

WATER RESOURCES ADVISORY BOARD MEETING

MEETING DATE: Monday, 14 December 2015

MEETING TIME: 7:00 p.m.

MEETING LOCATION: Municipal Services Center, 5050 E. Pearl St., Boulder, CO 80301

Agenda Highlights:

1. Call to Order (7:00 p.m.)
2. Approval of Nov. 16, 2015 Meeting Minutes (7:01 p.m.)
3. *Public Comment (7:05 p.m.)
4. *Public Hearing and Consideration of a Motion Regarding WRAB response to City Council Retreat Questions (7:15 p.m.)
5. Information Item – Update on Stormwater Collection System Permit and Regulatory Changes (7:35 p.m.)
6. Information Item – Update on Wastewater Permit Renewal (8:10 p.m.)
7. Information Item – Update on Wastewater Treatment/Renewable Energy (8:45 p.m.)
8. Matters from Board (9:15 p.m.)
9. Matters from Staff (9:20 p.m.)
10. Discussion of Future Schedule (9:25 p.m.)
11. Adjournment (9:30 p.m.)

* Public Comment Item

Agenda item times are approximate.

Information:

- Please contact the WRAB Secretary email group at:
WRABSecretary@bouldercolorado.gov
- Packets are available on-line at: <http://www.bouldercolorado.gov> – [A to Z, Water Resources Advisory Board \(WRAB\), Next Water Resources Advisory Board Meeting](#)

**CITY OF BOULDER, COLORADO
BOARDS AND COMMISSIONS MEETING MINUTES**

Name of Board / Commission: Water Resources Advisory Board	
Date of Meeting: 16 November 2015	
Contact Information of Person Preparing Minutes: Rene Lopez 303-413-7149	
Board Members Present: Vicki Scharnhorst, Dan Johnson, Mark Squillace, Lesley Smith, Mike Barnes	
Board Members Absent: None	
Staff Present: Joe Taddeucci, Water Resources Manager Bret Linenfelser, Water Quality and Environmental Services Manager Russ Sands, Watershed Sustainability & Outreach Supervisor Katie Knapp, Engineering Project Manager Annie Noble, Acting Principal Engineer for Flood and Greenways Ward Bauscher, Engineering Project Manager Joanna Bloom, Source Water Administrator Rene Lopez, Board Secretary	
Consultants Present: Craig Jacobson of Icon Engineering, Inc.	
Meeting Type: Regular	
Agenda Item 1 – Call to Order	[7:02 p.m.]
Agenda Item 2 – Approval of the 21 September 2015 Meeting Minutes [7:02 p.m.]	
Motion to approve minutes from 21 September 2015 as presented. Moved by: Squillace Seconded by: Barnes Vote: 5:0	
Agenda Item 3 – Public Participation and Comment	[7:03 p.m.]
Public Comment:	
Michele Bishop; Co-Chair of Goss Grove Neighborhood Association - Came to let the board and staff know that both co-chairs of the neighborhood association are here to participate in any future developments in this area, they can address the neighborhood and bring feedback from residents.	
Jim Starry – Discussed creating flood and fire control using impoundments along the creek to create trout habitat and a beautiful scenery.	
Carl Norby– Bear Creek and Frasier Meadows area; reach 3 of the bear creek mitigation study, both creeks flow into storm drains causing sewage to back-up in homes during the flood. Since December – a cause was determined and mitigation plan was developed for the back-up. Requesting some of the Bear Creek area to be reassigned into the flood plain so that it can be maintained, and to keep the plans moving forward.	
Martha Jones – Bear Creek flood prevention– Requests improved storm and sewer drainage systems so water can flow by quickly rather than being obstructed. Suggestions for larger underground stormwater drains to accommodate increased water flows, new technology and new piping.	
Agenda Item 4 – Update on Bear Canyon Creek Mitigation Study	[7:24 p.m.]
Annie Noble and Ward Bauscher presented this item	
Annie provided an overview of the floodplain management program as context for this agenda item and Agenda Item 5. She also provided an update on the status, along with a handout, on the work group’s work efforts, which is attached for reference.	
Executive Summary from the Packet Materials:	
The purpose of this memorandum is to provide an update to the WRAB on the progress and current status of the Bear Canyon Creek Flood Mitigation Plan. An information item memo was submitted to the WRAB in April 2015 for this mitigation plan and is attached for reference as Attachment A. The projected timeline for the mitigation plan, as outlined in the previous memo, has been extended due to modeling challenges, including the comparison to and the incorporation of a two-dimensional model,	

and an increase in study area due to spill flow paths identified in the modeling. There is currently no adopted flood mitigation master plan for Bear Canyon Creek. Although improvements have been made along the creek over time, the 2013 flood showed that areas along the creek lack conveyance capacity during large storm events. As a result, the city retained AMEC Foster Wheeler (AMEC) in December 2014 to help identify mitigation needs and evaluate potential alternatives to alleviate future flooding along Bear Canyon Creek in the selected stream reaches. The study reaches are identified in Figure 1 below. AMEC's original scope of work included the analysis of three segments of the creek using the original one-dimensional HEC-RAS models. Development in the floodplain often triggers updates to the floodplain mapping through a letter of Map Revision (LOMR) processed through FEMA. AMEC modified the HEC-RAS model to incorporate revisions that occurred since the last mapping study into what is considered a "Best Information" model. The revisions made the model unstable and highlighted other modeling gaps. The older HEC-RAS technology is ineffective in modeling spill flows that leave the main channel. It was determined that the use of an updated two dimensional mapping technology (Flow-2D) might help staff and AMEC better understand the spill flow paths throughout the drainage way. The HEC-RAS and Flow 2D models would be compared and a determination of the degree and location of further model refinement would be examined.

As a result, the city expanded AMEC's scope of work to develop a more comprehensive model using Flow-2D to better define major flow paths and spill flows. As warranted, the Flow-2D model would be overlaid and converted to a 1-dimensional HEC-RAS model that is more appropriate for analysis of system hydraulics and corresponding flood mitigation measures.

To date, AMEC has established a survey of the baseline conditions along the drainage way, refined the working HEC-RAS model including incorporating Letter of Map Revisions (LOMRs) from several improvement projects, and identified potential mitigation alternatives. AMEC is currently modeling Bear Canyon Creek using Flow-2D and will compare it to the working model to determine where further model refinement is necessary. Once the model is sufficiently refined, alternatives will continue to be analyzed for incorporation in the Bear Canyon Creek Flood Mitigation Plan. The mitigation plan will be presented to WRAB for recommendation when complete.

WRAB Discussion Included:

- Questions regarding what is maintenance rather than capital improvements
- Questions regarding cooperation with CU campus
- Comments regarding channel work and mitigation as part of the modeling
- Comments requesting for alternatives in plan;
 - Maintenance being a primary goal
 - Suggestions for volunteers as an alternative
 - Maintenance budgets discussed

Agenda Item 5 – Public Hearing and Consideration of a Recommendation to City Council Regarding the Boulder Creek Restoration Master Plan [7:58 p.m.]

Katie Knapp and Craig Jacobson of Icon Engineering, Inc. presented this item.

