The Reclaimed Water Technical Committee: A Summary of Activities

March 2006 - December 2006

Regional Water Supply Planning
http://www.govlink.org/regional-water-planning/index.htm

A grant from the Washington Department of Ecology funded some of the activities summarized in this report.

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Overview: Regional Water Supply Planning

Multiple agencies and organizations working together to develop data, information and pragmatic tools to assist in water resource and supply planning activities in the region.

The regional water supply planning process is an effort to develop substantive technical information regarding current and emerging water resource management issues in and around King County. The planning process is generally guided by a Planning Framework developed in October 2005. The Framework outlined a multi-year schedule for studying water resource conditions and management approaches related to meeting the combined needs of water for people and fish from all available sources, including reclaimed water and conservation.

The planning process was initiated as a result of a February 2005 Memorandum of Understanding (MOU) on water resource and water supply planning between King County and the Cascade Water Alliance – a group of eight local governments and special purpose districts in King County. King County initiated the planning process by inviting a large group of stakeholders to participate on a Scoping Committee. Stakeholders included Muckleshoot Indian Tribe, three state agencies, some cities and utilities, two county agencies, Shared Strategy for Puget Sound, and an environmental group.

From the Scoping Committee emerged a framework for a regional planning process that would be led by a Coordinating Committee. This committee's membership was expanded beyond the membership of the initial Scoping Committee to include Pierce County, a business community representative, another environmental organization, and an elected official from the membership of the Suburban Cities Association.

The work of this planning process is being accomplished through seven technical committees in the following topic areas: water demand forecast, water supply assessment, climate change impacts, reclaimed water, tributary stream flows, source exchange strategies, and small water systems. To guide the technical committees, the Coordinating Committee developed and adopted a statement that clarifies the roles of the participants:

Clarifying Statement
Approved by the Coordinating Committee
May 3, 2006

Multiple agencies and organizations are voluntarily participating in a regional water supply planning process for the purpose of identifying, compiling information on, and discussing many of the key issues that relate to or may affect water resources of the region. The goal is to develop the best available data, information, and pragmatic tools that the participants may use, at their discretion, to assist in the management of their respective water systems and resources, and in their water supply planning activities. Information developed by each technical committee is advisory only and development of that information in no way expands or limits the authority of any entity. All information generated will be shared among all those interested in receiving it. The planning process is not required by statue, but is expected to provide useful data that may support other processes that any participant may use to address water resource and water supply issues. Each of the participants is free to accept or reject the results of this process.

The Reclaimed Water Technical Committee: *A Summary of Activities*

Abstract
Regional water supply planning in the state of Washington requires consideration of the opportunities for use of reclaimed water, particularly if the use of reclaimed water will augment or replace the need for potable water (Reclaimed Water Use Act, Chapter 90.46.120 RCW). As part of the Regional Water Supply Planning process, King County convened a self-selected reclaimed water technical committee that included representatives from water and wastewater agencies and the state Department of Ecology.

The original purpose of this technical committee--as described in the planning framework developed by a multi-agency scoping group--was to develop an analysis that could be used to identify reclaimed water opportunities, issues and potential solutions for use in Coordinated Water System Plans. The planning framework also stated that the committee would recommend (1) potential users of reclaimed water and (2) potential for source exchange using reclaimed water as a source substitute. In addition, the scoping group posed five questions for the consideration of the committee:

- Where are the current and future opportunities for the use of reclaimed water?
- Where are the opportunities to use reclaimed water as part of source exchange to benefit vulnerable tributaries?
- Are there opportunities to use reclaimed water for ground application to help augment flows in streams and tributaries identified as vulnerable?
- Is the proposal [sic; there was no “proposal”] by King County cost-effective?
- In evaluating costs and pricing policies for reclaimed water, how should costs be allocated between wastewater and water utilities?

Members of the technical committee, however, decided that selection and evaluation of specific projects was premature in the absence of any generally agreed upon model or tool for analyzing projects. The members also decided that policy questions should be left to the decision-makers of the various agencies. So the committee modified their charter and elected to develop planning-level technical information concerning the use of reclaimed water. A specific objective identified by the committee was to identify a uniform framework that could be used to evaluate the full economic, environmental, and social benefits and costs of potential projects. Such a tool could be used by any agency, at its discretion, to assist in the management of their water systems and in their water supply planning activities.

With its revised emphasis on developing analysis tools, the committee began to investigate benefit-cost analysis and existing models. Two technical tools were presented to the committee for its review and consideration:

(1) a cost model for calculating planning-level costs of producing reclaimed water and (2) a benefit/cost economic framework for analyzing reclaimed water projects and programs. Rather than develop its own economic model or attempt to modify others, the committee elected to review a new framework that was designed to be used by any agency in the country for full cost accounting (economic, environmental and social). This framework was commissioned by the national WateReuse Foundation (WRF) and developed by Dr. Bob Raucher of Stratus Consulting. Under a grant from the

Washington State Department of Ecology, Dr. Raucher conducted two workshops with the Reclaimed Water Technical Committee on the use of the framework.

The committee also had several discussions about issues that affect the production and use of reclaimed water in this region. Some potential users of reclaimed water were identified and mapped, although this initial effort needs to be refined. Committee members had differing levels of familiarity with reclaimed water. The committee did not attempt to develop solutions to long-standing policy and jurisdiction questions or to evaluate opportunities for source exchange or enhancement of vulnerable streams.

Members of Reclaimed Water Technical Committee:

Lead: King County	Peggy Leonard
Alderwood Water & Sewer	Arden Blackledge
Auburn, City of	Jeff Roscoe
Bothell, City of	Gary Sund
Cedar River Water & Sewer	Walt Canter
Covington Water District	Judy Nelson
Kent, City of	Greg Reed
King County	Jane Lamensdorf-Bucher
Lakehaven Utility District	Don Perry
Redmond, City of	Scott Thomasson
Sammamish Plateau Water & Sewer	Lisa Tobin
Seattle Public Utilities	Bruce Flory, Terry Martin
South King County Regional Water Association	Don Wright
Tukwila, City of	Pat Brodin
Washington State Department of Ecology	Kathy Cupps, Paul Fabiniak
Woodinville Water District	Geoff Clayton
Facilitator	Mike Sharar

Committee Support:
Erika Peterson
Elizabeth Elliott
Steve Gilbert
Laurie McCray
Shari Cross (GIS)

Committee Charter

The Coordinating Committee proposed a charter for the Reclaimed Water Technical Committee (see Appendix A). That charter outlined that the purpose of the Reclaimed Water Technical Committee was to provide technical information concerning the use of reclaimed water (demands, alternatives, costs of production and conveyance, and environmental benefits). The information and work products developed were to be suitable for inclusion in new or updated Coordinated Water Supply Plans (CWSPs) in King County, as well as for planning and water resource management decisions in areas not covered by CWSPs and in the watersheds of the major WRIAs (water resource inventory areas) of King County. The charter called for the final report to contain:

- an analysis of the costs and benefits of using reclaimed water as an alternative source of supply
- a set of reclaimed water projects recommended by the committee that could occur within the King County Wastewater Treatment Division (KC WTD) service area
- recommendations for actions to remove barriers and constraints to the use of reclaimed water
- a plan for introducing the recommendations to various governing bodies including district commissioners, Metropolitan Water Pollution Abatement Advisory Committee, the King County Council and its Regional Water Quality Committee

The original charter proposed several other work products:

- maps showing the current and 2020 reclaimed water availability in the KC WTD service area and areas of potential demand
- the cost of reclaimed water from the WTD system
- an evaluation of revenue sources other than the wastewater rate.

However, in its early meetings, the committee decided that selection or recommendation of specific projects was premature in the absence of any generally agreed upon model or tool for analyzing projects. The members also decided that policy recommendations should be left to the decision-makers of the various agencies. So the committee revised its charter and shortened it to the paragraphs below (see shaded box). The evaluation framework described below would be a tool that could be used by any agency, at its discretion, to assist in the management of their water systems and in their water supply planning.

Proposed Working Draft Charter
Developed by the Reclaimed Water Technical Committee
May 2006

The purpose [of the committee] will be to provide planning-level technical information concerning the use of reclaimed water. A specific objective of the committee is to identify a uniform framework that may be used by any agency to evaluate the economic, environmental, and social benefits and costs of potential projects.

The information and work products developed will be consistent with the “clarifying statement” and the Web site home page of the Coordinating Committee. The committee will also identify policy issues and recommendations to be addressed by appropriate governing and policy-making bodies.

Differences of Opinion and Perspective

There were differences of opinion among committee members on some fundamental issues of regional water resources management. These differences were so profound that they interfered with progress on the original charter and led to development of the abbreviated charter on the previous page (shadow box). Some examples of areas of dissent were:

(1) Water Supply – some agencies stated that most of the region has sufficient water supply for 50+ years. However, other agencies said they needed or wanted alternative sources of water now.
(2) Improvements to Puget Sound – some agencies are under regulatory pressure to reduce discharge of wastewater effluent to the Sound. Other agencies believe that discharge of Class A water or reducing the volume of discharges to the Sound would have negligible effects.
(3) Brightwater – some agencies were so dissatisfied with the County's decision to build the reclaimed water Backbone that they would not move forward with any discussions about reclaimed water, which might be perceived as an endorsement of the Brightwater reclaimed water system. Other agencies did not want to discuss the Brightwater system; they wanted to discuss options for reclaimed water in their own districts.

From the earliest committee meetings, it was apparent that there was no consensus on the need for reclaimed water in central Puget Sound, the drivers for its use or the magnitude of its benefits. However, committee members did find common ground in their desire to (1) learn more about reclaimed water and (2) find an evaluation tool that could be useful in analyzing projects. This report summarizes the committee's activities in pursuit of these two goals.

Developing a Knowledge Base on Reclaimed Water

Many committee members wanted to learn more about reclaimed water and its use in this region. Several guest speakers were invited to present information on their programs or, in the case of the Department of Ecology, information on the state's existing policies and guidelines. Summaries of these presentations are provided in the next section. As a prelude to the committee's main tasks, committee members brainstormed factors that should be considered when evaluating reclaimed water in this region. Over the course of several meetings, they developed lists of issues to consider--some issues that could be classified as benefits and some as barriers to reclaimed water use. (Although some of the items on these lists may not be actual benefits or barriers, all comments are reproduced here as they were described, without editing, since they represent the contributions and thoughts of committee members in the brainstorming sessions. These lists were taken from meeting summaries that were approved by the committee.)

Regulatory/Operational

- The state requires future water supply planning to include consideration of reclaimed water.
- Regulatory agencies (Washington Departments of Natural Resources and Ecology) expect King County and other wastewater service agencies to make progress in reducing discharges to the Sound; reclaimed water is one way to do this.
- Water rights: The misuse of exempt wells and other water rights issues, if corrected, could create a market for reclaimed water.
- Reclaimed water can reduce regulatory burdens for new water sources.
- Water rights policy issues are complex.
- Summer irrigation is a key water supply issue in our region. However, we need greater wastewater capacity in the wet winter. We need infrastructure to meet both needs.

Opportunities

- The committee reviewed a public survey showing strong support for reclaimed water, including a willingness to pay more for it.
- New wastewater technology is leading to cleaner products like reclaimed water. It would be irresponsible not to use these products.
- Reclaimed water offers opportunities for indirect potable and aquifer recharge. (Although King County is not pursuing those options at this time, some members feel they will be considered in the future.)
- Treatment levels can vary by use (and possibly costs) to create the "right water for the right use."
- Reclaimed water can be used for public safety, such as fire prevention.
- Reclaimed water can offer flexibility for the future, allowing the region to:
    - Leave more water in streams for fish
    - Support a growing population
    - Prepare for climate change

Water supplies

- Certain areas in the region are facing insufficient water supplies. Reclaimed water could augment the water supply for non-potable uses in specific areas.

