SALT WASTE PROCESSING FACILITY PROJECT

NEXT GENERATION SOLVENT TEST REPORT INCLUDING A HIGHER CONCENTRATION WASTE DEMONSTRATION

Contract No. DE-AC09-02SR22210
Phase II

Function: **Test Report**
Doc. No.: **P-RPT-J-00028**
Revision: **0**
Date: **03/02/2015**

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SUMMARY OF CHANGES

Revision No.	Date	Description of Change
0	03/02/2015	Issued for Approval

*NOTE: Previous draft revisions of this test report (Revisions 0A1, 0A2, and 0B) were distributed for IDC/IDR/DOE Formal Review as P-RPT-J-00024, *Next Generation Solvent Test Report*. Per DOE Comment #1 in a Letter No. SWPF-14-188 dated September 18, 2014 the document number and title was changed to P-RPT-J-00028, *Next Generation Solvent Test Report Including a Higher Concentration Waste Demonstration.* The technical content from P-RPT-J-00024 has been retained and included in this report.

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
%	Percent
µm	Micron
AMWD	Assistant Manager for Waste Disposition
BOBCalixC6	Calix[4]arene-bis(tert-octylbenzo-crown-6)
CF	Concentration Factor
CFF	Cross-Flow Filter
Ci/gal	Curies per Gallon
CINC	CINC Industries, Inc.
CIP	Clean-in-Place
COA	Certificate of Analysis
Cs	Cesium
Cs-7SB	1-(2,2,3,3-tetrafluoropropoxy)-3-(4-sec-butylphenoxy)-2-propanol
CSS	Clarified Salt Solution
CSST	Clarified Salt Simulant Feed Tank
CSSX	Caustic-Side Solvent Extraction
DCiTG	N,N'-dicyclohexyl-N''-isotridecylguanidine
D_{Cs}	Cs Distribution Coefficients
dP	Differential Pressure
DF	Decontamination Factor
DOE	U.S. Department of Energy
DSS	Decontaminated Salt Solution
DWPF	Defense Waste Processing Facility
E_i	Contactor Countercurrent Efficiencies
EPA	U.S. Environmental Protection Agency
EPC	Engineering, Procurement, and Construction
FFT	Filter Feed Tank
g/cc	Grams per Cubic Centimeter
GC	Gas Chromatography
GEL	General Environmental Laboratory
gpm	Gallons per Minute
HCWD	Higher Concentration Waste Demonstration
HCWDT	Higher Concentration Waste Demonstration Testing
H_2O	Water
H_3BO_3	Boric Acid
HNO_3	Nitric Acid
hp	Horsepower
HPLC	High Pressure Liquid Chromatography
IT	Integrated Test
K^+	Potassium
kg	Kilogram
M	Molar
MaxCalix	1,3-alt-25,27-bis(3,7-dimethyloctyl-1-oxy)calyx[4]arene-benzocrown-6

MBM	Mass Balance Model
MCU	Modular Caustic-Side Solvent Extraction Unit
mg/L	Milligrams per Liter
Mgpy	Million Gallons per Year
mL	Milliliter
mm	Millimeter
mM	Millimolar
MOC	Materials of Construction
MS	Mass Spectrometer
Na^+	Sodium
NaOH	Sodium Hydroxide
NGS	Next Generation Solvent
NGST	Next Generation Solvent Test
NTU	Nephlometric Turbidity Unit
O:A	Organic-to-Aqueous (Ratio)
P_{DCiTG}	DCiTG Partition Ratio
ppmv	Parts per Million Volume
PTC	Parsons Technology Center
QA	Quality Assurance
rpm	Revolutions per Minute
SE	Strip Effluent
SHT	Solvent Hold Tank
SOP	System Operating Procedure
SRR	Savannah River Remediation
SRS	Savannah River Site
SSFT	Salt Solution Feed Tank
SSW	Strip, Scrub, and Wash
SVOA	Semi-Volatile Organic Analysis
SWPF	Salt Waste Processing Facility
TiDG	N, N’,N”-tris(3,7-dimethyloctyl)guanidine
TMA	Trimethylamine
TOA	Trioctylamine
UV/VIS	Ultraviolet/Visible
VFD	Variable Frequency Drive
WAC	Waste Acceptance Criteria

EXECUTIVE SUMMARY

PURPOSE

The overall goal of the Next Generation Solvent Test (NGST) was to profile solvent recovery, hydraulic and mass transfer performance at varying organic-to-aqueous (O:A) ratios and rotor speeds with the Next Generation Solvent (NGS) flowsheet at increased waste simulant throughput. Additional scope for Higher Concentration Waste Demonstration (HCWD) Testing (HCWDT) followed testing with 5.6 molar (M) Sodium ([Na^+]). The HCWDT utilized the operational parameters established during NGS testing with 5.6M [Na^+] simulant with more concentrated simulated waste; (6.44M and 7.5M [Na^+] stimulants). Only minor hardware changes were made to existing test system to accommodate increased system flow rates and chemistry changes for 5.6M testing. The system hardware was unchanged for the HCWDT from the 5.6M testing with NGS.

MASS TRANSFER

NGS provided superior mass transfer performance compared to BOBCalixC6 solvent. At 100 percent (%) simulant flow (21.43 gallons per minute [gpm]), the NGS had nearly six (6) times the decontamination factor (DF), measured over four (4) contactors, of the BOBCalixC6 solvent at the same flow. At higher flows, up to 134% (28.72 gpm), the DF was even higher for the NGS with the best DF occurring at 121% (25.93 gpm). The maximum DF achieved with NGS, measured over four (4) contactors, was 392 ± 78, making the theoretical Salt Waste Processing Facility (SWPF) DF approximately 23.7 billion. NGS also performed well when using higher concentration simulant. Theoretical SWPF DFs of 3.9 billion and 65.6 million were achieved with 6.44M and 7.5M [Na^+] respectively.

In addition to the high DF observed with NGS, higher concentration factors (CFs) were achieved. A CF of 20 was tested for higher concentration simulant with DFs in the billions and a CF of 40 was successfully tested while maintaining the theoretical SWPF DF above 1 million. These high CF tests were conducted with a 134% simulant flow (28.72 gpm). To put this in perspective the BOBCalixC6 solvent with lower concentration waste (5.6M), at a lower flow rate (21.43 gpm), and with a lower CF (15) had a maximum DF of 4.3 million during the previous testing campaign.

ISOPAR®L CARRYOVER

NGS produced nearly undetectable amounts of Isopar®L carryover in both the Strip Effluent (SE) and the Decontaminated Salt Solution (DSS) when processing the 5.6M [Na^+] simulant. During a typical run, the Isopar®L concentration in the outlet of both the SE Coalescer and DSS Coalescer were at or just above the Parsons Technology Center (PTC) Laboratory detection limit (~2 milligrams per liter [mg/L]).

The Isopar®L carryover in the SE remained below the detection limit during the HCWDT. However, the carryover in the DSS did not. The first detectable amounts of Isopar®L were seen in the DSS for the first test conducted with 6.4M [Na^+] simulant. Each subsequent test resulted in

higher levels of carryover into the DSS. A step change increase in the carryover was observed when the simulant concentration was increased to 7.5M [Na^+], and Isopar®L carryover continued to climb at a faster rate than with the 6.4M [Na^+] simulant. Isopar®L concentrations in the DSS had reached ~90 mg/L at the conclusion of HCWDT.

HYDRAULIC PERFORMANCE

Stable hydraulic performance was achieved with NGS, but the nominal 1% aqueous carryover limit used during BOBCalixC6 testing did not seem to apply. Aqueous carryover in the extraction contactors as high as ~3% was observed to be stable and provide extremely high mass transfer performance. NGS solvent appeared to be more sensitive to some operationally parameters, i.e. flow rates (particularly solvent flow) and rotor speeds than BOBCalixC6 solvent, but the parameter space for stable performance was wide enough for easy operation once the parameter ranges were established.

THROUGHPUT

Caustic-Side Solvent Extraction (CSSX) throughputs were substantially increased with NGS flowsheet. A volumetric processing rate of 28.7 gpm was demonstrated with 5.6M, 6.4M, and 7.5M [Na^+] simulants. The maximum processing rate previously demonstrated with the BOBCalixC6 flowsheet was 21.4 gpm. The equivalent effective SWPF throughput for NGS with 5.6M, 6.4M, and 7.5M [Na^+] simulants and BOBCalixC6 are shown in Table ES-1. As it can be seen, the throughput was nearly doubled with 7.5M [Na^+] simulant and NGS as compared to baseline with BOBCalixC6 and 5.6M [Na^+] simulant.

Table ES-1. Equivalent Effective CSSX Throughputs Demonstrated During NGST and HCWDT

	CSSX Volumetric Rate (gpm)	SWPF Instantaneous Effective Throughput (million gallons per year [Mgpy])[4]	SWPF Nominal Effective Throughput (Mgpy)[5]
BOBCalixC6[1]	21.43	9.3	7.0
NGS - 5.6M[1]	28.7	12.5	9.4
NGS - 6.4M[2]	28.7	15.1	11.3
NGS - 7.5M[3]	28.7	17.6	13.2

[1]In SWPF 5.6M feed is produced by caustic dilution of 6.4M waste in the Alpha Sorption Process. This results in a 20.5% increase in the waste volume and lowers the effective throughput accordingly.

[2]6.4M salt solution is 20.5% more concentrated than 5.6M (all species by volume).

[3]7.5M salt solution is assumed to be 16.8% more concentrated than 6.4M (7.5/6.42 = 1.168).

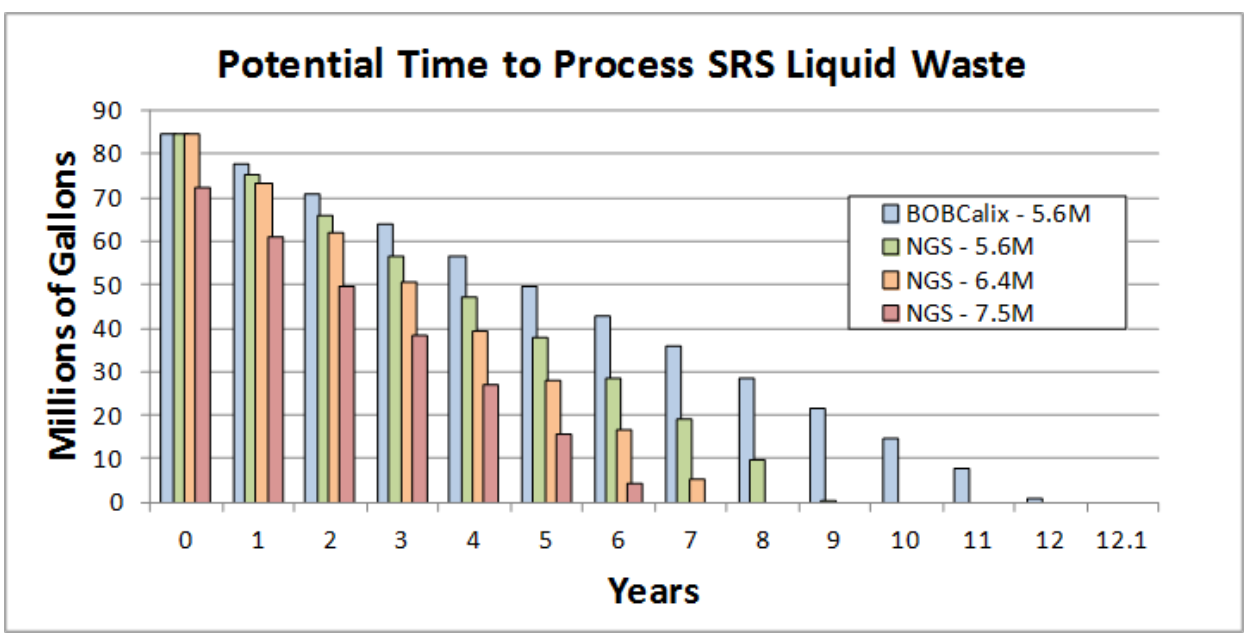
[4]Corrected to 6.4M equivalent throughput.

[5]75% availability is assumed.

Higher cesium (Cs) CFs of 20 and 40 were also demonstrated with NGS, as compared to the baseline of 15 with BOBCalixC6. Higher CF effectively reduce the Cs-laden SE throughput per unit volume of salt waste processed. In SWPF the CF can be increased substantially with lower activity waste batches (e.g. less than 2 curies per gallon [Ci/gal]). This reduces the volume of Cs-laden high level waste to be vitrified at Defense Waste Processing Facility (DWPF) and minimizes water (H_2O) recycled from DWPF back to the Tank Farm. This is possible because the processing of lower activity waste batches with a nominal CF of 15 results in a SE activity well below the DWPF waste acceptance criteria (WAC) limit. Utilizing the greater CFs afforded by NGS will allow more optimal loading of Cs in the SE (e.g. closer to the DWPF WAC limit) and result in substantial reduction in the volume of SE sent to DWPF.

The NGS flowsheet with or without higher concentration waste feed processing has the potential to result in a huge life-cycle savings for the U. S. Department of Energy (DOE). The potential effect on the estimated time to complete treatment of all the Savannah River Site (SRS) liquid waste targeted for SWPF (based on 84,700,000 gallons fixed initial volume after adjustment to 6.44M [Na^+]) is illustrated by Figure ES-1. The time to complete SRS liquid waste treatment, the number of tank farm batches to blend and qualify, the number of Saltstone grout vaults (total volume of decontaminated waste), and the volume of Cs-laden high-level waste to be vitrified could all, potentially, be reduced simultaneously. In addition, the overall increased flowsheet performance ensures that unforeseen operational issues throughout the SRS Liquid Waste System have minimal impact on annual waste processing rates.

Figure ES-1. Estimated Time to Complete Liquid Waste Processing with NGS and Increasing Waste Concentrations



1.0 BACKGROUND

The NGS was developed through research funded by the DOE to improve Cs decontamination and provide potential for increased performance of high-level waste processing in the SWPF and SRS Modular CSSX Unit (MCU). The majority of NGS development was conducted at Oak Ridge National Laboratory (ORNL/TM-2014/22, *Next-Generation Solvent Development for Caustic-Side Solvent Extraction of Cesium*[1]). In addition, Savannah River Remediadtion (SRR) conducted single contactor testing with a different NGS formulation (SRNL-STI-2013-00413, *Mass Transfer and Hydraulic Testing of the V-05 and V-10 Contactors with the Next Generation Solvent*[2]) and is currently conducting hot operations with NGS at MCU. The SWPF Engineering, Procurement, and Construction (EPC) Contractor was awarded funding to develop and perform CSSX testing that evaluated maximum waste throughput, effects of chemistry changes, mass transfer and solvent recovery performance that could be expected with NGS full-scale implementation. The funding for this effort was provided by the Assistant Manager for Waste Disposition (AMWD) for the purposes of risk reduction of meeting the site treatment plan date of 2028 and for potential life-cycle savings.

The NGS, along with improved scrubbing and stripping chemistry, was developed to enhance the Cs extraction performance of the CSSX process to accelerate disposition of the SRS salt waste. In addition, the performance enhancement extends the viability of processing the higher potassium salt wastes stored at Hanford with CSSX. Initial NGS development efforts were largely focused on increasing the SRS MCU Cs DF from 12 to ≥ 40,000 without extensive hardware changes.

The primary metric for overall flowsheet performance is DF and is defined according to:

$$DF = X_{CSS} / X_{DSS}$$

Where: X_{CSS} = Cs concentration in the waste feed (or Clarified Salt Solution [CSS]) and X_{DSS} = Cs concentration in the DSS

DF is dependent on hardware and chemistry performance. High values are desired and result in low Cs concentrations in the DSS relative to the Cs concentration in the CSS.

The primary metric for mechanical (or hardware) performance in CSSX centrifugal contactors is stage efficiency or mass transfer efficiency. Contactor countercurrent efficiencies (E_i) are calculated based on the following equation:

$$E_i = (X_{i+1} - X_i) / (X_{i+1} - X_{i,eq})$$

Where: X_{i+1} = concentration of Cs in the aqueous phase entering stage i, X_i = concentration of Cs in the aqueous phase exiting stage i, and $X_{i,eq}$ is the concentration of Cs in the aqueous phase at equilibrium.

Substantial flowsheet performance improvements from NGS implementation were expected to be a result of superior Cs removal chemistry. Performance metrics for CSSX chemistry (or

CSSX solvent) are the stripping and extraction Cs distribution coefficients (D_{Cs}). The D_{Cs} is the ratio of Cs concentration in the solvent to the Cs concentration in the aqueous phase (CSS or strip solution) at equilibrium, defined according to:

$$D_{Cs} = Y_{Cs,eq} / X_{Cs,eq}$$

Where: $Y_{Cs,eq}$ = concentration of the Cs in the organic phase at equilibrium and
$X_{Cs,eq}$ = concentration of the Cs in the aqueous phase at equilibrium.

The extraction D_{Cs} indicates how effectively Cs extracts from the CSS; higher extraction D_{Cs} indicates better solvent performance. The strip D_{Cs} indicates how effectively Cs strips into the strip solution; lower strip D_{Cs} indicates better stripping performance.

Substantial increases (three orders-of-magnitude) in CSSX DFs required dramatic concurrent improvements in both CSSX extraction and stripping performance. The extraction improvements were accomplished via implementation of more soluble calixerene-crown ether, MaxCalix, to replace BOBCalixC6. The higher concentrations of Cs extractant in the solvent that are attainable with MaxCalix due to higher solubility in the solvent matrix result in proportionally higher extraction D_{Cs}.

Simultaneous improvements in the stripping and scrubbing chemistries were also made. The scrub solution was changed from a nitric acid (HNO_3) to a sodium hydroxide (NaOH) solution. The strip solution was changed from a dilute HNO_3 to a dilute boric acid (H_3BO_3) solution. These chemistry changes effectively altered Cs stripping from a nitrate-swing cycle to a more effective pH-swing cycle. The trioctylamine (TOA) suppressor (used in BOBCalixC6 solvent) was no longer effective due to the alternative strip chemistry and was replaced with a N,N'-dicyclohexyl-N"-isotridecylguanidine (DCiTG) suppressor[1]. The alternative scrub and strip solutions along with the new suppressor resulted in a drastic decrease in stripping D_{Cs}. Without the new strip/scrub chemistry, the increased calixarene concentration in the solvent would simply increase the stripping D_{Cs} by the same factor as extraction. If the extraction and strip D_{Cs} increase proportionally there is no net improvement in flowsheet performance because Cs would not be effectively stripped from the solvent prior to recycling back into extraction. Thus the stripping performance needed to be improved, by lowering strip D_{Cs}, at least proportionally to the increase in extraction D_{Cs} for an overall benefit in flowsheet performance to be realized.

The SWPF was purposefully designed with 36 centrifugal contactor stages to process the higher activity SRS salt wastes. Due to the number of contactor stages, SWPF is not as DF limited as MCU which has 18 stages. Results from the recently completed P-RPT-J-00020, *Test Report: Cross-Flow Filter and Caustic-Side Solvent Extraction Integrated Test*[3], showed that the theoretical SWPF DF could exceed 1,000,000 with the baseline CSSX chemistry. Further increases in SWPF DF would not directly result in acceleration of SRS waste disposition.

[1] In January 2013, ORNL issued a report (ORNL/TM-2012/625, *Recommended Guanidine Suppressor for the Next-Generation Caustic-Side Solvent Extraction Process*) recommending N, N',N"-tris(3,7-dimethyloctyl)guanidine (TiDG) as an alternative suppressor to DCiTG. This recommendation was primarily based on superior lipophilicity of TiDG compared to DCiTG.

However, acceleration could be accomplished by increasing the effective processing rate of SWPF through leveraging of the NGS chemistry.

The potential to accelerate waste processing with NGS can be attributed to superior Cs kinetics over the BOBCalixC6 solvent and an associated reduction in the required solvent flow rate needed to achieve target DFs. The NGS has faster Cs mass-transfer kinetics in extraction primarily due to having seven (7) times as many Cs extraction molecules in the solvent. In other words, the probability of a random interaction between Cs in the aqueous-phase and a solvent extraction site is higher, particularly over the short time intervals experienced in the centrifugal contactor mixing zone at high flow rates. Just as importantly, boric acid provides much faster Cs chemical interaction kinetics during stripping as compared to the baseline nitric acid solution.

The superior kinetics of NGS should allow the flowsheet to function well over a broader range of conditions including higher flows in extraction and lower flows in strip. The enhanced extraction and stripping performance of NGS can be leveraged to reduce the flow rate of solvent required to exceed SWPF design DFs while increasing the waste flow rate and maintaining nearly the same total flow through the contactors. In theory, the effective waste processing rate of the SWPF CSSX process can be increased with minimal impacts to SWPF hardware.

In addition to an increased waste processing rate, the potential benefits of NGS implementation include an increase in SWPF process robustness, and elimination of acid-base reactions from extraction and scrub mixing. The high potency of the NGS chemistry could potentially increase SWPF process robustness and make the CSSX system less sensitive to minor process deviations that impact distribution coefficients. For example, satisfactory DFs could still be obtained at lower stage efficiencies that may result from increased flow rates, increased organic or aqueous carryover, extreme O:A ratios, or off-normal conditions. The tolerance for lower efficiencies means that hydraulic throughput of the contactors could likely be sustained above the previously established maximum of 30 gpm total flow.

