Tomahawk Creek WWTP
Updates to Process Improvements Pre-Design Study
Alternatives Selection – Dry Weather Treatment

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Note: Portions of the information presented in TM No. 3 have subsequently been updated in TM No. 6. Specifically, the treatment processes have been modified to reflect the updated effluent limits as have the Life Cycle Cost estimates for the retained alternatives.

Introduction

The Basis of Analysis for this Process Improvements Pre-Design Study Update for the Tomahawk Creek Wastewater Treatment Plant (WWTP) was presented in Technical Memorandum (TM) No. 1. TM No. 1 documented Target Effluent Levels, Performance of Existing Treatment Plant, Projected Flows and Loadings, Economic Analysis Assumptions, and Summary of Existing Facilities.

TM No. 1 was presented at Workshop No. 1 on December 17, 2010. In the second half of Workshop No. 1, a list of Dry Weather Flow Treatment alternatives was developed. The qualitative screening criteria from the 2006 Pre-Design Study was updated and used to select alternatives from this list for further evaluation. Four Biological Nutrient Removal (BNR) alternatives each for the 10 mgd and 19 mgd treatment capacity levels were selected. Modifications to each to achieve Limits of Technology (LOT) treatment levels were also identified.

In TM No. 2, Alternatives Identification and Development, the selected Dry Weather Flow treatment alternatives were evaluated using the calibrated Pro 2D process model. Specifically, TM No. 2 included: a summary of the Qualitative Screening Criteria; the Alternative Evaluation including for each alternative a schematic, a discussion with respect to the qualitative criteria, key design criteria, preliminary site layouts, and a hydraulic profile. TM No. 2 was presented at Workshop No. 2 on February 22, 2011.

The Alternative Development and Identification to date has focused on Dry Weather Flow treatment only. Proper evaluation of alternatives for Wet Weather Flow management is partially dependent on understanding of the Kansas City, Missouri's (KCMO's) conveyance facilities downstream of the Tomahawk Creek WWTP. In KCMO's Overflow Control Plan (OCP) provisions have been included to convey, store, and treat JCW's peak wet weather flows from the Tomahawk Creek WWTP as well as other connection points in the South Blue River watershed. In order to perform a meaningful comparative analysis between conveyance/storage/treatment by KCMO to other alternatives, it was determined that a more in depth understanding of KCMO's assumptions and analysis protocols was required. The process of obtaining the needed information from KCMO is underway. In the meantime, it was decided that the Dry Weather Flow evaluation should proceed independent of the Wet Weather Flow evaluation. Wet Weather Flow alternatives will be developed and evaluated in a separate TM once the information from KCMO has been obtained. The dry and wet weather results can then be combined into the recommended Implementation Plan.

This TM No. 3 Alternatives Selection – Dry Weather Treatment presents the results of the Life Cycle Cost evaluation for the four 10 mgd and four 19 mgd Dry Weather Flow Treatment alternatives. The preferred alternative from each capacity sub-set is identified. The final choice between 10 mgd and 19 mgd for the dry weather capacity is interdependent with the wet weather evaluation outcome, and therefore will be deferred until the Wet Weather Flow evaluation has been completed and the dry and wet weather results can be combined into the recommended Implementation Plan. Specifically, TM No. 3 includes the following:

- Overview of the Dry Weather Flow Treatment alternatives evaluated in TM No. 2.
- Identification of process components that differ between alternatives, and those which are common to all alternatives and hence are not included in the comparative analysis.
- Conceptual development of a representative biosolids treatment and handling approach.
- Determination of the timing and need for rehabilitation/replacement of existing facilities.
- Further refinement of economic evaluation protocol.
- Capital, O&M, and Life Cycle Cost estimates for each alternative.
- Carbon Footprint, non-economic criteria scoring, and Cost-per-Benefit Score for each alternative.
- Selection of the preferred Dry Weather Flow Treatment alternative for each of the 10 mgd and 19 mgd capacity levels.

Process Alternatives Overview

The dry weather treatment alternatives are developed, evaluated and compared for one treatment level condition, Goal Level 1 (BNR), and two capacity scenarios - 10 mgd and 19 mgd. Four alternatives were retained for each scenario, resulting in eight total alternatives being compared.

Process Alternative Summary

Based on a comparison of advantages and benefits, four alternatives were selected during the Alternatives Screening Workshop, Workshop No. 1, for further analysis as documented in TM No. 2:

- Alternative A3 – Existing WWTPs plus chemical phosphorus removal and nitrifying moving bed bioreactor (MBBR) and denitrification deep bed filter for nitrogen removal. Capacity expansion to 19.1 mgd would be accomplished through construction of a new treatment train consisting of fine screens (in lieu of primary clarifiers), MBBR for both BOD removal and nitrification, dissolved air flotation (DAF) following the MBBR for both chemical phosphorus removal and removal of biomass generated due to BOD removal in the MBBR, and additional denitrification filter capacity.
- Alternative B3 – Existing WWTPs plus a three-stage BNR – Activated Sludge (AS) system integrated with the trickling filters for biological nitrogen and phosphorus removal. In cold weather months, use of ferric at the primary clarifiers and supplemental carbon to the anoxic zone of the AS process would be required to achieve BNR level treatment. Capacity expansion to 19.1 mgd would be accomplished through construction of a new treatment train consisting of primary clarifiers, three-stage BNR-AS process, and secondary clarifiers.
- Alternative C1 – Replacement of the existing trickling filters with a three-stage BNR-AS system for biological nitrogen and phosphorus removal. Capacity expansion to 19.1 mgd would be accomplished through construction of a new treatment train consisting of primary clarifiers, three-stage BNR-AS process, and secondary clarifiers.
- Alternative C4 – Replacement of the existing trickling filters with a four-stage MBBR processes for BOD and nitrogen removal. Fine screens would be used in place of primary clarifiers, and DAFs would be used in place of secondary clarifiers. Phosphorus removal would consist of coagulant and polymer feed ahead of the DAFs. Filters for final polishing are no-longer believed to be required as the use of coagulant and polymer feed ahead of DAF's has been shown to produce very low effluent TSS values. Capacity expansion to 19.1 mgd would be accomplished through construction of a new treatment train also consisting of fine screens, four-stage MBBR, DAF's.

Preliminary site layouts, hydraulic profiles, and key process design criteria for each of the above alternatives were presented in TM No. 2 – Alternatives Screening. Detailed preliminary cost information is provided in the following sections only for attainment of Goal Level 1 (BNR) as that level is the primary objective of the Pre-Design Study.

Existing Processes and Components to be Retained

The Dry Weather Flow alternatives vary considerably in terms of the extent to which existing facilities and processes are retained and incorporated into the alternative. Due to their age, existing facilities to be retained will require rehabilitation as part of the upgrade project to being them up to "like new" condition at the beginning of the 20 year planning period. The cost of rehabilitation must be included in the comparative analysis, so that alternative with more retained existing components (DW A-3 and DW B-3) can be compared on an "apples-to-apples" basis with alternatives with less retained facilities (DW C-1 and DW C-4).

Several components at the WWTP are common to all of the alternatives under consideration, and will therefore not be included in the comparative analysis. However, they will be subject to rehabilitation and be included in the recommended Implementation Plan. Common elements include:

- Maintenance Building – will be retained with rehabilitation
- Diversion Structure – will be retained with rehabilitation. Will require some modifications in conjunction with the wet weather alternatives
- Influent Pump Station – the Influent Pump Station consist of bar screening with a current capacity of 66 mgd, dry weather pumping with a capacity of 12 mgd and wet weather pumping with a capacity of 25 mgd. It will be retained with rehabilitation. The dry weather pumping capacity will need to be upgraded for both the 10 mgd and the 19 mgd capacity levels, however the upgrades will be common to all alternatives within a given capacity level. The bar screens and wet weather pumping may require capacity upgrades depending on the wet weather scenario.
- Biosolids Facilities – all sludges from the treatment processes are assumed to be treated on-site using the existing digesters, Digester Building, Sludge Storage Tank, and Solids Processing Building. The existing structures of these facilities will be retained and structurally rehabilitated as necessary; however, complete replacement of all sludge processing equipment, piping, electrical, and instrumentation and controls have been assumed. Biosolids processes are assumed to include: (a) thickening of primary and secondary sludges with either gravity belt thickeners or DAFs, depending on the alternative, to approximately 5 percent total solids, (b) high-rate mesophilic anaerobic digestion with a pumped mixing system similar to the Douglas L. Smith Middle Basin WWTP, and (c) dewatering of digested biosolids to approximately 25 percent total solids with centrifuges. Filtrate, DAF underflow, and centrate would all be returned to the head end of the WWTP. The digestion and dewatering processing are common to all alternatives. Estimated sludge production quantities from the four retained alternatives are within approximately 10 percent of each other, so for this study, will be assumed to be approximately equal and require equivalent size equipment and facilities for 10 or 19.1 mgd plant capacity, as appropriate.
- Odor Control Facility – will be retained with rehabilitation. This facility processes air from the Diversion Structure, Influent Pump Station, Grit Removal Facility, and Primary Clarifiers. All of the above, with the exception of the Primary Clarifiers, will be common

to all of the alternatives, therefore the Odor Control Facility will be considered a common component for the purposes of the comparative analysis.

- Grit Removal Facility – the Implementation Plan will include decommissioning of the existing facility and construction of a new Grit Removal Facility
- Disinfection Facility – the Implementation Plan will include decommissioning of the existing chlorination / de-chlorination facilities, and construction of a new Ultraviolet Disinfection Facility.
- Site Work and Utilities – Rehabilitation of the roads and parking areas and of the plant water system will be included in the Implementation Plan.

Facilities that do vary between alternatives and will be included in the comparative analysis include:

- Primary Clarifiers and Sludge Pumping
- Trickling Filters and Recirculation Pump Station
- Trickling Filter (TF) Effluent Pump Station
- Final Clarifiers and Sludge Pumping
- Chemical Feed Building
- Plant Electrical Switchgear

Cost Analysis

The focus of the cost analysis approach is to identify costs for process components that differ between the dry weather treatment alternatives, so that a preferred 10 mgd BNR treatment alternative and a preferred 19.1 mgd BNR treatment alternative can be selected in conjunction with the non-economic factors.

Condition Assessment and Needed Rehabilitation of Retained Facilities

Many of the existing facilities at the Tomahawk Creek WWTP have been in service for many years, some in excess of 50 years, and are in need of rehabilitation. Since the existing facilities to be retained differ between alternatives, it was necessary that these facilities be evaluated to determine what rehabilitation work was needed so that cost allowances could be included in the comparative cost analysis, thus providing for a more “apples-to-apples” comparison between alternatives with more retained facilities (Alternative A3) and those with fewer retained facilities (Alternatives B3, C1, and C4).

The Condition Assessment was performed by a combination of visual inspection and discussions with operations staff during a “walk through” on April 11, 2011, and through review of data in JCW’s Asset Management system including CMMS (Antero) data and TEAM data. The following information was generated as a result of the Condition Assessment:

- Table 1, Condition Assessment Matrix – summarizes the results of the walk through.

- Table A.1 (Appendix A), Rehabilitation Cost Matrix – summarizes the cost of rehabilitation or replacement for each item show in Table 1. For equipment items, the replacement costs were coordinated with the TEAM database and adjusted where believed appropriate.
- Table A.2 (Appendix A), Asset Management: Existing Facility Age / Condition Assessment – summarizes for each major equipment item data from CMMS and TEAM including in service date, service life, end of service life date, and condition rating.
- Table A.3 (Appendix A), Rehabilitation and Salvage Allowances for Retained Facilities – tabulates the costs to be included for each alternative, along with the year in which the improvement is to be made. The majority of the improvements will be included in the initial project. Some equipment items will not require replacement at the time of the initial project, but will at some point during the 20 year project life as their service life, per the Asset Management data, reaches its end. Salvage values are included for equipment replacements in years beyond the initial project, and these will be incorporated into the Life Cycle Cost evaluation.

The Life Cycle Cost evaluation will also require comparison of operations and maintenance (O&M) costs between alternatives. In order to properly reflect the O&M associated with the retained facilities, an analysis of the existing plant's O&M budget was performed. The following information was generated by this analysis:

- Table A.4 (Appendix A), Existing O&M Budget Analysis and Breakdown by Unit Process – the 2011 O&M budget, less KCMO cost of treatment and inter-departmental contracts was sub-divided by the individual unit processes. It was then scaled from the plant's existing "effective" capacity to the 10 mgd and 19 mgd levels.
- Table A.5 (Appendix A), Annual O&M Allowances for Retained Facilities – tabulates the O&M costs to be included for each alternative. O&M costs for "common" facilities are included in the table but shown separately and will not be included in the comparative analysis.

	Table 1 – Condition Assessment Matrix								
#	**Item**	**Concrete (A)**	**Super-structure (B)**	**Metals (C)**	**Equip-ment (D)**	**Covers (E)**	**Piping (F)**	**Electrical (G)**	**HVAC (H)**
1	Primary Clarifier 1	Minor[1-4A]	N/A	Replace	Replace[1D]	Remove/ Reinstall 1-4E	N/A	Replace	N/A
2	Primary Clarifier 2	Minor[1-4A]	N/A	Replace	Replace 2-4D	Remove/ Reinstall 1-4E	N/A	Replace	N/A
3	Primary Clarifier 3	Minor[1-4A]	N/A	Replace	Replace 2-4D	Remove/ Reinstall 1-4E	N/A	Replace	N/A
4	Primary Clarifier 4	Minor[1-4A]	N/A	Replace	Replace 2-4D	Remove/ Reinstall 1-4E	N/A	Replace	N/A
5	Primary Sludge Pump Station 1/2	OK	Major	Replace	Replace	N/A	Replace	Replace	Replace
6	Primary Sludge Pump Station 3/4	OK	OK	Replace	Replace	N/A	OK	Replace	Replace
7	Trickling Filter 1	Major[7-8A]	N/A	Replace	Major	N/A	N/A	N/A	N/A
8	Trickling Filter 2	Major[7-8A]	N/A	Replace	Major	N/A	N/A	N/A	N/A
9	Trickling Filter 3	Minor[9-10A]	N/A	Replace	OK	N/A	N/A	N/A	N/A
10	Trickling Filter 4	Minor[9-10A]	N/A	Replace	OK	N/A	N/A	N/A	N/A
11	Lagoon Blower Building	OK	OK	Replace 11C	OK	OK	N/A	Minor	OK
12	Recirculation Pump Station	Minor[12A]	Minor[12B]	Replace 12C	Replace	N/A	Replace	Major[12G]	OK
13	Final Clarifier 1	Major[13A]	N/A	Replace 13-14C	Replace 13D	N/A	N/A	Replace	N/A
14	Final Clarifier 2	Major[14A]	N/A	Replace 13-14C	Minor[14D]	N/A	N/A	N/A	N/A
15	Final Sludge Pump Station	OK	OK	Replace	Replace	N/A	OK	Replace 15G	OK
16	Chemical Feed Building	Minor	OK	OK	OK	N/A	OK	OK	OK
17	Maintenance Building	Minor[17A]	Minor	N/A	N/A	N/A	N/A	Minor[17G]	Replace

Table 1 – Condition Assessment Matrix

#	Item	Concrete (A)	Super-structure (B)	Metals (C)	Equip-ment (D)	Covers (E)	Piping (F)	Electrical (G)	HVAC (H)
18	Diversion Structure	Major[18A]	N/A	Minor	N/A	N/A	N/A	Replace	N/A
19	Influent Pump Station – Bar Screens	OK	Minor[19-20B]	OK	Replace[19D]	N/A	N/A	Replace	N/A
20	Influent Pump Station – Dry Weather Pumps	OK	Minor[19-20B]	Minor-outside Major-inside	Replace	OK	Replace	Minor[20G]	N/A
21	Influent Pump Station – Wet Weather Pumps	OK	N/A	OK	TBD	OK	OK	TBD	N/A
22	T.F. Effluent Pump Station	Minor[22A]	Minor[22B]	Replace[22C]	Replace	N/A	OK	Minor[22G]	OK
23	Digesters and Digester Building	Minor[23A]	Major[23B]	Replace	OK	Replace	N/A	Replace[23G]	OK
24	Sludge Storage Tank	OK	OK	Replace[24C]	N/A	N/A	Replace	Replace	OK
25	Odor Control Facility	Major[25A]	OK	OK	Replace	N/A	N/A	Replace[25G]	OK
26	Solids Processing Bldg. (Lab)	Minor[26A]	Minor[26B]	Replace	Replace	Replace	Replace	Replace	Replace

Notes: Replace = Self Explanatory; Major = Major Rehabilitation Required; Minor = Minor Rehabilitation Required; OK = Rehabilitation Not Required; N/A = Not Applicable

Other Notes:

- Most of the roadway pavement needs repaired or replaced.
- Plant had Eaton repair six (6) 480V circuit breakers ’09. Still have nuisance tripping. Substation switchgear system should be replaced. Utility Overhead-Underground interface should be moved out further North to avoid tree interferences.
- Plant 480V MCC’s and outdoor area/site lighting aged and should be replaced.
- Plant water quality is poor, water system may need replaced.

