous water systems are defined as systems with similar characteristics such as demographics, housing sizes, income levels, lot*

sizes, climate, water pricing structure, conservation practices, use restrictions, and soils and landscaping [see WAC 246-290-221(1)(a)].

Based on these criteria, the proposed UGA system and City's existing system would not be considered analogous for the following reasons:

1. The City system has been in place for many years, whereas the UGA will be a completely new system. The losses in the City system are likely much larger than would be experienced with the UGA system constructed to contemporary municipal standards.
2. A consumption based rate schedule will be in place for the UGA, whereas one has not been in place for the City system until recently. Prior to the adoption of the consumption-based rate schedule, metered services in the City were billed on a flat rate charge basis.
3. The UGA will restrict the amount of area that may be irrigated. The water demands assume all lots will be irrigated to the maximum permissible area. In reality, many lot owners will landscape with low water demand landscaping. There are no existing City landscaping restrictions.
4. The UGA residential construction will follow the current Uniform Plumbing Code requirements. These requirements provide for water saving devices and construction methods that were not used for construction of the vast majority of City residences. Additionally, the new residential construction in the UGA will not necessitate that faucets be run in the winter to prevent freezing as is currently done for many residences in the City of Cle Elum.

As neither metered records nor an analogous system are available, the third method outlined by DOH applies. This was the basic method used for the UGA.

The ERU value for the UGA are based on analyses of:

- Internal demands.
- External (irrigation) demands.
- Peaking factors to adjust from Average Daily Demand (ADD) to Maximum Day Demand (MDD).

Internal demands were based on a standard residential demand of 100 gallons per day per capita (gpcd). A single-family residential occupancy of 2.4 persons per dwelling unit was used, based on the Hobson Johnson Associates, Inc. occupancy analysis for the UGA, as discussed previously. From these values, an ADD internal demand of 240 gallons per day (gpd) was calculated (2.4 persons/unit x 100 gpcd).

Relative to the internal demand estimate, it should be noted that Ecology specifies a 100 gpcd wastewater flow (which includes normal infiltration) for dwellings served by new systems. As

unit internal water demands and wastewater contributions are closely related, the 100 gpcd water demand value is supported by Ecology's wastewater criteria.

Irrigation demands were based on a maximum allowable (per proposed CC&Rs) residential irrigated landscape area of 1,200 square feet, net irrigation requirements for pasture/turf at Cle Elum as given in the Washington State Irrigation Guide and a residential irrigation application efficiency of 60 percent. Homeowners will be required to install efficient irrigation systems, and to operate the systems effectively. The total annual net irrigation demand is 18.1 inches. On an average annual basis, this irrigation demand equates to a daily rate of about 62 gpd per unit. The maximum month net irrigation demand (July) is 6.5 inches. During July, the average daily demand is about 261 gpd [(6.5 inches/12 inches/foot) x (1/60 percent efficiency) x (1200 square feet) x (7.48 gallons/cubic foot) x (1/31 days)].

The ADD value is calculated as 240 gpd (internal) plus 62 gpd (irrigation) for a total of 302 gpd per ERU. The average peak month (July) demand is calculated as 240 gpd (internal) plus 261 (irrigation) for a total of 501 gpd. The MDD demand is calculated as 1.5 times the average peak month demand, or about 750 gpd (1.5 x 501 gpd). The resulting peaking factor for ADD to MDD is about 2.5.

The ERU value does not include an allowance for system losses and miscellaneous public uses. System losses and miscellaneous public uses (flushing of mains, fire suppression water, etc.) are calculated as 10 percent of the average annual demand, as discussed previously. This allowance is included in the capacity requirements for the water system facilities and in water demands used in the water supply analysis.

As discussed earlier, the preferred method of establishing ERUs is from meter records. Once residences are occupied in the UGA, water meter records from a consumption based rate structure will be available for the UGA. From the operating records, the preliminary UGA ERU values of 302 gpd/ERU ADD and 750 gpd/ERU MDD presented can be evaluated. The actual ERU values from monitoring may be higher or lower than the values presented here.

In accordance with the City of Cle Elum's adopted water policy for the UGA, the City will initially issue certificates of water availability for the project based on the water use rate set forth in the City's Comprehensive Water Plan (October 1997), which is currently 610 gallons per ERU. The Washington State DOH design criteria requires a minimum of three years of historical consumption data be used in establishing ERU average demand.

Water system plans are required by DOH to be updated at least every six years. An analysis of ERU values is a required part of a plan update. Therefore, in addition to initial monitoring and evaluation of the UGA ERU values, a more formal evaluation will need to be performed by the City every six years.

Fire Flows. Chapter 248-57-500 Washington Administrative Code (WAC), specifies minimum fire flow demands of 500 gpm for 30 minutes for residential areas, and 750 gpm for 60 minutes for commercial and multi-family areas. The City of Cle Elum has not established fire flow requirements for structures within the City. However, its 1997 Comprehensive Water Plan recommends 3,000 gpm for two hours for its commercial areas and 500 gpm for residential areas. For the purposes of environmental review, all UGA commercial structures were assumed to be equipped with interior fire sprinkler systems. Also assumed was a fire demand of 1,500 gpm per the 1997 Uniform Fire Code (6,000 gpm requirement assumed with full building sprinkler reduction allowance of 75 percent and four hour duration, per Appendix III-A of the Uniform Fire Code). The 1,500 gpm demand is the fire suppression demand on the distribution system and includes both the interior sprinkler demand and exterior hydrant demand. The building designers will determine the sprinkler portion of the required fire flow rate at the building. This fire flow demand was used in the preliminary sizing of the water system for both commercial and residential areas. Minimum fire demands for the UGA will be determined by the City and included in the update to the City's Water System Plan to include the UGA. All proposed construction will be evaluated by the City of Cle Elum and the Kittitas County Fire Marshall for compliance with applicable fire protection safety standards.

Untreated Water Requirements

Depending on the alternative, untreated water demands consist of golf course irrigation, recreational irrigation, public landscape irrigation, and artificial water body evaporation make-up. Untreated water demands were calculated as the irrigated land area times the unit landscape water demands. Unit irrigation demands for the golf courses and other highly maintained landscaped areas have been assigned demands that provide for an adequate supply of water in 9 out of 10 years. This is appropriate because of large initial cost of the facilities. The total annual net irrigation demand for these uses is 23.0 inches, which includes some early and late season demands specific to golf course and recreation field maintenance. An irrigation efficiency of 80 percent for golf course areas, and 70 percent for recreation areas, was used to calculate total demands.

Evaporation from artificial water bodies (i.e., lakes or golf course ponds) was calculated from net unit monthly evaporation rates. Net evaporation is calculated as lake evaporation less precipitation. Lake evaporation is calculated as pan evaporation times an appropriate pan coefficient. Monthly pan evaporation values were taken from the pan evaporation time series derived for the HSPF hydrologic simulation model used for drainage planning (refer to Section 2). A pan coefficient of 0.75 was used to convert the monthly pan evaporation values to lake evaporation. Net evaporation occurs only during the months of April through September. In other months of the year, site precipitation exceeds site lake evaporation. Monthly net evaporation rates for the site are given in **Table 3-10**.

Table 3-10: Monthly Net Site Lake Evaporation, Inches

April	May	June	July	August	September	Total
0.7	2.7	3.9	5.2	4.3	1.9	18.7

A preliminary design of untreated water system for each alternative has not yet been prepared. Golf course irrigation supply ponds would be constructed with equalizing storage that would allow peak daily irrigation demands to be met from a constant 24-hour supply. The ponds would also provide storage for emergency conditions. The pumping systems to the ponds would have the capacity to deliver daily demands as well as deliver make-up water for emergency storage that has been used.

The projected monthly untreated water demands at buildout for Trendwest demands and non-Trendwest demands, for the uses identified earlier, are provided in **Tables 3-11** and **3-12**, respectively.

Table 3-11: Trendwest Untreated Water Demands[a], acre-feet/month

Alternative	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Alternative 2	0	0	0	6	12	106	182	135	98	9	0	0	548
Alternative 3	0	0	0	7	14	81	128	95	68	10	0	0	403
Alternative 4	0	0	0	7	14	117	199	148	107	10	0	0	603
Alternative 5[b]	0	0	0	1	3	6	8	7	3	0	0	0	28

[a] Includes system loss allowance.
[b] Excludes Reserve Area.

Table 3-12: Non-Trendwest Untreated Water Demands[a, b], acre-feet/month

Alternative	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Alternative 2	0	0	0	0	0	14	27	20	14	0	0	0	75
Alternative 3	0	0	0	0	0	11	21	15	11	0	0	0	58
Alternative 4	0	0	0	0	0	6	12	9	6	0	0	0	33
Alternative 5[c]	0	0	0	0	0	18	35	26	19	0	0	0	98

[a] Includes system loss allowance.
[b] Non-Trendwest untreated water demands include irrigation for the School Expansion, Cemetery Expansion, Business Park and the Community Center.
[c] Excludes Reserve Area.

Water Use Standards

Draft Water Use Standards have been prepared as part of the Draft Development Standards for the Trendwest Master Site Plan Application (Alternative 5). While Alternative 5 is considered the preferred alternative, these Standards would also apply to Trendwest uses in Alternatives 2, 3, and 4. The Standards would be required under the project CC & R's. The Draft Water Use Standards are provided at the end of this section. The conditions of approval as well as the CC&Rs will require that these water use standards in the UGA be met.

Source of Water Supply

Proposed Joint Participation Project

The City of Cle Elum and Town of South Cle Elum are planning to construct a new 4 mgd capacity (expandable to 8 mgd) water treatment plant, which is scheduled for completion in 2003. Trendwest has entered into an agreement with the City of Cle Elum to participate in the project's river intake facilities, transmission mains, distribution mains, reservoir and water treatment plant. The proposed plant location is on Trendwest property, just west of SR 903 and south of the Puget Sound Energy Substation as shown in **Figure 3-1**. Trendwest stand-alone alternatives were described in the Draft EIS.

Water Intakes

The intakes are proposed to be side bank surface water intakes, one drawing water from the Cle Elum River, and one drawing water from the Yakima River. The Cle Elum intake is proposed to be located on the east bank of the river, between the two Bullfrog Road bridges. The Yakima River intake is proposed to be located at the City's existing water treatment plant surface diversion location on the south bank of the river. These locations are shown in **Figure 3-1**. In-river work will be required to construct river training structures to maintain the diversion. The domestic water for the UGA would be treated at the new water treatment facility, and pumped to storage reservoirs located within the MountainStar MPR site and the City of Cle Elum. The lower pressure zone of the UGA will be supplied by the City's existing new 0.50 MG reservoir located outside the UGA. The upper UGA pressure zone will be supplied by a reservoir located in the MPR. Under Alternatives 2, 3, and 4, untreated irrigation water would be pumped directly from the intakes to storage ponds in golf courses within the property, as previously discussed. Under Alternative 5, untreated water would be delivered to the lake features of the alternative. Under all alternatives, an intermediate booster or distribution pumping station would likely be installed to receive water pumped from the river and transfer it to points of use or storage.

Selection of side bank intake structures was made after completion of an exploratory program to determine the feasibility of infiltration facilities or well fields located a short distance inland from the banks of the rivers. Associated Earth Sciences, Inc. (AESI) conducted the exploratory program in late 1999. The program included drilling several exploratory borings at locations on both the north and south banks of the Yakima River east of the South Cle Elum bridge, and on the east bank of the Cle Elum River between the two Bullfrog Road bridges. Preliminary results of the program indicate that the saturated thickness of the water table (floodplain) aquifer ranges from approximately 5 feet at the Yakima River site to 23 feet at the Cle Elum River site, with the aquifer underlain by a regionally extensive silt/clay unit. The limited saturated thickness at the Yakima River sites precluded any plans for further testing and analysis for the construction of an infiltration gallery along the Yakima River.

