COMPARING ELECTRICITY RESOURCE PLANNING WITH WATER RESOURCE PLANNING[1]

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Much of my career as an energy policy analyst dealt with long-term resource planning at electric utilities. This focus grew out of my work on energy efficiency, which became, starting in the 1980s, an increasingly important way for electric utilities to meet future customer energy-service needs.[2]

I was recently struck by the dramatic differences between how society plans to meet its energy-service needs in a cost-effective, resilient and environmentally sensitive fashion[3] and how little of that applies to the even more important need to manage our water resources.

The next section briefly describes how electric utilities develop resource plans. The following section explains the comparable processes with respect to water applied to Whatcom County. And the final section compares the two sets of processes. Although electricity and water differ in many important ways, there is much we in the world of water can learn from electricity planners.[4]

ELECTRICITY PLANNING

Integrated resource planning (IRP) is a process that helps utilities and public utility commissions (PUCs) consistently assess various demand and supply resources to meet customer energy-service needs at the lowest economic and social risk-adjusted cost. The end result is a plan to provide reliable and low-cost customer services, financial stability for the utility, a reasonable return on investment for shareholders,[5] and environmental protection.

Typically, a utility begins its IRP process by identifying its goals and the key issues the resource plan must address (Fig. 1). Corporate goals often concern customer service, returns to shareholders, maintenance of low electricity prices, and environmental protection. Specific issues might involve forthcoming decisions on an aging power plant that could be retired or

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[1] I thank Henry Bierlink, Dan Eisses, Chuck Goldman, Ron Lehr, Gary Stoyka, Joel Swisher, and two anonymous reviewers for their very helpful comments on a draft of this paper.

[2] Energy-service needs are the services that electricity provides, such as heating, cooling, water heating, and operation of electronic devices. Historically, utilities viewed customer electricity demand as entirely outside their influence. Beginning in the 1980s, utilities increasingly recognized the economic and environmental benefits of working with customers to modify/reduce their demand for electricity to meet their energy-service needs.

[3] E. Hirst, *A Good Integrated Resource Plan: Guidelines for Electric Utilities and Regulators*, ORNL/CON-354, Oak Ridge National Laboratory, Oak Ridge, TN, Dec. 1992. For an updated explanation, see F. Kahrl et al., *The Future of Electricity Resource Planning*, LBNL-1006269, Lawrence Berkeley National Laboratory, Sept. 2016.

[4] Water, like air, is a natural resource, whereas electricity is a human creation.

[5] About 75% of the electricity sold in the U.S. comes from investor-owned utilities. For public utilities (municipalities, rural electric coops, and the federal power entities) shareholder returns are irrelevant.

repowered; demand-side management (DSM) programs that might be expanded or modified; a response to a recent PUC order requiring the utility to acquire additional renewable-energy resources; and so on.

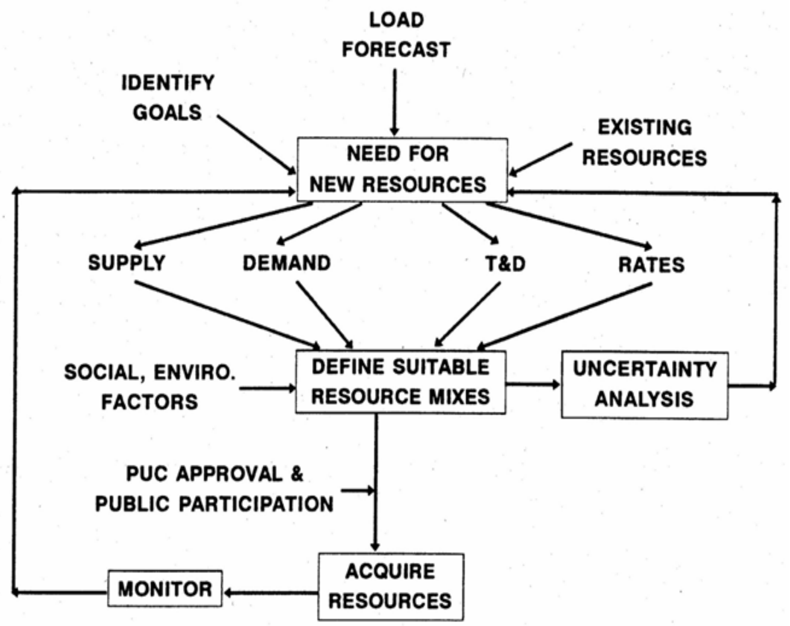

Fig. 1. Activities involved in electricity IRP.

Next, the utility develops alternative load forecasts. Then, the utility assesses the costs and remaining lifetimes of its existing resources and identifies the need for additional resources. Resources include utility-owned power plants, contracts to buy electricity from other distributed energy service providers and generation companies, programs that improve the efficiency or timing of customer electricity use, customer-owned distributed generation, and energy storage (to offset nondispatchable generation such as wind and photovoltaics).

