5.1 INTRODUCTION

Highly treated wastewater effluent is an important water resource in the Spokane Region. Potential uses could include streamflow augmentation, irrigation, wetlands creation, industrial water supply, and groundwater recharge. In this chapter, alternative effluent management strategies are reviewed by considering their applicability to Spokane County, defining effluent quality requirements, outlining implementation steps, identifying facility needs and associated costs, and listing key advantages and disadvantages. Finally, the alternatives are compared against an array of evaluation criteria.

5.1.1 Existing Effluent Management Practices

Currently, nearly all of the County's wastewater is treated at the Spokane Advanced Wastewater Treatment Plant (SAWTP) and discharged year-round to the Spokane River near Riverside State Park. To comply with the current NPDES permit for the SAWTP, the treatment plant must achieve "secondary treatment" standards for BOD and suspended solids, remove ammonia-nitrogen year-round, and reduce phosphorus seasonally.

Effluent from five small County treatment facilities (package wastewater treatment plants or community septic tanks) is infiltrated using either community drainfields or infiltration ponds. These facilities are being phased out as the County extends its sewer system to remote service areas.

5.1.2 Projected Effluent Quantity

Chapter 3 of the *Basis of Planning Report* gives a detailed evaluation of existing and future development to be served by the County's wastewater treatment facility. Flow is collected in three major interceptors – two in the Spokane Valley area (North Valley Interceptor north of Interstate 90 and Spokane Valley Interceptor south of Interstate 90) and one in the North Spokane area (North Spokane Interceptor). Average wastewater flow projections for each of these interceptors are shown in Table 5-1 (Projected Effluent Flow). There is little seasonal variation in these flows. Potential effluent demand under the various effluent end-use management options will be compared to these values.

5.1.3 Projected Effluent Quality

Effluent quality requirements will vary depending on the specific effluent end-use application. To facilitate comparison of treatment costs for the alternatives, a "baseline treatment level" was established based on the anticipated requirements for year-round discharge to the Spokane River. These standards were described in detail in Chapter 4 of the *Basis of Planning Report* and are summarized later in this chapter; see Table 5-2 (Projected Effluent Quality of Surface Water Discharge). Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality) presents a representative treatment train capable of meeting the projected effluent quality requirements for discharge to the Spokane River.

Table 5-1. Projected Effluent Flow

Year	Average Flow (mgd)			
	Interceptor			Total
	North Spokane	North Valley	Spokane Valley	
1999	1.0	1.1	3.5	5.7
2000	1.3	1.4	3.9	6.5
2005	2.4	2.7	5.3	10.4
2010	3.6	4.1	6.8	14.5
2015	4.3	5.8	8.7	18.8
2020	4.7	6.5	9.5	20.6
2025	**4.9**	**7.0**	**10.0**	**21.9**
2030	5.1	7.4	10.4	23.0
2035	5.4	7.9	10.8	24.1
2040	5.6	8.4	11.2	25.2
2045	5.8	8.8	11.6	26.2
2050	**6.0**	**9.3**	**12.0**	**27.3**

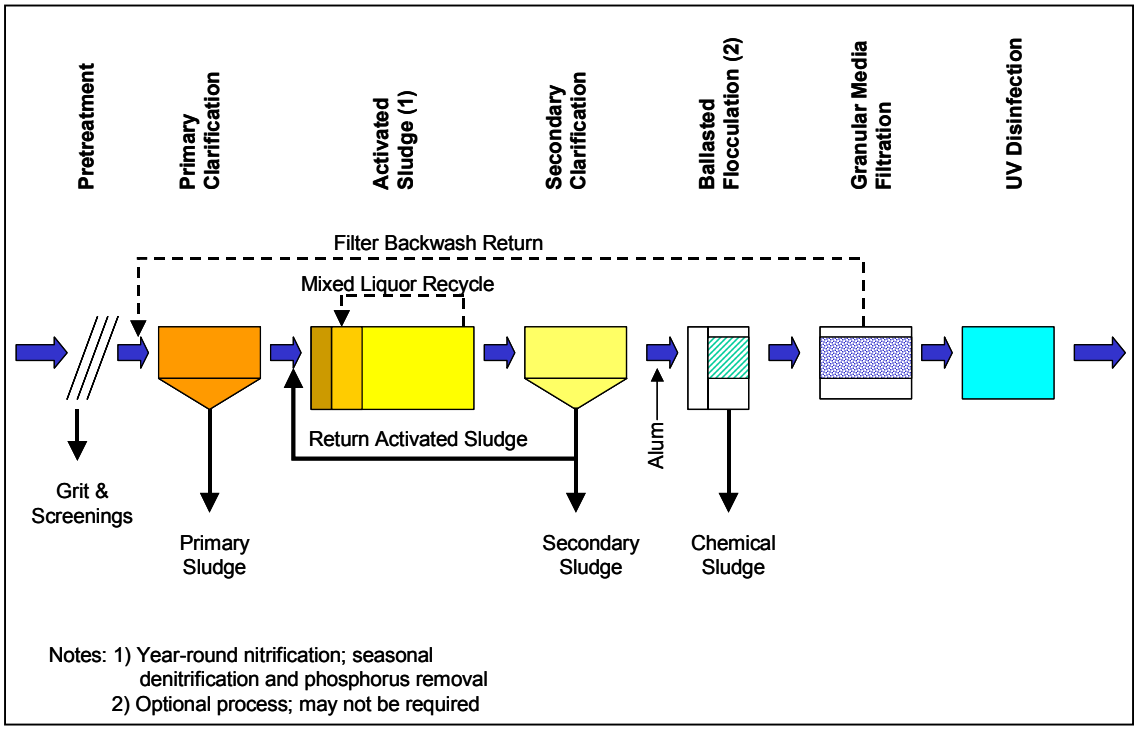

Figure 5-1. Process Schematic Diagram of Baseline Effluent Quality

5.1.4 Water Rights

Water rights are a significant benefit of water reclamation. RCW 90.46 defines reclaimed water as a new water source, provides that the owner of the treatment plant reclaiming wastewater is granted exclusive access for use of the water, and exempts the use of the water from the application and permitting requirements of the Water Code for surface water rights (RCW 90.03) and groundwater rights (RCW 90.44). The only limitation on this exclusive right is that withdrawal of water from freshwater discharges cannot impair the rights of downstream water rights holders without mitigation or compensation.

As discussed in the *Basis of Planning Report*, the ability to gain new water rights in the Spokane region is becoming increasingly difficult, and the future may see a situation where little or no "new" water will be available for consumptive use. In this environment, the County's exclusive right to reclaimed water will become an increasingly important component of the region's water supply capacity.

5.2 ALTERNATIVES DESCRIPTIONS

5.2.1 Listing of Alternatives Surviving Initial Screening

Many effluent management alternatives were identified during the brainstorming workshop and in public meetings; see Chapter 3 (Alternatives Evaluation Methodology). Those ideas selected for detailed review are listed below:

- Discharge to surface waters
  - Spokane River
  - Little Spokane River
  - Tributaries
- Irrigation of agricultural land
- Irrigation of poplar farms
- Irrigation of urban green spaces
- Industrial reuse
- Wetlands creation or enhancement
- Groundwater recharge

5.2.2 Basis of Economic Comparison

Capital Costs

The economic comparison of alternatives is based primarily on capital costs. In developing the relative capital costs for each alterative, four components were considered:

- **Treatment Cost.** This represents the incremental treatment cost (or savings) compared to the baseline treatment train presented in Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality).

- **Conveyance and Storage Cost.** This includes the cost of pipelines, pumping stations, reservoirs and outfalls needed to implement the alternative.
- **Site Development Cost.** This includes any on-site development costs associated with the effluent use alternative such as wetlands development, infiltration basins, etc.
- **Land Cost.** This includes the cost of land for alternatives that require County-owned property.

A key challenge in developing the economic comparison is that the different alternatives result in differing levels of demand for the effluent. Some alternatives can use all of the effluent on a year-round basis, whereas others can use only a portion of the effluent and/or operate on a seasonal basis. For this reason, costs are presented based on a unit cost per million gallons/year of effluent utilized ($/MG/year).

It must also be pointed out that specific infrastructure required for some alternatives cannot be accurately defined until additional study is completed. Consequently, the actual costs of implementing some of the alternatives may vary considerably from the values presented here.

Operating Costs, Revenue, and Value of the Reclaimed Water

To simplify the economic analysis, operating costs and revenue potential from the sale of reclaimed water were not included in the preliminary economic analysis. This is because most reclaimed water systems have high infrastructure requirements, causing capital costs to dominate the economic comparison.

With respect to revenue from sale of reclaimed water, systems in water-short regions of the country have been able to sell water at 75% to 85% of the price of the displaced or alternative water supply. For urban irrigation systems, the reference supply is typically a potable water supply; whereas for agricultural systems, the reference supply may be untreated irrigation water. Some systems, such as the Irvine Ranch Water District in southern California, have found that the revenue from sale of reclaimed water roughly pays for the cost of operating the reclaimed water storage and distribution system, but does not pay for treatment costs or major capital investments.

In agricultural applications or poplar farms, a revenue-generating crop may be produced. These situations must be viewed on a case-by-case basis, and conservative assumptions should be applied.

Beyond the direct revenue from sale of the water, reclaimed water has economic value to the community because it extends the opportunity for growth in water-short areas, and helps allow the highest and best use of the region's water supplies. This value is difficult to quantify, but must be considered in selecting the optimal management approach.

5.3 DISCHARGE TO SURFACE WATERS

5.3.1 Concept

Surface water discharge is the conventional effluent management practice for municipal wastewater plants. During dry summer periods, highly treated effluent provides an important water supply to augment streamflows and support beneficial uses.

During the alternatives development process, three opportunities for surface discharge were identified:

- Discharge to the Spokane River
- Discharge to the Little Spokane River
- Discharge to smaller tributaries

The Spokane River runs through the northern portion of the Spokane Valley area and into the City of Spokane, while the Little Spokane River skirts the northeastern boundary of the North Spokane area. Major tributaries near the study area, shown in Figure 5-2 (Major Rivers and Tributaries near the Planning Area), include Latah Creek south of the City of Spokane, and Deadman Creek near the North Valley area. All of these water bodies have Class A (exceptional) designations, and are protected for beneficial uses such as fish and shellfish rearing, spawning, and harvesting; water supply; recreational use; wildlife habitat; and commerce and navigation.

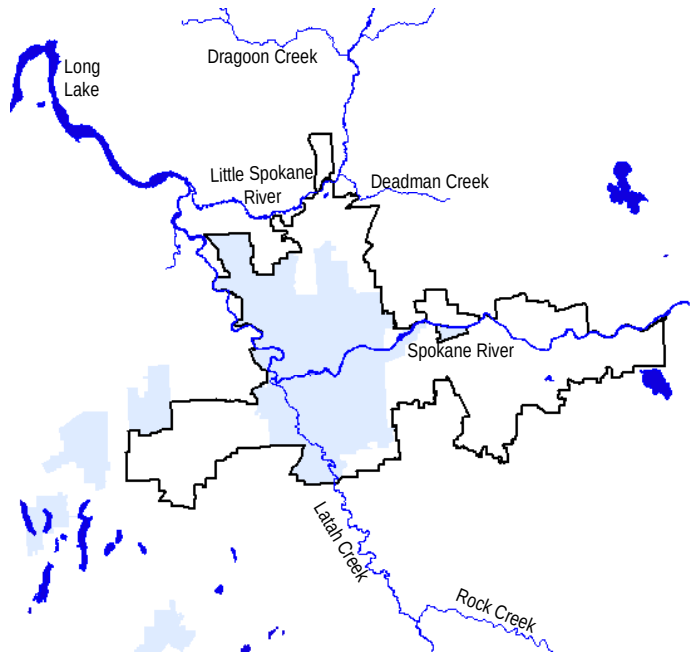

Figure 5-2. Major Rivers and Tributaries near the Planning Area

5.3.2 Discharge to the Spokane River

In this alternative, treated effluent would be discharged to the Spokane River year-round. If all Spokane County flow were discharged to the Spokane River, the average effluent flow rate in 2025 and 2050 would be 34 and 42 cfs, respectively. By comparison, average monthly streamflows in the river (as measured at the Spokane Gage) range from 1,400 cfs in August to 17,000 cfs in May. During the critical 7Q20 streamflow condition (about 600 cfs), the Year 2025 effluent flow rate would represent approximately 6 percent of the total streamflow.

Applicability to Spokane County

Year-round discharge to the Spokane River is currently practiced for most wastewater generated in the Spokane Region. When considering ways to modify or expand this practice, it is important to consider factors that influence the ability of the river to assimilate the pollutant loading. These factors include:

- **Proximity to Existing Dischargers**. Currently, there are four major dischargers to the Spokane River in Washington: Liberty Lake Water and Sewer District, Kaiser Aluminum, Inland Empire Paper and the City of Spokane (SAWTP). The first three discharges are located along the Spokane River between the Idaho border and the Upriver

Dam, whereas the SAWTP's discharge is downstream of the confluence with Latah Creek. Spreading out point discharges along the river minimizes local toxicity issues associated with ammonia, metals, and selected organics, and it increases the river's ability to assimilate impacts from nutrients and dissolved-oxygen-consuming pollutants.

- **Interaction with Spokane Aquifer**. It would be preferable to discharge treated effluent to a reach of the river that is recharged with groundwater from the aquifer ("gaining reach"). This has multiple benefits. First, the aquifer recharge adds hardness to the river, which reduces the toxicity of heavy metals of concern. Second, discharge to gaining stretches of the river reduces potential regulatory and public concerns regarding migration of the wastewater discharge into the aquifer.

Figure 5-3 (Existing Dischargers and River/Aquifer Interaction) shows the major municipal and industrial discharges on the Spokane River in Washington (green circles), as well as gaining and losing reaches of the river. Red circles indicate discharges to the Little Spokane River. Based on the factors identified above, and discussions with Ecology, Reach 4 appears to be the most attractive location for a new wastewater discharge to the Spokane River. It is in a gaining stretch of the river, has free-flowing characteristics to promote re-aeration, and provides a good separation from the SAWTP discharge. Locating a discharge at this location would require consideration of the interrelation with upstream discharges such as that from Inland Empire Paper.