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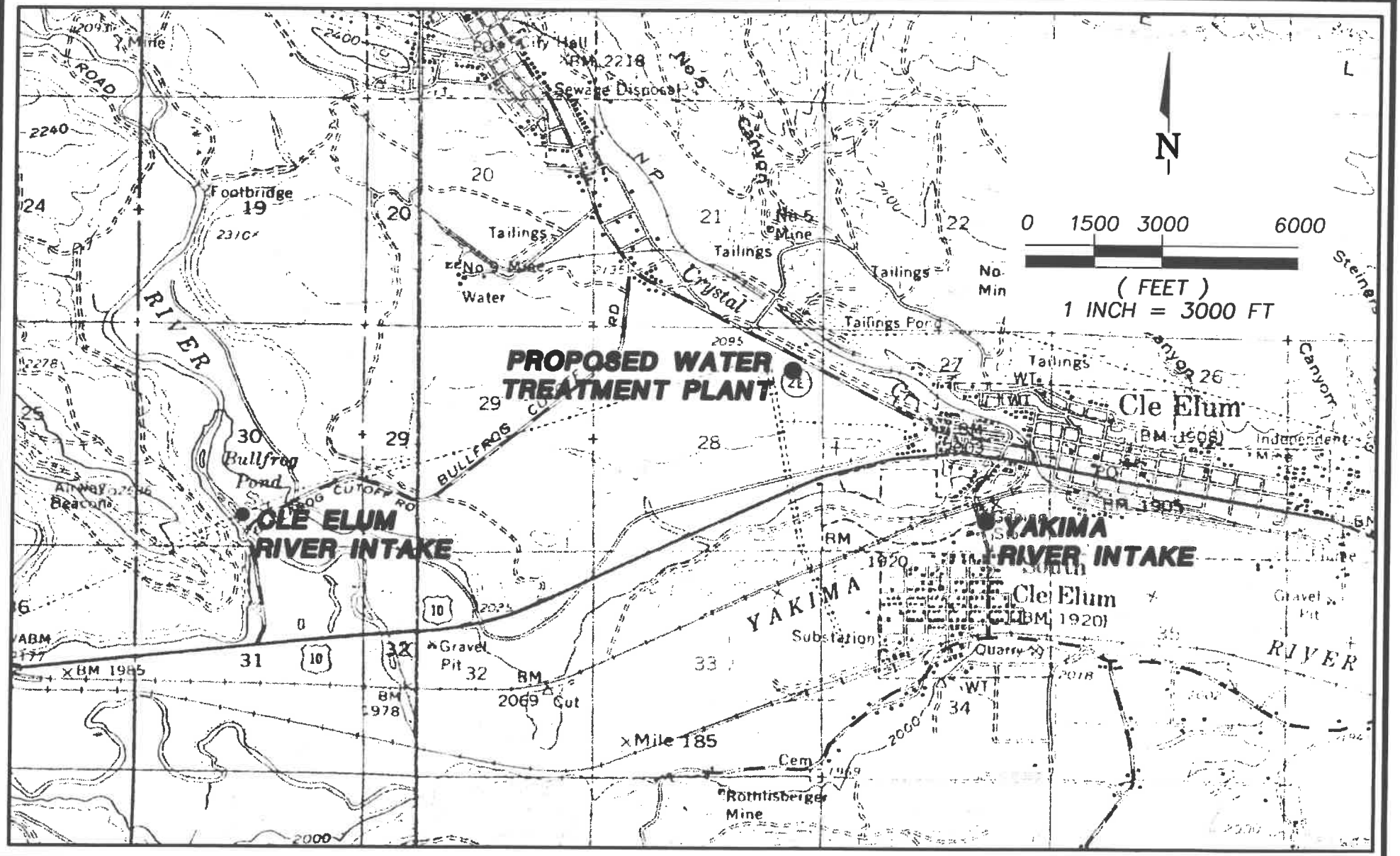


W&H PACIFIC

Cle Elum Urban Growth Area

Figure 3-1
Raw Water Intake & Treatment Plant Locations

At the Cle Elum River site one test (pumping) well was completed with four observation wells to determine the feasibility of the construction of an infiltration gallery or well field. Stepped-and continuous rate aquifer tests were completed in the pump well during late 1999. Preliminary analysis of the aquifer test data indicate low yields compared to project needs. The conclusions from this program are that extensive infiltration galleries with attendant difficult construction, or extensive shallow well fields, would be required to meet project demands. It was therefore concluded that side bank intake structures, which is the City's current method of diversion on both the Yakima and the Cle Elum Rivers, was the only feasible method of diversion.

Water Treatment System Alternatives

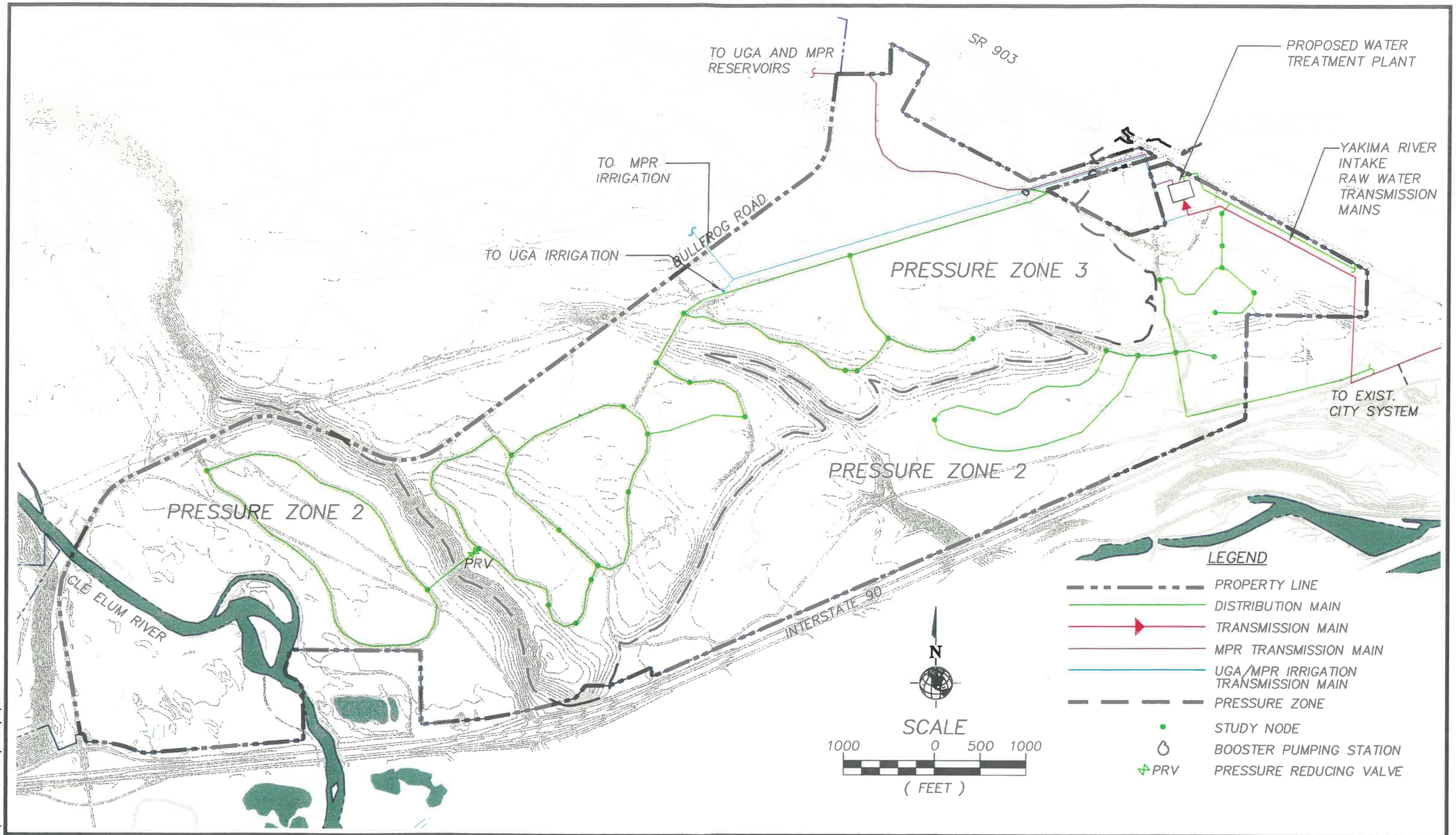
The proposed water treatment plant and water system improvements are discussed in the draft report, *"Project Report for Water System Improvements Including Water Treatment"*, prepared by Huibregtse, Louman Associates, Inc., September 1998. It outlines the proposed water treatment processes and identifies a number of potential alternatives for filtration and disinfection processes. The proposed water treatment processes include coagulation with flash mixing, flocculation, filtration, disinfection, and to remove solid matter in the backwash water, sedimentation. Solids from the treatment process would be disposed of at a landfill that accepts water treatment plant sludge.

The treated water quality is required to meet the standards of the Surface Water Treatment Rule (SWTR) and Part 6 of Chapter 246-290 WAC. The SWTR pertains to all public water systems, which utilize a surface water source, and was implemented to minimize contamination of public water systems by pathogenic organisms and viruses.

Construction documents for the water treatment plant and intake facility are currently being prepared. Environmental and permitting documents in support of this project include a SEPA (MDNS by City), biological assessment, NEPA environmental report, JARPA submittal, shoreline substantial development permit, floodplain development permit application, and WDNR state aquatic land lease application.

Preliminary Water Distribution System Plan

The preliminary water distribution system for domestic supply includes water reservoirs, transmission lines, distribution lines, and pressure reducing stations. The major facilities for Alternatives 2, 3, 4 and 5 are shown on **Figures 3-2, 3-3, 3-4 and 3-5**, respectively, along with topographic contours. Also shown on **Figures 3-2, 3-3, 3-4 and 3-5** are MPR water utilities that will pass through the UGA. These include a treated domestic water transmission main and an untreated raw water irrigation transmission main. The sizing of preliminary water systems for each alternative has been designed in accordance with Washington State Department of Health standards.



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Cle Elum Urban Growth Area

Figure 3-2
Preliminary Water Plan
Alternative 2

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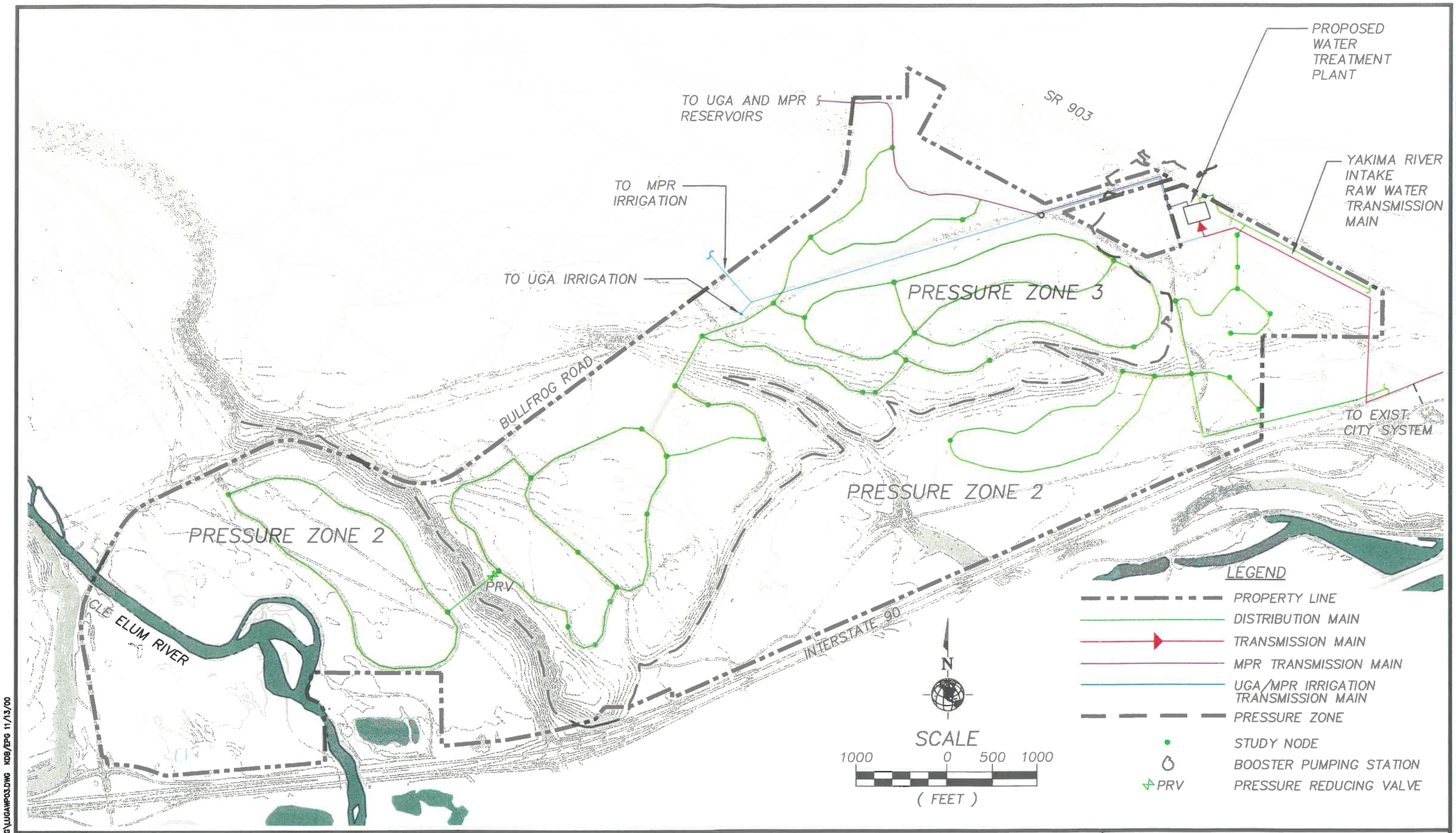