Executive Summary from the Packet Materials:

The purpose of this memorandum is to present the Draft Boulder Creek Restoration Master Plan for the WRAB's consideration, input and recommendation to Council. The Executive Summary of the plan is included as Attachment A and the full plan is available at <http://www.iconeng.com/project/boulder-creek/>. The City of Boulder joined regional partners, including the Urban Drainage & Flood Control District (UDFCD), Boulder County, and the City of Longmont on the development of the Boulder Creek Restoration Master Plan. This study was also partially funded through the Colorado Water Conservation Board (CWCB) grant program. The purpose of the master plan is to develop guidance in planning ongoing and long-term watershed recovery efforts.

This project encompasses nearly 24-miles along Boulder Creek, extending from the confluence with Fourmile Creek, located within Boulder Canyon upstream of the City of Boulder, downstream to the confluence with the St. Vrain River, in the City of Longmont, as shown in the Project Overview Map (Attachment B). The master plan area crosses through the City of Boulder and also includes city-owned open space lands outside of the city limits.

The focus of this master plan is to provide a planning tool for stream and ecological restoration along Boulder Creek. As such, this master plan does not comprehensively evaluate Boulder Creek through the

City limits given that Boulder Creek through this reach resembles more of an urban stream corridor. Instead, the plan addresses specific areas of concern identified by the city staff and other interested parties who participated in the planning processes. Similarly, the plan does not reevaluate the current 100-year floodplain limits regulated by FEMA, although it is likely that the implementation of some proposed projects would improve flood conveyance and the regulatory floodplain limits. Icon Engineering was retained by the project team to develop and evaluate alternatives for Boulder Creek and prepare the draft master plan, which identifies and prioritizes feasible drainage, flood management, and restoration opportunities. Icon Engineering is requesting input on the draft master plan prior to finalization. City staff is recommending that the Civic Area Flood Information (Attachment C) be incorporated into the master plan.

The draft master plan is now being presented to the WRAB for consideration, input and a recommendation to City Council. After consideration and input from the WRAB and the Open Space Board of Trustees (OSBT), the master plan will be finalized and presented to City Council for acceptance.

Public Comment:

Donald Rogers – Questions regarding if Boulder Creek, in conjunction with Open Space, will remain as it is now going through Pit D – where it easily goes during a flood.

WRAB Discussion Included:

- Comments regarding specific species in the environmental assessment.
- Comments regarding partner stakeholders
- Questions regarding budgeting with Capital Improvement Projects.

Staff requests Water Resources Advisory Board consideration of this matter and action in the form of the following motion:

Motion to recommend Council acceptance of the Boulder Creek Restoration Master Plan with the inclusion of the Civic Area Flood Information.

Motion by: Johnson; **Seconded:** Smith

Vote: 5:0

Motion Passes

Agenda Item 6 – Information Item - Sustainability Programs **[8:42 p.m.]**
 Russ Sands presented this item.

Executive Summary from the Packet Materials:

The purpose of this Information Item is to provide the Water Resources Advisory Board (WRAB) a summary of various sustainability and outreach initiatives that are being developed and implemented by the Watershed Sustainability and Outreach (WSO) Program that was created in 2014 as part of the Public Works, Utilities, Water Quality and Environmental Services (WQES) Group. This item does not require WRAB action and is intended to provide WRAB with a background on the WSO Program and related initiatives the WSO Program has helped lead.

WRAB Discussion Included:

- Green infrastructure comments
- Comments regarding transportation maintenance chemical use on water quality impacts
- Requests for metrics on improvements in water quality

Agenda Item 7 – Matters from Board: **[9:12 p.m.]**

- Scharnhorst
 - Discussion of City Council 2016 Retreat Questions
 - Retreat scheduled for Dec. 8th 6-8pm
- Smith
 - Toured the watershed with Macon Cowles before the first snow
- Johnson
 - Update on the rate study requested

Agenda Item 8 - Matters from Staff: **[9:16 p.m.]**

- Taddeucci

<ul style="list-style-type: none"> ○ RFP for Utility Rate Study in December scheduled ● Bret Linenfelser <ul style="list-style-type: none"> ○ Update on Water Fluoridation <ul style="list-style-type: none"> ▪ Formal recommendation from the US Department of Health and Human Services to lower dosage of fluoride to the lower optimal range of .0.7 milligrams per litre in treated water. The city plans to follow the recommendation and reduce the level of fluorosilicic acid (fluoride additive) to meet a level of 0.7 milligrams per litre fluoride in the treated water distribution system. The reduction in fluoride complies with the city's ordinance to add fluoride.
<p>Agenda Item 9 – Future Schedule [9:23 p.m.]</p> <p>The next WRAB meeting has been moved up to December 14th rather than Dec. 21st to better accommodate schedules</p>
<p>Adjournment [9:23p.m.]</p> <p>There being no further business to come before the Board at this time, by motion regularly adopted, the meeting was adjourned at 9:46 p.m.</p> <p>Motion to adjourn by: Smith Seconded by: Squillace</p> <p>Motion Passes 5:0</p>
<p>Date, Time, and Location of Next Meeting:</p> <p>The next WRAB meeting will be Monday, 14 December 2015 at 7:00 p.m., at the City's Municipal Services Center, 5050 East Pearl St., Boulder, CO 80301</p>

APPROVED BY:

Board Chair

Date

ATTESTED BY:

Board Secretary

Date

An audio recording of the full meeting for which these minutes are a summary, is available on the Water Resources Advisory Board web page.

<https://bouldercolorado.gov/boards-commissions/water-resources-advisory-board-next-meeting-agenda-and-packet>

Agenda Item 4 Public Hearing and Consideration of a Motion Regarding WRAB response to City Council Retreat Questions will be included as a sperate packet material added after the December 8th Retreat.

**CITY OF BOULDER
WATER RESOURCES ADVISORY BOARD
INFORMATION ITEM**

MEETING DATE: December 14, 2015

AGENDA TITLE: Update on Stormwater Collection System Permit and Regulation Changes

PRESENTER/S Jeff Arthur, Director of Public Works for Utilities Bret Linenfelser, Water Quality Environmental Services Manager Russ Sands, Watershed Sustainability and Outreach Supervisor Candice Owen, Stormwater Quality Engineer
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EXECUTIVE SUMMARY

The purpose of this Information Item is to provide the Water Resources Advisory Board (WRAB) an update on current City of Boulder (city) Stormwater Quality Program initiatives and upcoming regulatory changes including updates to the city’s state-issued Municipal Separate Storm Sewer System (MS4) Permit. This item does not require WRAB action and is intended to provide WRAB with background on the current program and additional upcoming work.

BACKGROUND:

The city’s Stormwater and Flood Management Utility was established in 1973 just one year after the federal government enacted the Clean Water Act (CWA). The CWA set a framework for regulating the protection of water quality and the 1987 CWA amendments specifically regulated runoff from rain and snowmelt (stormwater) discharges. Though it would take several years, these CWA amendments created a pathway for state permitting of municipal stormwater discharges. As part of the city’s 1989 Comprehensive Drainage Utility Master Plan, the city took proactive measures to address stormwater quality concerns by creating the city’s Stormwater Quality Program.

In 1990, the CWA act began requiring large municipalities, or *Phase I* municipalities, with populations of greater than 100,000 to receive permit coverage for their stormwater discharges. Under the CWA’s National Pollutant Discharge Elimination System (NPDES), MS4 permits are issued and enforced at the state level; in Colorado this is done by the Colorado Department of Public Health and Environment’s Water Quality Control Division (Division).