The change to an alkaline sodium hydroxide scrub solution from nitric acid eliminates acid-base reactions resulting from scrub solution mixing with the waste feed in the first extraction contactor, with respect to aqueous flow, and aqueous carryover from extraction into scrub. This will likely reduce two possible sources of aluminate particulate matter within the extraction contactors and DSS Coalescer. A build-up of sodium aluminosilicate has been observed in the first extraction contactor at MCU with BOBCalixC6-based solvent (X-ESR-H-00362, *Response to Path Forward for the Degradation of the Cs-137 Decontamination Factor at the MCU*[4]).

Thus, the potential SWPF benefit from implementation of NGS is multi-fold (1) an increase in waste processing rate with minimal hardware changes, (2) an increase in process robustness, and (3) reduction in particulate fouling of the CSSX process.

Higher concentration SRS liquid waste feeds (“high sodium”) to SWPF may also be realized with NGS deployment. Higher concentration SRS liquid waste processing has the potential to result in substaintial life-cycle savings for DOE SRS. Processing of a 7.5M [Na^+] feed at a volumetric demand of 12.5 Mgpy would result in an equivalent effective throughput of 17.6

Mgpy of baseline 5.6M [Na^+][2]. Thus, moderately higher waste concentrations combined with NGS can reduce the time to complete liquid waste processing by up to nine (9) years compared to baseline with BOBCalixC6 processing. Higher concentration waste could also simultaneously reduce the number of Tank Farm batches to blend/qualify and the number of Saltstone grout vaults required for the low-level waste disposal.

The Cs CF can also be increased substantially with NGS and lower activity waste batches (e.g. less than 2 Ci/gal which reduces the volume of Cs-laden high level waste to be vitrified at DWPF and minimizes H_2O recycled from DWPF back to the Tank Farm. This is possible because the processing lower activity waste batches with a nominal CF of 15 results in a SE activity well below the DWPF WAC limit. Utilizing the greater CFs afforded by NGS will allow more optimal loading of Cs in the SE (e.g. closer to the DWPF WAC limit) and result in substantial reduction in the volume of SE sent to DWPF.

2.0 TEST DESCRIPTION

The overall goal of the NGST was to profile solvent recovery, hydraulics, and mass transfer performance at varying O:A ratios and rotor speeds with increased waste simulant throughput. The NGST used, where practical, existing testing facilities and equipment from previous testing of the BOBCalixC6 solvent. Only minor hardware changes were made to existing test system to accommodate increased system flow rates and chemistry changes; see Section 2.6. Thus, any flowsheet improvements realized result from the use of NGS, modifications in the scrubbing and stripping chemistry and operational parameters optimized for NGS; not as a result of hardware improvements.

Additional scope for HCWDT followed testing with 5.6M [Na^+] and utilized NGS to evaluate hydraulic, mass transfer performance and solvent recovery with increased throughput and more concentrated simulated waste; i.e. 6.44M and 7.5M [Na^+] simulant. Strip flow was reduced to assess the effect on DF.

Test operations for the NGST and HCWDT were conducted from December 2011 through February 2013 and May 2013 through January 2014.

2.1 Test Objectives[5]

The test objectives for the initial NGST and HCWDT are provided below.

2.1.1 NGST

1. Evaluate hydraulic and mass transfer performance at elevated throughputs with varying O:A ratios and 5.6M [Na^+] simulant.
2. Demonstrate acceptable solvent recovery in the full-scale equipment.
3. Determine aqueous and solvent throughputs for maximum waste processing.

[2] The volumetric concentration differences between 5.6M, 6.4M, and 7.5M [Na^+] salt solutions are discussed in Section. 2.7.2.

4. Evaluate the effects of all chemistry changes required to support use of NGS on the SWPF CSSX process.

2.1.2 HCWDT

1. Evaluate hydraulic and mass transfer performance at elevated throughputs with >5.6M [Na^+] simulant.
2. Evaluate the effect of decreased strip flow on the DF.
3. Profile solvent recovery in the full-scale equipment.

2.2 NGST and HCWDT Matrices

Systemization activities with the NGS and 5.6M [Na^+] simulant focused on achieving sustained operations at 50% to 75% flow. Initially, only flows of ≤ 50% were maintainable as a result of hydraulic instability in the extraction contactors. Ten (10) weir sets were tested with all resulting in poor hydraulic performance. Acceptable hydraulics were only accomplished during the NGST after modifying the NGS composition, changing the weir set back to nominal, reducing the organic flow, and adjusting the rotor speeds. These changes were preserved for the HCWDT. Further discussion of systemization activities are provided in Section 4.0.

Workup tests were conducted with each simulant concentration (5.6M, 6.4M, and 7.5M[Na^+]) to verify operational conditions for the flow rates anticipated in formal tests. 5.6M [Na^+] simulant was used during the NGST. 6.4M and 7.5M [Na^+] simulants were used during the HCWDT. Phase carryover, mass transfer and coalescer performance data was collected for each expected flow rate and optimum extraction rotor speed. Typically, the data collected during the work-up tests was consistent with that of formal testing, thus further verifying the operating conditions selected. Run conditions for each workup test performed with 5.6M, 6.4M, and 7.5M [Na^+] simulants are provided in Table 2-1, Table 2-3, and Table 2-4, respectively.

Table 2-2, Table 2-3, and Table 2-5 below provide the tested conditions and data collected for the NGST and HCWDT formal and optional tests performed. The test durations for the NGST and HCWDT formal and optional tests were sufficient to allow a minimum of one (1) hour of steady-state operation at the final test conditions prior to sampling. Formal tests were previously identified in the P-TPL-J-00016, *Caustic-Side Solvent Extraction Next Generation Solvent Test Plan*[5]. Optional tests were supplemental to the required formal tests and were performed as time and budget permitted. The data collected for each formal and optional test included Cs DF and solvent recovery performance.

Table 2-1. NGST Workup Test Matrix with 5.6M [Na^+] Simulant

Workup Test No.	% Simulant Flow	Simulant Flow Rate (gpm)	Solvent Flow Rate (gpm)	Extraction O:A	SSW+ Flow Rate (gpm)	Extraction Weir Set	Extraction Rotor Speed (revolutions per minute [rpm])	Scrub Rotor Speed (rpm)	Strip Rotor Speed (rpm)	Wash Rotor Speed (rpm)	Time of Sampling	Data Collected
1	100%	21.43	2.14	1:10	1.43	EXT-201A/B/C/D: 5.7-inch	2000	1000	1000	1000	• After 10 minutes of establishing flow and rotor speed	• DSS and strip effluent (SE) solvent recovery • Turbidity of DSS and SE • DF and Concentration Factor (CF) • Aqueous and organic carryover • Solvent composition
2	134%	28.7	2.14	1:13.4	1.43	EXT-201A/B/C: 5.4-inch EXT-201D: 5.7-inch	2200	1000	1000	1000	• After 20 minutes of establishing flow and rotor speed	• DSS and SE solvent recovery • Turbidity of DSS and SE • DF and CF • Solvent composition
3	134%	28.7	2.87	1:10	1.43		2200	2000	1000	1000	• Every 10 minutes for 30 minutes to evaluate time to steady state	• DSS and SE solvent recovery • Turbidity of DSS and SE • DF and CF • Aqueous and organic carryover • Solvent composition
4	134%	28.7	2.87	1:10	1.43		2000	2000	1000	1000	• After 2 hours of establishing flow and rotor speed	• DSS and SE solvent recovery • Turbidity of DSS and SE • DF and CF • Aqueous and organic carryover • Solvent composition
5	75%	16.07	1.61	1:10	1.07		1700	2000	1000	1000	• After 2 hours of establishing flow and rotor speed	• DSS and SE solvent recovery • Turbidity of DSS and SE • DF and CF • Aqueous carryover • Solvent composition
6	121%	25.96	2.60	1:10	1.43		2200	2000	1000	1000	• After 1.5 hours of establishing flow and rotor speed	• DSS and SE solvent recovery • Turbidity of DSS and SE • DF and CF • Aqueous carryover • Solvent composition
7	110%	23.61	2.36	1:10	1.43		2200	2000	1000	1000	• After 1.5 hours of establishing flow and rotor speed	• DSS and SE solvent recovery • Turbidity of DSS and SE • DF and CF • Aqueous and organic carryover • Solvent composition
8	150%	32.15	3.22	1:10	1.43		1900	2200	1000	1000	• After 1.5 hours of establishing flow and rotor speed	• DSS and SE solvent recovery • Turbidity of DSS and SE • DF and CF • Aqueous and organic carryover • Solvent composition

+ Strip, scrub and wash (SSW)
* CF is the Cs concentration in the strip effluent divided by the Cs concentration in the simulant waste feed

Table 2-2. NGST Formal and Optional Test Matrix with 5.6M [Na^+] Simulant

Test	% Simulant Flow	Potential SWPF (Mgpy)	Extraction O:A	SSW O:A	Simulant Flow Rate (gpm)	Solvent Flow Rate (gpm)	SSW (gpm)	Extraction Total Flow (gpm)	Extraction % Total Flow	Strip Total Flow (gpm)	Strip % Total Flow	% SE Flow to DWPF	Data Collected
Formal 1	134%	12.51	0.1	2.01	28.70	2.87	1.43	33.0	110%	4.30	50%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending • Measured stage efficiency in one extraction contactor
Formal 2	100%	9.34	0.1	1.50	21.43	2.14	1.43	25.0	83%	3.57	42%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
Formal 3	75%	7.00	0.1	1.50	16.07	1.61	1.07	18.8	63%	2.68	31%	75%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
Formal 4	110%	10.29	0.1	1.65	23.61	2.36	1.43	27.4	91%	3.79	44%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
Optional 1*	50%	4.67	0.1	1.51	10.72	1.07	0.71	12.5	42%	1.78	21%	50%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending • Measured stage efficiency in one extraction contactor
Formal 5	121%	11.32	0.1	1.82	25.96	2.60	1.43	30.0	100%	4.03	47%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
Optional 2**	155%	14.48	0.067	1.57	33.22	2.25	1.43	36.9	123%	3.68	43%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending • Measured stage efficiency in one extraction contactor
Optional 3 Extended Duration Test	134%	12.51	0.1	2.01	28.70	2.87	1.43	33.0	110%	4.30	50%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending

* Minimum flow for formal testing
** Maximum flow for formal testing

Table 2-3. HCWDT Matrix with 6.4M [Na^+] Simulant

Test	% Simulant Flow	Potential SWPF (Mgpy)	Extraction O:A	SSW O:A	Simulant Flow Rate (gpm)	Solvent Flow Rate (gpm)	SSW (gpm)	Extraction Total Flow (gpm)	Extraction % Total Flow	Strip Total Flow (gpm)	Strip % Total Flow	% SE Flow to DWPF	Data Collected
6.4M [Na^+] Workup 1	134%	15.0	0.10	2.0	28.7	2.87	1.43	33.0	110%	4.30	50%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
6.4M [Na^+] Formal	134%	15.0	0.10	2.0	28.7	2.87	1.43	33.0	110%	4.30	50%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
6.4M [Na^+] Optional 1	134%	15.0	0.07	1.3	28.7	1.91	1.43	32.0	107%	3.34	39%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
6.4M [Na^+] Optional 2	120%	13.5	0.07	1.2	25.7	1.71	1.43	28.8	96%	3.14	37%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending

* Minimum flow for formal testing
** Maximum flow for formal testing

Table 2-4. HCWDT Workup Test Matrix with 7.5M [Na^+] Simulant

Test	% Simulant Flow	Potential SWPF (Mgpy)	Extraction O:A	SSW O:A	Simulant Flow Rate (gpm)	Solvent Flow Rate (gpm)	SSW (gpm)	Extraction Total Flow (gpm)	Extraction % Total Flow	Strip Total Flow (gpm)	Strip % Total Flow	% SE Flow to DWPF	Data Collected
7.5M [Na^+] Workup 1	134%	17.6	0.07	1.5	28.7	2.14	1.43	32.3	108%	3.57	42%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Workup 2	134%	17.6	0.10	2.0	28.7	2.87	1.43	33.0	110%	4.30	50%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Workup 3	134%	17.6	0.05	1.0	28.7	1.43	1.43	31.6	105%	2.86	33%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Workup 4	134%	17.6	0.05	1.0	28.7	1.43	1.43	31.6	105%	2.86	33%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Workup 5	134%	17.6	0.07	1.5	28.7	2.14	1.43	32.3	108%	3.57	42%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Workup 6	134%	17.6	0.06	1.2	28.7	1.72	1.43	31.9	106%	3.15	37%	100%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending

* Minimum flow for formal testing
** Maximum flow for formal testing

Table 2-5. HCWDT Formal and Optional Test Matrix with 7.5M [Na^+] Simulant

Test	% Simulant Flow	Potential SWPF (Mgpy)	Extraction O:A	SSW O:A	Simulant Flow Rate (gpm)	Solvent Flow Rate (gpm)	SSW (gpm)	Extraction Total Flow (gpm)	Extraction % Total Flow	Strip Total Flow (gpm)	Strip % Total Flow	% SE Flow to DWPF	Data Collected
7.5M [Na^+] Formal 1A	134%	17.6	0.07	3.0	28.7	2.14	0.72	32.3	108%	2.86	33%	50%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Optional 1	100%	13.1	0.07	3.0	21.43	1.60	0.54	24.5	82%	2.14	25%	37%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Formal 1B	134%	17.6	0.07	3.0	28.7	2.14	0.71	32.3	108%	2.86	33%	50%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Optional 2	134%	17.6	0.07	3.0	28.7	2.14	0.71	32.3	108%	2.86	33%	50%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Formal 1C	134%	17.6	0.07	3.0	28.7	2.14	0.71	32.3	108%	2.86	33%	50%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Optional 3	75%	9.9	0.07	2.2	16.07	1.20	0.54	18.3	61%	1.74	20%	37%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending
7.5M [Na^+] Optional 4	134%	17.6	0.07	3.0	28.7	2.14	0.71	32.3	108%	2.86	33%	50%	• Measured Cs DF • Evaluated solvent recovery performance • Performed solvent composition trending

* Minimum flow for formal testing
** Maximum flow for formal testing

2.3 Process Description

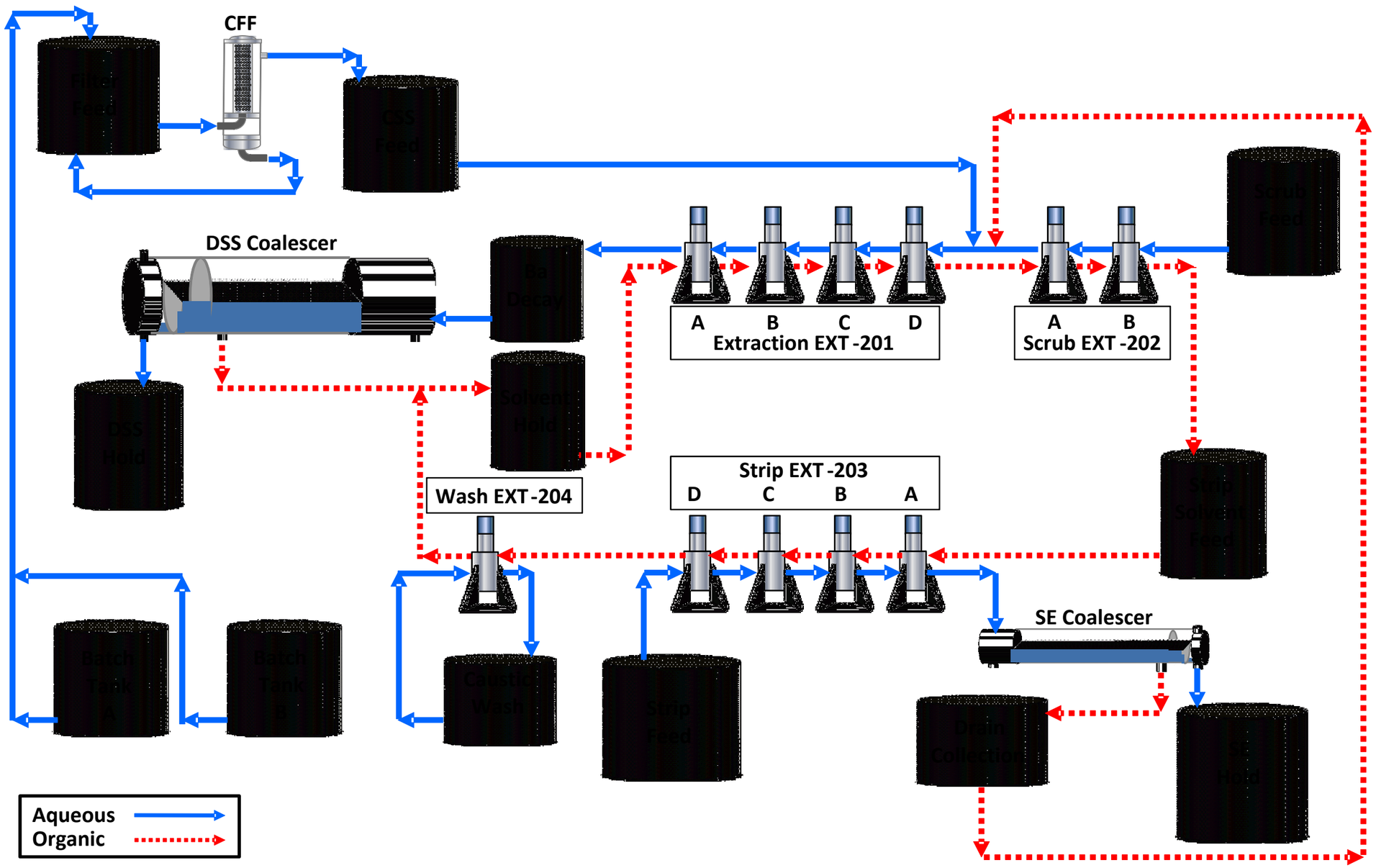
The design basis for the test system was to allow up to 12 hours of continuous CSSX operation at 100% nominal flow and with salt simulant (see Section 2.7.2 for simulant description). A schematic of the nominal operation configuration is provided in Figure 2-1.

The salt simulant solution was stored in the Salt Solution Batch Tank. During operations, the simulant was pumped to the Filter Feed Tank (FFT) and then sent to the cross-flow filter (CFF). The filter concentrate was recycled back to either the CFF or the FFT. The filtrate was directed to the Clarified Salt Simulant Feed Tank (CSST) and then pumped to the CSSX System for Cs removal as described below.

CSS was fed counter-current to the solvent through a series of centrifugal extraction contactors, where non-radioactive Cs-133 was extracted from the aqueous simulant stream into the organic solvent stream, producing DSS and Cs-rich solvent. Entrained solvent was removed from the DSS in the DSS Coalescer and recycled back to the Solvent Hold Tank (SHT). After a single pass, the CSSX DSS was sent back to the Salt Solution Batch Tank, where it was reconstituted.

The Cs-rich solvent stream leaving the extraction contactors continued through additional series of contactors where the solvent stream was: 1) “scrubbed” for removal of competing extracted ions (Na^+ and potassium [K^+]); 2) “stripped” for transfer of extracted Cs from the solvent back into a concentrated aqueous SE stream; and 3) “washed” for removal of any extracted impurities and solvent degradation products. Entrained solvent was removed from the SE stream in the SE Coalescer and deposited into the Drain Header Collection Tank for reprocessing. The scrubbed, stripped, and washed solvent stream was recycled in the CSSX process to continually contact the incoming simulant for Cs removal in the extraction contactors. The piping and instrument diagrams (PTC-TCD-0007, *CFF/CSSX Integrated Test System P&IDs*[6]) provide further system details and equipment descriptions.

Figure 2-1. Simplified Schematic for CSSX NGST



2.4 Testing Parameters

The testing parameters used in the NGST and HCWDT are shown in Table 2-6. The nominal stripping temperature was selected to be 36 degrees Celsius (°C) as this provided a direct comparison to the CFF/CSSX Integrated Test (IT)[3].

Table 2-6. Test Parameters

Parameter	Nominal Value
Ventilation Pressure	- 4 in H_2O
Recirculated Filter Concentrate Temperature	22°C ± 3°C
Extraction Temperature	23°C ± 3°C
Strip Temperature	36°C ± 3°C

2.5 Prototypical Equipment

The test system used for the NGST and HCWDT was the same as that for the CFF/CSSX IT; with the exception of the Simulant Feed Pump (P-215B-Test). This pump was upgraded to provide higher flow. Table 2-7 details the equipment that is prototypic of SWPF design.

Table 2-7. SWPF Prototypic NGST Hardware

NGST Hardware	Prototypic Aspects	Non-Prototypic Aspects	Fidelity
CFF	Wetted geometry, mechanical assembly, and vessel materials of construction (MOC)	Mechanical seal design, number of sintered metal tubes, zirconia coating, and pore size (0.1 micron [µm] absolute versus prototypic 0.1 µm nominal)	Medium-High
Extraction Centrifugal Contactors	Wetted geometry, shaft length, bearings, labyrinth bearing seals, inter-contactor spacing, and MOC of non-elastomeric parts	Housing-to-bearing and bearing-to-shaft mechanical tolerances, bearing grease, clean-in-place (CIP) system, outlet nozzle diameters, motors, contactor module stand/supports, and MOC of elastomeric seals	High

Table 2-7. SWPF Prototypic NGST Hardware (cont.)