- Satellite plants could offer reclaimed water in specific areas that are far from regional treatment plants.
- As a drought-tolerant supply, reclaimed water could:
  - Supplement the region's water supply portfolio, increasing reliability
  - Mitigate climate change impacts such as loss of snowpack.

Environment

- Use of reclaimed water can reduce summer irrigation withdrawals from the region's waterways, which could:
  - Benefit instream flows
  - Improve stream temperatures
  - Replace water in hydrologic cycle closer to where it was withdrawn (re-hydrate watershed)
  - Leave more water in streams for fish.
- Using reclaimed water promotes environmental stewardship (conservation).
- Using reclaimed water would reduce discharges to receiving waters from wastewater outfalls.
- Although people in the King County area generally support protecting the environment, it can be challenging to quantify the value of specific environmental benefits
- There may be multiple ways to achieve specific benefits.
- To ensure safety to environment and people, we are continuing to learn more about emerging issues such as endocrine disrupters and thermal issues.

Economy

- Reclaimed water can provide increased reliable water supplies to farmers to help them stay in business.
- It can foster economic development of water-dependent businesses.
- Reclaimed water can extend existing water supplies to handle new growth in the region.

Recreation

- Used for irrigation, reclaimed water supports golf courses and sports fields.
- Reclaimed water can keep water in streams during summer recreation season.

Cost/financing

- Reclaimed water infrastructure could have high capital costs. Doing nothing could have costs to the economy and the environment.
- There are a number of issues to consider when establishing fairness about who pays:
  - Different geographic regions have different proximity to reclaimed water.
  - Using wastewater or water rates to fund environmental benefits is complex. General purpose agencies and single purpose agencies have different levels of flexibility in how funds can be spent.
  - The water and wastewater ratepayer base is smaller than the wider community that would benefit from reclaimed water. The larger community includes individuals on wells and/or septic systems who do not pay rates, but who would enjoy environmental benefits.
  - There is concern about potential for stranded costs for water suppliers.
  - It may be important to distinguish reclaimed water costs from wastewater treatment costs.
- It is a challenge to price reclaimed water rates in areas with low potable water rates.

Presentations made to the Technical Committee

(Copies of slides are located in Appendix C)

State Policies for Reclaimed Water – April 7, 2006
Kathy Cupps, Agency Lead for Reclaimed Water, Washington State Dept. of Ecology

Kathy discussed the Washington State Department of Ecology's mission to protect and restore the environment, including water quality and quantity. She reported that Department Director Jay Manning has described reclaimed water as an underutilized resource. Ecology believes that reclaimed water use is a fundamental element of our state's strategy to provide sustainable water supplies that will meet our future needs. Ecology also supports the use of reclaimed water whenever feasible or practical, although it may not be the least expensive option. Ecology recognizes that economic forces may be unlikely to create a market today, but will work with project proponents to make it more workable in the future.

The Reclaimed Water Use Act, Chapter 90.46 RCW, is the law governing reclaimed water use in Washington. State law encourages reclaimed water use, requiring consideration in both wastewater and water supply planning.

Anyone who generates reclaimed water must obtain a state reclaimed water permit before using the water. The reclaimed water permit includes requirements for treatment, public health protection, water quality, monitoring, distribution, and use of reclaimed water. Whenever the water is transferred to another party for distribution or use, the permittee must transfer under a legal contract assuring proper and safe water use.

Reclaimed water is considered a new water supply. The owner of the reclaimed water facility receives an exclusive right to the use, distribution of the water, and exemption from water right permitting requirements. However, the owner may not be able to divert reclaimed water from an existing effluent discharge location if this would impair existing downstream water rights.

An impairment analysis is required to evaluate whether existing water right holders might be impaired when a reclaimed water facility decreases or eliminates its discharge of wastewater. In complex situations, Ecology is able to provide assistance with the impairment analysis if contacted early in the planning process.

Kathy directed the group to state standards that describe the various classes of reclaimed water and their specific uses. She handed out a new Ecology publication, *Case Studies of Reclaimed Water Use in Washington State*. She showed the committee a copy of EPA's federal guidelines for reclaimed water and encouraged all members to order a copy from EPA.

Listed below are links to information provided by Kathy:
Everything below is accessible through this site:
http://www.ecy.wa.gov/programs/wq/reclaim/index.html

Specifically, Kathy encouraged committee members to review the following for basic information:
The Washington Reclaimed Water Use Act - Ch 90.46 RCW

http://apps.leg.wa.gov/RCW/default.aspx?cite=90.46

Reclaimed Water Standards:
http://www.ecy.wa.gov/programs/wq/reclaim/standards.pdf

Reclaimed Water - Answers to Frequently Asked Questions
http://www.ecy.wa.gov/biblio/0510012.html

Case Studies in Reclaimed Water Use (in Washington State)
http://www.ecy.wa.gov/biblio/0510013.html

Water Reuse Planning for Washington State (2003)
http://www.ecy.wa.gov/biblio/0310061.html

Links to Other State, Federal and Non-profit Organizational Resources:

(California, Florida, USEPA, WateReuse Assoc., WEF, AWWA, etc.)
http://www.ecy.wa.gov/programs/wq/reclaim/index.html#Links

EPA 2004 Guidelines for Reclaimed Water
http://www.epa.gov/ord/NRMRL/pubs/625r04108/625r04108.pdf

A Model for Estimating Cost to Produce Reclaimed Water – April 7, 2006
Jim Hegstrom and Alison Payauys, Carollo Engineers

Committee members reviewed a model for estimating the cost of producing Class A water from various points in the King County wastewater treatment system. The model, developed by Carollo Engineering, runs on Excel and is available upon request.

The model uses information on treatment facility construction costs to determine how much it will cost to produce reclaimed water at a facility, such as a treatment plant or satellite plant. The model shows the cost of water at the facility and does not include cost of distribution to users.

The model considers two sources of water:

- Secondary effluent from South Plant & West Point
- Raw sewage in wastewater pipelines

Note: The model contains a cost/cubic foot for water from Brightwater. This number represents the cost of the pipeline only. Because Brightwater will produce reclaimed quality water from its treatment process, no costs were added for production of reclaimed water. The Brightwater cost number was not developed by the model (since the model does not estimate distribution system costs), but was provided for comparison with other projects.

The model was developed as a tool to come up with planning-level comparative costs quickly and easily. It provides the ability to adjust the costs for site-specific circumstances and to compare projects to one another. There are many additional factors to consider to make a

decision. In fact, the purpose of the model is not to make a decision but to compare costs of alternatives. The model is still in the draft stage.

The model includes several assumptions that can be changed to fit the project being analyzed. It contains 30 Excel worksheets linked together to evaluate different cost assumptions. The model's spreadsheets can also be modified to put in different design and financial parameters.

For example, the annual cost and the average daily cost of reclaimed water are influenced in the model by the length of our relatively short irrigation season. Some reclaimed water uses, such as industrial, would have a longer period of use, which would substantially change the average daily cost of producing reclaimed water.

The model has been reviewed for accuracy by a leading manufacturer of membrane bioreactor treatment systems. The Carollo consultant team tested it by evaluating several existing projects, including the previously proposed reclaimed water plant in the Sammamish Valley, and the model accurately represented their costs.

The model is based on production capacity and cost to produce reclaimed water. It does not evaluate demand or other factors that might go into a decision on reclaimed water. The estimated costs per ccf of water are based on the capacity of the plant and make no assumptions about sale of the water.

The estimated costs include operations and maintenance costs, taking into account the need to start and stop for each irrigation season, labor, and chemicals. These factors can be adjusted for a specific plant, for example, using tablet chlorination instead of other disinfection alternatives.

The model can accommodate site-specific adjustments. For example, using generic assumptions, a class C project on the South Effluent Transfer System (ETS) might be $2.19 per ccf. However, by making adjustments for a specific case right off the ETS, the costs come down significantly.

The model assumes lifecycles of 15 years. At present, the model is being adjusted for inflation and commodity manually, using *Engineering News Record* estimates.

Each utility would need to estimate additional conveyance costs using its own conveyance cost curves. Acknowledging differences between utilities, the model does not assume specific allied costs, such as agency administration, land acquisition, public involvement, environmental review, or permitting. Those would need to be added to the model for a specific project in a specific locale.

The model does not evaluate benefits such as avoided costs, which could change the cost dramatically.

The Brightwater Backbone – September 15, 2006
Don Theiler, Director, King County Wastewater Treatment Division

Because several committee members were interested in King County's decision to construct a reclaimed water backbone for the Brightwater Treatment Plant, they requested that Don Theiler make a presentation to the Reclaimed Water Technical Committee on this subject.

Wastewater's Vision for the Future
Don pointed out that wastewater treatment is growing more difficult. Every day brings new issues: concerns about emerging contaminants such EDCs (endocrine disrupting chemicals) and phthalates to name two. Another issue is pressure on the County to reduce discharges to the Sound, from environmental groups and increasingly strict regulations from Ecology. Water users with illegal water rights will eventually get pressured to stop their practices. Reclaimed water can reduce discharges into the Sound with the added bonus of providing an alternative source of water.

Don explained the Wastewater Treatment Division's vision for the future, developed by its management team: Creating Resources from Wastewater. This vision is demonstrated by recycling biosolids, generating and using energy (gas) from digesters, and reclaiming water. It will be some time before any of these programs realizes large revenues – in fact, some may think that sending biosolids to the landfill is a better solution – but recycling is the right thing to do.

Decision to Build the Backbone
Don emphasized that the decision to use MBR (membrane bioreactor technology) at Brightwater was made wholly for water quality purposes for the Sound discharge and was completely free from the issue of reclaimed water for water supply. The decision to pursue the use of reclaimed water followed the realization that MBR technology creates Class A reclaimed water; it just didn't make sense to discharge that into the Sound when it could be put to beneficial use.

The fact that the Washington State Department of Natural Resources (DNR) wouldn't approve a "water dependent" Brightwater discharge into the Sound provided yet another reason to move forward in the direction of building reclaimed water conveyance for supply. An additional benefit is that reclaimed water adds a drought-resistant source of water.

When asked by committee members why the Backbone discussions didn't address aquifer recharge, Don explained that he prefers agronomic uses because he still has concerns about certain pollutants, concerns not answered to date through aquifer recharge research. Committee members suggested keeping aquifer recharge potential as a regional placeholder for future discussion.

Don said that because he had heard numerous rumors and comments relating to exactly when King County began planning for the Backbone, he was taking this opportunity to put any myths to rest that County staff had the Backbone plan ready to spring on the County Council at the last minute. He said that it was only after DNR refused their water-dependent discharge permit that King County WTD started thinking of alternatives.

Don repeated that the Council decision to fund Backbone Phase 1 results only in permission to place purple pipe inside the influent/effluent pipe (west and south legs); additional phases must be Council-approved on a per-case basis, and actual conveyance of reclaimed water begins in Phase 2.

Don said that the County won't really know if the Backbone will pay for itself until about 10 years into operation but the County believes user fees from the south leg could pay for the entire project. In the event that user fees would not cover the costs, the County projects that ratepayers would pay 10 cents per month or less – and Don doesn't foresee having to charge even that. He repeated that the County will not proceed with Phase 2 until it has customers in place and Council approval. He said much study and analysis will take place before considering Phase 2, including the Regional Water Quality Committee's request that the County conduct a Reclaimed Water Feasibility Study by December 2007.

Don said because King County prefers to focus its attention on its conveyance and treatment facility operations, the County's preference is to provide reclaimed water as a wholesaler, not a retailer. He said that while the County will own the purple pipe, he believes that water purveyors should retail the reclaimed water.