Eventually smaller, *Phase II* municipalities like Boulder were required to acquire MS4 permits beginning in 2003. One year earlier, the city and other Boulder County MS4 permittees organized the Watershed Approach to Stream Health (WASH). The WASH program helped regional Phase II permittees meet MS4 requirements for, among other things, education and outreach. In 2006, the WASH program evolved into the Keep It Clean Partnership (KICP) that continues to be a collaborative partnership between the municipalities in Boulder County.

The City of Boulder is not only a KICP partner but is also contracted by KICP to manage and perform regional stormwater education and outreach activities. While valuable, this contracted work has required significant funding and staff time. Additionally, upcoming MS4 permit changes significantly shift the

focus from outreach to in-field oversight and enforcement. Staff has worked with KICP partners to reduce funding and staff time while maintaining the most valuable community programs. This will allow staff to focus resources on improved compliance efforts.

The Division has revised and reissued the city's MS4 permit twice since 2003 with the most recent permit taking effect in 2016. The 2016 permit is roughly three times longer than the current permit and contains many new compliance requirements that will rollout over the next few years. The Stormwater Quality Program is proactively working to prepare for and address new MS4 permit requirements that not only call for more prescriptive MS4 reporting but also require reporting for overlapping water quality regulations related to bacteria and nutrient loading.

ANALYSIS:

State regulation of stormwater and water quality has consistently become more stringent and the longer and more prescriptive 2016 MS4 permit is no exception. Specific MS4 requirements and related water quality efforts that will require additional staff focus are detailed below.

MS4 Permit Requirements and Actions:

In addition to the current MS4 permit annual reporting requirements, the 2016 MS4 permit places significant focus on recordkeeping and the development of a Public Description Document (PDD). The PDD must detail program action areas in keeping with the six critical focus areas or Minimum Control Measures (MCMs) of the MS4 permit. The details of each MCM follow:

- *MCM 1 & 2 – Public Involvement/Participation and Public Education and Outreach*
Requires both community engagement efforts like organizing stream-team clean-ups and sending utility bill inserts. New requirements are prescriptive, but are not the focus of the permit (just 1 of 60 pages).
- *MCM 3 – Illicit Discharge Detection and Elimination (IDDE)*
Requires the city to prevent pollutants from entering the storm sewer and local waterways. New written procedures for record keeping, tracking and business outreach are mandated.
- *MCM 4 – Construction Site Management*
Requires specific erosion and sediment control measures on construction sites. New permit procedures have increased drastically including new recordkeeping and inspection requirements.
- *MCM 5 – Post-Construction Stormwater Management in New Development and Redevelopment*
Requires developing properties to mitigate the effects of impervious area on stormwater through structures such as detention/infiltration ponds that reduce pollutant loading. New requirements have doubled for design standards, maintenance, written procedures and recordkeeping.
- *MCM 6 – Pollution Prevention/Good Housekeeping for Municipal Operations*
Requires pollution reduction measures at city facilities that range from additional inspection and recordkeeping requirements to establishing secondary containment for the city's Magnesium Chloride tanks which store deicing chemicals for transportation winter weather operations. The latter will ultimately require new tanks and containment.

While more stringent requirements of the MS4 permit will rollout over the next 4 years, staff has already taken several measures to increase both near-term and long-term compliance. Specific actions include:

- Participating in Division MS4 permit stakeholder meetings.
- Incorporating the MS4 permit and water quality in the Stormwater Master Plan update.
- Restructuring to hire a new Stormwater Quality Engineer without requesting new budget.
- Reducing KICP funding in support of new compliance requirements.
- Hiring support staff to focus on illicit discharges, improving spill response time and reporting.
- Increasing enforcement response time for city-issued stormwater violations and follow-up.
- Improving city construction oversight and coordination with city inspectors on private sites.
- Identifying post construction maintenance needs and locating sites in GIS.
- Developing Stormwater Management Plans for city facilities.
- Partnering with Municipal Services Center (MSC) and engineering staff to address issues at city facilities.
- Surveying stormwater outfalls to Boulder Creek.
- Creating a draft PDD that will launch in early 2016.
- Coordinating with staff to provide training opportunities.

TMDL and Impaired Waters Listing

The permit will also require the city to report on current work towards compliance with the city's *E. coli* Total Maximum Daily Load (TMDL). The TMDL for *E.coli* in section 2b of Boulder Creek extends from 13th Street to the confluence with South Boulder Creek. The primary objective of a TMDL is to define what level of pollutants can be discharged by permittees to meet instream water quality standards. The city's 2011 TMDL Implementation Plan (Implementation Plan) identifies potential steps the city can take to reduce *E.coli* loading to attain instream standards. Any efforts made will now need to be reported in the MS4 annual report.

While the Implementation Plan offers several suggested efforts that range from outreach to installing UV in pipes prior to discharging to Boulder Creek, staff suspects wildlife (e.g. raccoons) may be a significant contributor. In a pilot study where grates were installed on the storm sewer line (inlets and outfall); subsequent sampling determined that *E.coli* values had dropped substantially at the outfall. Staff is continuing to explore a range of potential actions that includes partnering with capital improvement project efforts. Partnering opportunities might involve adding additional storm drain inlet/outfall protection and using new pipelining related TV work to definitively eliminate cross-connection concerns. Staff are additionally sampling for optical brighteners that are commonly found in detergents to potentially identify illicit discharges to the storm sewer.

City staff has been actively engaged in dialogue with the state on new, 2016, impaired waters listings which will be finalized at the end of 2015. A draft list was issued in mid- 2015 and the final hearing for these listings will take place in December of 2015. The city commented on a few issues identified in the draft listing, and will continue to work with the Division to ensure accurate water body impairments are captured in the final list.

Nutrients, Regulation 85 and Periphyton

The new MS4 permit speaks to reducing nutrient loading from various sources. This is in line with the Division's Nutrients Management Control Regulation (Regulation 85), which places into effect control regulations on the concentration of nutrients, nitrogen and phosphorus, that can be discharged to state waters from point and nonpoint sources. While regulation 85 focuses heavily on wastewater treatment facilities it also has stormwater requirements.

Regulation 85 requires cities to provide the state with instream and stormwater nutrient sampling data and a data gap analysis report which the city submitted in 2014. Nutrient education and outreach is also

required. In partnership with KICP, the city created a “Green is the New PiNK” campaign (symbolizing P-N-K or Phosphorus, Nitrogen and Potassium). This campaign targets residential sources of nutrient loading (e.g. lawns) which is the largest source of urban nutrient loading (next to agriculture) according to analysis provided to the Division by the Colorado Stormwater Council.

Nitrogen and phosphorus loading is of key concern because these nutrients, in excessive amounts, accelerate eutrophication of waterways resulting in algal blooms, reduced water transparency and possible fish kills. While monthly instream sampling for nutrients has been conducted since the 1980s, new proactive quarterly Periphyton sampling to determine background chlorophyll *a* (as measured by attached algae) was initiated in 2014. Sampling data collected for nitrogen, phosphorus and chlorophyll *a* will be used to determine the status of compliance for each compared to potential water quality criteria for Boulder Creek.

NEXT STEPS

Continued planning is positioning the city to comply with the initial phases of the new MS4 permit and related TMDL and Regulation 85 stormwater requirements. Staff will continue to work with maintenance staff, construction project managers and engineering to address the more stringent compliance components that could require additional investments (e.g. new storage tanks with secondary containment at the MSC). As some of these components may require revisions to Boulder Revised Code, staff anticipates future coordination with WRAB. As staff continues to work on program development and enhancements, the following will be focus areas:

Staff Training and PDD Development

The PDD is the first compliance deadline of the new MS4 permit and staff is developing this document in a way that meets the intent of the permit but also allows it to be a training and outreach tool for staff and members of the public. Information in the PDD will be used to support planned 2016 stormwater training efforts for staff throughout the city.

