CITY COUNCIL
AGENDA REPORT

DATE: January 13, 2015

AGENDA OF: January 27, 2015

DEPARTMENT: Water Supply Advisory Committee (CN)

SUBJECT: Water Supply Advisory Committee Report on Completion of Phase One of Work

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RECOMMENDATION: Motion to accept the report from the Water Supply Advisory Committee on phase one of its work.

BACKGROUND: In February 2014 the Santa Cruz City Council appointed representatives to a new advisory body whose role is to provide the City Council with recommendations on issues related to improving the reliability of the current water supply serving the Santa Cruz water service area. This new advisory committee, the Water Supply Advisory Committee (WSAC or Committee) has specifically been asked to "explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future threats; analyze potential solutions to deliver a safe, adequate, reliable and environmentally sustainable water supply, and develop strategy recommendations for City Council consideration."

In establishing the WSAC, the Council asked to receive periodic reports from the Committee. The purposes of these reports are to give the Council updates, to ask for Council action on key steps in the process, for example the WSAC Charter or the problem statement, and to provide opportunities for the Council to give the WSAC its feedback about issues or topics such as the work-plan.

As the Council may recall, the Committee divided its work into two distinct phases: the initial reconnaissance or "Recon," and an in-depth analysis of alternatives and development of recommendations, called the "Real Deal." The Recon phase allows for a broad survey of challenges, issues and options around Santa Cruz's water supply, and development of methodology to winnow the options and issues to a manageable subset for in-depth exploration in the Real Deal phase. To complete Recon, the Committee convened nine times. All agendas

and meeting materials can be found on the Committee's website: www.santacruzwatersupply.com.

Attachment A, The Recon Report, summarizes the Committee's efforts and accomplishments during its first phase of work. The Recon Report includes an executive summary that provides a high level overview of the Committee's work during its first phase. An additional summary of Recon that is focused on the key objectives that the Recon phase was designed to achieve is provided in the Discussion section of this staff report.

In phase two of its work (the "Real Deal"), the Committee's recommendations for the City Council will be formulated. The Committee, working with City staff and the consultant and facilitation teams, has created an approach and schedule for phase two. These are presented and discussed in a companion staff report prepared on that topic.

DISCUSSION:

The purpose of the Recon phase was to provide an opportunity for the Committee to explore the water supply issues it has been charged with addressing in an iterative manner that emphasized learning and understanding rather than problem solving. Recon was consciously designed to provide a time for exploration of issues and decision tools and development of relationships and comfort with selected approaches.

The objectives identified by the facilitation team for Recon included:

- Build the Committee's collaborative problem solving skills and capacity;
- Work with the Committee to build a common vocabulary of terms related to the issues they are dealing with;
- Build the Committee's shared knowledge and understanding about the issues, and in particular, the uncertainties around and complexities of the issues;
- Introduce the Committee to a variety of decision support and analytical tools and work with members to select tools they want to develop and use;
- Work with the Committee to learn about and apply selected analytical tools such as scenario planning, multi-criteria decision support models, and triple bottom line analyses;
- Work with the Committee to identify and begin to work with a range of criteria and metrics that will be used in evaluating alternatives;
- Work with the Committee to identify and begin evaluating a diverse set of alternatives; and
- Work with the Committee to identify and prioritize additional questions that need to be answered about alternatives, areas of uncertainty, policy questions, and evaluation criteria and metrics.

The work of the Recon phase has provided the WSAC with opportunities to learn about and explore the challenges and opportunities facing the Santa Cruz water system. It has produced a rich and diverse set of alternative approaches for decreasing or managing demand, for enhancing operating flexibility, and for supplementing supply to improve reliability. Committee members have created relationships and learned about each other's interests and perspectives. Teams of technical and analytical support experts and independent reviewers have been assembled and established working relationships with individual Committee members and the Committee as a whole. Evaluation criteria have been identified, explored, refined, and where additional work is needed to support further refinement, that work has been identified. Decision support tools have been identified and developed and the Committee has had an opportunity to try them out, learn about how they work and what they do well, and how several tools can be used to support a more comprehensive exploration of the full range of alternatives and strategies.

As a result of all of the above, the Committee is ready and well positioned for phase two of their work. They are familiar with the many aspects of the problem and the likely range of approaches for addressing it, and well prepared to engage in the collaborative problem solving and interest-based bargaining that come next. City staff and the technical and facilitation teams are working to create an effective work plan for phase two of the Committee's work. The Committee is actively engaged in these efforts both through reviewing and approving work plans and schedules, and through a Planning Subcommittee working in tandem with City staff and the technical and facilitation teams.

The Committee is pleased to submit this report and welcomes comments and feedback from the Council.

FISCAL IMPACT: There is no additional fiscal impact of the report on the first phase of the Water Supply Advisory Committee's work. A companion staff report laying out the work plan and schedule for the remainder of the Committee's work outlines proposed contract amendments that are requested and recommended to support completing the Committee's work.

Submitted by: Rosemary Menard on behalf of
the Water Supply Advisory Committee

Attachment A

Report on Phase One Work

City of Santa Cruz Water Supply Advisory Committee

I. Introduction

In its first meeting, the Water Supply Advisory Committee (WSAC) made a decision to use a two phased, iterative process to conduct its work. The first phase is designed to take the Committee through the range of pertinent issues at a coarse level of detail, with a goal of familiarizing WSAC members with the information and tools they can use to address uncertainty about the future as they consider options and develop recommendations. This phase is basically a reconnaissance effort and is called "Recon" for short.

The Committee also chose to use a planning approach tailored for highly complex problems characterized by uncertainty. When combined with a reconnaissance phase, this approach begins with a first pass at a problem using very preliminary analyses and a quickly-constructed decision model. The product of this is a tested and improved decision model, increased understanding of the issues, shared knowledge among Committee members, and a rigorously prioritized research and discussion agenda.

There are at least three significant benefits to the Committee's Recon process:

1. This process uses a "learn by doing" approach to engage Committee members in working with key content (i.e., current and future supply and demand and the uncertainty around each, values, evaluation criteria and rating scales) from the beginning, which is more engaging than traditional "feed forward" methods for getting groups up to speed on issues.
2. The Recon process helps the Committee become familiar with issues of uncertainty and to develop both the tools and perspectives they will need to develop recommendations that appropriately take into account uncertainties that exist today and into the future.
3. Recon allows Committee members to learn about how sensitive various options are to changes in assumptions, which will help them prioritize the key questions and information that their technical consultants will need to work on.

The second phase of the work, called "The Real Deal" for short, takes all the learning and skill building developed in Recon and applies it in a much more granular consideration and analysis of the options, including integrating results from the technical support consultants' work on specific questions identified during Recon.

II. The Purpose and Objectives of Recon

The purpose of Recon was to provide an opportunity for the Committee to explore water supply issues in an iterative manner that emphasized learning and understanding rather than problem solving. Recon was consciously designed to provide a time for exploration of issues and decision tools and development of relationships and comfort with selected approaches.

In designing the WSAC process for Recon, the WSAC facilitation team identified several key objectives that would need to be met for this phase of work to be successful. The objectives identified by the facilitation team for Recon included:

- Build the Committee's collaborative problem solving skills and capacity;
- Build a common vocabulary of terms related to the issues they are dealing with;
- Build shared knowledge and understanding about the issues, and in particular, the uncertainties around and complexities of the issues;
- Introduce a variety of decision support and analytical tools and work with members to select tools they want to develop and use;
- Learn about and apply selected analytical tools such as scenario planning, multi-criteria decision support models, triple bottom line analyses;
- Identify and begin to work with a range of criteria and metrics that will be used in evaluating alternatives;
- Identify and begin evaluating a diverse set of alternatives; and
- Identify and prioritize additional questions that need to be answered about alternatives, areas of uncertainty, policy questions, and evaluation criteria and metrics.

Significant progress was made on achieving all of these objectives and, as a result of its successful work during Recon, the Committee is now well positioned to move into phase two of its work.

III. Setting the Stage – Overview Presentation on Water System Supply and Demand:

To provide a comprehensive overview of the City's situation related to water supply reliability, a presentation was given by City staff at the June 24, 2014 meeting. The presentation covered current and relevant information about the water system's supply resources, including discussions of:

- water quantity and water quality issues;
- water demand, including information about the use of different customer classes;
- current water conservation programs and the pending water conservation master plan covering additional potential demand management strategies;
- water rates, including an acknowledgement that past demand forecasting does not take into account the potential for price to influence demand;

- regulatory issues such as the pending need to meet fish flow requirements;
- the Water Shortage Contingency plan; and
- very high level information on the potential impacts of climate change on the Santa Cruz water system.

To view the presentation and/or listen to the audio file for this meeting go to: http://www.santacruzwatersupply.com/meeting/wsac-meeting-june-2014.

This presentation was prepared to provide a primer on the topics Committee members would be working with in the months to come. The City explicitly stated that the goal for the presentation was not to "define the problem" the Committee needs to address. The reasons for not attempting to define the problem at this early stage of the Committee's work were twofold:

1. The City anticipated additional work to refine information on both demand and supply being done during the Committee's term of work; and
2. One goal of Recon was to support the Committee's learning about the various factors affecting the problem and to work together with City staff and the technical team to generate the problem statement from that learning.

Through most of the Recon phase, the information in this presentation has been referenced and helped create context without being viewed as written in stone, which is exactly what the City staff intended when they prepared it.

IV. Long Range Planning in an Environment Characterized by Both Complexity and Uncertainty

The most important element of a problem solving process is defining the problem. Yet one of the characteristics of complexity is that even the problem is difficult to define. This is true of Santa Cruz's water planning.

Like all long range planning, water supply planning must deal with the realities of an uncertain future. In a historical context, water supply planning uncertainties have included the normal sources of variability:

- weather and its impacts on supply;
- demand increases in the future due to growth and development;
- demand decreases resulting from changing plumbing codes, technologies, demographics, or consumer behaviors (conservation); and
- potential supply decreases due to regulatory requirements to release water to support threatened or endangered fish species.

Today, uncertainties related to impacts of climate change must be added to this list.

Appendix A-1 provides a more detailed listing of the various uncertainties that the Committee and its City staff and technical and facilitation teams have identified as they worked through Recon.

Taken together, these uncertainties create a level of complexity that makes planning for Santa Cruz's water supply future particularly challenging. One of the objectives of Recon was to create opportunities for Committee members to discover and understand the nature of this complexity through exercises, tours, and discussions about issues.

A. Tools for Planning in the Face of Uncertainty and Complexity

During Recon the Committee was presented information about a variety of decision tools that the technical and facilitation teams believed could be useful in the Committee's work. The Committee chose to develop four basic tools:

- Scenario planning, including portfolio development,
- Risk analysis and risk management
- Criteria based evaluation of alternatives and portfolios using a Multi-Criteria Decision Support tool (MCDS), and
- Triple-bottom line analysis.

A brief description of each of these tools is included below and scenario planning and criteria development and evaluation using MCDS are discussed in more detail in the sections that follow.

1. Scenario Planning and Portfolio Development

Scenario planning is a tool that allows users to simultaneously examine several alternative futures and, in this case, the water supply problem related to that scenario. In each scenario, the central scientific questions (i.e., how much water will we have and how much we will need) are developed based on a set of reasonable but different assumptions. Portfolios are packages of actions that are created to respond to each scenario.

The goal of scenario planning is to understand how different futures might require different sets of actions. Ultimately working with scenarios will assist the Committee in developing and reaching agreement on a set of future conditions they will plan for and the portfolio of actions they believe the City should pursue to respond to that future.

2. Risk Analysis and Risk Management

Risk analysis is an inherent element of scenario planning. In creating portfolios to respond to scenarios, Committee members will be required to weigh and balance the benefits and costs of a

variety of potential actions, consider the likelihood that various actions can achieve their desired goals of reducing demand or increasing supply, and can be implemented in the timeframe required. Risk assessment and adaptive risk management will be needed to decide how to meet the potential range of impacts from climate change into water planning

Other than generally being exposed to the risk analysis and to adaptive risk management concepts, the Committee has yet to fully engage with these tools. Their use will be essential in phase two of the Committee's work.

3. Criteria Based Evaluation and MCDS Model

During the Recon phase, the Committee's job is to learn about and begin evaluating what is known about both the problem and potential alternatives to address the problem. A key outcome of this work is to identify what further research and technical analysis needs to be done related to the problem and potential solutions so that informed decisions can be made during the second phase of the Committee's work.

Developing appropriate criteria for evaluating the merits of proposed solutions is essential for effective problem solving. Understanding how various alternatives or portfolios of alternatives rate against those criteria is at the heart of the problem solving process. The Committee's development of the multi-criteria decision support (MCDS) model provided a focal point for the definition of criteria, subcriteria, and rating scales. In addition, the MCDS model was designed to assist the Committee in identifying and prioritizing the additional research and technical analyses that are needed to answer key questions about alternatives or aspects of the problem.

4. Triple Bottom Line Analysis

A triple bottom line analysis looks at a proposed action, for example an alternative or portfolio of alternatives to address Santa Cruz's water supply issues, from three perspectives: financial performance, environmental performance, and social performance. The analysis attempts to quantify and compare each element in a manner intended to fully disclose the positive and negative impacts for each perspective and allow for the comparison of actions and support communication about their similarities and differences. Importantly, these impacts are typically normalized using agreed-upon financial metrics, facilitating objective discussion of what are often "values-based" criteria.

Stratus Consulting, the Committee's lead technical consultant presented some preliminary analyses of water reuse alternatives at the November 2014 Committee meeting. Appendix A-2 includes this presentation.

V. Scenario Planning

Throughout the Recon phase of its work, the Committee used simple scenario planning to explore a range of potential water futures. For example, different scenarios were created to explore how the community's water supply needs would be affected by the need to release water for fish, the implications of climate change, and potential changes to the local economy that would make Santa Cruz a place where people could both live and work.

Scenario planning isn't intended to result in the selection of a preferred scenario to pursue but to explore and get a better understanding of the degree to which key uncertainties such as climate change could affect the problem we need to solve or the outcomes we might be able to achieve. The "best" solutions are those that address conditions in multiple scenarios.

A. Simplified Scenarios for December MCDS Exercise

As part of the December MCDS exercise, Committee members were asked to rate alternatives under three simplified scenarios with different supply-demand gaps. One of the Committee members was asked to prepare supply-demand gaps for two options and came up with worst year gaps of zero and 1 billion gallons based on different assumptions. City staff was asked by the Committee to provide a third alternative and produced a worst year gap of 650 million gallons.

For each supply-demand gap, City staff created a short name and prepared a brief descriptive narrative about circumstances related to that scenario. The goal of this was to provide context for those considering alternatives at different levels of supply-demand gaps and to show the potential for water supply to be related to other factors that may be of interest or concern to the community.

For the December MCDS exercise the simplified scenarios were as follows:

- Zero supply-demand gap: "Nada Problem"
- 650 million gallon supply-demand gap: "A Little for Fish"
- 1 billion gallon supply-demand gap: "A Deep Hole"

Appendix A-3 provides the simplified scenarios that were used in the Committee's MCDS modeling exercise in December.

B. Scenario Planning in Phase Two of the Committee's Work

Scenario planning is expected to be a key tool used during phase two of the Committee's work, especially as it relates to dealing with the potential uncertainties of climate change and with the creation of portfolios of projects that may be part of recommendations the Committee will

develop. Early in phase two, the Committee will work to fully develop a set of robust scenarios that circumscribe the problem space.