In conclusion, Don said that while there had been mistrust, wrong information, and rumors concerning the Backbone, at the end of the day he feels everyone wants the same thing: a clean, reliable water supply that exceeds standards while protecting and preserving people, wildlife, and natural resources such as local streams and the Puget Sound. He said we shouldn't feel threatened when discussions turn "lively" because the important thing is having a venue to discuss issues.

Report of Tributary Streamflow Technical Committee – October 6, 2006
Holly Coccoli, Committee Co-Chair

Holly Coccoli, fish biologist for the Muckleshoot Indian Tribe, presented the results of the Tributary Streamflow Technical Committee's work. The committee identified and prioritized flow-impaired streams whose salmon runs could potentially benefit from instream flow restoration. The full report may be seen at: http://www.govlink.org/regional-water-planning/tech-committees/trib-streamflow/index.htm

Use of Reclaimed Water in Washington – December 1, 2006
Kathy Cupps, Agency Lead for Reclaimed Water, Washington State Dept. of Ecology

Kathy's presentation was based on the new Department of Ecology publication *Case Studies in Reclaimed Water Use: Creating New Water Supplies Across Washington State*, which can be ordered online from the Ecology Website: http://www.ecy.wa.gov/programs/wq/reclaim/index.html This publication is invaluable for those interested in reclaimed water programs. It includes the following operating or planned reclaimed water programs:

City of Sequim, Clallam County
Sunland Sewer District, Clallam County
North Bay/Case Inlet, Mason County
The LOTT Alliance, Thurston County
City of Yelm, Thurston County
King County Wastewater Treatment
City of Walla Walla, Walla Walla County
City of College Place, Walla Walla County
Holmes Harbor Sewer District, Island County
City of Ephrata, Grant County
City of Royal City, Grant County
City of Quincy, Grant County
City of Snoqualmie, King County
City of Medical Lake, Spokane County
City of Cheney, Spokane County

More facilities are engaged in various stages of planning, design, or construction. Several

tribal governments within the state of Washington are also planning and constructing reclaimed water facilities. The publication contains the following information about each project: why each facility chose to produce reclaimed water and the creative ways in which they have used the water, outreach and planning, treatment methods and financing. Each study provides a picture of the decisions made, lessons learned, and problems solved. Uses of reclaimed water from these facilities include crop and landscape irrigation, toilet flushing, dust control, construction water, industrial cooling, created wetlands, ground water recharge, and stream-flow augmentation. For more information, contacts for each project are listed at the end of each case study.

Committee members noted that each project was unique. There were a variety of drivers, funding sources, and uses for reclaimed water represented by the projects. Some tended to be water supply driven, others driven by wastewater utility needs. Some wastewater utilities were discharging to fresh water and others to salt water.

Kathy clarified that state law requires reclaimed water be considered in all but the smallest water systems. She said the legislature has been very clear that reclaimed water is in the best interest of the state, and the departments of Health and Ecology are striving to make reclaimed water workable and successful.

LOTT's Experiences with Reclaimed Water – December 1, 2006
Karla Fowler, Planning and Programs Director, LOTT Alliance

The LOTT Alliance is a partnership of four governments: Lacey, Olympia, Tumwater, and Thurston County. LOTT's main wastewater treatment plant, the Budd Inlet Treatment Plant, is located between downtown Olympia and the Port of Olympia peninsula. LOTT treats about 10 million gallons a day of wastewater to "advanced secondary" standards, and most of that water is discharged into Budd Inlet at the southern end of Puget Sound.

Why reclaim water? Their communities want them to do it. LOTT's long range planning, conducted from 1995-1999, identified the need for future wastewater treatment capacity. The public told them they shouldn't be wasting water, or more specifically: "Treasure LOTT's treated wastewater as a valuable, long-term resource to be cleaned and restored, reused, then ultimately returned to the environment." This reflects the strong environmental ethic of their constituents. The beginning of long-range planning in 1995 was the beginning of an 11-year process to produce and distribute reclaimed water.

LOTT's long-range Wastewater Resource Management Plan is based on providing satellite treatment facilities throughout the service area. They plan to build incrementally, "just in time" as water is needed, a system of 3 satellite plants that will produce the highest quality (Class A) reclaimed water. That water will be available to all the partner jurisdictions and for irrigation, industrial uses and groundwater recharge. Map on the slide shows the Urban Growth boundary for their jurisdictions in relation to their facilities.

LOTT's first reclaimed water plant was built at the Budd Inlet Treatment Plant.
This sand filter system was completed in 2005 and became fully operational for the first time this year (2006). It takes a portion of the already-treated water from the Budd Inlet Plant – up to 1 mgd – and filters it further to Class A standards. From the plant, the reclaimed water is sent through a pipeline through Downtown Olympia – Olympia Avenue and Columbia St – through Heritage Park, and across Capitol Lake to LOTT's Capitol Lake Pump Station.

Along the way, that water gets put to use.

LOTT is a wastewater utility, not a water utility. Their 3 city partners do operate water utilities, and will be serving as the water utilities for the reclaimed water LOTT produces.
The City of Olympia serves as the water utility for the water coming from the Budd Inlet Plant. There are current three users of that water: State Department of General Administration, Port of Olympia and City of Olympia. The Dept. of General Administration began using reclaimed water for irrigation at the state's Heritage and Marathon Parks in July 2006, after an official "valve-turning" celebration.

Construction of their first satellite plant–the Hawks Prairie Reclaimed Water Satellite Plant–is nearly complete. It is located on Martin Way in Lacey. It was built initially to treat 2 mgd, and is expandable to 5. This satellite uses a different technology for producing Class A reclaimed water: a membrane bioreactor.

See slides for pictures of the main control building, underground process tanks, and membrane filter building, with racks of membrane cartridges that look like strands of thin spaghetti. There are microscopic holes in the sides of the strands. Water is drawn through those holes, leaving pollutants and solid material on the outside. The cleaned water is disinfected with a form of chlorine and solids are sent to the Budd Inlet Plant.

Cleaned water from Hawks Prairie is piped 3 miles to a 40-acre site that contains a series of constructed wetland ponds and groundwater recharge basins. (However, the water is available for other uses along the pipeline between the treatment plant and the ponds.) The reclaimed water circulates through the ponds, and then ultimately goes to the recharge basins to infiltrate to ground.

The site is open to the public from dawn to dusk. It has walking trails, benches and 4 kiosks that include interpretive exhibits. Public education is a primary purpose of this site.
It provides an opportunity to see reclaimed water up close and interpretive panels help tell the story. LOTT's extensive public education and information program also includes workshops with elected officials, utility staff members, and presentations to service clubs.

Finding property for future satellite plants is challenging, given the amount of growth and development in their region. LOTT is studying the option of piping reclaimed water from Budd Inlet plant to Tumwater rather than constructing a satellite plant.

An interagency Reclaimed Water Policies Task Force has spent more than 5 years identifying and addressing more than 40 policy issues related to distribution and use of reclaimed water. Most issues are resolved through a series of Interlocal, Distribution, Supply and End User Agreements. The agreements strive to offer a regional resource approach while preserving each jurisdiction's operating autonomy.

Committee members had questions about reclaimed water rates and availability. LOTT's reclaimed water facilities are paid for with monthly sewer rates and connection fees so that growth pays for growth. LOTT does not assume cost recovery from water users. The three cities are the reclaimed water purveyors and LOTT provides the reclaimed water to them for a nominal fee. Olympia set its reclaimed water rate at 70% of potable.

In some parts of the country, people pay the same rate for both types of water and the reclaimed water supply is backed up with potable. In other areas reclaimed water costs more,

but it is guaranteed (meaning not interruptible). Karla pointed out that in LOTT's service area, each city maintains its autonomy to make these decisions about purveying reclaimed water.

Members of Reclaimed Water Technical Committee clarified that during this start-up phase at Hawks Prairie, most reclaimed water is going to infiltration, while irrigation and other types of users and customers are developed. Karla clarified that the three cities look at reclaimed water as a new source of supply and have built it into their water plans. Using the water for recharge at present does not allow the cities more access to groundwater, although negotiations continue on that topic with Ecology. One committee member cautioned that there might not be as much opportunity to use groundwater recharge in King County.

Woodinville Water's Experience with MBRs (Membrane Bioreactors) – December 1, 2006
Ken McDowell, District Engineer, Woodinville Water District

Geoff Clayton, Commissioner for the Woodinville Water District, introduced district Engineer Ken McDowell, who described the District's experience with a very small membrane reactor system for treating wastewater from the District's offices.

The Kubota MBR system has been installed underground, consisting of three chambers and an equipment vault. The District still has a septic system in a mound that receives effluent from the MBR.

The smallest MBR unit available is 3000 gallons per day (gpd). The district has only 300 gpd of wastewater, so the unit operates at 10% of design capacity. Because this small system was an unusual application of the technology, the district faced permitting challenges. They had to work with the local health department and the state departments of Health and Ecology and finally received a permit for an experimental or pilot system.

Ken said that MBRs require more attention than a septic system: monitoring the biological system and the equipment, removing the waste solids. The system operates with a much higher solids retention time than conventional treatment systems. The small openings in the membrane (0.4 microns) provide the physical barrier required to remove coliform bacteria.

The group discussed specific issues like the need for backup power and the need to monitor or screen what enters the MBR. Ken described a challenge with a specific cleaning product the district used in new waterless urinals that appeared to negatively affect the micro-organisms in the MBR system. With that exception, the system works well and produces a high quality effluent.

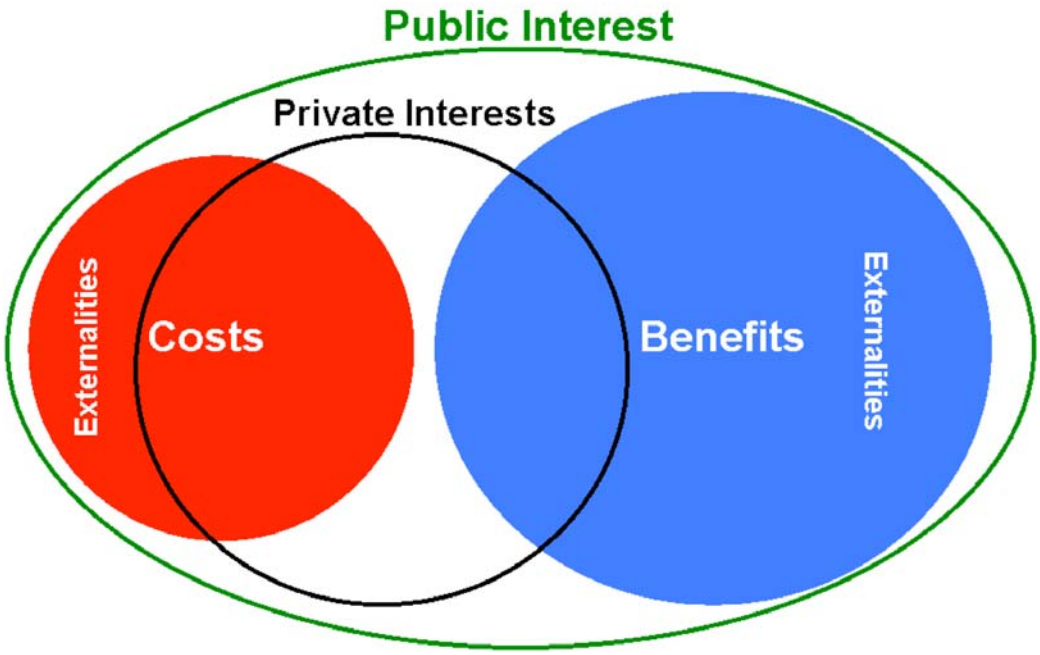
The committee determined that its primary objective would be the identification and review of a decision framework that could be used to evaluate the full economic, environmental and social benefits and costs of potential projects. The committee agreed that introductory material on benefit-cost analyses would be helpful before undertaking a more detailed examination of an economic decision-making framework. Seattle Public Utilities economist and committee member Bruce Flory volunteered to prepare a primer on benefit-cost analysis for the benefit of committee members. He has provided the following text version of his presentation; see Appendix C for a copy of the slides.