Stormwater Compliance Specialist Position

Through the re-evaluation and restructuring of the city’s KICP commitment, newly available funds and FTE will be allocated to create a Stormwater Compliance Specialist position. This position will help advance MS4 permit compliance efforts around IDDE issues, construction oversight and enforcement.

Stormwater Master Plan Update

The release of the 2016 Stormwater Master Plan update will integrate city infrastructure needs with stormwater regulatory requirements and stormwater quality efforts. The update will be specifically be used to address various aspects of MS4 permit compliance by identifying program challenges, opportunities and recommendations.

Green Infrastructure Study

Green infrastructure (GI) features infiltrate, treat or otherwise mitigate stormwater by mimicking nature. Many GI features are used in development to mitigate the effects of added impervious surfaces and are required as part of the city’s post-construction oversight program. Unfortunately, there can be a perception with contractors that GI is always space intensive and too costly, but this is not necessarily the case. Additionally, GI has many co-benefits such as reducing heat island effect, adding habitat, etc. Staff has contracted with a consultant to evaluate the best GI applications for Colorado’s climate and city land uses and to help quantify the cross-benefits of GI to other city programs. This study will further be used to educate the Utility Rate Study by exploring options to incentivize customers to reduce runoff from their properties through reductions on their utility bill.

TMDL Implementation Planning

New MS4 related TMDL reporting requirements will require staff to evaluate whether the Implementation Plan needs to be updated. This review includes creating a matrix or “checklist” of outfall evaluation efforts which combines data such as new outfall screening results and cross-connection elimination efforts. This process will help staff target areas where new projects will likely be effective such as coupling optical brightener sampling (an indicator of human sources like detergents) with *E.coli* sampling or determining which high-flow outfalls would be good candidates for installing flow meters to help better characterize flow and therefore bacteria loading.

**CITY OF BOULDER
WATER RESOURCES ADVISORY BOARD
INFORMATION ITEM**

MEETING DATE: December 14, 2015

<p>AGENDA TITLE: Update on Wastewater Treatment Facility Permit Renewal and Regulatory Activities</p>
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<p>PRESENTER/S:</p>

<p>Jeff Arthur, Director of Public Works for Utilities Chris Douville, Wastewater Treatment Manager Bret Linenfelser, Water Quality and Environmental Services Manager</p>
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EXECUTIVE SUMMARY:

The purpose of this memorandum is to update WRAB on the status of key permit compliance items associated with the treated effluent from the 75th Street Wastewater Treatment Facility (WWTF). The Colorado Discharge Permit System (CDPS) permit renewal is the first high priority item, and important regulatory issues are also covered herein.

The outcome of the WWTF permit renewal has significant and direct impacts on how the WWTF is operated, maintained, and sets necessary funding schedules associated with the Capital Improvements Projects (CIP) program, which in turn affects the Wastewater Utility Fund and rates of wastewater services within the community.

City staff remain proactive with respect to upcoming regulatory concerns that could impact the city's wastewater treatment program. Some of the regulatory issues are aspects of the current permit and have evolved over time (i.e. copper, arsenic, temperature). Examples of new issues that are expected to be implemented in the WWTF permit renewal are nitrate and nutrients. Current status of each regulatory item is summarized along with known options to achieve and maintain regulatory compliance.

BACKGROUND:

The city's 75th WWTF CDPS permit was last renewed in 2011(May 1 effective date) and expires April 30, 2016. Permit limits of most concern in the current CDPS permit are the future low daily maximum ammonia limits, daily maximum nitrate limits, and a low monthly average arsenic limit. A monitoring only requirement for temperature was also included in the permit

and could lead to a temperature effluent limit in the future. A copper Temporary Modification is effective until December 31, 2015 to address potential non-compliance with copper effluent limits and allowed time to develop a site-specific approach for compliance. The current CDPS permit also includes a compliance schedule for ammonia, nitrate, arsenic, temperature, and copper, and multiple annual progress reports are also required.

Since the current CDPS permit effective date, additional regulatory requirements have been adopted by the Colorado Water Quality Control Commission (Commission). New regulations with significant future WWTF impacts include Regulation 85 – *Nutrients Management Control Regulation*, technology-based total inorganic nitrogen (TIN) and total phosphorus (TP) effluent limits. Regulation 31 – *Basic Standards for Surface Water*, Interim Nutrient Values were also adopted and when effective will require very low total nitrogen (TN) and TP effluent limits.

City staff continued to work with the Colorado Water Quality Control Division (Division) regulatory and technical work groups to address the basis for new and future regulatory requirements. Staff have also been active in Commission Rulemaking Hearings requesting additional time to collect needed data and to develop site-specific approaches to protecting Boulder Creek beneficial uses and developing protective water quality standards.

WRAB last received an update on CDPS permit renewal efforts and regulatory issues related to the 75th Street WWTF permit in October 2012 (*reference Agenda Item VI from the October 15, 2012 WRAB Meeting*). Many of the same issues remain, and this memorandum will update WRAB with the most recent information.

ANALYSIS:

75th Street Wastewater Treatment Facility CDPS Permit Renewal

The city's 75th WWTF CDPS permit (No. CO-0024147) was last renewed in 2011. Consistent with the 5-year renewal timeline, the current permit is set to expire April 30, 2016. As renewal applications are due 6-months prior to expiration, city staff collaborated with a consultant to complete the significant renewal packet. The renewal application submittal was delivered to the Division on October 28, 2015.

Schedule. The current permit was administratively extended three and a half years beyond the original expiration date, largely due to Division workload. Recent discussions with the Division about renewal timing suggest that 75th Street WWTF CDPS permit will likely receive a brief administrative extension (less than 6 months duration) and renewal is anticipated near the end of 2016.

Highlights and Requests. As part of the 75th Street WWTF CDPS permit renewal application, the city highlighted certain items for the Division to focus on during evaluation of the CDPS permit renewal:

- Request for two WWTF flow-based tiered effluent limits

- Request for monthly ammonia and nitrate limits
- Request for tiered ammonia and nitrate limits
- Ammonia water quality modeling using the AMMTOX model
- Biochemical Oxygen Demand (BOD) concentrations as analyzed by total organic carbon (TOC)
- Effluent flow reported with facility-specific calculation

Brief details on each of these evaluations and requests are provided below, and will be discussed further as desired at the WRAB meeting.

Two Flow Tiers. The current permit includes limits established within two WWTF flow tiers (less than 20 MGD and between 20 and 25 MGD). Establishing a lower flow tier provides some relief for mass balance based effluent limits, as loading theoretically remains the same with lower flow and higher concentrations. To better align with historical and expected WWTF flows, a low flow tier of 18 MGD and less has been requested (high flow tier would be between 18 and 25 MGD).

Ammonia and Nitrate Limits. Due to the importance of compliance with ammonia and nitrate limitations, and the costs associated, the city requested both monthly limitations as well as tiered limits. Monthly limitations involve concentrations that are adjusted monthly to better represent seasonal changes and receiving water quality conditions, and result in some months with less stringent limitations and others where limits are low. Tiered limitations provide some appropriate additional compliance cushion, as most months will result in an effluent flow of less than 18 MGD.