Footnotes:

[1-4A] – Rehab concrete for minor H2S attacks.

[1D] – Center column is wobbly. Primary Clarifier 1 has no drain, install new drain. Replace mechanisms at end of service life.

[2-4D] – Replace mechanisms at end of service life.

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1-4E – Remove and reinstall cover for access to equipment and weir access improvements.
7-8A – Underdrain is collapsing, concrete falling apart throughout. Replace entire underdrain system and raise walls above 100-year flood elevation in initial project.
9-10A – Replace entire underdrain system in Year 10, and raise walls above 100-year flood elevation in initial project.
11C – Replace doors, the rest of structure is OK.
12A – Note: condition of concrete in wet well is unknown. Assume some rehabilitation/coating.
12B – Repaint.
12C – Replace handrail.
12G – Complete electrical system rehab.
13A – Raise walls for flood protection.
13-14C – Includes weirs, handrails, and walkways for access.
13D – Repaint. Replace clarifier drive system.
14A – Center column is wobbly. Can't level arms because bottom of center column is moving/tipped, likely due to concrete support failure. Repair concrete support and raise walls for flood protection.
14D – Repaint.
15G – Replace Building 3 interior lighting system.
17A – Slab repair.
17G – Replace lighting system – indoors/outdoors, make energy compliant. Outdoor PVC and flex conduit systems need replacement with RMC.
18A – Interior Concrete rehabilitation.
19-20B – Replace roofing and insulation of Influent Pump Station.
19D – Replace Bar Screens in 2024.
20G – Replace MCC's (see "Other Notes"), bulk of electrical in good shape.
22A – Note: condition of concrete in wet well is unknown. Assume some rehabilitation/coating.
22B – Crack repair.
22C – Replace door frame.
22G – Replace MCC's (see "Other Notes"), bulk of electrical in good shape.
23A – Rebuild sludge control boxes.
23B – Cut control joints in brick walls.
23G - Bldg 8 requires new Electrical Replacement.
24C – Replace exterior guardrail and walkway.
25A – Major repair to slab.
25G –Replace MCC and outdoor lighting. Indoor lighting okay, except emergency lights (replace).
26A – Note: floor/column strength may need upgrade for centrifuge.
26B – Painting, repair doors/windows.

Economic Analysis Protocols

Life Cycle Cost (LCC) analyses will be based on the 2011 Discount Rates presented in the President's Office of Management and Budget (OMB) Circular No. A-94 published on February 3, 2011. The real discount rate, which is a forecast of real interest rates from which the inflation premium has been removed, will be utilized in the LCC analyses as it is most appropriate for discounting constant-dollar flows, such as required in cost-effectiveness analysis. The 2011 real discount rate is 2.1 percent for a 20 year analysis.

The planning horizon for comparison of alternatives is 20 years (2020 – 2040) with the following assumed dates based on the current long-term Capital Improvements Program (CIP):

- Design completed in 2018
- Construction conducted in 2018 and 2019 with midpoint of construction assumed to be January 2019
- Operations of upgraded facilities to start January 2020

The timing for this project is subject to change, either earlier or later depending on revisions to future CIPs and also the timing of Kansas City, MO rate increases for treatment of wastewater sent through the interceptor. A sensitivity analysis of the project timing will be evaluated in the Implementation Plan TM.

Capital, O&M, and Life Cycle Cost Estimates

Capital, O&M, demolition allowances, and net present value cost information for the retained alternatives are presented in Appendix B and summarized in Table 2. The table separates the evaluation by the four 10-mgd and four 19-mgd Dry Weather Flow Treatment alternatives.

TABLE 2
Tomahawk WWTP Dry Weather Alternative Cost Summary

10-mgd BNR Alternatives

Alternative	Total Capital Cost[1]	First Year O&M[2] (Escalated)	Net Present Value[3]
Net Discount Rate = 2.1%			
A3	$70,970,000	$4,790,000	$148,580,000
B3	$55,670,000	$3,190,000	$107,270,000
C1	$69,660,000	$2,200,000	$105,310,000
C4	$81,380,000	$3,570,000	$139,180,000

19-mgd BNR Alternatives

Alternative	Total Capital Cost[1]	First Year O&M[2] (Escalated)	Net Present Value[3]
Net Discount Rate = 2.1%			
A3	$140,840,000	$9,600,000	$296,270,000
B3	$117,890,000	$6,050,000	$215,740,000
C1	$115,950,000	$4,040,000	$181,260,000
C4	$135,610,000	$6,310,000	$237,790,000

Notes:

1. Costs presented in 2011 dollars.
2. First Year O&M costs are for the new and retained facilities.
3. Net Present Value includes 20 years of O&M, from 2020 through 2040 and the total capital cost from the 2019 mid-point of construction, including non-construction costs (engineering and administration fees).

The first year O&M costs in Table 2 include general WWTP labor as well as power, electricity, maintenance and repairs for both new and retained facilities. The O&M costs are itemized by alternative in Appendix B.

Carbon Footprint

To aid in assessing the environmental impacts (one of the qualitative criteria), greenhouse gas emissions were calculated to compare carbon footprints of each alternative. The carbon footprint was estimated for both construction and BNR treatment level operation of each alternative. Table 3 summarizes the resulting emissions for each treatment alternative for a 20-year life cycle. Appendix C contains tables and graphs for the carbon footprint calculations.

TABLE 3
Tomahawk WWTP Dry Weather Alternative Greenhouse Gas Contribution

10-mgd BNR Alternatives

Alternative	Power Emissions (tons of CO_2e/yr) [2]	Chemical Emissions (tons of CO_2e/yr)	Construction Emissions (tons of CO_2e) [3]	Total Anthropogenic Emissions (tons of CO_2e/life cycle)	Biogenics Emissions (tons of CO_2e/yr)
A3	4,110	1310	700	109,220	[4]
B3	6,060	490	780	131,820	4,090
C1	6,740	0	1,140	136,100	4,030
C4	7,660	550	290	164,350	[4]

19-mgd BNR Alternatives

Alternative	Power Emissions (tons of CO_2e/yr) [2]	Chemical Emissions (tons of CO_2e/yr)	Construction Emissions (tons of CO_2e) [3]	Total Anthropogenic Emissions (tons of CO_2e/life cycle)	Biogenics Emissions (tons of CO_2e/yr)
A3	9,460	2,630	1,400	243,240	[4]
B3	11,830	500	1,970	248,570	7,870
C1	11,880	70	3,050	241,970	7,590
C4	14,960	1,040	540	320,600	[4]

Notes:
1. Operational emissions are based on BNR level treatment.
2. CO_2e/yr = carbon dioxide equivalents per year
3. Construction emissions are single-time event, not an annual emission.
4. Biogenics emissions are directly related to the effluent quality achieved. As all alternatives achieve nearly identical effluent quality, biogenics emissions are projected to be similar to B3 and C1.

The power emissions calculation converts electrical usage to tons of carbon dioxide equivalents (CO_2e / yr) by applying factors to the total electrical consumption for each alternative. Electrical consumption includes equipment horsepower and electricity usage of buildings. The chemical emissions calculations consider production and transportation of chemicals. Construction emissions are determined for transportation and diesel consumption based on volume of concrete, excavation, backfill, and piping used for each alternative. The biogenics emissions above are calculated based on liquid process-related emissions. Biogenics emissions related to solids handling will be quantified with implementation plan for preferred alternative.

Alternative Comparisons

The dry weather treatment alternatives are compared on both a non-economic basis and a cost-per-benefit basis as described below.

Non-Economic Evaluation

An initial list of potential qualitative screening criteria were presented and reviewed at Workshop No. 1. This list was consolidated to the 7 criteria presented in Table 4 that were determined to be most important to Johnson County Wastewater (JCW).

TABLE 4
Revised Qualitative Criteria for Tomahawk Creek WWTP Process Improvements

Criterion	Description
Flexibility/Performance	How well is the alternative able to successfully deal with fluctuations of flow and load; e.g., number of "tools" available to respond to changing conditions? Is it resistant to upset conditions? How extensive are the ramifications if all or part of the process fails?
Adaptability/Phasing	How easily can the process/alternative be upgraded for future conditions or requirements? How easily can the alternative be phased in to meet JCW's needs over time in a cost-effective fashion?
Staffing/Multiple Processes	How well does the alternative match with existing operational staff in terms of numbers, capabilities, procedures, and experience? Does the alternative incorporate additional unit processes?
Land Requirements	How well does the alternative fit on the existing site?
Social Impacts	How well does the alternative prevent off-site impacts for traffic, noise, odors, visual, etc. (excluding construction impacts)? Are these impacts easily mitigated?
Environmental Impacts	How well does the alternative minimize impacts to the environment? Methanol production creates Green House Gases. Chemical versus biological phosphorus removal increases carbon footprint.
Safety	How well does the alternative minimize safety risks? Onsite methanol storage is a fire risk. Additional chemical storage increases safety risks.

The relative importance of these criteria was established in Workshop No. 2 through a pair-wise comparison to force-rank the criteria and develop relative criterion scoring weights. The results of these comparisons and the relative weight scores are presented in Table 5.

TABLE 5
Qualitative Screening Criteria Comparative Scoring and Relative Weights[1]

Criteria	Flexibility/ Performance Risk	Adaptability/Phasing	Staffing/ Multiple Processes	Land Requirements	Social Impacts	Environmental Impacts	Safety	Total Scores	Weighting Percentage	Relative Weights
Flexibility/ Performance Risk		6	3	3	4	7	5	28	12.1%	1.22
Adaptability/ Phasing	5		3	3	4	5	5	25	10.8%	1.09
Staffing/ Multiple Processes	8	8		5	5	7	4	37	16.0%	1.61
Land Requirements	8	8	6		6	8	8	44	19.0%	1.91
Social Impacts	7	7	6	5		8	7	40	17.3%	1.74
Environmental Impacts	4	6	4	3	3		3	23	10.0%	1.00
Safety	6	6	7	3	4	8		34	14.7%	1.48
TOTALS								231	100%	

[1] Comparative scoring of criteria ranges from a low of 1 – significantly less important to a high of 10 – significantly more important

During Workshop No. 2, conducted on May 2, 2011, the alternatives were rated and ranked using the above criteria. Alternatives were scored using the qualitative screening criteria and the following benefit scores:

1. Significantly negative benefit
2. Negative benefit
3. Neutral score or no impact
4. Positive benefit
5. Significantly positive benefit

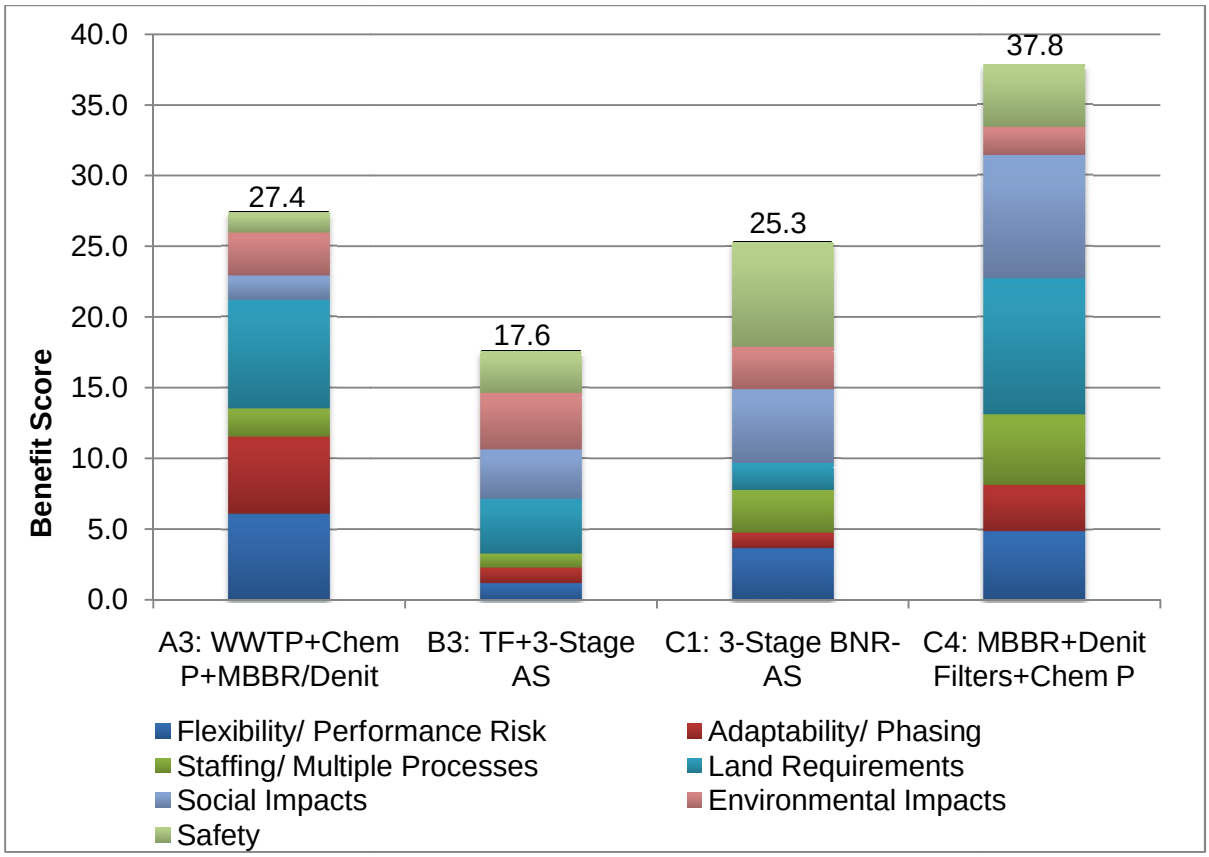
The scores and ranking for the alternatives are presented in Table 6.

TABLE 6
Benefit Scoring of Alternatives by Qualitative Screening Criteria

Alternative	Flexibility/ Performance Risk	Adaptability/Phasing	Staffing/ Multiple Processes	Land Requirements	Social Impacts	Environmental Impacts	Safety	Total Score
A3: Add-on MBBR + Denit Filter + Chem P	5	5	2	4	1	3	1	21
B3: Existing TF + 3 Stage BNR-AS	1	1	1	2	2	4	2	13
C1: 3 Stage BNR-AS	3	1	4	1	3	3	5	20
C4: 4 Stage MBBR + Fine Screens and DAFS + Chem P	4	3	5	5	5	2	3	27

The relative importance of the qualitative screening criteria was determined through the pair-wise comparison and the relative weighted scores for each criterion as presented previously in Table 5. The weighted benefit scores are summarized in Figure 1. As shown, Alternative C4 provides the greatest benefits with a total relative score of 37.8.

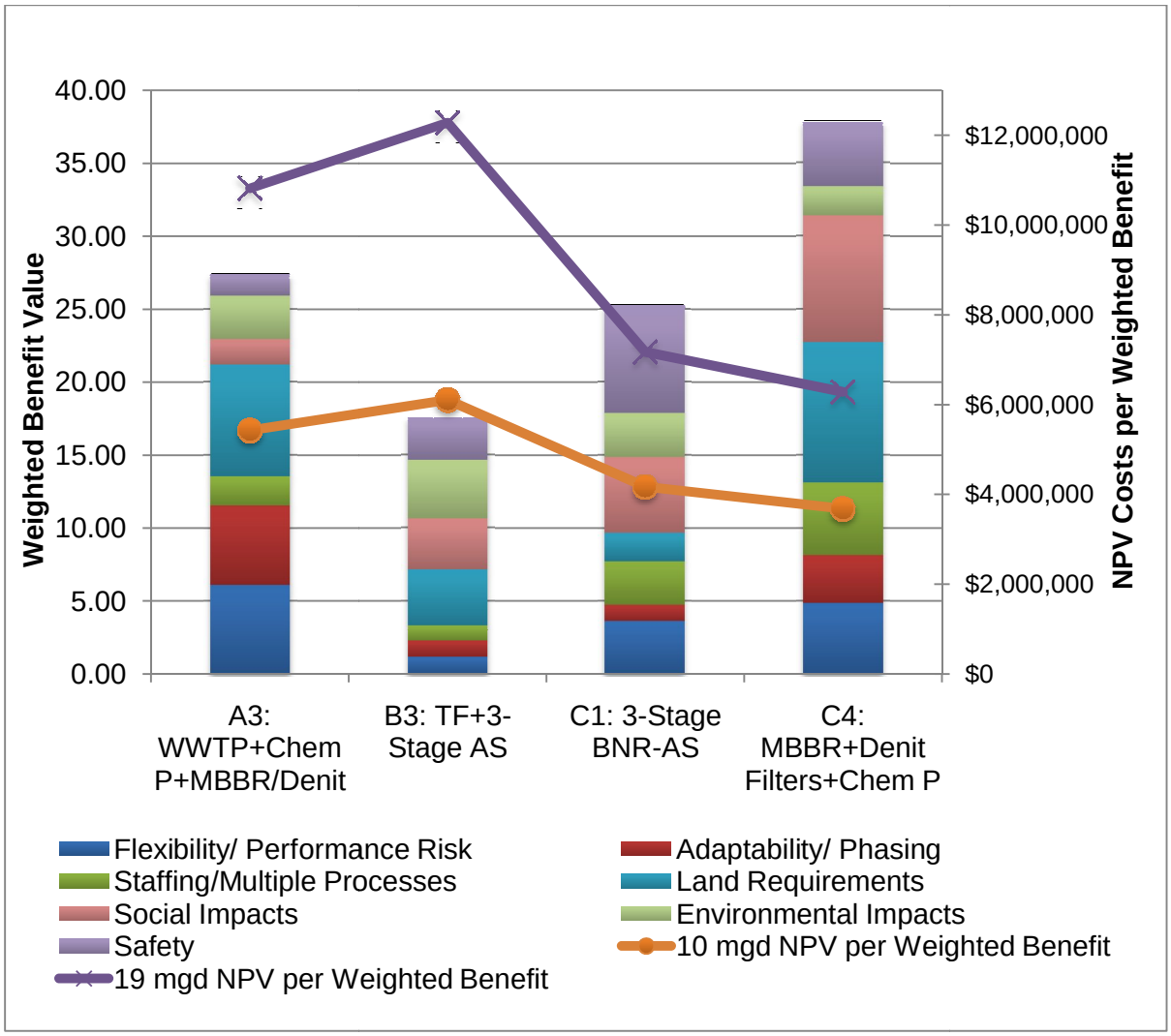
FIGURE 1
Weighted Benefit Scores of Alternatives



Cost – Benefit Analysis

The total weighted scores above indicate that Alternative C4 provides relatively more benefit than the other three alternatives. Factoring in comparable net present value cost estimates from Table 2 by dividing the total net present value by the weighted benefit scores, as shown in Figure 2, indicates that Alternative C4 also offers the lowest cost-per-benefit score.

