March 21, 2013

David Allen, Ph.D.
Chair
US EPA Science Advisory Board
200 E Dean Keeton St. Stop C0400
Austin, TX 78712-1589

RE: SOUTHERN NEVADA WATER AUTHORITY COMMENTS ON THE SCIENCE ADVISORY BOARD DRAFT ADVICE ON APPROACHES TO DERIVE A MAXIMUM CONTAMINANT LEVEL GOAL FOR PERCHLORATE DOCKET ID NO. EPA-HQ-OW-2009-0297.

The Southern Nevada Water Authority (SNWA) appreciates the opportunity to comment on the Science Advisory Board's (SAB) Advice (02/25/13 Draft) on Approaches to Derive a Maximum Contaminant Level Goal for Perchlorate. SNWA is the water wholesaler responsible for the treatment and delivery of potable drinking water to metropolitan Clark County, Nevada, established in 1991 as a special district by an act of the Nevada Legislature. SNWA has the capacity to process 900 million gallons of water per day (MGD) from Lake Mead to service a population of approximately 2 million. This represents 90 percent of the local water supply with the remaining 10 percent supplied by local groundwater. Lake Mead was contaminated with perchlorate by an industrial plume that intercepts the Las Vegas Wash and then flows into Lake Mead. Remediation efforts, since the discovery of the plume, have lowered ambient concentrations in Lake Mead to approximately 2µg/L.

SNWA is concerned about the methodology utilized to develop the MCLG for perchlorate. The very conservative approach to derive the MCLG could have an enormous economic impact on very large drinking water systems.

For the SAB's consideration, and by extension, EPA's attention, SNWA contracted with a consulting firm to develop cost analysis for treating water to meet a perchlorate MCL of 1µg/L. They have estimated that the cost to treat 900 MGD to a perchlorate concentration of 1µg/L by anion exchange to be 512 million dollars in capital, and 64 million dollars per year in operating costs. There are a number of large water systems on the Colorado River that treat water for 22 million people; each would be impacted with similar costs. The consulting firm's analysis is included as an attachment to this letter.

SNWA appreciates the opportunity to comment on these important drinking water issues.

Sincerely,

Patricia Mulroy
General Manager
Southern Nevada Water Authority

Attachment(1)

TECHNICAL MEMORANDUM CH2MHILL®

Perchlorate Treatment Strategies and Estimated Costs

PREPARED FOR: Southern Nevada Water Authority

PREPARED BY: CH2M HILL

DATE: January 7, 2013

PROJECT NUMBER: 420617.CS.12

Introduction

The Southern Nevada Water Authority (SNWA) operates two water treatment facilities that receive raw water from Lake Mead, and one facility that receives raw water from the Colorado River downstream of Lake Mead. The facilities receiving water directly from Lake Mead are the Alfred Merritt Smith Water Treatment Facility (AMSWTF) and the River Mountains Water Treatment Facility (RMWTF). The facility receiving water from the Colorado River is the Big Bend Water District (BBWD) Water Treatment Plant (WTP). The raw water intake for the BBWD WTP is located approximately 60 miles downstream of Lake Mead.

Perchlorate (ClO_4^-) was introduced into Lake Mead by an industrial plume that intercepts the Las Vegas Wash and then flows into Lake Mead. Perchlorate is a contaminant formed from the solids salts of ammonium, potassium, magnesium, or sodium perchlorate. Perchlorate is both a naturally occurring and manmade contaminant that has been found in groundwater, surface water, and soil. Most perchlorate (in the form of ammonia perchlorate) that is manufactured in the U.S. is used as an oxidizer in solid fuels for explosives, fireworks, road flares, and rocket motors. Perchlorate can inhibit the thyroid gland's ability to absorb iodine from the bloodstream, which can negatively impact thyroid hormone production. Over the past four years, concentrations of perchlorate in Lake Mead have been consistently less than 5 µg/L based on SNWA's sampling program. However, with the uncertainty associated with the EPA's establishment of a perchlorate maximum contaminant level (MCL), it is not yet known if these low levels of perchlorate will be below the future MCL.

In the February 11, 2011, Federal Register notice, the EPA stated that perchlorate would be federally regulated under the Safe Drinking Water Act (SDWA) based on data indicating risks associated with perchlorate exposure. This reversed the EPA's previous decision in October of 2008 to refrain from implementing a national drinking water regulation for perchlorate. The decision in 2011 to regulate perchlorate did not impose any requirements on public water systems, but initiated a process to establish a national primary drinking water regulation (NPDWR) by February of 2013. The EPA's Science Advisory Board (SAB) issued a draft report on September 5, 2012, on the approaches to derive a maximum contaminant level goal (MCLG) for perchlorate.

SNWA requested that CH2M HILL perform a preliminary evaluation of perchlorate treatment strategies for these three water treatment facilities and develop conceptual cost opinions for selected alternatives. This technical memorandum (TM) summarizes the approach and findings of this evaluation. The following information is presented in this TM:

- Water Quality Review and Objectives
- Alternatives Screening and Evaluation
- Cost Estimate Summary

Water Quality Review and Objectives

SNWA provided water quality data for the raw and finished water at the AMSWTF and RMWTF. Summaries of the data provided are presented in Tables 1, 2, and 3. Perchlorate data was also provided for the AMSWTF, RMWTF, and BBWD WTP, and summaries of this data are presented in Figures 1, 2, and 3.

TABLE 1

Summary of Water Quality Data at AMSWTF (January 2009 to October 2012)

Item	Alkalinity, HCO_3 (mg/L)	pH (units)	Chloride (mg/L)	Nitrate as N (mg/L)	Sulfate (mg/L)
Raw Water					
Average	135.9	8.07	84.1	0.59	227.4
Minimum	128	7.72	71	0.40	200
Maximum	141	8.35	97	1.10	260
Count	46	46	46	46	46
5th Percentile	130.3	7.89	71.3	0.44	210.0
10th Percentile	132.0	7.93	73.0	0.45	210.0
Median	136.5	8.07	85.0	0.57	230.0
90th Percentile	139.5	8.20	92.0	0.71	250.0
95th Percentile	140.0	8.22	93.0	0.78	250.0
Finished Water					
Average	130.2	7.70	86.2	0.59	225.0
Minimum	123	7.48	74	0.41	200
Maximum	135	8.06	98	0.99	260
Count	46	46	46	46	46
5th Percentile	123.0	7.54	75.0	0.45	202.5
10th Percentile	126.0	7.57	76.5	0.46	210.0
Median	131.5	7.70	87.0	0.59	220.0
90th Percentile	133.5	7.80	93.0	0.73	240.0
95th Percentile	134.0	7.85	95.0	0.78	250.0

TABLE 2
Summary of Water Quality Data at RMWTF (January 2009 to October 2012)

Item	Alkalinity, HCO_3 (mg/L)	pH (units)	Chloride (mg/L)	Nitrate as N (mg/L)	Sulfate (mg/L)
Raw Water					
Average	135.7	8.09	82.8	0.57	224.7
Minimum	128	7.87	71	0.40	200
Maximum	141	8.40	94	1.00	270
Count	43	44	43	43	43
5th Percentile	129.2	7.90	71.1	0.42	210.0
10th Percentile	131.2	7.95	73.0	0.45	210.0
Median	136.0	8.09	84.0	0.56	220.0
90th Percentile	139.0	8.23	91.0	0.69	248.0
95th Percentile	139.9	8.27	91.9	0.72	250.0
Finished Water					
Average	134.4	7.89	91.3	0.58	224.9
Minimum	125	7.64	80	0.39	200
Maximum	140	8.10	120	0.94	270
Count	43	43	43	41	43
5th Percentile	129.0	7.76	80.0	0.43	210.0
10th Percentile	129.4	7.77	81.2	0.46	210.0
Median	136.0	7.87	92.0	0.58	220.0
90th Percentile	138.0	8.02	98.0	0.71	240.0
95th Percentile	138.0	8.05	100.0	0.75	250.0

TABLE 3
Summary of Finished Water TOC Data at AMSWTF and RMWTF (January 2009 to September 2012)

Item	Finished Water TOC at AMSWTF (mg/L)	Finished Water TOC at RMWTF (mg/L)
Average	2.47	2.49
Minimum	2.20	2.20
Maximum	2.80	2.80
Count	150	134
5th Percentile	2.30	2.30
10th Percentile	2.30	2.30
Median	2.45	2.50
90th Percentile	2.70	2.70
95th Percentile	2.70	2.70