An Introduction to Benefit-Cost Analysis

Presentation by Bruce Flory, Seattle Public Utilities

As the name implies, ***benefit-cost analysis*** is a systematic evaluation of the advantages (benefits) and disadvantages (costs) of a set of alternative actions. Typically, a base case is compared to one or more alternatives. It entails adjusting conventional business profit-and-loss calculations to reflect social instead of just private objectives, criteria, and constraints. A ***full social cost accounting*** identifies and accounts for *all* benefits and costs of potential actions (financial, environmental, and social), even those that do not have readily observable market values.

Private and public entities assess benefits and costs differently. While a private company is interested in only the benefits it can capture and the costs it must pay, a governmental agency should consider all benefits of a project no matter who receives them, and all costs regardless of who bears them. This difference in the perspectives of private and public entities is illustrated in the diagram below (following page).



Costs that a private company doesn't have to pay and benefits that it cannot collect are known as ***externalities***. For example, a private decision to drive to work will probably consider the costs of fuel, maintenance, and parking but not the "external" costs that one more driver imposes on the rest of society. These externalities include increased traffic congestion and higher levels of greenhouse gases and other pollutants. An example of a positive externality would be the case of a landowner who, by choosing not to develop her land, preserves a water recharge source for an aquifer shared by the entire community. A benefit-cost analysis tries to draw a circle around all the costs and benefits, "***internalizing***" all the externalities.

Several other concepts are central to understanding the reasoning behind benefit-cost analysis. These are scarcity, choice, opportunity cost, and efficiency. ***Scarcity*** refers to the fact that we live in a finite world with limited resources but seemingly unlimited wants. We must therefore make ***choices*** in how we use our time, labor, capital and natural resources. And every choice has an ***opportunity cost***, i.e., the benefits we could have had if we had made a different choice. While the cost of a good or service often is thought of in monetary terms, the opportunity cost of a decision is what must be given up (the next best alternative) as a result of the decision.

Finally, ***economic efficiency*** is the ratio or proportionality between the values of the human objective achieved ("benefits" or "satisfactions") and the value of the scarce resources expended to achieve it (opportunity costs). When an economist calls a situation or a practice "inefficient," he is claiming that we could achieve exactly the same desired goals with the expenditure of fewer scarce resources, or, put another way, that the amount of resources being employed could potentially produce even more of the beneficial results intended than they do. Efficiency simply means making the most we can of the limited resources we have – getting the most "bang for the buck."

The goal of benefit-cost analysis is more than simply determining whether a project's benefits exceed its costs. It's to identify which project among all the alternatives produces the greatest ***net*** benefits, i.e., the project with benefits that exceed its costs by the largest margin. Such a project achieves the goal of economic efficiency.

Moving away from high concept and more into the nuts and bolts of benefit-cost analysis is the issue of finding a common unit of measure. The problem is the standard economist cliché, "you can't compare apples to oranges." Before all the costs can be totaled and subtracted from the sum of all the benefits, everything must be expressed in the same units, and the traditional choice of units is dollars. While dollar values for many components of benefit-cost analysis are easily obtained – for example, the land, labor, capital, and resources used in building a project – others require more effort. If a project results in reduced traffic congestion (driver hours), reduced cancer risk (deaths per million), or improved habitat for endangered species (spotted owls per acre), the challenge is to translate these different units into dollars. Ideally, all benefits and costs can be quantified in dollar terms.

Even when that has been accomplished, there remains one more step because not all dollars are equal. A dollar a year from now is not worth as much as a dollar now. A dollar 10 years from now is worth even less. Why? There are three reasons: time preference, the

opportunity cost of capital, and risk.[1] If you ask me for $100 now and promise to pay me the $100 back in a year, I'm going to say no. If I give you that $100, I'll lose the option of using it myself to buy something I need or want right now. I'll also lose the option of saving that $100 and earning interest. Finally, there's the risk that you will not pay me back as promised. So to get that $100 from me now, you'll have to promise to pay me back more than $100 a year from now. The extra amount that must be paid, expressed as a percentage, is the discount rate. If I'm just willing to give you $100 in exchange for your promise to repay me $105 in one year, my discount rate is 5%.[2] In other words, $100 a year in the future is worth 5% less to me than it is now.

This concept is used to convert the dollar value of benefits and costs that will occur in various future years to "present values," a common unit of measure that allows "apples to apples" comparison. The present value of a future benefit is equal to its future value in real dollars reduced by the discount rate (say 5%), as many times as the number of years in the future the benefit will occur.[3] Calculating present values is one of the necessary tasks in conducting a benefit-cost analysis.

The other basic steps of benefit-cost analysis are summarized below:

- Identify the problem(s) to be solved. Determine objective(s).
- Define the "baseline," i.e. what will happen if no action is taken.
- Identify possible alternatives for solving the problem/achieving the objective.
- Identify all benefits and costs for each alternative.
- Quantify benefits and costs in real dollars.
- Calculate Present Values (PV) of all benefits and costs
- Calculate the Net Present Value (NPV) for each alternative. The NPV is the PV of all the benefits minus the PV of all the costs.
- Identify the preferred alternative, usually the one with the highest NPV. (In some circumstances, it's more appropriate to use benefit/cost ratios.)

Some of these steps sound easy enough but are often difficult to accomplish in practice. Probably the biggest challenge for benefit-cost analysis is quantifying all benefits and costs, especially environmental externalities, in dollars. Externalities, by their very nature, are often characterized by a paucity, if not the complete absence, of hard data. For example, consider a potential reclaimed water project that could provide water to a several farms, parks, and golf courses, allowing them to reduce withdrawals from their own wells that are believed to be in hydraulic continuity with a nearby stream with less than ideal flow and temperature conditions for various types of fish including one endangered species. Scores of questions would have to be answered to quantify the environmental benefits: How would the reduced well withdrawals affect ground water levels? What is the extent of hydraulic continuity between ground water and the stream? What is the temperature differential? How would the

[1] There's actually a fourth reason - inflation - that reduces the worth of future dollars, but this is handled differently. Economists adjust for inflation by using "constant" or "real" dollars as their unit of measure. Constant dollars are dollar amounts that have been adjusted by means of price and cost indices to eliminate the effects of price inflation and allow the direct comparison of dollar values across years.

[2] This is a "real" discount rate with no inflation premium because it's associated with "real" dollars.

[3] In mathematical terms, the present value (PV) is equal to the future value (FV) divided by (1+r) to the t power, where r equals the discount rate and t equals how many years in the future the benefit occurs:

$$PV = \frac{FV}{(1+r)^t}$$

increased flow of colder groundwater impact water temperature as well as the width and depth of the stream? What effect would these changes have on the different fish populations?

Assuming the science was available to answer these questions, there would still remain the task of assigning approximate dollar values to the estimated increase in fish populations. Market prices would provide little help in determining the value of these fish, except perhaps as a food source. But what about their value in preserving bio-diversity (the endangered species) or improved recreational opportunities (the non-endangered species)? Economists have developed a number of non-market valuation methods to try to estimate dollar values for these kinds of "outside-the-market" services provided by ecosystems. (A description of many of these can be found on the website "Ecosystem Valuation" at http://www.ecosystemvaluation.org.)

Stated Preference Methods

- *Contingent Valuation Method*
  Estimates economic values for virtually any ecosystem or environmental service. The most widely used method for estimating non-use, or "passive use" values. Asks a person to directly state their willingness to pay for specific environmental services, based on a hypothetical scenario.

- *Contingent Choice Method*
  Estimates economic values for virtually any ecosystem or environmental service. Based on asking people to make tradeoffs among sets of ecosystem or environmental services or characteristics. Does not directly ask for willingness to pay – this is inferred from tradeoffs that include cost as an attribute.

Revealed Preference Methods

- *Hedonic Pricing Method*
  Estimates economic values for ecosystem or environmental services that directly affect market prices of some other good. Most commonly applied to variations in housing prices that reflect the value of local environmental attributes.

- *Travel Cost Method*
  Estimates economic values associated with ecosystems or sites that are used for recreation. Assumes that the value of a site is reflected in how much people are willing to pay to travel to visit the site.

Other Methods

- *Benefit Transfer Method*
  Estimates economic values by transferring existing benefit estimates from studies already completed for another location or issue.

None of these methods are perfect; in fact, most have serious shortcomings. They can be time-consuming and costly to conduct with massive data requirements, susceptible to numerous kinds of bias and a tendency to produce inconsistent results. The drawbacks are really too numerous to be described herein but again, the reader is referred to the Ecosystem Valuation website for a fuller exposition. In short, all these methods should be used with caution.

Fortunately there are sometimes shortcuts that can allow the analyst to avoid having to use one of the non-market valuation methods.

- **The 80/20 Rule:** The familiar 80/20 rule often applies to economic analysis, i.e. you can probably get 80% of what's possible out of the analysis for about 20% of the effort. And 80% is often good enough to make an unambiguous project decision. Once all costs have been estimated, it may become clear that not all the benefits have to be quantified to know which option is superior. At that point, you may stop quantifying those benefits, although you should be able to describe them qualitatively. For example, suppose that Option A has $100 in benefits and $50 in costs. Option B has $110 in *quantified* benefits and $40 in costs plus an additional unquantified benefit from reduced pollution. Because Option B has $10 more in quantified benefits and $10 less in costs, even without the additional benefits from reduced pollution, it is preferred to Option A. It's not necessary to quantify the benefits from reduced pollution to conclude that the Net Present Value for Option B is both positive and greater than the NPV for Option A.

- **Cost Effectiveness Analysis:** The phrases cost effectiveness analysis and benefit-cost analysis are often confused. Cost effectiveness analysis involves specifying a set of benefits or level of service, then comparing the costs of various alternatives that can deliver those benefits. The alternative with the lowest life-cycle costs is the most cost effective. This can be a helpful shortcut when the benefits of a project are difficult to quantify but all options under consideration provide the same or at least similar benefits. The option having the lowest present value cost becomes the preferred option as long as it can be convincingly argued that the benefits, though unquantified, clearly exceed the cost of the least-cost option.

Another shortcoming of benefit-cost analysis is that it doesn't consider the distributional implications of a project. It determines whether *total* benefits exceed *total* costs but ignores who wins and who loses. This can be overcome by including a "perspectives analysis" as part of the project evaluation process. A perspectives analysis links benefits and costs to various groups, identifying who incurs costs and who receives benefits from a particular project. These groups may include direct beneficiaries, all utility ratepayers, and/or the entire region or beyond. For example, consider a project to improve the quality of stormwater discharge that benefits the whole region by enhancing fish habitat. A spillover benefit of the project is aesthetic improvements to the neighborhood. The capital costs are funded through the utility's drainage rates but neighborhood volunteers will perform required maintenance to keep the project functioning. This is depicted in the perspectives table, below.