The utility then assesses a broad array of alternatives that could satisfy the need for more electric-energy services, including supply, demand, transmission and distribution, and pricing options. Supply resources include modifications to existing power plants that extend their lifetimes or increase their output; purchase of power from other utilities and from nonutility companies; construction of new power plants; and purchase of power from customers with solar systems. Utility DSM programs might include (1) promotion of new lighting systems, motors, and other equipment to improve energy efficiency; (2) direct control of customer loads at critical times; and (3) different pricing schemes to shape customer energy use. These DSM programs constitute resources that can substitute for power plants, transmission lines, and distribution systems.

Different combinations of these supply and demand resources are then analyzed to see how well they meet future electricity needs and how expensive they are. These analyses are repeated time and again to test various resource portfolios for their resilience against different uncertainties. These analyses test (1) different assumptions about the external environment (e.g., local economic growth and fossil-fuel prices), (2) different estimates of the costs and performances of resources, and (3) different combinations of resources. Such uncertainty analysis helps to identify a mix of resource options that meets the demand for electricity, is consistent with the utility's corporate goals, avoids exposure to undue risks, and satisfies other environmental and social criteria. Fig. 2 illustrates a typical analytical process.

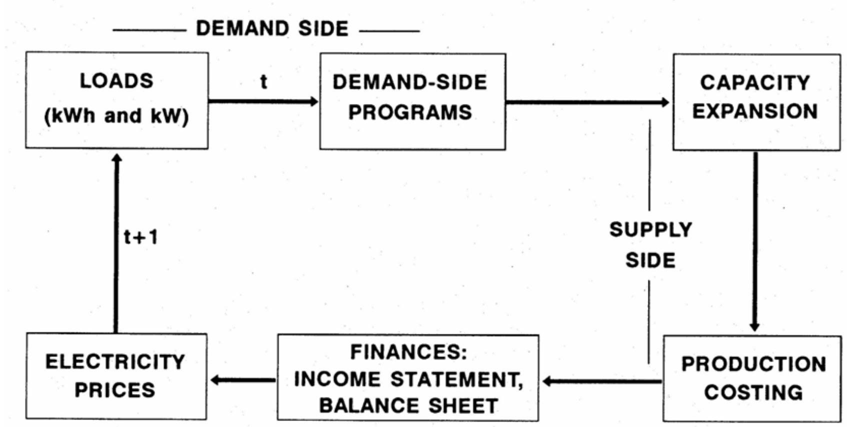

Fig. 2. Analytical processes include demand, supply and pricing as resources within the modeling framework. (t is time in years.)

Then the utility prepares a formal report based on the preceding analyses and on public involvement. That report presents the preferred resource plan and the reasons why, in the utility's view, this plan is the best mix of resources. After acceptance or approval by the PUC, the plan is implemented and resources are acquired. Although the PUC formally reviews the plan and various nonutility parties participate in its preparation, the utility has ultimate responsibility for its implementation.

While the plan is in force, the utility monitors changes in its environment and its implementation of the resource plan; and the plan is modified as events and opportunities change. Although resource planning is an ongoing process, only once every few years does the utility issue a formal plan along the lines discussed here.

As described above, IRP has several key elements:

- Integration of supply, demand, transmission and distribution, and pricing alternatives;
- Coordination and communication among people from various utility departments;
- Treatment of uncertainty;
- Participation in the planning process by outside experts, customers, and regulators;
- Consideration of environmental factors;
- Implementation of the plan, including acquisition of supply and demand resources, and collection and analysis of data needed to improve planning; and
- Continued monitoring of the plan's implementation and iteration of the planning process.

WATER PLANNING

Industry structure

The water "industry" structure is entirely different from that of the electricity industry, and these differences greatly complicate water-resource planning. The electricity industry is dominated by large companies that serve millions of retail customers. For example, Puget Sound Energy serves more than one million customers in Washington and has revenues of $2.4 billion a year. Because PSE is a monopoly, it is regulated by the Washington Utilities and Transportation Commission at the retail level and by the Federal Energy Regulatory Commission at the wholesale level.

Whatcom County has no centralized water industry. Almost all residential, commercial, and industrial water users are served by municipal utilities, water districts, or water associations. The largest local utility is the City of Bellingham, which serves 25 thousand customers and has revenues of $25 million a year. The city's water utility is overseen by the city council, which approves rates and the annual operating budget. The state Dept. of Health also regulates the city's water quality.