FIGURE 1
Summary of Perchlorate Data at the AMSWTF

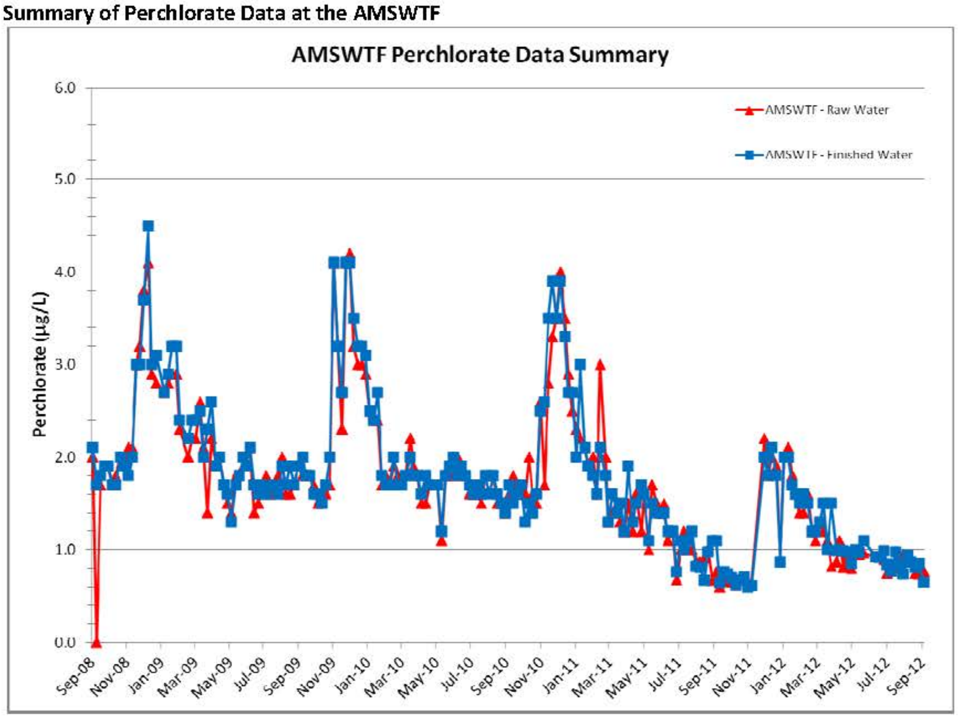


FIGURE 2
Summary of Perchlorate Data at the RMWTF

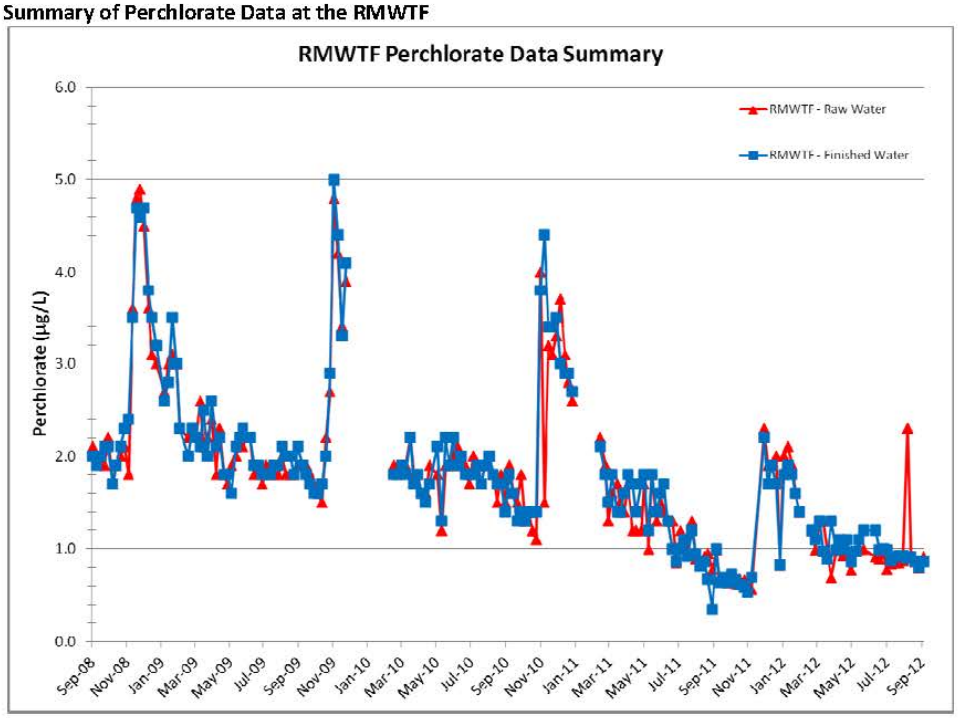
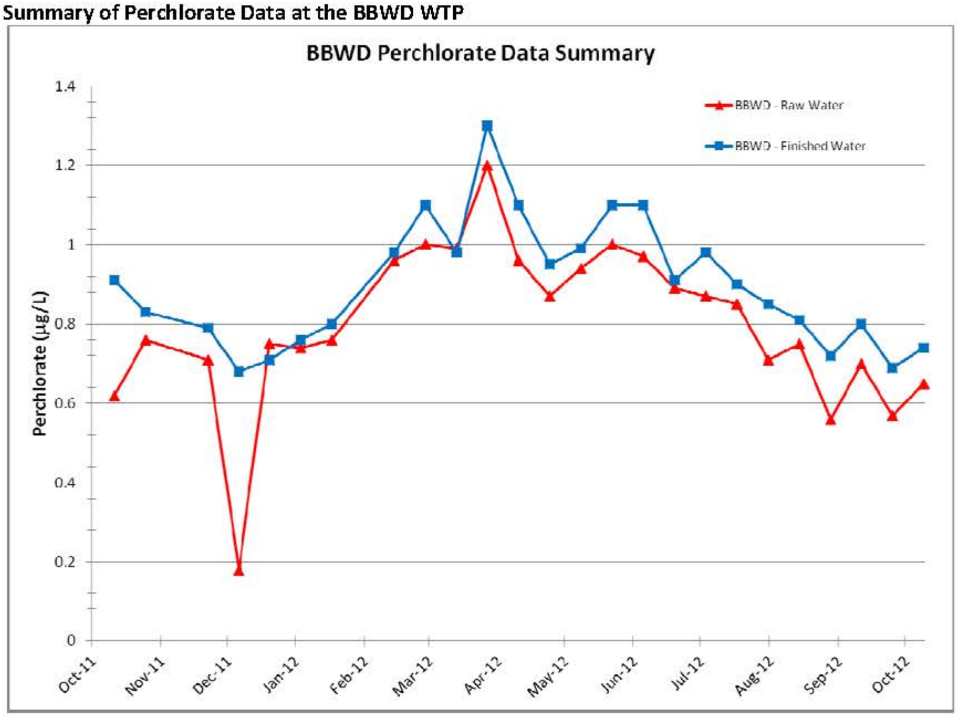


FIGURE 3
Summary of Perchlorate Data at the BBWD WTP



Perchlorate data was provided from 1999 through 2012 for the AMSWTF, and from 2002 through 2012 for the RMWTF. However, the perchlorate levels have continually declined each year; therefore, only the previous four years of data are shown in Figures 1 and 2. The average perchlorate concentration since September 2008 ranges from 1.74 to 1.83 µg/L in the raw and finished waters of the AMSWTF and RMWTF. The 90^{th} percentile perchlorate concentration during this period was approximately 3.0 µg/L. For the purposes of this evaluation a "design perchlorate concentration" of 3.0 mg/L has been assumed for both the AMSWTF and RMWTF.

Perchlorate data for the previous year was provided for the raw and finished water at the BBWD WTP. The average perchlorate values ranged from 0.8 to 0.9 µg/L during this period. The maximum value recorded during this period was 1.3 µg/L. For the purposes of this evaluation a design perchlorate concentration of 1.3 µg/L has been assumed for the BBWD WTP.

The EPA has not yet established an MCL for perchlorate , but an MCL as low as 1.0 µg/L would impact SNWA's treatment facilities and potentially require additional treatment for regulatory compliance. This evaluation assumes an MCL of 1.0 µg/L and considers perchlorate treatment technologies to reduce the perchlorate concentration in the potable water produced from each of SNWA's facilities to: 1) half the assumed MCL at 0.5 µg/L, and 2) the assumed MCL of 1.0 µg/L. A summary of the perchlorate concentrations and treatment goals assumed for this evaluation is presented in Table 4.

TABLE 4
Summary of Perchlorate Water Quality Design Criteria

Facility	Design Influent Concentration (µg/L)	Potable Water Goal "A" (µg/L)	Potable Water Goal "B" (µg/L)
AMSWTF	3.0	0.5	1.0
RMWTF	3.0	0.5	1.0
BBWD WTP	1.3	0.5	1.0

Alternatives Screening and Evaluation

A screening of perchlorate treatment technologies was conducted to select the preferred approaches for additional evaluation at SNWA's water treatment facilities. The following sections present the results of the alternatives screening as well as an evaluation of the preferred alternative(s).

Alternatives Screening

An initial screening of perchlorate treatment technologies was conducted to eliminate alternatives with fatal flaws or limited proven full-scale experience. The following perchlorate treatment technologies were considered as part of this screening process:

- Ion Exchange
- Carbon Adsorption
- High-Pressure Nanofiltration or Reverse Osmosis Membranes
- Electrodialysis Reversal
- Fluidized Bed Reactor
- Membrane Biofilm Reactor

A summary comparing these established perchlorate treatment technologies for municipal drinking water applications is presented in Table 5.

TABLE 5

Comparison of Established Perchlorate Treatment Technologies for Municipal Drinking Water Applications[a]

Technology	Typical Influent Concentration	Advantages	Limitations
Ion Exchange	6 - 100 μg/L	▪ Proven technology ▪ Most effective and commonly used ▪ Capable of removing multiple contaminants ▪ Potential for high rate of treatment ▪ No brine generation for non-regenerable type systems	▪ Generation of brine for regenerable type systems ▪ Potential to concentrate radionuclides if present in the feed water causing disposal issues for spent resin ▪ Efficiency impacted by competing anions
Carbon Adsorption	60 - 80 μg/L	▪ Existing facilities can be used ▪ No waste brine is generated ▪ Improved organics removal reduces disinfection byproduct formation potential	▪ Efficiency depends on GAC tailoring ▪ Limited full-scale installations ▪ Efficiency impacted by competing anions (nitrate and sulfate) and TOC ▪ System may require frequent carbon replacement generating high O&M costs
High-Pressure Nanofiltration and Reverse Osmosis Membranes	100 - 800 μg/L	▪ Proven technology ▪ Multiple contaminant removal ▪ Hardness reduction ▪ Improved organics removal reduces disinfection byproduct formation potential	▪ Generates large quantity of brine ▪ High energy consumption ▪ High capital and O&M costs ▪ Water may require stabilization following treatment
Electrodialysis Reversal (EDR)	10 - 130 μg/L	▪ Proven technology ▪ Multiple contaminant removal	▪ Generates large quantity of brine ▪ High energy consumption ▪ High capital and O&M costs
Fluidized Bed Reactor (FBR)	8 - 10,000 μg/L	▪ Proven technology ▪ Can be cost effective compared to ion exchange when influent perchlorate concentration is high ▪ Complete attenuation of perchlorate and nitrate	▪ Public/regulatory acceptance ▪ Efficiency impacted by acclimation of the microorganisms used ▪ Could require downstream polishing step to remove microbes that leach from reactor
Membrane Biofilm Reactor (MBR)	50 - 1,000 μg/L	▪ Complete attenuation of perchlorate and nitrate ▪ No waste brine is generated	▪ Public/regulatory acceptance ▪ No full-scale applications ▪ Efficiency impacted by competing anions (nitrate and sulfate)

[a] Source: *State-Of-Science on Perchlorate Treatment Technologies and Regulations*, Water Research Foundation, 2011.

The following presents brief descriptions and the screening results of each technology evaluated.

Ion Exchange

Ion exchange is the most effective and commonly used technology to remove perchlorate in drinking water applications. Ion exchange systems remove perchlorate by using specialized resins designed to exchange an anion such as chloride with a perchlorate anion. Ion exchange resins have been developed to selectively target perchlorate anions. Certain resins are designed to be regenerated using specialized solutions to either displace perchlorate ions from the resin or to reduce the perchlorate on the resin to chloride. The regeneration process generates a brine solution that may require further treatment and disposal. However, IX systems designed for perchlorate removal are often designed for single-pass usage with zero liquid waste. The resin in single-pass systems is replaced with fresh resin once exhausted. The spent resin is most commonly disposed of using thermal destruction such as incineration, but can be disposed of in a landfill if the material passes permitting requirements. A significant advantage of using a thermal destruction entity to dispose of spent resin is that it often comes with a certificate of disposal that would significantly reduce SNWA's liability pertaining to the perchlorate removal and disposal. For landfill disposal, the original entity that removes the perchlorate may be liable for the material's ultimate fate. For this reason, thermal destruction is much more common than landfill disposal. Considering that single-pass ion exchange is one of the most operationally simple technologies for perchlorate removal, and has proven effectiveness and prevalent usage, ion exchange was selected for further evaluation.

Carbon Adsorption

Carbon adsorption for perchlorate removal involves the use of granular activated carbon (GAC) as adsorbent media. The removal mechanism for perchlorate is by adsorption of the negatively charged perchlorate ions to the positively charged sites on the GAC media. The adsorptive capacity of GAC media for perchlorate can be enhanced by tailoring the GAC using various surface coating materials and application techniques. The GAC can be regenerated through thermal processes or replaced with virgin GAC once exhausted. However, since there is limited full-scale installation experience utilizing carbon adsorption for perchlorate removal and this evaluation is focused on well-established perchlorate removal technologies carbon adsorption was not considered for further evaluation.

High-Pressure Nanofiltration and Reverse Osmosis Membranes

High-pressure membranes such as nanofiltration (NF) and reverse osmosis (RO) remove perchlorate using a semi-permeable membrane. These technologies are highly effective at removing perchlorate and other contaminants, but compared to non-regenerable ion exchange require significantly more energy, are costly to implement and operate, and generate high volumes of concentrated brine waste. The rejection rate of these membranes would significantly decrease the finished water production capacity of SNWA's facilities without additional raw water supplies. For these reasons, high-pressure membranes were not considered for further evaluation.