FIGURE 2
Benefit and Net Present Cost-per-Weighted Benefit Scores for Alternatives



As shown in Figure 2, Alternative C4 provides the greatest benefit score and the lowest cost-per-weighted benefit ratios for both the 10-mgd and 19-mgd scenarios; however, its capital and NPV costs are also greater than the majority of the other alternatives.

Selection of the Preferred Alternative

The final selection of the preferred dry weather treatment alternative was conducted in Workshop No. 3 (Alternative Selection Workshop) on May 3, 2011. Alternative C1 had the lowest Life Cycle cost for both the 10-mgd and 19-mgd scenarios. Alternative C4 had the most favorable cost-benefit scores for each scenario, with C1 being second and within 14% of C4. It was noted in the Workshop discussion that actual operating history with the C4 process configuration in the United States is limited. It was concluded that C1 should be selected as the preferred alternative as it incorporates technologies JCW is familiar with and has the greatest site (floodplain) impacts, hence is a conservative "worst case" approach to

this issue. However, C4 should be revisited at such time as the project moves into the implementation phase.

Appendix A
Asset Management, Condition Assessment, Rehabilitation Allowances (Including Demolition), and Operational and Maintenance Costs

	Table A.1. – Rehabilitation Cost Matrix								
#	Item	Concrete	Super-structure	Metals	Equip-ment	Covers	Piping	Electrical	HVAC
1	Primary Clarifier 1	$20,000	X	$32,000	$120,000	$50,000	X	$15,000	X
2	Primary Clarifier 2	$25,000	X	$42,000	$160,000	$100,000	X	$15,000	X
3	Primary Clarifier 3	$25,000	X	$42,000	$160,000	$100,000	X	$15,000	X
4	Primary Clarifier 4	$25,000	X	$42,000	$160,000	$100,000	X	$15,000	X
5	Primary Sludge Pump Station 1/2	X	$42,000	$27,000	$140,000	X	$80,000	$40,000	$40,000
6	Primary Sludge Pump Station 3/4	X	X	$29,000	$160,000	X	X	$60,000	$18,000
7	Trickling Filter 1	$400,000	X	$2,000	$160,000	X	X	X	X
8	Trickling Filter 2	$800,000	X	$2,000	$225,000	X	X	X	X
9	Trickling Filter 3	$800,000	X	$2,000	$225,000	X	X	X	X
10	Trickling Filter 4	$800,000	X	$2,000	$225,000	X	X	X	X
11	Lagoon Blower Building	X	X	$5,000	X	X	X	$25,000	X
12	Recirculation Pump Station	$40,000	$4,000	$5,000	$220,000	X	$80,000	$150,000	X
13	Final Clarifier 1	$110,000	X	$160,000	$160,000	X	X	$10,000	X
14	Final Clarifier 2	$100,000	X	$160,000	$240,000	X	X	X	X
15	Final Sludge Pump Station	X	X	$33,000	$75,000	X	X	$40,000	X
16	Chemical Feed Building	$15,000	X	X	X	X	X	X	X
17	Maintenance Building	$28,000	$102,000	X	X	X	X	$180,000	$150,000

	Table A.1. – Rehabilitation Cost Matrix								
#	**Item**	**Concrete**	**Super-structure**	**Metals**	**Equip-ment**	**Covers**	**Piping**	**Electrical**	**HVAC**
18	Diversion Structure	$225,000	X	$30,000	X	X	X	$15,000	X
19	Influent Pump Station – Bar Screens	X	$33,000	X	$975,000	X	X	$25,000	X
20	Influent Pump Station – Dry Weather Pumps	X	$41,000	$109,000	$850,000	X	$100,000	$200,000	X
21	Influent Pump Station – Wet Weather Pumps	X	X	X	X	X	X	X	X
22	T.F. Effluent Pump Station	$5,000	$10,000	$5,000	$320,000	X	X	$120,000	X
23	Digesters and Digester Building	$65,000	$350,000	$245,000	CPES	CPES	CPES	CPES	CPES
24	Sludge Storage Tank	X	X	$60,000	X	X	$25,000	$25,000	X
25	Odor Control Facility	$125,000	X	X	$660,000	X	X	$150,000	X
26	Solids Processing Bldg. (Lab)	$10,000	$140,000	$105,000	CPES	CPES	CPES	CPES	CPES
	Substation (15kV, 480V, transformers, incoming circuits) Site Power Distribution Allowance							$500,000 $150,000	

JCW Tomahawk WWTP Pre-Design Study Update
Table A.2. - Asset Management: Existing Facility Age/Condition Evaluation

Item	Date in Service	Maximum Effective Life per Database	End of Service Life per Database	Condition Rating
Influent Building				
Screenings Belt Conveyor	1991	20	2011	2
Bar (Climber) Screen & Drive 1	1994	30	2024	2
Bar (Climber) Screen & Drive 2	1994	30	2024	2
Bar (Climber) Screen & Drive 3	1994	30	2024	2
Influent Pump 1 & Motor	1992	20	2012	1
Pump 1 VFD	2010	10	2020	3
Influent Pump 2 & Motor	1992	20	2012	1
Pump 2 VFD	2010	10	2020	1
Influent Pump 3 & Motor	1992	20	2012	2
Motor Control Center 1	1956	20	1976	3
Motor Control Center 2	1956	20	1976	3
Storm Pump 5	1995	20	2015	2
Storm Pump 6	1995	20	2015	2
Storm Pump 7	1995	20	2015	2
Storm Pump 8	1995	20	2015	2
Primary Clarifiers				
Primary Clarifier 1 - Drive	1994	30	2023	2
Primary Clarifier 2 - Drive	1993	30	2023	2
Primary Clarifier 3 - Drive	1993	30	2023	2
Primary Clarifier 3 - Scraper Assembly	1994	30	2023	3
Primary Clarifier 4 - Drive	1993	30	2023	2
Primary Clarifier 4 - Scraper Assembly	1993	30	2023	3
Trickling Filters				
Trickling Filter 1 - Mechanisms	2008	20	2028	1
Trickling Filter 2 - Mechanisms	2008	20	2028	1
Trickling Filter 3 - Mechanisms	2008	20	2028	1
Trickling Filter 4 - Mechanisms	2008	20	2028	1
Final Clarifiers				
Final Clarifier 1 - Drive	1960	30	1990	2
Final Clarifier 2 - Drive	2006	30	2036	3
Primary (Raw) Sludge Building				
Primary Sludge Pump SPP3 & Motor	1969	20	1989	3
Primary Sludge Pump SPP4 & Motor	1969	20	1989	3
Primary Sludge Pump SPP5 & Motor	1969	20	1989	3
Motor Control Center 6	1956	20	1976	3

Item	Date in Service	Maximum Effective Life per Database	End of Service Life per Database	Condition Rating
Primary Sludge Control Building				
Sludge Pump SPP1	1986	20	2006	2
Sludge Piston Pump Motor 1	2002	15	2017	3
Sludge Pump SPP2	1986	20	2006	2
Sludge Piston Pump Motor 2	2002	15	2017	3
Recirculation Control Building				
Recirculation Pump LPR 1 & Motor	2011	20	2031	1
Pump LPR2 VFD	2011	10	2021	1
Recirculation Pump LPR2 & Motor	2010	20	2030	1
Pump LPR2 VFD	2011	10	2021	1
Recirculation Pump LPR3 & Motor	2010	20	2030	1
Pump LPR3 VFD	2011	10	2021	1
Recirculation Pump LPR4 & Motor	2011	20	2031	1
Pump LPR4 VFD	2011	10	2021	1
Motor Control Center 5	1992	20	2012	3
Motor Control Center EB	1956	20	1976	3
Final Sludge Building				
Final Sludge Pump 1	1981	20	2001	3
Final Sludge Pump 2	1981	20	2001	2
Final Sludge Pump 3	1981	20	2001	3
Chemical (Dechlorination) Building				
Ferric Tank	2007	30	2037	3
Polymer Feed System 1	2007	20	2027	3
Polymer Feed System 2	2007	20	2027	2
T.F. Effluent Building				
T.F. Effluent Pump LPE1	1974	20	1994	2
T.F. Effluent Pump LPE1 Motor	2001	15	2016	2
T.F. Effluent Pump LPE1 VFD	2001	10	2011	1
T.F. Effluent Pump LPE2	1974	20	1994	2
T.F. Effluent Pump LPE2 Motor	1974	15	1989	2
T.F. Effluent Pump LPE3	1974	20	1994	2
T.F. Effluent Pump LPE3 Motor	2001	15	2016	2
T.F. Effluent Pump LPE3 VFD	2001	10	2011	1
Motor Control Center 3	1956	20	1976	3
Motor Control Center 4	1956	20	1976	3

Item	Date in Service	Maximum Effective Life per Database	End of Service Life per Database	Condition Rating
Filter (Lab) Building				
Motor Control Center 2	1956	20	1976	3
Motor Control Center 7	1956	20	1976	3
Sludge Transfer Pump SPD7 & Motor	2011	20	2031	1
Sludge Transfer Pump SPD8 & Motor	2011	20	2031	1
Odor Control Building				
Hypochlorite Storage Tank	2009	30	2039	1
Odor Control Fan 1 & Motor	2011	10	2021	1
Odor Control Fan 2 & Motor	2011	10	2021	1
Odor Control Fan 3 & Motor	2011	10	2021	1
Odor Control Fan 4 & Motor	2011	10	2021	1
Odor Control Scrubbers (1-3)	1995	25	2020	3
Motor Control Center 13	1992	20	2012	3
Scrubber Recirculation Pump 1	1995	20	2015	2
Scrubber Recirculation Pump 4	1995	20	2015	1
Scrubber Recirculation Pump 5	2010	20	2030	1
Scrubber Recirculation Pump 6	2010	20	2030	1
Treatment Plant Electronics				
Primary Transformer 1	1956	15	1971	2
Primary Transformer 2	1956	15	1971	3
Primary Transformer 3	1992	15	2007	3
Substation HV Switchgear	1992	50	2042	3
Substation LV Switchgear	1956	50	2006	2

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Equipment Replacement Percent Life in 2040	Equipment Replacement Salvage Value ($)
	Alternative DW-A3 (10 mgd), Page 1 of 4						
Varies	Primary Clarifiers 1 - 4						
	Concrete	Rehab	2020	95,000			
	Metals	Replace	2020	158,000			
	Equipment	Replace	2023	600,000	30	43%	258,000
	Covers	Replace	2020	350,000			
	Electrical	Replace	2020	60,000			
Varies	Primary Sludge Pump Stations						
	Superstructure	Rehab	2020	42,000			
	Metals	Replace	2020	56,000			
	Equipment	Replace	2020	300,000	20	0	0
	Piping	Replace	2020	80,000			
	Electrical	Replace	2020	100,000			
	HVAC	Replace	2020	58,000			
Varies	Trickling Filters 1 - 4						
	Concrete (Filters 1 & 2)	Rehab	2020	1,200,000			
	Concrete (Filters 3 & 4)	Rehab	2026	1,600,000			
	Metals	Replace	2020	8,000			
	Equipment	Replace	2028	835,000	20	40%	334,000
Varies	Lagoon Blower Building						
	Metals	Replace	2020	5,000			
	Electrical	Rehab	2020	25,000			
Varies	Recirculation Pump Station						
	Concrete	Rehab	2020	40,000			
	Superstructure	Rehab	2020	4,000			
	Metals	Replace	2020	5,000			
	Pumps & VFDs	Replace	2031	220,000	20	55%	121,000
	Piping	Replace	2020	80,000			
	Electrical	Rehab	2020	150,000			
Varies	Final Clarifiers 1 & 2						
	Concrete	Rehab	2020	210,000			
	Metals	Replace	2020	320,000			
	Equipment - FC 1	Replace	2020	160,000			
	Equipment - FC 2	Replace	2036	240,000	30	87%	208,000
	Electrical	Replace	2020	10,000			

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Equipment Replacement Percent Life in 2040	Equipment Replacement Salvage Value ($)
	Alternative DW-A3 (10 mgd), Page 2 of 4						
Varies	Final Sludge Pump Station						
	Metals	Replace	2020	33,000			
	Equipment	Rehab	2020	75,000	20	0	0
	Electrical	Replace	2020	40,000			
Varies	Chemical Feed Building						
	Concrete	Rehab	2020	15,000			
Common	Maintenance Building						
	Concrete	Rehab	2020	28,000			
	Superstructure	Rehab	2020	102,000			
	Electrical	Rehab	2020	180,000			
	HVAC	Replace	2020	150,000			
Common	Diversion Structure						
	Concrete	Rehab	2020	225,000			
	Metals	Rehab	2020	30,000			
	Electrical	Replace	2020	15,000			
Common	Influent Pump Station - Bar Screens						
	Superstructure	Rehab	2020	33,000			
	Equipment	Replace	2024	975,000	30	47%	455,000
	Electrical	Replace	2020	25,000			
Common	Influent Pump Station - Dry Weather Pumps						
	Superstructure	Rehab	2020	41,000			
	Metals	Rehab	2020	109,000			
	Pumps	Replace	2020	600,000	20	0	0
	VFDs	Replace	2026	250,000	10	0	0
	Piping	Replace	2020	100,000			
	Electrical	Replace	2020	200,000			
Varies	T.F. Effluent Pump Station						
	Concrete	Rehab	2020	5,000			
	Superstructure	Rehab	2020	10,000			
	Metals	Replace	2020	5,000			
	Pumps & VFDs	Rehab	2020	320,000	20	0	0
	Electrical	Rehab	2020	120,000			

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
	Alternative DW-A3 (10 mgd), Page 3 of 4						
Common	Digesters & Digester Building						
	Concrete	Rehab	2020	65,000			
	Superstructure	Rehab	2020	350,000			
	Metals	Replace	2020	245,000			
Common	Sludge Storage Tank						
	Metals	Replace	2020	60,000			
	Piping	Replace	2020	25,000			
	Electrical	Replace	2020	25,000			
Common	Odor Control Facility						
	Concrete	Rehab	2020	125,000			
	Equipment	Replace	2020	660,000			
	Electrical	Replace	2020	150,000			
Common	Solids Processing Building						
	Concrete	Rehab	2020	10,000			
	Superstructure	Rehab	2020	140,000			
	Metals	Replace	2020	105,000			
Varies	Plant Electrical						
	Substation	Replace	2020	500,000			
	Site Power Distribution	Replace	2020	150,000			
Common	Sitework & Utilities						
	Plant Water System	Replace	2020	275,000			
	Pavement - Roads & Parking	Replace	2020	700,000			
	Sub-Total, Alternative DW-A3 (10 mgd) - Items that Vary between Alternatives			8,284,000			921,000
	Sub-Total, Alternative DW-A3 (10 mgd) - Common Items			5,998,000			455,000
	Total, Alternative DW-A3 (10 mgd)			14,282,000			1,376,000

Note: Salvage values only included for equipment replacements occuring within the 20-year planning period but after the initial project.