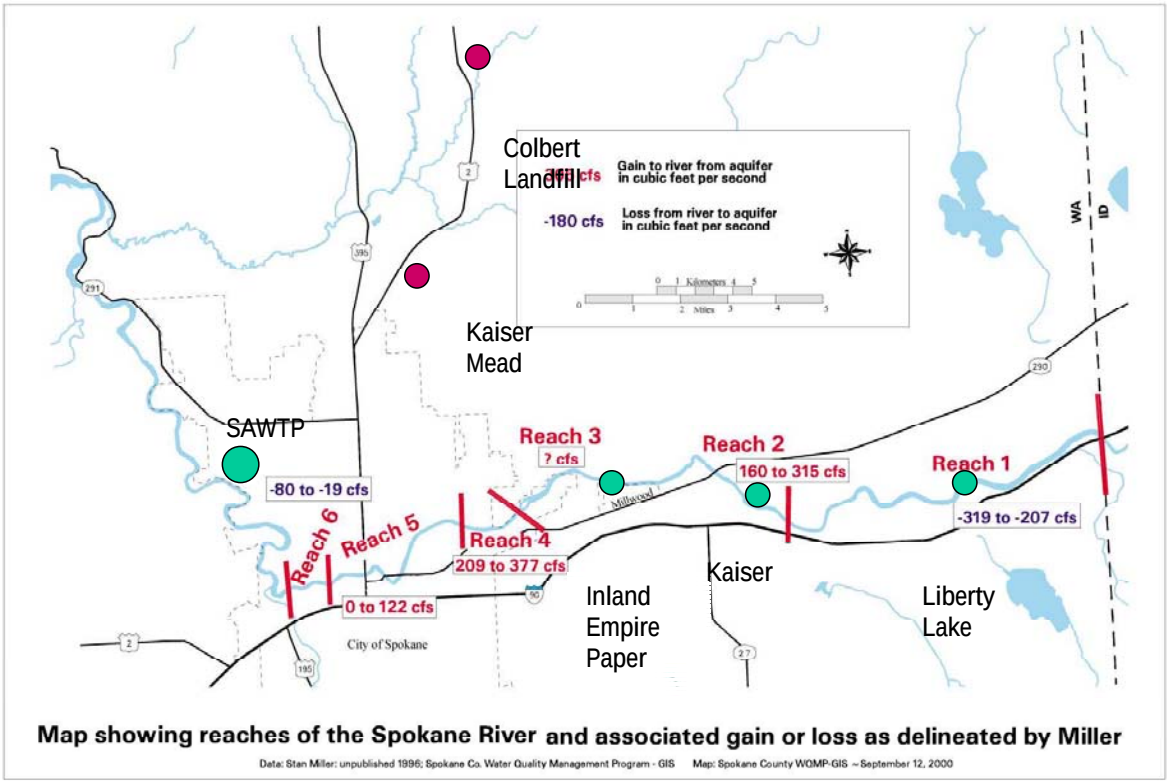

Figure 5-3. Existing Dischargers and River/Aquifer Interaction

Effluent Quality Requirements

Chapter 4 of the *Basis of Planning Report* provided a detailed review of anticipated effluent quality requirements for a new discharge to the Spokane River. Since receiving waters are most sensitive to effluent discharge during the late summer (when streamflows are lowest), it is likely that Ecology would establish a seasonal permit for a new wastewater discharge.

Based on preliminary discussions with Ecology and review of NPDES permits for other discharges to the Spokane River, anticipated effluent quality requirements have been identified for surface water discharge; see Table 5-2 (Projected Effluent Quality of Surface Water Discharge). Refinements to these requirements will be driven by the exact location of the discharge, results of mixing zone studies, effluent concentrations of metals, results of the dissolved oxygen TMDL study, and negotiations with the Phosphorus Technical Advisory Committee (TAC).

Table 5-2. Projected Effluent Quality of Surface Water Discharge

Parameter	Summer	Winter
BOD, mg/L[1]	10-20	30
Total Suspended Solids, mg/L	30	30
Ammonia-Nitrogen, mg/L[1,2]	1-2	4-8
Total Nitrogen, mg/L	No limit	No limit
Total Phosphorus, mg/L[3]	0.3-0.6	No limit
Dissolved Oxygen, mg/L[1]	> 6.0	No limit
Fecal Coliform, cfu/100 mL	200	200
Chlorine Residual, µg/L[2]	≈ 8	≈ 8
pH (s.u.)[4]	6.0-7.8	6.0-7.8
Lead, µg/L[5]	≈ 2	≈ 2
Zinc, µg/L[5]	≈ 60	≈ 60
Cadmium, µg/L[5]	≈ 0.2	≈ 0.2

1. Required value will be defined by dissolved oxygen TMDL process.
2. Required value will be defined by mixing zone study for toxicity.
3. Required value will be defined through negotiation with Phosphorus TAC.
5. Instantaneous value
6. Required value will be defined based on monitoring of actual effluent metals concentration.
This effluent quality would be achieved using a treatment train similar to that shown in Table 5-3 (Capital Cost of Surface Discharge to Spokane River).

Implementation

Implementing a new surface water discharge for the County's treated effluent would require:

- Negotiating a new NDPES discharge permit with the Department of Ecology. This effort would include:

  - Conducting dilution studies and a mixing zone study to determine local impacts of the proposed discharge on toxicity and temperature.
  - Conducting modeling to assess the near-field impact of the discharge on dissolved oxygen levels.
  - Using Ecology's new water quality model to assess the far-field impacts of the discharge on algal growth and dissolved oxygen levels.
- As part of the NPDES permitting process, gaining the Department of Health's approval of the streamflow augmentation project as a water reclamation project, as defined by RCW 90.46.
- Negotiating with the Phosphorus TAC to allow a new point source discharge of phosphorus. Although the Long Lake Phosphorus Management Agreement does not allow new point source discharges of phosphorus, initial discussions with Ecology and the TAC indicate that these groups would consider Spokane County as an existing discharger to the river, not as a new discharger.
- Conducting public information/public involvement efforts to assure the public that the new discharge would not adversely impact beneficial uses of the receiving water.
- Gaining necessary permits for construction of the outfall, including a Corps of Engineers 404 permit and a Shoreline Management permit.

Facility Requirements and Cost

Assuming water quality criteria can be met, this alternative can handle all Spokane County flow on a year-round basis. Facility requirements primarily consist of an outfall pipeline and a multi-port diffuser. Depending on the location and elevation of the treatment plant, effluent pumping may be required. The estimated capital cost for this alternative is presented in Table 5-3 (Capital Cost of Surface Discharge to Spokane River ($/MGY).

Table 5-3. Capital Cost of Surface Discharge to Spokane River ($/MGY)

Cost Component [1]	Gravity Discharge	Pumped Discharge
Incremental Treatment Cost Savings	$0	$0
Conveyance	$190	$690
Site Development	$0	$0
Land	$0	$0
Total	**$190**	**$690**

1. Alternative can handle 8,000 MG/year (21.9 mgd for 365 days).

Advantages and Disadvantages

Advantages

- Highly treated effluent can augment low streamflow during the late summer, supporting fisheries and providing an environmental benefit.
- Surface water discharge facilities are simple to construct, operate and maintain.
- Anticipated water quality requirements for stream discharge can be met with conventional treatment technologies.
- The capital cost for an outfall is low.

Disadvantages

- Surface water discharge does not maximize use of the effluent as a water resource.
- Depending on the results of the dissolved oxygen TMDL, effluent quality requirements may be more restrictive than anticipated, requiring higher treatment costs. Although unlikely, it is possible that the allowable quantity of effluent discharged may be limited during critical periods of receiving water quality.
- Future regulatory changes may increase treatment requirements and associated costs.
- Siting a new outfall may encounter opposition from current dischargers or other interest groups.

5.3.3 Discharge to the Little Spokane River

This alternative involves discharging treated effluent from the North Spokane Service Area to the Little Spokane River below Dartford. Because of the conveyance distance involved, the alternative does not include sending flows from the Spokane Valley to a discharge point on the Little Spokane River.

As shown in **Figure 5-3**, the stretch of river below Dartford is a gaining reach, where the aquifer contributes to river flow. During critical summer months, the estimated streamflow at Dartford is approximately 250 cfs (personal conversation, Stan Miller). By comparison, the projected effluent flow rate from the North Spokane Service Area in 2025 and 2050 is 8 and 9 cfs, respectively; or less than 4 percent of the summer streamflow.

Applicability to Spokane County

The key considerations for locating a new outfall on the Little Spokane River are the same as those for the Spokane River. As Figure 5-3 (Existing Dischargers and River/Aquifer Interaction) shows, there are two existing discharges to the Little Spokane River, so proximity to these discharges would be a consideration. In the stretch of river below Dartford, potential impacts of a new outfall on the aquifer would be minimal because the aquifer discharges to the river.

While there are portions of the Little Spokane River where declining flows have been a concern in the past, these areas are upstream of Dartford and therefore would not be positively impacted by the addition of treated effluent (see later discussion of discharge to tributaries).

Effluent Quality Requirements

It is anticipated that effluent quality requirements for this alternative would be similar to those for discharge to the Spokane River.

Implementation

Most key implementation considerations are the same as for discharge to the Spokane River. The lower part of the Little Spokane River (from its confluence with the Spokane River to River Mile 5) is a state-designated wild and scenic river. While this designation does not carry the same regulatory significance as a federal designation, there likely would be some public opposition to any activities impacting the river in this area. This may require additional mitigation.

Facility Requirements and Cost

This alternative can handle flows from only the North Spokane Service Area. Wastewater from the Spokane Valley must be handled by other means such as discharge to the Spokane River.

Given the topography of the Little Spokane watershed, it has been assumed that effluent from a new plant could be discharged by gravity. The estimated unit cost is presented Table 5-4 (Capital Cost of Surface Discharge to Little Spokane River).

Table 5-4. Capital Cost of Surface Discharge to Little Spokane River

Cost Component[1]	Unit Cost ($/MG/Year)
Incremental Treatment Cost Savings	$0
Conveyance	$450
Site Development	$0
Land	$0
Total	**$450**

1. Alternative can handle 1,790 MG/year (4.9 mgd for 365 days)

Key Advantages and Disadvantages

Advantages

- Key advantages listed for the Spokane River discharge option apply to this alternative.
- This concept returns the flows generated within the Little Spokane watershed to the river rather than exporting them out of the watershed.
- Sending a portion of Spokane County's effluent to the Little Spokane River further spreads out the loading to the region's receiving waters, making greater use of assimilative capacity and reducing localized impacts.

Disadvantages

- Key disadvantages listed for the Spokane River discharge option apply to this alternative.
- This alternative handles only the flow generated in North Spokane.
- This alternative does not address the declining stream flows experienced in the upper reaches of the Little Spokane River watershed.
- Discharge to the Little Spokane River would likely encounter opposition from local residents and environmental groups.

5.3.4 Discharge to Tributaries

The concept of this alternative is to augment minimum streamflows in smaller tributaries to augment beneficial uses such as fisheries, or to offset declining streamflows due to overuse of surface withdrawals and groundwater pumping.

Applicability to Spokane County

Three tributaries were identified as potential locations for augmenting streamflow.

Latah Creek. As shown in Figure 5-2 (Major Rivers and Tributaries near the Planning Area), Latah Creek is one of the closest tributaries to the planning area. There is little stream gauging information for this tributary, however the estimated summer flow in the stream is approximately 20-30 cfs (personal conversation, Stan Miller). Because of insufficient data, further study would be required to determine where an outfall should be located to augment streamflow and how much effluent would be needed. During the alternatives workshop, discharge to Latah Creek was discussed with staff from Ecology, the County and the City. There was little support for the concept because no significant environmental benefits were identified.

Crab Creek (Lincoln and Grant Counties). This concept was examined as a streamflow augmentation option in the City of Spokane's Facilities Plan, based on interest from Lincoln County, the State of Washington, and other parties. Crab Creek is located approximately 15 miles west of Medical Lake.

Upper Tributaries of the Little Spokane River. As mentioned earlier, declining flows in the upper Little Spokane River basin have been a concern. In 1975, water availability was of such concern that the major tributaries of the Little Spokane River were closed to further water appropriation, and water rights issued were conditioned to specific "base" flows measured at Dartford. Continuing development of exempt wells contributes to water shortages in the basin.

Effluent Quality Requirements

The majority of tributaries in the region are designated Class A streams, and thus would be subject to the type of treatment illustrated in Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality). In discussions with the City regarding the potential Crab Creek discharge, Ecology indicated that water quality requirements may be relaxed somewhat if the streamflow augmentation project significantly benefits water quality in a stream. However, this would need to be evaluated on a case-by-case basis. For purposes of analysis, it is

assumed that the treatment train shown in Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality) would be required for discharge to any tributary.

Implementation

Implementation considerations would include those described for discharge to the Spokane River. In addition, easements and right-of-ways would be required for long conveyance pipelines. Studies would be required to determine how much effluent could be sent to the tributaries during various times of the year.

Facility Requirements and Cost

Depending on the carrying capacity of the tributary, this alternative may not be able to handle all effluent generated by Spokane County. For the purposes of this analysis, it has been assumed that one-half of the wastewater generated by the County in 2025 could be discharged to tributaries. The remaining flow must be discharged either to a major stream or reused in some other manner.

Since the baseline treatment train would be used, the primary cost would be associated with conveyance. With the exception of Latah Creek, discharge to a tributary would require pumping treated effluent from 20-40 miles. Estimated costs are based on sending Spokane County's flow through a 20-mile pipeline. The estimated cost of this option is presented in Table 5-5 (Capital Cost of Surface Discharge to Tributaries).

Table 5-5. Capital Cost of Surface Discharge to Tributaries

Cost Component [1]	Unit Cost ($/MG/Year)
Incremental Treatment Cost Savings	$0
Conveyance	$7,340
Site Development	$0
Land	$0
Total	**$7,340**

1. Alternative can handle 4,000 MG/year (11 mgd for 365 days).

Key Advantages and Disadvantages

Advantages

- Key disadvantages listed for the Spokane River discharge option apply to this alternative.
- This concept could potentially enhance water resources in the region by augmenting low streamflow or providing an alternative water supply to groundwater.
- This alternative spreads out loadings to receiving waters, reducing localized water quality impacts.

Disadvantages

- Key disadvantages listed for the Spokane River discharge option apply to this alternative.

- Requires significant infrastructure for conveyance.
- Streamflow augmentation in tributaries may not be adequate for all of the County's flows, requiring an additional surface water discharge to a major river.
- Additional study would be necessary to determine whether there is a true water quality or beneficial use benefit to augmenting streamflow in the tributaries.
- Discharging treated wastewater to tributaries may be opposed by local property owners.

5.4 IRRIGATION OF AGRICULTURAL LAND

5.4.1 Concept

This alternative investigates the use of treated effluent for irrigation of agricultural properties in Spokane County. Reclaimed water would be used for irrigation on a seasonal basis to match crop demand. For the remainder of the year, effluent would be discharged to surface water. The concept is illustrated in Figure 5-4 (Irrigation of Agricultural Land).

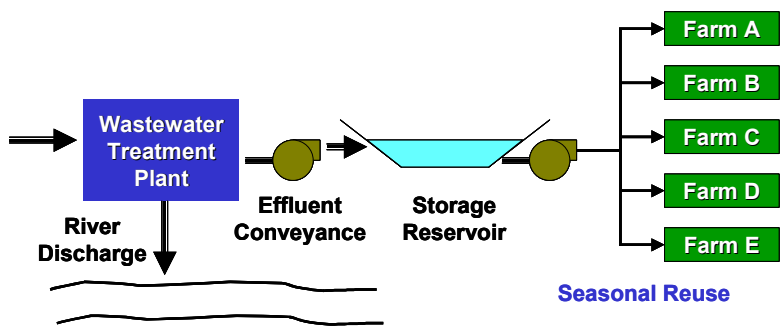

Figure 5-4. Irrigation of Agricultural Land

5.4.2 Applicability to Spokane County

Potential Reuse Locations

While development in the Spokane Valley has reduced the number of farms in the County, many agricultural areas were protected through the growth management practices outlined in the 1980 County Comprehensive Plan and continued in the 2000 Draft Comprehensive Plan (Draft Comp Plan, 2000). The Draft County Comprehensive Plan includes agricultural land in its designation of Natural Resource lands, offering protection to "ensure their viability for future generations" (Draft Comp Plan, Page NR-15). According to the County's Planning Department, protection of these natural resource lands is anticipated to extend far into the future, well beyond the horizon of either the current Comprehensive Plan or this Facilities Plan.

Protected agricultural lands (based on zoning information from the Draft Recommended Comprehensive Plan) are shown in Figure 5-5 (Locations of Protected Agricultural Areas in Spokane). The five primary areas have been numbered for later use in reuse demand analyses. This figure also shows the total acreage for each area, and the boundaries of the Draft Urban Growth Area (in black) and the Aquifer Sensitive Area (in red).