Electrodialysis Reversal

Electrodialysis reversal (EDR) removes perchlorate and other anions and cations by applying an electrical potential difference using oppositely charged electrodes and permeable membranes. EDR systems are similar to high-pressure membranes in that the technology is highly effective at removing perchlorate and other contaminants. These systems also require significant energy, are costly to implement and operate, and generate significant brine quantities, when compared to non-regenerable ion exchange. Therefore, EDR was not considered for further evaluation.

Fluidized Bed Reactor

A fluidized bed reactor (FBR) removes perchlorate by biologically reducing the contaminant to chloride and oxygen. The reactor generally consists of a hydraulically fluidized bed of biologically active media. The media provides a large surface area for the microorganisms to attach and grow. Sand or activated carbon is commonly used for the media. FBRs are most cost effective compared to non-regenerable ion exchange when the perchlorate feed concentration is a couple orders of magnitude greater than the levels in the source waters to SNWA's facilities. Additionally, FBRs are not generally capable of producing treated water perchlorate levels as low as 1.0 μg/L. For these reasons, FBRs were not considered for further evaluation.

Membrane Biofilm Reactor

A membrane biofilm reactor (MBR) removes perchlorate by biological reduction similar to a FBR. The reactor consists of a bundle of gas-transfer fibers in a continuous flow reactor chamber. A biofilm grows on the outside walls of the fibers which oxidized hydrogen to reduce perchlorate ions to chloride and oxygen. There are no full-scale installations utilizing the MBR technology for perchlorate reduction. This screening evaluation is focused on well-established perchlorate treatment technologies; therefore, MBR was not considered for further evaluation.

Alternative Evaluation

The alternatives screening evaluation resulted in single-pass ion exchange remaining as the preferred alternative for additional evaluation at each of SNWA's three water treatment facilities. Single-pass ion exchange is the most commonly used technology to remove perchlorate from municipal drinking water systems. The anticipated performance of single-pass ion exchange systems is primarily dependent upon the following:

- Influent perchlorate concentration
- Competing ions (e.g., sulfate and nitrate)
- Ion exchange resin selection
- Ion exchange system configuration

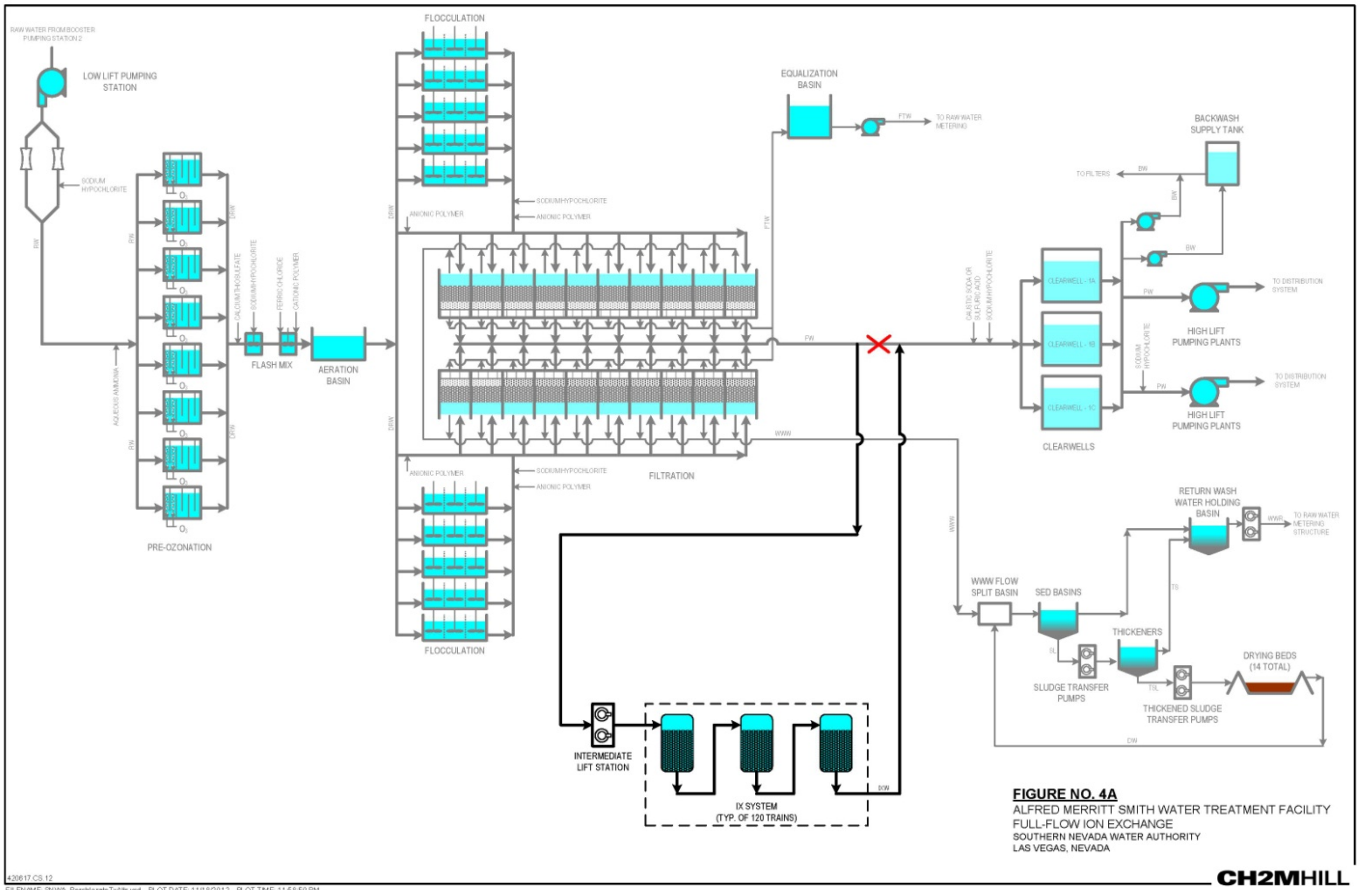
As described previously, the design influent perchlorate concentrations assumed for this evaluation are generally low at 3.0 μg/L for the AMSWTF and RMWTF, and 1.3 μg/L for the BBWD WTP. To achieve a finished water perchlorate concentration of 0.5 μg/L, the ion exchange system should achieve at least 83.4 percent removal at the AMSWTF and RMWTF, and 61.5 percent removal at the BBWD WTP. Ion exchange systems for perchlorate removal often include at least two vessels in series that operate in lead-lag mode. These vessels are of the same size and contain the same amount of resin. To meet these removal rates at SNWA's facilities a third vessel in series was assumed for polishing. A three-vessel train of single-pass ion exchange, with the low influent perchlorate concentrations, low nitrate and moderate sulfate levels, and an appropriate resin, was assumed to be capable of reducing perchlorate to 0.5 μg/L.

This evaluation considered two single-pass ion exchange options with three-vessel trains for each of SNWA's facilities:

- **Option A:** Treat the full plant flow through the ion exchange system to achieve a potable water perchlorate concentration of 0.5 μg/L.
- **Option B:** Treat only a portion of the full plant flow through a sidestream ion exchange system to achieve a blended potable water perchlorate concentration of 1.0 μg/L.

Process flow diagrams of each of these options at each facility are presented in Figures 4A/4B, 5A/5B, and 6A/6B. These alternatives assume the ion exchange feed pump station and ion exchange system would be installed on-site at each water treatment facility. The ion exchange system would be installed outside on a slab on grade. The ion exchange process was assumed to be located downstream of filtration because the ion exchange resin can be susceptible to organic fouling. The organic loading to the ion exchange system was assumed to be less downstream from the filters than upstream.

Design criteria common to each ion exchange alternative are presented in Table 6. Design criteria specific to each option (A or B) at each facility are presented in Table 7.


LOW LIFT PUMPING STATION
PRE-OZONATION
FLASH MIX
AERATION BASIN
FLOCCULATION
FILTRATION
EQUALIZATION BASIN
BACKWASH SUPPLY TANK
CLEARWELLS
HIGH LIFT PUMPING PLANTS
RETURN WASH WATER HOLDING BASIN
WWW FLOW SPLIT BASIN
SED BASINS
THICKENERS
SLUDGE TRANSFER PUMPS
THICKENED SLUDGE TRANSFER PUMPS
DRYING BEDS (14 TOTAL)
INTERMEDIATE LIFT STATION
IX SYSTEM (TYP. OF 120 TRAINS)
FIGURE NO. 4A
ALFRED MERRITT SMITH WATER TREATMENT FACILITY
FULL-FLOW ION EXCHANGE
SOUTHERN NEVADA WATER AUTHORITY
LAS VEGAS, NEVADA
CH2MHILL

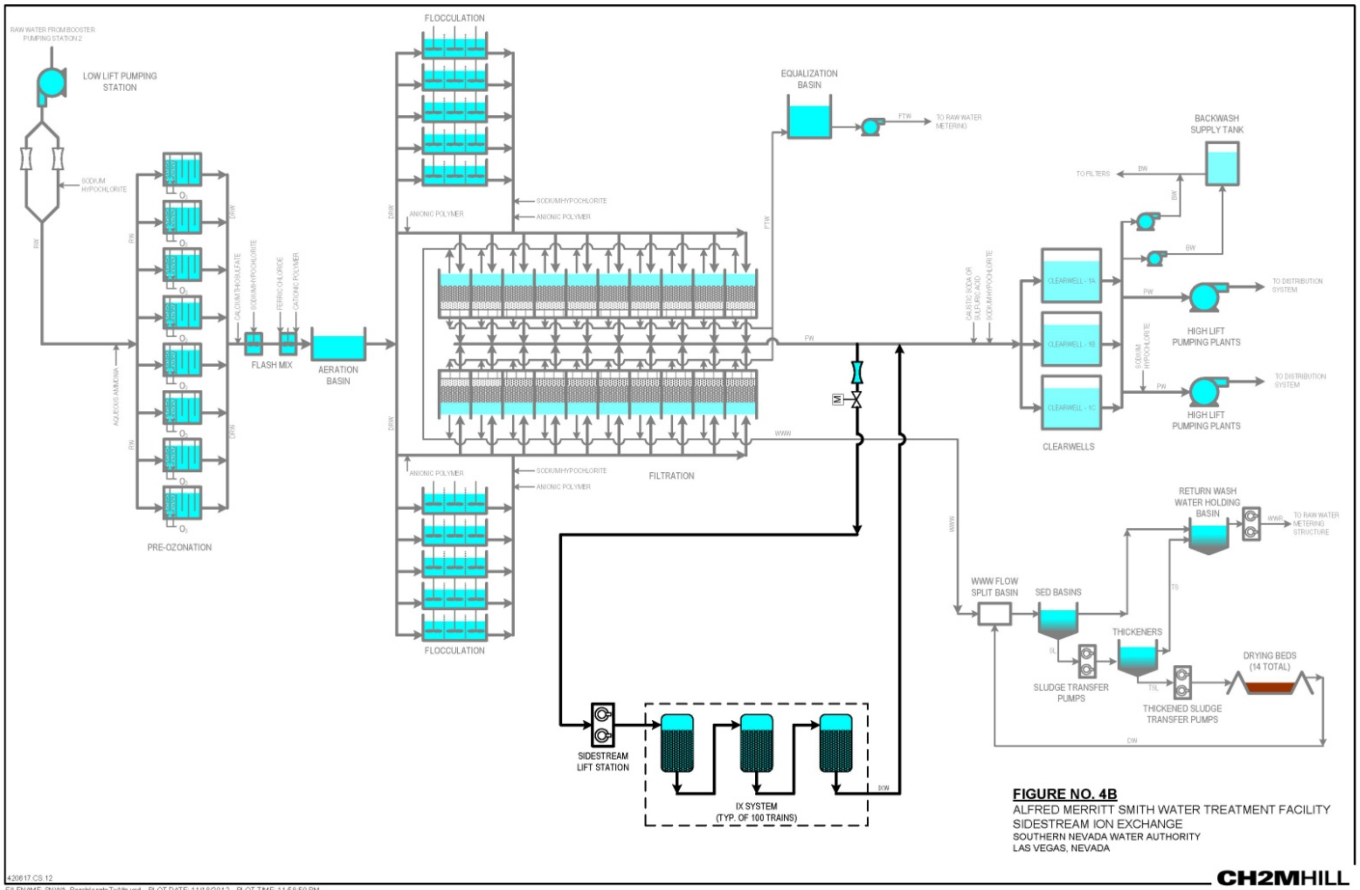


FIGURE NO. 4B
ALFRED MERRITT SMITH WATER TREATMENT FACILITY
SIDESTREAM ION EXCHANGE
SOUTHERN NEVADA WATER AUTHORITY
LAS VEGAS, NEVADA