Perspectives Analysis Summary Table – Stormwater Project

	Neighbors	Rest of Ratepayers	Rest of Region	TOTAL
Habitat Benefits (PV)	$50	$199,950	$400,000	$600,000
Aesthetic Benefits (PV)	$100,000			$100,000
TOTAL BENEFITS	$100,050	$199,950	$400,000	$700,000
Capital Costs (PV)	$50	$499,950		$500,000
O&M Costs (PV)	$15,000			$15,000
TOTAL COSTS	$15,050	$499,950	$0	$515,000
NET PRESENT VALUE	$85,000	-$300,000	$400,000	$185,000

Capital costs are shared by the neighbors (who are also ratepayers) and the rest of the ratepayers. Habitat benefits are shared between ratepayers (including the neighbors) and the rest of the region. An economist has assigned dollar values to the habitat and aesthetic benefits. A standard benefit-cost analysis has identified this project as the preferred option with a Net Present Value of $185,000. However, the perspectives analysis reveals that the costs and benefits are not spread evenly among the different groups. While the neighbors pay very little of the cost, they get a portion of the habitat benefits and all the aesthetic benefits, enjoying $85,000 in benefits above their costs. The rest of the ratepayers are the big losers in this, paying $300,000 more in costs than they get back in benefits. In the winners column is the rest of the region, which gets $400,000 in benefits without paying any of the costs.

If the utility only considers the welfare of its own ratepayers in deciding which projects to undertake, it will reject this project, even though this would clearly be a mistake from society's point of view. By identifying beneficiaries of the project outside the utility's service area, the perspectives analysis could be used to facilitate equitable cost recovery, providing justification for grants and other external financial assistance from county or state agencies, and possibly making the difference between the project going forward or not.

The overall conclusion of the presentation was that despite its challenges and shortcomings, benefit-cost analysis can be a very useful tool in helping public agencies to:

- Ask the right questions,
- Make good investment decisions,
- Avoid costly mistakes, and
- Get the most "Bang for the Buck."

Options for Applying Benefit Cost Analysis to Reclaimed Water

The committee considered several possible approaches to developing an analytical framework for evaluating reclaimed water projects. Options included:

- "Do it ourselves"
  This option would have meant using internal resources (committee members) to construct an economic, environmental, and social analysis. This approach was likely to take time, would duplicate work already done elsewhere, and assumed that members of the committee would have the skills and time to create this tool. This approach would not have had the advantage of third-party objectivity and perspective from other agencies experienced in water reuse planning and implementation.

- Use internet available software
  There are a number of spreadsheet models for doing cost effectiveness analysis -- not a complete benefit-cost analysis -- of specific projects, such as those from the California Urban Water Conservation Council and Texas Water Development Board. These models were reputed to have limited input for environmental and social benefits and costs and were not considered readily adaptable for the committee's specific purposes.

- Hire institutional consultants to create or tailor an existing tool
  There were at least two organizations known to have the capabilities of performing a full Benefit-Cost Analysis (BCA) that could serve as the analysis framework: Pacific Institute and Rocky Mountain Institute. Either could have probably developed such a framework for the specific purpose of evaluating reclaimed water projects over a period of several months and at significant cost.

- Conduct or be a part of a university study
  The Woods Institute for the Environment, Stanford University, was undertaking a project to expand the approach of benefit-cost analysis (BCA) to include the evaluation of ecosystem services (putting a dollar value on the production of a wetland, for example), the effects of future events such as climate change, and degraded ecosystems. The outcome of the study was considered likely to be an advance in BCA analytical tools but probably several years away.

- Use framework developed by WateReuse Foundation
  The WateReuse Foundation is the research arm of the WateReuse Association, a national non-profit organization. The WRF selected Dr. Robert Raucher of Stratus Consulting, Boulder, Colorado, to prepare a tool for conducting full social cost accounting of reclaimed water projects. It was developed in consultation with planners, economists, and water reuse specialists from various regions of the U.S. Although the framework was completed, it was not yet published at the time the committee was considering options.

Because of the time and resources that would have been required to pursue the first four options, the committee decided to examine the WRF framework. Other reasons for selecting this framework tool were that it was developed with the input and review of reclaimed water experts and users around the country and that it applies specifically to reclaimed water. The WRF framework is, in essence, a tool to help water agencies and other water sector

professionals apply a full social cost accounting (economic, environmental, and social benefits and costs) to potential investments in reclaimed water.

The WateReuse Economic Framework

After the decision to focus on the WateReuse framework, the committee agreed to contract with the framework author, Dr. Bob Raucher of Stratus Consulting, for a local review of the framework to ensure that it could be modified for use in the King County region. The committee submitted a request to the Department of Ecology for funds to cover 2 full-day workshops in Seattle with Dr. Raucher and his associates. The committee's request was approved. Bob Raucher and his associate, James Henderson, conducted a workshop in Tukwila on August 25th, introducing the economic framework to an audience that included committee members and approximately 50 guests and agency staff. The presentations were videotaped and transferred to DVD.

The committee met with Raucher and Henderson again on October 27th for a further discussion of the framework, in the context of two local test cases. See the summaries that follow for notes from this meeting and details on the test case presented by Seattle Public Utilities.

Just prior to this second workshop, the framework was published by the WateReuse Foundation. The full 188-page report is titled ***An Economic Framework for Evaluating the Benefits and Costs of Water Reuse: Final Report and User Guidance,*** Robert S. Raucher, Ph.D., Principal Investigator, published by the Water Reuse Foundation, Alexandria, VA, 2006. The report and its accompanying CD-ROM can be obtained from the WateReuse Foundation at this site:

http://www.watereuse.org/Foundation/documents/wrf_03-006-02_Proj_Prof.pdf

The following pages (outlined in text boxes) are taken directly from the WateReuse report. The steps in the framework are reproduced here because they form the structure for the workshops that were conducted by Bob Raucher and James Henderson for the Reclaimed Water Technical Committee. For more detail on the framework, please consult the full WateReuse report.

The report begins by noting that one of the key challenges for reclaimed water projects is that financial assessments of such projects may often appear unfavorable, even if total project benefits outweigh the project's costs. While financial analyses are very important and useful in many ways, they typically provide too limited a context with which to evaluate the true social worth of a reclaimed water project. This is because a financial analysis focuses strictly on revenue and cost streams internal to the water agency, its purpose to determine whether projected revenues and other funding sources will be sufficient to pay for a project's capital and operating costs. Like the decision-making process of a private company, a financial analysis ignores externalities, (i.e., the costs the agency doesn't have to pay and the benefits that don't provide revenue).

In contrast, an economic analysis takes into account, not only financial costs and revenues, but the full range of benefits and costs associated with a project from the perspective of society as a whole. These can include environmental and social benefits and costs not captured in a financial analysis. Economic analysis answers questions such as:

- Is the value of all of the benefits of a project greater than the value of all the costs (i.e., does the project have a positive net present value)?
- How do the net present values of an array of alternative projects compare?

The term "full social cost accounting" refers to the economics perspective of trying to identify and account for all the benefits and costs of a potential action or policy, regardless of who bears the impact, or whether the impact can be valued using observed market prices. In other words, the benefit-cost analysis framework is intended to help utilities include benefits, costs, and risks borne "internally" by the wastewater (and/or water supply) agency as well as those impacts borne "externally" by other parties (e.g., ratepayers, other agencies, special interest groups, the broader region, and society as a whole).

How does an agency demonstrate that a reclaimed water project is "economically and environmentally appropriate," or that a project has "equitable access to benefits" and provides "the greatest public benefits?" Today, many wastewater and water supply agencies are individually developing their own "templates" for comparing alternatives and selecting water reuse management plans. These individual approaches vary in their quality and extent, and are likely to include widely differing approaches with widely differing effectiveness. And, as the public grows increasingly aware of and interested in water reuse and supply planning for their communities, the necessity for thorough, acceptable analyses of alternatives continues to grow. A uniform and well-founded approach is needed to ensure quality, reduce utility effort, and promote broader acceptance and usefulness.

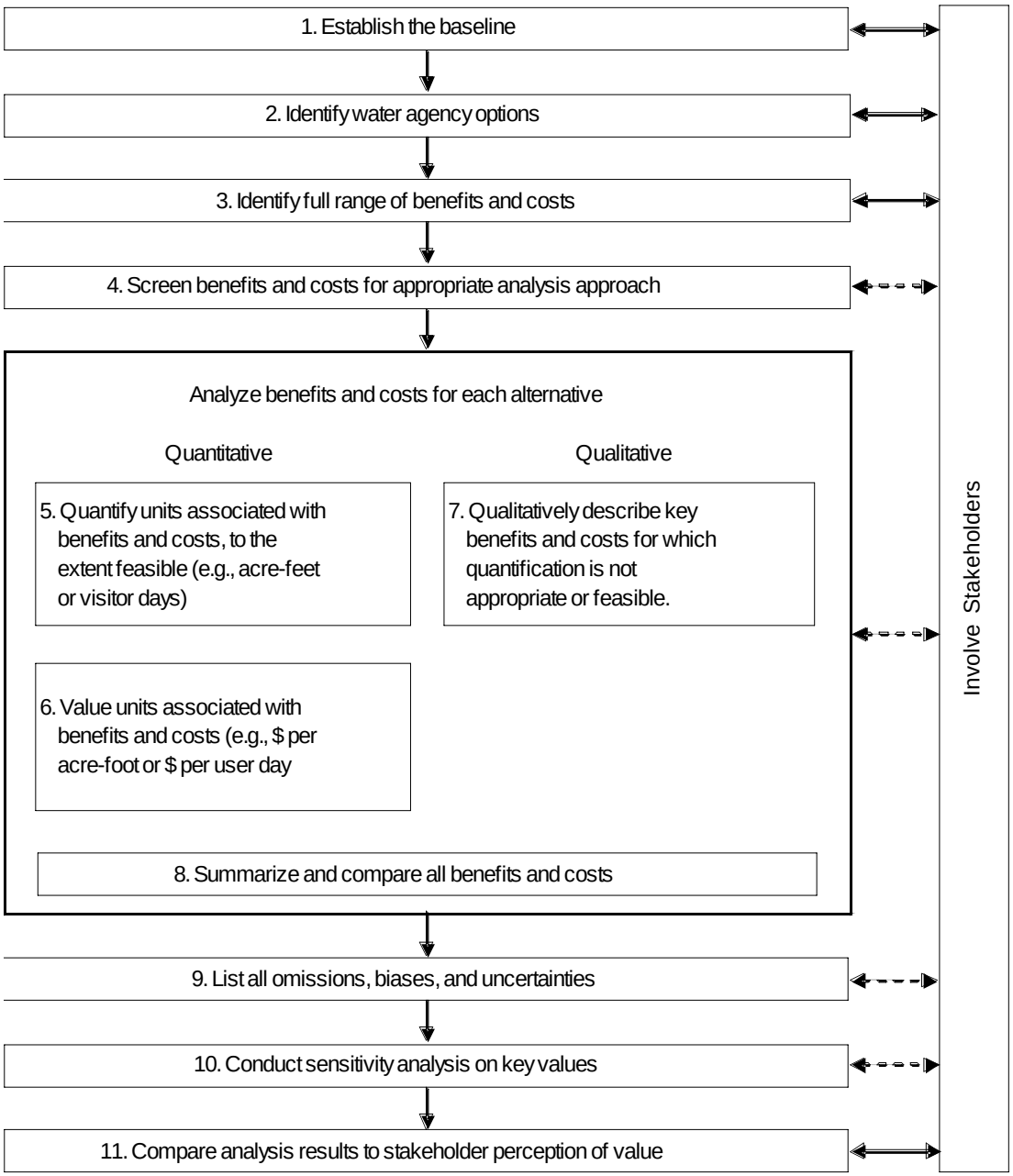
To address this need, the WRF report provides an analytical framework for conducting a "full social cost accounting of the benefits and costs of reclaimed water projects. The benefit-cost analysis framework enables project evaluators to undertake structured comparative analyses of alternative approaches to help determine which projects should be undertaken and which should not. Benefit-cost analysis is widely used, and in some cases federally mandated, in evaluating complex projects that have substantial environmental and social impacts. However, benefit-cost analysis alone does not provide all the answers. For example, it does not address the equity issues that often arise with public projects.