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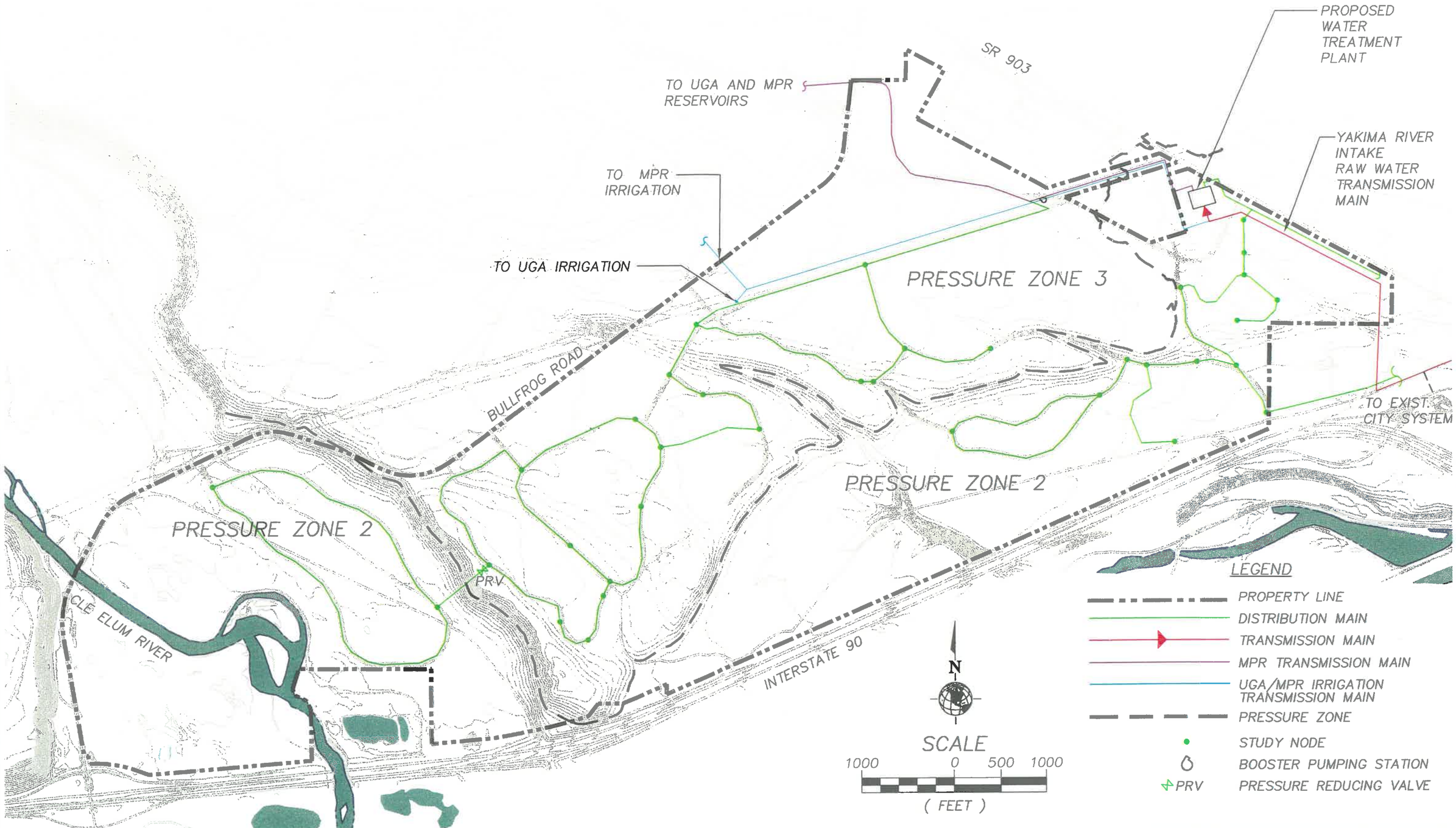
Cle Elum Urban Growth Area

Figure 3-3
Preliminary Water Plan
Alternative 3



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Cle Elum Urban Growth Area

Figure 3-4
Preliminary Water Plan
Alternative 4

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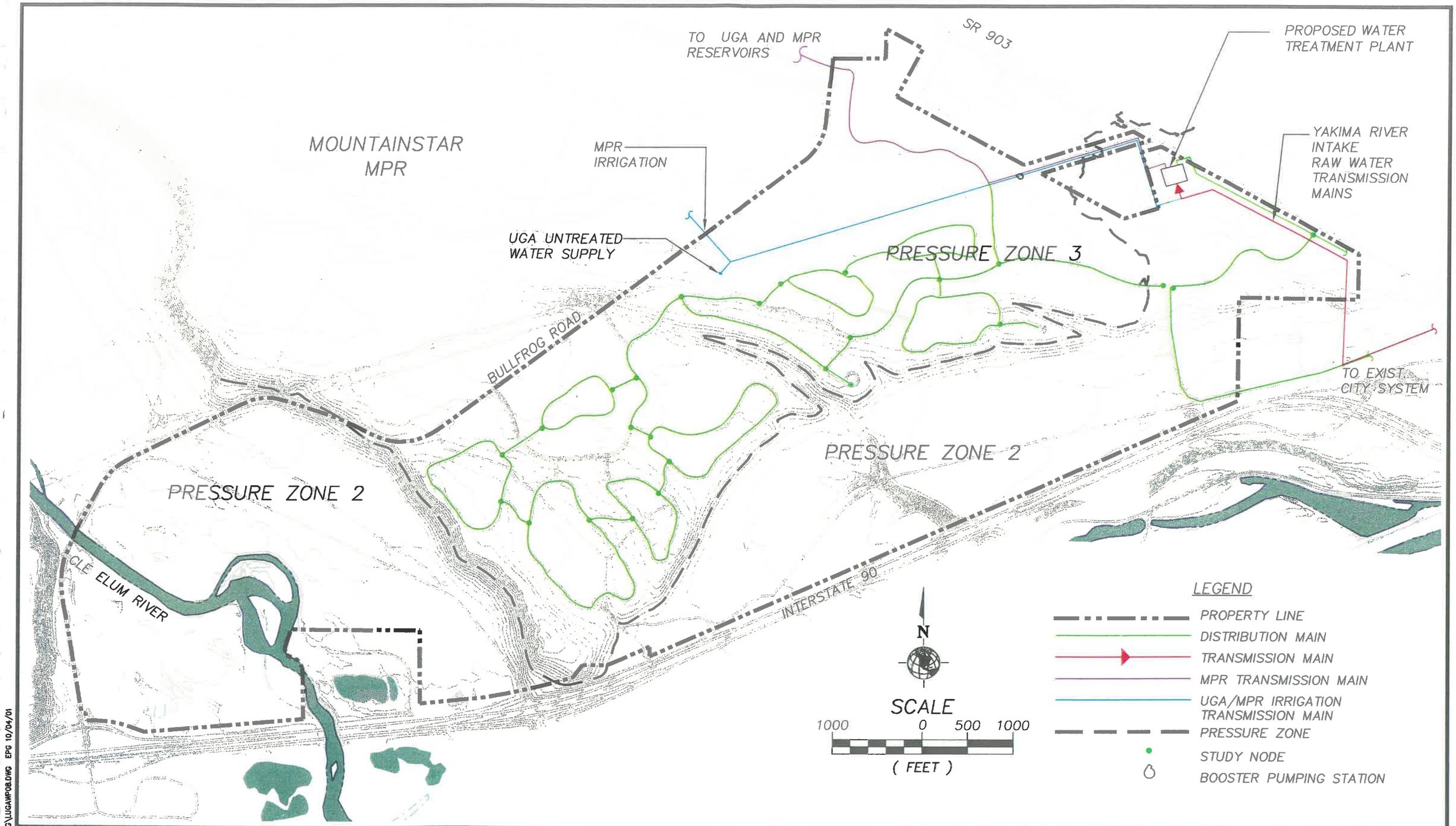

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Cle Elum Urban Growth Area

Figure 3-5
Preliminary Water Plan
Alternative 5

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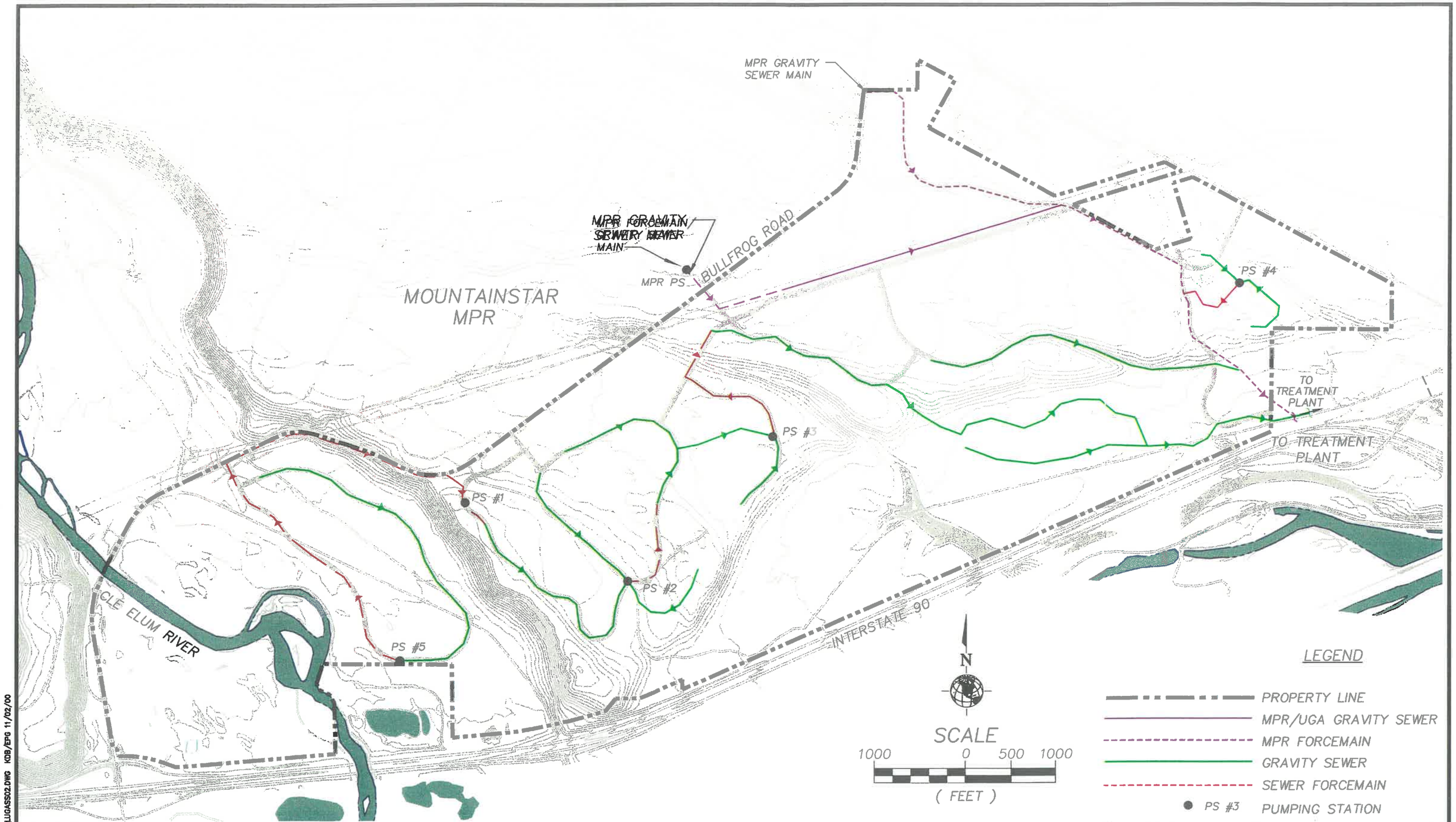