When evaluating agricultural reuse in these areas, there are several issues that need to be considered:

- Within the agricultural land designation, the County identifies "large tract" (one residential unit per 40 acres) and "small tract" (one residential unit per 10 acres) agricultural properties that have long-term commercial significance. The large-tract properties are more attractive for an effluent reuse program because they result in fewer contracts with farmers, require fewer metering points and are more likely to remain in agricultural use on a long-term basis.
- Much of the southern portion of Area 5 is being converted to small ranchettes, and the recent construction of a new high school will promote further development. Based on this development pattern, any agricultural demand in Area 5 is likely to be associated with small-scale farming operations.
- Although not in a protected agricultural area, there are existing farms in the Chattaroy area along the Little Spokane River east of Area 4; see Table 5-6 (Irrigation Demand for Designated Agricultural Areas). Providing reuse water for irrigation in this area would offset the surface water or groundwater impacts of existing irrigation withdrawals. Local topography favors sending reuse water from the planning area to the Chattaroy area.
- Many of the potential reuse locations in all areas would require pumping to higher elevations. For example, there are potential reuse sites in the Green Bluff area (northern portion of Area 5); however, reaching these locations would require pumping to an elevation of approximately 2,400 feet.

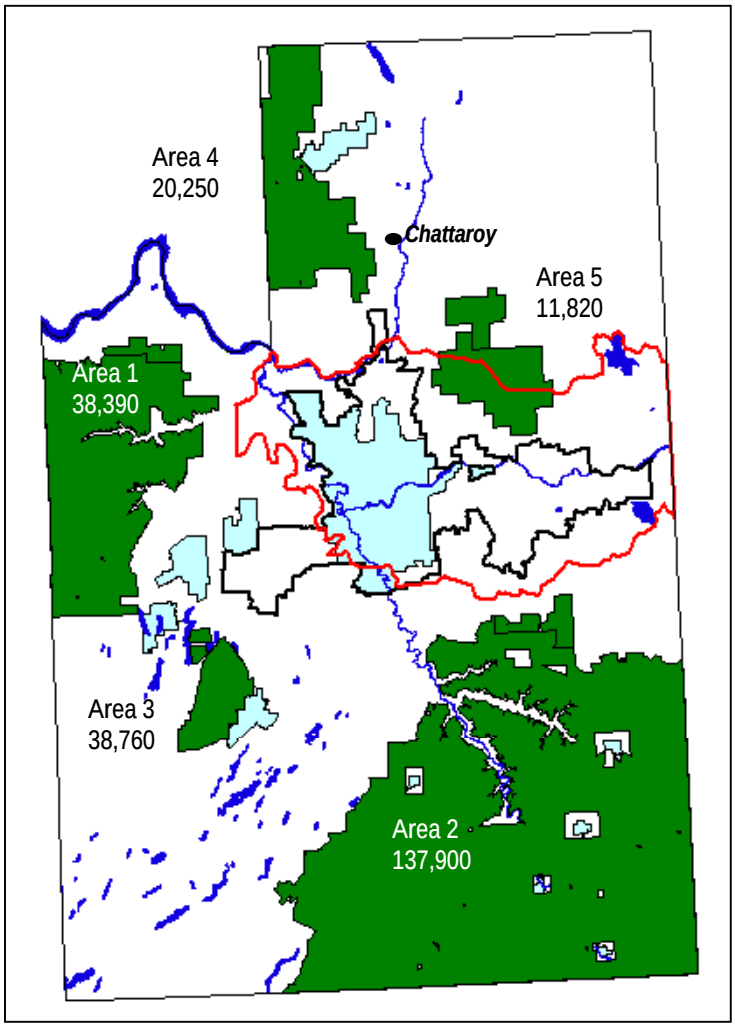

Figure 5-5. Locations of Protected Agricultural Areas in Spokane

Estimates of Demand Potential

Irrigation with reclaimed water must be based on agronomic loading rates; however, the amount of nutrients in wastewater is generally well below crop requirements, resulting in the need for supplemental fertilization. Given this situation, application rates for most reclaimed water systems are limited by the crop's water demand

David Bezdicek of Washington State University provided guidelines regarding evaporative demand for representative crops grown in the designated agricultural areas. These irrigation requirements are shown in Figure 5-6 (Net Irrigation Requirement of Crops in Spokane County). These requirements take into account monthly precipitation, as well as the impacts of agricultural management practices (harvesting, planting, etc.) that reduce the full evaporative demand.

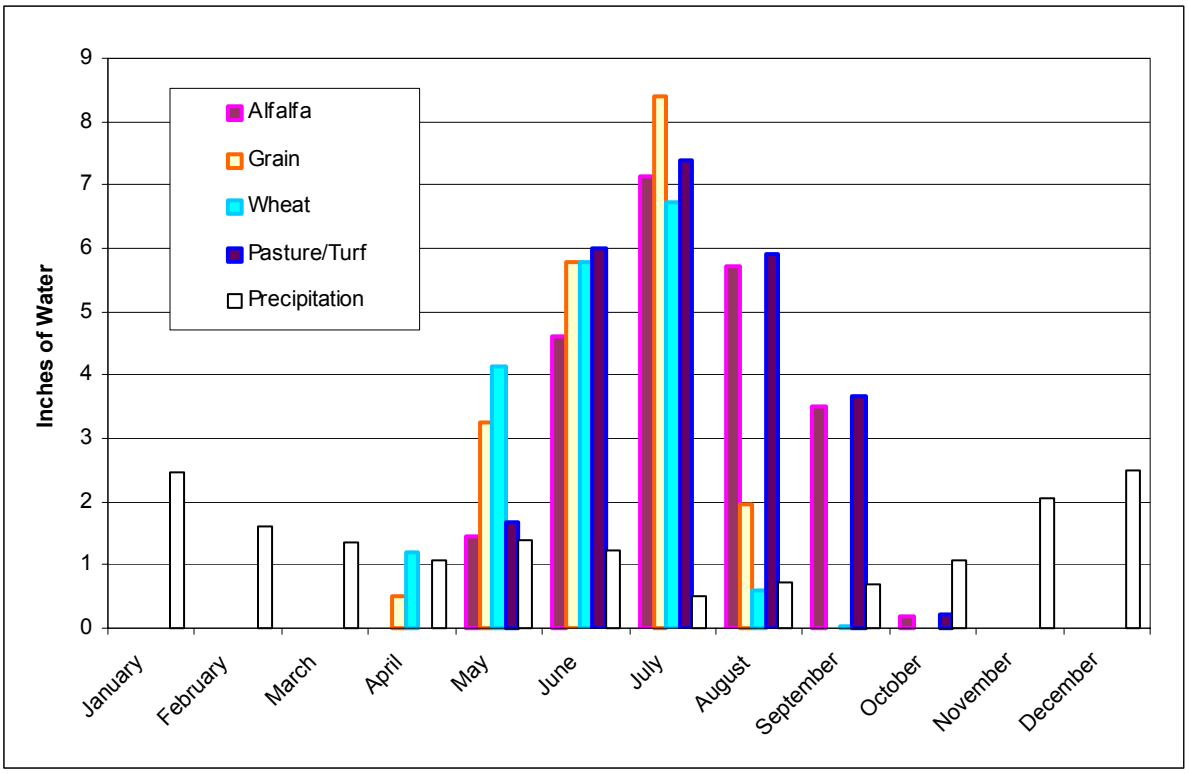

Figure 5-6. Net Irrigation Requirement of Crops in Spokane County

For purposes of evaluation, the estimated demand for water has been based on a blend of grain, wheat, alfalfa and pasture production. This provides a representative mix of cropping patterns that may occur in the region. To maximize water use, particularly in September and October, it would be best to maximize use of pasture crops. However, this may not be economically attractive to farmers.

To determine the volume of water demand for each of the designated agricultural areas, the following assumptions were applied to the data shown in Figure 5-6 (Net Irrigation Requirements of Crops in Spokane County):

- 60% of the total land in the protected agricultural areas would be available for crop production.
- Irrigation with treated effluent would begin the last week of April and continue through the end of September (October demand is minimal).
- Monthly irrigation demand is spread evenly over all days of the month.

Based on these assumptions, Table 5-6 (Irrigation Demand for Designated Agricultural Areas) shows the total irrigation demand for each of the five designated agricultural areas. By comparison, the average effluent production rate in 2025 and 2050 is projected to be 22 and 27 mgd, respectively.

Table 5-6. Irrigation Demand for Designated Agricultural Areas

Month	Gallons/ day/acre	Demand for Designated Agricultural Area (mgd) [1]				
		1	2	3	4	5
January	0	0	0	0	0	0
February	0	0	0	0	0	0
March	0	0	0	0	0	0
April	1,560	60	210	11	31	18
May	2,590	100	360	17	53	31
June	4,860	190	670	33	100	58
July	6,560	250	900	45	130	77
August	3,080	120	420	22	63	36
September	1,540	60	210	11	31	18
October	90	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0

1. See Figure 5-5 for location of designated agricultural areas.

Based on the estimates of reuse demand shown in Table 5-6, there is sufficient potential demand in Areas 1, 2, 4 and 5 to handle all effluent production from April through September for the year 2025. Area 3 could handle all of the effluent in May through August, and most of the effluent during April and September. Reuse demand in October would be minimal in all areas.

Interest Level of Potential End Users

A targeted survey of farmers in the region was not conducted as part of this project. The City of Spokane's 1999 Facilities Plan also investigated agricultural reuse as an effluent management option; however, no investigations were made into the potential interest of regional farmers. Issues that have been raised by farmers during other feasibility studies of agricultural reuse in Northwest communities include:

- **Cost.** For farmers with existing water supply, there must be an economic incentive to switch to reuse.
- **Adequacy and Availability of Current Water Supply.** Interest is typically higher among farmers that lack adequate irrigation water.
- **Water Quality.** Farmers value the nutrient content of the reclaimed water but are concerned about other parameters that could impact their crops such as salinity, chlorine or metals.
- **Food Processors.** Farmers are concerned about the reaction of the food processing industry to irrigation with treated effluent.
- **Water Pressure.** Various irrigation systems have differing pressure requirements for operation. For example, "big gun" irrigation systems require significantly higher pressure than most irrigation methods. Farmers would prefer the reuse delivery pressure to be adequate to operate their preferred irrigation equipment.
- **Reluctance to Dedicate Land for Long-Term Agricultural Uses.** Although the areas investigated for this study are protected for long-term agricultural use, current owners may perceive a reduction in value if they feel long-term agreements or use of reclaimed water could complicate their ability to convert their property to other uses in the future.
- **Regulation.** Some potential users of reclaimed water may perceive that this practice brings with it an added set of regulatory requirements with which they must comply.

Based on the results of other feasibility studies for agricultural reuse, it is clear that farmers would not be willing to pay the true cost to deliver the reuse water to their sites. At best, they would be willing to a price equivalent to that for other irrigation water supplies in the region. Since this represents only a fraction of the true costs to supply the water, an agricultural reuse program would need to be heavily subsidized by the wastewater utility.

Water Resource Implications

The optimal locations for agricultural reuse are in areas where treated effluent could replace existing surface water or groundwater withdrawals.

Effluent also could serve as a new source of water in areas that have no water supply. This is attractive from the perspective of increasing the value of the land; however, it does not free up other water supplies for alternative use.

A large-scale agricultural reuse program could reduce or eliminate the need for surface water discharge during much of the summer; however, irrigation demand in September and October may be insufficient to use all of the effluent. Figure 5-7 (Timing of Spokane River Flow and Irrigation Demand) compares the month-by-month trends for streamflow in the Spokane River and irrigation demand, and shows that river flows remain low after the irrigation demand sharply decreases. Consequently, during the late summer and early fall, effluent would need to be discharged to receiving waters, necessitating high levels of nutrient removal.

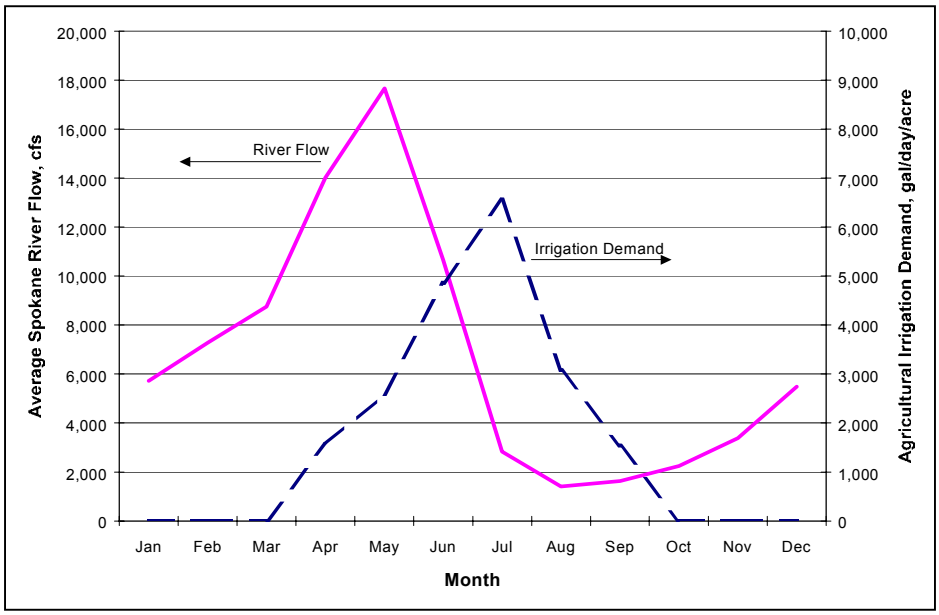

Figure 5-7. Timing of Spokane River Flow and Irrigation Demand

5.4.3 Effluent Quality Requirements

Effluent quality requirements for agricultural reuse are set forth in Washington's *Water Reclamation and Reuse Standards,*[1] and were summarized in Chapter 4 of the *Final Basis of Planning Report*. The reuse standards allow various qualities of reclaimed water to be used for agricultural irrigation, depending on the crop to be grown, the irrigation method, setback provisions and other considerations. Since the specific types and uses of potential crops are not known at this time, it has been assumed that effluent must be treated to Class A reuse standards, allowing it to be used for the greatest variety of crops and with the least restrictions on the end-user. This quality of water would have the greatest appeal to farmers.

Class A water has more stringent disinfection requirements than the effluent parameters listed in Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality) for surface water discharge. However, the treatment process shown in Figure 5-1 would be capable of meeting these tougher standards. Because some nutrient loading is beneficial to crops, it may be possible to reduce the amount of ammonia-nitrogen and phosphorus removal that must be provided at the County's treatment facility during the summer.

While there are no specific guidelines for reuse over the aquifer in Washington, the Idaho Division of Environmental Quality developed the *Special Supplemental Guidelines for Spokane Valley-Rathdrum Prairie Aquifer Wastewater Land Application (1995)*[2] to provide

1 *Water Reclamation and Reuse Standards*. Washington State Department of Health and Washington State Department of Ecology, Publication 97-023. September 1997.

2 *Special Supplemental Guidelines for Spokane Valley-Rathdrum Prairie Aquifer Wastewater Land Application.* Idaho Department of Health and Welfare, Division of Environmental Quality. January 1995

direction for a land application project for the Hayden Area Regional Sewer Board (HARSB) in Idaho. These guidelines recommend that both hydraulic application and nitrate-nitrogen loading be limited to amounts required for crop uptake. As a general guideline, it has been assumed that nitrate concentrations would need to be reduced to less than 10 mg/L for large-scale agricultural irrigation over the aquifer.

5.4.4 Implementation

Reclaimed water programs are administered jointly by the Departments of Ecology (90.48 RCW) and Health (90.46 RCW), with irrigation programs permitted through Ecology. As part of the regulatory review process, the wastewater utility must complete an engineering report that describes the design and operation of the proposed program and indicates the means of compliance with all applicable standards.

