Triple Bottom Line Illustration
(Water Reuse Options)

Bob Raucher, Stratus Consulting

November 12, 2014

The Committee has asked for an illustration of what a Triple Bottom Line (TBL) assessment would look like for an example of a water supply alternative(s) for Santa Cruz. As part of the WSAC meeting on Friday, November 21, we will provide such an illustration, with a focus on a couple of potential water reuse alternatives. This document provides background information in support of the forthcoming illustration, including a brief discussion on the range of water reuse options and the associated issues that underlie their respective financial, societal, and environmental impacts (i.e., their TBL costs and benefits).

Why are we Focusing on Water Reuse for this Illustration of TBL?

The WSAC "red dot" exercise resulted in the greatest number of votes going to Water Department's water reuse submittal. Several other Alt submissions (and votes) also entail water recycling in one form or another. Thus, there is considerable interest evident in water reuse within WSAC and across the broader community.

In addition, there is a considerable volume of reclaimed water potentially available for various water reuse applications -- perhaps 4 to 5 MGD might be consistently available from the wastewater effluent currently discharged to the ocean. In addition, there are numerous variations possible on how and where reclaimed water might be used in Santa Cruz, and each alternative carries its unique set of costs and benefits, spanning the financial, societal, and environmental "bottom lines." Thus, there are a lot of factors and tradeoffs to consider when weighing water reuse alternatives.

How is Water Reuse Defined for this Illustration?

For the purposes of this exercise, we define water recycling (also referred to as water reuse or water reclamation) as making safe, productive use of highly purified effluent from the municipal wastewater treatment plant (WWTP). That is, we are focusing on options that entail tapping into wastewater that is captured within the City (or County) sewer system and associated wastewater treatment system. It may also include extracting wastewater effluent from points along the sewer system and purifying it at "scalping" treatment plants for more localized applications.

Excluded from this illustration are smaller-scale on-site water recycling options, such as may occur when a household taps its graywater for landscape irrigation. Likewise, on-site recycling of water at a car wash facility, or other such water-using entity, is not included in this illustration. These forms of on-site recycling are important in their own right, but for simplicity are excluded from this discussion. These on-site recycling practices also may be considered as conservation (water use efficiency) measures.

What is the Range of Water Reuse Options?

Recycling of highly purified municipal wastewater typically is characterized in three general forms:

1. **Nonpotable Reuse (NPR)**, in which highly purified (tertiary treated) municipal wastewater is applied to specific non-drinking water uses (typically including crop or landscape irrigation, streamflow augmentation or habitat restoration, industrial processes, and/or cooling system applications). There are several proposed Alts that include some form of NPR, including conveyance to North Coast farmers for irrigation uses, or to other locations for purposes such as golf course and other turf/park irrigation.

   NPR is governed by water quality regulations (Title 22 requirements) for tertiary treatment before application. There are many successful applications of NPR in place across California and elsewhere. NPR requires dedicated pipelines and pump systems to deliver reclaimed water to users (often referred to as "purple pipe" systems), which tends to add considerable cost, energy requirements, and carbon footprint. And many users/applications only use reuse water on a seasonal basis, limiting the volume of reuse water that is applied and, hence, limiting the potential value of NPR.

2. **Indirect Potable Reuse (IPR)**, in which very highly purified municipal wastewater—derived from what is referred to as "Complete Advanced Treatment (CAT)" -- is introduced into an *environmental buffer* for a specified period of time before being withdrawn for potable purposes. The environmental buffer may be a groundwater aquifer or a surface water reservoir. The purpose of the environmental buffer is to provide an additional barrier for the protection of public health. For example, the Division of Drinking Water (DDW) of California's State Water Resources Control Board (SWRCB) allows one-log of virus removal credit for each month the purified water remains in the aquifer. IPR is safely practiced in many locations in California and elsewhere, including the Orange County Water District's Groundwater Replenishment System.

3. **Direct Potable Reuse** (**DPR),** in which very highly purified wastewater from a CAT facility is introduced with or without the use of an *engineered buffer* into the raw water supply feeding a water treatment plant (or directly into a potable water supply distribution system, "downstream" of a water treatment plant). The purpose of the engineered buffer is to provide sufficient volumetric capacity to retain purified water for a specified period of time to allow for the measurement and reporting of specific water quality parameters, to be assured that the water provided meets all applicable water quality standards prior to being introduced into the potable water system. In most situations, the storage capacity of the transmission line used to transport the purified recycled water to a water treatment plant will provide sufficient retention time to make any needed interventions.