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Cle Elum Urban Growth Area

Figure 4-1
Preliminary Sewer Plan
Alternative 2

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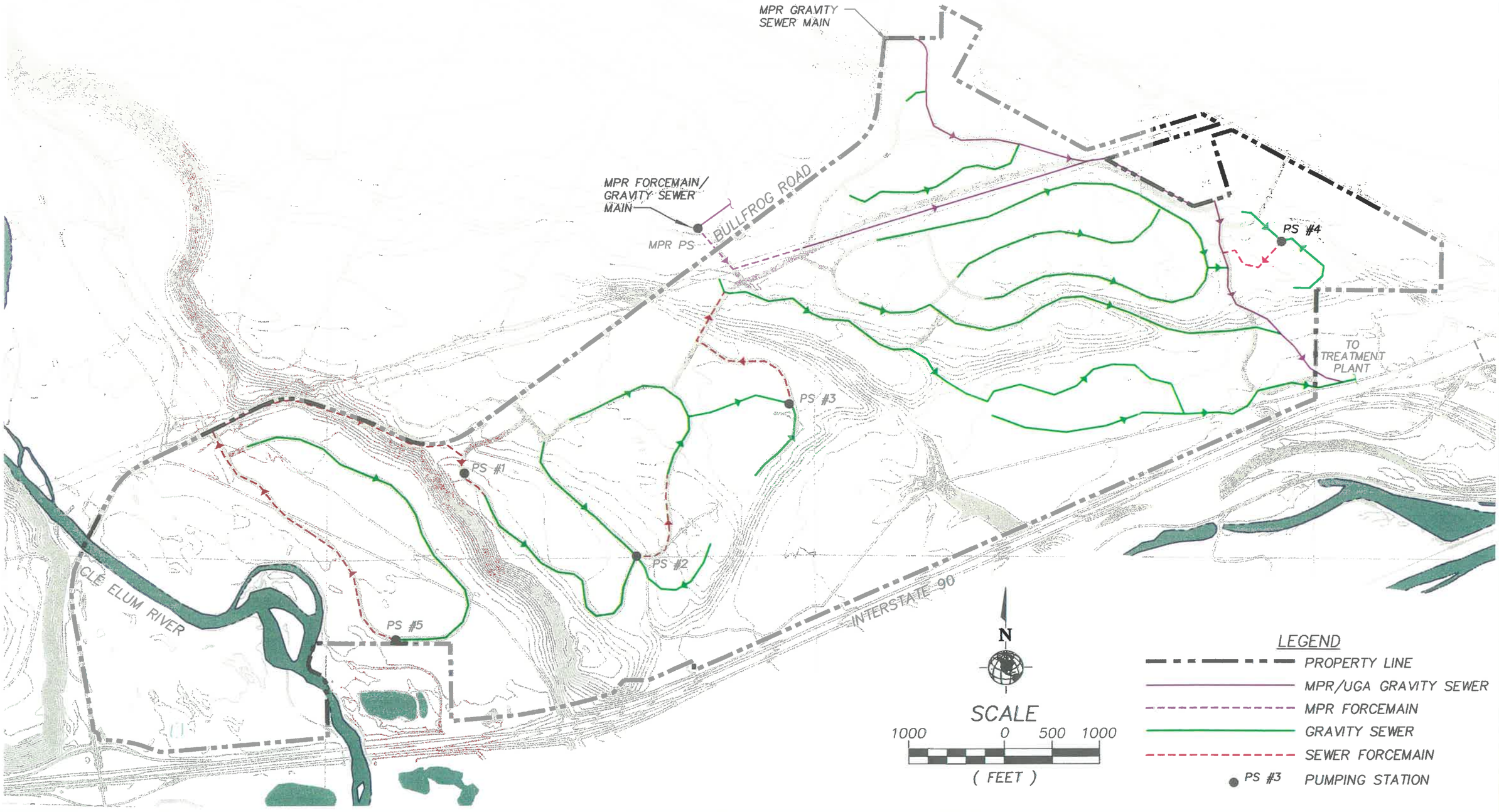

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Cle Elum Urban Growth Area

Figure 4-2
Preliminary Sewer Plan
Alternative 3

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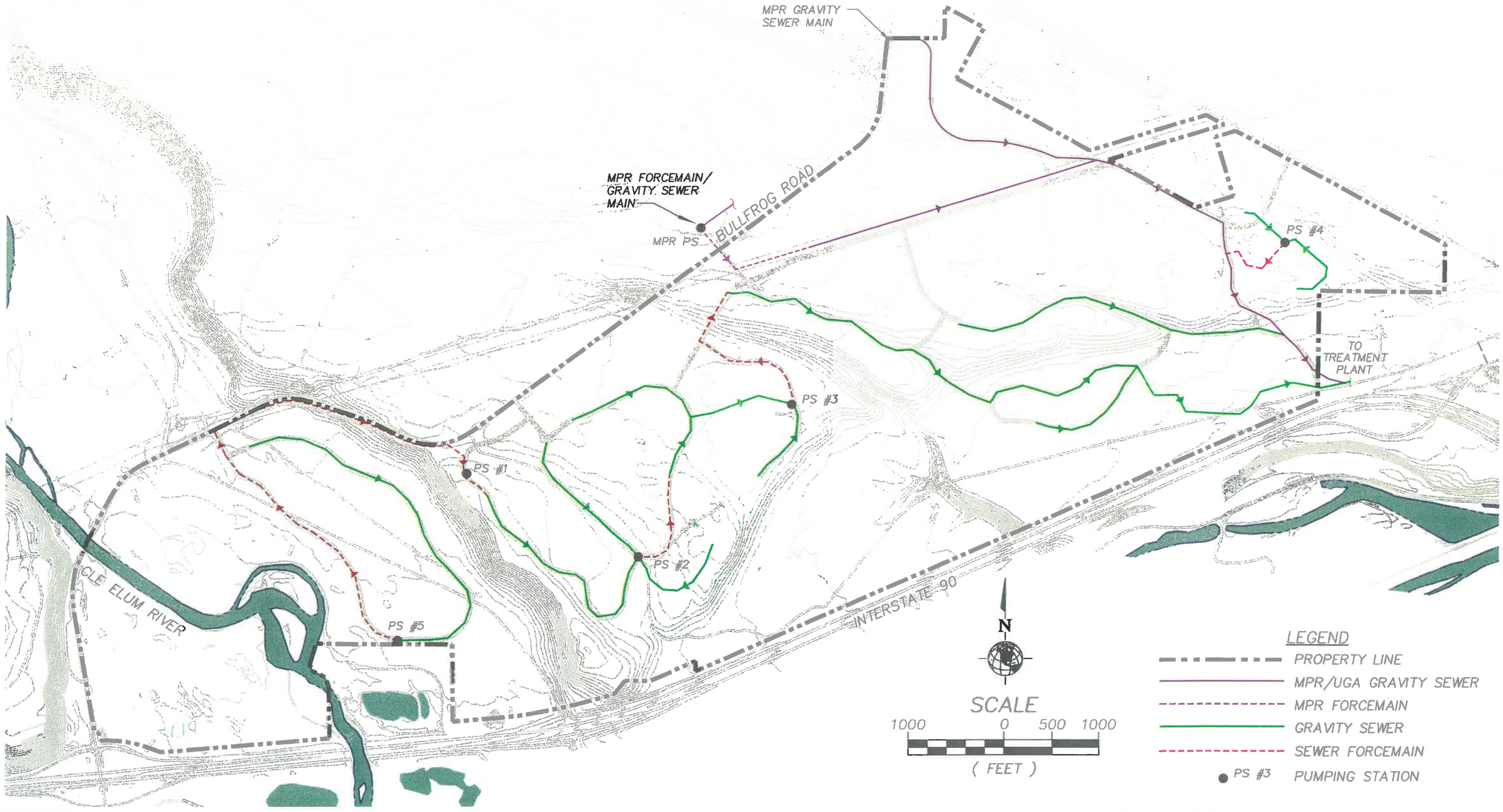

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Cle Elum Urban Growth Area

Figure 4-3
Preliminary Sewer Plan
Alternative 4

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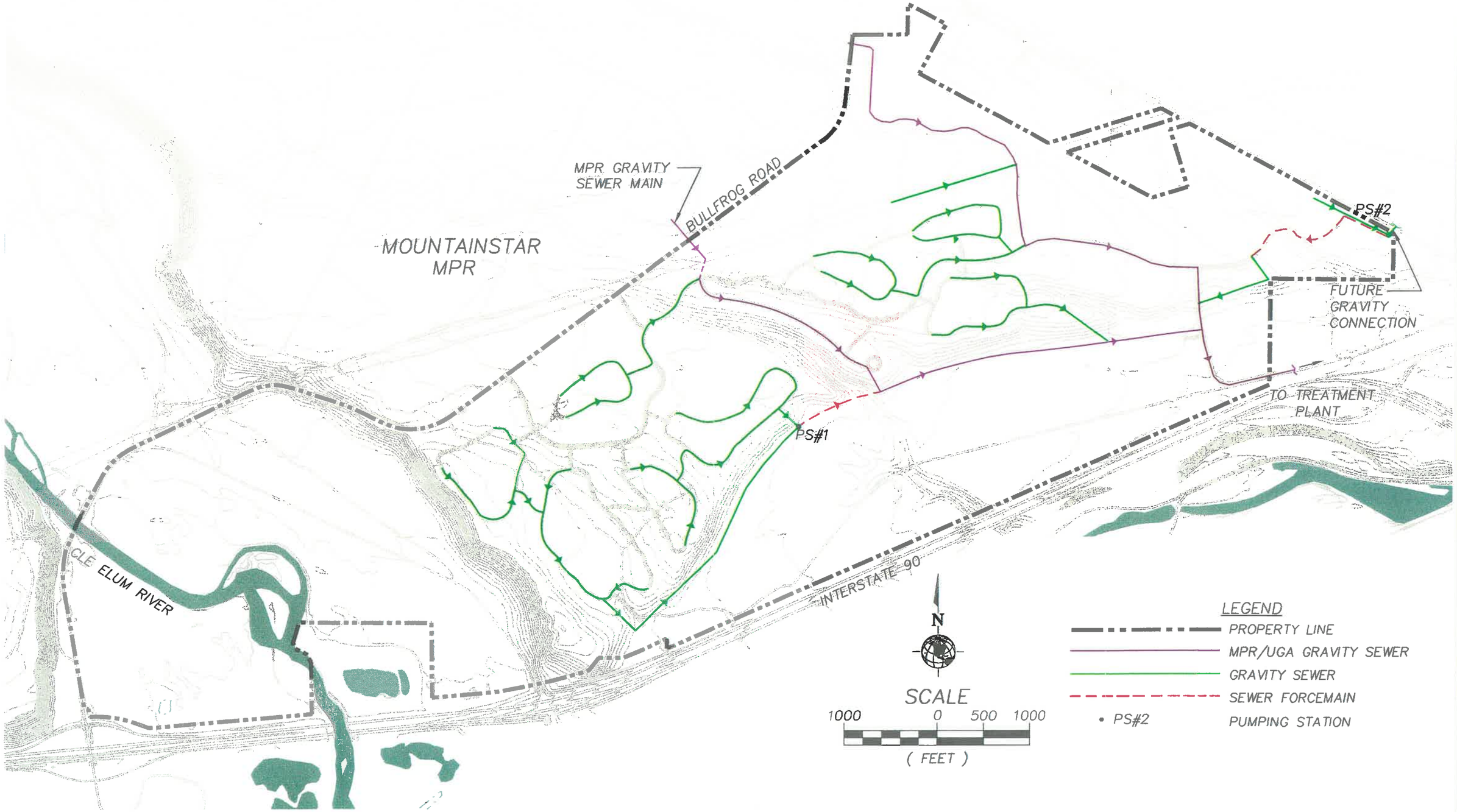

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Cle Elum Urban Growth Area

Figure 4-4
Preliminary Sewer Plan
Alternative 5

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Collection and Conveyance System

The preliminary sewer systems layout for Alternatives 2, 3, 4 and 5 are shown in **Figures 4-1, 4-2, 4-3** and **4-4**, respectively. The systems are based on the planning areas defined by the preliminary land use site plans for each alternative. Gravity sewer and gravity force mains that will convey MPR flows through the UGA are also shown on these figures. The gravity mains will also convey the UGA flows that can be intercepted by these mains. A deeper gravity main in lieu of the MPR pumping station and force main shown is an alternative being evaluated by the MPR.