Other key implementation steps would include:

- Conducting a needs survey/feasibility study to define potential demand and end-user requirements.
- Developing long-term agreements with private farmers or purchasing sufficient land to meet the program requirements.
- Developing an organizational structure to manage the reuse program.
- Siting and permitting critical infrastructure components such as reservoirs and pipelines.
- Preparing predesign and detailed design for all facilities.
- Conducting environmental assessments necessary to meet regulatory requirements.
- Developing operational plans, including reliability and emergency response measures.
- Developing and implementing monitoring plans.
- Implementing a comprehensive public education program.

The choice between purchasing land for irrigation or developing long-term agreements with private farmers is a key consideration. The first option would give the County more control over the long-term use of water and crop selection for agricultural areas. On the other hand, it would require greater capital expense, add the administrative task to develop and maintain the lease relationship, and may encounter opposition from individuals opposed to the County's purchase of large tracts of farmland. Developing long-term agreements would require that the farmer be committed to long-term agriculture. It also may require two separate negotiations (with the owner and the leaser) if the property is privately owned and leased to a private farmer.

Another key decision is whether the County would operate the reuse system or partner with a local water purveyor for this service.

5.4.5 Facility Requirements and Cost

The requirements described below are based on a system configuration that includes pumping of treated effluent to one or more reservoirs located near the various reuse areas,

and subsequent pumping through a distribution system to serve agricultural customers. There are four major components to this system: treatment, transmission, storage and distribution.

Treatment

To produce Class A reclaimed water, the required treatment train would be equivalent to that presented in Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality); however, the reuse standards specify additional reliability and redundancy components that must be incorporated into the treatment plant; see Appendix I (Reliability Assessment of Reclaimed Water Systems).

Transmission

Transmission distances to the designated agricultural areas vary widely. Serving Area 5 would require pipeline lengths of 6 to 8 miles from a North Spokane Plant and 8 to 12 miles from a plant located in the Spokane Valley. Pumping from the North Spokane area to Area 4 would require approximately 15 miles of transmission line. Transmission distances to Areas 3, 1, and 2 increase to 25 miles, 30 miles, and over 40 miles, respectively.

To the extent possible, transmission lines would be located in public right of way. For purposes of this analysis, it is assumed that the County would not need to pay to acquire any property or easements for reuse transmission.

Storage

There are two options for storage: provide storage to meet all seasonal irrigation demands, or provide irrigation water "on demand" with limited local storage to meet peak demands.

To maximize reuse of treated effluent, it would be necessary to provide storage during the early spring in order to meet the peak demand of June and July. Storage volume requirements were calculated based on annual average 2025 flows and 5,000 total acres of land application area. With this demand, the excess flow produced in April and May at 2025 flow rates would be sufficient to make up the deficit in wastewater flows through June, July and August, resulting in no excess storage during the non-irrigating period (late August through mid-April). This allows the County to avoid adverse impacts due to long-term storage. Experience shows that issues such as algal growth and odor generation can lead to serious water quality degradation if reclaimed water is stored for long periods without major reservoir maintenance efforts. The total storage volume required at 2025 flows would be 400 million gallons. Initial requirements, based on 2005 flow rates, would be 2,400 acres of land under irrigation and a reservoir capacity of 200 million gallons.

For "on demand" application, detailed discussions with farmers would be required to determine the daily peaking factor appropriate for sizing storage. Initial estimates of facility requirements are based on two days of storage.

Any storage reservoirs located over a potable water aquifer would need to be lined.

Distribution

Most irrigation systems can be categorized as medium-pressure (50-60 psi) or high-pressure (100-125 psi). Medium-pressure systems include center pivot, lateral move, and solid set irrigation, whereas high-pressure systems are needed for "big gun" irrigation. If the County were to implement agricultural reuse, it would make sense to provide a medium-pressure

system, with individual farmers providing booster stations as needed for "big gun" equipment.

Different irrigation systems also have different irrigation efficiencies, which can significantly impact the quality of water needed to meet a crop's demand. In planning a reclaimed system, the type and distribution of irrigation systems must be clearly understood.

Cost

The estimated cost of this alternative is presented in Table 5-7 (Capital Cost of Agricultural Reuse). This cost is based on conveyance of all flow from April through September to a storage reservoir located 14 miles from the treatment plant, and distribution to multiple farms with an average size of 450 acres.

Table 5-7. Capital Cost of Agricultural Reuse

Cost Component [1]	Unit Cost ($/MG/Year)
Incremental Treatment Cost Savings	$0
Conveyance	$8,600
Site Development (reservoirs)	$5,900
Land	$200
Total	**$14,900**

1. Alternative can handle 4,000 MG/year (21.9 mgd for six months)

5.4.6 Key Advantages and Disadvantages

Advantages

- Effluent reuse can have significant water resource benefits where irrigation water is currently obtained from surface water or groundwater resources. It would conserve and stretch potable water supplies
- For agricultural property without a water supply, a reuse program would increase crop yields and property value.
- Implementing a reuse program could reduce or eliminate discharge to surface waters during the spring and mid-summer months.

Disadvantages

- During October and possibly September, irrigation demand would not be sufficient to use all of the County's effluent. Consequently, treated effluent would need to be discharged to the river during low streamflow conditions unless other effluent management strategies were implemented for this period.
- Effluent storage reservoirs may prove difficult to site and permit.
- Infrastructure development costs are high.

- Operational costs for pumping would be high.
- This concept requires long-term agreements with farmers or purchase of large tracts of agricultural property. Both options may be difficult to implement.
- This alternative has risk associated with changing land use. However, applying effluent to agricultural areas that have been protected through the County's comprehensive planning and zoning process would reduce the risk that land will not be available for long-term effluent reuse.
- Local water purveyors may view this new water supply as competition that could reduce their revenue.
- Revenue from sale of the water would pay for only a fraction of the development and operating costs. Consequently, wastewater ratepayers would need to subsidize to program.

5.5 IRRIGATION OF POPLAR FARMS

5.5.1 Concept

This alternative involves a variation of agricultural reuse in which hybrid poplars would be grown. From an effluent management perspective, poplars are attractive because they have a high water demand. Also, the harvested poplars may produce revenue for the wastewater utility.

The use of poplars is an emerging management practice for municipal wastewater. In the Northwest, several communities are in various stages of implementation. The most established program is in Woodburn, Oregon where poplars have been grown for the past seven years.

5.5.2 Applicability to Spokane County

In the Spokane climate, poplars would have an estimated water consumption rate of 5 feet per year. If this water were applied over the six-month summer permit season, the required area of trees under irrigation would be 2,400 acres in 2025 and 3,000 acres in 2050. Taking into consideration buffers, harvesting requirements and other property management functions, the total property requirements would increase about 50 percent to 3,600 and 4,500 acres in 2025 and 2050, respectively. To maintain control of the irrigation and harvesting operations, the County would need to purchase the property and operate the facility.

With such a large land requirement, the cost of this alternative becomes highly dependent on the cost of land and the length of conveyance pipelines to deliver the water. Two scenarios were considered:

- A site in Peone Prairie located within 7 miles of the treatment plant. Estimated property costs in this area would be $10,000 per acre.
- A site in the Palouse, located 20 miles from the treatment plant. Property costs in this area are based on $2,000 per acre.

5.5.3 Effluent Quality Requirements

Poplars may be irrigated with Class C reclaimed water, which requires secondary treatment and effective disinfection. Since the poplar farm would only receive water during the six dry-season months, effluent would need to be discharged to a receiving water during the winter. This would require the ability to provide nitrification during cold weather conditions to meet in-stream toxicity limits for ammonia.

5.5.4 Implementation

Implementation requirements would be similar to that for agricultural irrigation with the exception that market surveys and long-term agreements with farmers would not be needed. Instead, the County would need to identify and acquire the large tracts of land needed for the poplar system.

5.5.5 Facility Requirements and Cost

Key facility requirements for a poplar system are outlined below:

- Treatment Plant – Advanced secondary treatment with nitrification (for winter discharge condition would be needed.
- Effluent Pumping – A high-head lift station would be needed to convey the effluent to the irrigation site.
- Transmission Main – Depending on the site location, a 7 to 20 mile pipeline would be required.
- Storage – A minimum of two days of operational storage should be provided to balance supply and demand variations and to accommodate emergency situations.
- Site Development – The property would need to be prepared for growth of poplar trees, including clearing and grading, construction of access roads, installation of surface runoff controls, and installation of groundwater monitoring wells.
- Irrigation System – A mechanical irrigation system would need to be installed.

The estimated unit capital cost is shown in Table 5-8 (Capital Cost of Poplar Farms) for both the Peone Prairie and Palouse sites. Compared to the baseline treatment system, elimination of effluent filtration and phosphorus removal is projected to save approximately $1.50 per gallon of capacity. This savings is offset by the other development costs for the system.

Table 5-8. Capital Cost of Poplar Farms

Cost Component [1]	Cost ($ per million gallon per year)	
	Peone Prairie	Palouse
Incremental Treatment Cost Savings	-$8,200	-$8,200
Conveyance	$5,400	$11,500
Site Development (reservoir, irrigation, etc.)	$1,900	$1,900
Land	$6,000	$1,200
Total	**$5,100**	**$6,400**

1. Alternative can handle 4,000 MG/year (21.9 mgd for six months)

The potential revenue from a poplar operation is highly speculative. Initially, poplars were thought to provide a quality source of pulp for paper mills; however, the acceptance of the poplar pulp has been mixed and the revenue generated small. Lately, interest has grown in the use of poplars as a clear softwood for non-structural products, such as blinds. The market value and demand potential for these products may be significant, but this has not been firmly established. If such a market exists, it is likely that the commercial wood products industry would grow poplars in sufficient quantity to satisfy the demand. In such a market place, a small to mid-size municipal utility would be a very small player with limited market access and pricing leverage. For these reasons, no revenue stream has been included for harvested poplars.

5.5.6 Advantages and Disadvantages

Advantages

- Eliminates discharge to receiving waters during the dry-season.
- Harvested poplars may generate revenue, although this remains uncertain.
- Growth of poplars may be positively viewed by the public and regulatory agencies as a "green solution" to wastewater management.
- Allows use of a less complex, less expensive treatment system.

Disadvantages

- Requires purchase of large tracts of agricultural land. The agricultural community and other land use interests may view this unfavorably.
- Operational costs for pumping would be high.
- Results in a more complex system to operate than river discharge.

5.6 IRRIGATION OF URBAN GREEN SPACES

5.6.1 Concept

Urban reuse involves the use of treated effluent as an irrigation supply for golf courses, school grounds, parks, and cemeteries. Reuse would be during the summer months only, when irrigation demand is highest. The basic concept of the program is illustrated in Figure 5-8 (Irrigation of Ur ban Green Spaces).

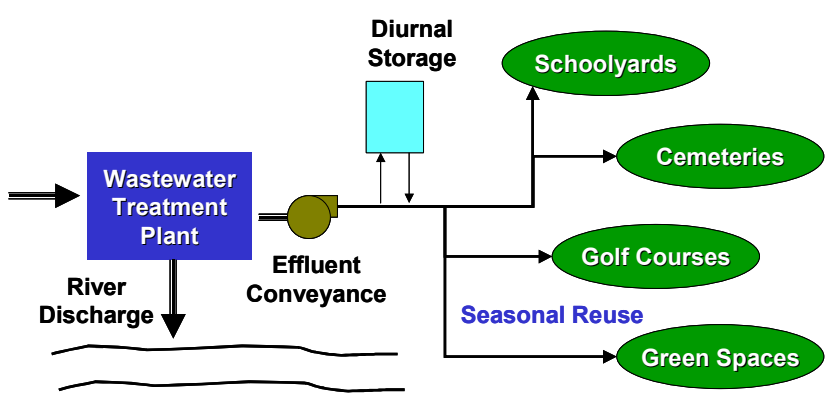

Figure 5-8. Irrigation of Urban Green Spaces

Urban irrigation using treated effluent has been practiced for decades across the nation and in the Northwest. In Oregon, Clean Water Services of Washington County has been irrigating school grounds and golf courses with treated effluent for over 20 years. In Washington, urban irrigation was included in several demonstration projects administered by the Departments of Ecology and Health.[3] Treated wastewater effluent is used for landscape irrigation by the City of Sequim, and for irrigation at local churches, city parks, and a private residence in the City of Yelm.

5.6.2 Applicability to Spokane County

Location of Potential Reuse Sites

Using the County's land use information system, an investigation was conducted to identify green space that could potentially be included in an urban irrigation program. In the Spokane area, the most significant green spaces are those associated with golf courses, parks, cemeteries and schoolyards. Figure 5-9 (Potential Urban Irrigation Sites) presents the location of these facilities in the greater Spokane region. Appendix C (Potential Water Reuse Sites), consists of tables showing all of the parks, cemeteries, and schools included for evaluation.

Golf courses are typically the most attractive reuse customers because of their large water demand. Areas with multiple golf courses include Liberty Lake, along the Little Spokane River in North Spokane, near Latah Creek at the south end of the City, and along the Spokane River near the western boundary of the City.

[3] *Water Reclamation and Reuse – The Demonstration Projects*, Publication 00-10-062. Washington State Department of Ecology. December 2000.

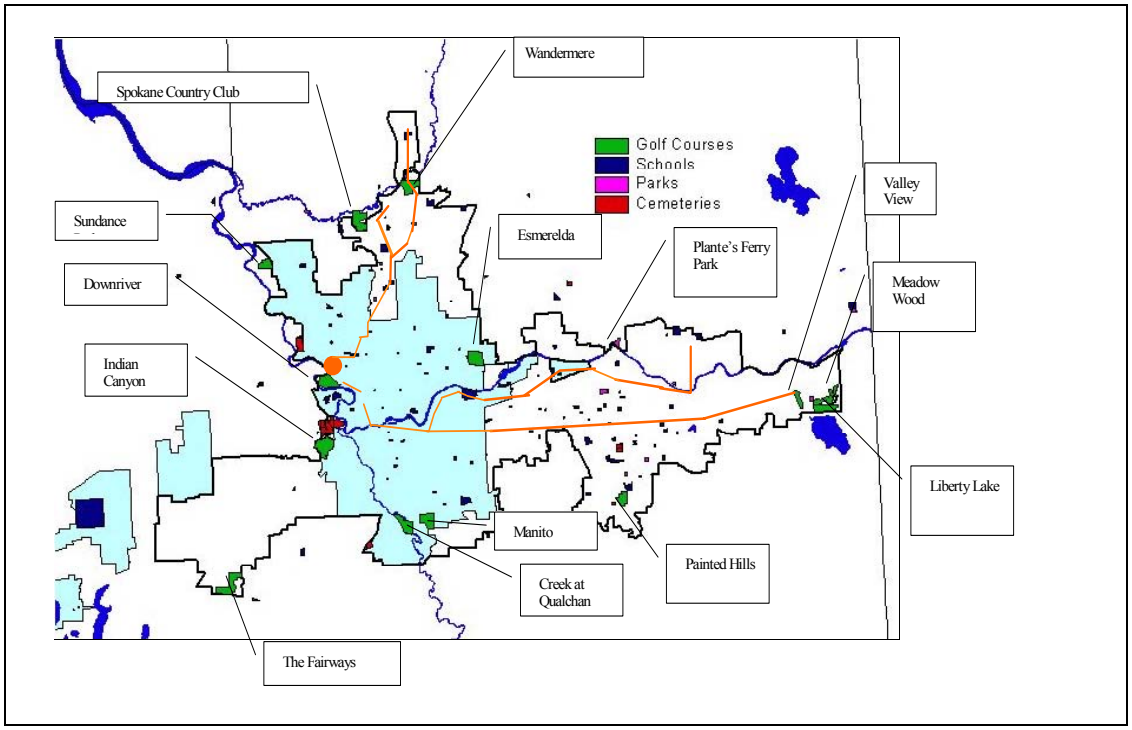

Figure 5-9. Potential Urban Irrigation Sites

In some communities, green space at industrial parks offer important reuse opportunities. Based on discussions with County personnel, industrial campuses with significant green space are limited to the Liberty Lake area.