VI. Evaluation Criteria and Multi-Criteria Decision Support Model

Criteria for a good solution are essential for effective problem solving. Understanding how various alternatives or portfolios of alternatives rate against those criteria is at the heart of the problem solving process. The development of the multi-criteria decision support (MCDS) model provided a focal point for the definition of criteria, subcriteria, and rating scales. A key purpose of using this approach is to support data-driven decision making.

The Council's charge to the Committee emphasizes the importance of data-driven decision making. The goal of developing and using a MCDS tool is not to produce an outcome by "pouring in the ingredients, turning the crank and having the answer come out." No analytical tool can (or should) completely replace the judgment and careful weighing and balancing of values, uncertainties, and risks in this kind of decision-making. Rather the goal of using such a tool is to help develop information in a form that decision-makers can effectively and efficiently use in as they make their decisions. An additional benefit is that the careful thought that goes in to the creation of the MCDS tool creates many opportunities to talk about values and interests that are important to address as the collaborative problem solving process proceeds. Creating the MCDS model required the WSAC to identify important criteria and subcriteria, define what is meant by those criteria, and create rating scales that appropriately measure what is important to Committee members related to the criteria identified.

Appendix A-4 provides the detailed criteria, subcriteria and rating scales developed for the MCDS model the Committee used to evaluate twelve selected alternatives between the November and December 2014 WSAC meetings. (See discussion of the Selected Alternatives in Section VIII below.) These criteria, sub-criteria, and scales will be further refined and developed during Phase Two.

The WSAC meeting agenda for December was largely devoted to reviewing and discussing the results of the MCDS exercise it participated in between the November and December meetings. The goal of MCDS exercise was three-fold:

1. Give the Committee members experience working with the MCDS tool;
2. To help transform the criteria, subcriteria and rating scales from abstract concepts into the more concrete elements of multi-party collaborative problem solving: values and interests; and
3. Identify area where additional research and analysis would provide the most value to the Committee in considering alternatives and preparing their recommendations.

While all three of the goals identified above were met, goal number two, in particular, was a highlight as WSAC members fully grasped the importance of criteria to their work in phase two of their effort. Their work during the December meeting on refining definitions for criteria set the stage for the interest-based discussions that will be the focus phase two. By creating a common lexicon on which they can build, the Committee will be able to use the MCDS tool during phase two of its work to great advantage and the products of the model runs will provide important information about Committee member values and interests that can support the development of agreement as the work proceeds.

VII. Alternative Identification: Our Water, Our Future – The Santa Cruz Water Supply Convention

During the community discussions of the desal DEIR, a common criticism was that the City hadn't really considered the full range of alternatives. Although many alternatives were identified and evaluated during the decades of water supply planning that preceded the selection of desal in the Integrated Water Planning process in early 2000s, a key element of the Council's reset decision was the desire to look in more detail at alternatives to desal while not excluding desal from further consideration.

As the Committee got underway in the spring of 2014, it was clear that a handful of very engaged citizens had ideas they wanted to share with the Committee regarding how to improve the reliability of the Santa Cruz water system. The challenge was to make sure that others who might have ideas to share would have the opportunity to do so as well.

In June, the WSAC decided to include in Recon an event that would engage the broader public by inviting those with strategies, alternatives, or ideas for improving water supply reliability to submit their proposals. The goal was to ensure that citizen and community-based ideas, as well as those provided by the technical team and other outside experts, were considered as possible strategies to improve water supply reliability in the Santa Cruz water system.

The WSAC established a subcommittee made up of Doug Engfer, Sarah Mansergh, and Sid Slatter, to work on the event. In early July the public was invited to submit brief write-ups of strategies, ideas and alternatives for improving the reliability of Santa Cruz's water supply to the WSAC. By July 28th, more than 80 submissions had been received.

Submissions covered a wide range of topics ranging from:

- enhancing conservation efforts
- landscaping improvements
- expanding rainwater catchments and grey water systems
- incentivizing conservation through pricing structures

- revisiting old strategies such as exchanging highly treated wastewater for irrigation water used for north coast agriculture
- developing recycled water facilities and systems
- more groundwater development
- aquifer storage and recovery
- on-stream and off-stream storage projects
- desalination using a variety of existing and new approaches and technologies for both the desalination process and the energy issues related to desalination.

In August those submitting ideas in the first round were invited to further develop their proposals for submission to the WSAC and for public review for an event called "*Our Water, Our Future – the Santa Cruz Water Supply Convention*."

Our Water, Our Future, the Santa Cruz Water Supply Convention was held from 11 a.m. to 9 p.m. on Thursday, October 16 at the Civic Auditorium. More than 40 ideas were presented in poster session presentations set up around the hall. Brief presentations by the submitters were provided at noon and at 6:00 p.m. and attendees were invited and encouraged to visit the poster presentations of strategies, ideas, and alternatives and to interact with the submitters.

Approximately 350 people attended the convention, and attendees included most of the members of the WSAC, members of the City Council, and many staff members of the Water Department. WSAC members practiced rating and ranking the proposals using four criteria: effectiveness, environmental impact, community impact, and practicability. Citizen attendees at the event were asked to rate proposals using a simple rating scale developed and deployed by Civinomics. Civinomics also conducted exit interviews with participants to gather qualitative information about participant impressions, ideas, and questions.

These evaluation efforts were designed to coarsely screen the options presented at the convention. At the end of Recon the goal was to produce a small number of options for detailed evaluation during phase two of work.

Appendix A-5 is the Summary Report Presentation from the Civinomics Community Engagement Effort for the *Our Water, Our Future* event.

Following the conclusion of the *Our Water, Our Future* event, the Committee has continued to accept ideas and alternatives for addressing the issues that have been identified. The most recent proposal, a project for storing water in Hanson Quarry, was received in early January 2015. During Recon especially, the Committee's purpose in keeping the door open is to ensure that the arbitrary exercise of a deadline does not keep a great idea from being considered.

VIII. Selected Alternatives

Between the Committee's October and November meetings, WSAC members provided their technical consultant, Stratus Consulting, with their input on the alternatives identified in the Water Supply Convention that they were most interested in using as a means to exercise the Committee's decision process. Stratus' job was to select a dozen or so alternatives that represented a broad range of approaches that the Committee would use in testing the decision model. Alternatives not selected as part of this effort were not eliminated from further consideration, just not selected for further evaluation in the Recon phase of the Committee's work.

Twelve alternatives were selected by Stratus and approved by the Committee at their November meeting. The alternatives selected were:

1. WaterSmart Software Implementation
2. Landscaping Revisions, Rainwater Capture and Grey Water Reuse
3. Water Neutral Development
4. North Coast Off Stream Storage
5. The Loquifer Alternative
6. Expanded Treatment Capacity on San Lorenzo River
7. Ranney Collectors on San Lorenzo River
8. Reuse for Agriculture
9. Aquifer Restoration
10. Potable Water Reuse
11. Reverse Osmosis Desalination
12. Forward Osmosis Desalination

The varied and often incomplete nature of the information provided by those proposing many of the alternatives submitted in the Water Supply Convention has proven to be a challenge for the Committee, City staff, and the technical team. Almost immediately following the November Committee meeting, information and assumptions about the selected alternatives were needed to support the Committee's use of the Recon MCDS model. To facilitate this timing, City staff made a variety of assumptions to fill in data gaps and used this information to provide default ratings for the alternatives and scenarios in the MCDS model. Still there is was a critical need to develop reasonably accurate technical details to support further analysis.

To achieve the goal of providing consistent, well-founded (though preliminary and incomplete) technical data, the WSAC's technical team was tasked with creating summary work sheets with the data and engineering information necessary to put cost and other analyses on an equal footing across the range of alternatives.

Appendix A-6 provides the consistent project descriptions developed by the technical team's engineering consultant, Brown and Caldwell. These descriptions were developed from the

information submitted by the project proposers and, where needed, additional information was developed to provide a sound basis for development of planning level analysis of costs, environmental impacts, and regulatory and permitting requirements. Appendix A-7 provides one example of a project specific technical summary.

IX. Transparency of Process, Data and Tools

As the work of the WSAC got underway, the key issue of transparency of data and of tools became a major focus for City staff supporting the Committee. Over the years, the City has invested heavily in a set of models and analytical tools for forecasting everything from stream flows to future demand. The nature of these tools makes them extremely expensive and time consuming to replace. This means that if they aren't viewed as valid, for whatever reasons, it isn't feasible to simply get another consultant to create new tools to support the analysis.

Throughout the WSAC process City staff and technical team members have done a lot of work to create opportunities for Committee and community members to gain an understanding of and develop confidence in the City's tool set. Several approaches described in more detail below have been used to achieve this important goal.

A. Responding to Requests for Further Information

When the Committee transitioned from the organizational work of its first two meetings to working on the issue before it, City staff presented a major overview of supply and demand issues. As mentioned previously, this presentation took place at the June Committee meeting and covered the topic in some detail. The goal of the presentation was <u>not</u> to definitively define the problem, but rather to present the issues related to supply and demand in a relatively comprehensive but preliminary fashion.

The presentation was intended to be preliminary because it was and is anticipated that technical and analytical work to be done as part of the WSAC process and for updating the Urban Water Management Plan in 2015 would update key elements such as the future projection of water demand.

Not unexpectedly, the June presentation of supply and demand issues raised a number of questions from Committee members and members of the public in attendance. In addition to answering questions received at the time of the presentation, two Committee members submitted written questions asking for further information or clarification of the material in the presentation. Appendices A-8 and A-9 are the responses provided to the inquiring WSAC members, copied to the full WSAC as well as the technical team and made available to the public.

During the preparation of these responses, City staff realized that a theme of the questions related to concerns about how the City's modeling and forecasting tools work. These tools are data-intensive and involve sophisticated analytical and statistical tools as well as many assumptions or parameters that are based on standards and practices that aren't known or understood by those outside of the utility and its consultants.

City staff also recognized that the allotted time for each of the WSAC's monthly meetings would not provide an adequate venue for presenting and discussing the City's modeling and forecasting tools. Yet if the opportunity for such a vetting did not occur, the potential of having the Committee confidently base its work on the information generated by these tools during the second phase of its work would be significantly diminished.

B. Modeling and Forecasting Working Group

The solution developed to open up the data inputs, assumptions and outputs of the City's modeling and forecasting tools is the Modeling and Forecasting Working Group. The four Committee members who are regularly participating in the Modeling and Forecasting Working Group process are spending an extra 25 to 35 hours in learning about a range of important water supply planning tools. Appendices A-10 and A-11 respectively, are the concept paper developed for the Modeling and Forecasting Working Group presented to the WSAC at its September meeting and the Work Plan and Schedule for the Modeling and Forecasting Working Group.

More information on the Modeling and Forecasting Working Group effort, including presentations can be found by visiting the web page on the project at: http://cityofsantacruz.com/departments/water/modeling-and-forecasting-work-group.

C. Enrichment Curriculum

Even with the Committee meeting for eight and a half hours every month, there isn't enough time in Committee meetings to educate the Committee about the full range of topics that might be useful for them to consider as they complete their task. There is substantial information about varied policy approaches, new technology, and scientific information about hydrology, geology, economics, and behavioral psychology that all have a bearing on the Committee's work. To address this "gap" the Committee has and continues to work on providing opportunities for members to be exposed to information and perspectives through an enrichment curriculum.

To date, two presentations have been given to provide information and perspective on local hydrogeology (groundwater issues and opportunities) and water rights. Additional presentations

are planned and are expected to cover a range of topics both at and outside of regular Committee meetings.

X. Outreach Accomplishments and Needs in Recon

The WSAC and City staff have taken very seriously the Council's direction and desire to work throughout the process to engage the broader community. Through the collaborative efforts of WSAC members and City staff, a lot of really creative work has been undertaken. These include:

A. WSAC Website: www.santacruzwatersupply.com

In mid-July, the Water Supply Advisory Committee's website was online. Committee members Sarah Mansergh and David Stearns worked with City staff Malissa Kaping and Boots Road website developers to create and launch a website dedicated to the Committee and its exploration process. This website serves as a key information portal for Committee members and the public alike. Meeting agendas and materials are posted, an extensive document library is being developed, and local, state, national and international news and analysis articles are posted. Interested members of the public can find out about the backgrounds and interests of WSAC members and the work of the Committee, and can sign up to receive regular updates, meeting highlights, invitations to events and more. The site will continue to evolve into an extremely rich data resource for the entire community.

B. Community Outreach Subcommittee

The Committee established a subcommittee to work on community outreach during ReconnaissanceRecon. Its members were Erica Stanojevic, Peter Beckmann, and Charlie Keutmann.City staff provided support and worked directly with the Committee to identify community engagement goals, strategies and opportunities. Recon efforts included:

- regular email updates to interested members of the public;
- a speaker's bureau program that engaged both Committee members and City staff in providing informative presentations to interested community groups;
- media-outreach including project-specific advertising related to the *Our Water, Our Future* event, working with news reporters scheduling and participating in editorial board meetings which resulted in in-depth stories in both Good Times and The Sentinel; and
- A 10-minute radio segments on KSCO on the third Monday of every month to discuss WSAC work and progress;

C. Community Attitudinal Survey

At the July 10 meeting of the WSAC Outreach Subcommittee, the idea of conducting a community attitudinal survey was raised as one way to generate information about community values and concerns which might be useful to the WSAC during its deliberations. Following City Council action in early September, Gene Bregman & Associates was hired to develop and deploy a survey in early October.

Mr. Bregman worked extensively with the members of the Outreach Subcommittee, expanded to include Committee members Doug Engfer and Sue Holt, and with City staff on the development of the survey instrument. Limiting Committee involvement in this group was necessary to protect the confidentiality of the survey questions. The survey development process included both a meeting to discuss goals and several rounds of review and refinement of survey questions.

The goal of the formal survey was to gather statistically valid, reliable, and significant data to measure the greater community's attitudes about community character and quality of life, as they relate to water supply and demand. This survey was not designed to serve as a vetting tool for possible strategies or options; rather, its purpose was to provide information to better understand the underlying community standards that any future strategies or options must take into account. In addition, survey results were intended to help the Committee better understand and plan for the nature, scope, and content of the conversation it will be having with the community when it presents its recommendations at the end of the Committee process.

Survey data was also intended to be used by the Committee as input for consideration during the evaluation of alternatives using MCDS., As the Committee develops and refines criteria for use in these evaluations, knowing that survey data is available to inform rating and weighting of criteria means that Committee members don't have to depend entirely on personal judgment, anecdotal evidence, or other informal sources of information as they rate alternatives and establish individual weights for criteria.