Preliminary sizing of the collection system is in accordance with the requirements set forth in the publication, "Criteria for Sewage Works Design" by the Washington Department of Ecology. The sizes of gravity sewers for Alternatives 2, 3, 4 and 5 range from 8 inches to 12 inches in diameter. The sizes of force mains for each alternative range from 4 inches to 6 inches in diameter.

The topography of the site requires a number of wastewater lift stations to transport sewage from lower to higher elevations. The locations of these stations are shown in **Figures 4-1, 4-2, 4-3, and 4-4**, respectively. Preliminary design conditions for each sewage lift station with 5 hp or more requirements are presented in **Table 4-6.**

Table 4-6: Preliminary Lift Station Design Parameters

Alternative	Lift Station No.	Capacity (gpm)	Head (ft)	Power Input[a] (HP)
2	1	96	30	5
	2	224	51	10
	3	337	55	11
	4	140	52	5
	6	81	158	21
3	2	197	49	10
	3	303	46	11
	4	98	40	5
	6	56	149	18
4	2	140	72	10
	3	233	34	7.5
	6	55	149	18
5	1	264	10	7.5

[a] Input horsepower values are given rather than standard motor horsepower values.

Wastewater Treatment and Disposal

Flows and Loadings

Estimated wastewater flows for Alternatives 2, 3, 4 and 5 are provided in **Tables 4-7, 4-8, 4-9**, and **4-10** respectively. Estimated wastewater loadings, in terms of biochemical oxygen demand (BOD) and total suspended solids (TSS) are given in **Table 4-11**. These loadings are based on a unit loading for BOD and TSS of 0.2 pounds per day per person. Population equivalents were calculated on the basis of 100 gpd per capita.

Table 4-7: Projected Wastewater Flows for Alternative 2, mgd[a]

Flow Condition	Year 5	Year 20	Year 30
Annual Average	0.27	0.32	0.33
Wet Weather (Oct.-Apr.):			
Average	0.26	0.31	0.33
Peak Hourly	0.91	1.10	1.14
Dry Weather (May-Sept.):			
Average	0.28	0.33	0.34
Peak Hourly	0.97	1.15	1.19

[a] Includes wastewater flows for non-Trendwest demands located in the UGA.

Table 4-8: Projected Wastewater Flows for Alternative 3, mgd[a]

Flow Condition	Year 5	Year 20	Year 30
Annual Average	0.24	0.33	0.35
Wet Weather (Oct.-Apr.):			
Average	0.23	0.32	0.35
Peak Hourly	0.80	1.12	1.21
Dry Weather (May-Sept.):			
Average	0.25	0.34	0.35
Peak Hourly	0.87	1.20	1.22

[a] Includes wastewater flows for non-Trendwest demands located in the UGA.

Table 4-9 - Projected Wastewater Flows for Alternative 4, mgd[a]

Flow Condition	Year 5	Year 20	Year 30
Annual Average	0.17	0.21	0.22
Wet Weather (Oct.-Apr.):			
Average	0.16	0.20	0.22
Peak Hourly	0.56	0.71	0.77
Dry Weather (May-Sept.):			
Average	0.18	0.22	0.23
Peak Hourly	0.61	0.76	0.81

[a] Includes wastewater flows for non-Trendwest demands located in the UGA.

Table 4-10 – Projected Wastewater Flows for Alternative 5, mgd[a,b]

Flow Condition	Year 5	Year 20	Year 30
Annual Average	0.25	0.33	0.36
Wet Weather (Oct.-Apr.):			
Average	0.26	0.34	0.37
Peak Hourly	0.90	1.19	1.28
Dry Weather (May-Sept.):			
Average	0.24	0.32	0.35
Peak Hourly	0.85	1.13	1.21

[a] Includes wastewater flows for non-Trendwest demands located in the UGA.
[b] Excludes reserve area.

Table 4-11 – Projected UGA Loadings for Alternatives 2, 3, 4, 5 lb. per day[a]

Alternative No.	BOD & TSS	Year 5	Year 20	Year 30
2	Annual Average	540	640	660
	Max. Month Average (Aug.)	570	670	690
3	Annual Average	480	660	690
	Max. Month Average (Aug.)	510	700	700
4	Annual Average	330	420	450
	Max. Month Average (Aug.)	360	440	470
5[b]	Annual Average	510	670	720
	Max. Month Average (Aug.)	530	700	760

[a] Includes wastewater flows for non-Trendwest demands located in the UGA.
[b] Excludes Reserve Area.

Wastewater Treatment and Disposal Alternatives

A regional wastewater facility planning study is underway by Earth Tech for local area entities and the UGA and MPR. Trendwest is a financial participant in the study. This alternative is described in the following section. Trendwest standalone alternatives, which would require a public entity (such as a sewer district) to operate, have been described in the Draft EIS.

With the regional alternative, wastewater treatment for the UGA would be accomplished at a new facility. The plant would be located at the existing Cle Elum treatment plant at the east end of the City. From preliminary regional facility planning efforts (Earth Tech), the estimate of capacity for this facility for a 30-year planning horizon is about 3.6 million gallons per day. The plant study area for this flow includes the City of Cle Elum, the Town of South Cle Elum, the City of Roslyn, Ronald, Pine Loc III (existing units), the UGA and the MPR. Trendwest would be a financial participant.

Maximum monthly wastewater design flows and pollutant loads for the study area for Year 30 (UGA and MPR Buildout) are presented in **Tables 4-12 and 4-13**, respectively (Earth Tech, February 2002). The flows are based on the MPR Reduced Density Alternative and UGA Alternative 5.

Table 4-12: Regional Wastewater Flows at Year 30[a]

Condition	Maximum Month Flow, mgd
Winter (March)	
Average	3.6
Peak Hour	10.7
Summer (August)	
Average	2.3
Peak Hour	8.0

[a] Source: Cle Elum Regional Sewage Facilities Plan Data, Earth Tech, February 2002.

Table 4-13: Summary of Pollutant Loads at Year 30[a]

Parameter	BOD5	TSS
August		
Average Day Influent pounds	4,767	4,388
Influent Concentration mg/l	256	236
Effluent Concentration mg/l	15	15
Effluent pounds	279	279
Percent Removal	94	94
March		
Average Day Influent pounds	3,979	3,775
Influent Concentration mg/l	132	126
Effluent Concentration mg/l	15	15
Effluent pounds	451	451
Percent Removal	89	88

[a] Source: Earth Tech, February 2002.

The portion of the regional wastewater flows and loadings attributed to the MountainStar MPR and Cle Elum UGA are as follows (Earth Tech, February 2002):

- Average Flows: Winter 1.3 mgd, Summer 1.3 mgd
- Average Influent BOD: Winter 2,198 lbs/day, Summer 2,685 lbs/day
- Average Influent TSS: Winter 1,685 lbs/day, Summer 2,123 lbs/day

The proposed treatment process is one of the forms of the activated sludge process. This process provides the capability of meeting anticipated permit standards. Disposal of treated effluent from the regional plant would be to the Yakima River via an upgraded outfall. An outfall study will be prepared as a part of the facility plan. The outfall study will include a hydraulic analysis (dilution analysis) to evaluate how effluent pollutants are dispersed (see Section 3.1.6 of the FEIS for additional details). Sludge handling and disposal alternatives would be evaluated in the facility plan to be submitted to Ecology. Composting of sludge would be one of the alternatives considered.

The City of Cle Elum has constructed interim improvements that bring its wastewater treatment plant into compliance. A new MDNS discharge permit has been issued. The steps in the regional project process include:

- An agreement between Trendwest and Cle Elum, South Cle Elum, and potentially Roslyn, to participate in the regional project.
- Modification of Cle Elum's NPDES permit to include a schedule for the planning, design and construction of the project.
- Preparation of a facility plan for the project with supporting SEPA documentation for approval by Ecology (in progress).
- Preparation of construction plans and specifications for the treatment plant and associated conveyance system.
- Permitting and environmental review.
- Construction and start-up of the regional facilities.

The interim capacity improvements were sized for about 150,000 gallons per day of added treatment capacity for the regional service area of Cle Elum, South Cle Elum and the Trendwest properties. The improvements to the Cle Elum plant for interim capacity included the addition of mechanical aeration, mixers and baffles in Cells No. 1 and No. 2, the addition of baffles in Cell No. 2 of the existing lagoon system, a constructed wetland in Cell No. 3 (final cell), effluent aeration in a reaeration chamber, and ultra-violet irradiation disinfection.

The temporary sewer connection alignment from the MPR and UGA service areas to the City system has not yet been constructed. The initial sewer from the UGA boundary east would be along Ranger Road to a location east of the Pacific Pride facility. From that location, the

alignment would be via Ranger Station Road and Second Street to Oakes Street where the line would be routed south to connect with the South Cle Elum trunk sewer.

On-Site Wastewater Systems

Proposed development on Trendwest properties within the UGA includes two temporary on-site septic tank and drainfield systems to serve the sales office and maintenance facility in advance of the availability of sewer service to their locations. These systems will be abandoned after connection to the UGA collection system. The systems will be abandoned in accordance with Kittitas County Health Department requirements.

The potential exists to have golf course comfort stations that are served by septic tank and drainfield systems if the needed locations are remote from sanitary sewer facilities. It is probable that there would be no more than two stations being served by septic tanks and drainfields. Assuming similar usage as expected for the MPR trail systems comfort stations, two golf course systems would generate an additional 800 gallons of septage per year. Refer to Page 5-8 of the Solid Waste section for discussion of disposal of septage wastes.

Presented in this section are the expected sources and quantities of solid wastes that would be generated by Alternatives 2, 3, 4 and 5. The estimated quantities are considered relative to the capacities of the existing Kittitas County solid waste management facilities. Also presented are the solid waste management provisions anticipated for the UGA

Solid Waste Sources and Classifications

Sources of Solid Waste

Sources of solid waste are, primarily, related to land use. Based on the land uses proposed within the Cle Elum UGA for the four development alternatives, the source categories of solid waste including wastes from construction and operations are as follows:

1. ***Construction and Inert Waste (CDL):*** Construction and inert waste includes waste material that is produced in the process of construction of new structures. (Note: Construction wastes from renovation or demolition of structures are estimated to be minor through buildout and are, therefore, not estimated.) Structures include buildings of all types, both residential and nonresidential, as well as roads, utilities and bridges.

2. ***Residential***: Residential solid waste would be generated from single family residences, multi-family units and in temporary and permanent RV parks.