A perspectives analysis is useful in sorting through the distributional implications of a reclaimed water project. It addresses the question of who benefits and who pays – an issue over which a number of committee members have frequently expressed concern.

There are several perspectives to consider when analyzing benefits and costs of a reclaimed water project. These include the direct beneficiary perspective, the water and/or wastewater ratepayer perspective, the regional perspective, and the societal perspective. A benefit from one perspective may be a cost from another perspective. For instance, providing reclaimed water at rates less than the price of potable water is a benefit to the reclaimed water customer, but may be a cost to ratepayers. Understanding and tracking all of these perspectives is key to understanding motivations for supporting reclaimed water projects and possibilities for cost-sharing arrangements. Identifying the beneficiaries of projects as well as those who bear the costs can help facilitate equitable cost recovery, provide justification for grants and other external financial assistance, and enable more extensive stakeholder identification and involvement.

In addition to developing tools to elucidate the financial, environmental, social and distributional implications of reclaimed water projects, another key function of the economic framework is to provide a means through which agencies can communicate their key assumptions, inputs, and findings with impacted communities and stakeholders. The WRF framework can and should be used to facilitate a process wherein input is invited from relevant individuals and organizations, and through which utilities systematically reveal the key assumptions, input values, sensitivities, and other factors embodied in the analysis.

Steps in the Economic Analysis Framework



Step 1. Establish the Baseline

Define the outcomes associated with the "no action" status quo. This base case may entail doing nothing (i.e., not pursuing a water reuse project, or not augmenting the utility's water supply through an alternative to reuse), or undertaking already planned actions. The baseline is the mark against which changes resulting from the project alternatives are measured. It is important to define the scale and timing of the impacts of the baseline, articulate what problems the proposed project (or range of project alternatives) are intended to resolve, be explicit about assumptions, and engage stakeholders about their perspective of what happens under a no action, status quo baseline (p. 20).

Recording baseline information in Step 1 will entail considering what the future will look like in terms of water supplies and future demands. It is good practice to explicitly state key assumptions and to provide a clear statement of what problem the potential project is intended to help address and/or state what desired objectives the project would help the utility and community attain (p.45).

The baseline is not the same thing as the "current" situation. Defining the baseline means looking into the years ahead, and since the useful lifetime of most water supply investments typically is 20 or more years, a matching long-term time frame needs to be applied for the baseline and reuse options (p.22).

Defining the baseline is a very critical step, not just because it establishes the accounting stance within which reclaimed water projects and other options are evaluated and compared, but also because it establishes the problem-solving context within which water reuse and other alternatives are being considered by the agency and the community as a whole. Thus the baseline needs to be defined carefully, explicitly, and in a manner suitable for local circumstances; it is the pivotal foundation for not just the BCA itself but also for framing the policymaking dialogue with governing officials, customers, and other stakeholders (p.22).

Presumably, a water agency or community is considering reclaimed water (and perhaps other water supply augmentation options) because it is seen as a possible solution to a current or anticipated problem and/or because it is seen as a way to promote or enhance values that are important to the community (e.g., embracing a recycling ethic or providing urban green space). Thus, in defining the baseline for the economic analysis, it is critical that the baseline be defined in a manner that helps articulate what problem(s) and/or value enhancements the reuse project or its alternatives would address. By specifying "what is the problem to be solved," the economic analysis is then suitably framed to compare how well reclaimed water and other options serve as vehicles to solve the problem(s) and provide the community with outcomes it values.

Another challenge to defining the baseline is that the "with" and "without" context can become a place where stakeholder and utility hidden agendas or disagreement over core assumptions often arise. For example, setting the baseline may set off a debate between the utility and stakeholders, over future demand projections (e.g., where some members of the community hold alternative views about the size and pace of

future population growth, or about the effectiveness of additional conservation opportunities).

Therefore, it is important to carefully define the baseline, be transparent about underlying assumptions, and engage relevant stakeholders at this critical stage of the economic analysis. The assumptions underlying these future projections should also be clearly stated, and may become a focal point for discussions with stakeholders (and/or serve as a basis for sensitivity analyses), as discussed later in Step 10.

Step 2. Identify Water Agency Options

Identify and develop all the relevant utility options that will be compared to the baseline and to each other. One important key to conducting a proper economic evaluation is to place reuse in a comparative context, evaluating these options in terms of both a default scenario of no new water supplies, as well as comparing reuse to other water supply alternatives specific to given regions (e.g., additional surface water extractions, agricultural-urban water transfers, water conservation) (p.20).

Obviously, the more options that are considered, the more complex the analysis will become. However, the results will also be most valuable if all the relevant feasible options are evaluated (p.24). It is also useful to scale project options to a common size or objective. For options available at different scales, it is helpful to consider staging or combinations of options (p.20).

Step 3. Identify the Full Range of Relevant Benefits/Costs for Selected Option

Develop a thorough inventory of all likely costs and benefits associated with each of the project alternatives (options). Include costs and benefits beyond those faced by the utility alone or customers alone. In other words, try to identify *all* the benefits and costs – financial, social, and environmental - regardless of to whom they may accrue or where they might be realized (p.20)

Note that that it is important to establish and then carefully maintain the appropriate accounting stance. Benefits and costs must be defined and measured relative to the baseline chosen in Step 1. For example, if a reclaimed water project would eliminate the need to build a new source of potable supply, then how the related benefits and costs are accounted for depends on the baseline. If the baseline scenario assumes the new potable supply would be built, then the avoided cost of building it would be one of the benefits of the reclaimed water project. If however, no new supply is assumed in the baseline and building a new potable supply is one of the alternatives under consideration, then the avoided cost of new supply would NOT be a benefit of the reclaimed water option. Instead, it would show up as a cost of the potable option (p.14).

Step 4. Screen Benefits and Costs for Appropriate Analysis Approach

In the screening step, the analyst determines which costs and benefits can and should be analyzed quantitatively, which should be described only qualitatively, and which are insignificantly small and can be eliminated from further analysis (p. 20).

Step 5. Quantify Units Associated with Benefits and Costs, to the Extent Feasible

In the first step of valuing a benefit or cost, the amount (quantity) of the outcome (e.g., water or resource use) should be established. These quantity outcomes may be a volume of water delivered (e.g., acre-feet), number of recreational user outings enabled by enhanced instream flows or provided by reuse-fed wetlands (e.g., recreational hiking or angling days per year), or in whatever units the outcomes are most readily and meaningfully measured. It is important to match the quantity units of measurement to whatever metric is available for the corresponding dollar values (e.g., if the valuation in step 6 uses a $/household measure, then the quantification in step 5 should be aimed at estimating the number of households affected). Ranges of quantity estimates (rather than a single point estimate) may be used to better represent variability or uncertainty associated with resource use estimates (p.20).

Step 6. Value Units Associated with Benefits and Costs in Monetary Terms

Once the quantity of resource use has been estimated, a per unit dollar value often can be assigned to the benefit or cost, to reach a total value (quantity times per unit value). The per unit values can be expressed as dollars per unit of water (e.g., dollars per acre-foot) or dollars per unit of resource use (e.g., dollars per visitor day). Ranges of values may be used to better represent per unit resource valuations. Annual benefit or cost values should be projected over the project life (either annualized or as a net present value, as per Step 8) (p.20).

Step 7. Qualitatively Describe Key Benefits and Costs for Which Quantification is Not Appropriate or Feasible

It may not be feasible or desirable to express some types of benefits or costs in quantitative or monetary terms (as per screening in step 3). However, it is always important to describe these nonquantified benefits and costs in a meaningful, qualitative manner. These benefits and costs may be described qualitatively, in part, by using a simple scale indicating the likely impact on net project benefits. Impacts can be qualitatively ranked on a 5-point scale, ranging from -2 to +2, to reflect unquantified relative outcomes that span from very negative to very positive (e.g., a "-1" may signify an outcome with moderate unquantified costs, and a "+2" may represent a high unquantified benefit). Qualitative ratings should be accompanied by descriptions of the impact, and should be explicitly carried through the analysis (p.21).

Step 8. Summarize All Present Value Costs and Benefits, and Compare Benefits to Costs

Quantitative benefit or cost projections over time (from Step 6) should be discounted to present values at an appropriate discount rate. The present values of monetized benefits and costs should be summarized in one location (i.e., a summary table), along with the listing and ranking of those benefits described only qualitatively (from Step 7). Calculate the Net Present Value (NPV) for each alternative by subtracting the present value costs from the present value benefits. It is important that one summary table include both the monetized benefits and costs, as well as a listing and some

qualitative assessment of the non-quantified benefits and costs, so that reviewers do not overlook potentially important outcomes when reviewing the empirical results. Distributional aspects also should be presented (Perspectives Analysis) (p.21).

Step 9. List and Assess All Omissions, Biases, and Uncertainties

All omissions, biases, and uncertainties associated with the estimated benefits and costs should be explicitly documented. The impact that these may have on the final outcome of the analysis (e.g., in terms of their likelihood of increasing or decreasing net benefits, or an uncertain direction of change in net benefits) should be noted (p.21).

Step 10. Conduct Sensitivity Analyses on Key Values

Sensitivity analyses should be conducted on key variables or benefit and cost estimates, to explore and communicate the impact of assumptions, uncertainty, or natural variability. Use sensitivity analyses to identify which assumptions or uncertainties have the largest impact on the outcome of the analysis (e.g., identify which assumptions might change the net benefits of an option from positive to negative, or alter the ranking of options in terms of their relative net benefits) (p.21).

Step 11. Compare Analysis Results with Values from Stakeholder Perspective

The quantitative and qualitative values that result from the analysis and from the various sensitivity analyses should be compared with stakeholder expectation of values. This comparison of expected values to the values derived in the analysis can be informative both as a check on the reasonableness of the analysis results and as a process for working with stakeholders to realize (or at least better articulate) the values that the reuse project provides to stakeholders. This understanding of values may become the basis for cost-sharing agreements with stakeholders to share costs for a project according to the relative shares of benefits derived from the project (p.22).

The vertical box on the right side of the above diagram emphasizes that stakeholder involvement should be sought throughout the project identification and valuation process, with stronger involvement (represented by the solid-line arrows as opposed to the dashed-line arrows) recommended at certain portions of the process (e.g., especially at the outset, and again to review and discuss findings) (p.22).

Dr. Bob Raucher and associate Jim Henderson presented an overview of the WateReuse economic framework to committee members and guests. The session was videotaped and participants had an opportunity to order DVDs. A summary of the discussion and flipchart notes is provided below. Copies of the three PowerPoint presentations can be found in Appendix E.

Dr. Raucher began the workshop by clarifying that the WateReuse framework is not a 'black box' solution but simply a systematic approach to examining all the relevant benefits and costs and informing stakeholders and public officials. The purpose of this workshop is to introduce the region (through the Reclaimed Water Technical Committee) to WateReuse tools and, in turn, for the committee to describe its regional context to the consultants. This workshop is designed to set the stage for continued dialogue and processes to assess water reuse in King County.

The framework was described as follows:

- Designed for use in an iterative process with public officials and other stakeholders.
- Allows for a broader economic analysis of benefits and costs than a more limited financial (cash flow) analysis
- Can highlight and focus attention and discussion on issues that can make a significant difference in the economic analysis
- Is generic and can be used with a wide range of situations
- Includes quantitative and qualitative evaluation of costs and benefits
- Transparently acknowledges areas of uncertainty

Raucher acknowledged that from a financial cash flow perspective, reuse projects might not seem fiscally sound, with high costs and limited revenue streams. But from the economic perspective, there may be benefits that outweigh the costs. The framework allows agencies to view a broader, "social cost" perspective and reflect the full value of reuse and other options.