   DPR is not yet permitted in California, although the SWRCB is actively working with an expert panel to develop pragmatic regulations that will permit DPR in the state by 2016 (in accordance to directives from the State Legislature and Governor). DPR has been used safely and reliably in Windhoek, Namibia for more than 40 years, and is now being implemented at the municipal scale in

Singapore, Texas, and elsewhere. These existing potable reuse projects are important because the treatment technologies employed have been accepted by various regulatory authorities as being able to reliably produce safe potable drinking water, and the implementation of these projects has been accepted by the public.

How Might Water Reuse Options be Implemented in Santa Cruz?

Each of the three main forms of water reuse may be implemented in various possible forms and configurations in Santa Cruz. These variations are evident across several of the Alternatives put forward for the Convention.

These variations may include off-stream surface water *storage* (e.g., a quarry configured into a reservoir), or groundwater storage (e.g., some form of aquifer storage and retrieval, ASR; or seawater intrusion barrier injection wells). Several variations include *exchanges* with neighboring communities or other parties, in which City-provided reclaimed water to neighboring water systems might be "returned" to the City system in kind, under various possible arrangements.

For example, NPR might include constructing a purple pipe conveyance system to deliver irrigation quality water to North Coast farmers. In exchange, the City might receive raw water that the farmers would otherwise tap for irrigation (e.g., freeing up more high quality North Coast stream water for the City, or providing local groundwater to the Water Department).

Likewise, IPR alternatives might include providing potable quality reclaimed water to neighboring water systems to help replenish their depleted aquifers. Exchanges may then be considered to "repay" the City system, especially in drought years. Or, if local aquifer systems tapped by the City's Water Department are physically suitable for recharge, storage, and extraction, then IPR could be confined to Water Department resources as a way to reliably and sustainably supplement its own groundwater yields. Or, potable-quality reclaimed water could conceivably be delivered to Loch Lomond (or other surface water storage facilities, if developed) for use as part of the potable supply and/or fish flow support.

DPR might be accomplished by delivering CAT-purified waters to the City's Graham Hill Water Treatment Plant (WTP), where it could supplement the other source waters the City treats and taps for its potable supply. Other possible DPR configurations and permutations are also possible.

Issues, Tradeoffs, and Other TBL Considerations

Each of the myriad possible water reuse approaches and configurations has its own suite of costs, energy requirements, public acceptance, regulatory, and yield considerations. The TBL framework provides one way to consider the array of tradeoffs across these alternatives. It also provides a useful construct for comparing water reuse alternatives to other options (such as desal, winter flow capture and storage, conservation, the do nothing status quo, etc.).

For the TBL illustration that we plan to convey at the Nov 21 WSAC meeting, we intend to compare and contrast a NPR alternative (probably the Reclamation/North Coast Irrigation Exchange approach per

Dana Ripley's "RCGE" submittal) to a potable reuse alternative (possibly a DPR approach, akin to a component of SCDW's Water Reuse submittal for "Option 1", but assuming the State facilitates DPR by issuing suitable governing regulations in the coming 2 years).

Disclaimer

The TBL illustration will – by design and intent -- include many assumptions and simplifications. This is because we do not yet have all the relevant technical information available to provide a more realistic and case-specific analysis. The intent is to illustrate the types of information the TBL assessment *could* provide, once a lot more analysis is completed, and once more time is available to more carefully compile and interpret the relevant technical information. We simply will be filling in the blanks with some very rough guesstimates as illustrative placeholders – as a means to help reveal what and how a TBL approach can communicate impacts and tradeoffs between alternative options.

Some Key Questions:

Evaluating water reuse alternatives requires that a long list of questions be investigated (regardless of the approach used to evaluate the options – TBL or otherwise). Some of the core questions include:

1. ***How much water is available for recycling?*** There may be up to 4 to 5 MGD available as potential reuse production, based on the WWTP flows. Half of the effluent that serves as potential reuse source water originates from beyond the City and might be used at Scotts Valley for reuse, so the available volume could be reduced. Indoor water conservation also may reduce volumes.

2. ***How much water would irrigators demand and use?*** And, would the demand be seasonal (leaving the treatment and pipeline system unused for large portions of the year)?

3. ***How much would it cost to build and operate the irrigation pipeline and associated pumping facilities?*** What would be the carbon footprint embedded in such facilities and operations?

4. ***How much water would be available in the NPR exchange from the North Coast, and when?*** What would be the potential water quality and yield issues? Are there infrastructure needs associated with facilitating an exchange (e.g., pipeline capacity, possible treatment challenges)?

5. ***What public acceptance (and regulatory) issues might arise with potable reuse?*** How might these concerns be effectively addressed?

6. ***What would it cost to develop CAT for potable water quality?*** And, how much would it cost to develop conveyance (pipeline and pumping) to the Graham Hill WTP facility?

7. ***Is storage required for either NPR or DPR alternatives?*** If so, what are the options and respective costs?