NGST Hardware	Prototypic Aspects	Non-Prototypic Aspects	Fidelity
Scrub, Strip, and Wash Centrifugal Contactors	Wetted geometry, inter-contactor spacing, and MOC of non-elastomeric parts	Shaft length, mechanical bearing seals, housing-to-bearing and bearing-to-shaft mechanical tolerances, bearing grease, CIP system, outlet nozzle diameters, motors, contactor module stand/supports, and MOC of elastomeric seals	Medium-High
SE Coalescer	Wetted geometry of fiber bed and MOC of non-elastomeric parts	Vessel diameter, coalescer element seals, and mechanical design of vessel	High
DSS Coalescer	Wetted geometry and MOC of non-elastomeric parts	Coalescer element seal MOC and mechanical design of vessel	High
Strip Solvent Pump Tank	Wetted geometry and MOC	Mechanical design of vessel	High

2.5.1 Cross-Flow Filter

The CFF was manufactured by Pall Corporation. The filter bundle is full-scale consisting of 220 individual tubes with a zirconia coating and a total filtering surface area of 216 square feet. Each tube is 10 feet long with a 0.46 inch outside diameter and 0.39 inch inside diameter for the porous section of the tube. The effective pore size is 0.1 μm. The filter housing is 26 inches in diameter and is 179 inches long. The feed, effluent, and loading/unloading connections on the filter housing are prototypical of plant design. Additional mechanical details can be found in Pall Corporation drawings (10000004897, *03.0072 Tubesheet Assembly*[7]; PTM0002713C, *Elem Filter*[8]; and 10000008137, *03.0072 Filter Housing-Tubesheet Retrofit*[9]).

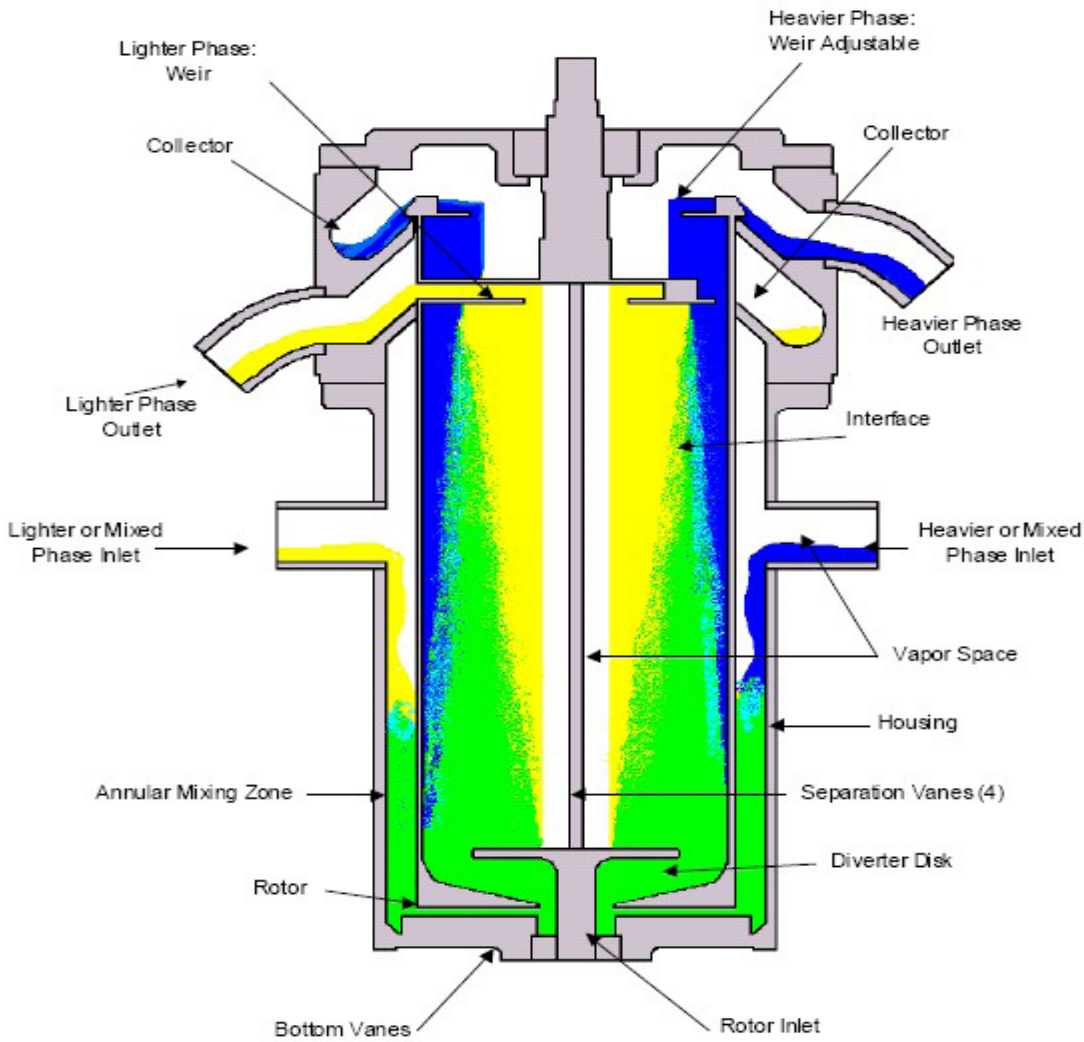
The SWPF CFF was manufactured by Mott Corporation. The filter tube dimensions are similar to the Pall filter, but the number of tubes was increased by approximately 5 - 10%. By increasing the surface area with the Mott filter, the flux observed should be comparable to that of the Pall filter; see INEEL/EXT-04-01933, *Alternative Ultrafiltation Membrane Testing for the SRS Baseline Process*[10]; Specification 11903, *Cross-Flow Filters*[11], and M-DS-J-00159, *Alpha Sorption Filters FLT-102A, 102B, and 102C*[12].

2.5.2 CINC V-10 Contactors

The CINC Industries, Inc. (CINC) Model V-10 Contactors are centrifugal separators, in which two (2) immiscible liquids of different densities are mixed in the annular mixing zone and then

separated in a spinning rotor by centrifugal force. Figure 2-2 shows a cutaway schematic view of the CINC contactor.

Figure 2-2. Cutaway View of CINC Contactor



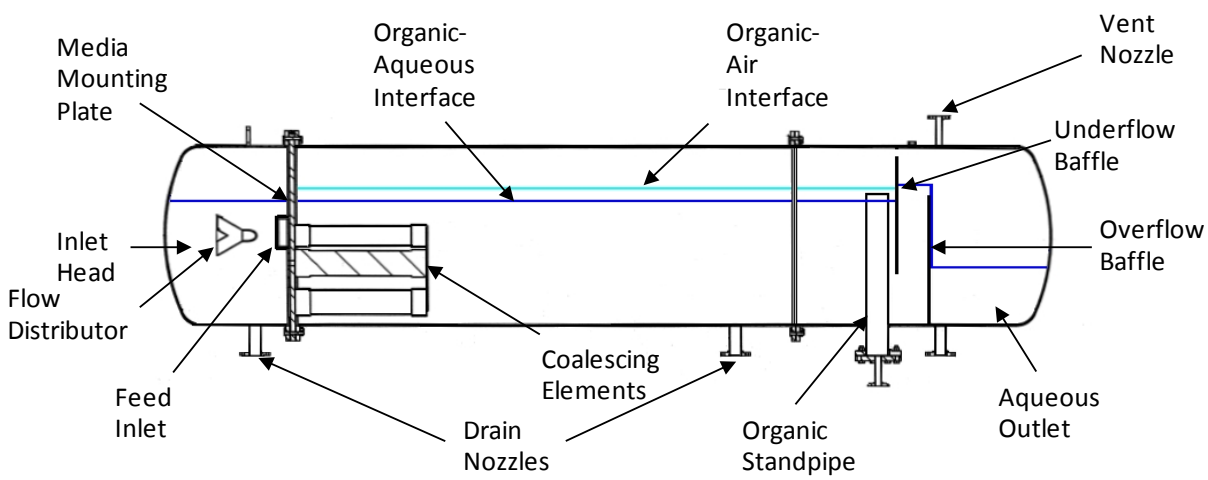
The contactor consists of an external housing with heavy- and light-phase inlet and outlet nozzles, an internal rotor assembly with a lower separation and upper collection areas, and an upper shaft extending and connected to a drive motor via a flexible, direct coupling. The 10-inch rotor assembly is supported at the upper end only by an upper and lower bearing set. A seal is located below the lower bearing to isolate the bearings from the process fluids. The entire rotor assembly is removable as a single unit, including all normally serviceable parts (seals and bearings). Control of the rotor speed is provided through a variable frequency drive (VFD). The extraction and strip contactor housings are jacketed for temperature control. All the contactors are provided with clean-in-place features for cleaning all rotor internal separation and collection areas.

The four (4) extraction and two (2) scrub contactors have "extended" rotor shafts, as compared to the "standard" CINC-design shafts used for the four (4) strip and single (1) wash contactors. The extended-shaft design was developed to better control radial deflection of the rotor by allowing increased spacing between the shaft bearing sets. The extended-shaft contactors were provided with non-contact, air-purged, labyrinth-type seals, as opposed to the standard contact lip-seal design used in the short-shaft contactors. In addition, the low-flow contactors (scrub, strip, and wash contactors) included an inner sleeve in the housing providing a smaller annual space to promote mixing by reducing the volume in the annular mixing zone between the inner wall of the housing and the outer surface of the rotor. Straight-vane bottom plates have been selected for all the contactors in the SWPF design and were used for the NGST.

2.5.3 DSS and SE Coalescers

Three-phase coalescers are used for solvent carryover recovery in the DSS and SE streams prior to discharge (or recycle). The DSS and SE Coalescers are horizontal, cylindrical vessels containing coalescing media (fiber bed) and internal weirs for passive control of phase separation and removal of the lower aqueous and upper organic phases. A schematic of the DSS Coalescer is provided in Figure 2-3. The SE Coalescer is similar in design to the DSS Coalescer, but did not require a distribution head.

Figure 2-3. Cutaway View of 3-Phase DSS Coalescer



The test platform SE Coalescer design is slightly different from that intended for the SWPF. The diameter of the SE Coalescer was increased from 8 inches in the test platform vessel to 12 inches in the SWPF design to improve constructability. For further detail of SWPF SE Coalescer design, refer to M-DS-J-00184, *Strip Effluent Coalescer TK-203*[13]. The DSS and SE Coalescers used 3-µm Franken coalescing elements to comply with recommendations in P-RPT-J-00020[3]. Table 2-8 further characterizes the media for each coalescer.

Table 2-8. Coalescer Mesh Media Specification

DSS Coalescer	Sixteen (16) x 3-µm pore size elements 1,250 millimeter (mm) in length and 150 mm in diameter
SE Coalescer	One (1) x 3-µm pore size element 1,000 mm in length and 120 mm in diameter

2.5.4 Strip Solvent Tank

The solvent stream leaving the scrub contactors is gravity fed to an intermediate Strip Solvent Feed Pump Tank before proceeding to the stripping heaters and contactors. Design of this vessel in the test system is prototypic to SWPF with respect to tank volume (60 gallons) and level detection. This capacity was selected to improve operability and stability at high throughputs. The tank is constructed of stainless steel and employs bubblers for overall level control and aqueous interface detection.

2.6 Non-Prototypical Equipment

The NGST utilized the same hardware as that for the CFF/CSSX IT. The internal wetted MOCs for the system are comprised mainly of stainless steel and polymer components limited to polyethylene, polypropylene, Viton® and Teflon® (materials compatible with BOBCalixC6). A few changes in the non-prototypical equipment were made to accommodate the increased flow. The extraction contactor VFD over-current limits were increased 25% above the 7.5 horsepower (hp) nameplate full-load amperage limit to more closely emulate the 10 hp motors that will be used in the SWPF. Similarly, the maximum frequency of the Barium Decay Pump (P-208-Test) VFD was increased above the maximum pump rating to accommodate the higher flow rates associated with the NGST. A new, larger capacity Salt Solution Feed Pump (P-215B) was also purchased in anticipation of increased flow rates.

All test equipment and instrumentation not indicated in Table 2-7 were not intended to be prototypic of the SWPF design. Ancillary equipment including tank agitators, pumps, heaters, and instrumentation were not prototypical, but were intended to provide prototypical feed conditions (e.g., flow rates, temperatures, etc.). Thus, use of this equipment supported completion of the test objectives. Other notable non-prototypical equipment included the contactor stand/supports and the contactor interstage piping. Use of this non-prototypical equipment was largely a cost-saving measure and should not impact the NGST objectives.

2.7 Feed Materials Description

2.7.1 Next Generation Solvent

The solvent was prepared, packaged and stored in accordance with Parsons Specification X-SPC-J-00013, *Next Generation CSSX Solvent*[14]. The modifier composition in the solvent was increased during testing to effectively increase the solvent density from 0.835 grams per cubic

centimeter (g/cc) (nominal) to 0.851 ± 0.01 g/cc. Further details concerning the rationale behind the modifier adjustment are provided in Section 4.1.3. Table 2-9 provides the target composition of the initial NGS, the as-received concentrations provided in the Certificate of Analysis (COA) (SRNL-STI-2012-00065, *Results of Analyses of the Next Generation Solvent for Parsons*[15]), the as-received concentration reported by the PTC Laboratory, and the concentration at the conclusion of formal NGST testing. Isopar®L and DCiTG additions were made periodically to maintain component concentrations (see Section 5.4 for details).

Table 2-9. Next Generation Solvent Test Solvent Component Concentrations

Chemical Constituent	Target (M)	Initial Reported by COA (M)	Average Initial Reported by PTC Laboratory (M)	Average Final Reported Concentration (M)
MaxCalix Extractant	5.00E-2	5.04E-2	5.36E-2	5.24E-2
Cs-7SB Modifier	5.00E-1	5.26E-1	5.39E-1	6.77E-1
DCiTG Suppressor	3.00E-3	2.93E-3[1]	2.82E-3	1.67E-3
Isopar®L Diluent	balance	3.66	3.76	3.92

[1]The COA DCITG concentration was derived from the provided gravimetric data reported in SRNL-STI-2012-00065 as low DCiTG concentrations were experienced with the Semi-Volatile Organic Analysis (SVOA) method.

The solvent in the system at the end of the NGST (5.6M salt simulant testing) was reused during the HCWDT (6.4M and 7.5M salt simulant testing). Table 2-10 compares the measured solvent component concentrations at the beginning and near the end of HCWDT.

Table 2-10. HCWDT Solvent Component Concentrations

Chemical Constituent	Target (M)	Average Final Measured Concentrations for 5.6M Testing (M)	Average Final Measured Concentration s for 6.4M and 7.5M Testing (M)
MaxCalix Extractant	5.00E-2	5.24E-2	5.07E-2
Cs-7SB Modifier	5.00E-1	6.77E-1	6.17E-1
DCiTG Suppressor	3.00E-3	1.67E-3	1.64E-3
Isopar®L Diluent	balance	3.92	3.82

At the end of the HCWDT, additional Isopar®L was added to drive the solvent density down to ~0.842 g/cc to re-evaluate the effect of lower solvent density on DSS Coalescer hydraulics during the last three tests. The solvent density adjustment was performed after attempts to improve DSS Coalescer performance failed (see Section 7.2.2) by adjusting operational parameters (eg O:As, rotor speeds). Note a solvent density of 0.842 g/cc is still within the

nominal solvent density envelope of 0.851 ± 0.01 g/cc. Table 2-11 provides the final measured composition of the Isopar®L diluted solvent.

Table 2-11. Isopar®L-Diluted HCWDT Solvent Component Concentrations

Chemical Constituent	Final Measured Concentrations for Diluted Solvent (M)
MaxCalix Extractant	4.40E-2
Cs-7SB Modifier	5.09E-1
DCiTG Suppressor	1.33E-3
Isopar®L Diluent	balance

2.7.2 Simulant Salt Solution

The simulant salt solution previously used for the CSSX Full-Scale Test and Integrated Test was reused for this testing and reconstituted after a single pass through the system. The simulant formulation was based on the average waste simulant recipe specified in WSRC-RP-2000-00361, *Preparation of Simulated Waste Solutions for Solvent Extraction Testing*[16], with the exception of Cs, ammonium nitrate, trimethylamine (TMA), and trace organics. The primary functional requirement of the simulant was to sufficiently emulate SWPF CSSX waste feed to ensure prototypic performance was demonstrated. Secondarily, utilization of a simulant salt solution with comparable composition to simulants used in past testing allowed a direct comparison to past performance. Consistency of the simulant salt solution composition was also a consideration as this ensures that system performance responses to changes in operating conditions are correctly interpreted.

The contributions of ammonium nitrate, TMA, and trace organics to the properties of the simulant were deemed insignificant in comparison to the health hazards the chemicals presented. Thus, after consideration, these components were omitted from the simulant formulation to mitigate health hazards. In addition, the recipe provided in WSRC-RP-2000-00361 indicates the Cs concentration should be 1.4E-04M. However, the simulant Cs concentration for testing was increased to be consistent with the total Cs in the salt feed at the ^{137}Cs SWPF design basis of 5.25 Ci/gal at 6.44M [Na^+], P-DB-J-00004, *SWPF Balance of Plant Basis of Design*[17]. ANL-01/10, *Interim Report on a Multi-day Test of the Caustic-Side Solvent Extraction Flowsheet for Cesium Removal from a Simulated SRS Tank Waste*[18] reported that 22.5% of the total Cs in the waste (by weight) was ^{137}Cs. The Cs concentration specified (4.30E-4M) was equivalent to the total Cs concentration (^{133}Cs and ^{137}Cs) expected in the SWPF feed after dilution to 5.6M [Na^+] in the Alpha Strike Process.

For demonstration of higher concentration waste processing, 6.4M and 7.5M [Na^+] simulant salt solutions were used. The 6.4M [Na^+] simulant was prepared by up-blending all components of the 5.6M [Na^+] simulant using the ratios provided in the Mass Balance Model (refer to P-ESR-J-00001, *Mass Balance Model Summary Description*[19]). The 6.4M [Na^+] simulant is

nominally 20.5% more concentrated than the 5.6M [Na^+] simulant. Potassium was not added during preparation as the concentration already exceeded the target concentration for 6.4M [Na^+] simulant; i.e. >35 millimolar (mM) compared to 18 mM. Potassium is coextracted and competes with Cs for extraction sites in the solvent. Exceeding the target value for potassium makes the mass transfer results from this testing more conservative, since D_{Cs} and DFs are depressed by the increased potassium concentration. In addition, aluminum and silicon concentrations were slightly altered to reflect the current WAC limits (X-ESR-J-00001, *SWPF Feed Waste Acceptance Criteria*[20]). As a result of lowering the aluminum, the nitrate concentration required adjustment to ensure a charge balance at 5.6M [Na^+]. The 7.5M [Na^+] simulant was prepared subsequent to runs requiring the 6.4M [Na^+] simulant and was prepared by increasing the component concentrations of the 6.4M [Na^+] simulant by a target of 16.8%.

Overall the 7.5M [Na^+] simulant was approximately 40.7% more concentrated than the 5.6M baseline simulant salt solution. The up-blend of the simulant was based on calculations as has mostly been the case in previously completed CSSX testing. This method has been effective as the specific ion concentrations, with the exception of cesium and potassium, are not as important as the total ionic concentration with respect to CSSX flowsheet performance. The testing scope did not include trimming the simulant based on analytical feedback. This would have added substantial costs to the testing due to analytical costs and, more importantly, analytical lag times.

The simulant salt solution was recycled and reconstituted after each pass through the system. Reconstitution was necessary because scrub solution was added to the simulant feed and Cs removed during operations. To recover and reprocess the simulant, each constituent was reconstituted to return the simulant to the pre-run target concentrations. The nominal chemical make-up of each salt simulant solution is indicated in Table 2-12. The resulting estimated ionic species concentrations are provided in Table 2-13.