3. ***Commercial***: Commercial solid waste would be generated from the neighborhood center, community recreation center, horse park and business park.

4. ***Streets and Recreation Areas***: This source includes waste from all internal roads and alleys and recreation areas.

5. ***Water and Wastewater Treatment***: This source includes waste from the water and wastewater treatment facilities.

Classification of Solid Wastes

The solid wastes that will be generated from the UGA are classified as follows:

1. ***Construction and Demolition Debris (CDL)***: This waste stream is composed of both construction and demolition wastes, each of which includes inert and non-inert components. Demolition waste is defined as the solid waste resulting from the demolition or razing of buildings, roads, and other manmade structures (WAC 173-304-100(19)). Demolition waste consists of, but is not limited to, concrete, brick, bituminous concrete, wood and masonry, composition roofing, and roofing paper, steel, and minor amounts of other metals like copper. Inert waste is non-combustible, non-dangerous wastes that are likely to retain their

physical and chemical structure under the expected conditions of disposal, including resistance to biological attack and chemical attack from acidic rainwater (WAC 173-304-100(40)). Specific components of demolition waste – drywall, plaster, wood, and asphalt shingles – are not considered inert waste.

Neither drywall nor wood waste are considered CDL for disposal. Drywall must be disposed of as municipal solid waste. Wood waste can be recycled, given away, converted to wood chips, or disposed of as municipal solid waste.

2. ***Municipal Wastes***: These include food wastes and rubbish. Food wastes are the animal, fruit or vegetable residues resulting from the handling, preparation, cooking, and eating of foods. They are generated from the residential and commercial areas.

   Rubbish consists of combustible and noncombustible solid wastes of households, institutions, commercial activities, excluding food wastes or other highly putrescible materials. It is produced by the residential, commercial and recreational land uses.

3. ***Hazardous/Moderate Risk Wastes***: These include chemical, biological, flammable, explosive, or radioactive wastes that pose a moderate risk, immediately or over time, to human, plant or animal life. In the UGA, moderate risk wastes will be generally produced by households and commercial operations in small quantities. These waste materials include many common products, such as:

   - Oil based and water based paints
   - Paint thinners and solvents
   - Adhesives, glues and sealant
   - Brake fluid and antifreeze
   - Used motor oil
   - Car batteries
   - Pesticides/herbicides
   - Photograph chemicals
   - Unwanted fuels (gasoline, kerosene)

4. ***Biosolids/Septage***: Biosolids include the solid and semi-solid wastes from water and wastewater treatment facilities in this classification. Septage (the combination of sludge, scum and liquid pumped from septic tanks) is also included in this classification.

5. ***Yard Waste***: This includes leaves, grass clippings, brush, garden waste, tree trunks, holiday trees and prunings from trees or shrubs. Yard waste results from the care and maintenance of landscaped areas. It is mostly generated by residential, commercial, street, and recreational land uses.

6. ***Land Clearing***: Land clearing waste includes trees and vegetation removed for construction, but not sold as timber.

Waste Stream Quantities and Management

The waste stream quantities estimates from the project construction and operation of each alternative along with proposed management procedures for the UGA alternatives are presented in this section.

CDL Wastes

Generation Estimate. CDL wastes have been estimated based on 4.38 lbs/sf of new construction for residential areas and 3.89 lbs/sf of new construction for non-residential areas (EPA, "Characterization of Building-Related Construction and Demolition Debris in the United State," 1998). Quantity estimates are based on these rates and the building areas given in **Tables 5-1** and **5-2**. Estimated CDL quantities by year are given in **Table 5-3** for Alternatives 2 through 5. According to the 1995 survey by Metropolitan Service District in Portland, Oregon, construction debris is typically comprised of 5 percent asphalt and concrete; 67 percent waste wood; 0.4 percent metal; 3 percent asphalt shingle; 20 percent drywall; and about 5 percent deconstruction. The majority of residential units in the UGA will be constructed with metal roofs. Therefore, there will be a minor asphalt shingle component, and the metal component will increase accordingly. The composition of CDL estimated for the UGA is: wood waste, 70.5 percent; asphalt and concrete, 5.3 percent; drywall, 21.0 percent; metals and metal roofing, 3.2 percent.

Inert CDL waste will be collected on-site and hauled directly to the Kittitas County Inert/Demolition Debris Waste Landfill at Ryegrass. Non-inert CDL wastes will be collected on-site and hauled to the Cle Elum transfer station for disposal. No inert construction waste will be hauled to Kittitas County-owned transfer stations. A CDL recycling program will be developed that will require participation of all Trendwest Properties' contractors working in the UGA. The program will be approved by the Kittitas County Solid Waste Department prior to the start of construction.

Table 5-1: Estimated Residential Building Areas, Cle Elum UGA

Residential Building Area, sf			
Alternative 2	**Alternative 3**	**Alternative 4**	**Alternative 5[a]**
1,672,000	2,587,000	1,519,000	2,719,000

[a] Excludes buildings in 175-acre reserve parcel, for which uses are undefined.

Table 5-2: Estimated Non-Residential Building Areas, Cle Elum UGA

	Total Building Area, sf			
Facility	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5[a]**
Water Treatment Plant	13,000	13,000	13,000	13,000
Golf Course Clubhouse/Recreation Center	17,000	17,000	17,000	-
Temporary Sales Center	8,000	8,000	8,000	-
Golf Maintenance Building	6,000	6,000	6,000	-
General Maintenance Building	6,000	6,000	6,000	9,000
Activity/Multi-purpose Barn	6,000	6,000	6,000	-
Lodge	45,000	45,000	45,000	-
Horse Park	545,000	-	545,000	-
Community Center	10,000	10,000	10,000	10,000
Business Park	950,000	600,000	300,000	950,000
RV Park/Temporary RV Park	4,500	4,500	4,500	2,500[b]
Residential Recreation Buildings/ Neighborhood Center	10,500	10,500	10,500	12,500
Total	**1,621,000**	**726,000**	**971,000**	**997,000**

[a] Excludes Reserve Area.
[b] Temporary RV park.

Table 5-3: Projected CDL Generation Rates (Tons/Year) and Total Quantity at Full Buildout, Cle Elum UGA

Buildout Year	Alternative 2		Alternative 3		Alternative 4		Alternative 5[a]	
	Residential	Non-residential	Residential	Non-residential	Residential	Non-residential	Residential	Non-residential
1	369	108	444	108	464	108	378	47
2	503	88	643	88	457	88	876	24
3	511	606	745	51	453	561	890	76
4	523	606	500	51	295	561	526	76
5	315	95	419	71	134	50	416	66
10	38	66	76	42	50	21	99	66
20	54	66	134	42	66	21	120	66
30	22	66	41	42	28	21	22	62
Buildout Total (tons)[b]	**3,661**	**3,151**	**5,666**	**1,411**	**3,327**	**1,887**	**5,955**	**1,939**

[a] Excludes Reserve Area.
[b] Buildout total represents the cumulative total quantity of CDL produced over the 30-year buildout period.

The generation estimates presented in **Table 5-3** do not include wastes from road, utility and non-building structure construction. Estimating criteria for this waste stream were not found in the literature. However, the magnitude of this waste stream is expected to be minor in comparison to the building CDL.

Management Provisions. CDL collection points will be locations specified by the City of Cle Elum through its building permit process. Inert and non-inert waste will be handled as described in the following.

Inert Wastes. Drop boxes will be maintained on-site for temporary storage of inert wastes during construction. Inert wastes collected in drop boxes will be hauled directly to the permitted Ryegrass CDL landfill by the contractors or by Waste Management by agreement with the contractors. The recyclable materials will be segregated from the waste stream on-site.

Non-Inert Wastes. Non-inert wastes will be temporarily stored in separate drop boxes on-site until hauled to the Cle Elum Transfer Station. The wastes except for the recyclables will then be transported to the Greater Wenatchee Landfill, Douglas County for the final disposal. Recycled materials will be segregated from the waste stream as discussed for inert wastes.

Wood Wastes. Construction wood waste will be handled on-site. Wood wastes will not be hauled to the Kittitas County municipal solid waste facilities. Wood waste will be given away as firewood, chipped, or recycled.

Municipal and Other Wastes

Generation Estimates. A generation rate of 5.45 lbs./person/day, based on 1999 Washington State average municipal solid waste production, has been applied to the residential areas and the temporary RV park. For the business park, the waste stream quantities have been estimated based on a generation rate of 0.16 lb/person/day (Tchobanoglous, "Integrated Solid Waste Management: Engineering Principles and Management Issues," 1993). This rate is multiplied by the projected occupancy (number of occupants times 365 days, times the occupancy rate). Waste stream quantities have not been estimated for the reserve area because definitive plans are not available for this area.

A generation rate of 0.25 lb/person/day has been used for wastes produced by street and alley cleaning (Tchobanoglous, "Solid Waste Management: Engineering Principles and Management Issues", 1993).

Yard waste has been estimated based on a generation rate of 0.44 lbs./person/day (EPA, *Decision-Maker's Guide to Solid Waste Management*, Second Edition, 1995). This may be a conservative rate, given the limited irrigated landscaping that will be allowed by the project's CC&Rs on individual lots. A unit area generation rate was not found in the literature to compare to the per capita rate.

The household hazardous/moderate risk waste rate has been based on 1997-1999 Kittitas County records during which households generated an annual average of 103.7 pounds, equivalent to a daily average of 0.29 pounds per household or 0.13 pounds per person per day using the Kittitas County persons per household data. The UGA value of 2.4 persons per household and number of units was multiplied by the 0.13 pounds per person per day to estimate solid waste generation for the UGA

Projections of municipal solid waste generation for Alternatives 2 through 5 are presented in **Table 5-4**, together with projections for yard and hazardous/moderate risk wastes.

Table 5-4: Solid Waste Production (tons/year), Cle Elum UGA

Buildout Year	Alternative 2	Alternative 3	Alternative 4	Alternative 5[a]
Project Year 1				
Municipal[b]	292	310	335	305
Yard	21	24	26	24
Hazardous/Moderate Risk	6	7	8	7
Total (tons/year)	**319**	**341**	**369**	**336**
Project Year 2				
Municipal	763	711	703	587
Yard	55	55	54	45
Hazardous/Moderate Risk	16	16	16	13
Total (tons/year)	**834**	**782**	**773**	**645**
Project Year 3				
Municipal	1,135	1,109	993	1,097
Yard	83	85	76	88
Hazardous/Moderate Risk	24	25	23	26
Total (tons/year)	**1,242**	**1,219**	**1,092**	**1,211**
Project Year 4				
Municipal	1,512	1,394	1,148	1,662
Yard	110	107	88	128
Hazardous/Moderate Risk	32	32	26	38
Total (tons/year)	**1,654**	**1,533**	**1,262**	**1,828**
Project Year 5				
Municipal	2,150	2,037	1,495	1,917
Yard	157	156	114	148
Hazardous/Moderate Risk	46	46	34	44
Total (tons/year)	**2,353**	**2,239**	**1,663**	**2,109**
Project Year 10				
Municipal	2,504	2,556	1,663	2,431
Yard	183	196	127	187
Hazardous/Moderate Risk	54	58	38	55
Total (tons/year)	**2,741**	**2,810**	**1,828**	**2,673**
Project Year 20				
Municipal	2,756	3,052	1,958	3,018
Yard	200	233	150	231
Hazardous/Moderate Risk	59	69	44	68
Total (tons/year)	**3,015**	**3,354**	**2,152**	**3,317**
Project Year 30				
Municipal	2,929	3,340	2,147	3,363
Yard	211	255	163	256
Hazardous/Moderate Risk	62	75	48	76
Total (tons/year)	**3,202**	**3,670**	**2,358**	**3,695**

[a] Excludes Reserve Area.
[b] Residential and commercial generation.