To initially screen candidate reuse sites, two criteria were used:

- Proximity to the planning area
- Complexity vs. benefit of administering reuse program

The first criterion was used to rule out sites such as the Sundance and Fairways Golf Courses (located 15-20 miles from the planning area). The second criterion was used to eliminate sites with small demand potential such as individual schools with a single private owner.

Potential Reuse Demand

Demand for urban irrigation water was assessed similar to that for agricultural irrigation, except that demand was based on turf requirements rather than a mixture of crops. Urban irrigation demand in gallons per day per acre is shown in Figure 5-10 (Water Demand for Urban Irrigation).

To put the potential demand in perspective, a typical 150-acre golf course would have a maximum demand in August of 900,000 gpd, which represents 4 percent of the County's projected effluent flow rate in 2025. During other summer months, a smaller portion of the effluent would be used. Extending this concept, Table 5-9 (Urban Irrigation Reuse Potential) illustrates the relationship between the size of a reuse site and the percentage of the total

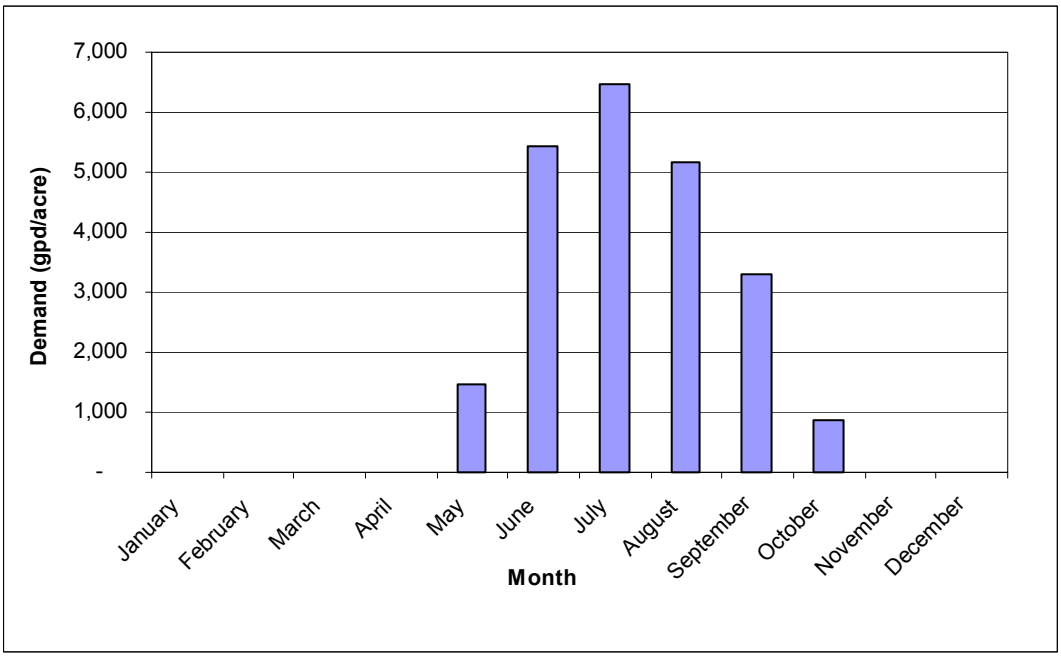

Figure 5-10. Water Demand for Urban Irrigation

County flow that can be used on the site. As this table illustrates, many large sites or clusters of smaller sites would be needed to use a substantial portion of the County's projected flow in 2025. As shown in Figure 5-9, potential reuse sites are highly dispersed with few clusters of sizeable acreage. Consequently, achieving a large volume of demand would require an extensive distribution network.

Table 5-9. Urban Irrigation Reuse Potential

Year	Peak Demand [1]			
	10-Acre Site	20-Acre Site	50-Acre Site	100-Acre Site
2000	1.00	2.00	5.00	10.00
2005	0.62	1.24	3.10	6.20
2010	0.45	0.90	2.25	5.50
2015	0.34	0.68	1.70	3.40
2020	0.31	0.62	1.55	3.10
2025	0.30	0.60	1.50	3.00
2030	0.28	0.56	1.40	2.80
2035	0.27	0.54	1.35	2.70
2040	0.26	0.52	1.30	2.60
2045	0.25	0.50	1.25	2.50
2050	0.24	0.48	1.20	2.40

1. As a percentage of projected annual average flow.

Golf Courses

Fourteen golf courses were evaluated as potential urban reuse sites. These are shown in Table 5-10 (Urban Golf Course Sites). Ninety-eight percent of the total golf course area is assumed to be irrigable.

Table 5-10. Urban Golf Course Sites

Name	Total Acres	Irrigable Acres
Indian Canyon Golf Course	210	205
Spokane Country Club	188	184
Hangman Valley Golf Course	174	171
Esmeralda Golf Course	165	162
Wandermere Golf Course	159	156
Downriver Golf Course	158	155
Manito Golf Club	139	136
The Creek at Qualchan Golf Course	138	135
Meadow Wood Golf Course	144	141
Liberty Lake Golf Course	125	123
Painted Hills Golf Course	89	87
Sundance Golf Course Inc.	87	85
Valley View Golf Course	61	60
Total	**2,046**	**2,005**

To evaluate the geographical distribution of reuse demand from golf courses, the courses listed in Table 5-10 were separated into six regions:

- North Spokane: Wandermere
- East County: Valley View, Liberty Lake, Meadow Wood
- South Spokane: Manito, The Creek at Qualchan
- Central Spokane: Indian Canyon, Downriver
- Esmeralda
- Painted Hills

The projected reuse demand for the golf courses within each region is presented in Table 5-11 (Monthly Irrigation Demand for Golf Courses). The Spokane Country Club was excluded from the demand projections based upon discussions with a representative from the club, who indicated that they irrigate using water from a private well, have very low irrigation costs, and are not likely to consider replacing this source with treated effluent.

Table 5-11. Monthly Irrigation Demand for Golf Courses

Month	Potential Irrigation Demand (mgd)						
	North Spokane	East County	South Spokane	Central Spokane	Painted Hills	Esmeralda	Total
January	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-
May	0.23	0.48	0.40	0.53	0.13	0.24	2.00
June	0.85	1.76	1.47	1.96	0.47	0.88	7.39
July	1.01	2.09	1.75	2.34	0.56	1.05	8.80
August	0.81	1.67	1.40	1.87	0.45	0.84	7.03
September	0.51	1.07	0.90	1.19	0.29	0.53	4.50
October	0.13	0.28	0.23	0.31	0.07	0.14	1.16
November	-	-	-	-	-	-	-
December	-	-	-	-	-	-	-

The County Parks department would be willing to use reclaimed effluent for irrigation of County-owned golf courses; however, two of their courses (Liberty Lake and Meadow Wood) are located in an area that is being annexed by Liberty Lake and is within the Liberty Lake Water and Sewer District. The County could implement reuse for irrigation of these courses if it maintains ownership of them; however, the Liberty Lake Water and Sewer District may also be interested in irrigating these courses if it has trouble expanding its discharge to the Spokane River.

Comparing the water demands in Table 5-11 with the projected effluent production rate in 2025 (22 mgd) demonstrates that if all golf courses in the region were served by reclaimed water, the peak demand would represent 40 percent of the available effluent. The average reuse demand over the course of the summer would be about 25 percent of the available effluent. If only one of the golf course "regions" were served, less than 10 percent of the County's summer effluent production would be used.

Urban Parks, Schools, and Cemeteries

In Spokane, the identified parks, schools, and cemeteries are relatively small compared to golf courses. Table 5-12 (Urban Parks, Schools, and Cemeteries) summarizes information on these facilities with respect to size range, number of sites, total area, and irrigable area. The estimates of irrigable area are based on research conducted for Clean Water Services of Washington County, Oregon's Recycled Wastewater Master Plan (1991).

In this study, the following values were developed to estimate irrigable area based on total area for each land use category: schools, 57%; parks, 55%; cemeteries, 94%.

Table 5-12. Urban Parks, Schools, and Cemeteries

Category	Number of Sites	Total Area	Irrigable Area
0-5 Acres			
Parks	10	33	18
Schools	23	62	35
Cemeteries	18	30	28
5-10 Acres			
Parks	7	53	29
Schools	15	117	66
Cemeteries	6	46	43
10-20 Acres			
Parks	2	34	19
Schools	16	209	119
Cemeteries	3	47	44
20-50 Acres			
Parks	2	71	39
Schools	11	364	208
Cemeteries	4	117	110
Over 50 Acres			
Parks	1	0	0
Schools	1	111	63
Cemeteries	3	206	194

The County is currently developing Plante's Ferry Park near Trent, which will have 90 acres of irrigated land that will be served by a local irrigation district rather than a private well. The Parks Department is open to using reclaimed effluent for irrigating Plante's Ferry Park if it can help eliminate part or all of the anticipated $10,000 to $15,000/year cost of purchasing water through the irrigation district.

5.6.3 Effluent Quality Requirements

Effluent used for landscape irrigation of open access areas must be treated to Class A reuse standards, so treatment requirements are similar to those described for agricultural reuse. As urban reuse sites are generally located over the aquifer, a 10 mg/L effluent nitrate-nitrogen guideline would also be used. The treatment train shown in Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality) would be adequate to meet urban irrigation effluent quality standards.

5.6.4 Implementation

As with agricultural reuse, urban irrigation programs are administered by both Ecology and Health, and require an Engineering Report presenting design, operational and compliance information. Other implementation steps are similar to those for an agricultural reuse program, except that an urban reuse program would likely be smaller in scale and involve fewer end users. Land application on County Facilities or school grounds would allow a single agreement to cover reuse on multiple sites; whereas, reuse on private property such as private golf courses would require negotiation of a separate agreement for every land application site.

Public acceptance and public safety may be a concern for some owners of urban green space. The County would need to implement a public information program to educate both landowners and facility users regarding the safety and benefits of urban irrigation.

As with the agricultural program, it is unlikely that end users would be willing to pay the full cost of producing and delivering the reclaimed water. Consequently, wastewater ratepayers would need to subsidize the cost of this program.

5.6.5 Facility Requirements and Cost

Based on the evaluation of potential demand, it appears that an urban reuse program would use only a portion of the effluent produced by Spokane County. Consequently, the program could be served "on demand" with storage requirements limited to those needed for operational fluctuations in supply and demand.

Initial estimates of facility requirements and cost are based on serving the East County and Esmeralda golf courses from a treatment plant located in the Spokane Valley. This would produce a maximum water demand of 3.1 mgd in August and an average demand of about 1 mgd over the six summer months. Storage volumes were based on two days of storage at the peak-month delivery rate. Booster pump stations would be required to increase the discharge pressure to 50-60 psi for medium pressure irrigation systems, and to convey flow for the reuse sites. The cost estimate for this alternative is shown in Table 5-13 (Capital Cost of Urban Reuse).

Table 5-13. Capital Cost of Urban Reuse

Cost Component	Unit Cost ($/MGY)
Incremental Treatment Cost Savings	$0
Conveyance	$10,800
Site Development (reservoir)	$10,400
Land	$0
Total	**$21,200**

1. Alternative can handle 340 MG/year (average flow of 1.8 mgd for six months)

5.6.6 Key Advantages and Disadvantages

Advantages

- Using reclaimed water to irrigate urban facilities such as large parks and golf courses would reduce demand for raw water from the aquifer.
- With increased tightening of water rights in the region, provision of a new water supply may allow development of new golf courses or green spaces that could not otherwise obtain an adequate water supply.
- Since the treatment requirements for reuse and river discharge are similar, it is relatively easy to provide multiple end uses from a single treatment plant.
- Urban reuse is a well-established practice that should readily gain public acceptance.

Disadvantages

- Urban reuse opportunities in the Spokane area are widely dispersed, increasing the cost of conveyance to serve them.
- The cost to provide reuse water will exceed the cost of alternative water supplies (if available). Consequently, the wastewater utility would need to subsidize the cost of this program.
- The demand for urban reuse would represent only a portion of the effluent generated by Spokane County, and would be a seasonal demand. Therefore, other effluent management strategies would be needed to handle the year-round wastewater flow.
- Long-term agreements with end users are needed to justify the capital expenditures for the reuse conveyance system.
- Management of reuse systems is more complex than discharge to surface waters.
- Local water purveyors may view this new water supply as competition that could reduce their revenue.

5.7 INDUSTRIAL REUSE

5.7.1 Concept

In this alternative, treated effluent would be routed to an industry for use in cooling or process applications as shown in Figure 5-11 (Industrial Reuse). Depending on site-specific requirements, supplemental treatment

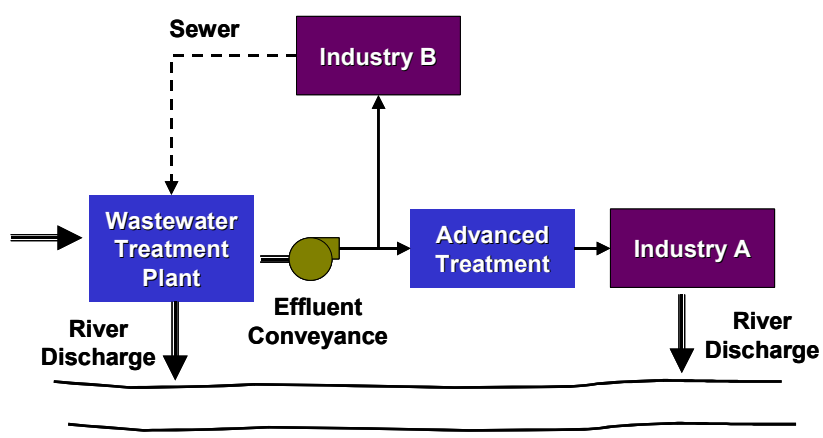

Figure 5-11. Industrial Reuse

may be needed to meet water quality requirements for industrial use. Effluent from the industries may be discharged directly to receiving waters or routed to the County's sewer system for treatment in a municipal plant.

5.7.2 Applicability to Spokane County

Efforts to investigate potential industrial reuse focused on four primary areas:

- Concrete manufacturing plants
- Kaiser Aluminum Facilities
- Inland Empire Paper
- Spokane Industrial Park

The locations of these industries are shown in Figure 5-12 (Potential Industrial Reuse Sites).

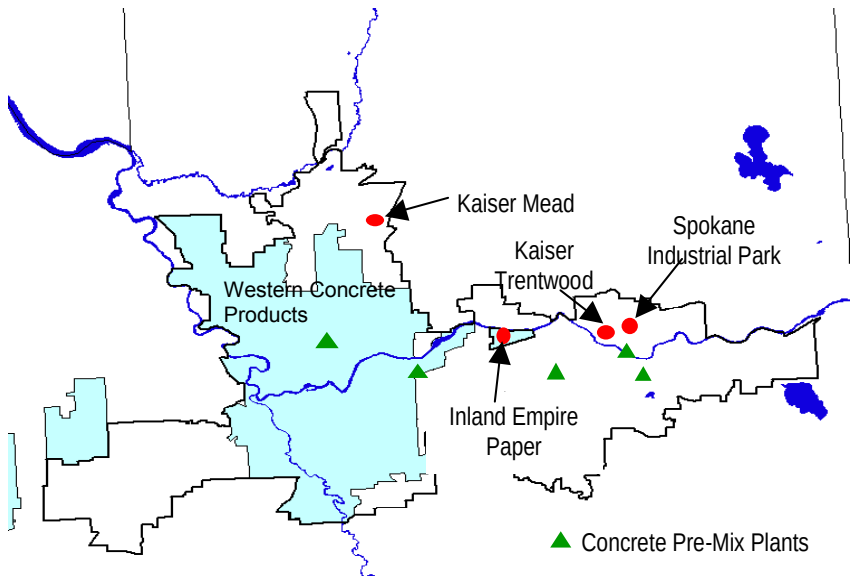

Figure 5 -12. Potential Industrial Reuse Sites

Concrete Plants

Central Pre-Mix and Western Concrete Products are the primary owners of concrete premix facilities in the County. Of these, only Western Concrete Products showed any interest in using treated effluent to replace City water for concrete processing. Central Pre-Mix uses private well water that they obtain cheaply, and is not interested in considering reclaimed water.