Table 2-12. Nominal Salt Simulant Solution Component Make-up per Gallon

Chemical Name	Chemical Formula	Molecular Weight (g/mole)	Quantity Required for 5.6M [Na^+] Simulant (g/gal)	Quantity Required for 6.4M [Na^+] Simulant (g/gal)	Quantity Required for 7.5M [Na^+] Simulant (g/gal)
Potassium nitrate	KNO_3	101.3	5.742	6.896	8.056
Cesium chloride	CsCl	168.37	0.274	0.329	0.384
Sodium hydroxide	NaOH	40	482.510	536.404	626.641
Sodium nitrate	$NaNO_3$	84.99	377.930	456.439	533.223
Sodium nitrite	$NaNO_2$	69	130.580	156.827	183.209
Aluminum nitrate nonahydrate	$Al(NO_3)_3 \bullet 9H_2O$	375.14	397.580	354.741	414.417
Sodium carbonate monohydrate	$Na_2CO_3 \bullet H_2O$	124.01	70.400	84.550	98.774
Sodium sulfate	Na_2SO_4	142.04	75.280	90.411	105.621
Sodium chloride	NaCl	58.44	5.310	6.377	7.450
Sodium fluoride	NaF	41.99	4.450	5.344	6.244
Sodium phosphate heptahydrate	$Na_2HPO_4 \bullet 7H_2O$	268.09	7.104	8.532	9.967
Sodium oxalate	$Na_2C_2O_4$	134	4.057	4.872	5.692
Sodium meta-silicate pentahydrate	$Na_2SiO_3 \bullet 5H_2O$	284.2	32.271	32.301	37.735
Sodium molybdate dehydrate	$Na_2MoO_4 \bullet 2H_2O$	241.95	0.072	0.086	0.101
Copper sulfate pentahydrate	CuSO4 • 5H2O	249.68	0.021	0.025	0.029
Zinc nitrate hexahydrate	Zn(NO3)2 • 6H2O	297.47	0.140	0.168	0.196
Iron nitrate nonahydrate	Fe(NO3)3 • 9H2O	404	0.039	0.047	0.055
Tin chloride dihydride	SnCl2 • 2H2O	225.63	0.017	0.020	0.024

Table 2-13. Nominal Salt Simulant Solution Ionic Species Concentrations

Ionic Species	Concentration for 5.6M [Na^+] (M)	Concentration for 6.4M [Na^+] (M)	Concentration for 7.5M [Na^+] (M)
Sodium (Na^+)	5.58E+00	6.42E+00	7.50E+00
Potassium (K^+)	1.50E-02	1.80E-02	2.10E-02
Nitrate (NO_3^-)	2.03E+00	2.19E+00	2.55E+00
Cesium (Cs^+)	4.30E-04	5.16E-04	6.03E-04
Chlorine (Cl^-)	2.46E-02	2.94E-02	3.43E-02
Hydroxide (OH^-)*	3.19E+00	3.54E+00	4.14E+00
Nitrite (NO_2^-)	5.00E-01	6.00E-01	7.01E-01
Aluminum (Al^{3+})	2.80E-01	2.50E-01	2.92E-01
Carbonate (CO_3^{2-})	1.50E-01	1.80E-01	2.10E-01
Sulfate (SO_4^{2-})	1.40E-01	1.68E-01	1.96E-01
Oxalate ($C_2O_4^{2-}$)	8.00E-03	9.61E-03	1.12E-02
Silicon oxide (SiO_3^{2-})	3.00E-02	3.00E-02	3.51E-02
Molybdite (MoO_4^{2-})	7.86E-05	9.44E-05	1.10E-04
Copper (Cu^{4+})	2.22E-05	2.67E-05	3.12E-05
Zinc (Zn^{2+})	1.24E-04	1.49E-04	1.74E-04
Iron (Fe^{3+})	2.55E-05	3.06E-05	3.57E-05
Tin (Sn^{2+})	1.99E-05	2.39E-05	2.79E-05
Fluorine (F^-)	2.80E-02	3.36E-02	3.93E-02
Monohydrogen phosphate (HPO_4^{2-})	7.00E-03	8.41E-03	9.82E-03

The Hydroxide (OH^-) concentration specified is the target amount added to the simulant. The actual free hydroxide concentration is expected to be lower as a result of secondary reactions, particularly with aluminum nitrate.

The simulant composition was analyzed for 13 tests spanning the 5.6M [Na^+] tests through the 7.5M [Na^+] test. The concentrations of Al, Cu, Fe, K, Mo, Si, Sn, Zn, Na, and Cs were included in the analysis and the concentration of each component was compared to the target value shown in Table 2-13. The trend for each component can be seen in Figure 2-4. Note the component concentrations have been normalized (measured / target X 100%) to show the trends over the entire test series (5.6M, 6.4M, and 7.5M). Idyllically, all species would have a value of 100% through the whole test program. The composition trends for the 5.6M [Na^+] tests are highlighted in blue, 6.4M [Na^+] tests are in the white region, and 7.5M [Na^+] tests are highlighted in red.

Figure 2-5 shows the more important components, Al, Na, and Cs, on a smaller scale for clarification.

Figure 2-4. Simulant Composition Trending (5.6M blue, 6.4M white, and 7.5M red)

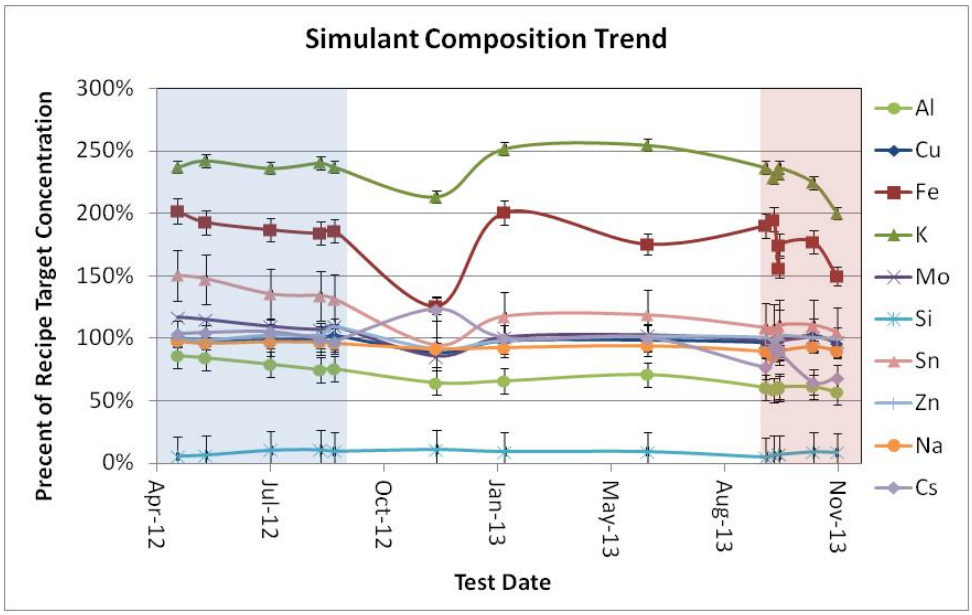
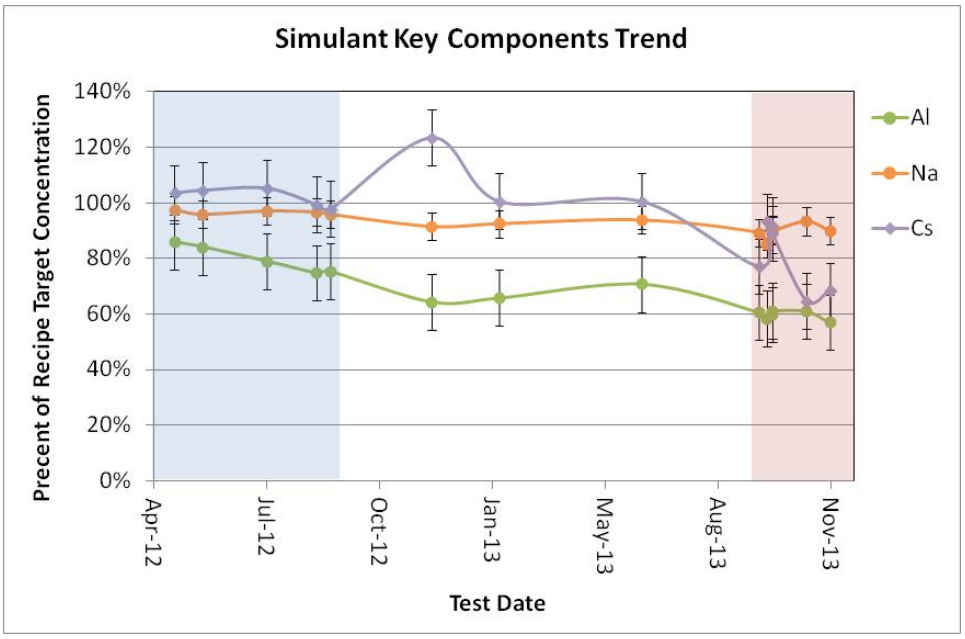


Figure 2-5. Simulant Al, Na, and Cs Trending (5.6M blue, 6.4M white, and 7.5M red)



2.7.3 Strip, Scrub and Wash Solutions

The strip solution was comprised of 0.01M H_3BO_3 and the scrub solution 0.025M NaOH as recommended in Paper No. 11346, *Development of the Next-Generation Caustic-Side Solvent Extraction (NG-CSSX) Process for Cesium Removal from High-Level Tank Waste*[21]. These solutions are prepared by dilution of concentrated feeds with deionized water. The nominal composition of the wash solution remained unchanged at 0.01M NaOH. The pH of the wash solution (nominally 12) was monitored, and reconstituted or changed, as necessary to maintain a pH in the range of 11.0 to 13.0.

2.7.4 Ancillary Cleaning Solution

As with previous testing, 1M HNO_3 solution was used for chemical cleaning of the extraction contactors and 0.5M oxalic acid[3] was used for the CFF loop. Cleaning effectiveness of the filter was determined by comparing the permeation of 0.02M caustic solution during final rinse of each cleaning cycle.

3.0 QUALITY ASSURANCE, TEST PROCEDURES, AND ANALYTICAL METHODS

3.1 Quality Assurance

Development and performance of the NGST program was completed in compliance with the SWPF Quality Assurance (QA) program as defined in Section 11.0 of V-QP-J-00001, *SWPF Project Quality Assurance Plan,*[22] and in accordance with the governing departmental procedure DP-CM-8001, *Conduct of Testing*[23].

3.2 Test Procedures and Analytical Methods

Thoroughly prepared test plans and procedures were used throughout the NGST and HCWDT programs to ensure proper completion of test objectives. Basic test objectives and procedures were previously defined in the Test Plan and System Operating Procedures (SOPs) (P-TPL-J-00016[5]; and NGST-CSSX- 001, *Caustic-Side Solvent Extraction Next Generation Solvent Test Standard Operating Procedure*[24], respectively). Instructions for any complementary testing were provided in Run Plans (see Folder A [provided on CD only]) as defined by the SOPs. Additional sampling details were provided here as well. Laboratory notebooks containing manually recorded data and observations can be found in Folders B and C (Folders B and C provided on CD only).

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[3] The SWPF will use nitric acid for chemical cleaning of the CFFs.

3.2.1 Inorganic Analysis

Offsite Analysis

The majority of inorganic analyses were performed offsite at General Environmental Laboratory (GEL) located in Charleston, South Carolina. GEL performed standard environmental methods (U.S. Environmental Protection Agency [EPA] Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*[25]) and QA/Quality Control to characterize metals, anion, and Cs concentrations in simulant. The EPA SW-846 base methods used by GEL for the CFF/CSSX IT are:

- Metals Preparation: EPA Publication SW-846: Test Method 3005A: *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*: "Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy"

- Total metals: EPA Publication SW-846: Test Method 6010B: *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*: "Inductively Coupled Plasma-Atomic Emission Spectroscopy"

- Cs analysis: EPA Publication SW-846: Test Method 6020: *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*: "Inductively Coupled Plasma-Mass Spectrometry"

Onsite Analysis

During operation, aqueous carryover amounts were determined by the collection of an organic sample that was then centrifuged and visually compared to a set of prepared aqueous carryover solvent standards ranging from 0.1% to 1%. The standards were prepared with either H_2O or simulant, depending on phase to be characterized, and NGS. The samples and standards were compared in 15-milliliter (mL) centrifuge tubes, consistent with the method documented in LAB-J-OPS-001, *Laboratory Operations*[26].

The metals concentration of various simulant batches were characterized through operation of an Inductively Coupled Plasma Emission Spectrometer as outlined in LAB-J-OPS-010, *Operation of the Inductively Coupled Plasma Emission Spectrometer at the Parsons Technology Center Testing Laboratory*[27].

3.2.2 Organic Analysis

Onsite Analysis

Onsite analysis of organic carryover into strip and simulant solutions was measured using Gas Chromatography (GC) (Varian 3900 GC with a Varian VF-5mss 25mm*0.25 mm ID DF=0.33 column) per LAB-J-OPS-012, *Operation of the Gas Chromatography*[28]. Methylene chloride was used to perform the extraction of solvent from the aqueous phase per LAB-J-OPS-011,

Extraction of Organic Solvents from Aqueous Solutions[29]. The methylene chloride extract was then analyzed on the GC.

Solvent characterization and trending was carried out using GC and by Liquid Chromatography (Agilent 1200 series) with a triple quadrapole mass spectrometer (ABSciex 3200)(MS/MS). After dilution, samples were injected into the High Pressure Liquid Chromatography (HPLC), where they were separated into individual components using a Thermal ODS Hypersil (50*4.6 mm 5-µm packing) column. The effluent flowed through an Ultraviolet/Visible (UV/VIS) detector to monitor for Cs-7SB and then through the triple quadrapole mass spectrometer, which detected DCiTG, Cs-7SB, and MaxCalix at low concentrations. LAB-J-OPS-014, *Operation of the High Performance Liquid Chromatography/Triple Quadrapole Mass Spectrometer*[30], outlines the operation. Isopar®L and Cs-7SB were also analyzed by GC. The multiple Cs-7SB analyses were used to determine possible biases in the analytical protocols.

For all samples analyzed using the GC and the HPLC, quantification was performed by comparison against a standards curve. Laboratory control samples, laboratory blanks, spikes, and duplicates were run with every batch of samples to determine extraction and analysis performance. Instrument performance was monitored through analysis of control samples and blanks at regular intervals. The general requirements for quantification and quality control are outlined in LAB-J-OPS-005, *Quality Assurance/Control and Administration Protocols for Parsons Technology Center Testing Laboratory*[31].

3.2.3 Analytical Uncertainty

The metals analysis errors used within this report, for both the PTC Laboratory and the third-party analyses performed by GEL, are shown in Table 3-1. Calculations of metals analysis errors for the PTC Laboratory is based on a very limited data set. Two (2) samples were collected at the beginning of NGS testing, one from each batch tank. Each of those samples were split into five (5) subsamples and analyzed on the same day in the PTC Laboratory. The error reported here is the standard deviation divided by the average measurement (standard error) for each component. Metals analysis error for the GEL was calculated in a similar way as the PTC metals analysis error. The difference being that there were only two (2) measurements for each sample, opposed to five (5).

The measurement errors of the solvent component concentrations are shown in Table 3-2 and are reported as the standard error based on repeated measurements of neat solvent. Neat NGS solvent was analyzed repeatedly, at least 11 times, for each component at the beginning of testing. The standard deviation of these measurements was calculated and then divided by the average to produce the standard error.

Table 3-1. Metals Analysis Errors

Metals GEL	Al	Cu	Fe	Mo	K	Si	Na	Sn	Zn
GEL Detection Limit (mg/L)	0.68	0.03	0.3	0.02	50	0.25	100	0.025	0.033
GEL Error	10%	10%	5%	10%	5%	15%	5%	20%	10%
PTC Detection Limit (mg/L)	10	1	1	1	35	1	1000	1	1
PTC Error	4%	13%	32%	18%	4%	3%	1%	N/A	12%

Table 3-2. Solvent Component Analysis Errors

Component	DCiTG	MaxCalix	Cs-7SB	IsoparL
Detection Limit (mg/L)	0.01	0.48	0.6	2.5
Error	9%	12%	7%	5%

Error of Isopar®L carryover in aqueous Strip and Extraction samples is reported as the largest percent difference between a spike amount and lab measurement of the spiked sample. Blank solutions (containing no Cs) of Strip and Simulant were produced in the lab. Spiked samples were prepared by adding a known quantity of neat NGS to a known quantity of blank solution. These samples were analyzed by the PTC Laboratory and the results were compared to expected values. The largest percent difference between a lab measurement and the expected amount was 17% and 24% for strip and extraction, respectively.

Cs samples were analyzed at the GEL and PTC laboratories. GEL samples were analyzed in duplicate, with the largest percent difference between identical samples being 11%. This is the value used to generate error bars on all figures reporting Cs data. PTC analysis included spiked samples. The lab measurement of spiked samples was compared to the expected Cs concentration based on the spike amount. The largest percent difference between a lab measurement and the expected amount was 8.1%.

Aqueous carryover error was calculated based on the graduation on the sample test tubes. In the lower range of the test tube the graduations are 0.1 mL, so the measurement error is assumed to be 0.05 mL in this range. In the upper region of the test tube the graduations are 0.5 mL, so the measurement error is assumed to be 0.25 mL in this range. The sample tubes are typically filled to 12+ mL when sampling. For the error on Aqueous carryover we assume that the tubes are only filled to 11 mL. Dividing the error in the low and high range by 11 mL gives 0.45% and 2.27% error respectively.

4.0 METHODOLOGY

4.1 Methodology with 5.6M Salt Simulant

The start-up parameters for the initial NGST systemization run were identical to those utilized during the CFF/CSSX IT. The simulant flow rate was 50%, the extraction O:A was 1:3 and the extraction rotor speeds were 2400 rpm. The initial weir size for all contactors were the same as that recommended in P-RPT-J-00020[3] and those intended for the SWPF. The extraction contactor weir configuration initially used for systemization is shown in Table 4-1.

Table 4-1. Initial NGST Extraction Contactor Weir Configuration

Contactor	Weir Size
EXT-201A	5.4”
EXT-201B	5.4”
EXT-201C	5.4”
EXT-201D	5.7”

Under these operating conditions, CSSX start-up was not achieved as a result of hydraulic instability. The upset condition was exhibited by extensive foam in the aqueous effluent of EXT-201A (the first extraction contactor with respect to solvent flow) and a loss of solvent flow to the Strip Solvent Tank; indicating solvent was not flowing from extraction to scrub. Figure 4-1 shows the aqueous outlet sight glass for EXT-201A. In Figure 4-1 (A) the flow under normal conditions is shown, while the flow under the upset condition is shown in (B). Notice that in (B) the sight glass is completely full of frothy, white foam. Upon reaching the DSS Coalescer, the foam broke to form an opaque, gelatinous-looking organic layer inside the coalescer as seen in Figure 4-2 (A). After settling for about a day the organic layer in the coalescer became translucent, with an appearance typical of CSSX solvent. This can be seen in Figure 4-2 (B). It can also be seen that the organic layer that developed in the coalescer was around 1” thick. This relatively thick organic layer formed as a result of just a few minutes of hydraulic upset.

Figure 4-1. EXT-201A Aqueous Outlet Sight Glass During: (A) Normal Operation and (B) Upset Condition

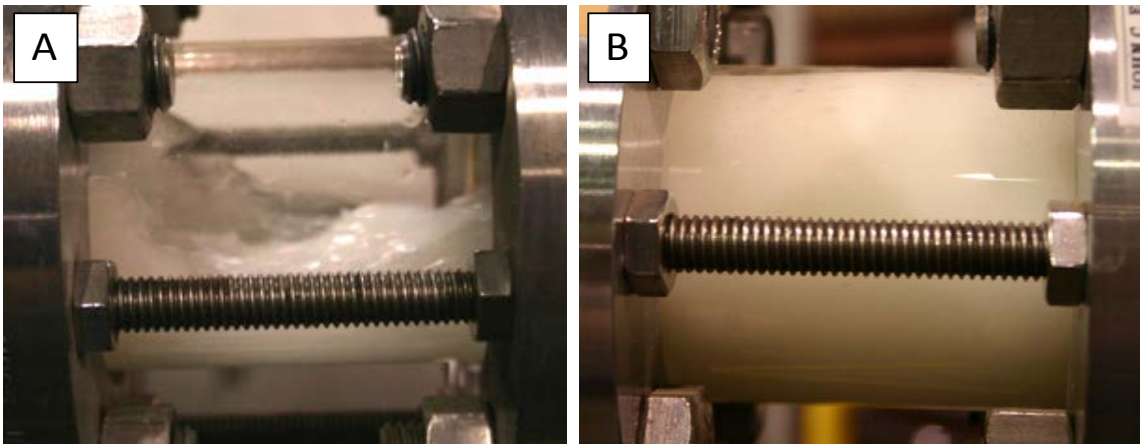
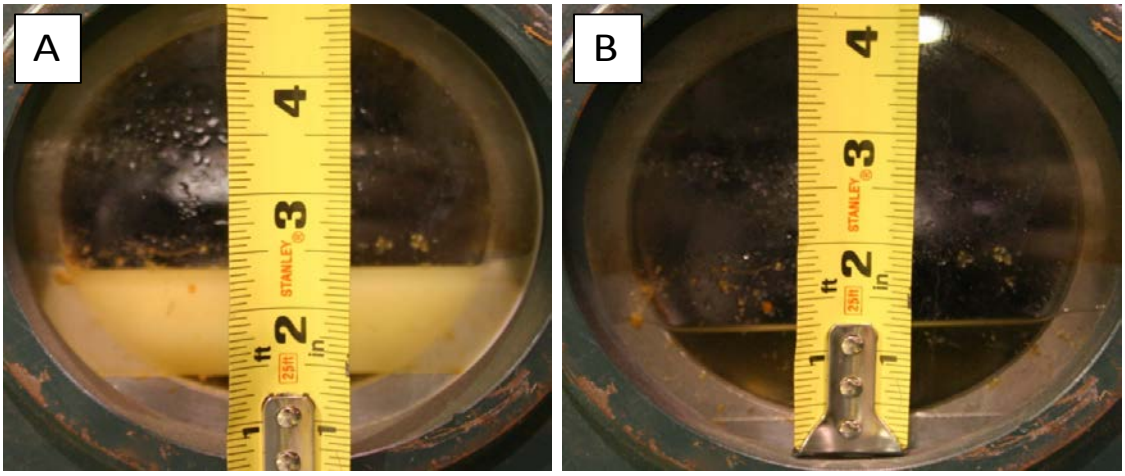


Figure 4-2. DSS Coalescer Sight Glass: (A) Immediately and (B) 24 hrs after Upset

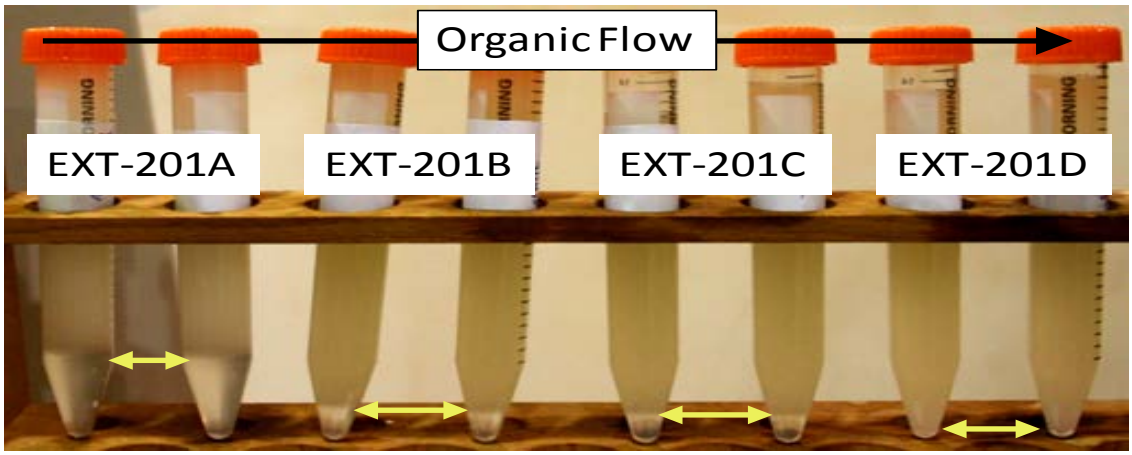


To successfully achieve system start-up and stability in subsequent systemization runs, the simulant flow was reduced to 25% and the extraction rotor speeds were reduced to 1000 rpm. At this flow rate, the maximum extraction rotor speed that achieved stable performance was 1000 rpm. Rotor speeds at 750, 850, 1000, 1200, and 1750 rpm were tested at 25% flow. Operations above 25% flow were not stable regardless of rotor speed. The range tested at >25% flows was 500 rpm to 2400 rpm.