And the agricultural sector is almost entirely self-serve; i.e., farmers directly divert water from a nearby stream or withdraw water from a well on or near their properties.[6] Except for dairy operations, which may need treated water for livestock, agricultural water use does not involve a utility. The same is true for the roughly 16,300 rural households that draw water from a well on their property.[7]

Because of these significant differences between electricity and water, planning for water is much more fragmented and complicated. In addition to the number and diversity of water providers, the number and diversity of those with some responsibility for managing water resources is also great. As shown in Fig. 3, the number of state and local governments plus interest groups involved with oversight is both large and confusing. Indeed, it is not possible to determine who (if anyone) has ultimate responsibility for planning and implementing resources to meet future water needs. The Dept. of Ecology, which oversees state water law, is not included in Fig. 3. This omission is surprising given the department's authority under state law (RCW 43.21A.064) for "… supervision of public waters within the state and their appropriation, diversion, and use … ."

Forecasting future water needs

Forecasts of future water use are a critical starting point for determining how best to meet future needs. And forecasts require a starting point that determines water use by sector and drainage basin for a recent year. Unfortunately, such a starting point does not exist in Whatcom County.

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[6] As of 2017, Whatcom County had 1,700 farms, of which 600 irrigated crops. (U.S. Dept. of Agriculture, *2017 Census of Agriculture*, https://www.nass.usda.gov/Quick_Stats/CDQT/chapter/2/table/1/state/WA/county/073)

[7] Page 3-4 of RH2 Engineering, *Whatcom County Coordinated Water System Plan Update*, May 2016.

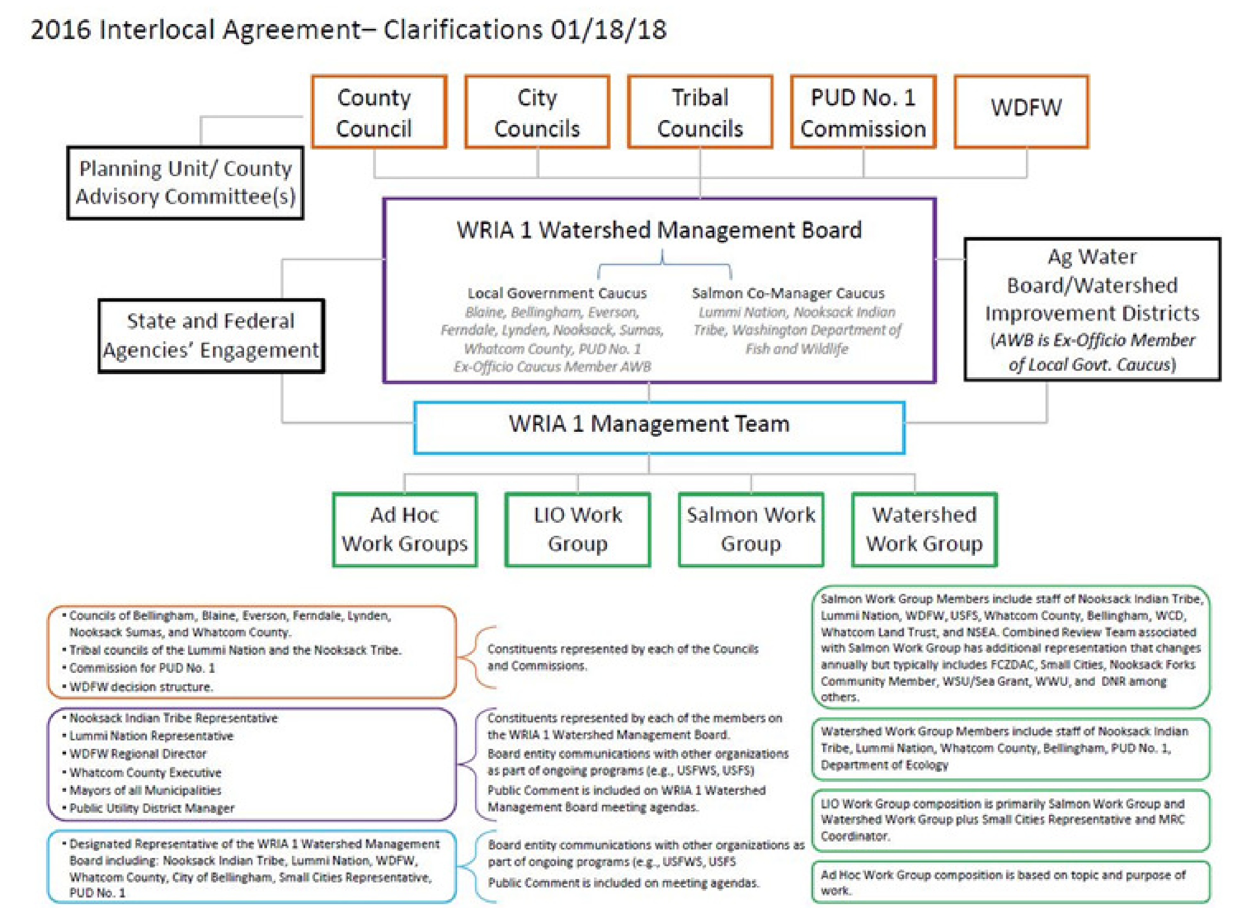

Fig. 3. Organization chart for Water Resource Inventory Area (WRIA) 1.