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
	Alternative DW-A3 (10 mgd), Page 4 of 4						
Varies	Demolition Items						
	Digester Bldg. - Equpment, Piping, & Electrical	Demo	2020	200,000			
	Sub-Total Alternative DW-A3 - Demolition Items			200,000			

Summary of Expenditures by Year - Items that Vary between Alternatives (Demolition not included)

Year	Amount ($)
2020	4,789,000
2023	600,000
2026	1,600,000
2028	835,000
2031	220,000
2036	240,000
Subtotal, Post 2020	3,495,000
Total	8,284,000

Summary of Expenditures by Year - Common Items (Demolition not included)

Year	Amount ($)
2020	4,113,000
2020	660,000
2024	975,000
2026	250,000
Subtotal, Post 2020	1,885,000
Total	5,998,000

Note: For 19.1 MGD scenarios, add $1.6 Million for Influent Pump Station upsizing of Pumps, Piping, and Electrical (based on scaling of DLSMB Contract 17 Influent Pump Station Upgrade), plus $0.5 Million for 1400 LF of 30-inch parallel influent forcemain. Total of $2.1 Million, all in initial project.

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Equipment Replacement Percent Life in 2040	Equipment Replacement Salvage Value ($)
	Alternative DW-B3 (10 mgd), Page 1 of 4						
Varies	Primary Clarifiers 1 - 4						
	Concrete	Rehab	2020	95,000			
	Metals	Replace	2020	158,000			
	Equipment	Replace	2023	600,000	30	43%	258,000
	Covers	Replace	2020	350,000			
	Electrical	Replace	2020	60,000			
Varies	Primary Sludge Pump Stations						
	Superstructure	Rehab	2020	42,000			
	Metals	Replace	2020	56,000			
	Equipment	Replace	2020	300,000	20	0	0
	Piping	Replace	2020	80,000			
	Electrical	Replace	2020	100,000			
	HVAC	Replace	2020	58,000			
Varies	Trickling Filters 1 - 4						
	Concrete (Filters 1 & 2)	Rehab	2020	1,200,000			
	Concrete (Filters 3 & 4)	Rehab	2026	1,600,000			
	Metals	Replace	2020	8,000			
	Equipment	Replace	2028	835,000	20	40%	334,000
Varies	Lagoon Blower Building						
	Metals	Replace	2020	5,000			
	Electrical	Rehab	2020	25,000			
Varies	Recirculation Pump Station						
	Concrete	Rehab	2020	40,000			
	Superstructure	Rehab	2020	4,000			
	Metals	Replace	2020	5,000			
	Pumps & VFDs	Replace	2031	220,000	20	55%	121,000
	Piping	Replace	2020	80,000			
	Electrical	Rehab	2020	150,000			
Varies	Final Clarifiers 1 & 2						
	Concrete	Rehab	2020	210,000			
	Metals	Replace	2020	320,000			
	Equipment - FC 1	Replace	2020	160,000			
	Equipment - FC 2	Replace	2036	240,000	30	87%	208,000
	Electrical	Replace	2020	10,000			

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
	Alternative DW-B3 (10 mgd), Page 2 of 4						
Varies	Final Sludge Pump Station						
	Metals	Replace	2020	33,000			
	Equipment	Rehab	2020	75,000	20	0	0
	Electrical	Replace	2020	40,000			
Varies	Chemical Feed Building						
	Concrete	Rehab	2020	15,000			
Common	Maintenance Building						
	Concrete	Rehab	2020	28,000			
	Superstructure	Rehab	2020	102,000			
	Electrical	Rehab	2020	180,000			
	HVAC	Replace	2020	150,000			
Common	Diversion Structure						
	Concrete	Rehab	2020	225,000			
	Metals	Rehab	2020	30,000			
	Electrical	Replace	2020	15,000			
Common	Influent Pump Station - Bar Screens						
	Superstructure	Rehab	2020	33,000			
	Equipment	Replace	2024	975,000	30	47%	455,000
	Electrical	Replace	2020	25,000			
Common	Influent Pump Station - Dry Weather Pumps						
	Superstructure	Rehab	2020	41,000			
	Metals	Rehab	2020	109,000			
	Pumps	Replace	2020	600,000	20	0	0
	VFDs	Replace	2026	250,000	10	0	0
	Piping	Replace	2020	100,000			
	Electrical	Replace	2020	200,000			
Varies	T.F. Effluent Pump Station						
	Concrete	Rehab	2020	5,000			
	Superstructure	Rehab	2020	10,000			
	Metals	Replace	2020	5,000			
	Pumps & VFDs	Rehab	2020	320,000	20	0	0
	Electrical	Rehab	2020	120,000			

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
	Alternative DW-B3 (10 mgd), Page 3 of 4						
Common	Digesters & Digester Building						
	Concrete	Rehab	2020	65,000			
	Superstructure	Rehab	2020	350,000			
	Metals	Replace	2020	245,000			
Common	Sludge Storage Tank						
	Metals	Replace	2020	60,000			
	Piping	Replace	2020	25,000			
	Electrical	Replace	2020	25,000			
Common	Odor Control Facility						
	Concrete	Rehab	2020	125,000			
	Equipment	Replace	2020	660,000			
	Electrical	Replace	2020	150,000			
Common	Solids Processing Building						
	Concrete	Rehab	2020	10,000			
	Superstructure	Rehab	2020	140,000			
	Metals	Replace	2020	105,000			
Varies	Plant Electrical						
	Substation	Replace	2020	500,000			
	Site Power Distribution	Replace	2020	150,000			
Common	Sitework & Utilities						
	Plant Water System	Replace	2020	275,000			
	Pavement - Roads & Parking	Replace	2020	700,000			
	Sub-Total, Alternative DW-B3 (10 mgd) - Items that Vary between Alternatives			8,284,000			921,000
	Sub-Total, Alternative DW-B3 (10 mgd) - Common Items			5,998,000			455,000
	Total, Alternative DW-B3 (10 mgd)			14,282,000			1,376,000

Note: Salvage values only included for equipment replacements occuring within the 20-year planning period but after the initial project.

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

Status		Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
	Alternative DW-B3 (10 mgd), Page 4 of 4						
Varies	Demolition Items						
	Digester Bldg. - Equpment, Piping, & Electrical	Demo	2020	200,000			
	Sub-Total Alternative DW-B3 - Demolition Items			200,000			

Summary of Expenditures by Year - Items that Vary between Alternatives (Demolition not included)

Year	Amount ($)
2020	4,789,000
2023	600,000
2026	1,600,000
2028	835,000
2031	220,000
2036	240,000
Subtotal, Post 2020	3,495,000
Total	8,284,000

Summary of Expenditures by Year - Common Items (Demolition not included)

Year	Amount ($)
2020	4,113,000
2020	660,000
2024	975,000
2026	250,000
Subtotal, Post 2020	1,885,000
Total	5,998,000

Note: For 19.1 MGD scenarios, add $1.6 Million for Influent Pump Station upsizing of Pumps, Piping, and Electrical (based on scaling of DLSMB Contract 17 Influent Pump Station Upgrade), plus $0.5 Million for 1400 LF of 30-inch parallel influent forcemain. Total of $2.1 Million, all in initial project.

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

	Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
Alternative DW-C1 (10 mgd), Page 1 of 3						
Primary Clarifiers 1 - 4						
Concrete	Rehab	2020	95,000			
Metals	Replace	2020	158,000			
Equipment	Replace	2023	600,000	30	43%	258,000
Covers	Replace	2020	350,000			
Electrical	Replace	2020	60,000			
Primary Sludge Pump Stations						
Superstructure	Rehab	2020	42,000			
Metals	Replace	2020	56,000			
Equipment	Replace	2020	300,000	20	0	0
Piping	Replace	2020	80,000			
Electrical	Replace	2020	100,000			
HVAC	Replace	2020	58,000			
Chemical Feed Building						
Concrete	Rehab	2020	15,000			
Maintenance Building						
Concrete	Rehab	2020	28,000			
Superstructure	Rehab	2020	102,000			
Electrical	Rehab	2020	180,000			
HVAC	Replace	2020	150,000			
Diversion Structure						
Concrete	Rehab	2020	225,000			
Metals	Rehab	2020	30,000			
Electrical	Replace	2020	15,000			
Influent Pump Station - Bar Screens						
Superstructure	Rehab	2020	33,000			
Equipment	Replace	2024	975,000	30	47%	455,000
Electrical	Replace	2020	25,000			
Influent Pump Station - Dry Weather Pumps						
Superstructure	Rehab	2020	41,000			
Metals	Rehab	2020	109,000			
Pumps	Replace	2020	600,000	20	0	0
VFDs	Replace	2026	250,000	10	0	0
Piping	Replace	2020	100,000			
Electrical	Replace	2020	200,000			

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

	Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
Alternative DW-C1 (10 mgd), Page 2 of 3						
Digesters & Digester Building						
Concrete	Rehab	2020	65,000			
Superstructure	Rehab	2020	350,000			
Metals	Replace	2020	245,000			
Sludge Storage Tank						
Metals	Replace	2020	60,000			
Piping	Replace	2020	25,000			
Electrical	Replace	2020	25,000			
Odor Control Facility						
Concrete	Rehab	2020	125,000			
Equipment	Replace	2020	660,000			
Electrical	Replace	2020	150,000			
Solids Processing Building						
Concrete	Rehab	2020	10,000			
Superstructure	Rehab	2020	140,000			
Metals	Replace	2020	105,000			
Plant Electrical						
Substation	Replace	2020	500,000			
Site Power Distribution	Replace	2020	150,000			
Sitework & Utilities						
Plant Water System	Replace	2020	275,000			
Pavement - Roads & Parking	Replace	2020	700,000			
Sub-Total, Alternative DW-C1 (10 mgd) - Items that Vary between Alternatives			2,564,000			258,000
Sub-Total, Alternative DW-C1 (10 mgd) - Common Items			5,998,000			455,000
Total, Alternative DW-C1			8,562,000			713,000

Note: Salvage values only included for equipment replacements occuring within the 20-year planning period but after the initial project.

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

	Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
Alternative DW-C1 (10 mgd), Page 3 of 3						
Demolition Items						
Digester Bldg. - Equpment, Piping, & Electrical	Demo	2020	200,000			
Final Clarifier 2	Demo	2020	120,000			
Chlorination Facility	Demo	2020	170,000			
Sub-Total Alternative DW-C1 - Demolition Items			490,000			

Summary of Expenditures by Year - Items that Vary between Alternatives (Demolition not included)

Year	Amount ($)
2020	1,964,000
2023	600,000
Subtotal, Post 2020	600,000
Total	2,564,000

Summary of Expenditures by Year - Common Items (Demolition not included)

Year	Amount ($)
2020	4,113,000
2020	660,000
2024	975,000
2026	250,000
Subtotal, Post 2020	1,885,000
Total	5,998,000

Note: For 19.1 MGD scenarios, add $1.6 Million for Influent Pump Station upsizing of Pumps, Piping, and Electrical (based on scaling of DLSMB Contract 17 Influent Pump Station Upgrade), plus $0.5 Million for 1400 LF of 30-inch parallel influent forcemain. Total of $2.1 Million, all in initial project.

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

	Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
Alternative DW-C4 (10 mgd), Page 1 of 3						
Maintenance Building						
Concrete	Rehab	2020	28,000			
Superstructure	Rehab	2020	102,000			
Electrical	Rehab	2020	180,000			
HVAC	Replace	2020	150,000			
Diversion Structure						
Concrete	Rehab	2020	225,000			
Metals	Rehab	2020	30,000			
Electrical	Replace	2020	15,000			
Influent Pump Station - Bar Screens						
Superstructure	Rehab	2020	33,000			
Equipment	Replace	2024	975,000	30	47%	455,000
Electrical	Replace	2020	25,000			
Influent Pump Station - Dry Weather Pumps						
Superstructure	Rehab	2020	41,000			
Metals	Rehab	2020	109,000			
Pumps	Replace	2020	600,000	20	0	0
VFDs	Replace	2026	250,000	10	0	0
Piping	Replace	2020	100,000			
Electrical	Replace	2020	200,000			
Digesters & Digester Building						
Concrete	Rehab	2020	65,000			
Superstructure	Rehab	2020	350,000			
Metals	Replace	2020	245,000			
Sludge Storage Tank						
Metals	Replace	2020	60,000			
Piping	Replace	2020	25,000			
Electrical	Replace	2020	25,000			
Odor Control Facility						
Concrete	Rehab	2020	125,000			
Equipment	Replace	2020	660,000			
Electrical	Replace	2020	150,000			

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

	Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)
Alternative DW-C4 (10 mgd), Page 2 of 3						
Solids Processing Building						
Concrete	Rehab	2020	10,000			
Superstructure	Rehab	2020	140,000			
Metals	Replace	2020	105,000			
Plant Electrical						
Substation	Replace	2020	250,000			
Site Power Distribution	Replace	2020	75,000			
Sitework & Utilities						
Plant Water System	Replace	2020	275,000			
Pavement - Roads & Parking	Replace	2020	700,000			
Sub-Total, Alternative DW-C4 (10 mgd) - Items that Vary between Alternatives			325,000			0
Sub-Total, Alternative DW-C4 (10 mgd) - Common Items			5,998,000			455,000
Total, Alternative DW-C4			6,323,000			455,000

Note: Salvage values only included for equipment replacements occuring within the 20-year planning period but after the initial project.

Demolition Items						
Digester Bldg. - Equpment, Piping, & Electrical	Demo	2020	200,000			
Final Clarifier 2	Demo	2020	120,000			
Chlorination Facility	Demo	2020	170,000			
Sub-Total Alternative DW-C4 - Demolition Items			490,000			

Table A.3. - Rehabilitation and Salvage Allowances for Retained Facilities

	Scope	Year	Cost (2011 $'s)	Equipment Replacement Effective Life (Years)	Percent Life in 2040	Salvage Value ($)

Alternative DW-C4 (10 mgd), Page 3 of 3

Summary of Expenditures by Year - Items that Vary between Alternatives (Demolition not included)

Year	Amount ($)
2020	325,000
Post 2020	0
Total	325,000

Summary of Expenditures by Year - Common Items (Demolition not included)

Year	Amount ($)
2020	4,113,000
2020	660,000
2024	975,000
2026	250,000
Subtotal, Post 2020	1,885,000
Total	5,998,000

Note: For 19.1 MGD scenarios, add $1.6 Million for Influent Pump Station upsizing of Pumps, Piping, and Electrical (based on scaling of DLSMB Contract 17 Influent Pump Station Upgrade), plus $0.5 Million for 1400 LF of 30-inch parallel influent forcemain. Total of $2.1 Million, all in initial project.

Tomahawk Creek WWTP
Pre-Design Study Update
Table A.4. - Existing O&M Budget Analysis and Breakdown by Unit Process
(2011 Dollars)

Item	Budget 2011	Screening/Grit Removal	%	Primary Clarifiers	%	Trickling Filters	%	Final Clarifiers	%	Sludge Pumping	%	Influent Pumping	%	Recirc Pumping	%	Effluent Pumping	%	Disinfection	%	Odor Control	%	Other	%
Personal Services																							
Labor & Benefits	$ 361,794	$ 36,179	10%	$ 36,179.40	10%	$ 72,359	20%	$ 18,090	5%	$ 18,090	5%	$ 36,179	10%	$ 18,090	5%	$ 18,090	5%	$ 54,269	15%	$ 18,090	5%	$ 36,179	10%
Sub Total Personal Services	$ 361,794																						
Contractual Services																							
Electricity	$ 138,136	$ 2,763	2%	$ 2,762.72	2%	$ 2,763	2%	$ 2,763	2%	$ 6,907	5%	$ 55,254	40%	$ 27,627	20%	$ 20,720	15%	$ 2,763	2%	$ 6,907	5%	$ 6,907	5%
Miscellaneous	$ 493,968	$ 74,095	15%	$ 49,396.80	10%	$ 49,397	10%	$ 49,397	10%	$ 49,397	10%	$ 49,397	10%	$ 24,698	5%	$ 24,698	5%	$ 49,397	10%	$ 49,397	10%	$ 24,698	5%
Sub Total Contractual Services	$ 632,104																						
Materials & Supplies																							
Chemical	$ 331,000	$ -	0%	$ 82,750.00	25%	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ 231,700	70%	$ 16,550	5%	$ -	0%
Miscellaneous	$ 168,943	$ 25,341	15%	$ 16,894.30	10%	$ 16,894	10%	$ 16,894	10%	$ 16,894	10%	$ 16,894	10%	$ 8,447	5%	$ 8,447	5%	$ 16,894	10%	$ 16,894	10%	$ 8,447	5%
Sub Total Materials & Supplies	$ 499,943																						
Total (6.0 mgd)	$ 1,493,841	$ 138,379		$ 187,983.22		$ 141,413		$ 87,144		$ 91,288		$ 157,725		$ 78,862		$ 71,956		$ 355,023		$ 107,838		$ 76,232	
Cost/mgd	$ 248,974	$ 23,063		$ 31,331		$ 23,569		$ 14,524		$ 15,215		$ 26,287		$ 13,144		$ 11,993		$ 59,170		$ 17,973		$ 12,705	
Total (10.0 mgd, assuming direct ratio)	$ 2,489,735	$ 230,631		$ 313,305		$ 235,688		$ 145,239		$ 152,146		$ 262,875		$ 131,437		$ 119,926		X		$ 179,729		$ 127,053	
Total (19.1 mgd, assuming direct ratio)	$ 4,755,394	$ 440,506		$ 598,413		$ 450,164		$ 277,407		$ 290,599		$ 502,091		$ 251,045		$ 229,059		X		$ 343,283		$ 242,671	

Note: Chemical cost adjusted from 2011 budget ($274,000) to actual cost incurred in 2010 ($331,000).