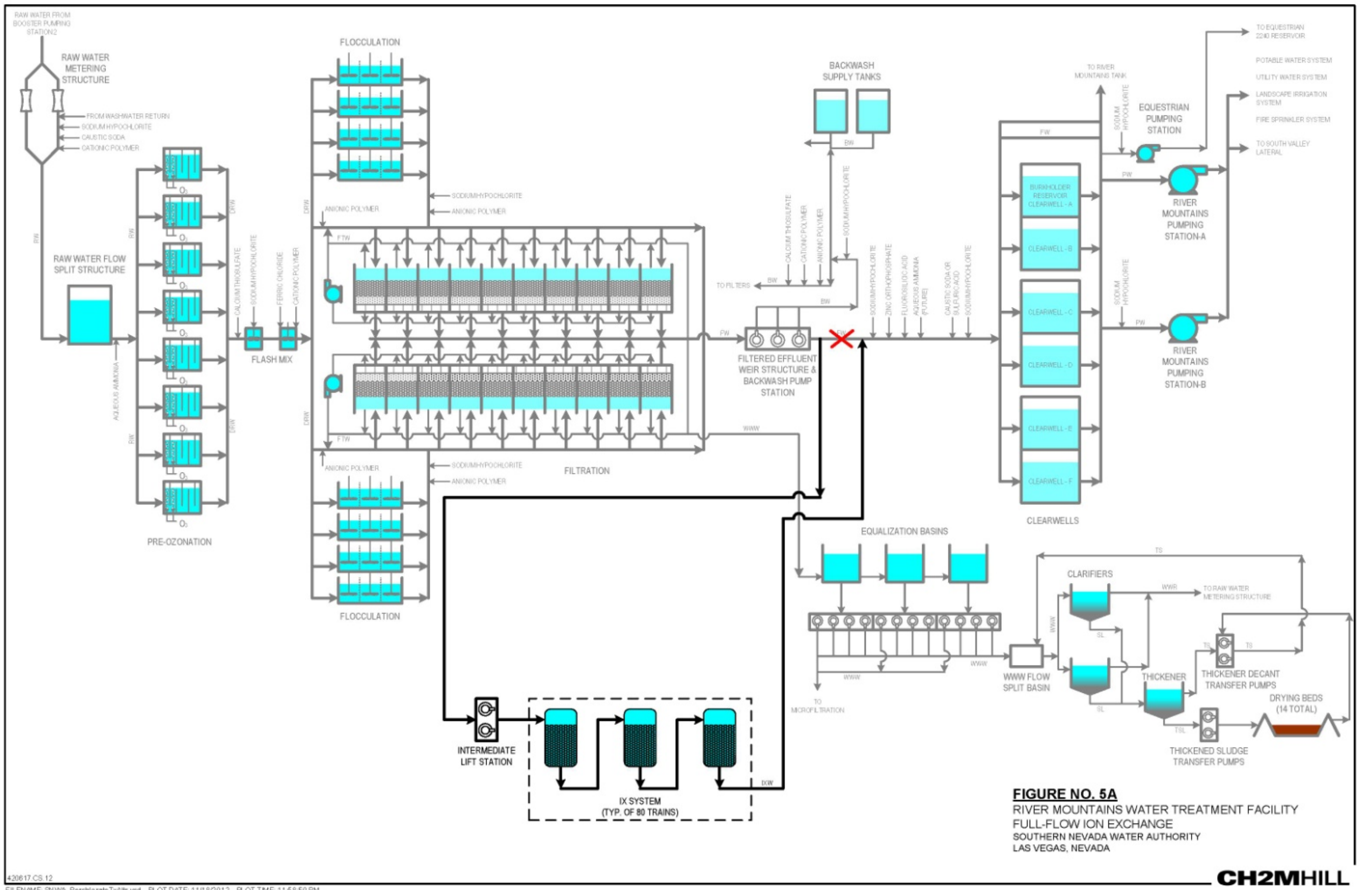


FIGURE NO. 5A
RIVER MOUNTAINS WATER TREATMENT FACILITY
FULL-FLOW ION EXCHANGE
SOUTHERN NEVADA WATER AUTHORITY
LAS VEGAS, NEVADA

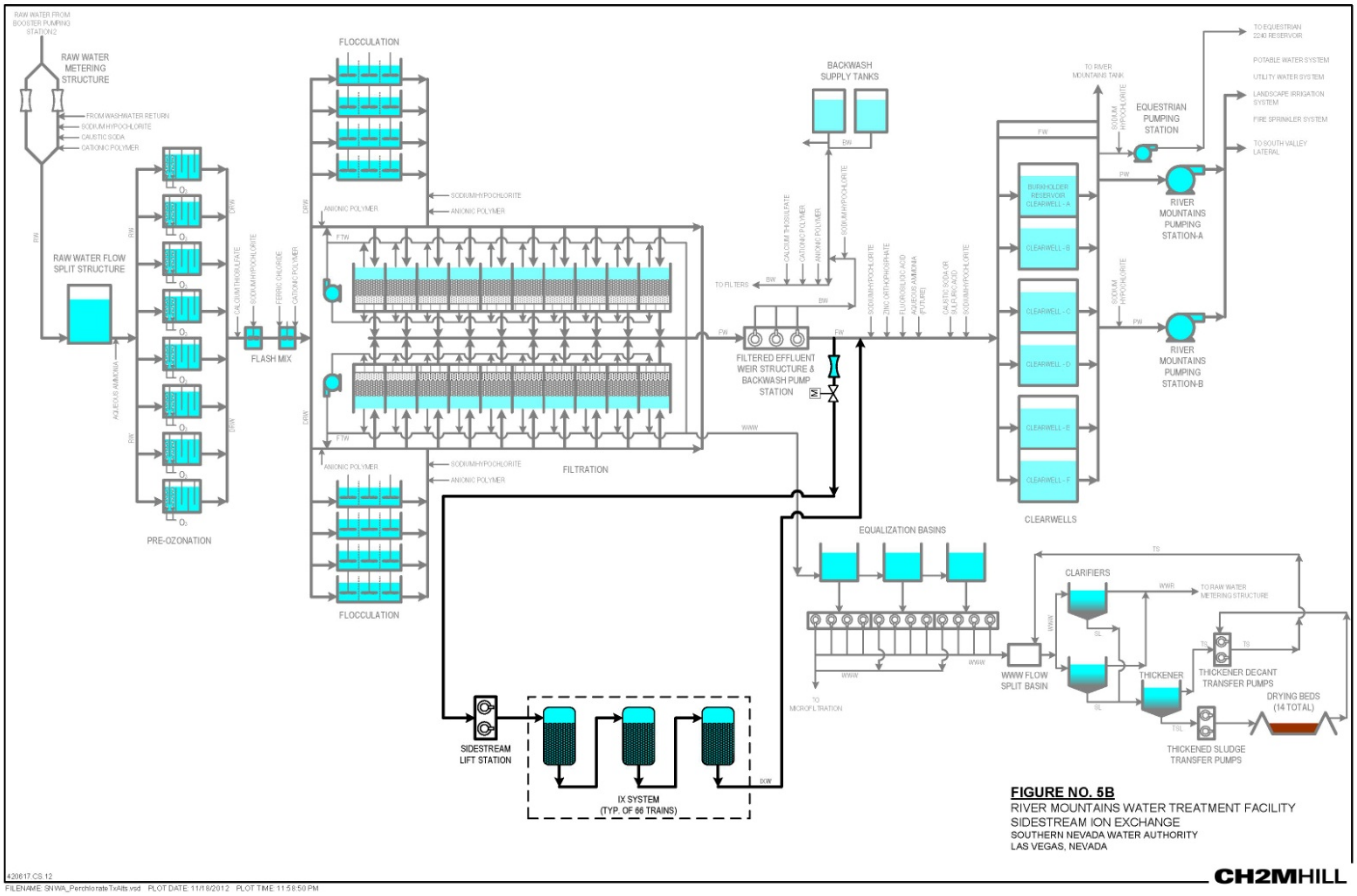


FIGURE NO. 5B
RIVER MOUNTAINS WATER TREATMENT FACILITY
SIDESTREAM ION EXCHANGE
SOUTHERN NEVADA WATER AUTHORITY
LAS VEGAS, NEVADA