Western Concrete Products operates three plants in the City of Spokane that manufacture concrete products. Based on water consumption records, an estimate of the potential reuse demand was developed assuming that 80% of current water use could be met by recycled wastewater. Figure 5-13 (Western Concrete Products Demand) shows the projected monthly reuse demand for all three plants. As shown, demand would typically be 37,000 gpd with occasional peak demands of up to 200,000 gpd. This volume of reuse could be met "on demand" without the need for storage.

Western Concrete Products Demand Kaiser Aluminum

Kaiser Aluminum operates two manufacturing facilities in the Spokane area: the Mead facility in the North Valley area, and the Trentwood facility along the Spokane River in the Valley. Kaiser is in the process of making changes in their water systems, and is not interested in considering use of treated effluent at this time. While they may be more

interested at some point in the future, they are likely to continue to use private well water for process needs in the near term.

Inland Empire Paper Company

Inland Empire Paper (IEP) Company produces newsprint at their Spokane mill. The current total water use is 4.3 mgd, with the potential to increase to 5.6 mgd if their paper production capacity increases to 900 tons per day. Of the current water use, approximately 1.2 mgd is used for non-contact cooling purposes. The mill operates 7 days per week, 24 hours per day except for a 32-hour shutdown at Christmas. They currently use water from a private well that supplies high-quality process water at 55°F. IEP treats wastewater onsite and discharges to the Spokane River in an impoundment behind the Upriver Dam. They currently incinerate primary and activated sludge in a fluidized bed furnace, but are interested in pursuing other options for biosolids disposal. The company owns 100 acres of land across the river from the mill, and have expressed interest in locating a County reclamation plant on that site that could process their biosolids in addition to producing reuse water for their paper production process.

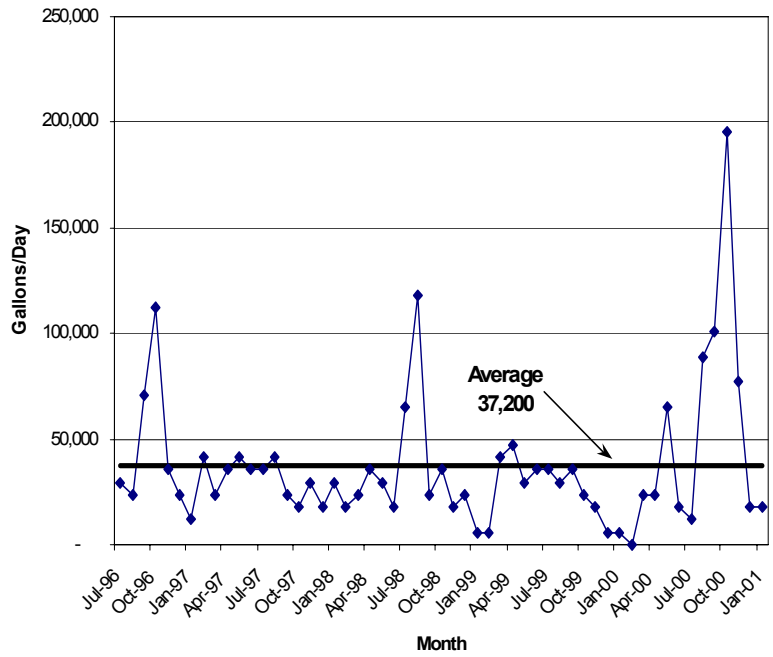

Figure 5-13. Western Concrete Products Demand

Potential reuse scenarios at IEP depend on whether the treated effluent could be used for part or all of the plant water needs, and whether additional treatment of the effluent is needed for use in the paper processing operation. Based on these considerations, four scenarios were identified:

- Use of 1.2 mgd of filtered effluent for non-contact cooling uses (requires significant piping changes)
- Use of 4.3 mgd of filtered effluent for general mill use (requires minimum piping changes)
- Use of 4.3 mgd of filtered and activated carbon-treated effluent for general mill use (if color reduction is required)
- Use of 3.1 mgd of filtered and activated carbon-treated effluent for general mill use and 1.2 mgd of filtered effluent for noncontact cooling use (needs significant piping changes)

Spokane Industrial Park

The Spokane Industrial Park manages four on-site wells, with a total production of 1.8 mgd. Industrial tenants purchase water from the Park for cooling and process water. Cooling water is discharged to drywells for infiltration and wastewater is routed to the Spokane County collection system for treatment at SAWTP. The Industrial Park manages over 100 different industries with seven requiring a significant volume of water for cooling. The industries with large volumes of water use include:

- Spokane Industries
- NEW Casting
- Medtronic
- Columbia Lighting
- CXT
- Dana-Fab
- Quintex

Interest on the part of the Park management was low. Concerns were expressed regarding the temperature and water quality of the recycled wastewater relative to the current groundwater source. Specific industries have not been contacted to determine individual interest, or to ascertain whether their agreements with the Industrial Park would allow them to engage in an agreement to accept treated effluent from the County.

5.7.3 Effluent Quality Requirements

Effluent quality requirements vary depending on the specific use at each industrial facility. For instance, effluent used for concrete manufacturing would need to be treated to at least Class C reuse standards, whereas as other uses require Class A reclaimed water. Unless a major demand emerged for lower quality water, it is likely that the County would supply Class A water to all industrial users.

Since IEP has the most significant reuse potential, the discussion of effluent quality requirements is primarily focused on issues of concern to their paper processing operation. These include temperature, color, total suspended solids and total dissolved solids.

Temperature. In recent years, effluent temperature has become a key area of regulatory focus, particularly for industries. At IEP, the groundwater used for noncontact cooling and other process needs is supplied at 55°F. Even with this low-temperature water, discharge temperatures at paper mills can reach 90°F. When considering alternative water supplies such as reuse water, the prospect of further increasing the temperature of the discharge is a concern. Effluent temperatures from the County's treatment plant are likely to be similar to those from the SAWTP, shown in Figure 5-14 (Temperature of SAWTP Effluent(1996). From May through October, historical effluent temperatures at the SAWTP exceed groundwater temperature by as much as 15°F.

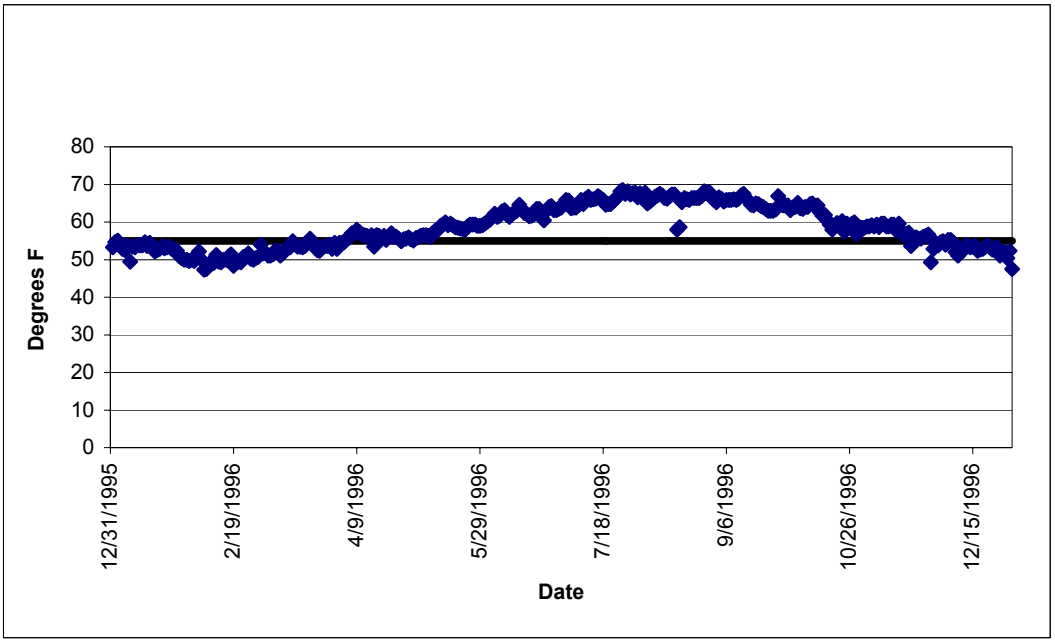

Figure 5-14. Temperature of SAWTP Effluent (1996)

Color. Based on discussions with IEP, color is not anticipated to be a problem; however, the County's effluent must not result in the need for additional brighteners to be added to the process. If color is determined to have an impact, activated carbon treatment of the County's effluent would be required. This concern does not apply to the 1.2 mgd of non-contact cooling water.

Total Suspended Solids (TSS). Studies with mills in the Tacoma, Washington area indicated a need for total suspended solids (TSS) of less than 1 mg/L for cooling system components such as vacuum pumps and steam condensers, and for sealing services such as pump seals and other equipment. If the County uses the treatment train shown in Figure 5-1, the effluent TSS concentrations would typically be in the range of 1 to 3 mg/L. Consequently, additional treatment may be needed to further remove suspended solids. Additional study of this issue would be required.

Total Dissolved Solids (TDS). The studies in Tacoma also indicated a potential concern regarding the concentration of both organic and inorganic TDS. However, a newsprint mill in Pomona, California uses treated effluent with no reduction in TDS. The projected TDS from the County's treatment plant would need to be compared to the current raw water TDS of approximately 125 mg/L to determine whether TDS would be an issue.

5.7.4 Implementation

Industrial reuse programs are permitted by the Department of Health through Ecology's waste discharge permit program. Key implementation steps would include:

- Conducting pilot tests to determine the potential impacts of using reclaimed water on the industrial process.

- Conducting detailed studies of the individual piping systems to determine how to segregate any uses that must remain on potable water.
- Addressing permitting issues for the industry's effluent discharge since the reuse water may alter the effluent quality.
- Educating staff and managers at the industries to gain acceptance for using reclaimed water.
- Developing a long-term agreement between the County and industry for use of the reclaimed water, particularly if either party is required to make substantial investment.

5.7.5 Facility Requirements and Cost

Facility requirements vary for the four IEP scenarios identified earlier. All of the scenarios require treatment to at least a Class A reuse standard and conveyance of the treated effluent from the municipal treatment plant to the industry. Internal piping changes at IEP would depend on whether the reuse water can be applied for general use or can only be used for the cooling operation. The general use scenarios would require minimal piping changes, whereas the cooling-water only scenario would require extensive replumbing to separate this water use from the other plant uses. For all alternatives, some level of storage would be needed. Initial cost estimates are based on 6 hours of storage. For those scenarios that involve reducing the color of the effluent prior to its use in the paper processing operation, it has been assumed that activated carbon treatment would be provided downstream of the main treatment plant.

The estimated capital costs of the four scenarios are presented in Table 5-14 (Capital Cost of Industrial Reuse at Inland Empire Paper).

Table 5-14. Capital Cost of Industrial Reuse at Inland Empire Paper

Cost Component	Cost ($ per million gallons per year)			
	Cooling Water Only[1]	General Use–No Treatment[2]	General Use–With Treatment[2]	Split Use–With Treatment[2]
Incremental Treatment Cost Savings	$0	$0	$2,700	$2,000
Conveyance	$2,900	$1,600	$1,600	$1,600
Site Development (Piping changes)	$400	$100	$100	$100
Land	$0	$0	$0	$0
Total	**$3,300**	**$1,700**	**$4,400**	**$3,700**

1. Alternative can handle 440 MG/year (1.2 mgd year-round).
2. Alternative can handle 1,570 MG/year (4.3 mgd year-round).

5.7.6 Key Advantages and Disadvantages

Advantages

- Potentially high-volume, year-round use.
- Would replace a significant groundwater withdrawal.
- Would reduce total volume of effluent discharged to Spokane River.
- May foster opportunities for the County and IEP to share other wastewater management functions.

Disadvantages

- There is risk that the industry may leave the area, change operation or otherwise change in ways that would preclude or reduce the ability to reuse the County's effluent.
- Depending on the implementation cost, and the willingness of the industry to participate in the costs, this alternative may need to be subsidized by the wastewater utility.
- If there is any concern among customers of the industry that using treated effluent as part of the industrial process could compromise the quality of the product, then industrial reuse would not be successful.
- Since the County's reuse water would end up in the industries discharge, this may create liability for the County in the event the industry experiences compliance problems.

5.8 WETLANDS CREATION OR ENHANCEMENT

5.8.1 Concept

Treated effluent could be used to create constructed mitigation wetlands or as a reliable water source to restore degraded natural wetlands. Several of the State's reuse demonstration projects have included discharge of treated effluent to constructed wetlands, including projects in Sequim (in Clallam County) and Yelm (in Thurston County).

5.8.2 Applicability to Spokane County

Washington's reuse standards dictate the wetted wetland area required for a given volume of reclaimed water discharge based on both hydraulic loading and water level. The criteria for constructed wetlands are:

- Maximum annual average hydraulic loading rate of 5 cm/day (calculated as the ratio of average annual flow rate of reclaimed water to the effective wetted area of the wetland).
- Average monthly water level elevations under the reclaimed water wetland hydrologic regime are not to increase by more than 10 cm compared to the average pre-augmentation monthly water level.

Based on annual average hydraulic loading, Figure 5-15 (Acreage of Wetted Surface Area Needed To Accommodate All Spokane County Flow) shows the acreage of wetted surface area that would be required to handle all projected flow generated by Spokane County

between 2000 and 2050. Taking into consideration buffer requirements, actual land requirements would be approximately 50 percent greater than those in the figure.

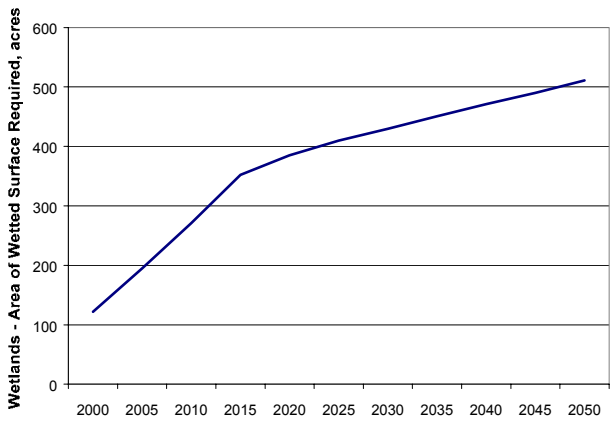

Figure 5-15. Acreage of Wetted Surface Area Needed To Accommodate All Spokane County Flow

According to a wetland inventory conducted for Spokane County in 1991, the majority of natural wetlands are located in the western and southwestern portions of the county, and along the lower portion of the Little Spokane River. This was illustrated in Drawing 2-9 of the *Basis of Planning Report*. In the Spokane Valley, there are few wetlands due to the permeable nature of the soils. Given this situation, developing wetlands of the magnitude listed in Figure 5-15 would be problematic. The wetlands would need to be spread out over long distances, and conveyance costs would be high. Consequently, the discussion of wetlands has been limited to creation of small to mid-size faculties that could use a portion of the effluent generated by the County.