To further understand and profile the upset condition, hydraulic samples were taken near the onset of an upset. Samples of the organic stream appeared very cloudy and showed high levels of aqueous carryover. Representative samples of all the extraction organic lines, taken in duplicate just after sampling and prior to centrifugation and/or settling, can be seen in Figure 4-3. The organic-aqueous interface for each sample pair is indicated by the small arrows. Note that because the samples had not fully settled in the photograph the actual aqueous carryover is not

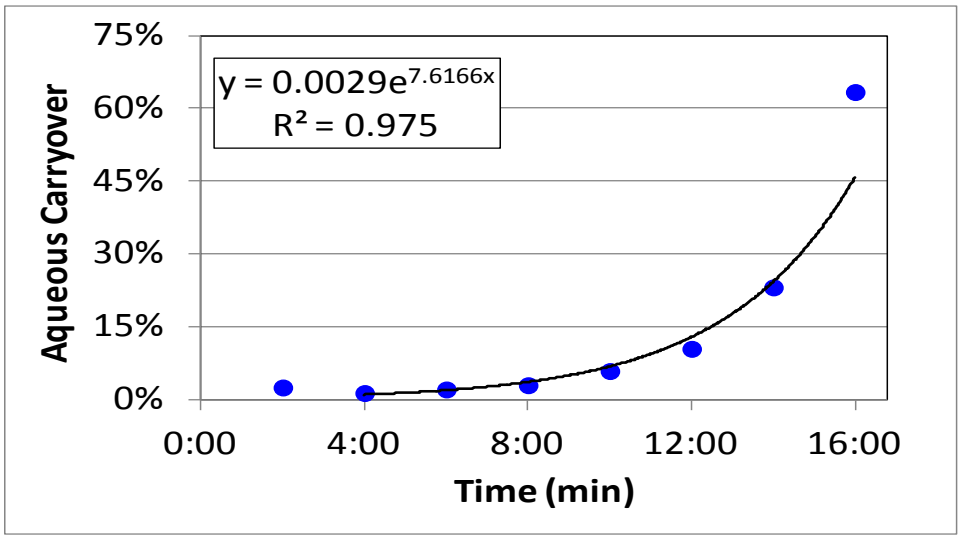
depicted accurately and was actually higher than indicated in the photo. This particular photo was included to show the nature of the hydraulic upsets as observed during test operations. Notice that EXT-201A has much higher aqueous carryover than the other stages. This is despite having the same weir size and operational conditions as the other extraction contactors.

Figure 4-3. Aqueous Carryover Samples Taken During Initial Systemization Runs



The hydraulic upset was likely caused by high aqueous carryover from a contactor, most likely EXT-201A, within the extraction phase. For example, if the aqueous carryover from EXT-201A was excessive, the total aqueous flow in EXT-201B would increase accordingly. When the solution in EXT-201B was separated, EXT-201A receives the nominal aqueous flow plus the surplus from carryover effectively increasing the total hydraulic flow. The result is that over time the carryover from the initial contactor grows exponentially. This effect can be seen in Figure 4-4. In this figure, EXT-201A organic outlet samples were taken every two (2) minutes from the time solvent flow was established until foam occurred in the EXT-201A sight glass. The data point at 16 min was taken during the upset condition at which point there was effectively no phase separation occurring within the extraction rotors.

Figure 4-4. Upset Condition Caused By Exponential Increase of Carryover



4.1.1 System Stability and Increased Flow

As previously indicated, the upset conditions observed during initial systemization runs were overcome by reducing the extraction rotor speeds and flow rates. In previous tests using BOBCalixC6 solvent, extraction rotor speed was not a key parameter, but higher speed did produce the best results[16]. The nominal rotor speed in extraction was set to 2400 rpm based on those test results. Early systemization runs during the NGST found that lower extraction speeds, 750 rpm, resulted in the best performance when the flow rate was at 25%.

Once consistent operation at 25% flow was achieved, 50% flow rate was attempted. Again upset conditions, similar to those experienced previously at 25% flow, were observed. Various extraction rotor speeds were attempted, but foaming was observed for each. These results lead to an extensive study of hardware configuration, solvent composition, and operational conditions that would result in sustained CSSX operation with flows above 25%.

4.1.2 Weir Selection

It was initially thought that the high aqueous carryover was a result of a mismatch between the standard weir selection used for the BOBCalixC6 solvent, and the new, less dense MaxCalix solvent. Based on the difference in solvent density, samples collected during testing, and observations made in field, it was believed that a larger heavy phase weir would be required. A series of runs were conducted with increasing weir size. These tests showed marginal improvement, if any, in system stability. A complete list of weir sets tested during this evolution can be seen in Table 4-2 and a compilation of all the data collected with the various weir sets can be found in Appendix A, *Compiled Analytical Data*. As the weir size was not found to be a major contributor in hydraulic stability, the extraction weirs were placed back in the original configuration to match that specified in P-RPT-J-00020[3] and scheduled to be used in SWPF.

Table 4-2. Complete List of Extraction Weir Sets Used During Systemization

Date	201A	201B	201C	201D
4-02-12	5.4”	5.4”	5.4”	5.7”
4-10-12	5.3”	5.4”	5.5”	5.7”
4-17-12	5.6”	5.7”	5.8”	5.7”
4-19-12	5.8”	5.7”	5.8”	5.7”
5-01-12	5.8”	5.8”	5.8”	5.8”
5-10-12	6.3”	6.3”	6.1”	6.1”
5-15-12	6.0”	6.0”	6.1”	6.1”
5-17-12	5.9”	5.9”	6.1”	6.1”
6-05-12	5.7”	5.7”	5.7”	5.7”
6-12-12	5.4”	5.4”	5.4”	5.7”

4.1.3 Modifier Concentration Adjustment

An evaluation of the impact of solvent composition on hydraulic performance was conducted subsequent to the elimination of weir size as a significant contributor. The density of the MaxCalix solvent was less than that of the BOBCalixC6 solvent because of a significant reduction in Cs-7SB modifier concentration, 0.5M versus 0.75M, respectively. This reduction was thought to affect not only density, but other mechanical properties as well, i.e. viscosity, interfacial tension, etc., that contribute to phase separation. By virtue of eliminating all other known variables, the hydraulic challenges encountered during systemization were likely due to the compositional differences between the new NGS formulation and the “baseline” BOBCalixC6 solvent formulation.

The differences between NGS and BOBCalixC6 solvent (in order of concentration and likely impact to bulk physical properties) include decreased modifier concentration, a slightly different extractant molecule (at seven [7] times the previous concentration), and the DCiTG suppressor that replaced TOA. Of these differences in solvent components, the decrease in modifier concentration was the only change that was not required to achieve the superior D_{Cs} expected from NGS. The modifier concentration was decreased in the original NGS formulation to lower the density of the solvent and was thought to provide a mechanical advantage for phase separation. In other words, the modifier was decreased not to improve Cs mass transfer (chemistry) but to theoretically improve hydraulics (physical separation). In fact Cs-7SB is known to promote Cs transport and increasing the concentration likely improves D_{Cs}[32].

The benefits of increasing the modifier concentration to achieve a NGS density of 0.851 g/cc include:

1. Elimination of a significant variable in the NGST. Provided indication of whether or not the change in modifier concentration was adversely affecting contactor hydraulics.
2. Minimization of SWPF design impacts (i.e. SE/DSS stilling tank and coalescer tank internals) resulting from NGS deployment and should allow the use of the weirs optimized and installed in SWPF for use with BOBCalixC6 solvent.
3. Slight improvement to D_{Cs} which increases flowsheet robustness with respect to operating parameters, stage efficiencies, and back mixing effects. Better D_{Cs} could also result in less solvent flow required to achieve satisfactory DFs. Thus, "wear and tear" on solvent would be decreased because it would be turned over less frequently. Lower required solvent flow could also improve hydraulics via an increase in the solvent residence time within the contactor rotors.

Three (3), 7-kilogram (kg) aliquots of Cs-7SB modifier were added over the course of two (2) weeks[4]. Each aliquot was added as a 3:1 solution of neat NGS and Cs-7SB. The calculated quantity of Cs-7SB to be added was based on the total solvent volume added to the system with the goal of reaching a solvent density of 0.851 g/cc from a starting density of 0.835 g/cc. After the addition of the third aliquot, the solvent density was 0.854 g/cc. Thus, an additional 45.7 kg of neat solvent was added to bring the density down to 0.851 g/cc; see Table 4-3. The CSSX system was run after each modifier addition ensuring multiple turnovers of the solvent.

Table 4-3. Cs-7SB Adjustments Made During NGST Systemization

			Solvent Density (g/cc)	
Date	**Solution Transferred/Comments**	**Quantity (kg)**	**Before**	**After**
5/25/2012	Cs-7SB	7.0	0.835	0.841
5/30/2012	Cs-7SB	7.0	0.840	0.846
6/18/2012	Cs-7SB	7.0	0.846	0.854
6/25/2012	Neat NGS	45.7	0.856	0.852

In Table 4-4, the effect of Cs-7SB concentration on hydraulic stability can be seen. The time from the start of 50% solvent flow to the observation of a hydraulic upset is reported for each Cs-7SB adjustment. The weir sets are reported according to date. The size for each date can be found in Table 4-4. It can be seen that the Cs-7SB additions did not have an appreciable impact on the system stability time (14 to 21 minutes).

[4] Isopar®L was not added to make up for evaporative losses prior to and during this time period. The intent was to drive off some of the Isopar®L so that the MaxCalix and DCiTG concentrations would not be diluted by the Cs-7SB additions.

Once the organic flow was reduced from 3.57 gpm to 2.61 gpm, the system appeared to be stable at 50% simulant flow. Subsequently, the simulant flow was increased to 75% with an O:A ratio of 1:10 and held for 15 minutes with no upset occurring. Simulant flow was then increased to 100% (1:10 O:A ratio) and held for 25 minutes. No upset occurred. Rotor speeds were then adjusted at this flow to evaluate the affect of hydraulic stability. Rotor speeds were increased to 1200 rpm and held for 17 minutes with no upset. Subsequent rotor speeds tested without hydraulic upset were 1500 rpm (held for 8 minutes), 1750 rpm (held for 5 minutes) and 2000 rpm (held for 15 minutes). A hydraulic upset only occurred after increasing the rotor speeds to 2400 rpm; see Section 4.1.5 for further discussion of the relationship between hydraulic stability and rotor speed. In total the system was stable for approximately 100 minutes after the organic flow was decreased and this upset was associated with too high of a rotor speed.

Table 4-4. Cs-7SB Addition Effects on Hydraulic Stability

Date	Organic Flow (gpm)	Cs-7SB Addition	Weir Set	Extraction Rotor Speed (rpm)	Time to Upset (min)
5/17/2012	3.57	No Cs-7SB addition	5/17/2012	1000	21
5/29/2012	3.57	1st Cs-7SB addition	5/17/2012	750	14
5/30/2012	3.57	2nd Cs-7SB addition	5/17/2012	750	18
6/05/2012	3.57	3rd Cs-7SB addition	6/05/2012	750	20
6/05/2012	2.61	3rd Cs-7SB addition	6/05/2012	750	100*
* Upset occurred at 100% flow after 100 minutes due to over increasing the extraction rotor speed to 2400 rpm.					

Thus, adjustment of modifier concentration to achieve a solvent density of 0.851 g/cc did not directly resolve the extraction contactor hydraulic challenges encountered with NGS. However, the modifier concentration (within the range of 0.5M to 0.75M) and associated impact on the solvent physical properties was eliminated (or reduced) as a significant contributor to the hydraulic instability phenomenon.

Although increasing the modifier concentration did not resolve hydraulic difficulties encountered up to this point in the program, it did not have any apparent negative impact on hydraulics either. As will be discussed in Section 5.0, the measured CSSX performance with the modified NGS was excellent. Thus, due to the benefits of increased modifier concentration discussed above, including minimization of impacts to SWPF and potential D_{Cs} enhancements the modifier was left at the higher concentration for the remainder of testing.

4.1.4 Organic Flow Rate

The third parameter evaluated was organic flow rate. The MaxCalix solvent has substantially higher extraction D_{Cs} as compared to the BOBCalixC6 solvent, thus permitting the use of much a more aggressive O:A ratio while still achieving satisfactory DFs.

While attempting to increase simulant flow to 50%, the organic flow was limited to 2.61 gpm (O:A of 1:4). This reduction in organic flow was the key to initial hydraulic stability at 50% throughput. To achieve sustained operations the organic flow had to be limited to ~3.3 gpm or less. In Figure 4-5, all extraction aqueous carryover data collected during the NGST is presented as a function of organic flow rate and includes samples from all four (4) extraction-contactor organic-interstage lines. Note that nearly all of the extreme carryover data, an indication of an upset condition, occurs when the organic flow rate was above ~3.3 gpm. There are a few points at lower organic flow that indicate extremely high carryover. These points correspond to grossly mismatched simulant flow rates and extraction rotor speeds (see Section 4.1.5). The details of aqueous carryover performance are discussed in Section 5.3.

Figure 4-5. All Extraction Aqueous Carryover Data Collected vs. Organic Flow

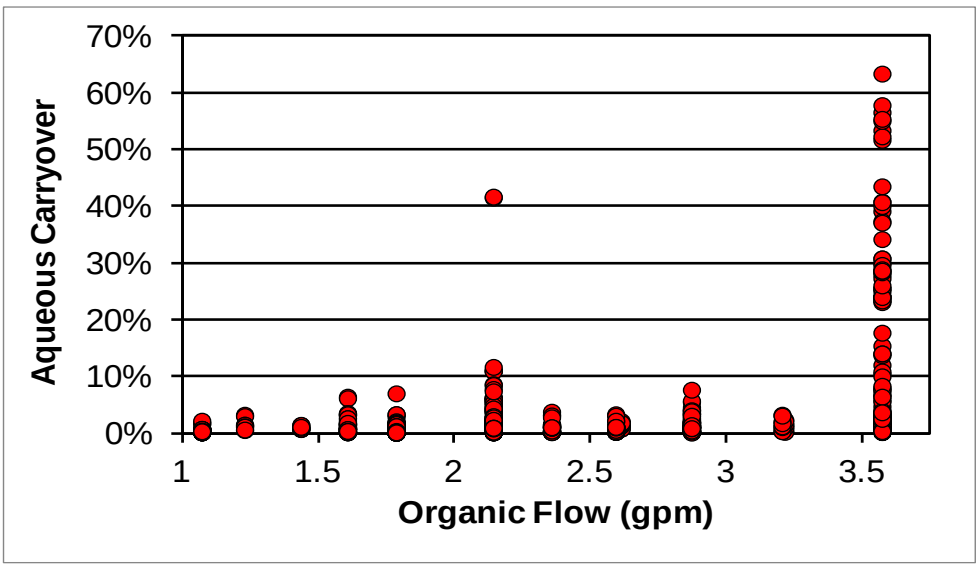


Table 4-5 shows the relationship between organic flow, aqueous flow, and operational stability. Note that O:A ratios of 1:3, 1:4, 1:10 and 1:15 all produced stable hydraulic performance as long as the organic flow was below ~3.3 gpm. At 25% flow a 1:3 O:A is appropriate, however, at 50% this ratio will cause an upset to occur since the total organic flow exceeds the 3.3 gpm limit. Sustained operations have been achieved by maintaining organic flow to around 3.3 gpm or less for flows up to 155%.

Table 4-5. Flow Rates and Operational Stability

Organic Flow (gpm)	O:A	Simulant (Mgpy)	Simulant (gpm)	Simulant (%)	Stable
1.79	1:3	2.34	5.36	25%	Yes
2.61	1:4	4.68	10.72	50%	Yes
2.14	1:10	9.36	21.43	100%	Yes
2.25	1:15	14.50	33.22	155%	Yes
2.87	1:10	12.53	28.72	134%	Yes
3.215	1:10	14.04	32.15	150%	Yes
3.57	1:3	4.68	10.72	50%	No

4.1.5 Rotor Speed Optimization

In previous testing with BOBCalixC6 solvent[16], extraction rotor speed was not a critical parameter. Modest improvement in extraction hydraulic performance was observed for higher rotor speeds. As a result, 2400 rpm was set as the nominal operational speed. Early in the NGST it was discovered that extraction rotor speed was of critical importance when using MaxCalix solvent. Early systemization tests were conducted at 25% flow. The operating strategy called for starting the extraction contactors at 1000 rpm, and after all flows were established, ramping rotor speeds to 2400 rpm. However, on each attempt to raise the rotor speeds a system upset would occur. This difference in speed sensitivity between the two (2) types of solvent is discussed in Section 6.2.3.

Samples were collected at various rotor speeds for 25% flow. The carryover was lowest and system was most stable when the extraction rotor speeds were 750 rpm. As flow was increased in subsequent tests, the rotor speed was increased to attain optimal hydraulic performance; i.e. minimized aqueous carryover. Figure 4-6 shows the relationship between simulant flow rate and optimum extraction rotor speed. There is a linear relationship from 25% to 110%. At flow ≥ 110%, increasing the rotor speed beyond 2200 rpm seemed to lead to a hydraulic upset. The upset resulting from too high of rotor speed has the same symptoms as the upset described earlier, but the mechanism may be different. Additional testing may be warranted to further understand the hydraulic relationship between flow rate and extraction rotor speed and the instability that occurs when operating outside the optimum envelope.

Figure 4-6. Optimum Extraction Rotor Speed vs. Simulant Flow Rate

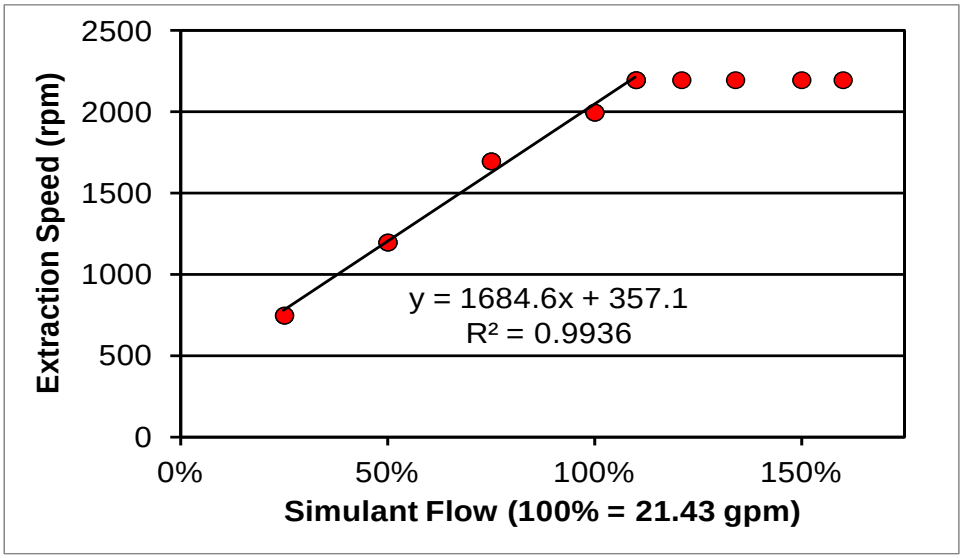


Figure 4-7 shows how aqueous carryover was affected by rotor speed at a given flow rate. The data presented here was obtained from EXT-201A organic effluent samples at 100% flow. In the case of 100% flow the optimum speed was 2000 rpm. Further increasing the rotor speed does not greatly reduce the aqueous carryover, but does increase the likelihood of an upset condition.