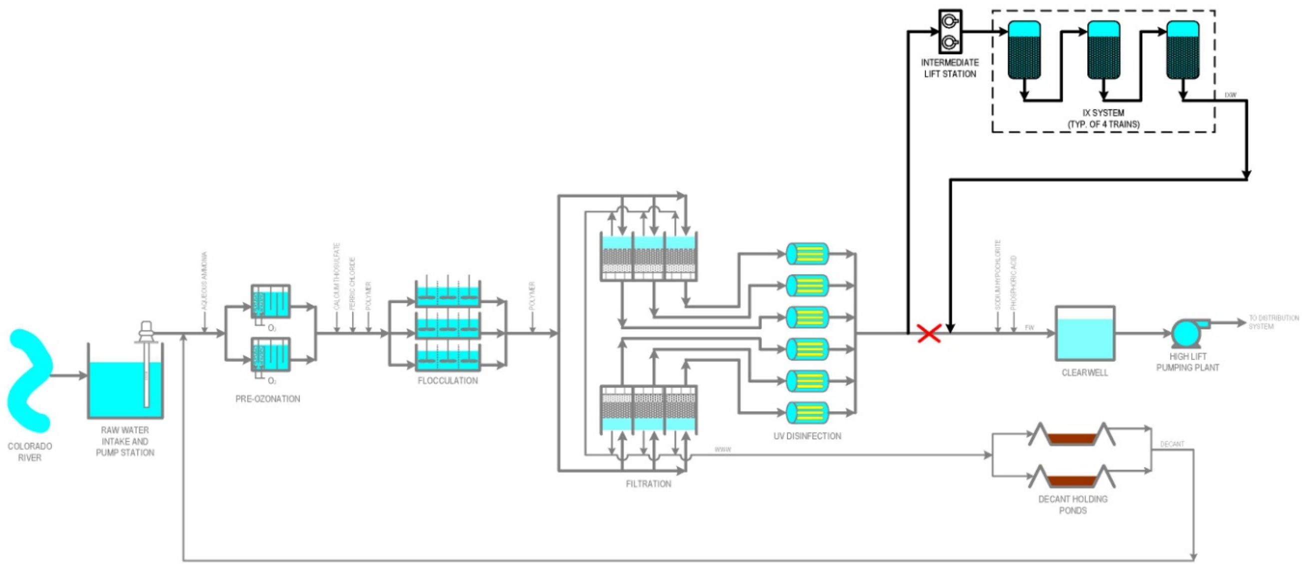


FIGURE NO. 6A
BIG BEND WATER TREATMENT PLANT
FULL-FLOW ION EXCHANGE
SOUTHERN NEVADA WATER AUTHORITY
LAS VEGAS, NEVADA

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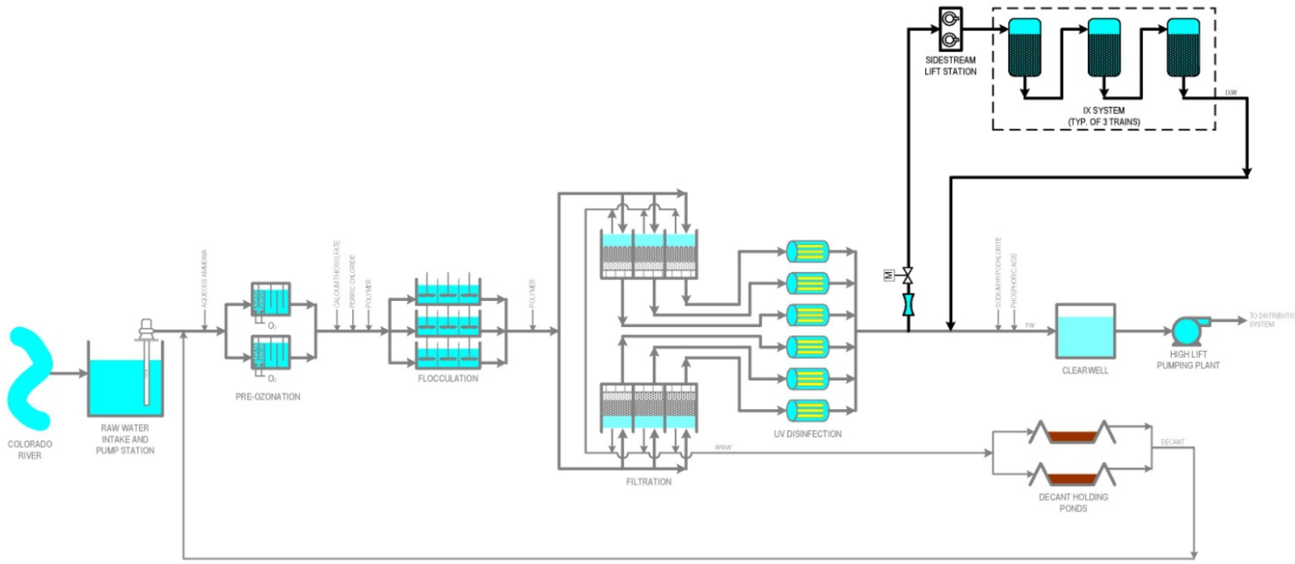

FIGURE NO. 6B
BIG BEND WATER TREATMENT PLANT
SIDESTREAM ION EXCHANGE
SOUTHERN NEVADA WATER AUTHORITY
LAS VEGAS, NEVADA

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TABLE 6
Common Design Criteria for Ion Exchange Alternatives

Criteria	Units	
Number of Vessels per Train	#	3
Diameter of Each Vessel	feet	12.0
Resin Bed Depth	feet	3.75
Resin Bed Volume per Vessel	cubic feet	425
Surface Hydraulic Loading Rate	gpm/sf	±10.0
Number of Bed Volumes to Exhaustion	#	135,000[a]

[a] An approximate design value for the number of bed volumes to exhaustion was assumed to be 135,000 based on a recommendation provided by Purolite®, an ion exchange supplier of perchlorate-specific resin.

TABLE 7
Specific Design Criteria for Ion Exchange Options

Criteria	Option A	Option B
AMSWTF		
Ion Exchange System Flow Rate (mgd)	600	480
Number of Ion Exchange Trains	120	100
RMWTF		
Ion Exchange System Flow Rate (mgd)	400	320
Number of Ion Exchange Trains	80	66
BBWD WTP		
Ion Exchange System Flow Rate (mgd)	15	12
Number of Ion Exchange Trains	4	3

Cost Estimate Summary

The CH2M HILL Parametric Cost Estimating System (CPES) was used for estimating the costs of the ion exchange alternatives associated with each of SNWA's facilities. CPES is a proprietary conceptual design and cost estimating tool that quickly generates detailed cost estimates at the conceptual stage of a water treatment project. CPES is based on general arrangement drawings derived from real projects. Using project specific design criteria and selected performance parameters, CPES can generate facility layouts and approximate quantities. These quantities are used to prepare a detailed construction cost estimate, as well as life cycle costs for operations and maintenance (O&M). Compared with traditional conceptual estimating techniques, CPES yields a more accurate definition of facility layout and cost during the conceptual and preliminary design stages of a project.

CPES construction and life cycle cost models were developed for single-pass ion exchange Options A and B at the AMSWTF, RMWTF, and BBWD WTP. The cost estimates were prepared using a variety of cost data including unit cost line items and parametric estimating tools. The cost estimates are considered to be consistent with Class 5 estimates as defined by the Estimate Classification system of the American Association of the Advancement of Cost Engineering International (AACE International). The estimates were developed without detailed engineering data and are considered approximate. Class 5 estimates are normally expected to be accurate within minus

50 percent to plus 100 percent. This range implies that there is a high probability that the final project cost will fall within the range.

A contingency has been included in these cost estimates as a provision for unforeseeable, additional costs within the general bounds of the project scope, particularly where experience has shown that unforeseeable costs are likely to occur. The contingency is used as a means to reduce the risk of possible cost overruns. The contingency in these estimates consists of two components: Bid Contingency and Scope Contingency. Bid Contingency covers the unknown costs associated with constructing a given project scope, such as adverse weather conditions, strikes by material suppliers, geotechnical unknowns, and unfavorable market conditions for a particular project scope. Scope Contingency covers scope changes that occur during final design and implementation.

The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimates. The final cost for the project will depend on such criteria as actual labor and material costs, competitive market conditions, actual site conditions, final project scope, and other variables. As a result, the final project cost will vary from this estimate. The proximity to actual costs will depend on how close the assumptions of this estimate match final project conditions. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help assure proper project evaluation and adequate funding.

The cost estimates developed are presented in November 2012 dollars. The costs in CPES are updated in January on an annual basis. To estimate the costs in November 2012 dollars an escalation factor was added. The escalation factor adjusts the cost estimate from January 2012 dollars to November 2012.

The markups applied to the facilities in the CPES cost estimates are presented in Table 8. The unit costs and markups assumed for these cost estimates are identical to those used in the "Study of Alternative DBP Strategies" prepared by CH2M HILL for SNWA in 2009.

TABLE 8
Markups in CPES Cost Estimates

Item	Value
Overhead	10%
Profit	7%
Mobilization/Bond/Insurance	3%
Contingency	30%

The additional project costs applied to the facilities in the CPES cost estimates are presented in Table 9.

TABLE 9
Additional Project Costs in CPES Cost Estimates

Item	Value
Overall Site Work	3.0%
Plant Computer System	1.5%
Yard Electrical	4.0%
Yard Piping	5.0%

A location adjustment factor of an additional 4.6 percent for construction in Las Vegas, Nevada, was also included.

Costs for the following were not included in the cost estimates:

- Escalation – All costs are presented in November 2012 dollars.
- Permitting
- Engineering
- Services During Construction
- Commissioning and Startup
- Land/Right-of-Way
- Legal/Administration

The CPES Life Cycle Tool extracts information from the construction modules that impact the capital and life cycle cost parameters. CPES allows for manipulation of life cycle cost parameters such as interest rate, inflation, labor rates, resin cost, and power consumption. These cost parameters are used to calculate life cycle costs associated with facility operations. The CPES Life Cycle Tool assumptions for power cost, resin costs, and annual maintenance are presented in Table 10.

TABLE 10
CPES Life-Cycle Tool Assumptions

Item	Value
Power Cost	$0.05/kwh
Ion Exchange Resin	$225/cf[a]
Removal and Disposal of Spent Ion Exchange Resin	$65/cf[b]
Annual Maintenance	±3.0% of equipment cost

[a] Unit cost for Purolite® A532E perchlorate-specific ion exchange resin.

[b] Unit cost obtained from Purolite® and includes $50/cf to remove spent resin and $15/cf to dispose of resin at incineration facility.

The AMSWTF and RMWTF were assumed to require one full-time maintenance worker and two full-time operators (40 hours per worker per week on average) for each ion exchange alternative. The BBWD WTP was assumed to require one full-time operator for each alternative. In the "Study of Alternative DBP Strategies" (CH2M HILL, 2009), an hourly labor rate of $57.60 was assumed for a Plant Operator 2, and an hourly rate of $60.80 was assumed for Plant Maintenance 2. These same rates were assumed for this evaluation. The rates include benefits plus the tax burden (1.6 times the raw rate), but do not include supervision burden rate (supervision and administration).

The O&M costs were based on the annual average flow rate of 267 mgd for the AMSWTF, 133 mgd for the RMWTF, and 8 mgd for the BBWD WTP. These facilities were assumed to operate 24 hours per day, 7 days per week, and every day of the year. However, the historical perchlorate data at all three of SNWA's facilities suggests that at some times during the year the perchlorate level may drop below 1.0 µg/L. During these periods the ion exchange facility may not be required to operate. Seasonal operation of the ion exchange facility may be considered as an optimization step, but for the purposes of this analysis the facilities are assumed to operate year-round.

The net present value (NPV) assumes 20 years at an annual discount rate of 5 percent and 0 percent inflation. Escalation in power or resin cost was not included in the life cycle cost estimates. A contingency of 20 percent was included with the O&M costs.

A summary of the cost estimates for each ion exchange option at SNWA's water treatment facilities are presented in Table 11. The CPES cost estimate summaries are presented in Attachment 1.

TABLE 11
Cost Estimate Summary[a,b,c]

Item	Construction Cost	Annual O&M Cost ($/year)	Net Present Value[d]
AMSWTF			
Option A	$307,270,000	$42,568,000	$837,730,000
Option B	$253,332,000	$31,497,000	$645,820,000
RMWTF			
Option A	$204,456,000	$20,660,000	$461,890,000
Option B	$167,753,000	$16,689,000	$375,700,000
BBWD WTP			
Option A	$10,830,000	$1,325,000	$27,310,000
Option B	$8,445,000	$1,083,000	$21,915,000

[a] Cost estimates considered Class 5 per AACE International Estimate Classification system.

[b] Cost estimates based on November 2012 dollars. An escalation factor was applied to adjust the cost estimate from January 2012 dollars to November 2012.

[c] Cost estimates do not include land acquisition or right-of-way costs.

[d] Net Present Value is based on the construction cost plus a discount rate of 5.0% for a 20-year period for O&M cost.

Attachment 1
CPES Cost Summary

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FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 9/17/2012 | Click for CPES QA/Q | To Concrete Wall Thickness | To Cost Summary Matrix | To Unit Cost Database

Project Capactiy: >>>		Project Unit: >>>		(For example: MGD, HP, GPM...)