Management Provisions. The Trendwest UGA development will generate an estimated 3,363 tons of municipal solid wastes annually at full buildout (Alternative 5, Year 30). Waste Management of Ellensburg or its successors will collect the wastes from UGA. The methods and points of connection will vary by type of use and accommodation. The principal arrangements are likely to be as follows:

Accommodation/Area	Collection Responsibility	Collection Point
Single family residential	Residents	Curb-side pickup by Waste Management
Multi-family residential	Residents	Central dumpsters
Business Park, lodge, horse park, RV park areas	Operators/tenants	Central dumpsters

The wastes will then be hauled to the Cle Elum Transfer Station prior to transport to the Greater Wenatchee Landfill in Douglas County for final disposal.

Yard waste disposal by residents will be by curb-side pickup by Waste Management, or self-haul to an allowable transfer station. Yard waste disposal for commercial operators/tenants will be the responsibility of their commercial landscape services.

Streets will be cleaned periodically in accordance with City of Cle Elum practices.

Hazardous/moderate risk wastes will be disposed of by residents and commercial operators/tenants at local community-sponsored turn-in events.

Recycling. Chapter 70.95 RCW establishes statewide recycling and waste reduction goals. A goal of 50 percent was established for 1995, realizing this would be more easily achieved in urban areas than rural eastern Washington areas. Kittitias County's goal is for an overall recycling rate of 50 percent by 2003 for the Kittitas County Solid Waste Management Plan. According to the Kittitas County Solid Waste Management Plan, a "best guess" of the recycling rate in 1997 is between 15 and 20 percent.

Recycling within the UGA will be encouraged. Many of the residents will move from areas with effective recycling programs, and will expect similar programs to be in place in the UGA. Curbside recycling is possible, but not included in the program at this time. Preliminarily, the recycling program elements are expected to include recycle bins at each central dumpster location for use by residents and commercial operators/tenants. It is recommended that the dumpster/recycle stations be designed so that the dumpsters can be removed without moving the recycling containers. These stations will receive aluminum, tin, glass, plastic bottles and milk jugs, mixed paper, and newspaper. The destination(s) of these materials will be determined at a later date.

Septage Wastes

Septage waste from the UGA will be limited to three permanent comfort stations serving trails or golf courses. These comfort stations would be served by septic tanks and drainfields due to their distance from UGA sewers. Additionally, up to two temporary stations are possible for sales and maintenance facilities constructed prior to availability of sewer service at those locations. The septic tanks would be pumped once every three to five years, and hauled directly to the County evaporation lagoons at Ryegrass Landfill for final disposal. An RV waste dumping facility will not be located in the UGA. For this reason, it is proposed that the temporary RV Campground be served by the UGA sewer system.

Land Clearing Wastes

It is not anticipated that any wastes generated from UGA land clearing operations will be hauled to Kittitas County solid waste facilities. Land clearing wastes remaining after removal of saleable timber will likely be burned, given away as free firewood, or chipped on-site. Chipped wood wastes could be marketed as pulp material, or made available free of charge to the public.

Waste Loading Impacts

Based on data presented in **Table 5-3** and **5-4**, Alternative 5 generates the greatest quantities of CDL and MSW. Therefore, assessment of impacts on existing solid waste facilities will be based on Alternative 5.

Cle Elum Transfer Station. The Cle Elum transfer station is reported by Kittitas County to have processed 4,632 tons of waste in 1999. Customers made a total of 20,646 deliveries to the transfer station. The station is reported to be near capacity, based on the number of cars queued at the station on Saturdays. Tuesdays are also busy days at the station, as it is closed Sundays and Mondays.

Assuming that 5,000 tons of municipal solid waste per year were to be processed in Year 1 of the UGA, UGA Alternative 5 municipal solid wastes would add 103 tons (without recycle), or 2 percent, to the then existing station loading (without recycle, assuming MSW generation lags construction MSW generation by one year). Similarly, for Year 5, the UGA would add 1,779 tons, or 36 percent, above an assumed 5,000-ton per year loading. The annual generation at Year 30 for the UGA is estimated at 3,383 tons per year, or 68 percent above an assumed 5,000-ton per year existing loading.

Based on the daily ratio of 4 cubic yards of MSW waste per ton, the daily average storage needs for the UGA (without recycle) would be 20 cubic yards for Year 5; 27 cubic yards for Year 10; and 36 cubic yards for Year 30.

The existing Cle Elum transfer station will need to be expanded in capacity to accommodate the UGA. However, the exact timing of need for capacity expansion relative to the UGA demands needs to be determined. Loading impacts to the Cle Elum transfer station will be minimal during the early years of the UGA because mandatory curbside pick-up will be in effect for the UGA. Curbside pick-up will distribute the waste loadings throughout the week instead of being concentrated on Saturdays and Tuesdays.

Design of the expansion of the Cle Elum Transfer Station is currently underway by Kittitas County. The capacity of expanded facility will take into account the capacity needs of the UGA.

Trendwest Properties will be responsible for its fair share of the costs associated with improvements to the Cle Elum Transfer Station required to mitigate identified impacts attributable to the project.

Ryegrass CDL Land Fill. UGA CDL inert wastes will be hauled to the CDL landfill at the Ryegrass site for disposal. According to the data from the Solid Waste Program of Kittitas County, currently 40 to 50 percent of capacity at the acre CDL landfill is filled. When the landfill reaches 60 percent capacity, the County would apply for a new permit for additional space at the existing landfill.

About 5 percent of the CDL wastes will be inert and hauled to the CDL landfill. During the first five years of construction, the total estimated CDL (non-Business Park) and inert waste volume is estimated at 157 tons (without recycle). Assuming an in-place density of 100 pounds per cubic foot on the average (concrete is in the range of 140 to 160 pounds per cubic foot), the year volume would be about 3,600 cubic feet, or 0.08 acres one foot deep. An effective recycling program would likely reduce this volume substantially.

Even with an effective recycling program, the UGA CDL wastes, together with other Kittitas County CDL wastes, will necessitate the enlargement of the CDL landfill facility.

Ryegrass Septage Ponds. Kittitas County currently has a septage lagoon facility at the Ryegrass site. The facility has two 350,000-gallon lagoons. The estimated 1999 accepted volume is 750,000 gallons. Because of the high summer evaporation rate, the facility was able to handle this volume easily. Kittitas County believes the facility has additional capacity, and this will be confirmed through future monitoring is planned. The annual UGA volume from the three trailside/golf septic systems should not impact the facility, based on the County's current understanding of the facility's capacity. In addition to the Ryegrass septage ponds, the proposed Regional Wastewater Treatment Plant may include a septage receiving facility that could accommodate the UGA.

Pressure Zones

The study area for each alternative is split into two pressure zones at an elevation of approximately 2,080 feet. Zone 3 (upper elevation pressure zone) encompass the elevations between 2,154 and 2,080. Zone 2 (lower elevation pressure zone) encompasses the elevations between 2,080 and 2,000. Pressure reducing stations would be installed at most of distribution lines crossing the boundary between Zones 3 and 2.

Treated Water Storage

Storage for the project includes the following elements:

- Equalizing storage to minimize pumping capacities required to meet peak hour demands.
- Fire storage to provide the required fire flow volume.
- Standby storage to provide water to the system during emergencies.
- Operational storage for pump protection.

Two storage reservoirs are proposed to serve the UGA for each alternative. These include a storage tank designed to serve the upper pressure zone, and a 0.50 MG regional reservoir recently constructed by the City of Cle Elum designed to serve the lower pressure zone. The lower pressure zone reservoir would serve the City of Cle Elum, Town of South Cle Elum and the UGA. The upper zone storage requirements for each alternative are listed in **Table 3-13**. Lower zone storage is included in the proposed City reservoir. Equalizing storage volumes were calculated by mass diagram methods. Standby storage was calculated as two times the average annual demand for the pressure zone. The provision for emergency power generation could reduce standby storage requirements. Fire suppression storage was based on 1,500 gpm for four hours. Operational storage will be determined during project design.

Table 3-13: Treated Water Storage Requirements, Gallons

Alternative	Service Area	Equalization Storage[1]	Fire Flow Storage	Standby Storage	Total Storage
2	Upper Pressure Zone	115,000	360,000	419,000	894,000
3	Upper Pressure Zone	150,000	360,000	552,000	1,062,000
4	Upper Pressure Zone	90,000	360,000	326,000	776,000
5	Upper Pressure Zone	188,000	360,000	787,000	1,335,000

[1] Size is based on equalizing storage for 24-hour pumping.

Transmission/Distribution Mains

Transmission mains will convey water from the Yakima River water intake structure to the proposed water treatment plant, and to irrigation storage ponds. These lines are expected to be 18 inches in diameter. The currently planned alignment to the plant is shown in **Figures 3-2, 3-3, 3-4, and 3-5**.

The distribution systems for Alternatives 2, 3, 4, and 5 are comprised of looping water distribution pipe networks of 8- to 12-inch diameter waterlines. The distribution system for each alternative will provide water at pressures between 31 and 72 psi to all services during maximum day demand.

The untreated irrigation demands for artificial water body evaporation make-up water and golf course and other landscape irrigation would be served from the transmission main shown in **Figures 3-2, 3-3, 3-4, and 3-5**. This line will serve both the MPR and UGA demands. The domestic supply transmission main for the MPR would be constructed parallel to the UGA/MPR irrigation main at an offset distance conforming to DOH standards. Much of the alignment of these mains would be located in the BPA powerline easement. If practicable, the two mains would be constructed at the same time.

Pumping Systems

The UGA upper zone reservoir and water distribution system for each alternative will be supplied by pumps at the water treatment plant. These pumps will be sized as a part of the treatment plant design. Sizing will accommodate UGA upper zone demands as well as a portion of the City of Cle Elum's water demands.

Water System Modeling

The preliminary water systems for the study area for Alternatives 2, 3 and 4 were modeled and analyzed using the Cybernet Water Distribution Modeling software. The water system for Alternative 5 was sized based on the modeling results for the other alternatives. The analysis was performed for average day demand, maximum day demand, maximum day with coincident fire flow, and peak hour demand. The fire demand nodes were selected at all junctions in the system to simulate the maximum effect on piping and pressures. The fire flow demand simulated was 1,500 gpm for residential and commercial areas. The lower system boundary node, which is the connection to the proposed water treatment plant, was set at the gradeline elevation of 2,160 feet for the water system model. This elevation represents the proposed operating elevation of the lower pressure zone regional storage reservoir planned by the City of Cle Elum.

The following criteria was used for the distribution system sizing:

- Minimum system pressure of 30 psi during peak hour demand.

- Minimum system pressure of 20 psi during maximum day demand plus fire flow conditions.
- Maximum system pressure of 100 psi during all flow conditions.
- Maximum velocity of 10 fps during maximum day demand plus fire flow conditions.
- Maximum velocity of 7 fps during maximum day demand.

Preliminary model results for each alternative indicate that the minimum residual pressure (20 psi) is provided during maximum day demand with coincident 1,500-gpm fire flow demand. During peak hour demands, the minimum pressure is 31 psi, which is greater than the minimum allowable of 30 psi. The maximum pressure of 72 psi is less than the maximum allowable of 100 psi. The model will be used to verify preliminary distribution system sizing and operating pressures for the final water system layout prior to design.

Water Use Standards

The following provides the water use standards contained in the Draft Development Standards for the Preferred Alternative (Alternative). As discussed previously, these standards would also apply to Alternatives 2, 3, and 4.

The UGA project planning principles include conservation objectives for both indoor and outdoor water use. Water rights for the project were procured in sufficient quantities to serve the needs of the residents with (1) indoor conservation measures in-place, and (2) irrigated area limitations and irrigation conservation measures in-place.

Indoor Water Use Standards

Water conservation fixtures to be installed in residential and residential-related buildings are as follows:

- 1.6 gallons per flush gravity flush toilets.
- 2.5 gallons per minute shower heads.
- 2.5 gallons per minute aerators on all faucets.
- 1.0 gallons per flush urinals.

Although the use of water conservation appliances is not required, residents are encouraged to evaluate the option of installing the following water conservation appliances and devices:

- Water efficient dishwashers (6 gallons per load).
- WashWise clothes washing machines (<24 gallons per load).
- Refrigerators with cold water dispensers.
- Pressure-reducing valves installed at individual services where system pressures exceed 60 psi to reduce pressures to 45 psi (to be maintained by homeowner).