Figure 4-7. Effect of Rotor Speed on Aqueous Carryover for 100% Flow

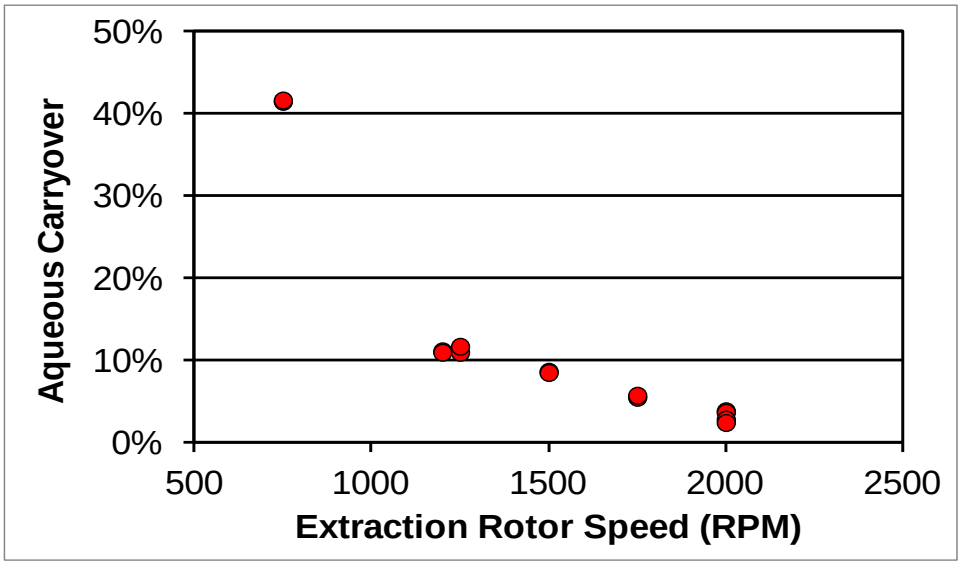
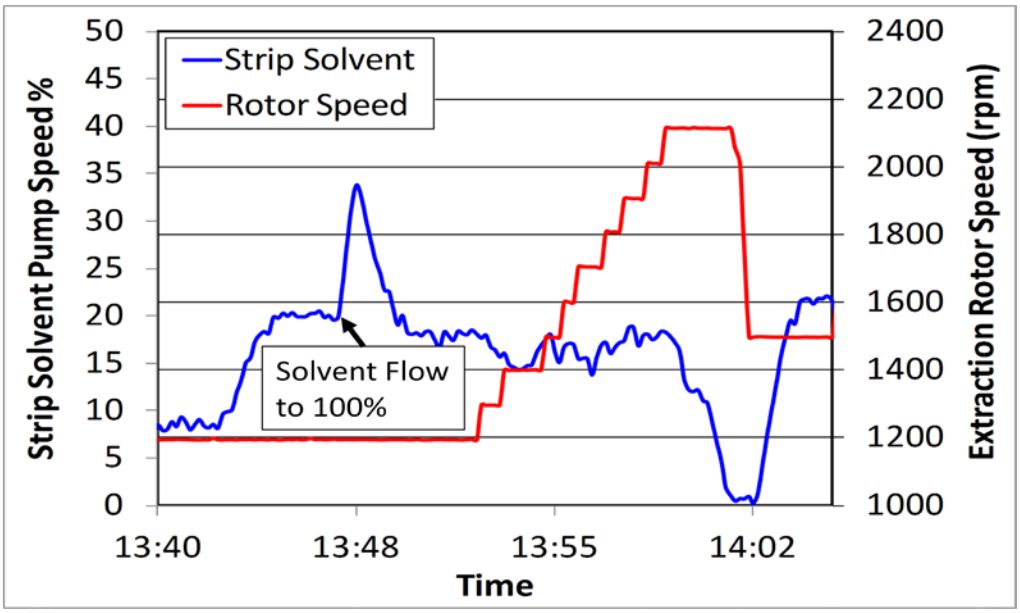


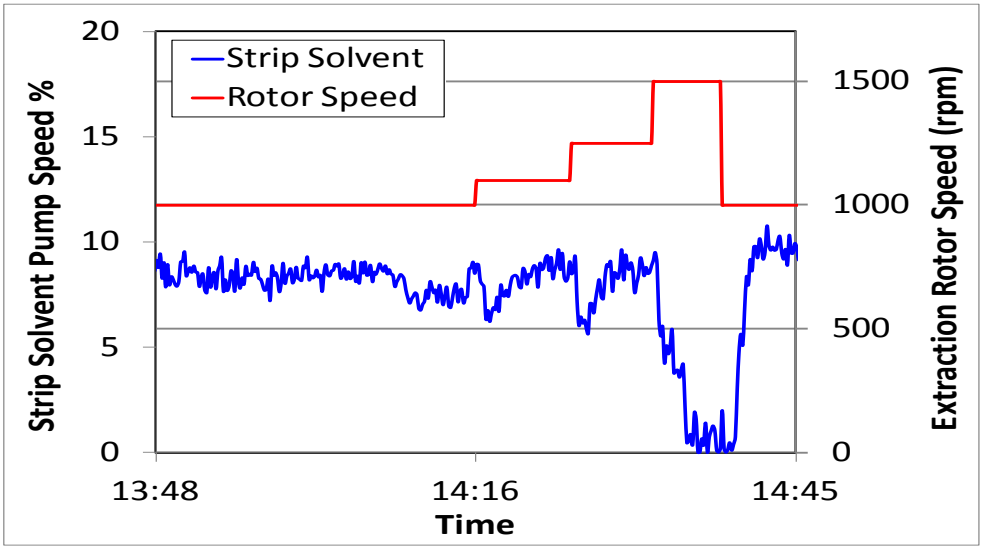
Figure 4-8 shows what happened when the extraction rotor speed was increased beyond the optimum speed. In this plot the extraction rotor speed and the Strip Solvent Pump speed are plotted against time. The Strip Solvent Pump speed is a good indication of the solvent flow through extraction. As the solvent flow increases so does the pump speed and vice versa. The plot begins at 50% flow. The simulant and solvent flows were increased to 100% and allowed to reach steady state before the rotor speed was changed. This can be seen as two sudden increases in solvent flow followed by a relaxation to steady state between 13:40 and 13:53. Once the solvent flow was established, the rotor speed was increased by 100 rpm increments. Just after each speed increase, the solvent flow drops by a few percent. This pattern continued until the speed was increased from 2000 to 2100 rpm. This final increase in speed resulted in a loss of solvent flow through extraction indicated by the sudden drop of the Strip Solvent Pump to nearly 0%. Solvent flow was recovered by quickly reducing the rotor speed back down to 1500 rpm. This phenomenon was observed for every flow rate tested. However each flow had a different maximum speed as seen in Figure 4-6.

Figure 4-8. Loss of Solvent Flow Caused By High Rotor Speed



Exceeding the maximum rotor speed in extraction is not the only mechanism that causes a hydraulic upset. The same type of upset can also be caused by increasing the rotor speed too quickly. Figure 4-9 illustrates this effect. Again, the extraction rotor speed and Strip Solvent Pump are plotted against time. Initially the rotor speed was 1000 rpm and the flows are at 100%. The speed was increased to 1100 rpm at 14:16 and there was a corresponding drop in solvent flow followed by a recovery. The speed was increased again to 1250 at 14:25, and again there was a drop in solvent flow (a larger one this time), followed by a recovery. The speed was then increased to 1500, which resulted in a near total loss of solvent flow that did not recover until the speed was reduced back to 1000 rpm. This demonstrates that hydraulic upsets can occur well below the maximum rotor speed if the speed is increased too rapidly.

Figure 4-9. Loss of Solvent Flow Caused By Rapid Increase in Rotor Speed



4.1.6 Scrub Section Adjustments

The weir size currently recommended for the SWPF scrub contactors is 4.9-inch. However, during the NGST, high aqueous carryover was observed with this weir size. A hydraulic upset condition, as described in Section 4.1, was never observed with the 4.9-inch weirs, but the weir set was changed to 5.0-inch for precautionary purposes. An increase in rotor speed was also found to decrease aqueous carryover. The nominal rotor speed for the scrub contactors was increased from 1500 rpm, in previous testing, to 2000 rpm. These changes and the associated carryover data can be found in Table 4-6.

Table 4-6. Scrub-Phase Aqueous Carryover for Different Configurations at 100% Flow

Weir Size (in)	Rotor Speed (rpm)	Aqueous Carryover (%)
4.9	1000	1.80
5.0	1500	1.33
5.0	2000	0.95

It is unclear why the preferred weir size would be different with the MaxCalix solvent as opposed to the BOBCalixC6 solvent. The density of the scrub solution used in both flowsheets, 0.025M NaOH versus 0.05M HNO_3, was virtually the same. One possibility is that the dispersion band in the scrub contactors is wider when using the MaxCalix solvent. If the dispersion band was skewed toward the organic outlet with the initial weir selection, then increasing the aqueous weir size would reduce the aqueous carryover.

4.1.7 Operational Strategies

The strategy for CSSX startup during NGS testing was altered from that used during prior BOBCalixC6 testing in an effort to prevent hydraulic upsets in the extraction phase. The approach for previous BOBCalixC6 testing was to start all contactors at the nominal rotor speed and then flows at 50%. The O:A ratio for extraction was 1:3 and 5:1 in scrub, strip, and wash. The system was operated at 50% flow until the extraction and strip phases reached temperature. The strip and wash flow rates were then increased to the test conditions, followed by an increase in solvent flow. In an effort to reduce Cs contamination of the DSS and prevent non-prototypic precipitation during start-up, the simulant and scrub flows were adjusted last.

The start-up methodology for the NGST was based on that of previous testing but with modifications to accommodate the hydraulic limitations observed in the extraction phase. The initial step in start-up was to start all the contactor rotors. The rotor speeds selected for formal testing were 1000 rpm in strip and wash and 2000 rpm in scrub. One thousand rpm was selected for strip because lower strip speeds were shown to produce good mass transfer efficiencies and coalescer performance in previous testing[3]. In addition, 1000 rpm provides margin above the presumed lower limit of 750 rpm in which some hydraulic instability was observed during the CFF and CSSX IT. The extraction rotor speeds were started at 1200 rpm to accommodate the 50% start-up flow and was increased as flows were increased; see Section 4.1.5.

As in prior testing, strip and wash flows were initiated at the 50% rate. Once strip flow was verified simulant and scrub flows were started in tandem. After scrub and simulant flow verification, the solvent flow was started. Unlike previous testing, “soft starts” were used to initiate solvent flow by starting the solvent pump at 2% speed until solvent flow rate feedback was observed. This technique was used to prevent controller wind-up, caused by feedback lag, which would result in an initial surge in solvent flow to the extraction contactors.

Once steady state temperatures were reached at 50%, the strip and wash feeds were increased to 100% (1.43 gpm), followed by an increase in solvent flow. The solvent flow was based on the final simulant flow rate and did not exceed 3.3 gpm (see Section 4.1.3). The solvent flow was ramped slowly to minimize perturbations to the organic-aqueous interface in the extraction contactor rotors. Simulant and scrub flows were increased to 100% (21.43 and 1.43 gpm, respectively) once solvent flow was stabilized. To maintain hydraulic stability, extraction rotor speeds were increased to the final setpoint (typically 2000 rpm) in 100 rpm increments. Solvent flow was allowed to stabilize in between each rotor speed increase as indicated by the Strip Solvent Tank level and pump speed. Note this description pertains to operations at or above 100% flow. For operations below this, i.e. 75% flow, the strip, scrub, wash and simulant flows were increased to the nominal values of 1.07 gpm and 16.07 gpm, respectively. The solvent flow was adjusted to 1.607 gpm to maintain a 1:10 O:A in extraction for hydraulic stability.

Steady state conditions were established before exceeding 100% flow. For tested conditions above 100% simulant flow, the simulant flow was increased to the desired rate and final adjustments to the extraction rotor speed and solvent flow rate were made if necessary. The strip, wash, and scrub flows were not increased above 1.43 gpm.

4.1.8 Factors Affecting Hydraulic Performance for NGS

Various parameters were explored during NGS testing in order to achieve high flows. Table 4-7 lists the parameters tested and the major and minor factors that contributed to sustained hydraulic performance.

Table 4-7. Factors Affecting Hydraulic Performance

Major Effect	Minor Effect
Organic Flow Rate	Weir Size
Rotor Speed	Cs-7SB Concentration between 0.5 to 0.75M
Operational Strategies	

The most important factor was the organic flow rate. Sustained operations were not achieved under any operational conditions when the organic flow was in excess of ~3.3 gpm. Rotor speed was also an important factor in achieving system stability. Each simulant flow rate required a different rotor speed. At flows < 110%, the optimum rotor speed was found to increase as simulant flow increased. For flows ≥ 110%, the optimum speed was fixed at 2200 rpm, as hydraulic upsets were likely to occur at higher rotor speeds. The start-up strategy and mechanism for implementing setpoint changes were also found to impact hydraulic stability. To minimize perturbations in the organic flow, changes in flow rates or extraction rotor speeds were made slowly.

Weir size and solvent density did not have a strong effect on system stability. For formal testing, the extraction weir selection was placed back in the nominal configuration to be consistent with that recommended in P-RPT-J-00020[3] and intended for SWPF. The solvent density was maintained within the range specified for previous BOBCalixC6 testing, 0.851 ± 0.01 g/cc.

4.2 Methodology with Higher Concentration Salt Simulants

When switching from 5.6M to 6.4M simulant, it was necessary to conduct several workup tests to allow the simulant concentration in the system to reach an equilibrium value of 6.4M [Na^+]. This was achieved by removing as much fluid from the CSSX system, CFF system, and associated tanks as reasonably possible before introducing the 6.4M simulant to the system. Then two full batches of 6.4M simulant were processed through the system before any 6.4M workup or formal tests were conducted. During those two (2) batches, run parameters used during the final 5.6M tests were tested for the higher concentration simulant. The weir sizes, rotor speeds, organic flow limitation, startup strategies, and NGS formulation that provided satisfactory hydraulic performance during the 5.6M testing was conserved and used during the 6.4M tests. Utilizing the same operating parameters also allowed system performance with the different simulant concentrations to be directly compared. A similar methodology was used when switching from 6.4M to 7.5M simulant.

5.0 TEST RESULTS WITH 5.6M SALT SIMULANT

This section presents mass transfer, solvent recovery and hydraulic data collected during NGST formal and optional testing with 5.6M salt simulant. Appendix A contains all compiled analytical data collected during the NGST.

5.1 Decontamination Factors

The measured overall flowsheet performance (in terms of DF) across four (4) extraction stages and the SWPF theoretical across 16 extraction stages are presented in Table 5-1. The "rule of thumb" SWPF DF metric required to meet the Saltstone WAC limit for Cs concentration is greater than 40,000. This roughly translates to a DF of at least 14 for the NGS test system. The theoretical DFs were approximated by taking the measured DFs to the power of four. The lowest measured DF during formal testing occurred at 155% flow, with a theoretical DF of 47 million, over 1000 times higher than the required DF in SWPF.

Table 5-1. Measured and Theoretical DFs

Flow	O:A	Measured DF*	Theoretical SWPF DF (millions)
50%	1:10	101 ± 20	104
75%	1:10	220 ± 44	2,343
100%	1:10	259 ± 52	4,500
110%	1:10	366 ± 73	17,944
121%	1:10	392 ± 78	23,613
134%	1:10	328 ± 66	11,574
155%	1:15	83 ± 17	47
* Measured DF for four, full-scale contactors.			

It is obvious from Table 5-1 that the DF was affected by running at different simulant flow rates. It is difficult to isolate the cause of this effect, since each flow requires different conditions for hydraulic stability. However, one possible explanation for the increase in DF from 50% to 121% is improved mixing. The extraction rotor speed increases with the flow rate, and both can contribute to mixing. In Figure 5-1 both DF and extraction rotor speed are plotted vs. simulant flow. The argument can be made that the DF increases with the rotor speed all the way to 134%. The DFs for 110% to 134% are statistically the same and the rotor speeds are also essentially the same.

The real outlier to this explanation is the DF for 155% flow. According to the mixing explanation this DF should be as high as or higher than any of the other DFs. The difference is in the O:A ratio. As seen in Figure 5-2, the O:A was the same for all the flow rates up to 134%, but

at 155% the O:A was reduced to ensure satisfactory hydraulic performance was maintained during the test. The organic flow used during the 155% flow test was 2.25 gpm. This leaves room for increased aqueous flow with the same O:A and rotor speed without exceeding 3.3 gpm solvent flow. During NGS testing 155% could not be exceeded due to non-prototypical equipment limitations, as discussed below.

Figure 5-1. DF as a Function of Simulant Flow, Compared to Rotor Speed

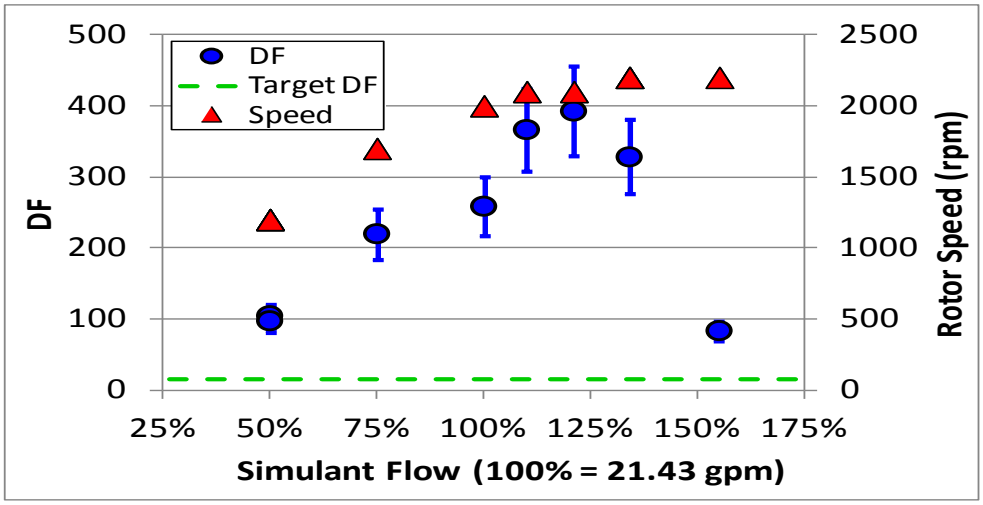
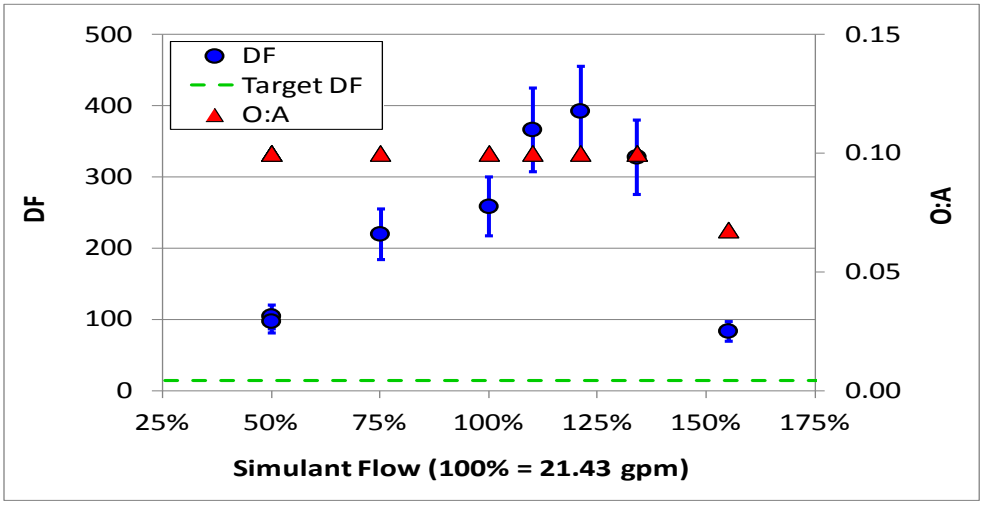


Figure 5-2. DF as a Function of Simulant Flow, Compared to O:A



Flows up to 155% were obtained with satisfactory results in DF. It is believed that satisfactory performance at flows above 155% could have been achieved. Operations above 155% were limited by the 7.5 hp motors on the extraction contactors drawing too much current due to torque requirements at such high flow. The SWPF contactor motors are 10 hp and should not reach this limit as easily as those installed at PTC.