Highlights of the survey results of the survey include the following:

- People are worried about future water supplies:
    - 88% - Agree we need a more stable and predictable water supply with or without drought
    - 79% - Very important to have a reliable supply of water for next drought
    - 74% - Very serious problem: Inadequate water supplies for future needs
    - 60% - We need new sources of water for long-term water supply problems
    - 52% - We have too little water; need to create new supplies and lessen demand

- Environmental Concerns Are a High Priority

- 79% - Very important to protect the environment, in general
- 72% - Very important to protect fish and wildlife
- 62% - Very important to plan for the effects of climate change
- 59% - Very serious problem: Threat of climate change to reduce water supply
- 54% - Very serious problem: Inadequate water for fish and wildlife
- 53% - Very serious problem: Protect drinking water from salt water contamination

- Residents Have Reduced and Are Willing to Reduce Water Usage
  - 88% - Have made sure any water leaks are repaired
  - 82% - Say current water restrictions are difficult, but they will continue even after drought
  - 81% - Do not leave water running when doing various tasks
  - 78% - Take shorter or interrupted showers
  - 66% - Have substantially reduced watering lawn/garden
  - 49% - Current level of water rationing is always acceptable

- Some Concerns Remain For Residents
  - 78% - Agree they have cut water usage in their homes as much as they can
  - 66% - Important to have parks and playgrounds restored with green grass
  - 63% - Important to be able to flush the toilet whenever it is used
  - 56% - Important to take showers without any worries

Appendix A-12 is the topline results from the October 2014 Community Attitudinal Survey, and Appendix A-13 is the survey presentation provided by Mr. Bregman at the October 23, 2014 WSAC meeting.

D. Engaging the Business Community

The Santa Cruz Chamber of Commerce has also been a partner in working with the Committee on a number of topics that are key to the Committee's deliberations. Because Santa Cruz's water supply is so vulnerable to drought, there have been continuing concerns that failure to improve the reliability of Santa Cruz's water supply would have a negative effect on Santa Cruz's, and possibly the region's, economy.

The 2014 drought created a unique opportunity to assess drought impacts on local businesses while the experiences and perspectives were still fresh and potentially ongoing. The Chamber assisted City staff in organizing two round table discussions (similar to focus groups) with representatives of the local green industry (nursery, landscaping design, irrigation and landscape maintenance) and the local hospitality industry (hotels, restaurants and visitor services) to better understand how the 2014 drought was affecting their businesses and what concerns they had about the future of water supply in Santa Cruz. This effort was followed by an online survey of Santa Cruz Chamber members in early December to gather information about drought impacts and concerns. Given that it rained heavily in December and the holiday crunch experienced by

many organizations, response to the online survey was small. The Chamber will be incorporating some of the survey questions into its annual business condition survey that it conducts in March.

Interacting with local businesses to gather this information produces important content for use by the Committee in its deliberations and it also serves to inform and engage business owners in the issues the Committee is dealing with.

E. Planning for Community Involvement and Engagement for Phase Two Work

The Committee has established a new subcommittee to work with City staff on planning and implementing community involvement and engagement activities during the next phase of its work. Its members include Doug Engfer, Erica Stanojevic, Peter Beckmann, Charlie Keutmann, Greg Pepping, and David Stearns. Their work plan is being developed during January and February and implementation will begin immediately thereafter.

XI. Independent Review Panel

In its first report to Council at the end of June, the Committee requested approval to create an Independent Review Panel (IRP) to provide review and quality control for the technical team's work products and to assist the Committee in defining questions for the technical team. A Request for Qualifications was issued for the IRP in mid-July and 13 Statements of Qualifications were received by the August 14th submittal deadline. A team of City staff and WSAC members David Green Baskin, Sue Holt, Rick Longinotti, and Sarah Mansergh, evaluated all the submittals and recommended to the full Committee that the following four individuals be asked to participate in the IRP:

- Mike Cloud – recently retired hydrogeologist for Santa Cruz County, possessing significant local knowledge and experience of water resources issues in Santa Cruz County;
- Patrick Ferraro – former director of the Silicon Valley Pollution Prevention Center, lecturer San Jose State University and Santa Clara University teaching Water Law and Policy, long-time San Jose based civil and environmental engineer, teacher of water policy and member of the Board of Directors for the Santa Clara Valley Water District for 22 years;
- Brian Ramaley – recently retired director for 20 years of the Newport News Virginia Water Department, civil and environmental engineer with expertise in water quality and treatment and former member and chair of EPA's National Drinking Water Advisory Council, long-time responsibility for regional water supply development, water security, and climate change issues in a coastal watershed subject to extreme weather events; and
- Roy Wolfe – Ph.D. environmental scientist, recently retired long-term Assistant General Manager for Metropolitan Water of Southern California, experience and expertise in a broad

range of utility management and planning activities and long-time member and immediate past president of the Board of Trustees of the subscriber based Water Research Foundation.

The Committee approved the sub-committee's recommendation for the IRP at its August meeting. IRP positions are essentially voluntary, with all members receiving only an honorarium of $5000 and reimbursement for direct expenses incurred in the performance of their duties.

IRP members have begun attending and participating in Committee meetings as well as participating in MCDS modeling efforts. As the Committee's work plan transitions to phase two, the IRP's role as independent reviewers of technical team work products will increase because of the increased focus on technical and analytical work that will be occurring during phase two. This quality team will be an asset to the WSAC as it completes its work in the months ahead.

XII. Summary and the Path Forward

The work of the Recon phase has provided the WSAC with opportunities to learn about and explore the challenges and opportunities facing the Santa Cruz water system. It has produced a richly diverse set of alternative approaches to consider for decreasing or managing demand, for enhancing operating flexibility, and for supplementing supply to improve reliability. Committee members have created relationships and learned about each other's interests and perspectives. Teams of technical and analytical support experts and independent reviewers have been assembled and established working relationships with individual Committee members and the Committee as a whole. Evaluation criteria have been identified, explored, refined, and where additional work is needed to support further refinement, that work has been identified. Decision support tools have been identified and developed and the Committee has had an opportunity to try them out, learn about how they work, what they do well and how several tools can be used to support a more comprehensive exploration of the a full range of alternatives and strategies.

As a result of all of the above, the Committee is ready and well positioned for the next phase of their work. They are familiar with the many aspects of the problem and the likely range of approaches for addressing it, and are well prepared to engage in the collaborative problem solving and interest-based bargaining that come next. City staff and the technical and facilitation teams are working to create a comprehensive and cohesive work plan and process for phase two of the Committee's work. The Committee is actively engaged in these efforts both through continuing engagement of the full Committee in reviewing and approving work plans and schedules, and through a Planning Subcommittee working with City staff and the technical and facilitation teams.

Appendix A-1

Water Supply Planning Uncertainties

Uncertainty about Technical and Scientific Issues

Determining the expected gap between supply and demand is characterized by irreducible uncertainty. Examples of major uncertainty associated with supply and demand identified in Recon are:

- Potential impacts of Climate Change on Supply and Demand including:
    - Changes in the total amount of rainfall from year to year
    - Changes in the seasonal distribution of rainfall
    - Changes in the intensity of storms or the amount of rain received in intense storms
    - Changes in temperature that affect demand
    - Changes in sea level that might affect either existing groundwater resources or existing water system facilities
    - Changes in the frequency and/or severity of drought events, especially multi-year droughts
- Potential impacts on current supply from requirements for flow releases to meet the needs of threatened and endangered fish species
- Potential changes in the population served or other characteristics of the water service area, for example economic growth or economic decline, that affect demand
- Potential impacts of rate increases on customer water use due to the price elasticity of demand
- Potential impacts of changes in technology including, for example,
    - New conservation strategies or technologies
    - New low greenhouse gas approaches to generating energy to be used in advanced treatment of wastewater, brackish groundwater or sea water
- Potential impacts of existing and future long term conservation programs on demand which make water use more efficient generally but also have the effect of hardening demand and making it more challenging for customers to respond to future requests for curtailment

Uncertainty about Policy, Programs, Procedures, Regulations and the Law

The problem statement is not solely about scientific questions such as “how much rainfall will we have in the future?” or “how much will demand be reduced by the combination of conservation and rate increases?” There are also policy questions such as “how much risk is too much?” or “what should Santa Cruz look like in 20 years?”

In discussions at the June meeting and in meetings throughout the Committee's process, several questions related to future demand were surfaced. Among the key questions were:

1. When will the City (or should the City) implement tiered rates for multi-family and non-residential users?
2. When will the City (or should the City) implement a Water Neutral Development Policy?
3. Can savings produced by conservation be applied to reduce over-all water consumption rather than to facilitate additional development and increase the number of residents?
4. As actual water demand has differed significantly from past demand projections, what can be done in terms of methodology, to make future demand projections more accurate?
5. Can demand projections discount the water demand projected to be needed to meet the growth projected in the City's 2030 General Plan, or must they assume GP levels will always be met?
6. What is "full build-out"? Does it mean that existing buildings in zones that allow increased density are torn down and new, denser developments replace them? When will (or should) the City develop local building codes that go beyond the Uniform Building Code as related to water use and conservation in new construction or the remodeling, expansion and/or renovation of existing buildings?

Appendix A-2

Preliminary Triple Bottom Line Analysis of Reuse Alternatives

Insert November Stratus presentation here

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Appendix A-3

Simplified Scenarios for WSAC Recon Phase Work

Simplified Scenario #1: "Nada Problem"

Between 2015 and 2035 rate increased induced demand reduction (driven by the price elasticity of demand) reduces demand by 1.53 billion gallons per year (bgy). The 1.53 bgy is used to meet DFG-5 fish flows, which provides about 80% of optimum flows for coho salmon and steelhead trout.
Curtailments of up to 25% are still anticipated to be needed during worst case droughts, but the community has historically responded well when reductions are called for, so this level of curtailment is considered to be achievable when it is necessary.

In 2015 the system wide gallons per capita per day figure was 97. The figure was calculated on a base demand of 3.5 bgy, and a service population of 94,000 people. In 2035 system demand is 1.97 bgy (3.5 bgy minus 1.53 bgy) and the population served is 102,000. This makes system wide gpcd 53 in 2035, which represents 45% decrease.

In severe, multi-year droughts, curtailments of up to 25% are needed, which further reduces system wide gpcd to 40. This figure compares to the estimated 2014 system wide gpcd of 82, and represents a 52% reduction of usage system wide compared to that experienced during the 2014 curtailments.

In this scenario, the community's use of water for irrigation from the potable supply system has been significantly reduced due to increasing water costs. As outdoor irrigation is inherently a more discretionary use of water than indoor uses, it is reduced first and most. Those with financial resources to invest, create a variety of alternative mechanisms for capturing rainwater and/or reusing water for irrigating landscaping and individual or community gardens.

The rising cost of water has an impact on publically owned and managed green spaces (schools and parks) as competing priorities for capital resources make transitioning to artificial turf, rainwater collection systems, or re-landscaped public spaces that are more drought tolerant and climate adapted, is difficult. During the long transition phase from old to new approaches, irrigated turf and landscaping in many publically owned playing fields, and parks are lost and the aesthetic value these resources provide to the community decline.

Public/utility resources available for conservation are limited to educational and informational materials, for example information about individual and community water consumption metrics.

Rebate or incentive programs for residential or commercial ratepayers are not established or implemented as they are not needed to incentivize demand reduction activities. Regulatory programs such as water neutral development and implementation of building codes emphasizing water efficiency are implemented. Funding from the fees collected for the water neutral development program is largely used to assist public agencies with retrofitting landscapes, fields, and facilities to be more water efficient.

The rising cost of water influences some commercial sectors, particularly landscaping and nurseries, and hospitality. Visitor services including hotels, vacation rentals, and some retail and restaurants struggle with rising costs for water and look for ways to improve efficiency without becoming uncompetitive with other areas in the region that provide similar kinds of services.

Simplified Scenario #2 – "A Little for Fish"

In 2015, in the fourth year of a persistent drought, City officials succeed in finalizing a Habitat Conservation Plan for coho salmon and steelhead trout that reduces water supply by the minimum amount likely to be acceptable to the water supply. In the worst case hydrology, the impact of the flow releases plus the naturally occurring shortfall of water is 650 million gallons. This commitment reduces available supply in the worst years by about 20%.

To achieve agreement with the fishery agencies for this flow commitment, the City needed to show that 350 mgy is the maximum amount of flow that can practicably committed to fish flow releases, and the ongoing and persistent drought has helped the City succeed in reaching agreement based on this analysis. Some national environmental interest groups, however, are not entirely convinced that the City's commitment is adequate to protect these threatened and endangered species, and have filed lawsuits challenging the Habitat Conservation Plan. This legal challenge is just beginning to be processed through the state and federal courts (state for steelhead, federal for coho) and the result is that the fish flow release question is still not finally resolved.

Regional growth and development is tracking reasonably close to the projections in the City's General Plan, and the County's new economic development strategy. The City is working hard to increase workforce housing resources in the community, and economic conditions are making this type of investment more feasible so there has been a surge in construction of new multi-family housing particularly as a redevelopment strategy in parts of western and eastern Santa Cruz. This new development is reducing the amount of turf and landscaped areas that accompany the housing (than would typically occur with single family housing development), but to compensate for this, the City is working hard to improve and maintain the quality and availability of public recreational and green spaces to meet the needs of these new residents.

Between 2015 and 2025, there is growing evidence that climate change will have a significant impact on Santa Cruz's water resources. The worst anticipated climate change impacts, increasing frequency of multi-year droughts, hasn't begun to really be felt, but the scientific analysis shows that droughts will become increasingly frequent in the next 25 years. This potential impact, along with the continuing challenges of implementing plans to restore regional aquifers without a significant new and drought proof water supply, is generating a lot of interest in more regional approaches to water resources management.

As the impacts of drought continue across much of the southern and western United States, water utilities and the communities they serve are increasingly looking to recycled wastewater as a new source of supply. In California, regulators met the 2016 timeline for issuing new regulations for direct potable reuse of wastewater, and a number of utilities in the state have begun implementing this approach. In Santa Cruz there are continuing lively discussions of the benefits, risks and costs of recycled water for any use, including irrigation of food crops, indirect potable reuse or direct potable reuse.

Simplified Scenario #3 – "A Deep Hole"

The impacts of climate change, fish flow release requirements and a slow but steady increase in water demand from planned levels of growth and economic development have generated a shortfall of 1 billion gallons in the worst case hydrological conditions. By 2025 climate change has resulted in a 50% increase in the number of dry or critically dry years the water system experiences, so the worst case hydrology isn't as infrequent as it used to be. The water year types that are reduced as a result of the increase in dry and critically dry years are the more normal and moderately wet years, meaning that the hydrological patterns seem to shift randomly from drought to flood conditions. Multi-year droughts are also increasing, with the record of nine years in a row between 2018 and 2027 that were classified as either dry or critically dry. Drought severity is also increasing, with longer demand seasons (when water required to meet customer usage exceeds water flowing into the system) and more regular instances of droughts as severe as those occurring in 1976, 1977, and 2014.

Using traditional water system design parameters, if the Santa Cruz water system were being designed under the emerging climate change conditions described above, water system storage (either above or below ground raw water storage reservoirs) would need to be 4 or 5 times larger than the system's current storage in Loch Lomond. Alternatively, access to similar volumes of water from drought proof alternate sources would be needed to provide the supply capacity needed to deal with multi-year droughts.

Analysis of system storage needs have focused on both the volume needed and the sources of supply that might be available to fill those volumes. A major focus is on taking advantage of wet

year flows when they are available, but there are difficult questions about this strategy because of the declining and intermittent frequency of wet years. A storage strategy that focuses on wet year flows means investing in building a lot of infrastructure to handle water during those wet years that ends up sitting idle a lot of the time.

Evaluation of alternate sources is focused on desalination and some form of water recycling because they represent locally available drought proof supplies that can be designed and operated with some scalability that can evolve over time to adapt to changing conditions. The technologies used for both of these alternatives have high energy requirements that present significant policy challenges for the community and City decision-makers.