Every utility meters the water use of all their customers. But no entity aggregates these data across utilities to document water use year by year for the county as a whole. More important, most farmers, because they self-supply, do not meter their water use. (Some farmers do meter their water use, but those data are not publicly available.) This omission is important because agricultural irrigation dominates Whatcom water use during the critical summer months (July through September), when streamflows are very low (Fig. 4).[8]

Also, water utilities use different methods to forecast demand and these methods are not documented in any central location. In addition, the forecasting methods used by local utilities are very simple, linking future water use primarily to population growth. Because the approaches used are so simple, it is not possible to estimate how future changes, such as the cost of water, crop prices, economic growth, and – especially – climate change, might affect instream and out-of-stream water uses.

[8] E. Hirst, *Analysis of Whatcom County Water Use*, Jan. 2017. See also RH2 Engineering, *Quantification of Agricultural Irrigation Water Use and Water Rights*, prepared for PUD #1 of Whatcom County, Dec. 2016.

Two sources of data exist that, in part, address thesee baseline issues. The U.S. Geological Survey estimates water use for every county in the United States once every five years.[9] The USGS estimates suffer from two key problems: (1) they are issued infrequently; and (2) the methods used to estimate sectoral water use vary over time, leading to difficult-to-explain changes in water use, as shown in Fig. 5.[10] For example, the dramatic increase in agricultural water use in 2010 relative to 2005 and 2015 is surely caused by differences in methodology, not by changes in actual water use.

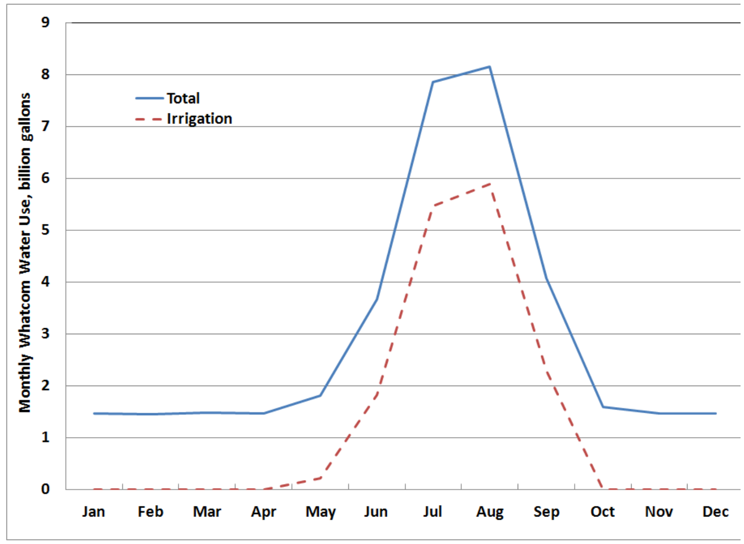

Fig 4. Month-by-month water use in Whatcom County, total and irrigation.

In addition, early this decade WRIA 1 sponsored studies of water supply and use in the Lower Nooksack area.[11] The strength of this study is its detail on streamflows and ground- and surface-water uses, disaggregated for 16 sub-basins. The primary weaknesses of this study are its reliance on estimates of water use rather than data and its one-off nature (i.e., there are no plans to replicate this study for later years).