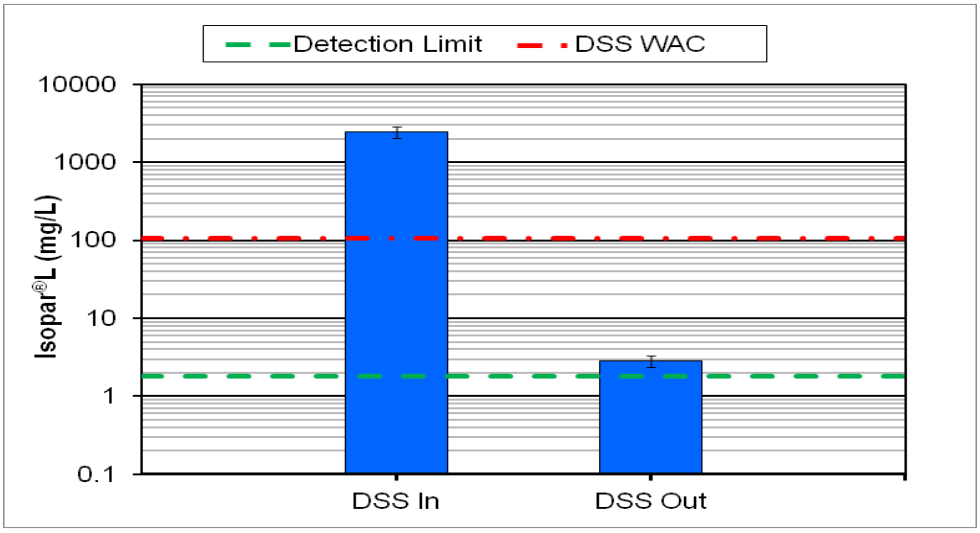
5.2 Coalescer Performance

Solvent recovery performance, for both the DSS and SE Coalescers, was evaluated during NGS testing. According to CBU-WSE-2005-00276, *Recommended Waste Acceptance Criteria for Transfers from the Salt Waste Processing Facility to the Defense Processing Facility and Saltstone Production,*[33] the WAC limit for Isopar®L concentration is 87.5 parts per million volume (ppmv) basis for the DSS and 87 ppmv for the SE. This is equivalent to 106.75 mg/L and 87 mg/L, respectively, and data is presented below using the same unit basis for consistency. Additionally, the analytical detection limit for Isopar®L has been reported as 1.90 to 2.25 mg/L. Thus, for conservatism, these values were used for data that was reported below detection limit.

5.2.1 DSS Coalescer

DSS Coalescer performance during the formal and optional tests with 5.6M salt simulant is depicted in Figure 5-3. As shown, the average Isopar®L concentration entering the DSS Coalescer was approximately 2337 mg/L. However, the average concentration of the effluent was 2.41 mg/L. This is both well below the DSS WAC limit of 106.75 mg/L and approaching the analytical detection limit. Furthermore, analytical data to-date shows all coalescer effluent samples containing Isopar®L concentrations at or near the detection limits of the analytical equipment. The highest concentration observed in the effluent stream was 3.31 mg/L.

Figure 5-3. DSS Coalescer Performance in mg/L of Isopar®L

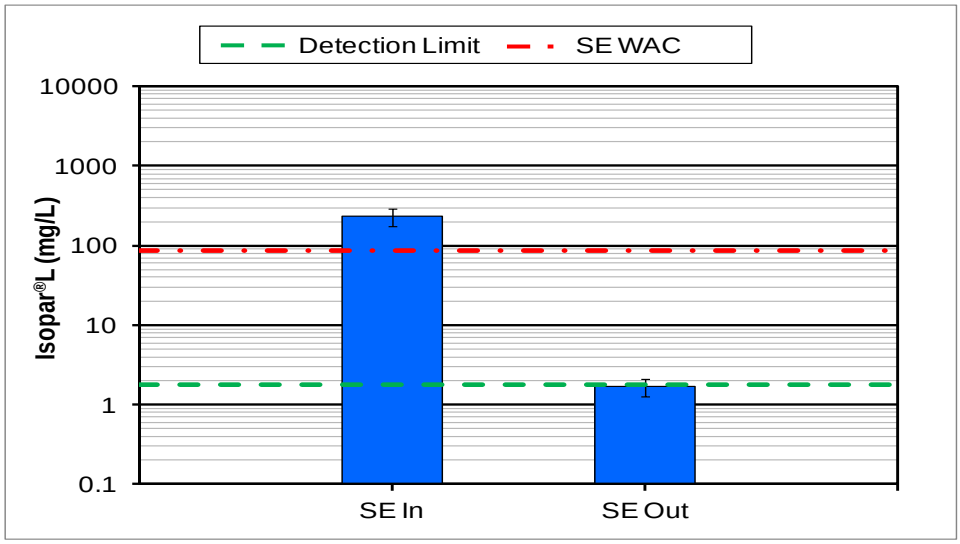


5.2.2 SE Coalescer

Figure 5-4 presents the average Isopar®L concentrations in the SE feed and effluent streams. The average Isopar®L concentrations of the feed into the SE Coalescer was approximately 250 mg/L. The SE concentrations were very low, with an average of 2.6 mg/L. These, again, are below the

SE WAC limit of 87 mg/L and approaching the detection limit of the analytical equipment. The highest concentration in the effluent stream was reported as 4.16 mg/L.

Figure 5-4. SE Coalescer Performance in mg/L of Isopar®L



5.3 Hydraulic Performance

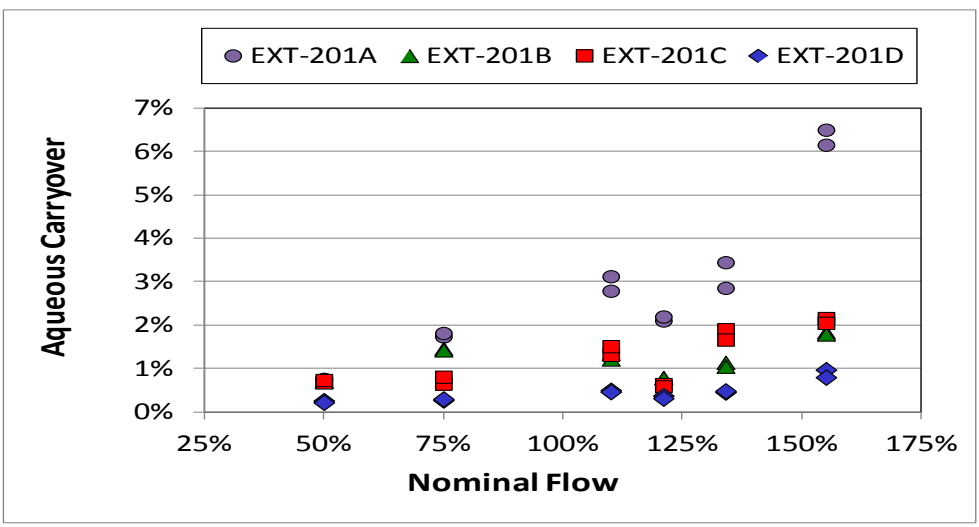
In previous testing, acceptable carryover was defined as: 1) organic carryover < 1% of aqueous flow, 2) aqueous carryover in the extraction organic effluent < 0.2% of organic flow, or 3) no gross organic or aqueous carryover from any contactor[16]. The organic carryover limit was based on the mass balance model (MBM) predictions for acceptable mass transfer performance with BOBCalixC6 solvent. Additionally, the aqueous carryover limit of less than 0.2% was defined for the extraction organic effluent to eliminate neutralization or titration of the acidic scrub solution used in previous testing. To ensure hydraulic stability, gross carryover was defined as > 1%. However, these criteria may not directly apply to the NGS flowsheet. The impact of organic or aqueous carryover on mass transfer performance is reduced by the increased potency of the NGS and the replacement of the previous acidic scrub solution with dilute caustic.

In addition, hydraulic stability in the extraction contactors may still be obtained with > 1% aqueous carryover as a result of reduced organic flow and increased aqueous flow. This is further explained when evaluating aqueous carryover in terms of both total flow and the organic flow. In previous testing, organic flow was limited to 7.143 gpm (the 100% nominal flow rate) with 1% aqueous carryover being equivalent to 0.071 gpm. The total flow for 100% nominal in previous testing was 30 gpm. Thus, 0.071gpm of aqueous carryover would be equivalent to 0.238% of the total flow. Furthermore, this is equivalent to 0.079 gpm of total flow for 134% NGS testing or 2.74% of the reduced NGS organic flow. The redefined limit would be similar for all other NGS flow rates with the exception of 155% nominal flow where the O:A was decreased to 1:15. The redefined limit at this ratio would be 3.9% for NGS operations.

Interstage phase carryover was assessed in formal and optional testing at conditions that provided stable hydraulics and acceptable mass transfer performance. Qualitative assessment of organic carryover was more difficult due to the nature of sampling a high volume stream. However, organic carryover was estimated to be between 1% and 2% of all samples analyzed (for both extraction and strip) and did not appear to vary with flow rate.

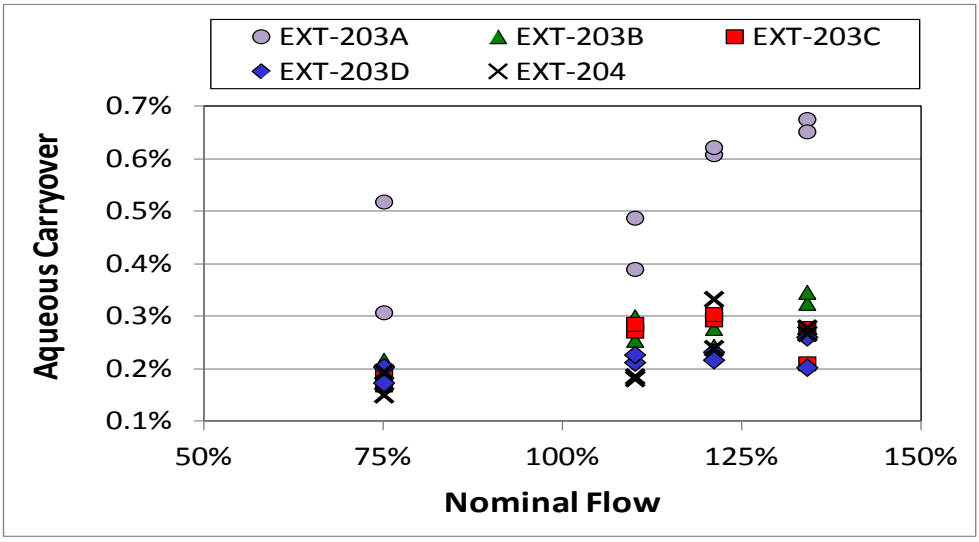
Figure 5-5 depicts the aqueous carryover in the extraction contactors for formal and optional testing. In general there was higher carryover in EXT-201A (the first extraction contactor with respect to organic flow). The carryover in all other contactors was shown to stay below the artificial limit of approximately 2.74% or 3.9% of organic flow. It is unclear why EXT-201A would have increased carryover, but one possible explanation may lie in the fact that this contactor has an additional vent to accommodate the organic feed. This vent could change the pressure balance in the contactor in such a way as to increase the aqueous carryover. Another contributing factor could be that EXT-201A (the first contactor with respect to solvent flow) has the highest superficial solvent flow rate due to solvent back mixing effects cascading across the extraction contactor array. The solvent flow in upstream contactor, with respect to organic flow direction, would be slightly higher due to solvent carryover losses. The higher carryover did not lead to a hydraulic upset nor did it result in unacceptable mass transfer performance.

Figure 5-5. Aqueous Carryover in Extraction Contactors for Formal and Optional Testing



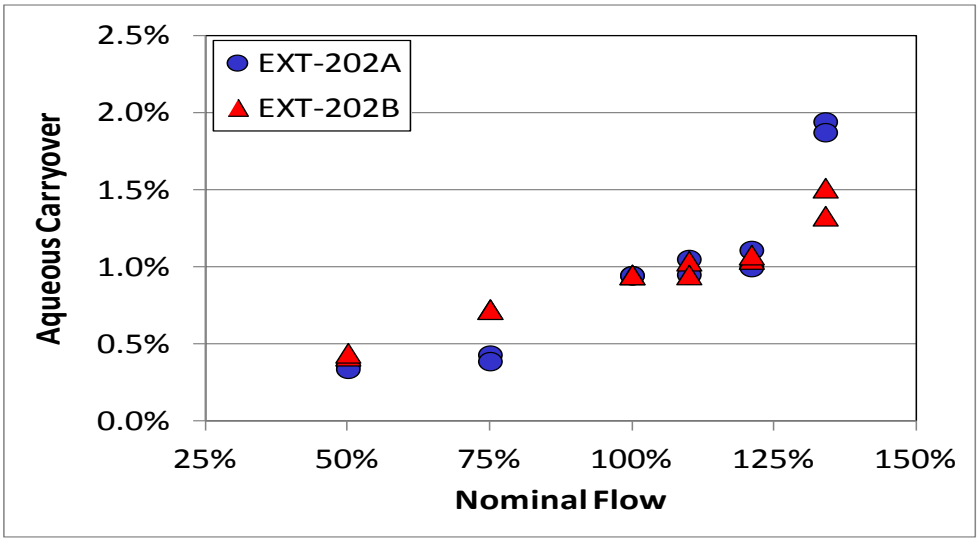
The aqueous carryover in the strip and wash contactors for formal and optional testing are shown in Figure 5-6. All contactors had less than 0.7% of aqueous carryover and had a trend of increased carryover with increased flow. Similar to extraction, EXT-203A (the first contactor with respect to organic flow) had noticeably higher carryover than the other strip contactors. This contactor also has an additional vent, as a result of the organic feed line, which could affect the pressure balance in the contactor and aqueous carryover. EXT-203A is also subject to similar back mixing effects as EXT-201A resulting in a higher superficial solvent flow rate as compared to the other strip contactors.

Figure 5-6. Aqueous Carryover in the Strip and Wash Contactors for Formal and Optional Testing



The scrub contactors also exhibited a trend of increased carryover with increased flow; see Figure 5-7. However, the increase was much more dramatic than that observed in the strip contactors. The carryover observed at 134% flow was three times as much as that observed at 50% flow. However, no hydraulic upsets occurred while running at these conditions and mass transfer was acceptable despite the extraneous carryover.

Figure 5-7. Aqueous Carryover in the Scrub Contactors for Formal and Optional Testing



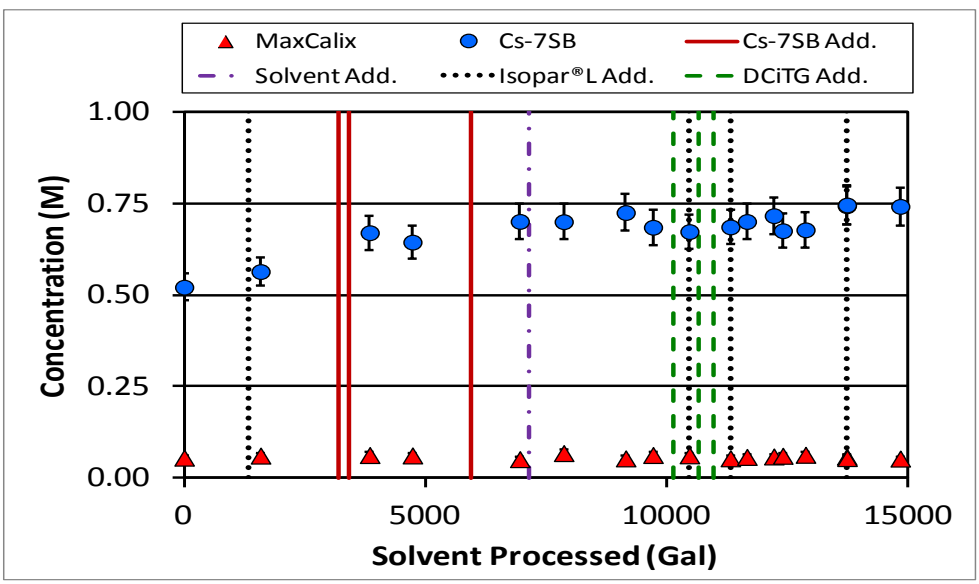
5.4 Solvent Component Trending

Over the course of testing, solvent adjustments were made to 1) increase the density to 0.851 ± 0.01 g/cc for consistency with the BOBCalixC6 solvent and 2) replenish Isopar®L and DCiTG as a result of evaporative losses and partitioning, respectively. Overall solvent quality was monitored via laboratory analysis of solvent samples taken throughout testing. Further discussion of the trends for each constituent are presented below. Cumulative solvent flow was used for evaluating MaxCalix, Cs-7SB and Isopar®L trending as the solvent may be affected by partitioning, evaporation, degradation, etc. throughout the flowsheet. DCiTG concentration was trended as a function of strip solution processed because the primary depletion mechanism for DCiTG was partitioning into the strip solution.

MaxCalix and Cs-7SB concentration are shown in Figure 5-8 as a function of cumulative solvent flow into the CSSX system. Note the reported starting concentration consists of collective data from both the submitted COA and that determined by the PTC Laboratory. The concentration of MaxCalix was relatively constant over the course of testing with the average concentration being 0.059M.

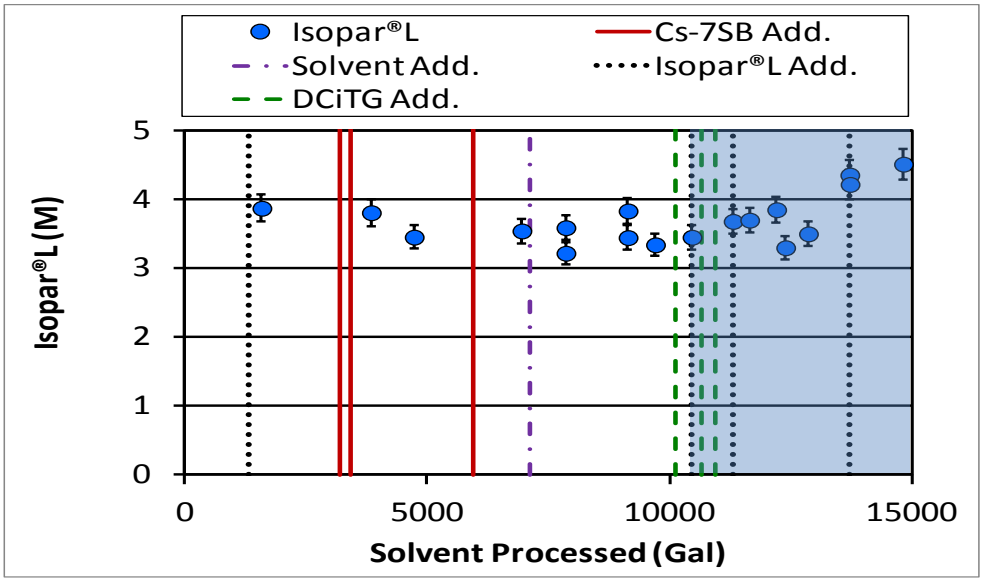
As discussed in Section 4.1.2, the solvent density was adjusted during systemization via three (3) aliquot additions of Cs-7SB. This resulted in a Cs-7SB increase from 0.52M to 0.68M. Indications for these additions and the resulting concentration increase are shown below. The concentration remained relatively constant after the additions with the average concentration being 0.71M.

Figure 5-8. MaxCalix and Cs-7SB Concentration Trending



Following the Cs-7SB adjustments, solvent density was maintained by Isopar®L additions. Figure 5-9 provides Isopar®L concentration over the duration of the test with all solvent adjustments indicated by vertical lines. The data collected during formal testing is highlighted. Isopar®L concentration appeared to be consistent throughout systemization and workup testing, but a slight increase was observed throughout formal testing.

Figure 5-9. Isopar®L Concentration Trending



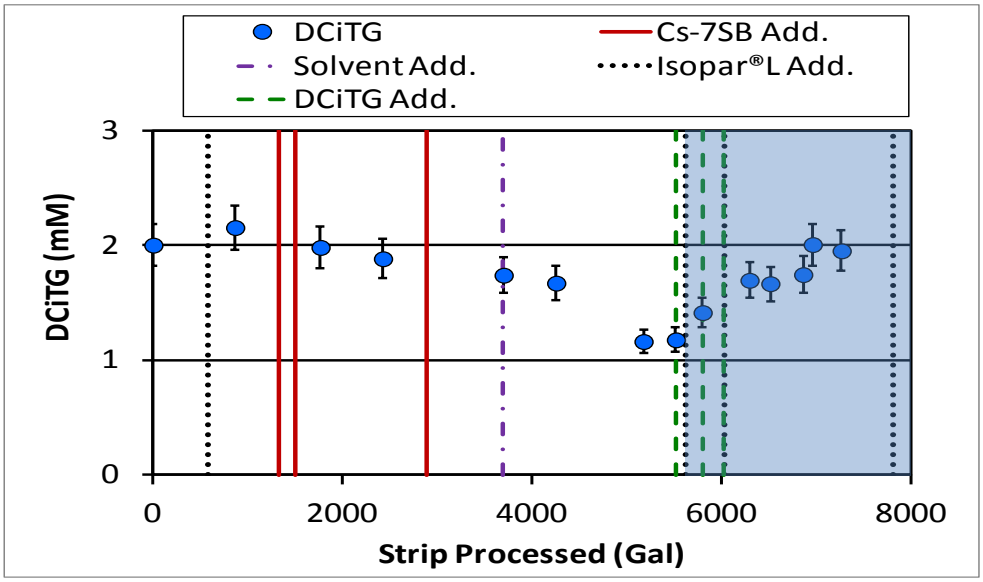
The DCiTG concentration trend is of particular concern due to its susceptibility to partitioning in the strip solution and its relatively low concentration in the solvent. The DCiTG decreased from an average concentration of 2.85 mM to 1.16 mM after processing 5170 gallons of strip solution. This equates to a loss of either 0.748 or 0.544 mols of DCiTG depending on whether a 117 gallons (volume added to the system) or 85 gallons (estimated volume actively circulated) NGS volume basis is assumed.[5] The moles of DCiTG lost divided by the volume of strip processed gives an average partition concentration in the strip effluent over this time period. A DCiTG partition ratio of (P_{DCiTG}) of 52 to 72 (depending of solvent volume basis) can be calculated by dividing the average DCiTG concentration in the solvent by the average DCiTG concentration in the strip effluent. This indicates the SWPF rate for DCiTG addition may be as frequent as every 12.7 days when assuming constant 1.43 gpm of strip flow and a SWPF solvent working volume of 500 gallons. While system performance was not impeded by the decline, the DCiTG concentration was replenished prior to formal testing.

