City of Flagstaff – CEC Advisory Panel Update

Overview of the City Manager's CEC Advisory Panel

The City of Flagstaff recycles over 700 million gallons of water each year for conservation purposes. By recycling we mean wastewater that is sent from our homes or businesses to a treatment plant where it is highly treated to meet state and federal reclaimed water quality standards. Once treated, the water is termed "reclaimed water, recycled water or effluent" and enters a separate distribution system after being chlorinated. Reclaimed water is used not only in Flagstaff but by communities around the world in lieu of drinking water for irrigation purposes. The City has undertaken this proactive water conservation strategy for the past 20 years in our community. Recently, there have been numerous studies both locally and nationally regarding trace (or extremely low concentrations) of certain chemicals found in water around the United States that are not regulated by the U.S. EPA. These are collectively known as Compounds of Emerging Concern (CECs) and include pharmaceuticals, personal care products, endocrine disrupters and antibiotic resistance genes. In Flagstaff, CECs can enter the wastewater system at our homes, businesses and medical care facilities and raw water.

The City Manager, Kevin Burke recognizing the importance of water to the future of our community, organized an Advisory Panel of 12 local, state and nationally recognized researchers, scientists and industry professionals to help understand what CECs mean locally. Flagstaff has been known around the State as a leader in its willingness to tackle tough issues relating to water head-on and the creation of this Advisory Panel is just one more example. The Advisory Panel first met in January 2013 and was asked to help the City determine what to study and identify steps that are necessary to better understand the effects, if any, CECs have in our raw water, drinking water and reclaimed water. The focus of discussions has initially been around the "human health impacts" as opposed to animal, aquatic or environmental impacts. The City recognizes that all of these are important to our community; however, the first priority is human health.

Review of Findings of Interim Report

The Advisory Panel issued an Interim Report in July 2013 which contained numerous findings, advice, recommendations and priorities to the City on CECs in drinking water and reclaimed water. A few of the findings and recommendations from the City Manager's CEC Advisory Panel Interim Report are paraphrased below:

Drinking Water

1. The U.S. EPA from the advice of various national scientific panels and analytical studies has developed a list of currently unregulated CECs that may warrant further consideration for

regulation in drinking water. The list of contaminants is referred to the Contaminant Candidate List #3 (CCL3) and is focused on human health impacts. Antibiotic resistant genes or microbes are not included on the list at this time. The Advisory Panel recommended the City consider evaluating which contaminants on the list are being utilized or prescribed within the Flagstaff community as background information in preparation for potential future regulation.

Reclaimed Water

1. There are no data at the present time to suggest that the continued use of reclaimed water provides undue risk to human health.
2. The Advisory Panel recommended the City monitor for four (4) chemicals on the CCL3 drinking water list in the City's reclaimed water.
3. A subgroup of the Advisory Panel was tasked with outlining a cutting edge epidemiological and microbial study, and to search for funding with partners or agencies regarding CECs. The conclusions of this type of study will help to provide a better understanding of what it means if the City detects antibiotic resistance genes or bacteria in reclaimed water in Flagstaff.
4. The Advisory Panel suggested a parallel study to compare the effects of various water treatment technologies on the removal of CECs, specifically antibiotic resistance genes in reclaimed water.

Status Update on Research Subcommittee

At the last full Advisory Panel meeting, there was agreement to convene a subcommittee of its members to discuss future study and possible funding opportunities. The Research Subcommittee quickly determined that a comprehensive epidemiological and microbial study of antibiotic resistant bacteria to determine any link between human health effects and reclaimed water within Flagstaff is of such scale, cost, and specificity that it is unlikely to find a specific grant to match the full scope of the study.

Therefore, the Research Subcommittee broke down the components of the Flagstaff study into smaller components that can be coupled or advanced in other research projects and include:

- Identify what, if any, antibiotic resistant bacteria (ARBs) are found leaving the treatment plants.
- Identify what, if any, ARBs are found at various end points in Flagstaff's distribution system.
- Identify if any of the identified ARBs can be found in raw and potable City water.
- Identify where any of the identified ARBs are most prevalent (ex: soil, raw meat, medical clinics, etc).
- Identify what are the most common ARBs encountered at FMC or in the Flagstaff medical community.
- Identify what treatments kill or remove ARBs in water.
    - How has the use of Chlorine in the reclaimed distribution system affected detection of ARG's?