Ongoing investments in demand management are paying off as demand is basically flat, in spite of the moderate level of ongoing growth and development. A variety of factors, including programs incentivizing re-landscaping with climate adapted plants, have resulted in a 15% reduction in demand between April 1st and October 31st when comparing this same time period in 2015 versus 2020. Unfortunately, the changing precipitation patterns that result from climate change have basically wiped out this reduction because the demand season is now two months longer, starting on March 1st and running through November 30th.

Santa Cruz's warmer, dryer climate is creating many challenges for the management of watershed lands, particularly from the potential risk of wildfire. To some degree, these risks are mitigated by the decision to permanently close the Loch Lomond recreation area to public use. This decision is made both to reduce the potential for human-caused fires, but is also a practical response to the fact that in many years Loch Lomond reservoir doesn't fill and lake access for recreational use is impeded by low reservoir levels.

Appendix A-4

Criteria, Subcriteria, and Rating Scales for Use in Evaluating Alternatives Against an Estimated Worst Case Supply-Demand Gap of 650 million gallon

Weighting of All Criteria

Question: How much does each high-level criterion matter to you when addressing a 650 MG shortfall?
Scale: Critical, Very Important, Moderately Important, Somewhat Important, Not Salient

Implementability Criterion

Notes: The likelihood of getting this approach done.

Weighting of Implementability Subcriteria

Question: How much does each subcriterion matter to you and your constituents in evaluating how well an approach meets the requirements for Implementability?
Scale: Critical, Very Important, Moderately Important, Somewhat Important, Not Salient

Technical Feasibility Subcriterion

Notes: Technical feasibility is an estimate of whether this approach would work as envisioned. For complex proposals, rated on the basis of core elements. When rating, City staff used the 10-year horizon on the assumption that it would be very difficult to make predictions about what technical innovations would occur more than 10 years out. If you want to change the ratings and look at a longer timeframe, the scale gives you the leeway to do that.

Question: How feasible is this approach technically?
Scale: Widely used, Demonstrated in field, Promising in 3-5 years, Promising in 6-10 years, Maybe 10-20 years, More than 20, Never

Legal Feasibility Subcriterion

Notes: Remember the initial ratings you see here are default ratings. You, the Committee members, initiate these ratings (not the City). This addresses siting, water rights, environmental and other legal rights relevant to implementing this approach as envisioned. As you learned from Martha Lennihan, to have a water right is only the beginning: numerous factors affect the way the right can be exercised. A water right that has limitations or questions about how it can be exercised would rate as having ‘some ambiguities.’

Question: Within the required timeframe for this approach, are the necessary rights currently held in the form needed or feasible to acquire or modify as needed?
Scale: Unambiguous yes, Yes but some ambiguities, Can probably acquire, Difficult to acquire, Very unlikely]

Regulatory Feasibility Subcriterion

Notes: This addresses environmental and regulatory review. When rating, the City staff looked at the difficulty of getting regulatory approvals under existing regulations as well as the possible necessity of responding to or taking advantage of potential new regulations that might come into place over the next decade. If you wish to adjust these ratings, please be sure to identify which type of regulatory approvals you think would be easier or harder to get (environmental, earthquake hazard, etc). In the scale, the analysis of regulatory feasibility includes the possibility of needing new regs or policies. Water Department staff did not think that any of the elements of our local situation would result in having regulatory agencies relax regulations to help Santa Cruz address the water situation. On the other hand, continuing drought at a state/western US level could over time result in regulatory revisions to facilitate addressing the larger water problem. This relaxation, if it occurred, could make some options more feasible from a regulatory point of view. When rating, City staff used a 10-year horizon on the assumption that it would be very difficult to make predictions about what regulatory innovations would occur more than 10 years out. If you want to change the ratings and encompass a longer timeframe, the scale gives you the leeway to do that.

Question: Is this approach likely to receive easy, quick regulatory approval?
Scale: Easy and quick, Slow but relatively sure, V slow no regulatory change, Up to 10 year new regulations likely required, Not feasible (regulatory)

Political Feasibility Subcriterion

Notes: Remember the initial ratings you see here are default ratings. You, the Committee members, initiate these ratings (not the City). Extent to which an approach will claim and retain the support of formal political entities as well as informal social and political groups. This applies to demand reduction (e.g. volunteerism, finances for incentives or enforcement of regulations) and to supply (e.g. majority public vote requirement for desalination, willingness to make large capital investments, or concerns about oversupply and immigration).

Question: What level of political support is this approach likely to have?
Scale: Enthusiasm now, Acceptable now, Active resistance now, Acceptable in 5 years, Acceptable in 10 years, Acceptable in 20 years, Likely never

Cost-Effectiveness Criterion

***Weighting of Cost Effectiveness Subcriteria*:**
Question: How important are the subcriteria to you or your constituents in evaluating how well an approach meets the requirements for Cost-effectiveness?
Scale: Critical, Very Important, Moderately Important, Somewhat Important, Not Salient

Cost to City: Upfront Costs Subcriterion
Notes: This includes siting, permitting, installation or construction and other start-up costs.

Question: What are the upfront costs of this proposal?
Scale: Worst: high (more than $20 Million), Best: low (less than $100,000)

Cost to City: Operation and Maintenance Subcriterion
Notes:
Question: What are the annual operating and maintenance costs of this proposal?
Scale: Worst: high (more than $2 Million) Best: low (less than $10,000)

Cost to Customer: Rates Subcriterion
Notes: This cost is based on a simplified lifecycle cost (capital cost divided by the life of the project plus annual O&M converted to cost per gallon) and compared to estimates of the cost of a gallon of water to an average single family residential customer in 2018, which is about 1 penny per gallon. An average single family residential customer uses 8 ccg (6,000 gallons) per month. Had to make scale in "per 100 gallons" to stay on the good side of the
software.

Question: How does the cost of this option compare to the cost of an average single family residential customer's cost for a gallon of water in 2018?
Scale: Worst: higher (more than 10 times) Best equal or lower

Cost to Customer: Individual Purchase Subcriterion
Notes: This subcriterion gets to the cost to an individual of buying, installing and maintaining a system that helps reduce demand or provide storage or supply for that particular household. Example: installing a cistern.

Question: What is the cost to the individual of buying, installing and maintaining this system?
Scale: None, Small, Significant

Community Well-being Criterion

Notes: Encompasses a range of social and community values. Notice now that this criterion now encompasses a pretty narrow range of social and community values (it was hacked back at the November meeting). When you assign your weights, make sure that you don't inadvertently give the subcriteria more weight than you really intended to.

Weighting of Subcriteria:

Question: How important are the subcriteria to you and your constituents in evaluating how well an approach meets the criterion 'Community Well-being?'
Scale: Critical, Very Important, Moderately Important, Somewhat Important, Not Salient

Regional Water Stability Subcriterion
Notes: This gets at approaches that would benefit Santa Cruz water customers and the region.

Question: Would this approach improve regional water stability?
Scale: Across County, 4 jurisdictions, 3 jurisdictions, 2 jurisdictions, SC Water only

Local Economy Subcriterion

Notes: This criterion is measured in terms of numbers of jobs and is meant to synthesize the effect of water supply, water reliability, confidence and local jobs as they might affect local economy. This is one of the technical criteria that changed across simplified scenarios. It turns out that the zero gap simplified scenario leaned into this criterion in some interesting ways.

Question: How might this proposal affect Santa Cruz's economy, as reflected in local jobs?
Scale: Positive local job, Slight positive, No effect, Slight negative, Negative for local jobs

Environmental Well-being Criterion

Notes: This criterion relates to the degree to which a water supply or demand management strategy contributes to or impacts the quality and sustainability of the natural environment.

Note: "terrestrial" was taken out as a subcriterion because none of these proposals appeared to impact terrestrial resources.

Weighting of Subcriteria

Question: How important are the subcriteria to you and your constituents in evaluating how well an approach meets the criterion "Environmental Well-being?'
Scale: Critical, Very Important, Moderately Important, Somewhat Important, Not Salient

Energy Subcriteria
Notes: In providing some very broad guesstimates for this criterion, the City staff considered the energy usage of the City's current treatment plant as a 4 and rated the others with respect to that.

The City recently compared energy intensity of the treatment of desal vs traditional sources (surface and groundwater) as 15, 1.5 and 2.1 kWh/1000 gallons respectively. This subcriterion has gone back and forth between carbon emissions and kWh/1000 gallons; later in the process you will want to look at both. There are several issues wrapped up (or lost) in the present kWh/1000 gallon scale that you will want to tease out in Real Deal. There is the actual energy use at the plant along with pumping and delivery. Differing emissions for different sources of energy. The energy that goes into construction parts including, as Bob outlined in his Reuse discussion, the impact of actually making (delivering, digging, installing?) the pipe. Where the emissions occur and what time of mitigation requirements there may be. ...Do you care about energy because of its cost? The volatility of its cost? Because it is a surrogate for carbon emissions?

Question: How much energy will this approach require per MG of water?
(Treating surface water, which the City rated as a 4, is about 1.5 kWhl1000 gallons, see accompanying note.)
Scale: 5 = Higher 5, 4 (same intensity as current treatment plant) ,3, 2, 1 = Lower

Marine Ecosystem Health Subcriterion
Notes:

Question: How would this approach affect marine ecosystem health?
Scale: Positive effect, does not harm, may harm, cumulative harm, Sig harm to population

Freshwater and Riparian Health Subcriterion
Notes: This rating encompasses the positive (e.g. when restoring watersheds or by creating an easier option to leave more water in the river) as well as potential harm. One

of the commenters on the Convention model referred to the former as 'direct beneficial impact' and the latter as 'indirect beneficial impact.'

Question: If this approach were implemented, how would it affect freshwater and riparian ecosystems?
Scale: Plentiful healthier water, About as it is now, Degraded ecosystem health

Groundwater Resources Subcriterion
Notes: The word "active" in the scale means putting water back not just resting wells.

Question: How would this approach affect groundwater resources?
Scale: Actively restores, Allows restoration, Does not affect, Depletes Resource, Greatly Depletes Resource

Adaptability Criterion
Notes: Characteristic of a supply project that relates to how well the approach can be modified over time to respond to changing conditions.

Weighting of Subcriteria:

Question: How important are the subcriteria to you and your constituents in evaluating how well an approach meets the criterion 'Adaptability?'
Scale: Critical, Very Important, Moderately Important, Somewhat Important, Not Salient

Infrastructure Resilience Subcriterion
Notes: Infrastructure resilience relates to the extent to which this approach will help the overall system to withstand natural disasters such as earthquakes, fires, floods, tsunamis and or systemic power outages related to the above--but not drought. (That is the next subcriterion.). Potable reuse rated lower than desal for resilience because desal uses another source of supply (the ocean) and would be a brand new facility built to all current seismic codes. In an earthquake, these factors would be assets compared to possible impacts of losing the wastewater treatment, which in turn would affect the reuse plant. In your rating, remember that in the extreme climate change simplified scenario (1 BG shortfall), fire and landslides may put more pressure on the system's resilience.

Question: How well would this approach contribute to the system's ability to withstand natural disasters and other disturbances? (The top of the scale is "meets most challenges well.")

Scale: Most challenges well, Many moderately well, Some somewhat, Few barely, Doesn't improve resilience, Slightly degrades, Significantly degrades]

Reliable Supply Subcriterion

Notes: Reliability of water supply relates to how much water can be produced under various climate conditions such as drought or extreme precipitation. Remember that in the extreme climate change simplified scenario (the billion gallon shortfall), less rainfall isn't the only issue: turbidity, timing of storm events or other factors may also affect the supply. In rating the alternatives against this subcriterion, City staff saw demand strategies as potentially reducing the reliability of supply. They felt that the water demand offset program generally makes the system less reliable. With demand management actions being used to offset growth, new customers can be added without increasing supply. But at the same time, all customers are living closer to some reasonable limit of possible reduction in water use or increases in water use efficiency. This means that if the supply drops even further, there is no cushion--little or no discretionary water use that can be eliminated or reduced--so curtailments would be more difficult for customers and, in worst case scenarios could significantly cut in to the water used to protect public health and safety.

Question: How much will this approach help the existing system to produce consistently?
Scale: Makes system sig more reliable, Somewhat more reliable, Slightly more reliable, No change, Makes system less reliable

Scalability Subcriterion

Notes: Scalability measures the extent to which an approach can be scaled up as needs change. Note that for Loquifer, as with some of the other proposals, the design is scalable but once you commit to one of the designs, the project is not. One of the Committee members had asked for a negative scale for scalability, but that just didn't make sense; it was hard to imagine a circumstance where adding one of these approaches would make the system less scalable.

Question: How easily can this approach be scaled up within the overall system? (The tilde~ in the scale is shorthand for 'might not meet by itself but sure would help a lot.')
Scale: Scales up w no limit, Can scale to ~1BG gap, Can scale to ~650 MG gap, Can scale to ~ 300 MG gap, Not scalable

Preserves Future Choices Subcriterion

Notes: In general, this rating was about the extent to which large capital investments might lock the city in to a certain set of solutions. The Ranney collectors rated well

because they would be helpful in perfecting the Felton water right at a higher level. What is missing in the structure of the model is a way to send a signal about options lost by INaction.

Question: How well does this approach preserve future choices?
Scale: Increases choice, Somewhat increases choice, No effect, Reduces choice, City locked in

Effectiveness Criterion

Notes: The ability of a particular approach to meet the gap by decreasing demand, increasing supply or instituting management changes that help the Water Department "do more with less."

Weighting of Subcriteria:
Question: How important are these subcriteria to you and your constituents in evaluating the how well a proposal meets the requirements for "Effectiveness?"
Scale: Critical, Very Important, Moderately Important, Somewhat Important, Not Salient

Yield
Notes: Reduction in demand or increase in supply.
Question: How much water will this approach save or produce?
Scale: Worst = lower yield , Best = higher yield

Flexibility Subcriterion
Notes: The degree to which this approach increases management flexibility that in turn helps the system "get by with less" while still meeting resilience, reliability and other goals. (This is particularly designed for approaches that don't actually increase supply or reduce demand, but might nevertheless be useful.) In rating 'flexibility,' the City staff looked at an approach's ability to provide diversity, the ability to create a cushion in terms of water availability and other factors. For instance, reuse and desal were seen as "adding another treatment plant" and therefore tended to rate well for flexibility.

Question: To what extent does this approach increase flexibility?
Scale: Greatly increases, Moderately increases, Somewhat increases, Does not increase, Decreases

Addresses Peak Season Demand Subcriterion
Notes: This subcritierion addresses the extent to which a proposal reduces peak season demand or provides water that is not dependent on winter rains.

Question: To what extent would this approach help address peak season demand?

Scale: Yes, Maybe, No

Appendix A-5

Civinomics Report on Community Engagement in Our Water, Our Future Event

insert Civinomics November Report here

civEngagementSumm
ary_Nov19.pdf

Appendix A-6

Draft

Santa Cruz Water Supply Advisory Committee

Preliminary Descriptions for Alternatives Selected for Recon Evaluation and MCDS Exercise[1]

This summary presents descriptions for nine Recon Level alternatives based on Brown and Caldwell's (BC) interpretation and evaluation of proposals submitted to the Water Supply Advisory Committee (WSAC) for the City of Santa Cruz (City). Where a proposal included two or more potential variations or where an alternative apparently had a potentially fatal flaw, Brown and Caldwell chose a single alternative for detailed develop.