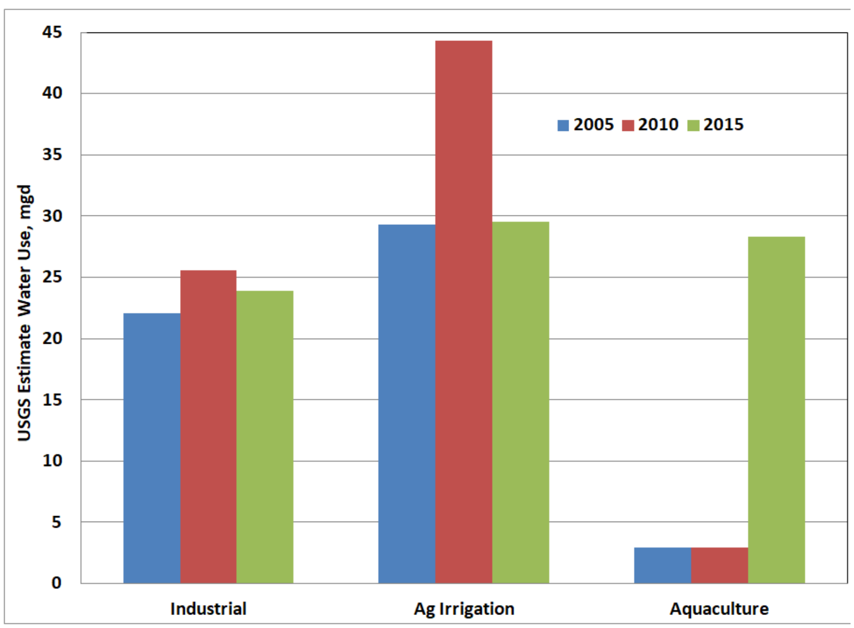

Fig. 5. U.S. Geological Survey estimates of Whatcom County water use for key sectors for 2005, 2010, and 2015.

[9] C. A. Dieter et al., *Estimated Use of Water in the United States, 2015*, Circular 1441, 2018.
[10] R. Dinicola, Associate Director U.S. Geological Survey, Washington Water Science Center, personal communication, Aug. 23, 2018.
[11] C. Bandaragoda et al., *Lower Nooksack Water Budget*, WRIA 1, Whatcom County, 2012; see especially Chapter 12 "Existing Condition Water Budget Scenario."

Even if we had good baseline data on local water use, we would find it difficult to develop meaningful projections of future water use because we don't have forecasting models that incorporate the key determinants of water use. For residential, commercial, and industrial customers these determinants include the price of water and the associated rate structure, economic activity and incomes, government regulations on the water-use efficiency (WUE) of key products (including showerheads, toilets, and washing machines), and the nature and extent of utility WUE programs.

For agricultural irrigation, forecasting models should account for soil types; crop types, prices, and water use; and the likely effects of higher summer air temperatures and lower summer precipitation on irrigation needs. As far as I know, no such forecasting system exists for Whatcom County.

Resource identification and assessment

Assuming we were able to develop alternative scenarios of future water needs, we would next compare those needs with today's ground and surface water supplies (disaggregated by season and drainage basin).

This comparison would show how much, when and where the gap is changing between future demand and today's supply. This deficit could then be filled with various supply, storage, efficiency, and water-reuse projects. Planners would develop a set of such projects and identify the key characteristics of each project. These characteristics include capital and operating costs; the location, amount and timing of water provided or saved; potential funding sources to pay for these projects; regulatory requirements (e.g., permits from Ecology); environmental effects; and cost-effectiveness (e.g., $/acre-foot). Figure 6 shows an example of such a curve, developed for the Bertrand Creek watershed.[12]

Two recent studies provide valuable technical detail on possible new water supplies (deep wells in Birch Bay[13]) and storage (managed aquifer projects on the three forks[14]), but offer no information on the economics of these projects. Without such estimates, how can potential buyers of these resources decide whether either or both are cost-effective?

[12] These numbers are from an untitled 2008 report by Hart Hodges, Western Washington University, based on a set of numbers developed by Tom Anderson when he was General Manager of PUD #1.

[13] CHS Engineers, *North Whatcom County Regional Water Supply Feasibility Study – Phase 1*, for Birch Bay Water and Sewer District, Feb. 2018.

[14] J. Chennault et al., "Nooksack River Managed Aquifer Recharge (MAR)," presented to Salmon Recovery Staff Team, Jan. 13, 2020.

Uncertainty analysis
The planners/analysts would next conduct sensitivity, scenario and other analyses to test the robustness of different resource portfolios against future uncertainties. The outcome of such analyses would be management agreement on which resources to acquire and when.

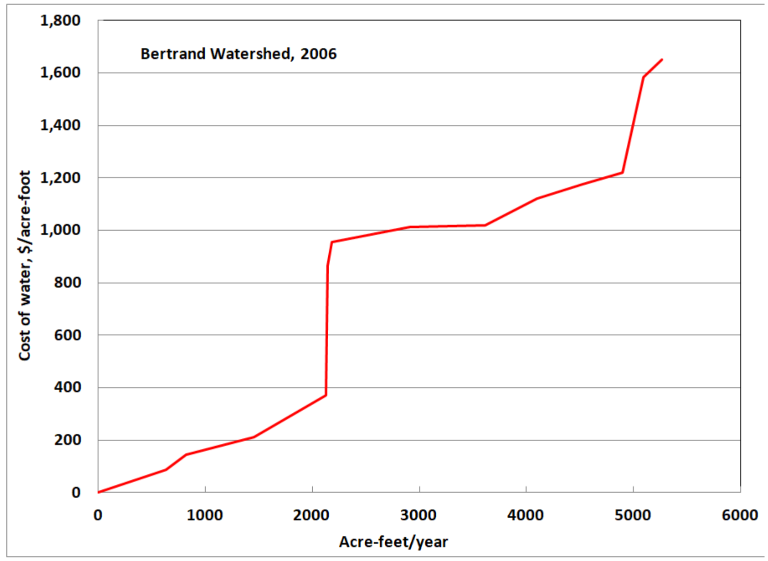

Fig. 6. Cumulative supply cost curve for Bertrand Creek watershed.