Ammonia Modeling with AMMTOX. The current permit contains daily maximum ammonia limits derived using the former Colorado Ammonia Model that are presently being met comfortably, however, ultra-low ammonia limits are set to go into effect on December 1, 2017 that were established using the newer AMMTOX model. The city has previously partnered with other wastewater dischargers in the Boulder, St. Vrain, and Coal Creek basins to collaborate and share costs of having Dr. Bill Lewis (CU-Boulder) perform the ammonia modeling effort and develop scientifically-valid ammonia limits. Earlier this year, the so-called tri basin group modeling effort was conducted once again, using the most recent WWTF effluent and receiving water data. Final results from the modeling show some relief in concentrations of ammonia for 8 of 12 months (4 months are slightly more stringent). The modeling report and developed limits are part of the permit renewal submittal to the Division.

Total Organic Carbon for BOD. City staff performed excellent background research into the feasibility of embracing TOC analysis as a substitute to the traditional BOD test. TOC is regularly used in drinking water analysis and other water quality work, traditionally with water matrices that are cleaner than wastewater. Advances in the analytical capabilities have allowed accurate and efficient analysis of TOC in wastewater samples, and reliable correlations of TOC vs. BOD have been developed. Some utilities in California, and others in Canada, have successfully implemented TOC as a substitute for BOD by working with their regulatory agencies. If successful, Boulder would be the first in Colorado to do so.

Effluent Flow Reporting. Historically, the 75th Street WWTF has not had an effluent flow meter so effluent flow is assumed to be equivalent to influent flow. In 2013, new flow meters at the UV system and associated non-potable water pump station now allow for an accurate reporting of effluent flow, via calculation.

Other Items. It is expected that a new parameter, nonylphenol, will be added to the permit as a monitoring (report-only) provision. Nonylphenols are generally man-made chemicals that are commonly used in manufacturing processes for various products (antioxidants, lube oils, detergents) and are concerning due to their ability to behave as endocrine disrupting compounds (EDCs). Nonylphenols can be difficult to biodegrade, however, proactive research has shown that percent removals from the 75th St. WWTF are quite high. Thus, compliance with a future numeric limit for nonylphenol is not anticipated to be a problem.

Regulatory Update

City staff are actively involved in evaluating existing and future regulatory requirements through Division regulatory and technical work groups and Commission Rulemaking Hearings. Provided below is a summary of regulatory changes that could impact wastewater treatment requirements and activities performed by city staff.

Nitrate. The Division is proposing to modify the point of compliance (in Boulder Creek) for the nitrate drinking water standard of 10 milligrams per liter (mg/L). Currently, the nitrate standard is applied at the point of raw water diversion to a water treatment facility. For Boulder Creek the closest point of diversion is the Lower Boulder Ditch diversion at 95th Street (emergency diversion for the City of Lafayette), approximately 2.8 miles downstream of the 75th Street WWTF.

The Division is proposing to move the nitrate point of compliance to the end of the regulatory mixing zone, which is approximately 0.1 miles downstream of the 75th Street WWTF, as part of the Basic Standards Rulemaking Hearing process in June 2016. This change will limit the ability to account for nitrate loss in Boulder Creek and will reduce the nitrate WWTF effluent limit to approximately 10 mg/L from the currently proposed 14.7 mg/L limit. Staff are working on a proposal to the Commission for a delayed effective date of 2021 (instead of September 2016) for the change in nitrate point of compliance. The delay will allow the city and other dischargers to develop an approach to support keeping the current nitrate point of compliance or some other alternative.

Arsenic. In 2007 the Commission adopted a restrictive arsenic water quality standard of 0.02 micrograms per liter (ug/L), which is applied state-wide. To comply with the 0.02 ug/L standard a monthly average arsenic effluent limit of 0.023 ug/L would need to be met at 75th Street WWTF, which is currently not achievable. Staff worked with the Division and Commission to adopt a Temporary Modification for arsenic which allows the WWTF to discharge arsenic at existing levels until the end of 2021.

In 2011 the city conducted a comprehensive evaluation of arsenic sources and determined that arsenic, in concentrations exceeding the 0.02 ug/L standard, is naturally occurring and present in the city's raw water sources. Arsenic has also been identified state-wide as a naturally occurring parameter above the 0.02 ug/L standard. In 2012 staff initiated the development of a state-wide arsenic work group which includes the Division and the U.S. Environmental Protection Agency (EPA). One goal of the work group is to re-evaluate the basis for the federal arsenic water quality standard, which was developed through the use of EPA's Integrated Risk Information System (IRIS) database.

In 2015 it was determined that the federal arsenic water quality standard should be re-calculated by modifying the human dietary assumptions used in the IRIS database. The current arsenic standard is based on dated dietary characteristics of people of the Asian Continent (low folic acid diet), and is not applicable to dietary characteristics of people in North America (higher folic acid diet). Higher folic acid intake, which is common world-wide outside of the Asian Continent, has shown to reduce the arsenic cancer risk. After adjusting for increased folic acid intake it is anticipated that the revised arsenic water quality standard will be one or two orders of magnitude higher and the resulting WWTF effluent will be attainable.

Copper. Since 2007, city staff have worked on developing and implementing a copper translator to increase the allowable discharge of copper from the 75th Street WWTF while still protecting aquatic life in Boulder Creek. In 2015 a copper translator was developed following EPA Guidance and accounts for the transformation of copper (from dissolved to total) below the WWTF, where the translator is expressed as a simple dissolved to total copper relationship. The translator study determined that a protective level of total copper could be 1.54 times the dissolved copper water quality standard applied to Boulder Creek.

On November 23, 2015, the Division issued a permit modification to the 75th Street WWTF CDPS discharge permit allowing the discharge of copper to be increased to 25.6 ug/L (as a 30-day average), compared to the proposed limit of 18 ug/L. The proposed daily maximum copper limit of 27 ug/L was removed and changed to a monitoring only requirement.

Temperature - 2015 South Platte Basin Rulemaking Hearing Proposal. Since issuing the May 2011 CDPS permit for the 75th Street WWTF, city staff have been actively involved in a stakeholder process with the Division to develop an alternative way to comply with proposed WWTF temperature effluent limits. The main area of concern is during the transition from the higher summer temperature water quality standard, which applies March through the end of November, to the much lower winter standard, which applies December through the end of February. The current application of the standards does not accurately reflect the natural transition between seasons and slow change in water temperature. The transition from the summer to winter standard creates a 50 percent reduction in the temperature standard, and WWTF effluent limit, from November 30 to December 1, each year.

In preparation for the June 2015 South Platte Basin Rulemaking Hearing, and development of a proposal, staff worked to develop a narrative standard for the summer to winter, and winter to summer, temperature transition season. The narrative standard would replace the numeric standard during the transition and rely on the narrative statement "Temperature will maintain a

normal pattern of seasonal fluctuations”. To help support the need for a narrative standard, or some other alternative, the city coordinated with Colorado Parks and Wildlife to collect fish data from Boulder Creek and completed a temperature treatment alternatives analysis with a consultant.

Boulder Creek Fish Collections. In August 2014, staff worked with Colorado Parks and Wildlife staff to collect and survey fish in Boulder Creek upstream and downstream of the 75th Street WWTF. Survey data were used to statistically evaluate similarities in fish populations and diversity upstream and downstream of the WWTF and determine potential impacts from WWTF effluent temperature. Results indicated that fish populations and diversity were statistically similar and that the WWTF effluent did not seem to have a negative impact. Fish data were also used to determine spawning periods for resident fish and evaluate the potential impacts of higher temperature in the beginning of the winter season. For all fish collected below the WWTF the spawning period is outside of the defined winter temperature standard season of December through February.