JCW Tomahawk WWTP Pre-Design Study Update
Table A.5. - Annual O&M Allowances for Retained Facilities

	10 MGD O&M Cost (2011 $'s)	19.1 MGD O&M Cost (2011 $'s)
Alternative DW-A3 - Items that Vary between Alternatives		
Primary Clarifiers	313,305	598,413
Sludge Pumping	152,146	290,599
Trickling Filters	235,688	450,164
Recirculation Pumping	131,437	251,045
Final Clarifiers	145,239	277,407
Effluent Pumping	119,926	229,059
Sub-Total, Alternative DW-A3 "Vary Items"	$1,097,742	$2,096,687
Alternative DW-A3 - Common Items		
Influent Pumping	262,875	502,091
Odor Control	179,729	343,283
Sub-Total, Alternative DW-A3 "Common Items"	$442,604	$845,374
Total, Alternative DW-A3	$1,540,346	$2,942,061
Alternative DW-B3 - Items that Vary between Alternatives		
Primary Clarifiers	313,305	598,413
Sludge Pumping	152,146	290,599
Trickling Filters	235,688	450,164
Recirculation Pumping	131,437	251,045
Final Clarifiers	145,239	277,407
Effluent Pumping	119,926	229,059
Sub-Total, Alternative DW-B3 "Vary Items"	$1,097,742	$2,096,687
Alternative DW-B3 - Common Items		
Influent Pumping	262,875	502,091
Odor Control	179,729	343,283
Sub-Total, Alternative DW-B3 "Common Items"	$442,604	$845,374
Total, Alternative DW-B3	$1,540,346	$2,942,061
Alternative DW-C1 - Items that Vary between Alternatives		
Primary Clarifiers	313,305	598,413
Sludge Pumping	152,146	290,599
Sub-Total, Alternative DW-C1 "Vary Items"	$465,451	$889,012
Alternative DW-C3 - Common Items		
Influent Pumping	262,875	502,091
Odor Control	179,729	343,283
Sub-Total, Alternative DW-C1 "Common Items"	$442,604	$845,374
Total, Alternative DW-C1	$908,056	$1,734,386
Alternative DW-C4 - Common Items		
Influent Pumping	262,875	502,091
Odor Control	179,729	343,283
Sub-Total, Alternative DW-C4 "Common Items"	$442,604	$845,374
Total, Alternative DW-C4	$442,604	$845,374

Appendix B
CPES Output

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	*Tomahawk WWTF - 2011 Update*
Project Number:	*382059.04*
Project Manager:	*Dale Gabel*
Estimator:	*E. Johnson*
Project Description:	*Alternative A3, 10 MGD, BNR*
Project Location (City):	*Kansas City*
Project Location (State):	*KANSAS*
Project Location (Country):	*USA*
Construction Start (Month):	*Jan*
Construction Start (Year):	*2018*
Construction Duration (months):	*24*
Mid-Point of Construction:	*Jan/2019*

SCOPE OF PROJECT		*Year 0 COST*
Liquid Chemical: Ferric		**$532,872**
MBBR: New		**$7,914,379**
Filters: DenFilt		**$7,200,241**
Liquid Chemical: Methanol		**$493,016**
Liquid Polymer: New		**$415,868**
GBT: Dig_Feed		**$2,761,601**
Blowers: Bldg_MBBR		**$1,582,617**
Submersible IPS: intoMBBR		**$1,793,968**
U.D. Facility: Retain_Fac		**$4,789,000**
SUBTOTAL - PROJECT COST		**$27,483,562**
ADDITIONAL PROJECT COSTS:		
Demolition	**Ref Appendix**	**$200,000**
Overall Sitework	**6.0%**	**$1,649,014**
Plant Computer System	**8.5%**	**$2,336,103**
Yard Electrical	**5.8%**	**$1,594,047**
Yard Piping	**10.0%**	**$2,748,357**
SUBTOTAL with Additional Project Costs		**$36,011,083**
CONTRACTOR MARKUPS:		
Overhead	**10%**	**$3,602,000**
Subtotal		**$39,613,083**
Profit	**5%**	**$1,981,000**
Subtotal		**$41,594,083**
Mob/Bonds/Insurance	**5%**	**$2,080,000**
Subtotal		**$43,674,083**
Contingency	**30%**	**$13,103,000**
SUBTOTAL with Markups		**$56,778,000**
TOTAL - CONSTRUCTION COST		**$56,778,000**
NON-CONSTRUCTION COSTS:		
Engineering/Admin	**25%**	**$14,195,000**
SUBTOTAL - Non-Construction Costs		**$70,973,000**
TOTAL - CAPITAL COST		**$70,973,000**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	*Tomahawk WWTF - 2011 Update*	*Life Cycle Analysis:*	
Project Number:	*382059.04*	*i =*	*2.10%*
Project Manager:	*Dale Gabel*	*n =*	*20*
Estimator:	*E. Johnson*	*Annual Inflation %:*	*0.00%*
Project Description:	*Alternative A3, 10 MGD, BNR*		
Project Location (City):	*Kansas City*		
Project Location (State):	*KANSAS*		
Project Location (Country):	*USA*		
Construction Start (Month):	*Jan*		
Construction Start (Year):	*2018*		
Construction Duration (months):	*24*		
Mid-Point of Construction:	*Jan/2019*		

SCOPE OF PROJECT	*Year 0 Construction Cost*	*Annual O&M Cost (Escalated)*	*Life Cycle Cost (NPV)*
Liquid Chemical: Ferric	**$1,049,630**	**$178,889**	**$3,946,677**
MBBR: New	**$15,589,442**	**$380,056**	**$21,744,337**
Filters: DenFilt	**$14,182,761**	**$214,359**	**$17,654,238**
Liquid Chemical: Methanol	**$971,123**	**$1,136,665**	**$19,379,096**
Liquid Polymer: New	**$819,161**	**$107,520**	**$2,560,416**
GBT: Dig_Feed	**$3,117,377**	**$265,435**	**$7,416,021**
Blowers: Bldg_MBBR	**$5,439,695**	**$81,591**	**$6,761,024**
Submersible IPS: intoMBBR	**$3,533,690**	**$81,792**	**$4,858,282**
U.D. Facility: Retain_Fac	**$9,433,190**	**$1,720,282**	**$37,292,690**

Additional Project Costs:			
Biosolids Disposal	**$0**	**$0**	**$0**
Standard Items	**$16,797,186**	**$568,299**	**$26,000,634**
User Defined Items	**$0**	**$0**	**$0**

Plant O & M Labor (based on wage, influent BOD, and solids handling)		**$59,905**	**$970,130**

TOTAL - Life Cycle Analysis	**$70,933,255**	**$4,794,793**	**$148,583,545**

Construction Cost per GPD	**$7.09**	**/ GPD**	
Annual O & M Cost per 1,000 Gallons		**$1.31**	**/Thousand Gal.**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	*Tomahawk WWTF - 2011 Update*
Project Number:	*382059.04*
Project Manager:	*Dale Gabel*
Estimator:	*E. Johnson*
Project Description:	*Alternative B3, 10 MGD, BNR*
Project Location (City):	*Kansas City*
Project Location (State):	*KANSAS*
Project Location (Country):	*USA*
Construction Start (Month):	*Jan*
Construction Start (Year):	*2018*
Construction Duration (months):	*24*
Mid-Point of Construction:	*Jan/2019*

SCOPE OF PROJECT		*COST*
Liquid Chemical: Ferric		**$456,611**
Liquid Chemical: Polymer		**$220,822**
Liquid Chemical: Methanol		**$382,759**
Aeration Basin: 3_Stage		**$6,875,362**
Blowers: New		**$2,149,024**
GBT: Dig_Feed		**$2,761,601**
Submersible IPS: Flood_PS		**$1,774,082**
U.D. Facility: Retain_Fac		**$4,789,000**
SUBTOTAL - PROJECT COST		**$19,409,261**
ADDITIONAL PROJECT COSTS:		
Demolition	**Ref Appendix**	**$200,000**
Overall Sitework	**9.0%**	**$1,746,834**
Plant Computer System	**8.5%**	**$1,649,788**
Yard Electrical	**10.0%**	**$1,940,927**
Yard Piping	**17.0%**	**$3,299,575**
SUBTOTAL with Additional Project Costs		**$28,246,385**
CONTRACTOR MARKUPS:		
Overhead	**10%**	**$2,825,000**
Subtotal		**$31,071,385**
Profit	**5%**	**$1,554,000**
Subtotal		**$32,625,385**
Mob/Bonds/Insurance	**5%**	**$1,632,000**
Subtotal		**$34,257,385**
Contingency	**30%**	**$10,278,000**
SUBTOTAL with Markups		**$44,536,000**
TOTAL - CONSTRUCTION COST		**$44,536,000**
NON-CONSTRUCTION COSTS:		
Engineering/Admin	**25%**	**$11,134,000**
SUBTOTAL - Non-Construction Costs		**$55,670,000**
TOTAL - CAPITAL COST		**$55,670,000**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	Tomahawk WWTF - 2011 Update	Life Cycle Analysis:	
Project Number:	382059.04	i =	2.10%
Project Manager:	Dale Gabel	n =	20
Estimator:	E. Johnson	Annual Inflation %:	0.00%
Project Description:	Alternative B3, 10 MGD, BNR		
Project Location (City):	Kansas City		
Project Location (State):	KANSAS		
Project Location (Country):	USA		
Construction Start (Month):	Jan		
Construction Start (Year):	2018		
Construction Duration (months):	24		
Mid-Point of Construction:	Jan/2019		

SCOPE OF PROJECT	Year 0 Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
Liquid Chemical: Ferric	$899,414	$64,239	$1,939,747
Liquid Chemical: Polymer	$434,965	$73,287	$1,621,819
Liquid Chemical: Methanol	$753,944	$74,062	$1,953,358
Aeration Basin: 3_Stage	$13,542,826	$161,576	$16,159,494
Blowers: New	$4,233,065	$323,636	$9,474,249
GBT: Dig_Feed	$5,439,695	$81,591	$6,761,024
Submersible IPS: Flood_PS	$3,494,519	$42,961	$4,190,256
U.D. Facility: Retain_Fac	$9,433,190	$1,720,282	$37,292,690
Additional Project Costs:			
Biosolids Disposal	$0	$0	$0
Standard Items	$17,407,031	$586,321	$26,902,331
User Defined Items	$0	$0	$0
Plant O & M Labor (based on wage, influent BOD, and solids handling)		$59,905	$970,130
TOTAL - Life Cycle Analysis	$55,638,649	$3,187,860	$107,265,098

Construction Cost per GPD	$5.56	/ GPD	
Annual O & M Cost per 1,000 Gallons		$0.87	/Thousand Gal.

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	*Tomahawk WWTF - 2011 Update*
Project Number:	*382059.04*
Project Manager:	*Dale Gabel*
Estimator:	*E. Johnson*
Project Description:	*Alternative C1, 10 MGD, BNR*
Project Location (City):	*Kansas City*
Project Location (State):	*KANSAS*
Project Location (Country):	*USA*
Construction Start (Month):	*Jan*
Construction Start (Year):	*2018*
Construction Duration (months):	*24*
Mid-Point of Construction:	*Jan/2019*

SCOPE OF PROJECT		*COST*
Aeration Basin: Default_1		**$10,646,627**
Blowers: Default_1		**$2,149,839**
GBT: Dig_Feed		**$3,323,753**
Round SC: Default_1		**$1,774,082**
Submersible IPS: Flood_PS		**$2,761,601**
U.D. Facility: Retain_Fac		**$1,964,000**
RAS WAS PS: New		**$2,099,510**
SUBTOTAL - PROJECT COST		**$24,719,412**
ADDITIONAL PROJECT COSTS:		
Demolition	**Ref Appendix**	**$490,000**
Overall Sitework	**7.5%**	**$1,853,956**
Plant Computer System	**8.5%**	**$2,101,151**
Yard Electrical	**10.0%**	**$2,471,942**
Yard Piping	**15.0%**	**$3,707,912**
SUBTOTAL with Additional Project Costs		**$35,344,373**
CONTRACTOR MARKUPS:		
Overhead	**10%**	**$3,535,000**
Subtotal		**$38,879,373**
Profit	**5%**	**$1,944,000**
Subtotal		**$40,823,373**
Mob/Bonds/Insurance	**5%**	**$2,042,000**
Subtotal		**$42,865,373**
Contingency	**30%**	**$12,860,000**
SUBTOTAL with Markups		**$55,726,000**
TOTAL - CONSTRUCTION COST		**$55,726,000**
NON-CONSTRUCTION COSTS:		
Engineering/Admin	**25%**	**$13,932,000**
SUBTOTAL - Non-Construction Costs		**$69,658,000**
TOTAL - CAPITAL COST		**$69,658,000**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	*Tomahawk WWTF - 2011 Update*	*Life Cycle Analysis:*	
Project Number:	*382059.04*	*i =*	*2.10%*
Project Manager:	*Dale Gabel*	*n =*	*20*
	E. Johnson	*Annual Inflation %:*	*0.00%*
Estimator:			
Project Description:	*Alternative C1, 10 MGD, BNR*		
Project Location (City):	*Kansas City*		
Project Location (State):	*KANSAS*		
Project Location (Country):	*USA*		
Construction Start (Month):	*Jan*		
Construction Start (Year):	*2018*		
Construction Duration (months):	*24*		
Mid-Point of Construction:	*Jan/2019*		

SCOPE OF PROJECT	*Year 0 Construction Cost*	*Annual O&M Cost (Escalated)*	*Life Cycle Cost (NPV)*
Aeration Basin: Default_1	**$20,971,319**	**$174,399**	**$23,795,653**
Blowers: Default_1	**$4,234,671**	**$335,509**	**$9,668,140**
GBT: Dig_Feed	**$6,547,001**	**$53,864**	**$7,419,305**
Round SC: Default_1	**$5,439,695**	**$81,591**	**$6,761,023**
Submersible IPS: Flood_PS	**$3,494,519**	**$42,961**	**$4,190,256**
U.D. Facility: Retain_Fac	**$3,868,613**	**$690,091**	**$15,044,449**
RAS WAS PS: New	**$4,135,535**	**$60,549**	**$5,116,095**

Additional Project Costs:			
Biosolids Disposal	**$0**	**$0**	**$0**
Standard Items	**$20,928,643**	**$704,662**	**$32,340,445**
User Defined Items	**$0**	**$0**	**$0**
Plant O & M Labor (based on wage, influent BOD, and solids handling)		**$59,905**	**$970,130**
TOTAL - Life Cycle Analysis (Construction only)	**$69,619,996**	**$2,203,531**	**$105,305,496**

Construction Cost per GPD	**$6.96**	**/ GPD**	
Annual O & M Cost per 1,000 Gallons		**$0.60**	**/Thousand Gal.**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	*Tomahawk WWTF - 2011 Update*
Project Number:	*382059.04*
Project Manager:	*Dale Gabel*
Estimator:	*E. Johnson*
Project Description:	*Alternative C4, 10 MGD, BNR*
Project Location (City):	*Kansas City*
Project Location (State):	*KANSAS*
Project Location (Country):	*USA*
Construction Start (Month):	*Jan*
Construction Start (Year):	*2018*
Construction Duration (months):	*24*
Mid-Point of Construction:	*Jan/2019*