The challenge in using the tool is that many benefits are not well recognized, are disbursed, and there may be a disconnect between who benefits and who pays. This may be a valid reason to seek funding and cost sharing.

The committee brought up a number of points and questions, including:

- How to place a value on some of the benefits
- Circumstances vary: you can't assume the value of benefits in arid regions is the same as the value of benefits here.
- A "portfolio approach" to balancing the water supply with climate-dependent sources and not-climate dependent sources.
- The undervaluing of potable water
- How the cost of specific capital projects is reflected within relatively low rate increases for water
- What people are willing to pay, and how to measure that given all the other priorities

Dr. Raucher spent some time discussing the challenges of assigning dollar values to benefits and costs that are made up of "non-market" goods and services, i.e., impacts that are not typically traded in markets and therefore do not have market-observable values. Economists employ a number of techniques to try to estimate these values: revealed or stated preference

methods as well as borrowing results from studies conducted elsewhere, an approach referred to as "benefits transfer." Some examples were highlighted of applying these methods to reclaimed water projects in other states. Mr. Henderson then took the group through the twelve steps of the analysis, using several examples and case studies.

Some issues the group discussed:

- How to avoid "double counting" certain benefits
- Basic assumptions behind the baseline (zero discharge or increase water supply?)
- How non-quantifiable benefits and costs can be rated and tracked through a qualitative assessment (+/-)
- Under what circumstances would the tool lead to a net present value that is not positive
- How to use the tool to compare alternatives
- How to identify who benefits/pays and how demographics affect who benefits/pays
- The challenges in identifying a baseline
- The projected life of projects typically used for values (20-50 years) and the effect of the discount rate selected for the analysis
- The potential for additional water supply to have a negative impact on water utility revenue
- Decision-making processes involving stakeholders: getting values assigned by all sides, decision-making styles (consensus or responsible party)

King County Regional Considerations

For the benefit of Dr. Raucher and Mr. Henderson, members of the committee highlighted circumstances that affect reclaimed water use in the King County region.

Regional geography/history

- Washington State has a wet and a dry side.
- A centralized wastewater system was developed in King County area to clean up polluted waterways. Now MBRs (membrane bioreactors) may make smaller plants cost effective and bring RW to specific communities. Local sewer agencies have contracts with King County for wastewater treatment, currently under review. New state legislation and rules being developed.
- King County irrigation season is only 4 months long.

Water supply issues

- In King County region, most of the water supply comes from snow pack feeding two main rivers, Green and Cedar.
- Some areas use groundwater for water supply. Groundwater utilities are not dependent on snow pack, but piping away wastewater and storm water means that groundwater may not get recharged.
- Rainy winters and very dry summers mean we need to consider storage. Ideas included using reclaimed water to recharge groundwater and/or harvesting rainwater.
- Climate change will have a large impact on water resources here. May need new strategies to manage changes in the amount and timing of rain/snow.
- Need to be specific and pinpoint which water utilities have a short supply of water: some areas of the region are in need of additional water supply; others have large, relatively inexpensive supply of potable water and close proximity to a source of reclaimed water.

Environmental issues

- Implementation of plans to recover threatened salmon is underway.
- Tribal treaty rights are important in this state. Tribes have a key legal role in managing fish, which are also culturally significant.
- Commercial and sports fisheries are important to the economy.
- Region is experiencing wetland habitat loss and working on wetland banking.
- Salmon need cold clean water. This may mean we may not be able to put reclaimed water too close to a stream or it may mean that reclaimed water needs to be substituted for non-potable uses, allowing groundwater to retain its hydrologic connection to cooling a stream.
- There are some concerns that restoring the quantity of water in streams could lead to more flooding.

Cost/price of potable/reclaimed water:

- Our wastewater ratepayer base is smaller than the wider community that would benefit from reclaimed water.
- There was concern about cost of building infrastructure given western Washington's strong economy.
- Water utilities are successfully promoting conservation but losing revenue. May lead to higher rates.
- Water supplies from the mountains use gravity; reclaimed water may require pumping, which could add to the cost.
- Local agency representatives expressed interest in state agency support for shared costs.

Marketing reclaimed water in the King County region

- Need to identify marketing opportunities for reclaimed water in our region
- There may be a disparity between the areas that need reclaimed water and the areas where it is available.
- People are expecting reclaimed water to be less expensive than potable, but it's not clear how it will be priced.
- Need to assess demand and whether customers want reclaimed water.
- Large water users such as golf courses are spread around in different water basins. They may have their own source of water (well or river) or be served by a water utility that may, or may not, have a sufficient supply of water.

Regulatory/Policy issues:

- Governor has launched an initiative to clean up Puget Sound.
- The state is not able to take action against those using illegal water rights because illegal users do not have an alternative water supply: in some cases, reclaimed water could be that alternative.
- Washington State expects agencies to improve the quality and reduce the quantity of wastewater discharges.
- Liability for long-term unforeseen impacts of using reclaimed water is a concern for some potential customers.

Equity/Perspectives Analysis

Using examples from other agencies, Dr. Raucher said that evaluating equity is subjective and requires discussion and deliberation. Sometimes it is based on stakeholder process; sometimes on weighted numeric outcomes, and sometimes it's a hybrid of the two.

The group discussed how weighting objectives is subjective and specific to each organization. Stakeholder groups aren't always distinct and can overlap.

Dr. Raucher noted the strong environmental ethic and commitment to the process among participants. In response to a question, he suggested the economic analysis tool was best used to evaluate projects and compare them to each other. It can be used in a general way to evaluate a program, but that would be more challenging because some of the data will be "squishier" on a regional or program-wide basis. For example, restoring stream flow may provide a benefit for some streams in the region but not others. Some projects may be more beneficial than others; it is easier to sort this out on a project-by-project basis. Committee members suggested that using the framework to evaluate a test case or two would make the use of the framework clearer. Members decided to discuss test case options at their next meeting.

Framework Workshop 2 October 27, 2006

The committee met with Dr. Bob Raucher and associate Jim Henderson of Stratus Consulting for a further discussion of the framework in the context of two local test cases. Just prior to this second workshop, the framework was published by the WateReuse Foundation. The full 188-page report is titled *An Economic Framework for Evaluating the Benefits and Costs of Water Reuse: Final Report and User Guidance*. The report and its accompanying CD-ROM can be obtained at this site: http://www.watereuse.org/Foundation/documents/wrf_03-006-02_Prof_Prof.pdf

Any agencies that wish to apply the framework to potential projects are encouraged to use the published Final Report and User Guidance from the WateReuse Foundation rather than rely on the discussions and notes from these workshops. The workshops introduced committee members to concepts, including the benefit-cost approach and perspectives analysis, but these notes are not a substitute for the full framework.

In the second workshop, Covington Water District and Seattle Public Utilities (SPU) each provided an example of a potential reclaimed water project that could be used to demonstrate real-world applications of the framework. Because of time constraints, neither project was put through all the steps of the framework. Instead, each was used as an example to highlight specific aspects of the framework. The SPU Jackson Park test case had been developed and analyzed by SPU staff; see Appendix D for descriptive materials. However, any descriptions of projects in the Covington Water District in these notes are conceptual only and provided for the purposes of this exercise; they do not represent policy or decisions of the water district.

In his introduction to this workshop, Dr. Raucher reminded committee members that the economic analysis tool is a "framework" instead of a "model" because it is an iterative decision-making process, not a model that data is plugged into and then an answer pops out. Raucher used the analogy of NPR's Car Talk radio show as a metaphor for the Framework: callers present a problem and the hosts ask questions to help qualify and quantify the situation until they fully understand what the caller is seeking. He said at its most basic this is how the Framework unfolds. He added that we would capture points for the perspectives analysis as we went though the exercises.

The framework is a "living" document that can allow a user to identify what needs to be known and can then be revisited to replace unknowns with new information.

Case Study #1
Covington Water District: Satellite Reclaimed Water Facility
The conceptual example provided by Covington Water District was a satellite reclaimed water facility that would provide reclaimed water to a golf course that is self-supplied for irrigation water by a well. Use of the well, for which the golf course has no water right, is thought to reduce stream flows and degrade habitat for Chinook salmon in a nearby stream.

Application of the Framework steps:

1. Establish the baseline

Dr. Raucher said part of setting up the baseline is examining what the future looks like if you don't do the project. He said you have to use common sense to try and capture all the "what ifs" prior to assigning fair values. He added that how well you set up the baseline determines your success in capturing losses and identifying benefits; so spend enough time thinking it through.

Dr Raucher explained that there can be alternative baselines. For the Covington example, Dr. Raucher mentioned two possible but very different baseline assumptions. The first was that the golf course would continue to use its well and the negative environmental impacts of this use on nearby streams would also continue. The second baseline assumed that because there was no water right, Department of Ecology would order that the golf course cease using its well. This would cause the golf course to go out of business. This second case is the one that the group used to explore the framework.

The choice of baseline is crucial to the analysis because all benefits and costs are measured relative to the baseline. For example, if the baseline assumption were that the golf course continues pumping ground water, potential reclaimed water project benefits would include the many environmental, cultural, and social benefits to stopping pumping groundwater. If it is assumed that the golf course will lose its irrigation source, then those benefits are not at issue, and would not be included as part of the benefit/cost analysis. Instead, project benefits associated with this baseline would be those stemming from keeping the golf course open.

The group asked about using alternative baselines when you don't know what will really happen in the future. Rather than using mathematical probability to compare different future scenarios, Dr. Raucher suggested evaluating two different baselines separately. Using probability may be neat mathematically, but it doesn't capture the fact that one future or the other will actually happen, even if there is only a 50% chance of it happening.

2. Identify water agency options

Covington did not provide any information on possible alternatives to the satellite reclaimed water project. Some members suggested there might be other options for providing water to the golf course (potable water from an existing or new source, a flow swap with Tacoma after contributing to a reclaimed water project there, for example). The published User Guidance states that "this economic framework is designed primarily to address a situation where one or more water reuse options are being considered. However, the approach is very generalizable, and its most suitable use is in looking at multiple water supply options that may be feasible for a utility and the community it serves. The more relevant options considered, the more complex the analysis will become, but the results will also be most valuable if all the relevant feasible options are evaluated." For this workshop, the group decided to focus on just the one option for the purpose of evaluating the framework. Dr. Raucher suggested that sometimes the iterative process might send you back to evaluate even more options.

3. Identify full range of benefits and costs

After the meeting, one member created the following chart to add to this meeting summary to clarify the points made in 1) Establish the Baseline (above). He used this table to demonstrate his opinion that the benefits in column 1 would never be added to the benefits in column 2 to obtain total project benefits because they apply to two different

baselines. In Baseline 1, the golf course benefits listed under Baseline 2 are not benefits attributable to the project because the golf course remains open whether the project is done or not. Similarly in Baseline 2, the fish habitat benefits listed under Baseline 1 are not benefits attributable to the project because fish habitat is improved whether the project is done (providing a substitute for pumping groundwater) or not (the golf course is closed and pumping is stopped).

Potential Project Benefits

Baseline1: Golf Course Continues to Pump	Baseline 2: Golf Course Closes
Enhanced habitat for endangered species Other environmental benefits associated with increased stream flows	Business income to golf course owner Consumer surplus (i.e. enjoyment benefits to golfers over and above what they pay to golf) Amenity value (reflected in higher property values for land immediately surrounding golf course)

The group chose "golf course closes without new source of water" as the baseline to run through the rest of the exercise.