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	AMSWTF - Full Flow AIX (Option A)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months):	1
Mid-Point of Construction:	Nov/2012

Roundup to the nearest: $1,000

This Report is for INTERNAL

This Report is for EXTERNAL

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT		Cost
	Yes	In-Plant PS: IXPS		$35,942,000
	Yes	Ion Exchange: AIX		$124,273,000
SUBTOTAL - PROJECT COST				$160,215,000
ADDITIONAL PROJECT COSTS:				
Demolition		0.0%		$0
Overall Sitework		3.0%		$4,807,000
Plant Computer System		1.5%		$2,404,000
Yard Electrical		4.0%		$6,409,000
Yard Piping		5.0%		$8,011,000
UD #1 Default Description		0.0%		$0
UD #2 Default Description		0.0%		$0
UD #3 Default Description		0.0%		$0
SUBTOTAL with Additional Project Costs				$181,846,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$181,846,000
CONTRACTOR MARKUPS:				
Overhead		10.0%	$181,846,000	$18,185,000
Subtotal				$200,031,000
Profit		7.0%	$200,031,000	$14,003,000
Subtotal				$214,034,000
Mob/Bonds/Insurance		3.0%	$214,034,000	$6,422,000
Subtotal				$220,456,000
Contingency		30.0%	$220,456,000	$66,137,000
SUBTOTAL with Markups				$286,593,000
ESCALATION (to Mid-Point of Construction)		2.5%	$286,593,000	$7,165,000
SUBTOTAL with Escalation				$293,758,000

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	A	B	C	D	E
54	**LOCATION ADJUSTMENT FACTOR**		104.6	$293,758,000	$307,271,000
55	**SUBTOTAL - with Local Adjustment Factor**				$307,271,000
56					
57	**RED FLAGS:**				
58	1	Rock Excavation			
59	2	Pile Foundations			
60	3	Seismic Foundations			
61	4	Dewatering Conditions			
62	5	Wetlands Mitigation			
63	6	Weather Impacts			
64	7	Depth of Structures			
65	8	Local Building Code Restrictions			
66	9	Coatings or Finishes			
67	10	Building or Architectural Considerations			
68	11	Client Material Preferences			
69	12	Client Equipment Preferences			
70	13	Piping Galleries, Piping Trenches, Piping Racks			
71	14	Yard Piping Complexity			
72	15	Existing Site Utilities (New, Retrofit, and Complexity)			
73	16	I & C Automation (New or Retrofit)			
74	17	Electrical Feed (New or Retrofit)			
75	18	Electrical Distribution			
76	19	Shoring			
77	20	Contamination			
78	21	User Defined Red Flag 1			
79	22	User Defined Red Flag 2			
80	23	User Defined Red Flag 3			
81	24	User Defined Red Flag 4			
82	25	User Defined Red Flag 5			
83	26	User Defined Red Flag 6			
84	27	User Defined Red Flag 7			
85	**TOTAL - RED FLAGS**				$0
86					
87	**SUBTOTAL - CONSTRUCTION COST with Red Flags**				$307,271,000
88					
89	**MARKET ADJUSTMENT FACTOR**		0%	$307,271,000	$0
90	**SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor**				$307,271,000
91	Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
92	Name of Process Reviewer			Odell	Click for Revie
93	Name of Estimator Reviewer			Meyer	
94	**MAXIMUM CONSTRUCTION COST**				$307,271,000
95					
96	**NON-CONSTRUCTION COSTS:**				
97	Permitting		0.0%	$307,271,000	$0
98	Engineering		0.0%	$307,271,000	$0
99	Services During Construction		0.0%	$307,271,000	$0
100	Commissioning & Startup		0.0%	$307,271,000	$0
101	Land / ROW		0.0%	$307,271,000	$0
102	Legal / Admin		0.0%	$307,271,000	$0
103	Other Default Description		0.0%	$307,271,000	$0
104	**SUBTOTAL - Non-Construction Costs**				$0
105					
106	**TOTAL - CAPITAL COST**				$307,271,000
107					
108	**Currency Conversion of TOTAL CAPITAL COST:**				
109		Currency	Unit of Measure	Conversion Rate	Converted Amount
110		None	U.S.Dollar	1	307,271,000

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CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS

File Version: 9/12/2012

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Import File: C:\CPES\Projects\SNWA\CPES_Cap_AMSWTF_AIX_FullFlow_OptionA.xlsm Browse

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	AMSWTF - Full Flow AIX (Option A)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months)	1
Mid-Point of Construction:	Nov/2012

Life Cycle Analysis:

i =	5.00%
n =	20
Annual Inflation %:	0.00%

To Global Life Cycle Data

To Annual O & M Cost Summary

This Report is for INTERNAL Distribution

This Report is for EXTERNAL Distribution

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
	Yes	In-Plant PS: IXPS	$60,732,000	$3,069,000	$98,971,000
	Yes	Ion Exchange: AIX	$209,987,000	$38,717,000	$692,482,000
		Additional Project Costs:			
		Biosolids Disposal	$0	$0	$0
		Standard Items	$36,551,000	$342,000	$40,802,000
		User Defined Items	$0	$0	$0
		Plant O & M Labor		$440,000	$5,475,000
TOTAL - Life Cycle Analysis			$307,270,000	$42,568,000	$837,730,000
Construction Cost per GPD (based on Maximum Daily Flow Rate)			$0.51 / GPD		
Annual O & M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)				$ 0.437	/ Thousand Gallons

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 9/17/2012 | Click for CPES QA/Q | To Concrete Wall Thickness | To Cost Summary Matrix | To Unit Cost Database

Project Capactiy: >>>		Project Unit: >>>		(For example: MGD, HP, GPM...)

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	AMSWTF - Sidestream AIX (Option B)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months):	1
Mid-Point of Construction:	Nov/2012

Roundup to the nearest: $1,000

This Report is for INTERNAL

This Report is for EXTERNAL

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT		Cost
	Yes	In-Plant PS: IXPS		$28,488,000
	Yes	Ion Exchange: AIX		$103,554,000
SUBTOTAL - PROJECT COST				$132,042,000
ADDITIONAL PROJECT COSTS:				
Demolition		0.0%		$0
Overall Sitework		3.0%		$3,962,000
Plant Computer System		1.5%		$1,981,000
Yard Electrical		4.0%		$5,282,000
Yard Piping		5.0%		$6,603,000
UD #1 Default Description		0.0%		$0
UD #2 Default Description		0.0%		$0
UD #3 Default Description		0.0%		$0
SUBTOTAL with Additional Project Costs				$149,870,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$149,870,000
CONTRACTOR MARKUPS:				
Overhead		10.0%	$149,870,000	$14,987,000
Subtotal				$164,857,000
Profit		7.0%	$164,857,000	$11,540,000
Subtotal				$176,397,000
Mob/Bonds/Insurance		3.0%	$176,397,000	$5,292,000
Subtotal				$181,689,000
Contingency		30.0%	$181,689,000	$54,507,000
SUBTOTAL with Markups				$236,196,000
ESCALATION (to Mid-Point of Construction)		2.5%	$236,196,000	$5,905,000
SUBTOTAL with Escalation				$242,101,000

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	A	B	C	D	E
54	**LOCATION ADJUSTMENT FACTOR**		104.6	$242,101,000	$253,238,000
55	**SUBTOTAL - with Local Adjustment Factor**				$253,238,000
56					
57	**RED FLAGS:**				
58	1	Rock Excavation			
59	2	Pile Foundations			
60	3	Seismic Foundations			
61	4	Dewatering Conditions			
62	5	Wetlands Mitigation			
63	6	Weather Impacts			
64	7	Depth of Structures			
65	8	Local Building Code Restrictions			
66	9	Coatings or Finishes			
67	10	Building or Architectural Considerations			
68	11	Client Material Preferences			
69	12	Client Equipment Preferences			
70	13	Piping Galleries, Piping Trenches, Piping Racks			
71	14	Yard Piping Complexity			
72	15	Existing Site Utilities (New, Retrofit, and Complexity)			
73	16	I & C Automation (New or Retrofit)			
74	17	Electrical Feed (New or Retrofit)			
75	18	Electrical Distribution			
76	19	Shoring			
77	20	Contamination			
78	21	User Defined Red Flag 1			
79	22	User Defined Red Flag 2			
80	23	User Defined Red Flag 3			
81	24	User Defined Red Flag 4			
82	25	User Defined Red Flag 5			
83	26	User Defined Red Flag 6			
84	27	User Defined Red Flag 7			
85	**TOTAL - RED FLAGS**				$0
86					
87	**SUBTOTAL - CONSTRUCTION COST with Red Flags**				$253,238,000
88					
89	**MARKET ADJUSTMENT FACTOR**		0%	$253,238,000	$0
90	**SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor**				$253,238,000
91	Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
92	Name of Process Reviewer			Odell	Click for Revie
93	Name of Estimator Reviewer			Meyer	
94	**MAXIMUM CONSTRUCTION COST**				$253,238,000
95					
96	**NON-CONSTRUCTION COSTS:**				
97	Permitting		0.0%	$253,238,000	$0
98	Engineering		0.0%	$253,238,000	$0
99	Services During Construction		0.0%	$253,238,000	$0
100	Commissioning & Startup		0.0%	$253,238,000	$0
101	Land / ROW		0.0%	$253,238,000	$0
102	Legal / Admin		0.0%	$253,238,000	$0
103	Other Default Description		0.0%	$253,238,000	$0
104	**SUBTOTAL - Non-Construction Costs**				$0
105					
106	**TOTAL - CAPITAL COST**				$253,238,000
107					
108	**Currency Conversion of TOTAL CAPITAL COST:**				
109		Currency	Unit of Measure	Conversion Rate	Converted Amount
110		None	U.S.Dollar	1	253,238,000

CPES_Cap_AMSWTF_AIX_Sidestream_OptionB

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FACILITIES LIFE CYCLE COST ANALYSIS

File Version: 9/12/2012

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Import File: C:\CPES\Projects\SNWA\CPES_Cap_AMSWTF_AIX_Sidestream_OptionB.xlsm Brows

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	AMSWTF - Sidestream AIX (Option B)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months)	1
Mid-Point of Construction:	Nov/2012

Life Cycle Analysis:

i =	5.00%
n =	20
Annual Inflation %:	0.00%

To Global Life Cycle Data

To Annual O & M Cost Summary

This Report is for INTERNAL Distribution

This Report is for EXTERNAL Distribution

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
	Yes	In-Plant PS: IXPS	$48,155,000	$2,377,000	$77,773,000
	Yes	Ion Exchange: AIX	$175,041,000	$28,398,000	$528,931,000
		Additional Project Costs:			
		Biosolids Disposal	$0	$0	$0
		Standard Items	$30,136,000	$282,000	$33,641,000
		User Defined Items	$0	$0	$0
		Plant O & M Labor		$440,000	$5,475,000
TOTAL - Life Cycle Analysis			$253,332,000	$31,497,000	$645,820,000
Construction Cost per GPD (based on Maximum Daily Flow Rate)			$0.42 / GPD		
Annual O & M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)				$ 0.323	/ Thousand Gallons

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FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 9/17/2012 | Click for CPES QA/Q | To Concrete Wall Thickness | To Cost Summary Matrix | To Unit Cost Database

Project Capactiy: >>> | Project Unit: >>> | (For example: MGD, HP, GPM...)