Bevirt North Coast Off-Stream Storage: This alternative for initial comparison uses only the Liddell quarry which would hold about 650 million gallons (MG) since its construction would not require building a dam. The San Vicente site was dropped since the San Mateo Peninsula Open Space Trust and the Sempervirens Fund have acquired the site and initiated creation of a conservation easement over the site to prevent future development. If the City withdrew stored water over a 3-year drought cycle, production would be about 200 MG annually after allowing for evaporation and leakage losses.

This alternative has several outstanding issues, e.g., water rights (new diversion location from which to fill the reservoir, routing of fill pipeline), geotechnical and construction issues associated with installing a liner on steep slopes over a porous karst formation, preparation and approval of environmental documents, California Department of Fish and Wildlife (CDFW) and National Marine Fisheries Service (NMFS) approvals for water diversions from streams with salmonid populations, and agreements with the landowner about ownership and operations.

SCWD McKinney Expanded Treatment Capacity: This alternative for initial comparison would add a new 14-mgd water treatment plant (WTP) (pretreatment for turbidity control and membrane filtration) near the Tait Street Diversion to produce treated water that would be piped directly into the distribution system. The write up for this alternative indicates that the alternative would allow an annual water diversion increase of about 560 MG.

[1] Disclaimer added by a WSAC reviewer: The information and calculations presented regarding these proposals has not yet been thoroughly vetted for technical accuracy or feasibility by the technical team, though many obvious outstanding issues have been identified. These proposals were selected as being representative of the 80+ proposals received for purposes of discussion and refining the criteria in the Multi-Criteria Decision System. When fully vetted during the Real Deal analysis, the information regarding the various proposals could be revised significantly.

The alternative has several outstanding issues, e.g., determine the final treatment train (MF would need pretreatment ahead of MF for elevated SLR turbidity concentration), preparation and approval of environmental documents, determination if water rights and diversion permits would need modifications, and development of a plan to store and use diverted water beneficially. If the City would have excess water during normal or wet years, it might transfer extra water to Soquel Creek Water District (SqCWD) and/or Scotts Valley Water District (SVWD) but doing so would require agreements with the agencies and likely would trigger water rights permit modifications since the place of use would change.

SCWD McKinney WSAC Ranney Collector: This alternative for initial comparison would use Ranney collectors with a 12.9-mgd capacity (maximum capacity allowed under the current City of Santa Cruz [City] diversion permit), installed near the City's Felton diversion to draw water allocated under the City's existing water rights. Water drawn through the collectors would have greatly reduced turbidity. Much higher water quality would allow continuous refilling of Loch Lomond while also operating the GHWTP. More studies would be required to project increased diversion opportunity, however the increased diversion likely would be somewhat less than about 560 MG annually as projected for Alternative 6.

The alternative has several outstanding issues, e.g., the City would need to conduct additional analyses for available flow, addressing any bypass requirements under the habitat conservation plan. The City would also need to determine its plan to store and use diverted water beneficially. If the City would have excess water during normal or wet years, the City might transfer extra water to Soquel Creek Water District (SqCWD) and/or Scotts Valley Water District (SVWD) but doing so would require agreements with the agencies and likely would trigger water rights permit modifications since the place of use would change.

Paul Lochquifer: This alternative would use treated water sold by the City to Soquel Creek County Water District (SqCWD) during normal and wet years. SqCWD would use the transferred water either for groundwater recharge through seven 250-gallon-per-minute (gpm) recharge wells, for conjunctive use (well field resting) recharge, or both. The City would take more water from its San Lorenzo River and/or Newell Creek diversions, about 2.5 million gallons per day (mgd) or about 915 MG annually, to match the desalination alternative. If recharge occurred continuously for five years, total transferred water would be about 4,600 MG. Facilities would include Ranney collectors at the Felton Diversion, to insure that the Graham Hill Water Treatment Plant (GHWTP) could treat the diverted water continuously. During drought years the City would receive returned water (groundwater) from SqCWD. The City also would pump its Tait Street wells year round since the recharged Purisima aquifer would yield available water without causing seawater intrusion. Potential yield would be 2 mgd from the Live Oak wells and 2.5 mgd from SqCWD; 4.5 mgd total. If the City used these sources for six months,

total production, after deducting out a 1-mgd production allowance for the existing wells, would be about 640 MG annually.

This alternative has several outstanding issues, e.g., water rights (modification of place of use), assembling appropriate information to site injection wells, modeling the Purisima aquifer to project better potential performance, and agreement with SqCWD on how the alternative's water would be conveyed, shared and paid for.

Ripley Reuse for Agriculture: This alternative for initial comparison would produce filtered disinfected effluent (CA Title 22 unrestricted water) from the City Wastewater Treatment Plant (WWTP) at a rate of about 4.3 mgd. The City would pump the effluent north through a new pipeline aligned along the railroad right of way, with turnouts to irrigate up to about 1,300 acres on private land and leased land on properties owned by the California State Parks (CSP) and the United States Bureau of Land Management (BLM),. This process is assumed to take place over 180 days per year and total water available for crop irrigation would be about 780 MG. The City would build 12 new 250-gpm extraction wells that discharge into new pipeline that in turn would connect to the existing City North Coast pipeline. The water would combine with diverted surface water from the City North Coast rights, for treatment at the GHWTP. To develop space for new facilities within the WWTP site, the City would need to relocate its Line Maintenance Facility from the WWTP site to a new site on the West Side.

The alternative has several outstanding issues, e.g., legal agreements with CSP, BLM, and property owners and with irrigators, securing the right of way for the new delivery and return pipelines such as along the railroad ROW, geotechnical investigations for well construction, assessment of the groundwater basin to ensure that operation would not adversely affect the groundwater basin, permitting through the California Coastal Commission, preparation and approval of CEQA/NEPA documents (NEPA is included because the project includes BLM land), and location and purchase of new Line Maintenance Facility site.

SCWA Regional Aquifer Restoration: This alternative would have the same components as Alternative 8 ("Paul Lochquifer") but the recharge and return rates would be lower. This alternative would transfer about 800 MG from the City to SqCWD over an extended period but SqCWD would return only about 145 MG to the City during dry years. The City's drought production from its Live Oak wells would increase from 1 mgd to 2 mgd, or about 365 MG. The long-term average approximate production increase appears to be [(145+365)/6.5] = 78 MG.

The alternative has several outstanding issues, e.g., water rights (modification of place of use), assembling appropriate information to site injection wells, modeling the Purisima aquifer to project better potential performance, and agreement with SqCWD on how the alternative's water would be conveyed, shared and paid for.

SCWD Water Reuse: This alternative for initial comparison would produce complete advance treatment (CAT) water from the City Wastewater Treatment Plant (WWTP) at a rate of about 3.7 mgd. The City would pump the CAT water from the WWTP through a new pipeline to the Bay street Reservoirs site where the new pipeline would connect to the existing North Coast pipeline. The combined water would flow to the inlet end of the GHWTP, to be treated and distributed to the City. This alternative would produce up to about 1350 MG annually. The City would have the option of selling surplus treated water to either SqCWD or Scotts Valley Water District as part of either a conjunctive use (aquifer resting) or ASR project.

To develop space for new facilities within the WWTP site, the City would need to relocate its Line Maintenance Facility from the WWTP site to a new site on the West Side.

This alternative has several outstanding issues, e.g., permitting such reuse through CA Division of Drinking Water, gaining public acceptance for adding CAT water as part of its potable water supply, and possibly reaching agreements with adjacent agencies.

SWC Desalination: This alternative for initial comparison would use seawater desalting through a new reverse osmosis desalination facility to produce about 2.5 mgd for addition to the City potable water supply. Annual production would be about 915 MG. This alternative's components and development would match those for the previously proposed scwd2 desalination facility. For comparison with other alternatives, BC has assumed that the City would own and operate the facility and would use the water produced year round. Excess water would allow the City to either idle the Live Oak wells for conjunctive use aquifer recover to perhaps undertake Live Oak well operation in an ASR mode to restore the aquifer more rapidly.

This alternative has several outstanding issues, e.g., environmental document completion, permitting through the California Coastal Commission, and public vote approving alternative implementation.

Trevi Forward Osmosis Desalination: This alternative for initial comparison would use seawater desalting through a Trevi forward osmosis (FO) system. This alternative's other components would match those for seawater desalting.

The alternative has several outstanding issues, e.g., Trevi technology is still in its infancy and being tested at a pilot scale. As described, it would require a lower grade heat source for separately drawing the solution from the potable water but the alternative description did not designate a source for lower grade heat.

Since the Trevi FO is still at the developmental stage, BC has not developed this alternative further. If future testing and implementation by other entities prove its value, it could replace RO if the City was to select and implement a desal alternative.

Appendix A-7
Example of Project Technical Summary

City of Santa Cruz Water Supply Advisory Committee

Recon Phase -- Technical Summary

Alternative 5 - "Bevirt: North Coast Water"

This alternative for initial comparison uses only the Liddell quarry which would hold about 650 million gallons (MG) since its construction would not require building a dam. BC dropped the San Vicente site since the San Mateo Peninsula Open Space Trust and the Sempervirens Fund have acquired the site and initiated creation of a conservation easement over the site to prevent future development. If the City withdrew stored water over a 3-year drought cycle, production would be about 200 MG annually after allowing for evaporation and leakage losses.

This alternative has several outstanding issues, e.g., water rights (new diversion location from which to fill the reservoir, routing of fill pipeline), geotechnical and construction issues associated with installing a liner on steep slopes over a porous karst formation, preparation and approval of environmental documents, California Department of Fish and Wildlife (CDFW) and National Marine Fisheries Service (NMFS) approvals for water diversions from streams with salmonid populations, and agreements with the landowner about ownership and operations.

Initial Ranking	Convention Number
1	

Description: "Storage (on-stream, off-stream, underground, and groundwater development)"

Estimated Annual Yield (million gallons [MG]) [Quarry reservoir would be dry after three drought years.]	200
Reliability Over Time (seasonal and inter-annual variability)	

Costs	Best Estimate	Likely Range	Comments
650-MG Liddell alternative:			
Capital	$25M	$20M to $50M	
Annual			
Present Value			
Capital cost/MG	$125,000	$125,000 to	

		$250,000	
PV Cost/MG			
Energy (KWh/MG)			

Key Components	
1. Stabilize quarry rim to prevent landslides and protect proposed new facilities. Cleaned and Recontoured quarry walls 2. Impervious poly liner with supporting cushion layer, installed over chainlink base to separate liner from remaining wall roughness. 3. Directionally drilled inlet/outlet pipeline, connected to Liddell Springs pipeline.	4. Pumping stations to draw water from other City North Coast water sources. 5. Installation of Ranney collectors or new SLR WTP, so that City would use SLR water rights, allowing North Coast rights to fill new reservoir. 6
Implementation Requirements Summary	
Carry out preliminary planning; prepare, circulate and certify environmental documents; complete design documents; file for and obtain permits; negotiate and execute contracts with property owners; bid and construct improvements; determine if new conservation easement over San Vicente quarry site would preclude development of any sort of reservoir.	
Required Land Area (acres)	50 +
<u>Permitting Summary</u> Likely permits include stream bed alteration permit(s) from CA DF&W, CA Division of Safety of Dams, County building permits (s),Coastal permits, USACE (?), and NMFS (?)	
<u>Legal Requirements/Issues</u> Water rights for diversion from existing stream flows; releases to maintain downstream flows; landownership and deed/land-use restrictions.	
<u>Environmental Considerations</u>	

Remediation of limestone quarries, salmonoid population impacts and required bypass flows and other aquatic/land species, karst topography; potential energy use for pumping water into or out of storage reservoirs. Unknown impacts on other species around the reservoirs.

Related Opportunities

To avoid requirements for new diversion rights, consider routing water from existing City North Coast water rights into new quarry storage. This change would happen in conjunction with improvements at the Felton diversion so that GHWTP could treat water regardless of river flows or turbidity levels.

Issues to Resolve

Landownership and project compatibility with proposed easements; karst topography and geology; slopes, potential annual loss through leakage; legality of water appropriation and transfer; impact of variations in annual rainfall versus actual water production.

Initial Evaluation

Effectiveness	
Practicality	
Environmental Impacts	
Weighted	

Appendix A-8

Improving Transparency – Responding to Written Questions

DATE: **August 22, 2014**
TO: **Water Supply Advisory Committee**
FROM: **Rosemary Menard, Santa Cruz Water Director**
SUBJECT: **Recon Report Response to Questions Related to the supply/demand slide deck**

On Friday August 1, 2014 email WSAC member Rick Longinotti sent the following email to Bob Raucher (see also the attachment provided and referred to in the last paragraph of the email. This report provides information in response to this request, including a schematic of how the Confluence model works (inputs, process, outputs), specific responses to the question regarding the starting lake level for Loch Lomond used in developing slides 54, 55, and 56, and an explanation of how the model projects lake levels in all the years of the hydrologic record (e.g., what is the rule curve for the operation of Loch Lomond that is used as an input to the model.)

> Dear Bob,
> I am putting this in writing in order to spare my colleagues on the WaterSac a long-winded request. At yesterday's meeting, I made a request that the model for the worst-case year (1977) be updated given our experience with this year's runoff conditions. I would like to understand the discrepancy between the model's prediction of a peak season shortfall of 650 million gallons when the water supply forecast given to the Water Commission in April predicts a shortfall of 383 million gallons. The April agenda packet reports, "Staff is forecasting that the river can be expected to run at levels equal to 100% of what occurred in 1977".
> I have three additional requests:
>
> 1. that all the assumptions and data for the *Confluence* model be made public.
> 2. that the water supply operations assumptions for the baseline scenario (the do-nothing scenario) include the capital improvements and conservation measures that are already underway or planned by the Water Department.
> 3. that the all scenarios assume that the City will receive state approval of its water rights applications once the fisheries agencies approve of the City's Habitat Conservation Plan.
>
> **Making *Confluence* Modeling Transparent** The *Confluence* model is a very valuable tool for understanding our supply versus demand situation under a variety of cenarios. The California Department of Fish and Wildlife is the only entity outside of the Water Department that became privy to the model's inner workings. To the rest of us it was a black box.