Finally, the organizations responsible for implementing these projects would report annually to Ecology on their progress in meeting agreed-upon milestones, sometimes called adaptive management.

Past and current efforts at local water resource planning
Plans were published in 2005 and 2007, which I do not discuss because they are so old, have not been fully implemented, and are not resource plans as described here.[15] Also, individual utilities develop plans, but I don't discuss them here because they are limited in scope and deal only with that utility and its customers and water supplies.[16]

The closest approximation to a recent county-wide plan is the 2016 *Whatcom County Coordinated Water System Plan Update*.[17] This plan, overseen by the state Dept. of Health, covers all the local utilities and by design omits agriculture. This omission is important because agricultural irrigation is the largest water use in Whatcom County (Fig. 4).

The *Update* used population forecasts from the Whatcom County Comprehensive Plan to estimate the amounts of water each utility would need at full buildout, increasing from 20 million gallons/day to 45 million gallons/day. The *Update* also compared the water rights that each utility holds with expected water use at full buildout. Almost all utilities had sufficient rights to meet future demand. This is the only comparison of demand and supply, with paper water rights implicitly equated to actual (wet) water.

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[15] *WRIA 1 Watershed Management Plan*, June 2005; *WRIA 1 Detailed Implementation Plan,* July 2007.
[16] See, as examples, City of Bellingham, *2013 Water System Plan Update*, CH2MHILL, Oct. 2013; and Birch Bay Water and Sewer District, *Comprehensive Water System Plan*, CHS Engineering, June 2019.
[17] RH2 Engineering, *Whatcom County Coordinated Water System Plan Update*, May 2016.

The report contains no discussion of the sources and availability of water today and where additional supplies are expected to come from. The only treatment of water-use efficiency is a brief section (8.7), which says nothing specific about the programs that Whatcom County utilities run, and their current and expected benefits and costs. And the report nowhere discusses water prices, what local utilities charge their customers for water and the form of these rate structures (e.g., seasonal rates and/or block-rate structures).

Another example of local water planning is the *WRIA 1 Watershed Management Board 2018-2023 Implementation Strategy*.[18] This document is a plan to develop a plan rather than a resource plan itself. The plan identifies "technical appendices," which are not available as of this writing. It also includes several milestones that have already been missed. More important, this plan nowhere includes any of the elements described above: forecasts of future water needs, identification of resources, analyses of different resource portfolios, and so on.

The *Implementation Strategy* does cover several important topics and identifies the lead agency for each one: Groundwater model (Whatcom County lead), Regional Water Supply Plan (PUD #1), Drainage-Based Management (County), Salmon Recovery, Plan Update, and Monitoring and Data Management. The estimated cost for this 5-year plan is about $6 million. Two projects – Regional Water Supply Plan and Drainage-Based Management – are intended to address current and projected needs and resources, solutions, and opportunities to integrate with other land use, water quality and habitation restoration plans.

The final example discussed here is the draft proposed rule issued by Ecology to offset the amount of water expected to be used by rural households that obtain water from a permit-exempt well over the next 20 years, 2018 – 2038.[19] Based on work done for a WRIA 1 planning effort in 2018, Ecology reviewed several forecasts of population growth and its allocation to rural areas. This allocation is needed to estimate the number of new rural homes that will use a well for their drinking water. Ultimately, Ecology estimated that about 2,150 such homes would be built during the 20-year period, with an average occupancy of 2.56 people per home.

Ecology then estimated the amounts of water needed for indoor and outdoor uses and set limits of 500 gallons/day for indoor use plus 1/12 acre for outdoor watering. The net effect of these decisions was an estimate of 260 acre-feet per year for consumptive water use.[20] The homes assumed to be built and their water use were then allocated across the nine Nooksack sub-basins. To account for the many uncertainties and assumptions needed to arrive at the 260 acre-feet total,

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[18] WRIA 1 Watershed Management Board, *WRIA 1 Watershed Management Board 2018-2023 Implementation Strategy*, Aug. 2019, approved Sept. 2019.

[19] Ecology, *Draft Rule Supporting Document, Amendment to Chapter 173-501, WAC Instream Resources Protection Program – Nooksack Water Resource Inventory Area (WRIA) 1*, Nov. 2019.

[20] Consumptive water is that portion of the water withdrawn or diverted that is *not* returned to the system. The remainder of the water use is return flow.