Depending on their location and potential interaction with potable water aquifers, created wetlands systems may need to be lined. Lining would likely be required for wetlands located away from stream corridors in locations underlain by porous soils. Unlined wetlands may be acceptable along gaining stretches of the river where the water is allowed to infiltrate and move laterally to the surface water. Unfortunately, in Spokane, many locations where such systems could occur are already developed. However, there maybe opportunities to site smaller wetlands along the River in areas of where shoreline setback requirements make the property immediately adjacent to the River undevelopable. Other potential sites would be along the Little Spokane River north of the North Spokane region; see Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality). Most of the Little Spokane River is recharged from the Aquifer in this area, so unless there are drinking water wells located between the wetlands site and the river, the risk of impacting water quality in a subsurface aquifer is minimal. Such a site would be conveniently located for discharge from a plant in the North Spokane area, but would require pumping effluent 12-15 miles from a plant in the Valley.

Treated effluent provides a reliable water supply for restoring degraded wetlands, so there may be some opportunities for the County to partner with the Department of Fish and Wildlife to restore natural wetlands. This alternative would not significantly impact the need for or size of the primary effluent disposal facilities (surface water discharge), but it would provide an opportunity to enhance natural resources in the area.

A final implementation option would be to locate constructed wetlands near Shelly Lake in the South Valley region. According to the County, this water body was once stream-fed, but

flows to the lake have decreased as the area became developed. Currently, a developer of homes near the lake pumps water to the lake during the summer to maintain the lake level. The quantity of water added to the lake is not known, nor have specific developments around the lake been evaluated to determine how much land may be available for constructed wetlands. Because the lake bottom sits 30 feet above the Spokane Aquifer, infiltration to the Aquifer might be a concern.

5.8.3 Effluent Quality Requirements

The Washington reuse standards establish conditions under which reclaimed water may be used to create wetlands. Because constructed wetlands that receive reclaimed water are considered waters of the State, the requirements of constructed wetlands are dictated by the anticipated beneficial use. To minimize public concern, it is assumed that any constructed wetlands would be designed for potential human contact. This means that the treated effluent would need to meet Class A treatment standards, as well as the following specific standards from the reuse guidelines:

- BOD_5 and TSS less than 20 mg/L (annual average)
- Total Kjeldahl nitrogen less than 3 mg/L (annual average)
- Total phosphorus less than 1 mg/L (annual average)
- Un-ionized ammonia less than Washington's chronic toxicity standards
- Metals concentrations less than Washington's surface water standards

These standards require a higher level of treatment than that provided by the treatment train in Figure 5-1 (Process Schematic Diagram of Baseline Effluent Quality). Specifically, year-round phosphorus removal and complete denitrification would be required.

In addition to meeting these specific criteria, a hydrogeologic evaluation must be conducted to determine whether the wetland is in an area that provides groundwater recharge. If this is the case, then reclaimed water discharged to the wetland must "exhibit parameter concentrations 50 percent or lower than the ground water quality criteria", or must demonstrate that local ground water quality will not be degraded.

5.8.4 Implementation

For approval of reclaimed water use in wetlands, the County would need to perform sufficient background studies to:

- Identify beneficial uses to be attained.
- Determine the hydrologic regime of the proposed systems.
- Identify the water quality to be provided and the annual loading rates.
- Determine potential groundwater impacts.
- Provide an estimated description of the mature biological structure for the wetland.
- Support any claims of net environmental benefit.

Other implementation steps would include:

- Property acquisition
- Predesign and design
- Environmental assessments necessary to meet regulatory requirements
- Monitoring plan development and implementation
- Public education program implementation

5.8.5 Facility Requirements and Cost

Preliminary development of facility requirements and cost are based on creation of 40 acres of wetlands to handle 2 mgd of flow. Costs include conveyance (estimated at 10 miles), construction of a lined wetland, land acquisition, additional treatment to meet the annual phosphorus and TKN requirement. Table 5-15 (Capital Cost of Wetlands Creation) summarizes the projected capital cost for this alternative.

Table 5-15. Capital Cost of Wetlands Creation

Cost Component [1]	Unit Cost ($/MGY)
Incremental Treatment Cost Savings	$2,700
Conveyance	$7,100
Site Development	$6,400
Land	$1,100
Total	**$17,900**
1. Alternative can handle 730 MG/year (2 mgd year-round)	

5.8.6 Key Advantages and Disadvantages

Advantages

- Constructed wetlands would improve natural conditions in the County by providing additional wildlife habitat and creating additional natural area.
- Degraded wetlands may be improved through addition of treated effluent.
- The County may be able to establish a wetlands bank that could be used to offset impacts to existing wetlands caused by development in the region.

Disadvantages

- Insufficient sites are available to create a large water demand.
- Regulatory restrictions addressing aquifer impact would require most wetlands systems to be lined, increasing costs.
- Wetlands systems create additional operational complexity and maintenance requirements.

- Mosquito generation is a potential problem with some wetlands systems.
- There may be localized public opposition to creation of wetlands using treated wastewater.

5.9 GROUNDWATER RECHARGE

5.9.1 Concept

Groundwater recharge is the use of treated effluent to supplement natural water supply in subsurface aquifers. This practice has been used for decades in the arid Southwest, and has recently become more common throughout the United States. One of the largest and best-known facilities – Water Factory 21 in Orange County, California – began using its 15-mgd reclamation facility in 1976 to replenish the local aquifer that serves nearly 2 million residents. Through development of Washington's Water Reclamation and Reuse Standards, the Departments of Health and Ecology established guidelines for recharge of both potable water and nonpotable water aquifers using treated effluent. Three demonstration projects in Washington, including two in Grant County are currently using reclaimed water for aquifer recharge. Four other projects in Washington are in various stages of planning, design, and construction.

5.9.2 Applicability to Spokane County

Nearly all of the planning area lies over the Spokane Aquifer, with four other aquifers nearby or adjacent to the planning area (Little Spokane River Aquifer, Green Bluff Aquifer, Peone Prairie Aquifer, and Orchard-Pleasant Prairie Aquifer). All of these aquifers are used for potable water supply. Drawing 2-4 in the *Basis of Planning Report* shows the locations of all aquifers in the County.

Groundwater recharge is allowed through both surface percolation and direct injection. With surface percolation, treated effluent would be stored in an infiltration lagoon and allowed to seep into the aquifer through natural percolation. This concept takes advantage of the soil as a treatment system to produce water that meets both drinking water and groundwater quality requirements by the time it reaches the groundwater beneath or down gradient of the recharge site. Figure 5-16 (Schematic Diagram of Surface Percolation System) illustrates this concept.

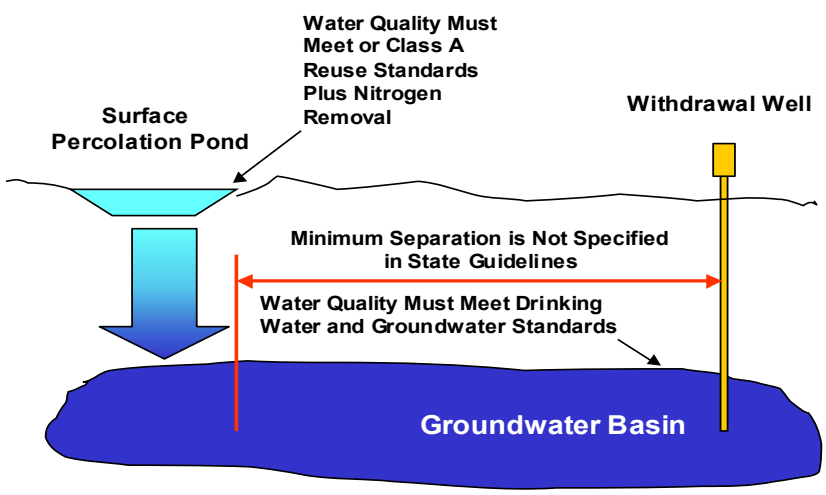

Figure 5-16. Schematic Diagram of Surface Percolation System

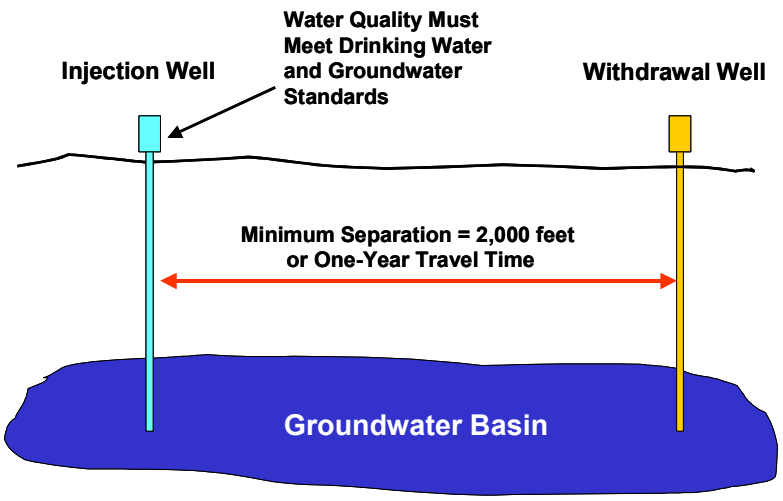

Figure 5-17. Schematic Diagram of Direct Injection System

With direct injection, groundwater is pumped directly into the aquifer through injection wells. Since treatment is not provided through the soil, the injected water must meet all drinking water and groundwater quality requirements. Figure 5-17 (Schematic Diagram of Direct Injection System) presents a schematic of the system.

Two key guidelines in the Reuse Standards determine potential locations for injection wells in potable water aquifers:

- Reclaimed water shall be retained underground for a minimum of 12 months prior to being withdrawn as a source of drinking water supply.
- The minimum horizontal separation distance between the point of direct recharge and withdrawal as a source of drinking water supply shall be 2,000 feet.

Figure 5-18 (Aquifer and Well Locations) shows the locations of aquifers in the Spokane County area, and the locations of wells in the Spokane Aquifer (as cataloged by the County). The figure also illustrates required separation based on the two criteria given above:

- The circle illustrates a 2000-foot radius from a given well location.
- The oval shows the wellhead protection area associated with a 1-year time of travel. This figure was derived from the City's Wellhead Protection Program Phase I Technical Assessment Report (CH2M Hill, 1998). Given the rapid movement of the Spokane Aquifer, the 1-year residence criterion requires a large separation distance between a recharge location and withdrawal well.

The separation criteria, combined with the large number of wells in the aquifer, severely limits locations where groundwater injection wells could be sited. More detailed study of the aquifer would be required to determine if feasible locations are available. One potential approach for the County would be to acquire enough existing wells to create the separation distances established in the standards. Obviously, an alternative water source would need to be provided to users of these wells. Alternatively, groundwater recharge could be practiced in one of the other local aquifers where there is less development and less rapid groundwater movement.

With respect to surface percolation, the reclamation and reuse standards are silent on the issue of minimum separation distances or retention time in the aquifer. Therefore, it is unclear whether the limitations stated above would apply to groundwater recharge using infiltration. This important issue requires clarification by the State.

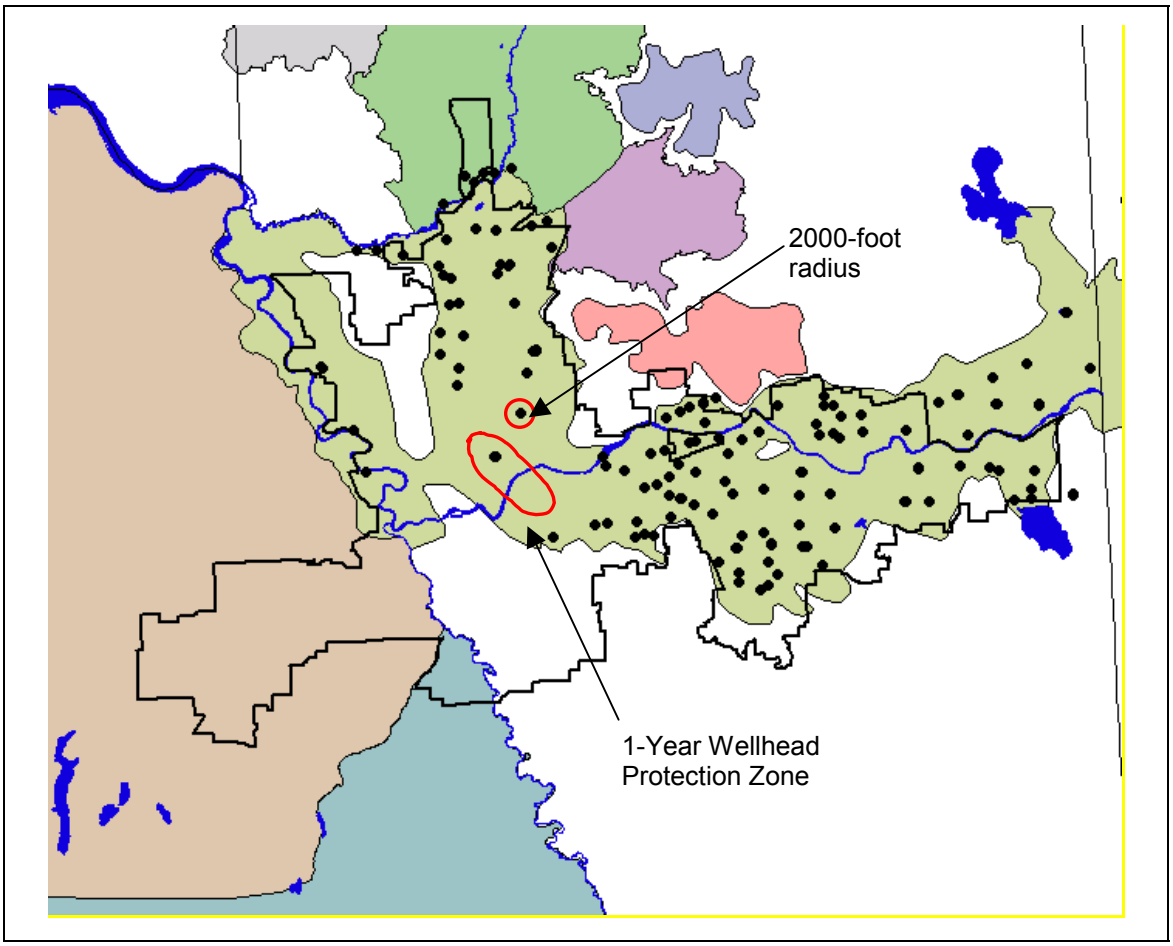

Figure 5-18. Aquifer and Well Locations

5.9.3 Effluent Quality Requirements

Minimum effluent quality requirements for surface percolation are addressed in the general requirements of the State's reuse standards. These standards specify Class A reclaimed water quality plus nitrogen removal. However, the combination of the wastewater treatment plant and the soil treatment provided in the vadose (unsaturated) zone must produce a water quality meeting both drinking water and groundwater quality requirements, including the State's antidegradation policy. By so doing, the total system ensures that "reclaimed water used for groundwater recharge shall be at all times of a quality that fully protects public health and the water quality of waters of the state." Given the porous nature of the sand and gravel soils in the study area, it seems unlikely that a significant level of soil treatment would occur before the recharged water reaches the groundwater table. Therefore, it has been assumed that the water introduced to the percolation ponds must meet both drinking water and groundwater quality requirements.