The WaterSAC will probably want to test various assumptions that feed the model. For example, in the past the model assumed that in normal years Loch Lomond would supply an amount of water equivalent to the maximum water rights limit for the reservoir (1 billion gallons/year), when the actual average allocation from the reservoir over a ten year period was about half that amount. Not surprisingly, the model predicted that in a second dry year there would be only 200 million gallons of water available from the reservoir. See the Table 2 from the 2005 *Urban Water Management Plan.*

Table 5-2. Water Supply Reliability for Average, Single Dry, and Multiple Dry Years (millions of gallons)

Source	Average Water Year	Single Dry Water Year	Multiple Dry Water Years	
			Year 1	Year 2
North Coast	1,077	500	400	300
San Lorenzo River	2,008	2,100	2,100	1,800
Live Oak Wells	187	300	300	400
Loch Lomond Reservoir	1,042	900	700	200
Total	**4,314**	**3,800**	**3,500**	**2,700**
Percent of Average	**100%**	**88%**	**81%**	**63%**

City Responses to Questions Raised:

On the next page of this memo, is a simplified schematic of the inputs, processes and key outputs of the Confluence model. This schematic isn't intended to answer every question, but with respect to issues related to how model inputs as they relate to Slides 54, 55 and 56, the schematic helps clarify several issues:

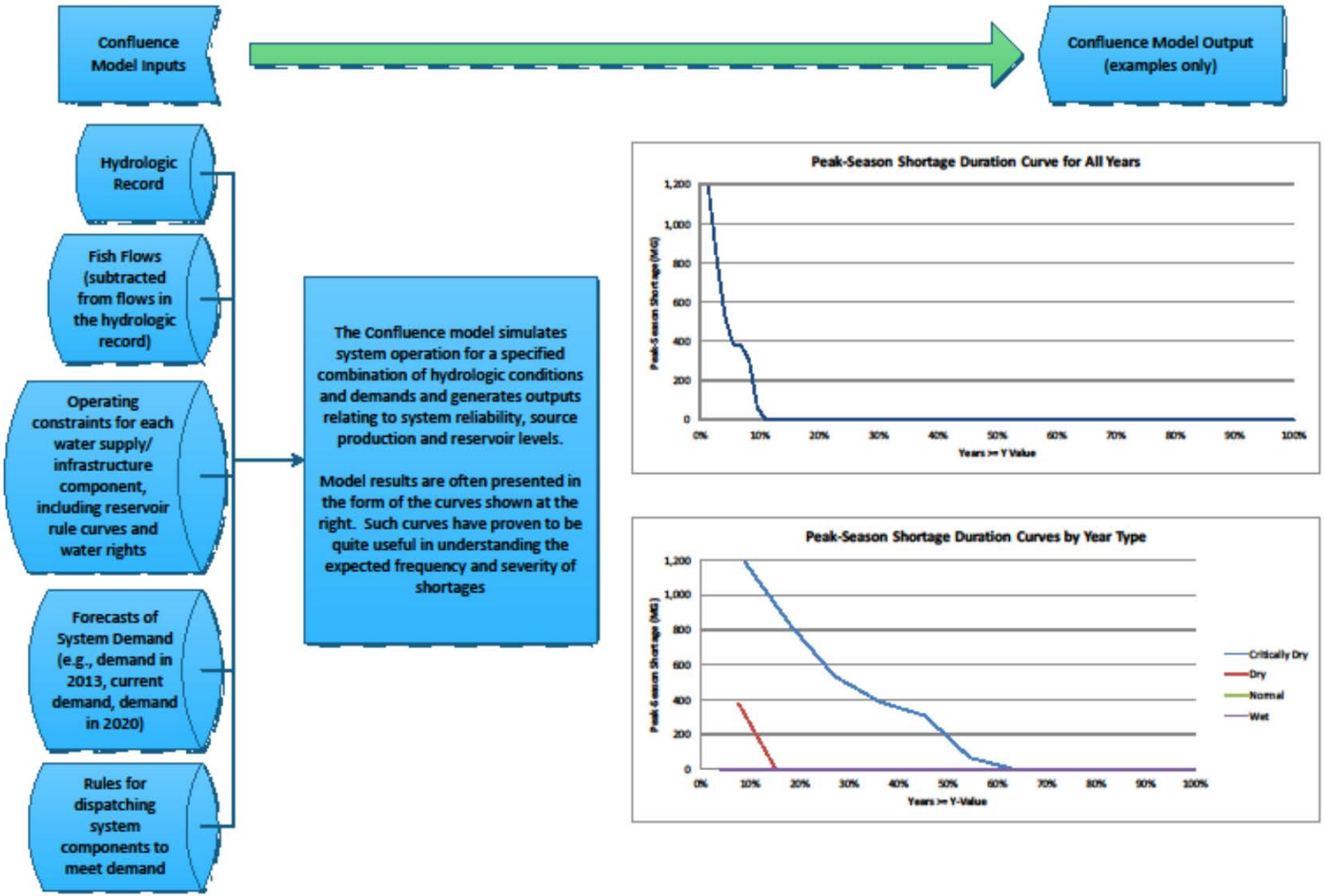
- Demand used in these slides (3500 million gallons/year) was an approximation of current demand. .
- Fish flows release regimes are specified in the graphs – slide 54 has none beyond releases required by current water rights (e.g., 1cfs bypass flow to Newell Creek); slide 55 has Tier 3/2 flows, and slide 56 has Tier 3 flows. A slide in this series created in exactly the same manner as these three slides is now available for the fish flow release regime called DFG-5.
- These slides assume flows from the 1977 hydrologic year which runs from November 1, 1976 to October 31, 1977.
- The basic operating strategy the model uses for dispatching sources is as follows:

  Take all available flows from the North Coast streams first (accommodating agreed upon fish flows, of course). Next go to the San Lorenzo River and take any available water that meets water quality criteria and is within the provisions of our water rights and after meeting agreed upon fish flow releases. If it is

winter, go to the lake next, if it is summer, go to groundwater sources next and then to the lake.

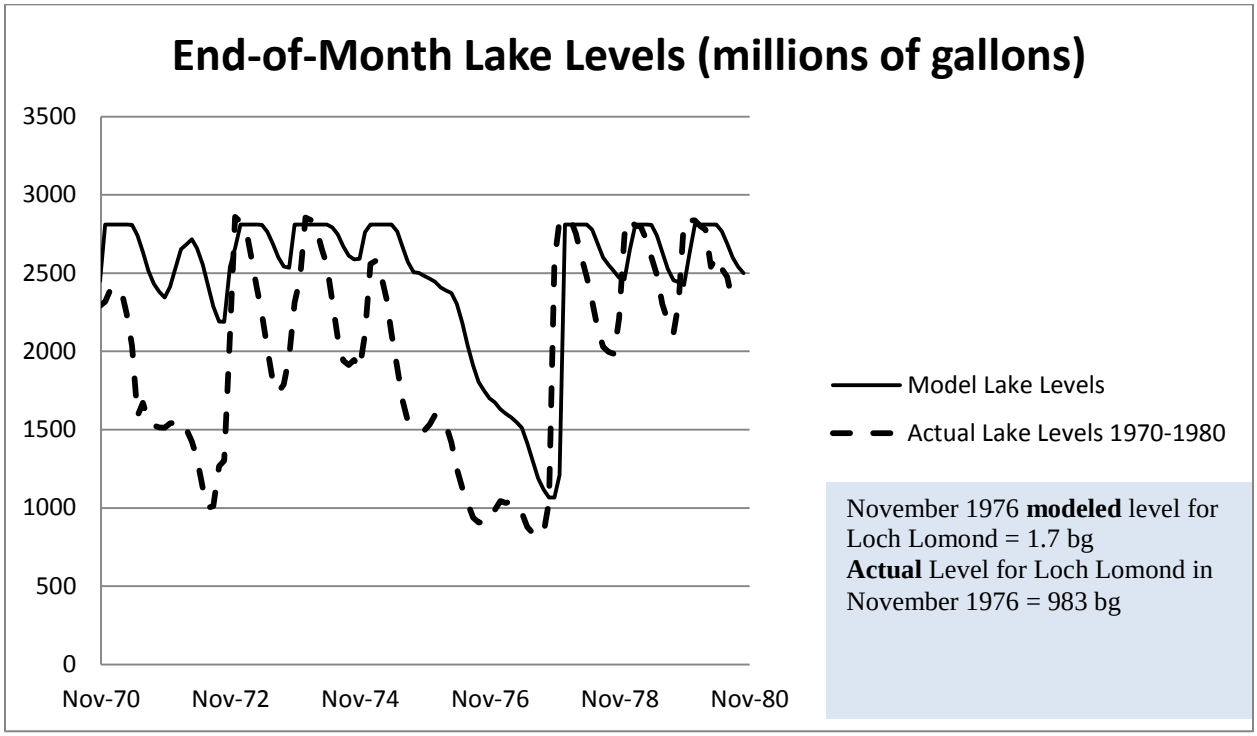
- The model runs underlying these slides assume base infrastructure, which reflects ongoing improvements to the North Coast pipeline and limited summer production from Beltz well 12.

Schematic of How the Confluence Model Works



Question: What was the starting lake level used in preparing the graphs shown in Slides 54, 55, and 56?

Answer: The lake level at any point is not an input to the Confluence model; rather it is a product of the model simulation. Likewise, the model is not "programmed" to release a specified amount of water for any year. Like in real life, the lake is always the last source of water dispatched in the model, and is treated as the source of last resort after all other supplies are fully maximized. The model governs the operation of the lake using something called a rule curve that determines whether the lake level at any point in the peak season is high enough to allow the lake to fully meet remaining demand, or whether lake draw down must be slowed, resulting in a shortage during the dry season. The chart below shows the lake levels that result from a model run that assumes Natural flows, current demand levels, and a 10-year hydrologic sequence running from water year 1971 through 1980. The chart also shows the actual lake levels for that 10-year period (dashed line). The differences between the two are due to a variety of factors, most notably differing demands, and changes since the 1970s in how the system is operated. Among other things, this chart tells us that in Slide 54, which is also based on a simulation assuming Natural flows, the starting lake level on November 1, 1976 is 1.7 billion gallons. The starting lake levels for slides 55 and 56 will differ because of different flow assumptions.

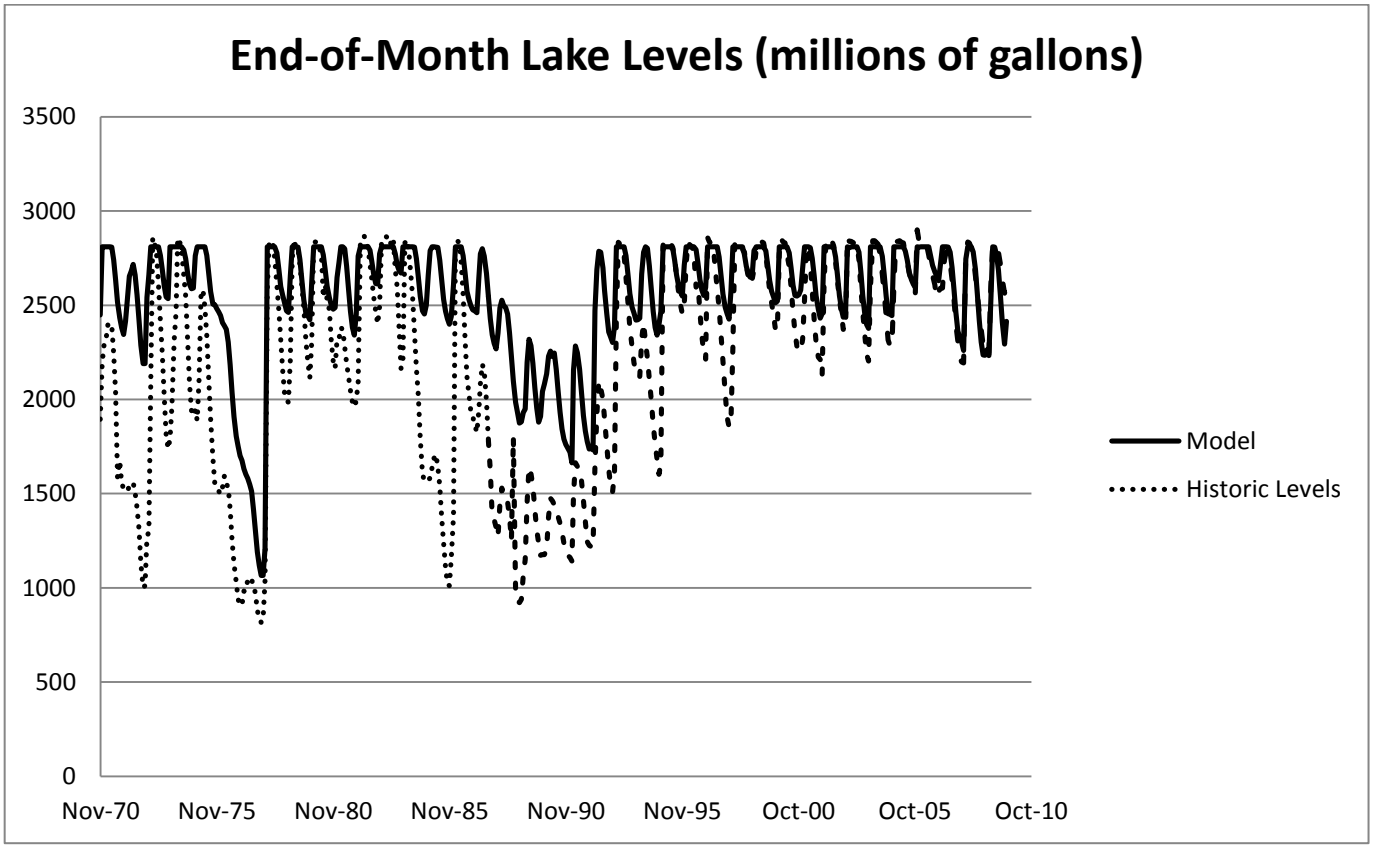


Question: Does Table 5-2 from the 2005 Urban Water Management Plan in any way reflect or direct water system operations in normal years?

The answer to this question is no. The graph on page 6 shows both the modeled lake levels and the actual lake levels for the period November 1970 to October 2009. Particularly since 1995, lake levels have seldom fallen below 2 billion gallons and in recent years, actual lake usage has typically been in the neighborhood of no more than 600 million gallons per year. It appears that the purpose of Table 5-2 may have been more related to theoretical capacities rather than operational practices, especially those occurring over the last 20 years.

In reviewing the chart on page 6, I want to call reviewers' attention to information that will help them understand and appropriately interpret what they are seeing.

The solid black line is modeled lake levels that are based on actual hydrology and constant demand equal to current demand levels (i.e., 3.5 bgy). The dotted black line is actual lake levels and has been influenced by management decision-making about how to use the lake in responding to the water supply situation in any given year.
It is interesting to note how much closer the modeled and historical lake levels are in recent years than in earlier years. This is to be expected, as modeled and actual demands as well as modeled and actual operating regimes have converged.


End-of-Month Lake Levels (millions of gallons)
3500
3000
2500
2000
1500
1000
500
0
Nov-70
Nov-75
Nov-80
Nov-85
Nov-90
Nov-95
Oct-00
Oct-05
Oct-10
Model
Historic Levels

Appendix A-9

Improving Transparency – Responding to Written Questions

DATE: Sept. 6, 2014

TO: Rosemary Menard

FROM: Sue Holt

SUBJECT: Comments on the Slide Deck (Supply and Demand), Document P (Recon Report Response To Questions Related To the supply/demand slide deck), and Document L (Historic Water Demand Related to Growth)

I have done some additional review of the material going into the Recon Report as of August 29, and I've identified some confusions and data questions. Many of these involve questions about incomplete links or citations. Others involve calculations or explanations. Rather than take time at a WSAC meeting, I've written my concerns here. Please feel free to treat them as food for thought for the next edition of the Recon Report.

1. It is unclear to me what "current" demand means. One might assume it means actual demand in the most recent period. However Document P shows current demand as 3500 MGY. As I understand it, that figure is an estimate of what demand would currently be if there were no drought and if demand had fully rebounded from the recession. Is this correct? If so, can we call it something else so as not to confuse people? Perhaps "no drought, no recession" demand or "rebounded" demand would be more informative?