Ecology applied a 50% safety factor "to ensure that the volumes achieved through this process more than compensate for the impact that occurs over the twenty-year planning horizon and accounts for uncertainty."[21]

Ecology, again relying primarily on work done by the WRIA 1 planning groups in 2018, developed a set of offset projects. Ecology selected 13 of these projects to offset the 390 acre-feet of consumptive use. In aggregate, these 13 projects are expected to produce 3,377 acre-feet a year, far more than required to offset the amounts used by rural residential wells.

Ecology's approach to project selection was deficient in several ways. First and most important, it largely ignored options to improve WUE in all sectors. Only one of the 13 projects dealt with WUE and that one was completely bereft of any details on who would implement the project, what sectors would be targeted, what measures would be promoted, promotion methods (e.g., workshops, written materials, and/or financial incentives for purchase and installation of WUE measures), and potential funding sources. And this project, unlike the others proposed by Ecology, lacks any quantification of offset amounts.

To illustrate the possible benefits of a robust WUE program consider the following comparison. Ecology's *Preliminary Regulatory Analysis* shows an average cost for three projects of $2,100 per acre-foot (Table 6, page 28). Water-use efficiency measures surely cost much less. Consider two simple hypothetical examples. Providing free garden-hose timers to homeowners might cost about $170 per acre-foot. Encouraging farmers to adopt internet-based, advanced irrigation scheduling methods might cost even less, $140 per acre-foot. And these savings occur during the critical low-flow summer months.

Second, Ecology conducted no independent analysis of these projects. Ecology offered no rationale for picking some projects and rejecting others. How important, in Ecology's view, are various factors that might affect the feasibility and attractiveness of different projects: capital cost, operating cost, overall cost effectiveness, environmental effects, regulatory obstacles, and political support? It appears that the sole factor for project selection was "likelihood of implementation." [22] Even here, Ecology did not explain how it determined this likelihood.

Finally, there is no way to ensure that the projects Ecology selected actually get done and are completed within the 20-year time frame. For example, the Birch Bay deep wells project (#24) has no contracts, now or planned, to build the infrastructure to pump water up from these wells and deliver that water to users; what, therefore, is Ecology's basis for assuming this project will offset 440 acre-feet of water?

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[21] Page 24 of footnote 19.
[22] Page 39 of footnote 19.

The Colorado River offers a useful example of good planning. The U.S. Bureau of Reclamation conducted a major study "to define current and future imbalances in water supply and demand in the Basin … over the next 50 years (through 2060), and to develop and analyze adaptation and mitigation strategies to resolve those imbalances."[23] The study was conducted with an extensive set of stakeholders, including "tribes, agricultural users, purveyors of municipal and industrial (M&I) water, power users, and conservation and recreation groups."

This study explicitly:

- recognized uncertainties in both supply and demand;
- considered a broad range of supply, demand, and management options;
- evaluated resource portfolios on both quantitative and qualitative measures; and
- involved a broad range of interested parties.

The study used a scenario planning approach to deal with uncertainty, including the likely effects of climate change (more frequent and longer lasting droughts).

To address growing imbalances between supply and demand, the study considered four sets of options to: increase supply, reduce demand, modify reservoir operations (Lake Powell and Lake Mead), and improve governance. About 30 options were developed quantitatively (including $/acre-foot) and qualitatively (Table 1, p 12) and then combined into four portfolios. In total, more than 20,000 simulations were run. Key results from these simulations included estimates of the percentage of years vulnerable[24] for the Upper Basis and Lower Basin (Fig. 3, p. 21).

DISCUSSION

The foregoing discussion and examples show that our ability and willingness to plan for a feasible and affordable water future is limited. This situation should alarm us because the demand for water is growing as Whatcom County population continues to increase and as the adverse effects of climate change (rising summer air temperatures and declining summer rainfall) increase the need for irrigation water. In addition, water supplies are declining, again because of climate change (less snowfall, earlier springtime snowmelt, and less summer rain).

Several factors contribute to this discouraging situation. First, decisions on water in Whatcom County are made by many different organizations (Fig. 3); as a consequence, nobody is in charge. Opinions differ on the need for a water czar; I think we do need such an entity to take the lead and help the Watershed Management Board achieve its goals.

Second, we don't know how much water is available for human, out-of-stream uses, for two reasons. First, the Lummi Nation and Nooksack Indian Tribe hold the most senior water rights in the county. Their rights to water stretch back to "time immemorial" and cover both instream

[23] U.S. Bureau of Reclamation, *Colorado River Basin Water Supply and Demand Study, Executive Summary*, Dec. 2012.