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	RMWTF - Full Flow AIX (Option A)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months):	1
Mid-Point of Construction:	Nov/2012

Roundup to the nearest: $1,000

This Report is for INTERNAL

This Report is for EXTERNAL

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT		Cost
	Yes	In-Plant PS: IXPS		$23,713,000
	Yes	Ion Exchange: AIX		$82,853,000
SUBTOTAL - PROJECT COST				$106,566,000
ADDITIONAL PROJECT COSTS:				
Demolition		0.0%		$0
Overall Sitework		3.0%		$3,197,000
Plant Computer System		1.5%		$1,599,000
Yard Electrical		4.0%		$4,263,000
Yard Piping		5.0%		$5,329,000
UD #1 Default Description		0.0%		$0
UD #2 Default Description		0.0%		$0
UD #3 Default Description		0.0%		$0
SUBTOTAL with Additional Project Costs				$120,954,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$120,954,000
CONTRACTOR MARKUPS:				
Overhead		10.0%	$120,954,000	$12,096,000
Subtotal				$133,050,000
Profit		7.0%	$133,050,000	$9,314,000
Subtotal				$142,364,000
Mob/Bonds/Insurance		3.0%	$142,364,000	$4,271,000
Subtotal				$146,635,000
Contingency		30.0%	$146,635,000	$43,991,000
SUBTOTAL with Markups				$190,626,000
ESCALATION (to Mid-Point of Construction)		2.5%	$190,626,000	$4,766,000
SUBTOTAL with Escalation				$195,392,000

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	A	B	C	D	E
54	LOCATION ADJUSTMENT FACTOR		104.6	$195,392,000	$204,381,000
55	SUBTOTAL - with Local Adjustment Factor				$204,381,000
56					
57	RED FLAGS:				
58	1	Rock Excavation			
59	2	Pile Foundations			
60	3	Seismic Foundations			
61	4	Dewatering Conditions			
62	5	Wetlands Mitigation			
63	6	Weather Impacts			
64	7	Depth of Structures			
65	8	Local Building Code Restrictions			
66	9	Coatings or Finishes			
67	10	Building or Architectural Considerations			
68	11	Client Material Preferences			
69	12	Client Equipment Preferences			
70	13	Piping Galleries, Piping Trenches, Piping Racks			
71	14	Yard Piping Complexity			
72	15	Existing Site Utilities (New, Retrofit, and Complexity)			
73	16	I & C Automation (New or Retrofit)			
74	17	Electrical Feed (New or Retrofit)			
75	18	Electrical Distribution			
76	19	Shoring			
77	20	Contamination			
78	21	User Defined Red Flag 1			
79	22	User Defined Red Flag 2			
80	23	User Defined Red Flag 3			
81	24	User Defined Red Flag 4			
82	25	User Defined Red Flag 5			
83	26	User Defined Red Flag 6			
84	27	User Defined Red Flag 7			
85	TOTAL - RED FLAGS				$0
86					
87	SUBTOTAL - CONSTRUCTION COST with Red Flags				$204,381,000
88					
89	MARKET ADJUSTMENT FACTOR		0%	$204,381,000	$0
90	SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$204,381,000
91	Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
92	Name of Process Reviewer			Odell	Click for Revie
93	Name of Estimator Reviewer			Meyer	
94	MAXIMUM CONSTRUCTION COST				$204,381,000
95					
96	NON-CONSTRUCTION COSTS:				
97	Permitting		0.0%	$204,381,000	$0
98	Engineering		0.0%	$204,381,000	$0
99	Services During Construction		0.0%	$204,381,000	$0
100	Commissioning & Startup		0.0%	$204,381,000	$0
101	Land / ROW		0.0%	$204,381,000	$0
102	Legal / Admin		0.0%	$204,381,000	$0
103	Other Default Description		0.0%	$204,381,000	$0
104	SUBTOTAL - Non-Construction Costs				$0
105					
106	TOTAL - CAPITAL COST				$204,381,000
107					
108	Currency Conversion of TOTAL CAPITAL COST:				
109		Currency	Unit of Measure	Conversion Rate	Converted Amount
110		None	U.S.Dollar	1	204,381,000

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CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS

File Version: 9/12/2012

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Import File: C:\CPES\Projects\SNWA\CPES_Cap_RMWTF_AIX_FullFlow_OptionA.xlsm   Browse

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	RMWTF - Full Flow AIX (Option A)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months)	1
Mid-Point of Construction:	Nov/2012

Life Cycle Analysis:

i =	5.00%
n =	20
Annual Inflation %:	0.00%

To Global Life Cycle Data

To Annual O & M Cost Summary

This Report is for INTERNAL Distribution

This Report is for EXTERNAL Distribution

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
	Yes	In-Plant PS: IXPS	$40,083,000	$1,562,000	$59,539,000
	Yes	Ion Exchange: AIX	$140,052,000	$18,430,000	$369,726,000
		Additional Project Costs:			
		Biosolids Disposal	$0	$0	$0
		Standard Items	$24,321,000	$228,000	$27,150,000
		User Defined Items	$0	$0	$0
		Plant O & M Labor		$440,000	$5,475,000
TOTAL - Life Cycle Analysis			$204,456,000	$20,660,000	$461,890,000
Construction Cost per GPD (based on Maximum Daily Flow Rate)			$0.51 / GPD		
Annual O & M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)				$ 0.426	/ Thousand Gallons

11/20/2012
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CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 9/17/2012 | Click for CPES QA/Q | To Concrete Wall Thickness | To Cost Summary Matrix | To Unit Cost Database

Project Capactiy: >>>		Project Unit: >>>		(For example: MGD, HP, GPM...)

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	RMWTF - Sidestream AIX (Option B)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months):	1
Mid-Point of Construction:	Nov/2012

Roundup to the nearest: $1,000

This Report is for INTERNAL

This Report is for EXTERNAL

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT		Cost
	Yes	In-Plant PS: IXPS		$19,068,000
	Yes	Ion Exchange: AIX		$68,367,000
SUBTOTAL - PROJECT COST				$87,435,000
ADDITIONAL PROJECT COSTS:				
Demolition		0.0%		$0
Overall Sitework		3.0%		$2,624,000
Plant Computer System		1.5%		$1,312,000
Yard Electrical		4.0%		$3,498,000
Yard Piping		5.0%		$4,372,000
UD #1 Default Description		0.0%		$0
UD #2 Default Description		0.0%		$0
UD #3 Default Description		0.0%		$0
SUBTOTAL with Additional Project Costs				$99,241,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$99,241,000
CONTRACTOR MARKUPS:				
Overhead		10.0%	$99,241,000	$9,925,000
Subtotal				$109,166,000
Profit		7.0%	$109,166,000	$7,642,000
Subtotal				$116,808,000
Mob/Bonds/Insurance		3.0%	$116,808,000	$3,505,000
Subtotal				$120,313,000
Contingency		30.0%	$120,313,000	$36,094,000
SUBTOTAL with Markups				$156,407,000
ESCALATION (to Mid-Point of Construction)		2.5%	$156,407,000	$3,911,000
SUBTOTAL with Escalation				$160,318,000

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	A	B	C	D	E
54	LOCATION ADJUSTMENT FACTOR		104.6	$160,318,000	$167,693,000
55	SUBTOTAL - with Local Adjustment Factor				$167,693,000
56					
57	RED FLAGS:				
58	1	Rock Excavation			
59	2	Pile Foundations			
60	3	Seismic Foundations			
61	4	Dewatering Conditions			
62	5	Wetlands Mitigation			
63	6	Weather Impacts			
64	7	Depth of Structures			
65	8	Local Building Code Restrictions			
66	9	Coatings or Finishes			
67	10	Building or Architectural Considerations			
68	11	Client Material Preferences			
69	12	Client Equipment Preferences			
70	13	Piping Galleries, Piping Trenches, Piping Racks			
71	14	Yard Piping Complexity			
72	15	Existing Site Utilities (New, Retrofit, and Complexity)			
73	16	I & C Automation (New or Retrofit)			
74	17	Electrical Feed (New or Retrofit)			
75	18	Electrical Distribution			
76	19	Shoring			
77	20	Contamination			
78	21	User Defined Red Flag 1			
79	22	User Defined Red Flag 2			
80	23	User Defined Red Flag 3			
81	24	User Defined Red Flag 4			
82	25	User Defined Red Flag 5			
83	26	User Defined Red Flag 6			
84	27	User Defined Red Flag 7			
85	TOTAL - RED FLAGS				$0
86					
87	SUBTOTAL - CONSTRUCTION COST with Red Flags				$167,693,000
88					
89	MARKET ADJUSTMENT FACTOR		0%	$167,693,000	$0
90	SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$167,693,000
91	Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
92	Name of Process Reviewer			Odell	Click for Revie
93	Name of Estimator Reviewer			Meyer	
94	MAXIMUM CONSTRUCTION COST				$167,693,000
95					
96	NON-CONSTRUCTION COSTS:				
97	Permitting		0.0%	$167,693,000	$0
98	Engineering		0.0%	$167,693,000	$0
99	Services During Construction		0.0%	$167,693,000	$0
100	Commissioning & Startup		0.0%	$167,693,000	$0
101	Land / ROW		0.0%	$167,693,000	$0
102	Legal / Admin		0.0%	$167,693,000	$0
103	Other Default Description		0.0%	$167,693,000	$0
104	SUBTOTAL - Non-Construction Costs				$0
105					
106	TOTAL - CAPITAL COST				$167,693,000
107					
108	Currency Conversion of TOTAL CAPITAL COST:				
109		Currency	Unit of Measure	Conversion Rate	Converted Amount
110		None	U.S.Dollar	1	167,693,000

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS

File Version: 9/12/2012

Click for CPES QA/Q

Import File: C:\CPES\Projects\SNWA\CPES_Cap_RMWTF_AIX_Sidestream_OptionB.xlsm Brows

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	RMWTF - Sidestream AIX (Option B)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months)	1
Mid-Point of Construction:	Nov/2012

Life Cycle Analysis:

i =	5.00%
n =	20
Annual Inflation %:	0.00%

To Global Life Cycle Data

To Annual O & M Cost Summary

This Report is for INTERNAL Distribution

This Report is for EXTERNAL Distribution

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
	Yes	In-Plant PS: IXPS	$32,231,000	$1,233,000	$47,591,000
	Yes	Ion Exchange: AIX	$115,565,000	$14,829,000	$300,356,000
		Additional Project Costs:			
		Biosolids Disposal	$0	$0	$0
		Standard Items	$19,957,000	$187,000	$22,278,000
		User Defined Items	$0	$0	$0
		Plant O & M Labor		$440,000	$5,475,000
TOTAL - Life Cycle Analysis			$167,753,000	$16,689,000	$375,700,000
Construction Cost per GPD (based on Maximum Daily Flow Rate)			$0.42 / GPD		
Annual O & M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)				$ 0.344	/ Thousand Gallons

11/20/2012
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CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 9/17/2012 | Click for CPES QA/Q | To Concrete Wall Thickness | To Cost Summary Matrix | To Unit Cost Database

Project Capactiy: >>> | Project Unit: >>> | (For example: MGD, HP, GPM...)