In anticipation of the perspectives analysis, Dr. Raucher and the group identified stakeholders along with some of the benefits and costs that would accrue to them. The group was going through an exercise in a limited amount of time in order to understand the WRF Framework without the opportunity to seek input directly from stakeholders; so many assumptions were made in order to work through this and other steps of the framework. The group developed the table below, but it is not meant to present conclusions that would be derived in an actual execution of the framework.

Benefit or Cost	Stakeholder
Golf course stays in business	Golf Course owner
Welfare value to golfers	Golfers
Future delivery opportunities ▪ Irrigation for recreation, public use ▪ Additional development	Covington Developers
*Improved delivery reliability	Covington
*Deferred water supply expansion	Covington
Capital costs	Covington
Operating costs	Covington

* After the meeting, one member suggested deleting these two benefits or costs from this table. They were added to the table during the discussion. However, in reviewing this meeting summary, this member stated his opinion that the Covington example project would not reduce demand on Covington's potable water supply and that therefore listing these two benefits or costs might confuse future readers of this summary.

4. Screen benefits and costs for appropriate analysis approach

Step 4 divides items captured during the benefits and costs screening between monetized and qualitative value; the group divided select items in the above Table as follows:

Monetized	Qualitative
Golf course property value	Future delivery opportunities
Welfare value to golfers	Deferred water supply expansion
Capital costs	Improved delivery reliability
Operating costs	
Golf course profit	

5. Quantify units associated with benefits and costs to the extent feasible.
   Step 5 aims to capture potential number of units for each quantifiable (monetized) item.

For example, the group suggested the following:

Quantifiable Item	Total Units
Nearby property values	200 homes
Value to golfers	1,000 games
Land value	400 acres

6. Value units associated with benefits and costs
   Step 6 seeks to apply dollar values to all benefits and costs for which it's feasible to quantify in monetary terms. For the purposes of the exercise, Dr. Raucher and Mr. Henderson quickly did some rough valuations based on their experience in other parts of the country. They assumed golf courses add 10 to 15% to the value of surrounding homes and that golfers receive $25 of value over and above their costs for each game played. Assumptions were also made about business income to golf course owners and annual O&M costs for the reclaimed water project. This allowed Dr. Raucher and Mr. Henderson to produce what were admittedly crude estimates for the dollar values of the project's primary benefits and costs. The group used generalized values for the purposes of practicing the exercise.

7. Qualitatively describe key benefits and costs for which quantification is not appropriate or feasible
   The Framework suggests using a scale of plusses and minuses to evaluate quantitative benefits like this: ++, +, -, --. There were differences of opinion among committee members about some of the values. One example was whether future delivery opportunities were a ++ or only a +, given the volume of wastewater available in the system near Covington. The framework supports this kind of iterative discussion, and does not require agreement on every point. Differences of opinion can be qualitatively noted.

8. Summarize and compare all benefits and costs
   It is important that qualitative benefits and costs, which are often paid little or no attention, be considered along with monetized benefits and costs. Sometimes the qualitative analysis of Step 7 supports the results of the quantitative analysis. For example, the option with the highest Net Present Value (NPV) may also have significant

non-monetized environmental benefits that just strengthen the case for choosing that option. At other times though, the qualitative benefits and costs may conflict with the quantitative results. For example, the option with the highest NPV may have some unquantified costs that make it less attractive, while options with lower NPVs may have enough qualitative benefits to keep them in the running. This process often helps pinpoint where it may be useful to go back and expend additional analytical resources to quantify some key benefit or cost. Dr. Raucher noted that this demonstrates the importance of tracking qualitative benefits and costs alongside quantitative analysis.

At this point, Dr. Raucher roughly estimated present values for the benefits that had been quantified in Step 6. One member pointed out that after an initial look at the benefits and costs, you would need to go back and examine assumptions more carefully, as described in the next steps of the framework. To determine which project alternatives have the highest Net Present Value, the analyst can conduct parallel benefit-cost analyses (for each alternative).

The last four steps of the WRF Framework were not discussed in this exercise:

9. List all omissions, biases and uncertainties

10. Conduct sensitivity analyses on key values

11. Compare analysis results to stakeholder perception of value

12. Use a communication tool to document inputs and assumptions, provide transparency and record stakeholder input.

One member noted that according to the group's discussion under this baseline, a Perspectives Analysis would reveal that the benefits of this project would be concentrated on a small group: the golf course owner, golfers and property owners immediately adjacent to the golf course. This would be relevant when it came time to decide "who pays" for the project.

Case Study #2
Jackson Park: Options for Irrigation Water

Seattle Public Utilities staff provided information on the Jackson Park golf course. Water is currently pulled from Thornton Creek, which is a fish-bearing stream, to irrigate the Jackson Park Golf Course. The golf course has a water right and diverts up to half of the flow at the point of diversion. (See Appendix D for details.) Seattle proposed several options to provide substitute irrigation water so that most of the creek diversions can be eliminated. In this test case, Dr. Raucher assisted the committee in using the framework to assess multiple options.

1. Establish the Baseline

Since the golf course has a water right, the choice of baseline was more straightforward than the Covington example. It was assumed that in the absence of a project, the golf course would continue to take water from Thornton Creek for irrigation.

2. Identify Options

Several ways of providing Jackson Park with substitute water are currently under consideration by the City of Seattle. The committee did not add any other alternatives to the list, but worked from the options presented by the city.

A. One proposal would **bring reclaimed water from Brightwater** Wastewater Treatment Plant to Jackson Park. This project would involve installing 3.6 miles of purple pipe from the Ballinger Way Portal of the Brightwater effluent tunnel/reclaimed water line to the northern boundary of Jackson Park. Pumping would be necessary, as would extension of and improvements to Jackson Park's irrigation system.

B. The city parks department could **purchase potable water from SPU** for Jackson Park. This would involve tapping into SPU's existing water main along the northern boundary of the park. As with the reclaimed water alternative, extension of and improvements to the park's irrigation system would be necessary.

C. The city parks department could **purchase potable water from SPU** for Jackson Park and then offset the increase in demand on SPU's water system by **improving irrigation efficiency** at Jackson Park and Seattle's three other public golf courses. SPU estimates that various conservation measures involving weather stations, flow sensors, increased automation, increased turf aeration, and replacement of leaky irrigation mains will provide enough savings to offset Jackson Park's anticipated demand for potable irrigation water.

3. Identify Full Range of Benefits and Costs

Benefits identified for all three options were associated with reducing diversions and increasing creek flows during the summer months. Stream flows through Jackson Park could double during the summer and early fall while further down Thornton Creek, flows might increase by as much as 15%. Possible benefits include:

- Increased fish production;
- Increased creek habitat value, particularly in the North Branch wetland;
- Further reduction in summer creek temperatures; and
- Recreational or other amenity values.

The types of costs for the different alternatives are summarized in the table below.

	Project Alternatives		
	Reclaimed Water	Potable Water	Potable Water w/ Conservation
Reclaimed Water Delivery Costs			
Capital Costs	X		
O&M Costs	X		
Jackson Park Onsite Costs			
Upgrade Infrastructure	X	X	X

Potable Water		X	
Conservation (including offsite)			X

Steps 4, 5, and 6 of the framework were combined in a lengthy discussion of which costs and benefits to quantify and how. There was little controversy over most of the costs but some issues did arise. It was noted that there was the potential to serve a number of additional irrigators located along the 3.6-mile pipeline between the Brightwater Backbone and Jackson Park. Involving these other potential new customers could lower Jackson Park's share of the costs. Seattle staff had estimated that if all potential customers along the distribution pipeline signed on, it could reduce Jackson Park's share of the pipeline and pumping costs by $1.2 million.

There was also discussion of the appropriate method for valuing the cost of water. SPU had used the marginal resource cost of water rather than the retail rate in its assessment of costs for the potable water option. Some members felt it made more sense to use the retail water rate. Full agreement was not reached on this issue though the marginal cost of water continued to be used for the purpose of this exercise.

To learn more about how to value environmental benefits (since they had not been a focus in the Covington exercise), the group discussed a number of questions about Thornton Creek: Who uses it? Who lives beside it? Who cares about the stream? Is it an open stream or does some go through piping? Other points noted by members:

- Unlike Covington, Jackson Park has no threats to the golf course's ability to use their water right to pull water from the stream.
- This creek is part of a highly developed, urban watershed.
- There is a large, active community alliance that have worked to have other sections of Thornton Creek daylighted and restored. Thornton Creek is not currently developed for public recreation, but the Thornton Creek Alliance is passionate about its restoration.
- Sustaining a base flow in the summer and mitigating the winter scour to control stormwater runoff are both issues here.
- Seattle Public Utilities is making investments (such as drainage swales) to protect the creek elsewhere in the watershed.

Members of the group disagreed about how to value existence of salmon in the creek, and Dr. Raucher said you don't have to set up an "either/or" situation. Many people value fish and water quality and irrigation, and it is possible to try and meet all these goals. Raucher suggested one way to get a realistic assessment of how much a stream or water body is valued is to conduct a "willingness-to-pay" survey in impacted neighborhoods. Some participants suggested this kind of survey might not be accurate because it needs to be done in the context of other expenses and family budgets. Dr. Raucher cautioned against trying to put a value on individual fish, since that is most often relative. For instance, if a project results in adding 1,000 fish per year to a stream and you currently have 10 fish in that stream – that number represents an entirely different story than if the project adds 1,000 fish and you currently have 20,000 fish.

Dr. Raucher concluded by saying the framework can capture differing opinions about the options by taking a more thorough look when assigning quantitative and qualitative values. He said that if, when you reach the end of the framework exercise, the benefits are relatively

similar for any or all options, you can then move into a standard cost effectiveness analysis. That is, you can identify which option can provide the same benefits package at least cost.

Miscellaneous Comments

- The group discussed who is likely to use this framework: typically the entity making the decision. That may be the local or regional utility or the end user – in the Covington scenario; it could be the golf course.
- The group discussed emerging science on the fate of various chemicals of concern in wastewater treated to reclaimed standards when applied on land at agronomic rates and agreed it was an issue that needed watching.
- Economic "ripple effects" are not *usually* counted in the Framework exercise but it is certainly okay if parties conducting the analysis agree to count them – especially "local" or even "regional" ripple effects. However, trying to quantify national ripples is not usually that meaningful.
- If the funding for start-up costs allows future delivery opportunities for clients along the pipeline, you should capture those benefits.
- You can use the framework to create a Perspectives Analysis to understand who benefits. That can lead to opportunities to cost-share. In that context, members discussed various combinations of increased greens fees, taxes, levies, or other options of this sort.

Those who wish to use the WateReuse Framework may find the Cost Model helpful in the quantitative portions of Step 6 of the framework. This model was presented to the committee and is summarized on page 9 of this report.

Conclusion

Members of the Reclaimed Water Technical Committee met ten times from March to December 2006. They revised and shortened the proposed charter provided to them by the Executive Committee of the Regional Water Supply Planning process. This new charter (page 4 of this report) defined a specific objective for the committee: to identify a framework that could be used by any agency to evaluate the economic, environmental and social benefits and costs of reclaimed water projects. The committee chose to focus on the framework commissioned by the national WateReuse Foundation. They learned about this tool by inviting its authors to present it in person and to discuss its use in the context of local test cases. The committee also devoted time to (1) identifying many of the issues to consider for reclaimed water use in this region; (2) accumulating some data about potential users of reclaimed water, and (3) learning about water reuse in the region through guest speakers. With these activities, the committee completed its revised charter. Consistent with guidance from the Coordinating Committee, the committee made no recommendations on the framework; each agency is free to make its own decision about the use of this tool.