SCOPE OF PROJECT		*COST*
Liquid Chemical: Ferric		**$513,506**
Liquid Chemical: Polymer		**$438,112**
Liquid Chemical: Methanol		**$383,670**
MBBR: New		**$19,290,071**
DAF: New		**$3,626,434**
Screening and Grit: New_3mmScr		**$2,458,832**
Blowers: Bldg_MBBR		**$1,901,877**
U.D. Facility: Retain_Fac		**$325,000**
SUBTOTAL - PROJECT COST		**$28,937,502**
ADDITIONAL PROJECT COSTS:		
Demolition	**Ref Appendix**	**$490,000**
Overall Sitework	**7.5%**	**$2,170,313**
Plant Computer System	**8.5%**	**$2,459,688**
Yard Electrical	**10.0%**	**$2,893,751**
Yard Piping	**15.0%**	**$4,340,626**
SUBTOTAL with Additional Project Costs		**$41,291,880**
CONTRACTOR MARKUPS:		
Overhead	**10%**	**$4,130,000**
Subtotal		**$45,421,880**
Profit	**5%**	**$2,272,000**
Subtotal		**$47,693,880**
Mob/Bonds/Insurance	**5%**	**$2,385,000**
Subtotal		**$50,078,880**
Contingency	**30%**	**$15,024,000**
SUBTOTAL with Markups		**$65,103,000**
TOTAL - CONSTRUCTION COST		**$65,103,000**
NON-CONSTRUCTION COSTS:		
Engineering/Admin	**25%**	**$16,276,000**
SUBTOTAL - Non-Construction Costs		**$81,379,000**
TOTAL - CAPITAL COST		**$81,379,000**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	*Tomahawk WWTF - 2011 Update*	*Life Cycle Analysis:*	
Project Number:	*382059.04*	*i =*	*2.10%*
Project Manager:	*Dale Gabel*	*n =*	*20*
Estimator:	*E. Johnson*	*Annual Inflation %:*	*0.00%*
Project Description:	*Alternative C4, 10 MGD, BNR*		
Project Location (City):	*Kansas City*		
Project Location (State):	*KANSAS*		
Project Location (Country):	*USA*		
Construction Start (Month):	*Jan*		
Construction Start (Year):	*2018*		
Construction Duration (months):	*24*		
Mid-Point of Construction:	*Jan/2019*		

SCOPE OF PROJECT	*Year 0 Construction Cost*	*Annual O&M Cost (Escalated)*	*Life Cycle Cost (NPV)*
Liquid Chemical: Ferric	**$1,011,485**	**$266,362**	**$5,325,142**
Liquid Chemical: Polymer	**$862,976**	**$145,058**	**$3,212,140**
Liquid Chemical: Methanol	**$755,737**	**$406,772**	**$7,343,286**
MBBR: New	**$37,996,846**	**$1,130,102**	**$56,298,539**
DAF: New	**$7,143,211**	**$178,906**	**$10,040,534**
Screening and Grit: New_3mmScr	**$4,843,314**	**$167,941**	**$7,563,065**
Blowers: Bldg_MBBR	**$3,746,244**	**$391,679**	**$10,089,371**
U.D. Facility: Retain_Fac	**$640,173**	**$0**	**$640,173**
Additional Project Costs:			
Biosolids Disposal	**$0**	**$0**	**$0**
Standard Items	**$24,335,183**	**$824,904**	**$37,694,280**
User Defined Items	**$0**	**$0**	**$0**
Plant O & M Labor (based on wage, influent BOD, and solids handling)		**$59,905**	**$970,130**
TOTAL - Life Cycle Analysis (Construction only)	**$81,335,169**	**$3,571,629**	**$139,176,660**

Construction Cost per GPD	**$8.13 / GPD**	
Annual O & M Cost per 1,000 Gallons	**$ 0.979**	**/Thousand Gal.**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	*Tomahawk WWTF - 2011 Update*
Project Number:	*382059.04*
Project Manager:	*Dale Gabel*
Estimator:	*E. Johnson*
Project Description:	*Alternative A3, 19.1 MGD, BNR*
Project Location (City):	*Kansas City*
Project Location (State):	*KANSAS*
Project Location (Country):	*USA*
Construction Start (Month):	*Jan*
Construction Start (Year):	*2018*
Construction Duration (months):	*24*
Mid-Point of Construction:	*Jan/2019*

SCOPE OF PROJECT		*Year 0 COST*
Liquid Chemical: Ferric		$735,801
MBBR: 10_MGD		$7,914,379
Filters: DenFilt		$13,645,724
Liquid Chemical: Methanol		$649,229
DAF: New		$3,626,434
Screening and Grit: New		$2,439,482
Liquid Chemical: Polymer		$806,777
MBBR: 9_MGD		$10,486,192
Blowers: Bldg_MBBR		$3,325,744
GBT: Dig_Feed		$2,761,601
Submersible IPS: intoMBBR		$1,793,968
Submersible IPS: toDentFltr		$1,719,017
U.D. Facility: Retain_Fac		$4,789,000
SUBTOTAL - PROJECT COST		$54,693,348
ADDITIONAL PROJECT COSTS:		
Demolition	Ref Appendix	$200,000
Overall Sitework	6.0%	$3,281,601
Plant Computer System	8.5%	$4,648,935
Yard Electrical	5.8%	$3,172,215
Yard Piping	10.0%	$5,469,335
SUBTOTAL with Additional Project Costs		$71,465,434
CONTRACTOR MARKUPS:		
Overhead	10%	$7,147,000
Subtotal		$78,612,434
Profit	5%	$3,931,000
Subtotal		$82,543,434
Mob/Bonds/Insurance	5%	$4,128,000
Subtotal		$86,671,434
Contingency	30%	$26,002,000
SUBTOTAL with Markups		$112,674,000
TOTAL - CONSTRUCTION COST		$112,674,000
NON-CONSTRUCTION COSTS:		
Engineering/Admin	25%	$28,169,000
SUBTOTAL - Non-Construction Costs		$140,843,000
TOTAL - CAPITAL COST		$140,843,000

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	*Tomahawk WWTF - 2011 Update*	*Life Cycle Analysis:*	
Project Number:	*382059.04*	*i =*	*2.10%*
Project Manager:	*Dale Gabel*	*n =*	*20*
	E. Johnson	*Annual Inflation %:*	*0.00%*
Estimator:			
Project Description:	*Alternative A3, 19.1 MGD, BNR*		
Project Location (City):	*Kansas City*		
Project Location (State):	*KANSAS*		
Project Location (Country):	*USA*		
Construction Start (Month):	*Jan*		
Construction Start (Year):	*2018*		
Construction Duration (months):	*24*		
Mid-Point of Construction:	*Jan/2019*		

SCOPE OF PROJECT	*Year 0 Construction Cost*	*Annual O&M Cost (Escalated)*	*Life Cycle Cost (NPV)*
Liquid Chemical: Ferric	$1,449,352	$338,663	$6,933,893
MBBR: 10_MGD	$15,589,441	$380,056	$21,744,336
Filters: DenFilt	$26,878,825	$418,689	$33,659,372
Liquid Chemical: Methanol	$1,278,825	$2,166,814	$36,369,786
DAF: New	$7,143,211	$178,906	$10,040,534
Screening and Grit: New	$4,805,197	$170,483	$7,566,119
Liquid Chemical: Polymer	$1,589,157	$277,975	$6,090,882
MBBR: 9_MGD	$20,655,299	$510,605	$28,924,406
Blowers: Bldg_MBBR	$6,550,924	$570,232	$15,785,671
GBT: Dig_Feed	$5,439,695	$81,591	$6,761,023
Submersible IPS: intoMBBR	$3,533,690	$81,792	$4,858,282
Submersible IPS: toDentFltr	$3,386,054	$76,480	$4,624,622
U.D. Facility: Retain_Fac	$9,433,190	$3,158,765	$60,588,520

Additional Project Costs:			
Biosolids Disposal	$0	$0	$0
Standard Items	$33,037,015	$1,130,937	$51,352,228
User Defined Items	$0	$0	$0

Plant O & M Labor (based on wage, influent BOD, and solids handling)	$0	$59,905	$970,130

TOTAL - Life Cycle Analysis (Construction only)	$140,769,875	$9,601,893	$296,269,804

Construction Cost per GPD	$7.37 / GPD		
Annual O & M Cost per 1,000 Gallons		$ 1.377	/Thousand Gal.

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	Tomahawk WWTF - 2011 Update
Project Number:	382059.04
Project Manager:	Dale Gabel
Estimator:	E. Johnson
Project Description:	Alternative B3, 19.1 MGD, BNR
Project Location (City):	Kansas City
Project Location (State):	KANSAS
Project Location (Country):	USA
Construction Start (Month):	Jan
Construction Start (Year):	2018
Construction Duration (months):	24
Mid-Point of Construction:	Jan/2019

SCOPE OF PROJECT		COST
Liquid Chemical: Methanol		$462,978
Aeration Basin: 10_MGD		$6,875,362
Aeration Basin: 9_MGD		$9,330,655
Blowers: 10_MGD		$3,586,142
Round SC: 9_MGD		$2,445,126
Round PC: 9_MGD		$2,149,024
Blowers: 9_MGD		$2,769,957
GBT: Dig_Feed		$3,963,700
Submersible IPS: Flood_PS		$2,083,564
U.D. Facility: Retain_Fac		$4,789,000
Liquid Chemical: Ferric		$453,985
Liquid Chemical: Polymer		$257,109
RAS WAS PS: 9_MGD		$2,091,299
SUBTOTAL - PROJECT COST		$41,257,901
ADDITIONAL PROJECT COSTS:		
Demolition	Ref Appendix	$200,000
Overall Sitework	9.0%	$3,713,212
Plant Computer System	8.5%	$3,506,922
Yard Electrical	10.0%	$4,125,791
Yard Piping	17.0%	$7,013,844
SUBTOTAL with Additional Project Costs		$59,817,670
CONTRACTOR MARKUPS:		
Overhead	10%	$5,982,000
Subtotal		$65,799,670
Profit	5%	$3,290,000
Subtotal		$69,089,670
Mob/Bonds/Insurance	5%	$3,455,000
Subtotal		$72,544,670
Contingency	30%	$21,764,000
SUBTOTAL with Markups		$94,308,670
TOTAL - CONSTRUCTION COST		$94,308,670
NON-CONSTRUCTION COSTS:		
Engineering/Admin	25%	$23,578,000
SUBTOTAL - Non-Construction Costs		$117,886,670
TOTAL - CAPITAL COST		$117,886,670

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	*Tomahawk WWTF - 2011 Update*	*Life Cycle Analysis:*	
Project Number:	*382059.04*	*i =*	*2.10%*
Project Manager:	*Dale Gabel*	*n =*	*20*
	E. Johnson	*Annual Inflation %:*	*0.00%*
Estimator:			
Project Description:	*Alternative B3, 19.1 MGD, BNR*		
Project Location (City):	*Kansas City*		
Project Location (State):	*KANSAS*		
Project Location (Country):	*USA*		
Construction Start (Month):	*Jan*		
Construction Start (Year):	*2018*		
Construction Duration (months):	*24*		
Mid-Point of Construction:	*Jan/2019*		

SCOPE OF PROJECT	*Year 0 Construction Cost*	*Annual O&M Cost (Escalated)*	*Life Cycle Cost (NPV)*
Liquid Chemical: Methanol	**$911,955**	**$140,737**	**$3,191,137**
Aeration Basin: 10_MGD	**$13,542,825**	**$161,576**	**$16,159,493**
Aeration Basin: 9_MGD	**$18,379,167**	**$156,504**	**$20,913,693**
Blowers: 10_MGD	**$7,063,845**	**$28,875**	**$7,531,462**
Round SC: 9_MGD	**$4,816,315**	**$42,081**	**$5,497,795**
Round PC: 9_MGD	**$4,233,065**	**$323,636**	**$9,474,249**
Blowers: 9_MGD	**$4,104,123**	**$279,053**	**$8,623,299**
GBT: Dig_Feed	**$7,807,544**	**$122,969**	**$9,798,984**
Submersible IPS: Flood_PS	**$5,456,156**	**$74,349**	**$6,660,216**
U.D. Facility: Retain_Fac	**$9,433,190**	**$3,158,765**	**$60,588,520**
Liquid Chemical: Ferric	**$894,242**	**$121,225**	**$2,857,440**
Liquid Chemical: Polymer	**$506,443**	**$73,078**	**$1,689,914**
RAS WAS PS: 9_MGD	**$4,119,361**	**$56,871**	**$5,040,363**

Additional Project Costs:			
Biosolids Disposal	**$0**	**$0**	**$0**
Standard Items	**$36,558,324**	**$1,246,330**	**$56,742,299**
User Defined Items	**$0**	**$0**	**$0**

Plant O & M Labor (based on wage, influent BOD, and solids handling)	**$59,905**	**$970,130**

TOTAL - Life Cycle Analysis (Construction only)	**$117,826,555**	**$6,045,954**	**$215,738,994**

Construction Cost per GPD	**$6.17**	**/ GPD**	
Annual O & M Cost per 1,000 Gallons		**$ 0.867**	**/Thousand Gal.**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	*Tomahawk WWTF - 2011 Update*
Project Number:	*382059.04*
Project Manager:	*Dale Gabel*
Estimator:	*E. Johnson*
Project Description:	*Alternative C1, 19.1 MGD, BNR*
Project Location (City):	*Kansas City*
Project Location (State):	*KANSAS*
Project Location (Country):	*USA*
Construction Start (Month):	*Jan*
Construction Start (Year):	*2018*
Construction Duration (months):	*24*
Mid-Point of Construction:	*Jan/2019*

SCOPE OF PROJECT		*COST*
Round PC: Main		**$1,890,423**
Aeration Basin: Default_1		**$19,856,808**
Blowers: Default_1		**$2,746,438**
Round SC: Default_1		**$5,121,084**
GBT: Dig_Feed		**$3,963,700**
Submersible IPS: Flood_PS		**$2,769,957**
U.D. Facility: Retain_FAC		**$1,964,000**
RAS WAS PS: New		**$2,354,494**
Liquid Chemical: Ferric		**$453,985**
Liquid Chemical: Polymer		**$259,195**
SUBTOTAL - PROJECT COST		**$41,380,084**
ADDITIONAL PROJECT COSTS:		
Demolition	**Ref Appendices**	**$490,000**
Overall Sitework	**7.5%**	**$3,103,507**
Plant Computer System	**8.5%**	**$3,517,308**
Yard Electrical	**10.0%**	**$4,138,009**
Yard Piping	**15.0%**	**$6,207,013**
SUBTOTAL with Additional Project Costs		**$58,835,921**
CONTRACTOR MARKUPS:		
Overhead	**10%**	**$5,884,000**
Subtotal		**$64,719,921**
Profit	**5%**	**$3,236,000**
Subtotal		**$67,955,921**
Mob/Bonds/Insurance	**5%**	**$3,398,000**
Subtotal		**$71,353,921**
Contingency	**30%**	**$21,407,000**
SUBTOTAL with Markups		**$92,760,921**
TOTAL - CONSTRUCTION COST		**$92,760,921**
NON-CONSTRUCTION COSTS:		
Engineering/Admin	**25%**	**$23,191,000**
SUBTOTAL - Non-Construction Costs		**$115,952,000**
TOTAL - CAPITAL COST		**$115,952,000**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	*Tomahawk WWTF - 2011 Update*	*Life Cycle Analysis:*	
Project Number:	*382059.04*	*i =*	*2.10%*
Project Manager:	*Dale Gabel*	*n =*	*20*
Estimator:	*E. Johnson*	*Annual Inflation %:*	*0.00%*
Project Description:	*Alternative C1, 19.1 MGD, BNR*		
Project Location (City):	*Kansas City*		
Project Location (State):	*KANSAS*		
Project Location (Country):	*USA*		
Construction Start (Month):	*Jan*		
Construction Start (Year):	*2018*		
Construction Duration (months):	*24*		
Mid-Point of Construction:	*Jan/2019*		

SCOPE OF PROJECT	*Year 0 Construction Cost*	*Annual O&M Cost (Escalated)*	*Life Cycle Cost (NPV)*
Round PC: Main	**$3,723,682**	**$14,818**	**$3,963,652**
Aeration Basin: Default_1	**$39,113,183**	**$305,956**	**$44,068,049**
Blowers: Default_1	**$5,409,829**	**$556,278**	**$14,418,594**
Round SC: Default_1	**$10,087,315**	**$75,013**	**$11,302,121**
GBT: Dig_Feed	**$7,807,544**	**$122,969**	**$9,798,984**
Submersible IPS: Flood_PS	**$5,456,156**	**$74,349**	**$6,660,216**
U.D. Facility: Retain_FAC	**$3,868,613**	**$1,300,019**	**$24,922,066**
RAS WAS PS: New	**$4,637,792**	**$94,849**	**$6,173,844**
Liquid Chemical: Ferric	**$894,242**	**$116,096**	**$2,774,382**
Liquid Chemical: Polymer	**$510,552**	**$136,536**	**$2,721,714**

Additional Project Costs:			
Biosolids Disposal	**$0**	**$0**	**$0**
Standard Items	**$34,383,842**	**$1,179,598**	**$53,487,098**
User Defined Items	**$0**	**$0**	**$0**
Plant O & M Labor (based on wage, influent BOD, and solids handling)		**$59,905**	**$970,130**
TOTAL - Life Cycle Analysis (Construction only)	**$115,892,750**	**$4,036,386**	**$181,260,850**

Construction Cost per GPD	**$6.07**	**/ GPD**	
Annual O & M Cost per 1,000 Gallons		**$ 0.579**	**/Thousand Gal.**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES DESIGN & CONSTRUCTION COST MODULE

Project Name:	*Tomahawk WWTF - 2011 Update*
Project Number:	*382059.04*
Project Manager:	*Dale Gabel*
Estimator:	*E. Johnson*
Project Description:	*Alternative C4, 19.1 MGD, BNR*
Project Location (City):	*Kansas City*
Project Location (State):	*KANSAS*
Project Location (Country):	*USA*
Construction Start (Month):	*Jan*
Construction Start (Year):	*2018*
Construction Duration (months):	*24*
Mid-Point of Construction:	*Jan/2019*