For groundwater injection, the standards establish both water quality limits and specify a treatment technique. The treated water must comply with drinking water standards plus the following limits:

- Turbidity less than 1 NTU (average) and 0.5 NTU (average)
- Total nitrogen less than 10 mg/L as N
- TOC less than 1.0 mg/L
- Other constituent limits deemed appropriate by Departments of Ecology or Health

The treatment requirements specify a Class A treatment train plus reverse osmosis.

5.9.4 Implementation

For a groundwater recharge project, an Engineering Report must be prepared that provides a complete hydrogeologic characterization of the project site. Specific requirements of this report are specified in the State's reuse standards.

More importantly, implementation of groundwater recharge will require public support. To achieve this, the County will need to implement a comprehensive, long-term public education program to clearly define the benefits and risks associated with the approach.

At a minimum, a pilot project of any proposed treatment/recharge system would need to be completed to demonstrate the ability of the process to protect the area's drinking water supply.

5.9.5 Facility Requirements and Costs

The key facility requirements are associated with treatment, storage and the method of recharge.

Treatment. In addition to the treatment technology considerations listed below under Effluent Quality Requirements, additional redundancy would need to be provided at the treatment facility than that normally provided. All key treatment processes (biological treatment, clarifiers, coagulation facilities, filtration, reverse osmosis, and disinfection) must have redundant units such that the entire flow can be treated at all times with one unit out of service.

With reverse osmosis, a major cost consideration is brine disposal. Given Spokane's location, inexpensive solutions such as ocean disposal are unavailable. Mechanical evaporation of this waste stream may be required.

Storage. Storage requirements for direct injection are mandated for situations in which there is no alternative disposal system. In this case, the storage volume must be three times the average daily flow. If aquifer recharge is used as the only type of effluent disposal, the storage volumes in 2025 and 2050 would be 66 and 82 million gallons, respectively.

Surface Percolation. This is the type of recharge used in Grant County, where liners were simply removed from existing lagoons and percolation tests used to confirm that adequate lagoon area was provided to accommodate all of the anticipated effluent production. The percolation area required is determined by the effluent flow rate, local hydraulic conductivity, the depth of the infiltration pond, and the depth over which water will percolate to reach the aquifer. Based on the discussion in Chapter 4 of the Final Basis of Planning Report, hydraulic conductivity is assumed to be 30 ft/day and the depth to the aquifer is

assumed to be 80 feet. Depending on the depth of water in the infiltration pond (i), required infiltration areas are shown in Table 5-16 (Infiltration Area for Groundwater Recharge).

Table 5-16. Infiltration Area for Groundwater Recharge

		Area (acres) at Height			
Year	Q (cu ft/sec)	5 ft	8 ft	10 ft	12 ft
2000	10.7	0.66	0.64	0.63	0.61
2005	17.2	1.07	1.03	1.01	0.99
2010	23.8	1.48	1.43	1.40	1.37
2015	30.8	1.92	1.85	1.81	1.77
2020	33.7	2.10	2.03	1.98	1.94
2025	35.9	2.23	2.16	2.11	2.06
2030	37.6	2.34	2.26	2.21	2.16
2035	39.4	2.45	2.37	2.32	2.27
2040	41.2	2.56	2.47	2.42	2.37
2045	43.0	2.68	2.58	2.53	2.47
2050	44.7	2.78	2.69	2.63	2.57

Including buffer zones, and sloped sides, the actual infiltration area would likely be double that listed in Table 5-16.

Direct Injection. Direct injection into a potable water aquifer has not been demonstrated in Washington, but if water quality standards are met and adequate separation from drinking water wells is maintained, the infrastructure needs are relatively simple. Design considerations specific to aquifer recharge wells include (Groundwater and Wells, 1986):

- Terminating the injection tube below the static water level and maintaining positive pressure at all times.
- Maintaining full flow to the injection well at all times to eliminate air entrainment.
- Controlling injection pressure to avoid fracture of the formation.
- Providing adequate screens and pumping capacity to accommodate a decrease in recharge rate over time due to clogging.

Cost. The estimated cost for aquifer recharge is driven strongly by the cost of reverse osmosis treatment and brine disposal (approximately $4/gallon). Cost estimates for the recharge options are presented in Table 5-17 (Capital Cost of Groundwater Recharge).

Table 5-17. Capital Cost of Groundwater Recharge

Cost Component [1]	Cost ($ per million gallons per year)	
	Surface Percolation	Direct Injection
Incremental Treatment Cost Savings	$11,000	$11,000
Conveyance	$1,100	$1,100
Site Development	$300	$900
Land	$0	$0
Total	**$12,600**	**$13,000**

1. Alternative can handle 8,000 MG/year (21.9 mgd year-round)

5.9.6 Key Advantages and Disadvantages

Advantages

- Provides the most complete and versatile use of the effluent.
- Groundwater recharge could be used year-round.

Disadvantages

- Public perception of the value of the regional raw water supply is very high, and any efforts to recharge potable water aquifers with treated effluent are likely to be met with skepticism.
- Local water purveyors may oppose the project.
- Treatment costs are very high.
- Brine disposal from the reverse osmosis process would be problematic and expensive

5.10 DISCUSSION OF ALTERNATIVES RELATIVE TO EVALUATION CRITERIA

Comparison of the effluent end-use alternatives with the evaluation criteria is summarized in Figure 5-19 (Comparison of Alternatives with Evaluation Criteria).

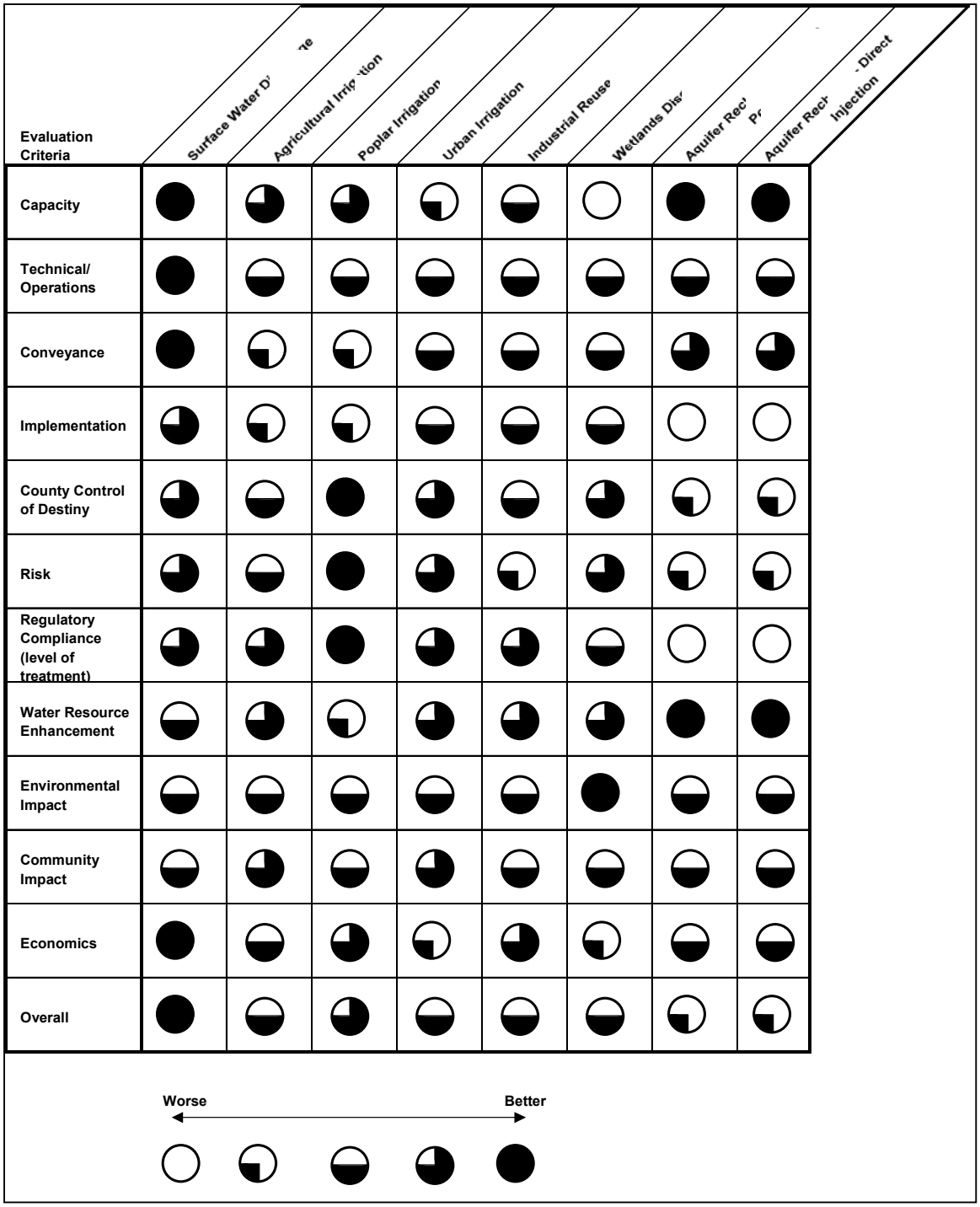

Figure 5-19. Comparison of Alternatives with Evaluation Criteria

5.10.1 Capacity

The capacity criterion addresses the ability of the alternative to handle all effluent produced by Spokane County. In performing this assessment, it has been assumed that the implementation hurdles and regulatory constraints for each alternative have been overcome. Only surface water discharge and groundwater recharge can accommodate all flow produced year-round. Agricultural irrigation and poplar farms can handle all effluent during the summer months, but require discharge to a surface water or some other effluent management strategy during the winter. Industrial reuse at the IEP has the potential to use about 20 percent of the County's projected effluent in 2025 on a year- round basis. Urban irrigation would produce a small to moderate demand for water during the summer months, depending on the extent of the distribution system. The effluent capacity of wetlands systems would likely be very small.

5.10.2 Technical/Operations

From a technical/operational standpoint, surface water discharge is clearly the simplest option. This is the conventional method of effluent disposal, and could be used year-round with minimal operational requirements. Any of the other alternatives require more complicated wastewater management, including some or all of the following:

- Pumping to offsite facilities
- Maintaining offsite facilities (storage reservoirs, infiltration ponds, recharge wells, poplar farms, wetlands)
- Addition of more sophisticated treatment processes
- Coordination of effluent supply with the needs of agricultural, urban, or industrial reuse customers

5.10.3 Conveyance

This criterion relates to the complexity and size of conveyance facilities needed to implement the alternative. Aside from surface water discharge, aquifer recharge through surface percolation requires the simplest conveyance, since it can be located relatively close to a treatment facility and discharge is to a single site. Industrial reuse at Inland Empire would not require conveying treated effluent very far (from a Valley plant); however, significant improvements could be needed to the on-site piping systems.

Conveyance to urban reuse sites and wetlands facilities could be relatively straight forward or complex, depending on the extent of the distribution system. Both the agricultural irrigation and poplar farm alternatives require extensive conveyance systems with high-head pumping.

5.10.4 Implementation

The implementation criterion addresses the number and difficulty of approvals, permits and agreements that must be attained plus the amount of land that must be acquired. Although there are certainly issues to be addressed, surface water discharge would likely be the

simplest alternative to implement. Urban reuse and wetlands were given moderate ratings for this criterion because of the relatively small size of the programs and the likelihood of public and agency acceptance. Poplar farms and agricultural irrigation rated fairly low because they require either purchase of large tracts of land or agreements with many end users. Industrial reuse also rated fairly low because of the lukewarm interest expressed by potential users. Groundwater recharge received the lowest rating because it would be challenging to convince the public and elected officials that this practice would not negatively impact water quality in a potable water aquifer.

5.10.5 County Control of Destiny

Assuming the necessary permits could be attained, the County could implement surface discharge without reliance on another agency or on end users. Similarly, the County would have complete implementation control over a poplar farm solution if adequate land could be acquired. County control is also maintained through beneficial reuse at County-owned offsite facilities such as golf courses or Plante's Ferry Park. If agricultural irrigation is implemented, the County could choose to purchase land and lease the land to farmers, thus maintaining control over the long-term use of and types of crops grown on the land. Otherwise, agricultural reuse would be dependent on agreements with many end users. This also is the case for industrial reuse. Aquifer recharge received a low rating because of the need to gain acceptance from the many water purveyors using the aquifer.

5.10.6 Risk

The alternatives with highest risk are those that involve discharge to potable water aquifers. Regulatory requirements for potable water supplies are likely to become increasingly stringent in the future as analytical methods for contaminants improve and more health effects studies are conducted. Consequently, groundwater recharge practices that may meet regulatory requirements now may be inadequate in the future. Also, groundwater recharge is highly dependent on public perception. Even if the public initially approves the concept, real or perceived problems with other recharge projects around the country could reverse public sentiment.

The industrial reuse alternative has significant risk since it depends on a user that could relocate, experience financial failure, modify operational practices or otherwise change in ways that could eliminate the need for the water.

Alternatives that continue summertime discharge to surface waters also face some risk that future changes in water quality requirements could restrict this practice.

5.10.7 Regulatory Compliance

It has been assumed that all alternatives would be designed and operated to be in compliance with regulatory requirements. Consequently, this criterion addresses the level of treatment that must be provided. The poplar farm alternative would require the lowest level of treatment; whereas, groundwater discharge would require the greatest treatment.

5.10.8 Water Resource Enhancement

Many of the options presented have the opportunity to enhance water resources in the region. Groundwater recharge received the highest rating because it provides the most extensive and versatile use of the treated effluent. Agricultural and urban irrigation, industrial reuse and wetlands received high ratings, particularly if these practices replace current surface or groundwater withdrawal. Poplar irrigation received the lowest rating since the water is consumed as part of the effluent management strategy and does not replace current water withdrawals.

5.10.9 Environmental Impact

Constructing wetlands for effluent discharge would benefit the environment by increasing wildlife habitat. The other alternatives were viewed as having similar impacts on the environment. Those with high pumping or treatment requirements (agricultural reuse, poplar farms and groundwater recharge) would create high energy consumption, consuming natural resources.

5.10.10 Community Impact

The alternatives were considered similar with respect to community impact. The agricultural and urban reuse options received slightly higher ratings since provision of a new water supply may increase property values or facilitate development in water short areas.

5.10.11 Economics

Table 5-18 (Cost Comparison of Effluent End-Use Alternatives) presents the unit capital costs for the alternatives. These are expressed in terms of dollars per million gallons per year of effluent processed. This table also shows the volume of effluent that each alternative can handle in one year.

While there is a wide range in costs between the alternatives, some general conclusions are:

- Surface discharge is significantly less expensive than other options.
- Alternatives that can handle only a small portion of the effluent have high unit capital costs.
- Groundwater recharge has a high unit cost because it needs reverse osmosis treatment.
- Agricultural reuse has a high unit cost because of the need for large storage reservoirs.

Table 5-18. Cost Comparison of Effluent End-Use Alternatives

Alternative	Capacity (MGY)	Unit Cost ($/MGY)
Surface Discharge:		
Spokane River (gravity flow)	8,000	$190
Little Spokane River	1,790	$450
Tributaries	4,000	$7,300
Agricultural Irrigation	4,000	$14,900
Poplar Irrigation:		
Peone Prairie	4,000	$5,100
Palouse	4,000	$6,300
Urban Irrigation	340	$21,200
Industrial Reuse—Option 1:		
Cooling water supply without added treatment	440	$3,400
General mill use supply without added treatment	1,570	$1,700
General mill use supply with added treatment	1,570	$4,400
Split cooling/mill supply with added treatment for mill	1,570	$3,800
Wetlands Discharge	730	$17,900
Aquifer Recharge:		
Surface Percolation	8,000	$12,400
Direct Injection	8,000	$13,000