   In the slides showing current demand, which does not include 5 to 15, which are labeled in slide 4 and were presented as "representational," current demand equals 3.5 bgy. As shown on slide 23, 2013 gross water supply, also referred to as gross water production was 3.477 bg, so this is the basis for the "current" demand number of 3.5 bgy.

   Please don't confuse what is in the slide deck presented in June as being what we are saying about the future. The purpose of the information presented in June was to help those not familiar with the topics covered to get the basic familiarity they would need to work with the information that will be developed during the WSAC process.

2. I understand that demand is usually forecasted as a single number in any year. But the "cone of uncertainty" suggests that a range of possible values would be more appropriate. For example, the maximum could be calculated as [the AMBAG-level population estimate + UCSC growth] times a recent high value for GPCD. The minimum could be current population (i.e., no population growth) times a GPCD value at least as low as the lowest recent value. Such a range could then be an input to the Confluence model and also potential scenarios. Does this make sense?

The issue of having a range of potential future demand numbers is, I think, reasonable. I have asked the consulting team to do two things related to demand forecasting:

1. Help us use the existing demand forecasting methodology to prepare a range of future demand forecasts for us during the Committee's work; and
2. Create an econometric demand-forecasting model for use in the work that will take place to develop the updated Urban Water Management Plan next year and for long term use in updating demand forecasts.

Unfortunately, the time involved in creating a new econometric demand model won't allow us to have this tool for use during the Committee's work, but I think that it is something we should do and a tool that is needed for ongoing use.

3. Regarding the Confluence model, I understand that the lake level is an output rather than an input to the model. However I suspect that the model is recalibrated each year and starts with the actual lake level. Otherwise, wouldn't errors propagate across years? Or do I misunderstand this?

Lake level isn't really an output, it's more of a consequence or result of running the system.

As I understand it, what happens in Confluence is that system demand and any flow release requirements are set and then, starting at the beginning of the hydrologic record, and using a daily time step, every single year of the hydrologic record is run through the model. For each day, given the hydrology of that day in that hydrologic year, the model dispatches water to meet that day's demand using the following source dispatching order:

- Take all available flows from the North Coast streams first (accommodating agreed upon fish flows, of course).
- Next go to the San Lorenzo River and take any available water that meets water quality criteria and is within the provisions of our water rights and after meeting agreed upon fish flow releases.
- If it is winter, go to the lake next, if it is summer, go to groundwater sources next and then to the lake.

This source dispatching order is the same as described in Document P (see 4th bullet on page 2).

When daily demands cannot be met by the flowing sources, for whatever reasons, water from the lake is dispatched into the system. If water from the lake is not available on that day due to lake rule curve constraints or the lake being empty, a shortage is recorded for that day. The volume of shortage for that day is calculated and accumulated with any other daily shortage volumes for that hydrologic year, which ultimately creates the "severity" of shortage number seen in Confluence output graphics shown on page 4 of Document P.

This process repeats for each day in each water year and wherever the lake is on September 30 each year, that level becomes the level of the lake in the new water year

that starts on October 1st.

Does this explanation help?

4. Document P, page 8, shows that modeled and actual lake levels approach each other. And page 6 explains that this is partly because actual demand has approached modeled demand – but I don't see that in the data. (I assume modeled demand means 3500 MGY. Is this correct?) In slide #31 of the slide deck, water production starts at 3900 MGY in 1977, falls to 2436, and rises and falls thereafter, bouncing above and below 3500, with a variation that is roughly steady rather than decreasing. Meanwhile on page 8 of Document P, the modeled lake level is above (or equal to) historic lake levels, which implies that modeled demand is below (or equal to) historic/actual demand, not above it. But slide #31 shows actual demand above modeled demand as often as below it. Thus I cannot see grounds for relating page 8 of Document P to a pattern between actual and modeled demand. Am I missing something?

   So, let's start with what the modeled lake level shown on page 8 (solid line) is. In this case the system demand the model was asked to meet was 3.5 bgy. The solid line was produced in exactly the way described in response to question 3. Actual demand in any of the years shown on slide 31 was not used. Rather the model was asked to meet 3.5 bgy for each of the hydrologic years in our hydrologic record.

   The dotted line on page 8 is based on actual information about lake levels that are based on actual conditions in each hydrologic year including actual demand with any curtailment in place and reflecting actual management decision-making about operations. The reason why the modeled lake levels is higher than actual lake levels in many cases particularly in the years before 2000, is that management decisions were made about how to operate the lake and those decisions didn't reflect the protocols in the model, which wasn't at all inappropriate because, of course, those decisions were made in real time.

   It is important to note that the Confluence model is a forecasting model, not an operational model. What this means is that it isn't used to guide daily operations, but to help us look at the reliability of the system as conditions change over time. What this also means is that systems operators in the moment can make decisions about how to operate the system that don't align exactly with what the model specifies. In the graph on page 8 of Document P, the historic levels data, the dotted line, used the lake in a manner fairly different that the model use levels, particularly in the years prior to 1995. When you look at the data on slide 25 that shows the contribution of sources to meeting water production, you can actually see that in the mid-1990s the way the lake was used shifted away from the past practice of using the lake so much and toward a greater dependence on the San Lorenzo supply.

   Finally, with respect to the referenced sentence on page 6 on modeled and actual demands converging – I'm sorry, I confused you. I didn't mean system demand, i.e., the 3.5 bgy, I meant demands on the lake. The real take away is that the way we model the system and the way we operate the system have converged to make the solid and dotted lines grow closer together.

5. Page 2 of Document P repeats Table 5-2 regarding water supply reliability. Page 6 states that the table is really about theoretical production capacity rather than practice. So I'm not sure what supply reliability means. Perhaps that will be defined in the next edition of the Recon Report.

   Table 5-2, as you know, comes from the 2005 Urban Water Management Plan. The table's content relates to providing the information required by Section 10631(c) of the California Water Code that "requires water suppliers to provide estimates of supply volumes for average, single dry, and multiple dry water years, and to describe the factors resulting in any inconsistency of supply."

   Slide 22 of the slide deck and Table 5-2 show the same number, 1,042 million gallons, for Newell Creek/Loch Lomond. So, what is this number? As indicated by the information presented in Slide 22, 1,042 million gallons is the amount of the City's water right for this source. In theory, at least, the full 1,042 million gallons of water stored in Loch Lomond is available for use in an average year. In practice, and especially since the mid-1990s, the chart on page 8 of Document P makes it clear that Loch Lomond is not operated in a manner that annually utilizes anything close to 1,042 million gallons, which would mean drawing the lake down to 1.76 billion gallons, annually.

6. I recommend that slide 15 (Supply and Demand in Drought) be repeated four times – in order to show how each of the Stage 2-5 deficiency levels on slide 19 would look. In this way WSAC members can directly compare drought supply with different levels of curtailed demand.

   As noted earlier, the purpose of slides 5 through 15 is intended to be illustrative of rather than specific to an actual operating scheme. In particular, the points being illustrated include how resources are deployed, the adequacy of supply in normal circumstances, and the inadequacy of supply in drought conditions. The point of the curtailment element in slide 15 is to both show how curtailment is used to "fill the gap" and to demonstrate basically when the gap occurs, which also allows the connection to be made between the timing of that gap and the opportunity to focus reductions on the discretionary uses that occur during the peak season.

7. Slide 19 states that normal peak demand is 2473 MG. I'd like to know what the peak months are (Apr-Oct?) and what years were used for the calculation.

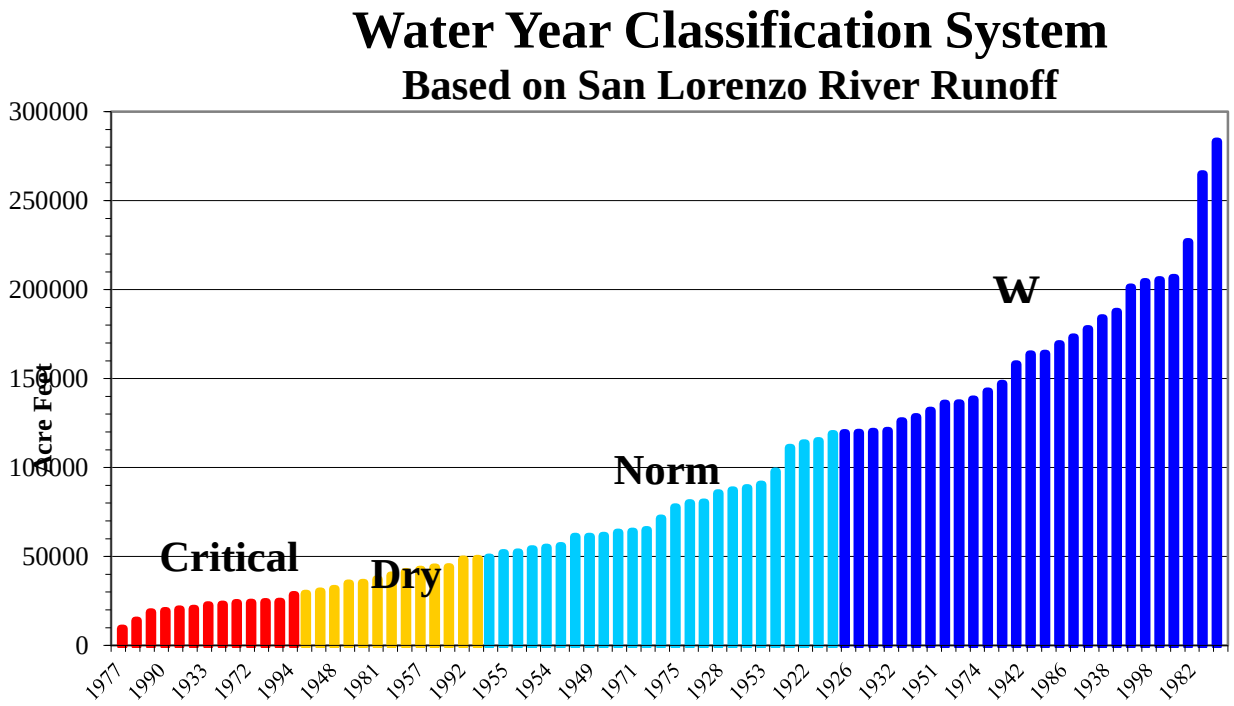
   Slide 19 is from the 2009 Water Shortage Contingency Plan. The analysis used to create this table was based on an analysis of consumption records for the three-year period from 2002 through 2004. The peak season demand at that time was 2,641 million gallons, of which 2,473 MG was metered water consumption and other system uses/losses was 168 MG. Refer to Table 3-4 in the Water Shortage Contingency Plan.

   The peak season demand period used in the analysis was April through October.

8. Slide 24 shows annual runoff and dryness categories. If possible, I would like a numerical list

of the runoff values, as well as the definitions of the categories (e.g., critically dry = runoff < AF).

Critically dry goes from 0 to 29,000 afy
Dry goes from 29,000 afy to 49,000 afy
Normal goes from 49,000 afy to 119,000 afy
Wet is anything above 119,000 afy



The chart above is a resorted version of the chart on slide 24 and you should be able to hover your cursor over the various bars and see the data for the individual years.

9. Slide 35 shows GPCD and refers to the 2010 UWMP. If possible, I would like these data as well as the more recent data used.

Year: (a)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Estimated Service Area Population	86,197	86,034	86,216	86,891	87,551	87,871	88,143	88,776	89,400	90,387	91,291	92,611	93,209	94,103
Population residing on UCSC Campus	5,916	5,846	6,462	6,681	6,889	7,111	7,392	7,526	7,887	7,666	8,097	8,278	8,768	8,768
Residential Population	80,281	80,188	79,754	80,210	80,662	80,760	80,751	81,250	81,513	82,721	83,194	84,333	84,441	85,335
Gross water use (gallons/day)	10,924,356	10,854,986	10,708,219	10,679,890	10,672,274	9,771,315	9,780,219	9,836,411	9,767,699	8,681,123	8,501,074	8,218,575	8,986,110	9,123,288
Gross Per Capita Water Use	127	126	124	123	122	111	111	111	109	96	93	89	96	97
Residential Water Use (gallons/day)	6,416,164	6,425,479	6,408,219	6,338,630	6,398,904	6,087,945	5,784,384	5,711,507	5,778,904	5,216,712	5,137,534	4,978,904	5,146,575	5,249,863
Residential Per Capita Water Use	80	80	80	79	79	75	72	70	71	63	62	59	61	62

Population estimates for 2000 and 2010 are based on the U.S. Census figures for the

City's service area. Annual estimates inside the City of Santa Cruz are based on data obtained from the CA Department of Finance and the University of California (for on campus population). Outside the City, annual population estimates between 2000 and 2010 were interpolated from census records, and after 2010, additional population was estimated using billing records of new accounts, and the average number of persons per account in the unincorporated area.

Year: (a)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
City Population	54,588	54,451	54,660	55,361	56,048	56,394	56,692	57,352	58,002	59,016	59,946	61,245	61,825	62,686
Outside City Population (c)	31,609	31,583	31,556	31,530	31,503	31,477	31,451	31,424	31,398	31,371	31,345	31,366	31,384	31,417
Estimated Service Area Population	**86,197**	**86,034**	**86,216**	**86,891**	**87,551**	**87,871**	**88,143**	**88,776**	**89,400**	**90,387**	**91,291**	**92,611**	**93,209**	**94,103**
Outside City Residential Service accounts added												7	6	11
Source:														
Service Area Population 2000, 201	US Census, City GIS													
City Population, 2000-2010:	http://www.dof.ca.gov/research/demographic/reports/estimates/e-4/2001-10/documents/E-4_2010.xls													
City Population, 2011-2012:	http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/documents/E-1_2012_Internet_Version.xls													
Outside City Residential Service Accounts: EDEN Report: New Accounts Created by Jurisdiction														
City Population, 2013	http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php													
City Population 2010 - 2014 (with 2012 ans 2013 slightly revised) http://www.dof.ca.gov/research/demographic/reports/estimates/e-4/2011-20/view.php														

10. Slide 40 shows indoor and outdoor water use by user group. How is population estimated for each year, including since 2010?

The indoor and outdoor use breakdown in slide 40 is taken directly from the Water Conservation Master Plan, Decision Support System model. It is based on an analysis of actual water use during 2007 and 2008 to represent conditions in 2010, the starting year of the DSS model.

See question above for population estimates.

11. Slide 41 shows typical single family water use by end use. How is "typical" defined? Are these local data or nationwide data or …? Why do the values add to such a nice round number – 200 GPD?

The figures in Slide 41 are based on the breakdown of end uses of water for the single family residential category that is used in the Water Conservation Master Plan, Decision Support System model. It shows average usage of the City's 18,862 single family accounts corresponding with year 2010, the initial year of the DSS model, to represent existing conditions before the effects of any new conservation programs are factored in. The actual figure for gallons per account per day in the model is 199.5, but it was rounded in the presentation to 200 gallons per account per day for illustration purposes.

12. Slide 70 states that water use in future development is modeled on recent actual experience. Does recent actual experience include all housing units or just the newest? The latter would be more appropriate, since it is narrowly focused on new development. If future development is modeled on the use exhibited by recent new housing (in Document L), it

could include an assumption of further efficiency improvements in future building codes. Is this reasonable?