Wastewater Temperature Treatment and Recovery Alternatives. In 2014 staff worked with a consultant to evaluate options to remove or recover heat from wastewater in the collection system, prior to reaching the WWTF, and final effluent discharged from the WWTF. A total of 22 alternatives, grouped into three categories, were evaluated and advantages and disadvantages of each alternative were considered. The three categories and a summary of alternatives evaluated follows.

- 1) Upstream Cooling Methods - cooling and heat recovery in the wastewater collection system.
- 2) Wastewater Facility Cooling Methods – cooling and heat recovery in WWTF processes and effluent.
- 3) Direct Cooling Methods – cooling post WWTF effluent discharge.

Of the 22 alternatives, six were selected for a conceptual engineering evaluation including estimated costs, as shown in the table below.

Wastewater Temperature Treatment Alternatives Description and Estimated Cost

Alternative Category	Alternative Description	Estimated Cost¹
Upstream Cooling	Collection system interceptor routed through pond adjacent to WWTF to enhance heat transfer	\$18,500,00
Direct Cooling	Wetlands development – discharge WWTF effluent to wetlands for passive cooling	\$4,400,000
Wastewater Facility Cooling	Install 14 heat exchange units within WWTF process areas to recover and use heat for building heating	\$7,251,000
Direct Cooling	Spray ponds to disperse WWTF effluent into air to enhance heat transfer	\$3,584,000
Wastewater Facility Cooling	Cool effluent by routing effluent through evaporative cooling tower	\$5,600,000

Wastewater Facility Cooling	Convert existing abandoned trickling filter into a cooling tower to enhance evaporative cooling	\$5,200,000
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¹ Planning level capital cost with 20 percent contingency. Does not include annual operation and maintenance cost.

Rulemaking Hearing Decision. The Commission ultimately denied the city’s request for a narrative temperature standard for Boulder Creek at the June 2015 hearing and recommended the Division and stakeholders take additional time to further evaluate temperature standard transition season options. The Commission approved adopting a temperature standard Temporary Modification on Boulder Creek which will allow the 75th Street WWTF effluent to remain at the current temperature level December 31, 2020.

Staff continue to work on additional alternatives to address temperature compliance and will be presenting a proposal at the June 2016 Basic Standards Rulemaking Hearing.

Boulder Creek Nutrient Modeling

In 2012 the Commission adopted nutrient controls under Regulation 85 – *Nutrients Management Control Regulation*, and the more restrictive instream Interim Nutrient Values under Regulation 31 – *Basic Standards for Surface Water*. In 2013 the city, in conjunction with the Colorado Monitoring Framework, received a grant from the Water Environment Research Foundation (WERF) to develop a water quality model and complete multiple nutrient management scenarios to estimate the effect on Boulder Creek from reducing 75th Street WWTF nutrient discharges.

Nutrient modeling included eight WWTF nutrient reduction scenarios and the evaluation of ecological response variables in Boulder Creek, including dissolved oxygen, pH, bottom algae chlorophyll-*a*, and benthic macroinvertebrates, all of which are known to be adversely affected by excessive nutrients. The eight nutrient modeling scenarios are shown below.

- 1) Existing WWTF Permitted Conditions – No additional nutrient removal.
- 2) Meet Regulation 85 Technology-based WWTF TIN and TP limits.
- 3) Attainment of dissolved oxygen (DO) and pH criteria at all locations in Boulder Creek below the WWTF.
- 4) Attain Regulation 31 Interim Nutrient Values for TN and TP in Boulder Creek.
- 5) Attainment of Regulation 31 Interim Nutrient Value for Chlorophyll-*a* in Boulder Creek.
- 6) Eliminate WWTP Nutrient Loads - Set WWTP Nutrient Concentrations to Zero.
- 7) Meet Mid-Range WWTF Nutrient Limits - Set WWTF Limits to 8 mg/L TN and 0.5 mg/L TP.
- 8) Set WWTF Limits to Limit of Technology Levels - 3 mg/L TN and 0.1 mg/L TP.

Based on the eight nutrient modeling scenarios the following major technical findings were identified.

- Under maximum permitted nutrient and BOD loadings, Boulder Creek was not

predicted to experience violations of DO criteria (< 5 mg/L).

- pH increases (above the water quality standard) in Boulder Creek downstream of the WWTF are due to both natural sources and bottom algae growth, and the pH standard cannot be consistently attained under any scenario.
- Regulation 31 Interim Nutrient Value for chlorophyll-*a* (150 mg/m²) is not consistently attainable at all locations in Boulder Creek.
- Attainment of all three Regulation 31 Interim Nutrient Values (chlorophyll-*a*, TN and TP) is not necessary to meet aquatic life uses at all locations in Boulder Creek.
- Attainment of pH criteria and Multi Metric Index (macroinvertebrates) thresholds at all locations in Boulder Creek would require extreme (and probably unattainable) nutrient reductions.
- Environmental benefits could be maximized with more phosphorus removal and less nitrogen removal than meeting Regulation 31 Interim Nutrient Values for TP and TN.

NEXT STEPS:

- Staff will continue to coordinate with the Division on the 75th Street CDPS permit renewal and provide comments on the draft permit once it is issued for Public Comment.
- Staff will also continue to prepare for the June 2016 Basic Standards Rulemaking Hearing, which will primarily focus on developing a site-specific approach to complying with Boulder Creek temperature standards.
- Staff will also provide WRAB updates in 2016 on the final CDPS permit requirements, if the permit is issued in 2016, and final decisions from the June 2016 Basic Standards Rulemaking Hearing that may affect future WWTF capital projects.
- In addition, WRAB will be provided updates on WWTF capital projects currently underway or included in the future CIP schedule. These projects include:
 1. Nitrogen Upgrades Project (achieving compliance with future ammonia, nitrate, and total inorganic nitrogen limits): Under construction, planned completion of January 2017.
 2. Phosphorus Removal Project (achieving compliance with total phosphorus per Regulation 85): In 6-year CIP schedule for design in 2019 and construction starting in 2020 (\$18,500,000 currently budgeted).

3. Regulation 31 Nutrient Removal Project (achieving compliance with future, very low total nitrogen, phosphorus, and chlorophyll-*a*): In the 20-year CIP schedule tentatively at year 2030 (\$11,000,000 currently budgeted).

**CITY OF BOULDER
WATER RESOURCES ADVISORY BOARD
INFORMATION ITEM**

MEETING DATE: December 14, 2015

<p>AGENDA TITLE: Information Item: Update on Wastewater Treatment Facility Renewable Energy</p>
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<p>PRESENTER/S:</p>

<p>Jeff Arthur, Director of Public Works for Utilities Chris Douville, Wastewater Treatment Manager Douglas Sullivan, Acting Principal Engineer - Utilities</p>

EXECUTIVE SUMMARY:

The purpose of this memorandum is to provide an update to WRAB on renewable energy systems at the 75th Street Wastewater Treatment Facility (WWTF). Current status and future opportunities are covered. The annual operating costs for the WWTF are significantly affected by electricity demands and use. Annually, over \$500,000 of grid electricity is purchased from Xcel (representing over 10% of the total annual O&M budget).