The following proposals were submitted by members of the Research Subcommittee. All abstracts are included in this update:

Annual Water Reuse & Desalination Research Conference

Advisory Panel Member: McLain

Jean McLain submitted a successful proposal to the 18th Annual Water Reuse & Desalination Research Conference, scheduled for later this month. The presentation will be in the form of a case study highlighting Flagstaff's story. The title of the session is *Separating Science from Emotion in Public Health-Related Perceptions of Recycled Water: A Case Study of Flagstaff, Arizona*.

National Science Foundation *Relative Abundance and Diversity of Antibiotic Resistance Genes and Pathogens in Reclaimed Versus Potable Water Distribution Systems*

Advisory Panel Members: Pruden, Engelthaler and McLain

Amy Pruden submitted this proposal to NSF which includes the following objectives:

- O1: Conduct a lab study to examine the interplay between water treatment, nutrient level, disinfectant type, distribution system design/operation, and temperature in selecting for microbial regrowth and microbial constituents of emerging concern (MCEC) occurrence in reclaimed water distribution systems (RWDSs).
- O2: Conduct a field survey comparing the microbiome composition and MCEC occurrence of paired RWDSs and potable water distribution systems (PWDSs) as a function of kind of treatment, nutrient levels, secondary disinfectant type and dose, distribution system materials, and water age.
- O3: Based on O1 and O2, identify engineering practices that are promising for minimizing the occurrence of MCECs in RWDSs to inform future design, management, and standards for safe application of reclaimed water for non-potable and potable reuse.

Environmental Protection Agency *Best Practices for Sustainable Water Management: An Integrative Approach to Optimizing Benefits and Minimizing Microbial Risk of Water Reuse*

Advisory Panel Members: Pruden, Engelthaler and McLain

Amy Prudent submitted this proposal to the U.S. EPA which includes the following objectives:

- O1: Survey the occurrence of fecal indicators and microbial constituents of emerging concern (MCECs) [(antibiotic resistant bacteria (ARBs), opportunistic pathogens, and antibiotic resistance genes (ARGs)] across a range of existing reclaimed water treatments and distribution systems and relevant background waters
- O2: Compare the molecular signatures of ARGs across a range of local water samples (e.g., raw sewage, drinking water, surface/ground water, and reclaimed water) to those identified in community sources of *Enterococci* and *Staphylococci*.

- O3: Engage stakeholders in quantifying benefits and identifying various practical factors that contribute to the success and challenges of reclaimed water projects
- O4: Develop a Best Management Practices tool box that optimizes benefits and minimizes microbial risk of recycled water by identifying promising engineering factors that limit occurrence of MCECs.

Environmental Protection Agency *Chemical and Biological Contaminant Attenuation and Life Cycle Assessment of Water Reuse*

Advisory Panel Members: Snyder and Rock

Shane Snyder submitted the proposal to the U.S. EPA. The overarching objective of this project is to demonstrate the efficacy of various water reuse scenarios for the attenuation of chemical and biological contaminants towards the protection of human and environmental health using life-cycle assessment to compare options. We will apply a proven battery of in vitro bioassays, advanced mass spectrometric approaches, and cultural and molecular microbiological methods to monitor conventional and advanced water treatment technologies. Life-cycle assessments will evaluate the energy and infrastructure of the selected treatment processes in comparison to efficacy in contaminant removal.

Sampling Protocol and Sampling Operations for Any and All of the above Studies

Earlier this month the Subcommittee discussed the need to proceed with a sampling plan in advance of hearing back on the proposals. Further the Subcommittee proposed to initiate the collection of some pilot data. Discussions to date include using some of TGen's pilot data, referencing the State-wide ADEQ Protocol, data collection site identification, and other sampling protocol needs.

This year the City will identify sampling locations within raw water, drinking water and reclaimed system for CECs and ARBs. This work will help compliment the City's prior sampling and understanding of these unregulated compounds. The City and its staff from the water and wastewater lab are now coordinating with Jean McClain and Amy Pruden on the sampling of both the reclaimed and drinking water distribution systems for ARB/ARGs. The City is also coordinating with Parks staff to determine the best locations to sample and swab. Concurrently, the City plans to sample both systems for CCL3 and CECs.

Next Steps for Full Advisory Panel

The City Manager will convene the full CEC Advisory Panel sometime between late August and early September. The Panel will discuss the aforementioned funding proposals and the outcomes of the Antibiotic Resistance in Agroecoystems Conference, scheduled in early August at Biosphere. (Jean McLain and Amy Pruden are both participating in this conference.) At the meeting the Panel will also receive an update from Brad Hill on the Water Reuse 2014 Conference being held in June in Prescott. This conference will examine reuse strategies and will include state and national leaders in wastewater reuse to discuss opportunities for Arizona's municipalities, counties and water districts.