[24] Vulnerability was defined as (1) Lake Mead elevation dropping below 1,000 feet above mean sea level, and (2) flows below 75 million acre-feet at Lee Ferry.

flows (primarily to support healthy salmon and other wildlife) and for on-reservation water use. Although both Tribes requested assistance from the federal government in quantifying their water rights, that has not happened.[25] Therefore, we don't know how much water the two Tribes are entitled to. We are also uncertain how much water fish need instream.[26] Therefore, we are unable to estimate how much water is left for human use.

Third, we lack data on the most important human water use in the county – agricultural irrigation. And farmers are, understandably, reluctant to share information on their water use for two reasons. First, roughly 40% of the water used for agricultural irrigation lacks authorization from Ecology.[27] Second, farmers that have become more efficient in their use of water are worried that the unused portion of their water right will be taken away by Ecology, under the use-it-or-lose-it relinquishment requirement of state law.[28]

Fourth, we lack reliable estimates of the value of water, in particular how much water users would be willing to pay for additional supplies. Although prices exist for all the water utilities, no such data exist for farmers because they self-supply and because their water use is generally not metered. Table 1 provides estimates of some local water prices.[29] The irrigation price is based on estimated energy and labor costs.[30]

Table 1. Water Prices in Whatcom County , approximate

	$/acre-foot	Ratio re Ag
City of Bellingham		
Average	3,260	56
Variable	847	15
PUD #1 Industrial	470	8
Agricultural irrigation	58	1

With prices across sectors varying by a factor of 50, it is challenging to decide how much to pay for new or conserved water. For example, a new supply costing $500/acre-foot might be a bargain for municipal utilities and far too expensive for farmers. In addition, the value of water is location specific. Water should be more valuable in a drainage where flows are low and salmon might do well with higher flows than in another drainage that has adequate flows. Also, water is more valuable in the upper reaches of a basin than in the lower reaches and more valuable during dry years than wet years.

Are there reasons to be optimistic? Projects are now underway that will fill at least some of the gaps discussed above:

- Regional Water Supply Project,

[25] See, for example, Lummi Indian Business Council, "Litigation Request to Protect Lummi Nation Treaty and Fishing Rights," letter to U.S. Dept. of the Interior, June 6, 2011.
[26] Ecology's 1985 instream flow rule is the only official measure of the amounts of water needed in various locations throughout the Nooksack River basin by month. Subsequent research by Utah State University suggests that fish ideally need more water than required under Ecology's rule.
[27] E. Hirst, *Unpermitted Irrigation Water Use in Whatcom County*, Sept. 2017.
[28] Ecology, *The Relinquishment, Recission, and Abandonment of Water Rights*, POL-1060, Dec. 2019.
[29] These prices are not directly comparable because Bellingham water is treated to drinking-water standards, PUD water is partially treated, and irrigation water is not treated at all (although it might be filtered).
[30] G.D. Schaible and M.P. Aillery, *Water Conservation in Irrigated Agriculture: Trends and Challenges in the Face of Emerging Demands*, U.S. Dept. of Agriculture, Sept. 2012

- Drainage-Based Management, and
- Two Whatcom Conservation District projects (both funded by Whatcom County) on WUE

should provide valuable information on resources available to meet future water needs.

What might/should happen to yield a system that thoughtfully plans for a cost effective and practical water future, one that provides enough water for all life – plants, animals, and people? I think it is possible to plan for and then create such a viable future.

First, in my view, the two Tribes need to be clear about the magnitudes of their water rights. How much water do they think is needed at various places and times in the Nooksack River basin to support their treaty rights to healthy salmon and other wildlife? These quantities may not be the final word on minimum instream flows. However, these quantities should be the critical starting point for negotiations among the tribes, Ecology, farmers (probably represented by the six Watershed Improvement Districts and/or Whatcom Family Farmers), and others.

Second, I suggest that Whatcom County, both the county council and executive, lead in organizing and catalyzing the work to produce a true action plan. Because the county holds no water rights, it is a neutral party in the allocation of such rights. Also, Ecology, which some might view as the natural leader (especially given its authority/responsibility under RCW 43.21A.064), has shown no leadership on local water issues. The county with a leader willing to take risks needs to step forward and take charge. I nominate the Whatcom County Executive for this role.

Third, farmers, tribes, county, utilities and others should petition the state legislature for a multi-year, temporary suspension of key elements of state water law, in particular the relinquishment requirement. Such a suspension would encourage farmers to actively participate in development and negotiations of solutions to our water-supply problems.

Fourth, we should focus more on data collection, management, and analysis. We need more and better data on streamflows, groundwater movement and connectivity to surface waters, out-of-stream water uses, and the costs and benefits of various resources to fill the growing gap between existing supplies and demand. And these data collection, analysis, and reporting activities need to be repeated every few years.

Ultimately, we have no choice. The erratic, but relentless pressure of climate change requires us to address the problems of growing summer demand for water and declining supplies.