Next year, the Cogeneration (Cogen) System will be 30 years old. Overall the system has performed well and has provided alternative electric power generation as well as beneficial heat recovery since its inception. As all systems have a limited life cycle, the Cogen system is nearing the end of its useful life. The electrical and control systems for Cogen are of particular concern, and at some point will cause Cogen to become unreliable and unsafe. A key upcoming decision will be whether to re-invest in Cogen and continue to produce electricity, or whether to pursue a different pathway which utilizes the biogas as a fuel commodity.

The Solar Photovoltaic (PV) System reached the 5-year operational milestone in July 2015. Because of the third party ownership by SunEdison and associated O&M responsibility, the city has benefitted from purchasing affordable, clean, alternative source power with minimal burden or complications. In 2014, Utilities staff investigated the possibility of installing an additional Solar PV array adjacent to the SunEdison system, but ultimately declined due to several factors including cost and Utilities workplan priorities.

BACKGROUND:

The Cogen system was placed into operation in 1986 to generate electricity from digester biogas (60% methane) and to perform waste heat recovery for the digester process and the four oldest buildings on the WWTF campus. Cogen also served as the primary means of emergency power during a power outage, and still functions as a component of the emergency power system today. The Cogen system was funded by a significant grant from the U.S. EPA which covered 80% of the system cost. Cogen was one part of a larger \$4,000,000 capital project (1985 dollars) that also included the flood protection levee and the septage receiving station. Initially, the Cogen system generated electricity that pushed on to the Xcel grid and the city earned revenue for the power generated through a Power Purchase Agreement (PPA). The PPA revenue exceeded the cost to purchase grid electricity, so this was a net revenue gain situation. Sometime in the mid-2000s, the cost of grid electricity exceeded the PPA revenue price, and in 2008, the system was reconfigured such that Cogen electricity fed directly to the WWTF to offset grid usage. The city owns, operates, and maintains the Cogen system.

In July 2010, the Solar PV System at the 75th St. WWTF went online. From the start, the system produced reliable, clean electricity and offset grid energy usage by approximately 15% during the first operational year. Fundamentally different from Cogen, the Solar PV system is owned, operated, and maintained by SunEdison. The city owns the land where the array is located, and has a 20-year land use agreement (ground lease) that dedicates the site for Solar PV. Since the electricity produced by the system is used directly by the WWTF (not pushed on to the Xcel grid), the city has a PPA with SunEdison and purchases all of the produced power. **Table 1** below includes a summary of the PPA cost terms over the 20-year agreement.

Table 1. 75th St. WWTF Solar PV System PPA Rates

Calendar Year	Operational Year	Rate (\$ / kWh)	Calendar Year	Operational Year	Rate (\$ / kWh)
2010	1	\$0.0320	2020	11	\$0.0420
2011	2	\$0.0329	2021	12	\$0.0420
2012	3	\$0.0338	2022	13	\$0.0420
2013	4	\$0.0347	2023	14	\$0.0420
2014	5	\$0.0357	2024	15	\$0.0420
2015	6	\$0.0366	2025	16	\$0.0420
2016	7	\$0.0377	2026	17	\$0.0420
2017	8	\$0.0387	2027	18	\$0.0420
2018	9	\$0.0398	2028	19	\$0.0420
2019	10	\$0.0408	2029	20	\$0.0420

Regarding source energy profiles, the combined Cogen and Solar PV systems constitute renewable energy sources that can supply up to 35% of the annual electric power needs for the WWTF. The power generation capability of the Cogen system is limited by how much biogas is available from the digesters. If more biogas was available, more electricity could be produced. The Solar PV system is producing all it can, based on weather conditions and known system degradation. **Table 2** summarizes the Solar PV system performance for the first five operational years, in comparison to projected performance.

Table 2. 75th St. WWTF Solar PV System Production

Calendar Year (ending)	Operational Year	Production (kWh)	Percent of 2009 Projection
2011	1	1,500,111	95
2012	2	1,576,071	100
2013	3	1,474,304	94
2014	4	1,451,745	92
2015	5	1,374,693	87

The WRAB memo items listed below can be referenced for additional background information on WWTF energy topics, as desired:

- December 2011 Meeting, Information Only Item – Energy Efficiency Work on City Facilities, and Wastewater Treatment Facility Energy Highlights
- January 2008 Meeting, Information Only Items –
 - Update on WWTP Electrical Usage and Energy Savings Measures
 - Photovoltaic Project at the WWTP

ANALYSIS:

The wastewater industry has seen impressive, recent results where some facilities are approaching and achieving net-zero energy usage (reference WERF Reports ENER 1C12b – *Demonstrated Energy Neutrality Leadership: A Study of Five Champions of Change* (2015) and ENER1C12 – *A Guide to Net-Zero Energy Solutions in Water Resource Recovery Facilities* (2015)). In Boulder, the commitment to diversifying source energy and moving away from grid electricity dependence began long ago and results are noteworthy. Cogen and Solar PV current provide approximately one-third (average of 33% since Solar PV came online) of the electricity needed at the WWTF, annually. This source electricity profile is encouraging and clearly aligns with overall city goals for greenhouse gas emissions reduction and climate action plan initiatives. **Table 3** below shows a summary of source power profiles from the past 10 years.

Table 3. Source Electricity Profile Summary for the 75th St. WWTF

Year	Total Electricity Used (kWh)	Percent Cogen	Percent Solar PV	Percent Renewables
2006	8,807,033	19.5%	n/a	19.5%
2007	9,230,673	18.2%	n/a	18.2%
2008	11,172,738	17.9%	n/a	17.9%
2009	11,021,096	18.4%	n/a	18.4%
2010	11,532,359	18.9%	5.4%	24.4%
2011	10,778,929	21.5%	14.2%	35.6%
2012	10,766,398	18.6%	14.1%	32.6%
2013	10,781,453	20.0%	13.8%	33.8%
2014	10,842,857	17.8%	13.1%	31.0%
2015 (thru Nov)	10,176,475	18.1%	13.0%	31.0%

Cogeneration Options

Utilities staff need to make an important decision in the next 2 to 4 years: either reinvest in cogeneration, or move away from cogeneration and utilize the biogas for a different purpose. Reinvesting in cogeneration could come in the form of modern, more efficient engine generators similar to the reciprocating, internal combustion engines currently in operation, or upgrading to microturbines. Most new facilities, or facilities that have embraced net zero initiatives, have installed microturbines due to the increased efficiency and ease of operation.

The “status quo” alternative includes implementing incremental repairs and minor upgrades to the various mechanical, electrical, and controls systems in order to keep the aging cogeneration system operational. This approach costs the city approximately \$100,000 per year in staff labor, and an additional \$50,000 to \$150,000 per year in capital/maintenance expenses.

Colorado School of Mines Cogeneration Study (2013). In the 2013, the City worked with the Colorado School of Mines (CSM) with assistance from Brown & Caldwell Engineers, to develop a Wastewater Treatment Plant Biogas Cogeneration conceptual design report. This was an engineering student design project so the report’s scope and findings should be taken in context with their relative expertise and experience. The purpose of the report was to evaluate various alternative energy options regarding the replacement of the existing cogeneration engines. The timing of the project was good because City staff was aware that impending cogen system changes were likely in the next 5-10 years.

The report evaluated five (5) alternatives including new cogeneration engines, microturbines, selling the biogas, as well the “do-nothing” alternative. The report concluded that new cogeneration engines similar to the existing engines were the most cost effective alternative at that time. This evaluation is merely one data point, and did not include an extensive alternative analysis of the various gas production or gas-to-energy alternatives available that would be typical if completed by a professional engineering consulting firm. City staff would complete a more comprehensive evaluation before proceeding with any future cogeneration system capital replacement project.