The forecasting of future demand water per housing units is based on recent demand trends for similar housing types so takes into account up to date plumbing codes etc.

13. Slide 71 on UWMP forecasts could incorporate a third scenario, based on per-account water use during 2009-2011. A fourth scenario with lower population growth could focus on the evidence that actual growth typically lags behind AMBAG targets. These scenarios could be incorporated in a new slide 73 for the UWMP Table 4-11: Water Demand Forecast.

The 2010 UWMP forecast is not intended to be "the" forecast that will be used by the WSAC in addressing the water supply reliability issue. Updated forecasts will be developed for the WSAC use and will include a range of options, and a new econometric demand model is going to be developed that will be used in future forecasting.

14. Slide 75 shows eight factors influencing elasticity of residential demand. The source is a table in the Billings and Jones AWWA text on forecasting water demand. The original sources of three of these values are cited (from Griffin, Water Resource Economics, 2006). The other five factors lack citations. Some of them lack basic economics understanding. I suggest that only the citable factors be listed (and some values corrected from Griffin) as follows:

- Marginal price on bills -0.16
- Winter (low irrigation season) +0.10
- Summer (high irrigation season) -0.15 to -0.20
- Long-term adjustment to rate change -0.20 to -0.30

This topic is more your bailey-wick than mine, so I'm not in a position to argue. If the Billings and Jones text is incorrect, that is obviously an issue as you can see that the information presented in slide 75 is taken directly from that source.

The purpose of including this information on price elasticity was largely to acknowledge that it is not included in the demand forecast we produce and to indicate at least the intellectual curiosity to look at this issue. Being in a position to more appropriately integrate price and other similar factors into our demand forecast is one reason for pursuing development of an econometric demand model.

15. Slide 75 and the Billings and Jones text include a factor called "Effective Long-Term Conservation." But the text does not explain how this factor operates and no citation is provided. There is no corresponding factor or value in the Griffin text. Without some documentation, I recommend that this factor be eliminated from slides 75 and 77.

16. Based on the two previous suggestions, slide 77 can be modified as follows:

- Residential summer elasticity (with marginal price info) -0.8
- Residential winter elasticity (with marginal price info) -0.5
- Non-residential summer elasticity (with marginal price info) -0.7
- Non-residential winter elasticity (with marginal price info) -0.4

I would omit the second column of values after the decimal place, because rules of thumb by their nature lack such precision. I have used the smaller values throughout – so as to be conservative. If the long-term adjustment factor were included, the four values here would be 0.2 to 0.3 more negative – measuring how rate payers have more opportunity to reduce their demand in the long-run than the short-run.

17. Slide 78 creates confusion by ignoring the factors that must be held constant when elasticity is properly estimated. The slide's presence suggests there is an easy way to calculate elasticity. Unfortunately, this is not true. I recommend the slide be eliminated.

I'm not responding to the grey shaded questions above because, as I said in response to question 14, the purpose of including a discussion on price elasticity was to acknowledge that the current demand forecasting approach doesn't take it into account. The econometric demand forecasting model will include an ability to take price elasticity into account.

18. On page 10 of Document L there are many math errors in the two rows of growth rates. For example, the 2007 water demand growth rate is shown as 0.2% but it really is -12.6%. I believe the numbers on the following page in bold italics are the correct values. In particular, the average annual growth in demand is not 0.3%, it is -1.05%. In other words, water demand decreased between 1996 and 2013.

I asked Toby Goddard to look at your comments and get back to me. Here's his response:

Here's what is going on with Sue's comments. She is correctly calculating the year over year change in total accounts and total demand and calculating overall account growth as a percent, and demand growth, which we all know has declined, as a percent.

It is just that she is doing a different calculation than what I presented. We're both right, but we are using different denominators.

I presented: 1) the number of new accounts each year, and 2) expressed the new accounts as a percentage the total accounts that year. Same with demand.

For example: in 2007, new accounts used 7.3 million gallons as against a system total 3,287 mg. As I expressed it, those new accounts represented an increase of 0.2 percent for that year.

Sue looked at the difference in total annual demand between two years and calculated the change and expressed it as a percent. In her table, the difference between 2008 (3,311 mg) and 2009 (2,893 mg) is – 12.6% (I think she meant 2007/08)

The purpose of the memo was to put the number of new accounts, and the water they consume relative to the total, into focus. It was not to analyze what is going on with overall demand – that would have been a much different story.

19. I suggest that page 10 of Document L include information on the range of annual values, not just the average values. Ranges are more useful in scenarios. The following page includes the min and max values, the median, and the standard deviation. For example,

1996-2013	Range	Middle 50% of values
New service connections	27 -214	72 - 154
New water demand	0.9 – 22.4 mgy	6.6 – 15.7 mgy
GPD	77 – 568	211 - 321
Account growth rate	-0.3 to 1.5%	0.2 to 0.6%
Water demand growth rate	-12.6 to 7.8%	-3.9 to 1.6%

Great suggestion, thanks

Appendix A-10

Improving Transparency of Modeling and Forecasting Tools and Approaches

DATE: September 17, 2014
TO: WSAC and Water Commission
FROM: Rosemary Menard
SUBJECT: Concept paper on Modeling and Forecasting Working Group

It is clear to me from a variety of inputs that there is significant interest on the part of members of the WSAC and possibly their constituents and the Water Commission in issues related to the modeling and forecasting tools that the City uses in water supply planning. The Water Department and its technical contractors have developed a variety of modeling, forecasting and analytical tools that are used in modeling the water system and forecasting its performance and demands under various future scenarios. The tools used by the Water Department that are particularly relevant to water planning include the following:

- Hydrologic model for surface water resources;
- Confluence model for system reliability analyses and system performance forecasting;
- Water demand management Program planning and analytical model; and
- Water demand forecasting model[2].

Due to the importance of the role of these tools in the water planning activities we are currently conducting, I want to create a planned and organized way for interested members of the WSAC, the constituent groups represented by the WSAC and the Water Commission to develop a level of understanding and, ideally, confidence in the modeling, forecasting and analytical tools the City is using.

To work toward the achievement of this outcome, I want to create a working group that includes members of the WSAC and the Water Commission who are interested in learning more about these tools and who are willing to invest the time necessary to do so. I propose to open this working group to public members of WSAC constituency groups so that WSAC members who are participating and have members of their group who want to or need to be included can participate directly with the group. In recommending this expanded participation, I am specifically seeking to avoid placing WSAC or Water Commission members in the position of having to be a go-between between interested individuals and the learning and understanding that it will be the goal of this effort to develop.

In recommending this approach, it is important for everyone to understand that I have no expectation that challenging questions and issues about the models the City uses won't emerge. By

[2] The existing approach to water demand forecasting will be included in the scope of this working group. In addition, I have given direction to our WSAC consulting team to begin work on an econometric demand forecasting model that will be used for future demand forecasting beginning with the work on updating the Urban Water Management Plan next year. An econometric demand forecasting model will give the City an opportunity to include economic factors such as price and income in demand forecasting, which should improve the accuracy of the forecasts. The working group will have an opportunity to provide input to the consultant team on the development of the new econometric demand forecasting model.

recommending that we work with citizens to explore how these models work, what their inputs and outputs are, and the model strengths and weaknesses, which all such tools have, I am implicitly acknowledging that we are open to learning about citizen concerns and issues about the models and analytical tools we use in water planning. I am also acknowledging that we are open to taking steps to address those issues where feasible and necessary. That said, and just to be clear, I am not agreeing that working group members will exercise any final decision-making authority over what models and analytical tools the City uses in water planning or the data inputs that are used in these models. I do not want anyone to view this statement as anything more than a practical limitation that is being openly communicated up front. And I do want people to recognize that by agreeing to form and support such a working group in the first place, I am willingly opening to public scrutiny what many consider to be the mysterious "black boxes" that drive outcomes for water policy. The timeframe for the performance of this working group is now, with membership defined by the conclusion of the Water Commission meeting on October 6, 2014.

A work plan and schedule for the working group will be developed by City staff in collaboration with relevant members of the consulting team. The timeline for completion of the working group's activities will be December 19, 2014. This timeline is necessary to allow modeling results to be produced for use by the WSAC during the Real Deal phase of their work.

Appendix A-11

Improving Transparency of Modeling and Forecasting Tools and Approaches

DATE: **October 23, 2014**
TO: **Members of the Water Supply Advisory Committee, the Santa Cruz Water Commission and Interested Members of the Public**
FROM: **Rosemary Menard, Director, Santa Cruz Water**
SUBJECT: **Modeling and Forecasting Working Group**

The Santa Cruz Water Department is sponsoring a Modeling and Forecasting Working Group in the coming weeks. The purpose of the working group is to create a planned and organized way for interested members of the WSAC and their constituent groups, members of the Santa Cruz Water Commission, and interested members of the public to develop a greater level of understanding and confidence in the modeling, forecasting and analytical tools the City uses in its water planning efforts.

I propose the following schedule, subject to availability of presenters and of appropriate facilities, to support the working group effort. The work plan follows.

Session Number	Session Title	Proposed Date/Time (All Wednesdays)
1	Overview of Work Plan and Modeling and Forecasting Tools	November 12, 4 pm to 6 pm
2	Modeling and Forecasting Flowing Source Supply and Groundwater Resources	December 3 4 pm to 8 pm
3	Current and Proposed Future Approaches to Forecasting Water Demand	December 10 4 pm to 7 pm
4	Demand Management Decision Support System Model	January 7 4 pm to 7 pm
5	Shortage Contingency Planning	January 14 4 pm to 8 pm
6	Confluence Modeling and Supply Forecasting	January 21 4 pm to 7 pm
7	Parking Lot Issues	January 28 4 pm to 7 pm
8	Modeling and Forecasting Products to be used in Phase 2 of the WSAC work	February 4 4 pm to 7 pm

In order to ensure that we have an adequate location for these sessions, **REGISTRATION** is required. To register, simply send an email to my assistant, Gloria Rudometkin (grudometkin@cityofsantacruz.com), with the Subject Line: Modeling and Forecasting Working Group, and indicate in the email message that you want to participate in the Modeling and Forecasting Working Group. Please provide an email address and a telephone number where you

can be reached or messages can be left. Registrations must be submitted by close of business on Monday, November 3, 2014.

Modeling and Forecasting Work Group Work Plan

10-23-14

Session 1: Overview of Work Plan and Modeling and Forecasting Tools 2 hours

Rosemary Menard

Focus: The models and forecasting tools the City uses for water supply planning, how they are used and the types and sources of data inputs.

Presentation and discussion will cover:

- Overview of work plan and schedule
- Overview presentation and discussion will cover the following modeling and forecasting tools:
  - Hydrologic model of flowing sources
  - Fish flow regimes
  - Current demand forecasting methodology, and planned econometric demand forecasting model
  - Demand Management Decision Support System Model
  - Confluence model – system reliability and forecasting
- Big picture discussion of how the tools fit together and are used in water planning

Session 2: Modeling and Forecasting Flowing Source Supply and Groundwater Resources 4 hours

Shawn Chartrand, Jeff Hagar and Isidro Rivera

Focus: Detailed analyses of the hydrologic data used in modeling and forecasting flowing source supply and groundwater resources, and how they are used, and the fish flow regimes that have been developed historically along with the scientific basis for developing fish flows.

Presentation and discussion will cover:

- Data sources
- Data quality
- Hydrologic flow forecasts – how they are developed, how they are used in supply modeling and forecasting
- Fish flow regimes and options (2014 drought flows, Tier 3/2, DFG 5, Tier 3) and the level of protection provided to fish under these various flow scenarios
- Groundwater resources, including wells and well operation

Session 3: Current and Proposed Future Approaches to Forecasting Water Demand 3 hours

Toby Goddard, David Mitchell

Focus: Current approach to forecasting demand, data types and sources, and econometric demand models, how they are developed, data types and sources, and timeframe for model development and use.

Presentation and discussion will cover:

- Demand forecast development for the 2010 Urban Water Management Plan and the Water Supply Assessment developed for the General Plan
- Data types and sources used in demand forecasting
- Demand forecasts versus actual demand – trends over time
- Approach to disaggregating an annual demand figure, for example, 3.5 bgy, into daily demands for use with the Confluence model
- Key factors, for example temperature and precipitation, used in disaggregating demand, and the types and sources of these data.
- Benefits and uses of an econometric demand forecast model
- Discussion of types and sources of data to be used in the development of an econometric demand model for Santa Cruz
- Areas of particular interest, e.g., incorporating price and income into water demand models

Session 4: Demand Management Decision Support System Model 3 hours

Lisa and Bill Maddaus

Focus: Evaluation of programs and projects to reduce or manage water demand.

Presentation and discussion will cover:

- Sources and types of data used in evaluating water demand management programs and projects
- Assumptions and basis for assumptions used in evaluating demand management programs and projects
- Applicability of experience and trends elsewhere to the Santa Cruz situation

Session 5: Shortage Contingency Planning **3 hours**

Toby Goddard

Focus: Session will cover the analytical framework used to develop the 2009 Water Shortage Contingency Plan.

Presentation and discussion will cover:

- Sources of data
- Policy Framework
- Review of recent experiences implementing the plan
- List of potential issues to be addressed in planned revision following the end of the current drought

Session 6: Confluence Modeling and Supply Forecasting **4 hours**

Gary Fiske

Focus: How the Confluence model works and the outputs of the Confluence model.

Presentation and discussion will cover:

- Data inputs to Confluence
- Municipal and Industrial (M&I) supply source dispatching protocol and operating rule curve for Loch Lomond
- Architecture of the Confluence model
- Confluence processing steps
- Confluence outputs and what they mean
    - Using Confluence to estimate the size of a shortage under a given set of past, current, or future annual conditions versus using Confluence to estimate the frequency and severity of shortages over the entire period of record or forecast period
- How Confluence will be used in creating the "baseline"

Session 7: Parking Lot Issues **3 hours**

Focus: Throughout sessions 1 through 6, items that come up and can't be responded to during the sessions will be placed on a parking lot list. In session 7, staff and various technical consultants will present and discuss results of follow up work done to address parking lot issues.

Session 8: Modeling and Forecasting Products to be Used in Phase 2 of the WSAC Work
3 hours

Focus: A range of modeling and forecasting products will be used in Phase 2 of the WSAC work. In this session, the various forecasts will be presented and discussed.

Presentation and discussion will cover:

- Potential range of impacts on hydrologic models due to various climate change scenarios
- Baseline water demand forecast without climate change or water demand management actions
- Baseline water demand forecast with water demand management actions but without climate change[3]
- Baseline water demand forecast with water demand management actions and with the most optimistic (least impactful) version of climate change
- Confluence reliability forecasts under various agreed upon fish flow and climate change assumptions

Additional modeling will be occurring throughout the second phase of the WSAC's work plan as options are developed and evaluated. The modeling products identified above are intended to be part of the initial analytical baseline. The methodologies used in creating these baseline products would be applied in any further analyses needed by the WSAC.

[3] It may well be that there would be several versions of this with different sets of water demand management actions in different forecasts.

Appendix A-12

Top Line Results

October 2014 Community Attitudinal Survey

(insert topline document here)

SantaCruzWater2014 Topline.doc

Appendix A-13

Presentation of Results

October 2014 Community Attitudinal Survey

(insert Bregman presentation here)

SantaCruzWaterDept Charts2014.pdf