SCOPE OF PROJECT		*COST*
Liquid Chemical: Ferric		**$531,922**
Liquid Chemical: Polymer		**$699,409**
Liquid Chemical: Methanol		**$404,946**
Screening and Grit: 9_MGD		**$2,132,614**
MBBR: New		**$35,062,344**
DAF: New		**$6,244,302**
Blowers: Bldg_MBBR		**$3,056,070**
U.D. Facility: Retain_Fac		**$325,000**
SUBTOTAL - PROJECT COST		**$48,456,607**
ADDITIONAL PROJECT COSTS:		
Demolition	**Ref Appendices**	**$490,000**
Overall Sitework	**7.5%**	**$3,634,246**
Plant Computer System	**8.5%**	**$4,118,812**
Yard Electrical	**10.0%**	**$4,845,661**
Yard Piping	**15.0%**	**$7,268,492**
SUBTOTAL with Additional Project Costs		**$68,813,818**
CONTRACTOR MARKUPS:		
Overhead	**10%**	**$6,881,382**
Subtotal		**$75,695,200**
Profit	**5%**	**$3,785,000**
Subtotal		**$79,480,200**
Mob/Bonds/Insurance	**5%**	**$3,974,000**
Subtotal		**$83,454,000**
Contingency	**30%**	**$25,036,000**
SUBTOTAL with Markups		**$108,490,000**
TOTAL - CONSTRUCTION COST		**$108,490,000**
NON-CONSTRUCTION COSTS:		
Engineering/Admin	**25%**	**$27,123,000**
SUBTOTAL - Non-Construction Costs		**$135,613,000**
TOTAL - CAPITAL COST		**$135,613,000**

C H2M HILL P arametric Cost E stimating S ystem (CPES)
FACILITIES LIFE CYCLE COST ANALYSIS

Project Name:	Tomahawk WWTF - 2011 Update	Life Cycle Analysis:	
Project Number:	382059.04	i =	2.10%
Project Manager:	Dale Gabel	n =	20
Estimator:	E. Johnson	Annual Inflation %:	0.00%
Project Description:	Alternative C4, 19.1 MGD, BNR		
Project Location (City):	Kansas City		
Project Location (State):	KANSAS		
Project Location (Country):	USA		
Construction Start (Month):	Jan		
Construction Start (Year):	2018		
Construction Duration (months):	24		
Mid-Point of Construction:	Jan/2019		

SCOPE OF PROJECT	Year 0 Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
Liquid Chemical: Ferric	$1,047,759	$500,715	$9,156,702
Liquid Chemical: Polymer	$1,377,669	$272,527	$5,791,168
Liquid Chemical: Methanol	$797,647	$771,188	$13,286,819
Screening and Grit: 9_MGD	$4,200,742	$236,311	$8,027,724
MBBR: New	$69,064,466	$2,028,428	$101,914,308
DAF: New	$12,299,787	$319,184	$17,468,882
Blowers: Bldg_MBBR	$6,019,730	$743,934	$18,067,527
U.D. Facility: Retain_Fac	$640,173	$0	$640,173
Additional Project Costs:			
Biosolids Disposal	$0	$0	$0
Standard Items	$40,098,857	$1,381,324	$62,469,013
User Defined Items	$0	$0	$0
Plant O & M Labor (based on wage, influent BOD, and solids handling)		$59,905	$970,130
TOTAL - Life Cycle Analysis (Construction only)	$135,546,830	$6,313,516	$237,792,446

Construction Cost per GPD	$7.10 / GPD	
Annual O & M Cost per 1,000 Gallons	$ 0.906	/Thousand Gal.

CPES Additional Project Cost
Alternative A3
WWTP Percentage Allowance Calculator

1.) Overall Sitework

Suggested percentage range for "Rehab" Project:	5 to 10%
Suggested percentage range for "Greenfield" Project:	12 to 20%
Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Low
Rock Excavation?	Yes
Groundwater?	No
Overall Sitework	**6.0**

2.) Plant Computer System

Suggested percentage range:	7 to 10%
Level of Sophistication?	Average
Plant Computer System	**8.5**

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power:	5 to 8%
Suggested percentage range for Plant without Available Primary Power:	10 to 25%
Is Primary Power Available to the Site?	Yes
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	**5.8**

4.) Yard Piping

Suggested percentage range:	10 to 30%
What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	**10.0**

CPES Additional Project Cost
Alternative B3
WWTP Percentage Allowance Calculator

1.) Overall Sitework

Suggested percentage range for "Rehab" Project:	5 to 10%
Suggested percentage range for "Greenfield" Project:	12 to 20%
Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	High
Rock Excavation?	Yes
Groundwater?	No
Overall Sitework	**9.0**

2.) Plant Computer System

Suggested percentage range:	7 to 10%
Level of Sophistication?	Average
Plant Computer System	**8.5**

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power:	5 to 8%
Suggested percentage range for Plant without Available Primary Power:	10 to 25%
Is Primary Power Available to the Site?	No
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	**10.0**

4.) Yard Piping

Suggested percentage range:	10 to 30%
What is the Relative Size of the Plant?	Medium
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	**17.0**

CPES Additional Project Cost
Alternative C1
WWTP Percentage Allowance Calculator

1.) Overall Sitework

Suggested percentage range for "Rehab" Project:	5 to 10%
Suggested percentage range for "Greenfield" Project:	12 to 20%
Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Medium
Rock Excavation?	Yes
Groundwater?	No
Overall Sitework	**7.5**

2.) Plant Computer System

Suggested percentage range:	7 to 10%
Level of Sophistication?	Average
Plant Computer System	**8.5**

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power:	5 to 8%
Suggested percentage range for Plant without Available Primary Power:	10 to 25%
Is Primary Power Available to the Site?	No
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	**10.0**

4.) Yard Piping

Suggested percentage range:	10 to 30%
What is the Relative Size of the Plant?	Medium
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	**15.0**

CPES Additional Project Cost
Alternative C4
WWTP Percentage Allowance Calculator

1.) Overall Sitework

Suggested percentage range for "Rehab" Project:	5 to 10%
Suggested percentage range for "Greenfield" Project:	12 to 20%
Rehab or Greenfield Project?	Rehab
Complexity of Tie-In's to Existing Plant?	Medium
Rock Excavation?	Yes
Groundwater?	No
Overall Sitework	**7.5**

2.) Plant Computer System

Suggested percentage range:	7 to 10%
Level of Sophistication?	Average
Plant Computer System	**8.5**

3.) Yard Electrical

Suggested percentage range for Plant with Available Primary Power:	5 to 8%
Suggested percentage range for Plant without Available Primary Power:	10 to 25%
Is Primary Power Available to the Site?	No
Connected HP Size?	Average
Size of Secondary Distribution Voltage System?	Small
Yard Electrical	**10.0**

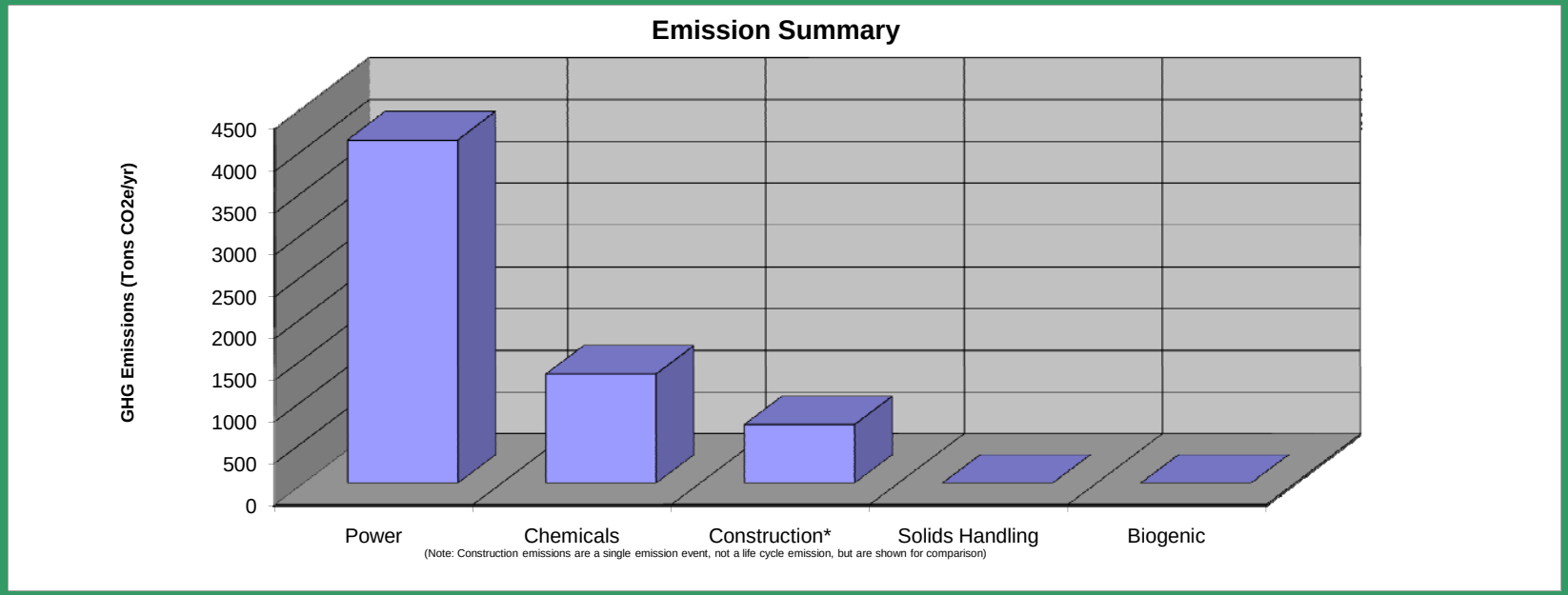
4.) Yard Piping

Suggested percentage range:	10 to 30%
What is the Relative Size of the Plant?	Small
Above Ground Piping?	No
Construction Cost per GPD	No
Annual O & M Cost per 1,000 Gallons	**15.0**

Appendix C
Carbon Footprint Calculations

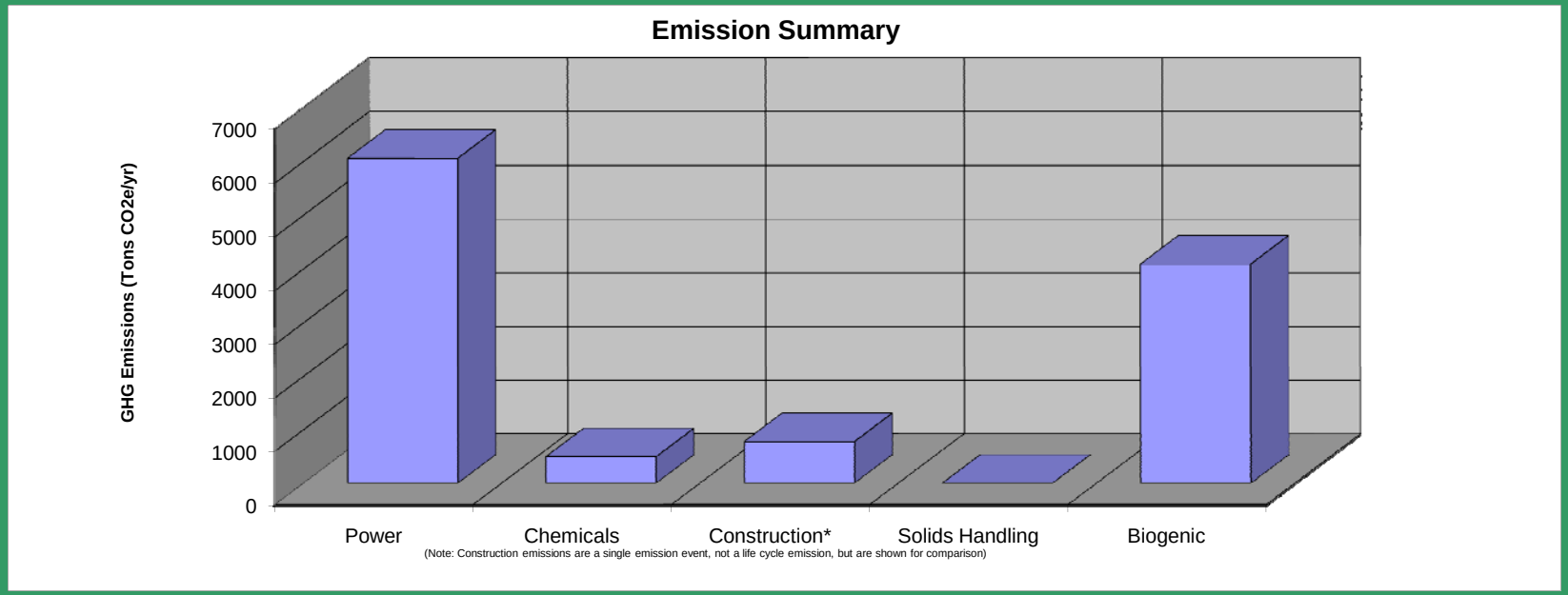
	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	4113.115	1313.1916	701.9525504		0	5426.306551

Total Truck Deliveries Per Year	88	Input Average Plant Capacity (mgd)	**10**
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	1.486659
Total Power Consumption (MWh/yr)	4155.979	Equivalent Number of U.S. Households (#/yr)	261.5087 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)



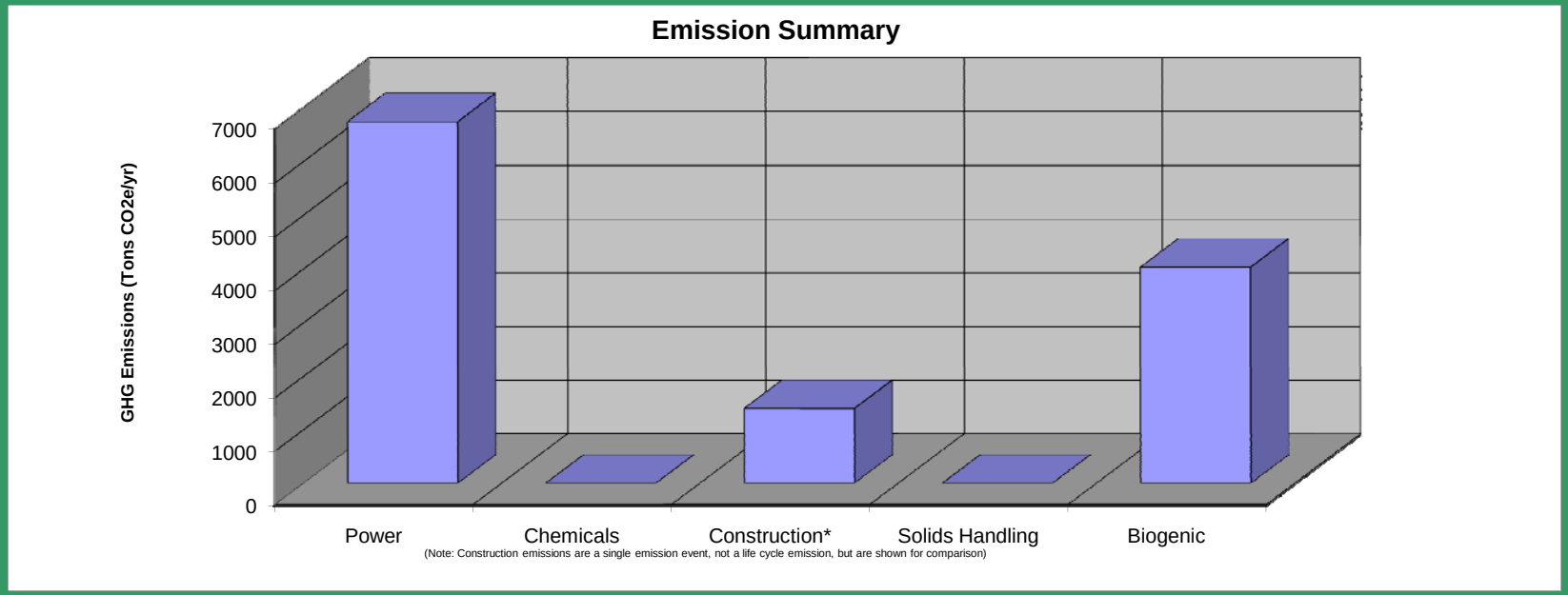
	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	6057.927	493.90809	775.3643471		4088.95	10640.78467

Total Truck Deliveries Per Year	18	Input Average Plant Capacity (mgd)	**10**
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	2.915283
Total Power Consumption (MWh/yr)	6121.059	Equivalent Number of U.S. Households (#/yr)	512.8089 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)