Controls Upgrades Bids (2015). During the past several years, the Cogen system has experienced an increased number of faults and shutdowns due to aging system components. This downtime negatively affects operations in two significant ways: 1) requiring more biogas to be flared and in turn purchasing more grid electricity, and 2) prevents staff from working on other facility priorities. While most of the known mechanical issues have been identified and repaired, the lingering problems are believed to be associated with electrical switchgear and controls. At the request of the city, some bids were obtained from a vendor familiar with the city’s Cogen system for various options to upgrade the controls to achieve a modernized, more automated, and safer system. Proposals were as follows:

1. Upgrade the main switchgear controls and protective relays for both cogeneration engines, improving synchronization with the main bus and automatic engine start/stop functionality. \$138,000

2. Upgrade the local engine controls and fuel system for both cogeneration engines, providing the ability to set a desired kW output and blend natural gas with biogas as needed. \$215,000

Due to the significant costs involved, this potential upgrade work has not been accomplished. Preliminary discussions have occurred with one of the city's consultants to review the bids and possibly develop a set of bid documents to facilitate obtaining multiple bids for these upgrades, due to costs exceeding \$50,000. Additionally, these upgrades are currently not funded within the CIP or operating budget.

Biogas Alternatives

The Utilities staff have received solicited input from consultants, academia, and peer communities regarding digester biogas and the tradeoffs of operating cogeneration vs. utilizing the fuel for other purposes. Unsolicited opinions from interested parties have also been obtained. The following information highlights a few noteworthy items with respect to biogas alternatives if the city decided to move away from cogeneration.

C2E Biogas Proposal (2014). The city was approached by a private development group named Carbon Cycle Energy (C2E) who submitted a proposal to implement a biogas-to-biofuel project. The essence of the project involved moving away from cogeneration, and installing gas treatment at the 75th St. WWTF to produce pipeline quality natural gas, and/or compressed natural gas (CNG) to fuel vehicles. A public-private partnership would be formed where C2E would own/operate the gas treatment and CNG station, and sell the fuel on the open market. It was estimated that approximately 300 gas gallon equivalents (GGEs) per day could be produced with current WWTF loadings. The presumed advantages for the city would be reduced O&M and capital burden (by no longer operating cogeneration), and access to BioCNG at a reduced price. While an appealing idea on some levels, the proposal heavily favored C2E economically, and the city declined the proposal.

Economic Evaluation (2015). One aspect missing from the cogeneration story is an economic comparison between the current situation of operating an aging system, and various future alternatives for biogas. Kennedy Jenks Engineers was hired to perform an economic evaluation for the city, to address the key question: What is the net economic benefit (or burden) of cogeneration today, and how do other options compare? The following scenarios were evaluated against the current Cogen system operation (baseline condition):

1. Heating and flare excess gas
2. New internal combustion engine (qty. 1)
3. New large microturbine engines (qty. 2)
4. New small microturbine engines (qty. 5)
5. BioCNG for fleet fuel (estimated to produce 500 GGE/day of fuel)

The work is being finalized. Preliminary findings suggest that when factoring in all appropriate O&M costs and savings for Cogen, the net result is a \$30,000-\$40,000 annual expense to operate the system. Alternatives to the existing Cogen system all have a capital investment, but show net annual savings when considering 20-year life cycle costs.

One concern with the BioCNG option is that the city has currently embraced electric vehicles and hybrids, along with biodiesel compatible vehicles, and does not own any CNG vehicles.

Thus, for a BioCNG project to be viable, the city would need to acquire a fleet of CNG vehicles, convert some of the existing fleet, or perhaps consider selling the CNG. High mileage vehicles are the best candidates to use CNG (trash truck and busses are excellent examples). The City of Grand Junction, Colorado is the best local example of a WWTF producing BioCNG.

Solar PV Options

McKinstry Proposal (2014). The city continues to embrace Solar PV technology, and the city's Energy Performance Contracting (EPC) company McKinstry brought a proposal to the table for a new 500-kW array located adjacent to the existing WWTF array. The large, flat, open acreage east of the WWTF fence line is ideal for Solar PV. The proposal included several cost scenarios:

1. City Owned, Financed
2. City Owned, Lease Purchase
3. City Owned, Cash
4. Third-party owned with PPA – this option was desired, but excluded as it would void a \$0.06 / kWh Renewable Energy Credit (REC) available to the city.

The project was drafted to be a change order to the larger city EPC program, which had certain advantages including turn-key construction. The complete cost of the Solar PV array was \$1,465,000, with an associated simple payback of 17 years. The system was projected to produce approximately 800,000 kWh of electricity per year (~7% of the WWTF annual use). The Utilities staff closely evaluated this opportunity, and ultimately declined the proposal due to cost and other higher priority projects.

Other Considerations

Digester Cover. The floating cover on the secondary digester has tipped 4 times within 35 years. While fortunately none of the tipping events were catastrophic, a digester cover tip is a very concerning episode. Also, fugitive gas can escape from the sludge seal around the annular space of the cover perimeter. To mitigate fugitive gas emissions and risk of cover tipping, a fixed digester cover is desired. Costs for a fixed cover are estimated at \$2,000,000 and budgeted in the 6-year CIP.

Gas Storage. The existing secondary digester floating cover does provide gas storage capability, which allows operations to use stored biogas during a power outage if needed, or send gas to storage temporarily if Cogen malfunctions. Gas storage is limited, however, and improved gas storage is desired in the future. Many facilities have embraced bladder systems to provide enhanced gas storage capability, which allow for greater flexibility to store or use gas, either proactively to manage digestion and biogas operations, or during emergency operations such as power outages. If the city moves away from cogeneration, however, a gas bladder system may not be warranted.

Supplemental Feedstock. Investment in any new system becomes financially more attractive with the prospect of generating more biogas. The most tangible way to generate more biogas is to introduce new or supplemental feedstock to the digestion process, such as food waste or fats, oils, and grease (FOG). Many WWTFs have made the leap to bring in supplemental feedstock and produce more biogas, which has resulted in significant jumps to achieve net-zero energy status. Work is required to identify local sources of potential feedstock, and explore transport and receiving options. A known issue for the 75th St. WWTF is the capacity of the digestion

process. Initial evaluation of the digester capacity indicated that a third digester would be required to successfully implement supplemental feedstock addition to the existing solids loading, so the cost of a third digester would need to be included.

Capital Improvements Program (CIP) Impacts

- Ongoing Major Rehabilitation of Cogeneration System – \$185,000 @ year 2020
- New Digester Cover and Gas Storage - \$2,000,000 @ year 2020
- New Cogeneration Engines (reciprocating engines or microturbines) – currently unfunded in CIP
- Biogas Treatment System or Alternative Use Project – currently unfunded in CIP

NEXT STEPS:

- Utilities staff will continue to evaluate options for upgrading the existing Cogen system, and make appropriate decisions on mechanical, electrical, and controls componentry that minimize stranded investments.
- Utilities staff will stay informed of industry trends with respect to biogas utilization.
- At some future date in late 2016 or early 2017, return to WRAB with a specific recommendation for a plan to study and make a determination for reinvesting in cogeneration, or proceeding with a biofuel project.
- Utilities staff will work with other city staff on how electric utility municipalization may affect the WWTF and associated electrical systems and goals.