Outdoor Water Use Standards

Irrigated area limitations by unit type are set forth in **Table 3-14**.

Table 3-14: Allowable Irrigated Areas

Unit Type	Maximum Irrigated Landscape Area, SF
Single Family Residential per Lot	1,000
Wholly-Owned Condominium per Unit	1,000
Multi-Family per Unit	400
Temporary RV Park per Space	200

The volume of water available to each lot for irrigation is based on:

1. the maximum area per unit given in **Table 3-14**,
2. the net amount of water needed to maintain turf, and
3. an irrigation efficiency of 60 percent.

The net unit area irrigation requirement for turf and the resulting applied irrigation rate at a 60 percent irrigation efficiency are given in **Table 3-15**. Maximum monthly irrigation allowances for each maximum irrigated area are presented in **Table 3-16**.

Table 3-15: Turf Irrigation Requirements

Month	Net Irrigation Requirement, in.[a]	Applied Irrigation Requirement, in.[b]
May	0.0	0.0
June	3.3	5.5
July	6.5	10.8
August	4.8	8.0
September	3.5	5.8
October	0.0	0.0
Total	18.1	30.2

[a] Source: Washington State Irrigation Guide, turf/pasture requirements, Cle Elum.
[b] At 60 percent irrigation efficiency.

Table 3-16: Maximum Allowable Irrigation Volumes

Residential Landscape Area, SF	Maximum Irrigation Volume by Month, Gallons			
	June	July	August	September
200	685	1,346	999	923
400	1,371	2,692	1,004	1,446
1,000	3,428	6,732	4,986	3,615

It will be necessary to achieve a 60 percent residential irrigation efficiency value to not exceed the irrigation volume given for each maximum area in **Table 3-16**.

Irrigation during the months of April and May will either not be practiced or will be very minor. The Washington State Irrigation Guide lists the growing season for a large number of grasses and vegetable crops at Cle Elum. The growing season for turf begins June 3 and ends October 7. A net irrigation requirement for turf is not shown in the Guide for October, which indicates the requirement during the first seven days are essentially zero. The growing season for green beans, cucumbers, and squash begins July 17 and ends October 7. As with turf, no requirements for October are shown for these crops in the Guide. Spring vegetables, such as peas and onions, have a growing season starting May 15. Corn and tomatoes have a growing season starting date of June 24. Based on these growing season start dates, residential landscape watering, except for a few specific home vegetables, will not begin until June. As the demand will be negligible during April, May and October, the water use policies will not specifically prohibit irrigation during these months.

Water use policies will be contained in the CC&R's for the project.

Recommendations to Achieve Irrigation Efficiency

The 60 percent efficiency can be obtained in several ways, or with a combination of methods. The first and most obvious is to control the applied irrigation water quantity such that no more than 30.2 inches of irrigation per unit area is applied to the landscape each year. Another method is to reduce the square-footage of turf on the lot and substitute other forms of landscape requiring less water. An additional method is to plant drought resistant turf requiring less water than the 18.1 inches/year that is required by the turf/pasture vegetation. Several species of suitable turf exist that require less than 18.1 inches/year. Any combination of these methods and others can be used to decrease the water consumption for the residential landscape areas. Pamphlets and other information are available from the City, which discuss the benefits of low-water use landscaping, and providing technical information on how to improve the efficiency of water use.

The aforementioned water saving methods are all components of a landscaping principle called Xeriscape™, which began in Denver, Colorado, in 1981. Xeriscape™ benefits landowners through reduced water costs, reduced maintenance, and beautiful landscapes. Xeriscape™ is a successful method for reducing landscape water needs by 60 percent. Residential and commercial property owners will be encouraged to follow some of the landscaping principles included in the Xeriscape™ landscape methodology.

Xeriscape™ consists of seven primary steps: design, soil improvement, inclusion of mulch areas, area-specific low flow irrigation systems, use of low water demand plants, and proper maintenance. These Xeriscape™ methods are summarized below.

- **Planning and Design**. The landscape should be designed using the principle of hydrazones - grouping plants of similar watering requirements together. Low water use plants are placed away from water intensive areas such as turf, thus reducing the tendency to apply water equally over the entire landscape. Hydrazones allow the homeowner (or professional gardener) to water each hydrazone according to the water needs of the plants within each zone.

- **Use of low water demand plants.** Use of native plants that do not require supplemental water can be just as colorful and beautiful as typical plants used in landscaping, and they will require significantly less water.

- **Reduction in turf areas.** Turf requires the most water in landscape; thus, reduction in turf area can lead to a significant reduction in outdoor water consumption. Turf is important to landscape, but it should not be used simply as a ground cover. Use should be limited to high activity and high visibility areas.

- **Soil improvement.** For a healthy, properly developed, properly draining, and water efficient turf, the recommended topsoil root-zone is 12 inches (6-inch minimum).

- **Inclusion of mulch areas.** Mulch covers soils, saves moisture, reduces water consuming weed growth, and adds variety to the landscape. Plants should be used to cover the majority of the mulch areas.

- **Efficient Irrigation.** There are a variety of irrigation system technologies and methods, including micro-irrigation systems, drip irrigation, underground automatic irrigation, and un-timed sprinklers. Efficiency with any irrigation system is obtained through proper maintenance and adjustment of the system so that only the landscape is watered, and the appropriate quantity of water is applied.

- **Appropriate Maintenance.** Proper maintenance of the turf and landscape is required to keep water use to a minimum. Lawns should be fertilized infrequently to avoid excessive growth, weeds should be removed because they compete for water, and diseased and dead plants should be removed.

To achieve the required irrigation efficiency of 60 percent or greater, it is recommended that two or more of the following Xeriscape™ principles be chosen and implemented by the property owner:

- Use of Chewings Fescue, SR 5100 seed, or equivalent drought resistant low water demand turf, for turf seeding.

- Reduce turf area to 70 percent of the allowable irrigated landscape envelope for the unit purchased and leave the remaining area native or plant alternative landscape consuming less water than turf.
- Installation of a metered, automatic irrigation system with programmable controller to vary application rates over the irrigation season.

The homeowners are encouraged to do the following as well:

- Remove first 12-inches of native soil and amend to achieve a topsoil mixture or replace the native soil with 12-inches of topsoil for all areas to be planned with turf.
- Use only required quantity of fertilizer, as use of excessive fertilizer leads to plants that require more water.
- Incorporate hydrazones in the planting scheme of the landscape.
- Use mulch areas in the landscape.
- Water between the hours of 5 a.m. to 8 a.m.
- Properly maintain the landscape by removing weeds, limiting fertilizer application, and mow turf to a minimum of 3 to 4 inches.

Presented in this section is information on the preliminary sewer system concepts for Alternative 2, 3, 4, and 5. In addition, information is provided on the proposed wastewater treatment and disposal facilities to serve the UGA and MPR.

Wastewater Flow Projections

Wastewater generation is a function of water use or demand. Hobson Johnson Associates, Inc. provided monthly occupancy estimates for each unit type through buildout of the UGA as well as monthly visitor estimates. These data provided information necessary to generate estimates of seasonally varying water demand. The wastewater production is calculated as a percentage of inside water demand, as shown in **Table 4-1**. The percent return values were developed considering Ecology's standard flow rate for new systems (including normal infiltration), side sewer length considerations relative to the type of unit appropriate adjustments infiltration, and typical wastewater flow data presented in the literature (i.e., Metcalf & Eddy, *Wastewater Engineering – Treatment, Disposal, Reuse*, 3rd edition). For purposes of system pipe sizing and design, seasonally varying infiltration and inflow percentages, shown in **Table 4-2**, were applied to the wastewater generation estimates.

Table 4-1: Wastewater Generation/Return Flow as a Fraction of Inside Water Demand

Unit Type	Percentage of Water Demand
Lodge[a]	95
Apartment & Condominium	90
Single Family	80
Daytime Visitors/Employees[a]	80
Campground	80
Business Center	80

[a] Alternatives 2, 3, and 4 only.

Table 4-2: Infiltration/Inflow as a Percentage of Maximum Month Wastewater Production

Month	Infiltration/Inflow, Percentage of Wastewater Production
January	20
February	25
March	25
April	15
May	15
June	10
July	10
August	10
September	10
October	10
November	10
December	15

Usual practice is to estimate infiltration/inflow rates as a maximum value on a per acre basis. However, seasonally varying infiltration/inflow (I/I) rates have been used to estimate the monthly I/I return flow component for the water supply analysis. Very little inflow is expected, as the UGA will prohibit discharge of stormwater to the sanitary sewer system. Ecology's standard residential unit rate of 100 gpcd includes an allowance for normal infiltration. From **Table 4-1**, the normal wastewater is 80 percent times the water demand of 100 gpcd, or 80 gpcd. From **Table 4-2**, the normal maximum seasonal I/I allowance is 25 percent of maximum month wastewater generation. Using the 80 gpcd inside generation for the maximum month and the 25 percent I/I allowance, the seasonal maximum wastewater generation would be:

80 gpcd + 25 percent x 80 gpcd = 100 gpcd.

This is the same value as recommended by Ecology for new sewer systems in its publication "Criteria for Sewage Works Design."

Wastewater generation for single family, condominium and apartment units are summarized in **Tables 4-3** and **4-4**, respectively.

Table 4-3: Wastewater Generation – Single Family

Parameter	Primary Residences
Party Size	2.4
Unit Water Demand (gpdpc)	100
Wastewater Production Percentage	80%
Total Wastewater Production (gpd)	192

Table 4-4: Wastewater Generation - Condominium and Apartment Units

Parameter	Wholly Owned Condominiums	Time Share Condominiums Non-primary Residences[a]	Apartment Primary Residences
Party Size	2.4	2.5	2.4
Unit Water Demand (gpdpc)	100	100	100
Wastewater Production Percentage	90%	90%	90%
Total Wastewater Production (gpd)	216	225	189

[a] Alternatives 2, 3, and 4 only.

Business Park wastewater production, which is assumed at 80 percent of inside water use, is assumed to be 0.068 gallons/day per square foot of the building.

Wastewater production estimates for project components associated with Alternatives 2, 3, and 4 only are provided in the following.

For the lodge, a daily wastewater production of 114 gpd per room was used. This was based on 1.5 persons per room, a demand of 80 gpd per person (for both guestroom and non-guestroom demands), and a 95 percent wastewater fraction of water demand.

For the campground, a daily wastewater production of 128 gpd per campsite was used. This is based on 3.2 persons per campsite, 50 gpd per person water demand and an 80 percent wastewater fraction of water demand.

For visitor and employees, 16 gpd per person was used based on a water demand of 20 gpd per person and an 80 percent wastewater fraction of water demand.

The projected monthly wastewater flows at buildout for Alternatives 2, 3, 4 and 5 are provided in **Table 4-5.**

Table 4-5: Monthly Wastewater Flow at Buildout, mgd[a]

Alter-native	Year	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Average Annual
2	30 w/o I/I[b]	0.26	0.27	0.27	0.28	0.29	0.30	0.31	0.31	0.30	0.28	0.27	0.27	0.29
2	30 w/ I/I	0.32	0.35	0.35	0.33	0.34	0.34	0.34	0.35	0.33	0.31	0.30	0.32	0.33
3	30 w/o I/I	0.28	0.28	0.29	0.30	0.31	0.31	0.32	0.32	0.31	0.30	0.29	0.29	0.30
3	30 w/ I/I	0.34	0.37	0.37	0.34	0.35	0.34	0.35	0.35	0.34	0.33	0.32	0.34	0.35
4	30 w/o I/I	0.17	0.18	0.18	0.19	0.20	0.21	0.21	0.22	0.21	0.19	0.18	0.18	0.19
4	30 w/ I/I	0.22	0.23	0.24	0.22	0.23	0.23	0.23	0.24	0.23	0.21	0.20	0.21	0.22
5[c]	30 w/o I/I	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
5[c]	30 w/ I/I	0.30	0.32	0.31	0.29	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28

[a] Includes wastewater flows from Non-Trendwest facilities located in the UGA.
[b] I/I represents infiltration and inflow, which varies by month from 10 percent to 25 percent of maximum month inside wastewater production.
[c] Excludes Reserve Area.