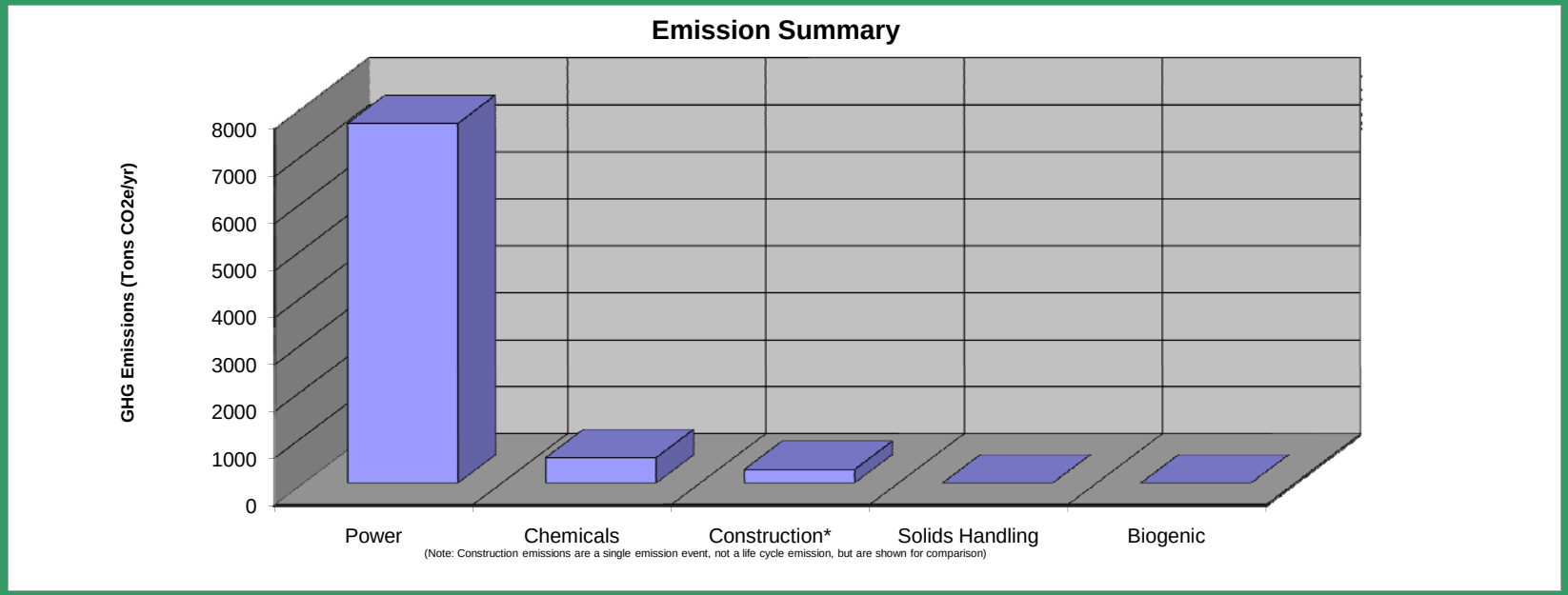
	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	6735.055	0	1395.363729		4032.019	10767.07383

Total Truck Deliveries Per Year	78.5138	Input Average Plant Capacity (mgd)	10
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	2.949883
Total Power Consumption (MWh/yr)	6805.243	Equivalent Number of U.S. Households (#/yr)	518.8951 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)



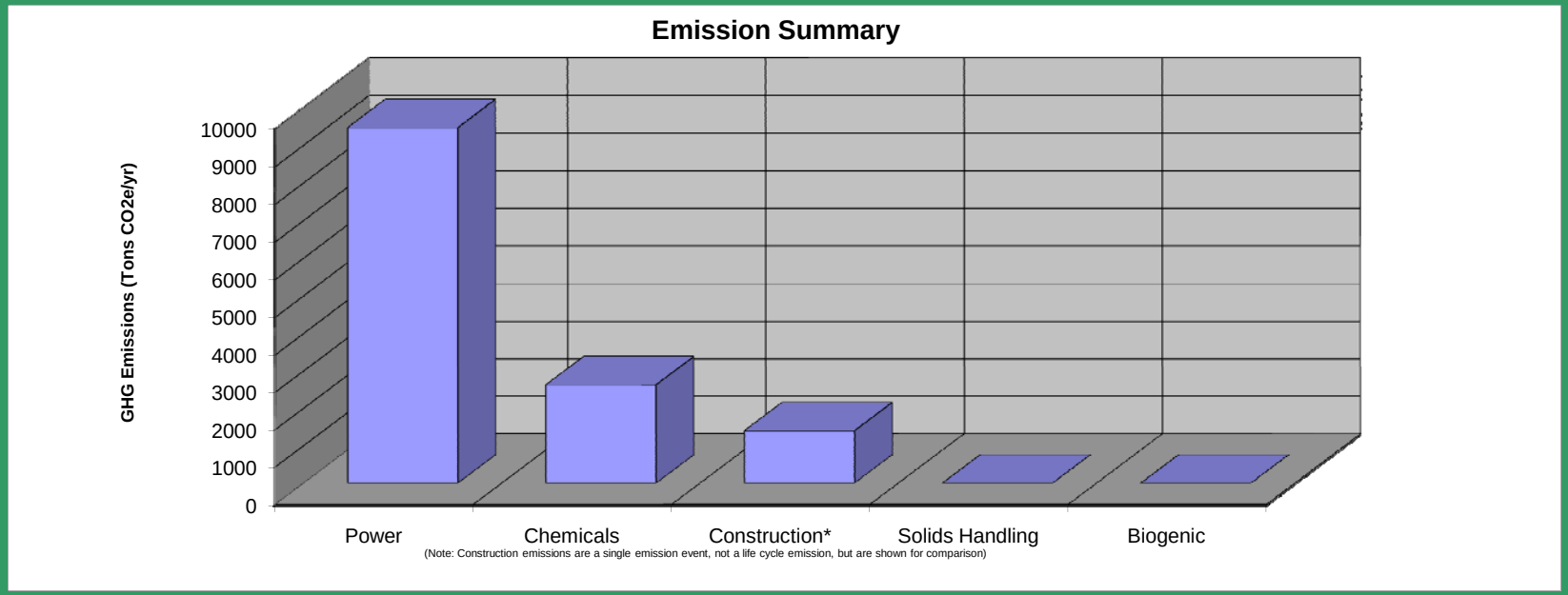
	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	7657.783	544.78046	288.20642		0	8202.563637

Total Truck Deliveries Per Year	63	Input Average Plant Capacity (mgd)	**10**
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	2.247278
Total Power Consumption (MWh/yr)	7737.587	Equivalent Number of U.S. Households (#/yr)	395.3043 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)



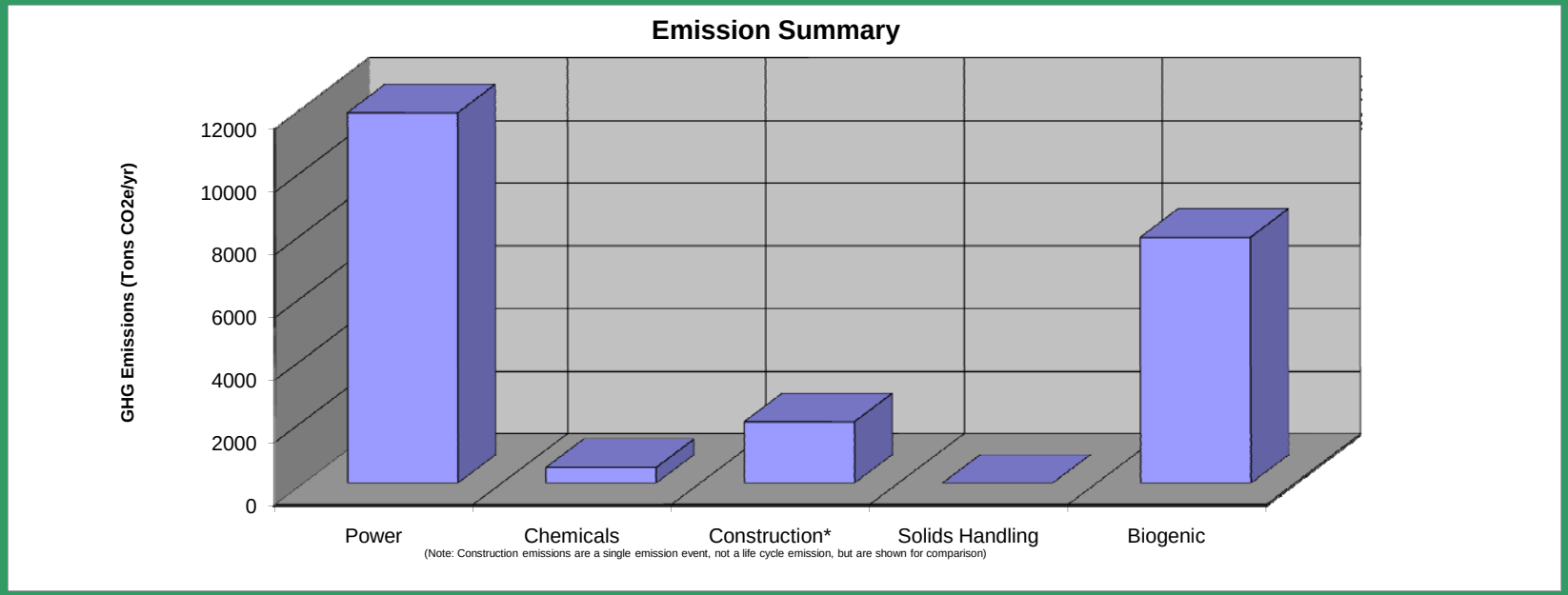
	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	9462.173	2629.6263	1395.891207		0	12091.79927

Total Truck Deliveries Per Year	179	Input Average Plant Capacity (mgd)	**19.1**
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	1.734462
Total Power Consumption (MWh/yr)	9560.781	Equivalent Number of U.S. Households (#/yr)	582.7373 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)



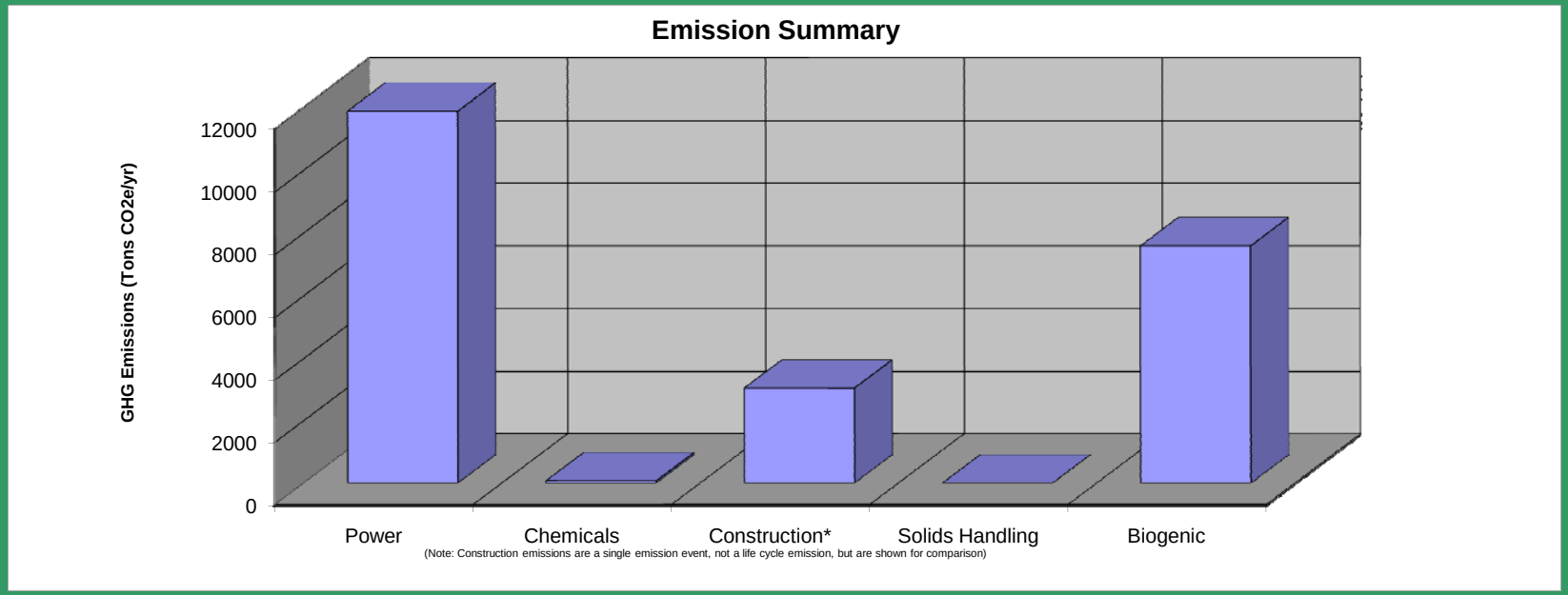
	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	11831.24	499.4336	1964.678013		7868.502	20199.17661

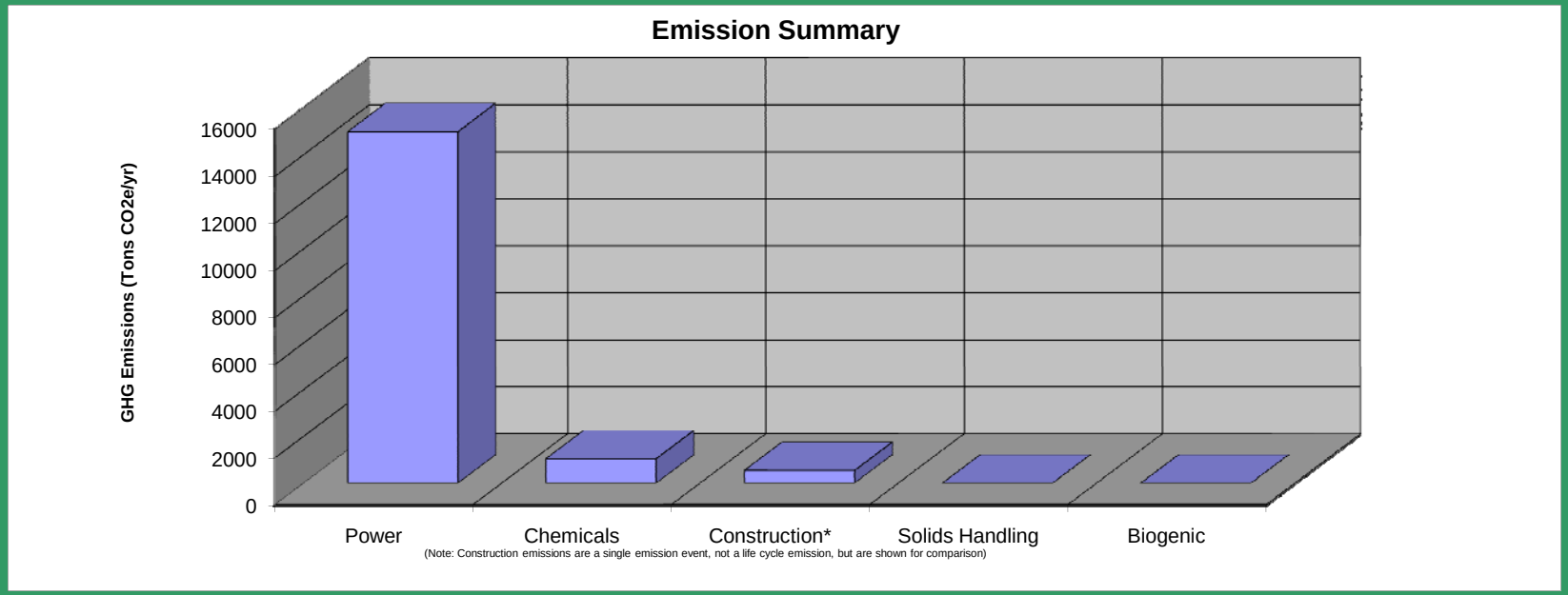
Total Truck Deliveries Per Year	34	Input Average Plant Capacity (mgd)	**19.1**
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	2.897393
Total Power Consumption (MWh/yr)	11954.54	Equivalent Number of U.S. Households (#/yr)	973.4543 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)



	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	11876.92	69.48006	3044.514788		7589.28	19535.67952

Total Truck Deliveries Per Year	185.3258	Input Average Plant Capacity (mgd)	**19.1**
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	2.80222
Total Power Consumption (MWh/yr)	12000.69	Equivalent Number of U.S. Households (#/yr)	941.4785 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)



	Power	Chemicals	Construction*	Solids Handling	Biogenic	TOTAL ANNUAL O&M
GHG Emissions (Tons CO2e/yr)	14962.05	1040.5181	536.4572974		0	16002.56371

Total Truck Deliveries Per Year	120	Input Average Plant Capacity (mgd)	**19.1**
Total Solids Produced (ton/yr)		GHG Emissions(Tons CO2e/Million Gallon Treated)	2.295426
Total Power Consumption (MWh/yr)	15117.97	Equivalent Number of U.S. Households (#/yr)	771.2079 (Based on EPA estimates of 41,500 lbs CO2e/yr for the average household)