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	BBWD - Full Flow AIX (Option A)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months):	1
Mid-Point of Construction:	Nov/2012

Roundup to the nearest: $1,000

This Report is for INTERNAL

This Report is for EXTERNAL

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT		Cost
	Yes	In-Plant PS: IXPS		$1,489,000
	Yes	Ion Exchange: AIX		$4,152,000
SUBTOTAL - PROJECT COST				$5,641,000
ADDITIONAL PROJECT COSTS:				
Demolition		0.0%		$0
Overall Sitework		3.0%		$170,000
Plant Computer System		1.5%		$85,000
Yard Electrical		4.0%		$226,000
Yard Piping		5.0%		$283,000
UD #1 Default Description		0.0%		$0
UD #2 Default Description		0.0%		$0
UD #3 Default Description		0.0%		$0
SUBTOTAL with Additional Project Costs				$6,405,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$6,405,000
CONTRACTOR MARKUPS:				
Overhead		10.0%	$6,405,000	$641,000
Subtotal				$7,046,000
Profit		7.0%	$7,046,000	$494,000
Subtotal				$7,540,000
Mob/Bonds/Insurance		3.0%	$7,540,000	$227,000
Subtotal				$7,767,000
Contingency		30.0%	$7,767,000	$2,331,000
SUBTOTAL with Markups				$10,098,000
ESCALATION (to Mid-Point of Construction)		2.5%	$10,098,000	$253,000
SUBTOTAL with Escalation				$10,351,000

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	A	B	C	D	E
54	LOCATION ADJUSTMENT FACTOR		104.6	$10,351,000	$10,828,000
55	SUBTOTAL - with Local Adjustment Factor				$10,828,000
56					
57	RED FLAGS:				
58	1	Rock Excavation			
59	2	Pile Foundations			
60	3	Seismic Foundations			
61	4	Dewatering Conditions			
62	5	Wetlands Mitigation			
63	6	Weather Impacts			
64	7	Depth of Structures			
65	8	Local Building Code Restrictions			
66	9	Coatings or Finishes			
67	10	Building or Architectural Considerations			
68	11	Client Material Preferences			
69	12	Client Equipment Preferences			
70	13	Piping Galleries, Piping Trenches, Piping Racks			
71	14	Yard Piping Complexity			
72	15	Existing Site Utilities (New, Retrofit, and Complexity)			
73	16	I & C Automation (New or Retrofit)			
74	17	Electrical Feed (New or Retrofit)			
75	18	Electrical Distribution			
76	19	Shoring			
77	20	Contamination			
78	21	User Defined Red Flag 1			
79	22	User Defined Red Flag 2			
80	23	User Defined Red Flag 3			
81	24	User Defined Red Flag 4			
82	25	User Defined Red Flag 5			
83	26	User Defined Red Flag 6			
84	27	User Defined Red Flag 7			
85	TOTAL - RED FLAGS				$0
86					
87	SUBTOTAL - CONSTRUCTION COST with Red Flags				$10,828,000
88					
89	MARKET ADJUSTMENT FACTOR		0%	$10,828,000	$0
90	SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$10,828,000
91	Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
92	Name of Process Reviewer			Odell	Click for Revie
93	Name of Estimator Reviewer			Meyer	
94	MAXIMUM CONSTRUCTION COST				$10,828,000
95					
96	NON-CONSTRUCTION COSTS:				
97	Permitting		0.0%	$10,828,000	$0
98	Engineering		0.0%	$10,828,000	$0
99	Services During Construction		0.0%	$10,828,000	$0
100	Commissioning & Startup		0.0%	$10,828,000	$0
101	Land / ROW		0.0%	$10,828,000	$0
102	Legal / Admin		0.0%	$10,828,000	$0
103	Other Default Description		0.0%	$10,828,000	$0
104	SUBTOTAL - Non-Construction Costs				$0
105					
106	TOTAL - CAPITAL COST				$10,828,000
107					
108	Currency Conversion of TOTAL CAPITAL COST:				
109		Currency	Unit of Measure	Conversion Rate	Converted Amount
110		None	U.S.Dollar	1	10,828,000

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CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS

File Version: 9/12/2012

Click for CPES QA/Q

Import File: C:\CPES\Projects\SNWA\CPES_Cap_BBWD_AIX_FullFlow_OptionA.xlsm Brows

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	BBWD - Full Flow AIX (Option A)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months)	1
Mid-Point of Construction:	Nov/2012

Life Cycle Analysis:

i =	5.00%
n =	20
Annual Inflation %:	0.00%

To Global Life Cycle Data

To Annual O & M Cost Summary

This Report is for INTERNAL Distribution

This Report is for EXTERNAL Distribution

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
	Yes	In-Plant PS: IXPS	$2,518,000	$93,000	$3,666,000
	Yes	Ion Exchange: AIX	$7,020,000	$1,075,000	$20,409,000
		Additional Project Costs:			
		Biosolids Disposal	$0	$0	$0
		Standard Items	$1,292,000	$13,000	$1,443,000
		User Defined Items	$0	$0	$0
		Plant O & M Labor		$144,000	$1,792,000
TOTAL - Life Cycle Analysis			$10,830,000	$1,325,000	$27,310,000
Construction Cost per GPD (based on Maximum Daily Flow Rate)			$0.72 / GPD		
Annual O & M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)				$ 0.454	/ Thousand Gallons

11/20/2012
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C H2M HILL P arametric Cost E stimating S ystem (CPES)

FACILITIES DESIGN & CONSTRUCTION COST MODULE

File Version: 9/17/2012 | Click for CPES QA/Q | To Concrete Wall Thickness | To Cost Summary Matrix | To Unit Cost Database

Project Capactiy: >>> | Project Unit: >>> | (For example: MGD, HP, GPM...)

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	BBWD - Sidestream AIX (Option B)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months):	1
Mid-Point of Construction:	Nov/2012

Roundup to the nearest: $1,000

This Report is for INTERNAL

This Report is for EXTERNAL

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT		Cost
	Yes	In-Plant PS: IXPS		$1,284,000
	Yes	Ion Exchange: AIX		$3,115,000
SUBTOTAL - PROJECT COST				$4,399,000
ADDITIONAL PROJECT COSTS:				
Demolition		0.0%		$0
Overall Sitework		3.0%		$132,000
Plant Computer System		1.5%		$66,000
Yard Electrical		4.0%		$176,000
Yard Piping		5.0%		$220,000
UD #1 Default Description		0.0%		$0
UD #2 Default Description		0.0%		$0
UD #3 Default Description		0.0%		$0
SUBTOTAL with Additional Project Costs				$4,993,000
TAX:		0.00%	$0	$0
SUBTOTAL with Tax				$4,993,000
CONTRACTOR MARKUPS:				
Overhead		10.0%	$4,993,000	$500,000
Subtotal				$5,493,000
Profit		7.0%	$5,493,000	$385,000
Subtotal				$5,878,000
Mob/Bonds/Insurance		3.0%	$5,878,000	$177,000
Subtotal				$6,055,000
Contingency		30.0%	$6,055,000	$1,817,000
SUBTOTAL with Markups				$7,872,000
ESCALATION (to Mid-Point of Construction)		2.5%	$7,872,000	$197,000
SUBTOTAL with Escalation				$8,069,000

11/20/2012
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	A	B	C	D	E
54	LOCATION ADJUSTMENT FACTOR		104.6	$8,069,000	$8,441,000
55	SUBTOTAL - with Local Adjustment Factor				$8,441,000
56					
57	RED FLAGS:				
58	1	Rock Excavation			
59	2	Pile Foundations			
60	3	Seismic Foundations			
61	4	Dewatering Conditions			
62	5	Wetlands Mitigation			
63	6	Weather Impacts			
64	7	Depth of Structures			
65	8	Local Building Code Restrictions			
66	9	Coatings or Finishes			
67	10	Building or Architectural Considerations			
68	11	Client Material Preferences			
69	12	Client Equipment Preferences			
70	13	Piping Galleries, Piping Trenches, Piping Racks			
71	14	Yard Piping Complexity			
72	15	Existing Site Utilities (New, Retrofit, and Complexity)			
73	16	I & C Automation (New or Retrofit)			
74	17	Electrical Feed (New or Retrofit)			
75	18	Electrical Distribution			
76	19	Shoring			
77	20	Contamination			
78	21	User Defined Red Flag 1			
79	22	User Defined Red Flag 2			
80	23	User Defined Red Flag 3			
81	24	User Defined Red Flag 4			
82	25	User Defined Red Flag 5			
83	26	User Defined Red Flag 6			
84	27	User Defined Red Flag 7			
85	TOTAL - RED FLAGS				$0
86					
87	SUBTOTAL - CONSTRUCTION COST with Red Flags				$8,441,000
88					
89	MARKET ADJUSTMENT FACTOR		0%	$8,441,000	$0
90	SUBTOTAL - CONSTRUCTION COST with Market Adjustment Factor				$8,441,000
91	Your CPES Estimate MUST be reviewed by a Process person AND an Estimator:				
92	Name of Process Reviewer			Odell	Click for Revie
93	Name of Estimator Reviewer			Meyer	
94	MAXIMUM CONSTRUCTION COST				$8,441,000
95					
96	NON-CONSTRUCTION COSTS:				
97	Permitting		0.0%	$8,441,000	$0
98	Engineering		0.0%	$8,441,000	$0
99	Services During Construction		0.0%	$8,441,000	$0
100	Commissioning & Startup		0.0%	$8,441,000	$0
101	Land / ROW		0.0%	$8,441,000	$0
102	Legal / Admin		0.0%	$8,441,000	$0
103	Other Default Description		0.0%	$8,441,000	$0
104	SUBTOTAL - Non-Construction Costs				$0
105					
106	TOTAL - CAPITAL COST				$8,441,000
107					
108	Currency Conversion of TOTAL CAPITAL COST:				
109		Currency	Unit of Measure	Conversion Rate	Converted Amount
110		None	U.S.Dollar	1	8,441,000

11/20/2012
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CH2M HILL Parametric Cost Estimating System (CPES)

FACILITIES LIFE CYCLE COST ANALYSIS

File Version: 9/12/2012

Click for CPES QA/Q

Import File: C:\CPES\Projects\SNWA\CPES_Cap_BBWD_AIX_Sidestream_OptionB.xlsm Brows

Project Name:	SNWA Perchlorate Removal Strategies
Project Number:	420617.CS.12
Project Manager:	Paul Swaim/DEN
Estimator:	Joseph Zalla/SLC
Project Description:	BBWD - Sidestream AIX (Option B)
Project Location (City):	Las Vegas NV
Project Location (State):	NEVADA
Project Location (Country):	USA
Construction Start (Month):	Oct
Construction Start (Year):	2012
Construction Duration (months)	1
Mid-Point of Construction:	Nov/2012

Life Cycle Analysis:

i =	5.00%
n =	20
Annual Inflation %:	0.00%

To Global Life Cycle Data

To Annual O & M Cost Summary

This Report is for INTERNAL Distribution

This Report is for EXTERNAL Distribution

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	Construction Cost	Annual O&M Cost (Escalated)	Life Cycle Cost (NPV)
	Yes	In-Plant PS: IXPS	$2,172,000	$77,000	$3,127,000
	Yes	Ion Exchange: AIX	$5,268,000	$852,000	$15,874,000
		Additional Project Costs:			
		Biosolids Disposal	$0	$0	$0
		Standard Items	$1,005,000	$10,000	$1,122,000
		User Defined Items	$0	$0	$0
		Plant O & M Labor		$144,000	$1,792,000
TOTAL - Life Cycle Analysis			$8,445,000	$1,083,000	$21,915,000
Construction Cost per GPD (based on Maximum Daily Flow Rate)			$0.56 / GPD		
Annual O & M Cost per 1,000 Gallons (based on Average Annual Daily Flow Rate)				$ 0.371	/ Thousand Gallons