[5] The volume of NGS added to the SHT was 117 gallons. Back-calculating the solvent volume based on the amount of Cs-7SB added to the SHT and the change in Cs-7SB concentration in the solvent yields a NGS volume of 85 gallons. Thus, it is likely that only ~85 gallons of NGS was actively circulated during testing. Seven (7) Isopar®L adjustments were made, following the Cs-7SB adjustment, using the working volume of 85 gallons with all adjustments resulting in the desired density.

ORNL determined a P_{DCiTG} of 35 ± 8 in laboratory testing; see ORNL-LTR-NGCSSX-018, *N, N'-Dicyclohexl-N"-Isotridecylguanidine Suppressor Variants for the Next Generation Caustic Side Solvent Extraction (NG-CSSX) Process*[34]. This value is slightly lower (partitions to the aqueous more readily) than the P_{DCiTG} determined during SWPF NGS testing, but are in reasonable agreement considering the varied conditions that existed during the SWPF NGS testing.

Figure 5-10 shows the DCiTG trend during testing along with indications for adjustments to the solvent and formal test data. Note the data presented, including the starting concentration of DCiTG in the solvent, are from analytical results submitted by the PTC Laboratory.

Figure 5-10. DCiTG Concentration Trending



A general conclusion can be made that solvent component trends had little to no impact on the flowsheet performance as superior Cs DFs (a measure of mass transfer performance) and solvent recovery performance were consistently obtained over the course of testing. ORNL[34] testing determined that stripping behavior became significantly impacted only when the DCiTG concentration was < 0.25 mM. The DCiTG concentration never approached this concentration during SWPF NGS testing.

5.5 Extended Duration Test Performance

As a result of the hydraulic instability exhibited during early NGST systemization, an extended duration run was conducted. The test system was started in the same manner as with previous runs in that steady state temperatures were established at 50% flow. Subsequently, flows were increased to 134%. More than 10,000 gallons of simulant were processed at this flow rate for over six (6) hours without any indication of hydraulic upsets or instability. Mass transfer and

solvent recovery samples were collected every hour over this operating period to profile performance.

All DF measurements made during the extended duration test were above 200. In Figure 5-11 the DF measurements over the duration of the test are shown. Over the duration of the test the DF exhibited a sawtooth pattern. In Figure 5-12 and Figure 5-13, the Isopar®L concentrations for the DSS and SE Coalescers are shown. The data also appear to have a sawtooth pattern. The cause of this pattern is unknown.

Many process variables were examined in an attempt to explain the cause of this phenomenon including an evaluation of temperatures, flow rates, rotor speeds, and tank levels. None of these parameters could readily explain the sawtooth pattern observed. However, it should be noted that the batch tank used to supply the CFF was switched during this test; about 30 minutes before the fourth sample set. At first it may seem obvious that switching feeds could cause such an effect. However, if the process is considered, it is clear that the fluid from the second batch tank would not have enough time to affect the CSSX feed due to the amount of holdup between the batch tank and the first extraction contactor (i.e. FFT, CFF, and CSS Tank). This is not to say that switching feeds did not attribute to this effect, but that it is unclear how it might have at this time.

Figure 5-11. Extended Duration Test DF

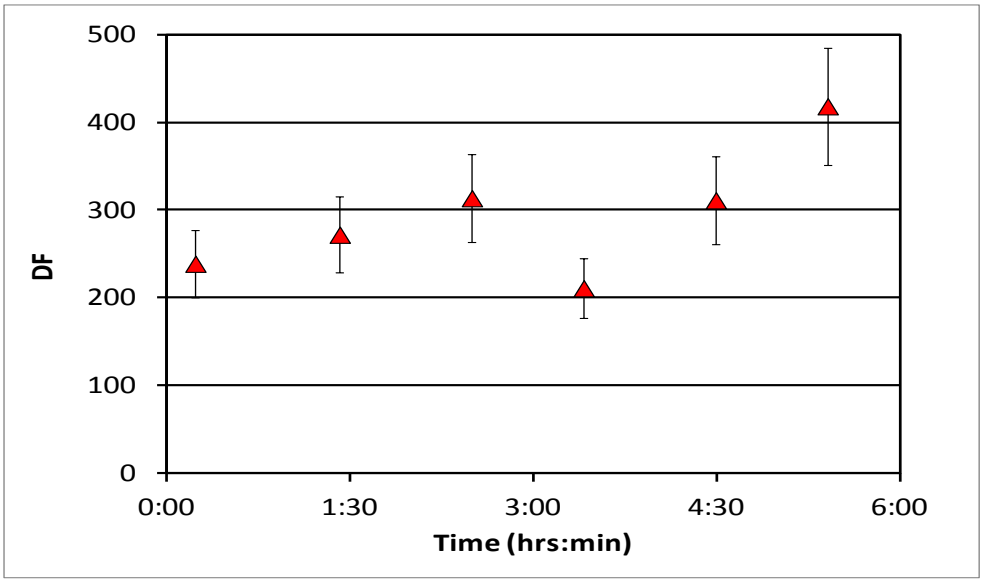


Figure 5-12. DSS Coalescer Isopar®L Concentrations

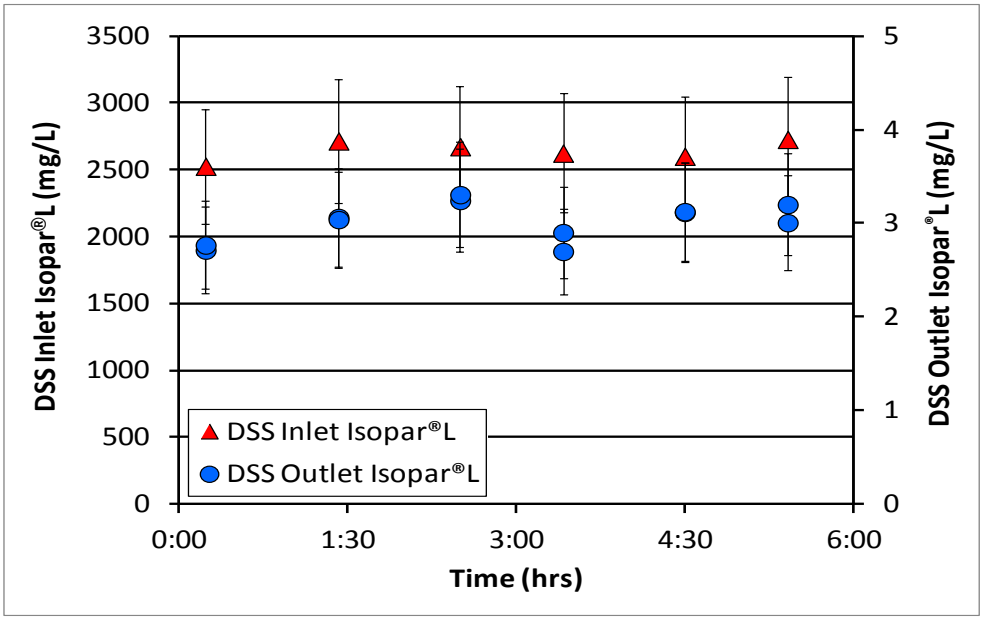
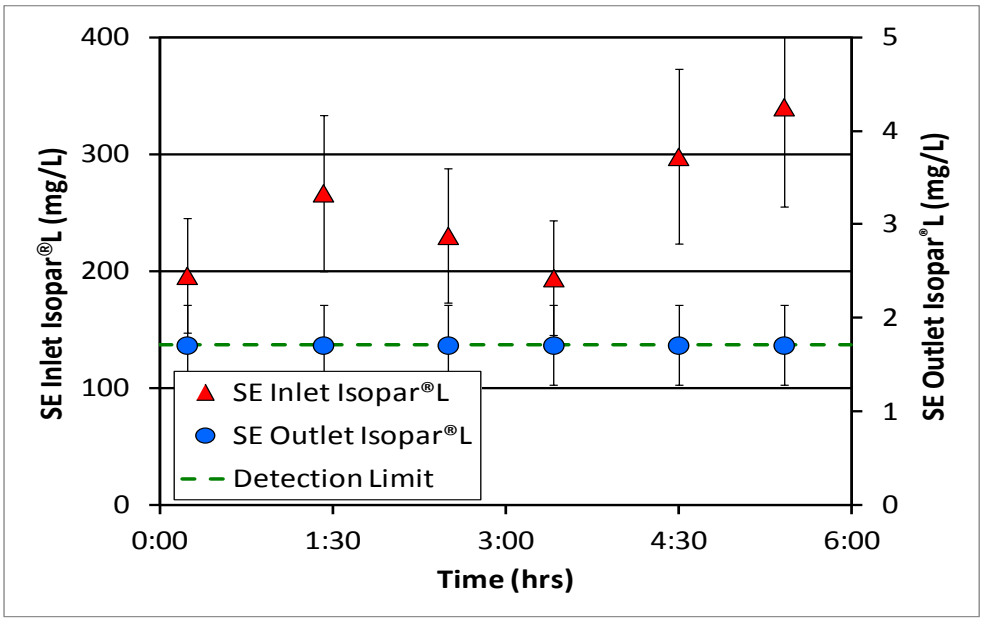


Figure 5-13. SE Coalescer Isopar®L Concentrations



Turbidity has been shown to provide an indirect measurement of Isopar®L; see P-RPT-J-00020[3]. The turbidity of the DSS and SE Coalescer effluent streams throughout the extended duration test are shown in Table 5-2. The DSS stream was consistently below 1 NTU, while the SE stream was below 2 NTU for the duration of the test. As shown in Figure 5-13, this corresponds

to Isopar®L concentrations that are at or below 2 mg/L for the SE. While the DSS Isopar®L concentrations were around 3 mg/L; see Figure 5-12.

Table 5-2. Coalescer Performance During the Extended Duration Test

Time (hrs)	Turbidity (NTU)	
	DSS	SE
1	0.7	1.5
2	0.9	1.6
3	0.8	1.3
4	0.9	1.1
5	0.8	1.2
6	0.8	1.1

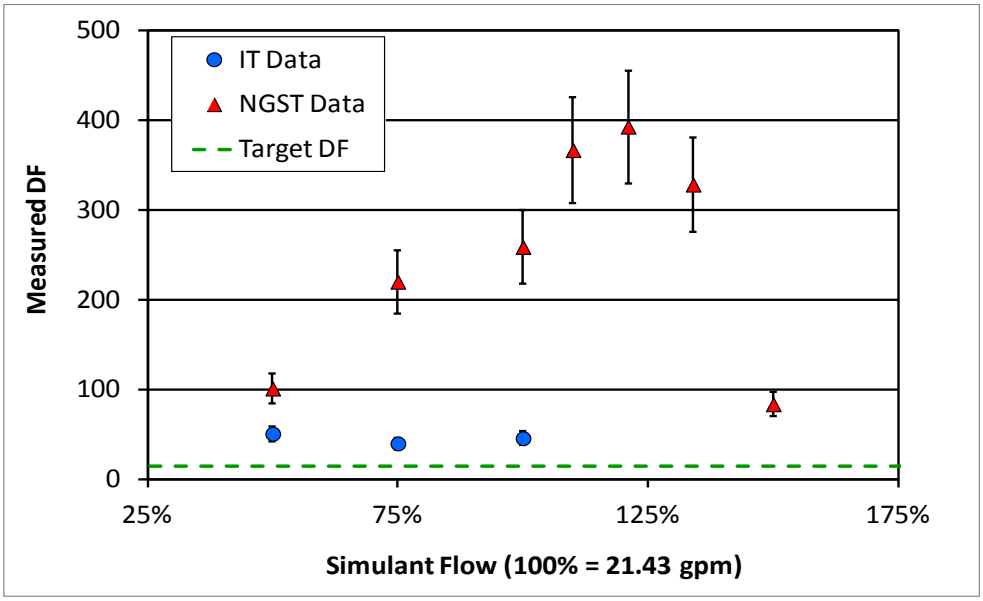
6.0 SOLVENT PERFORMANCE COMPARISON

The MaxCalix solvent demonstrated substantially higher DFs and better solvent recovery as compared to the BOBCalixC6 solvent used. Performance results from the NGST and those from previous testing with the BOBCalixC6 solvent are compared below.

6.1 Mass Transfer Performance Comparison

The BOBCalixC6 solvent has demonstrated effective Cs extraction and stripping, with DFs approaching 50 during the IT at the recommended operating conditions. Thus, the calculated, theoretical SWPF DFs were estimated to be between 17 and 45 million at flows of 50% to 100%. The MaxCalix solvent, used in the NGST, eminently outperformed the BOBCalixC6 solvent with respect to extraction and stripping D_{Cs}. The DFs for NGS formal and optional testing ranged from 83 to 392. The lowest DF observed was at 155% flow but remained almost twice that measured at 100% flow during the IT across the four extraction stages in the test system. Figure 6-1 compares the DFs obtained during the IT, using the BOBCalixC6 solvent to those obtained during the NGST.

Figure 6-1. DF Comparison of NGST and IT



As shown above, the DFs provided by the BOBCalixC6 solvent are sufficient to meet the Saltstone Cs WAC limits. However, the waste throughput with the BOBCalixC6 solvent is limited by the hydraulic limitations of the hardware and the required 1:3 O:A ratio necessary to obtain sufficient D_{Cs}. These limitations were overcome by the MaxCalix solvent. The concentration of the extractant in the MaxCalix solvent enabled sufficient extraction and stripping D_{Cs} to be obtained at flows > 100% by decreasing the solvent flow required, or O:A, while simultaneously increasing the simulated waste throughput.

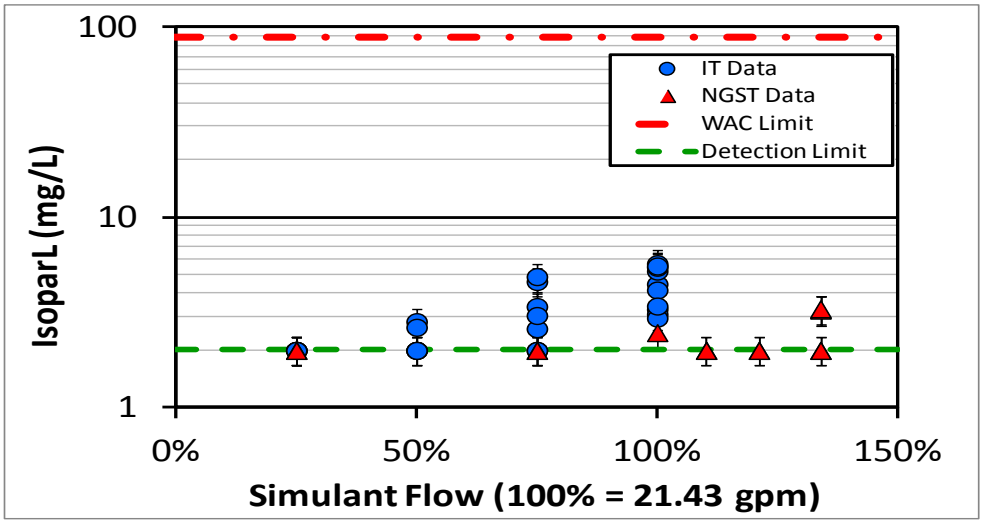
The enhanced extraction and stripping D_{Cs} also provides supplementary process robustness through increased hydraulic stability. Sufficient DFs can be maintained even at lower stage efficiencies that could result from increased flow rates or off-normal conditions.

6.2 Solvent Recovery Comparison

6.2.1 DSS Coalescer Performance

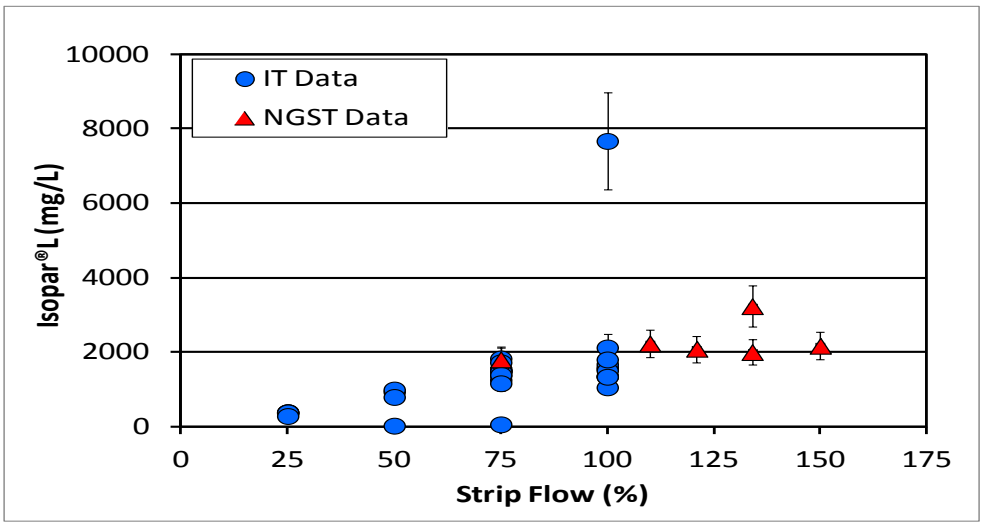
Excellent recovery of the BOBCalixC6 solvent was demonstrated with the DSS Coalescer during the IT. There were no DSS Coalescer effluent samples analyzed during the IT that contained more than 6 mg/L of Isopar®L. A trend of increasing Isopar®L concentration with DSS flow was observed, but all measurements were an order of magnitude below the WAC limit; 106.75 mg/L. The DSS Coalescer performance during the NGST was found to surpass that observed during the IT. With the MaxCalix solvent, most analysis of the DSS Coalescer effluent stream resulted in non-detection of Isopar®L; ≤ 2 mg/L. As a result, no discernible trend of Isopar®L concentration with flow could be established. Figure 6-2 compares DSS Coalescer performance during the NGST to that of the IT.

Figure 6-2. DSS Coalescer Performance for NGST and IT



In order to determine whether the improved coalescer performance seen during NGST was due to a lower inlet concentration of Isopar®L entering the DSS Coalescer, the Isopar®L values for both tests were plotted together. In Figure 6-3, it can be seen that the inlet Isopar®L concentrations were generally similar during NGST and IT. This considered, the concentration in the outlet was much less during the NGST. Since both solvents were maintained within the same density range (0.851 ± 0.01 g/cc), the difference in the solvent recovery is not related to Stokes settling due to density differences. The coalescer performance is likely dominated by factors that affect droplet coalescence rather than settling which include droplet size distribution and/or surface properties.

Figure 6-3. Isopar®L Concentration Entering DSS Coalescer

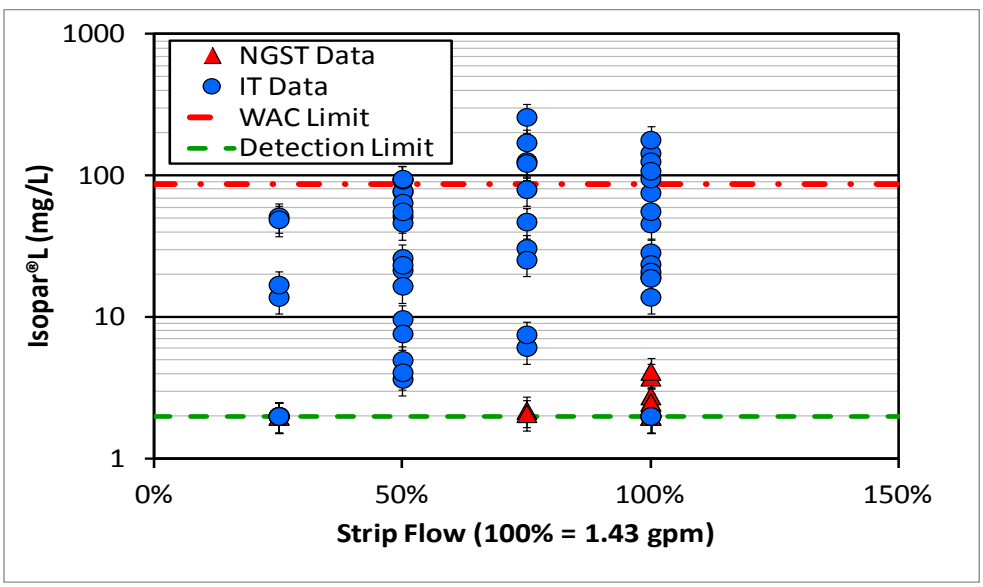


6.2.2 SE Coalescer Performance

During the IT, considerable effort was devoted to developing strategies to limit the concentration of Isopar®L in the SE. Many of the conditions tested resulted in high levels of Isopar®L near or exceeding the WAC limit; see P-RPT-J-00020[3]. These high levels of Isopar®L in the SE are thought to be caused by emulsification of organic in the aqueous stream during stripping. The two most important parameters affecting the emulsions were rotor speed and flow rate. Isopar®L concentration in the SE was reduced to below the WAC limit at lower optimum speeds. However, as a result of the hydraulic instability observed at 750 rpm during the IT, the strip contactor operating speeds were increased from 850 rpm to 1000 rpm for the NGST. This allowed additional margin for acceptable hydraulic and coalescence. All other operational strategies developed during the IT for acceptable SE Coalescer performance were adhered to during the NGST.

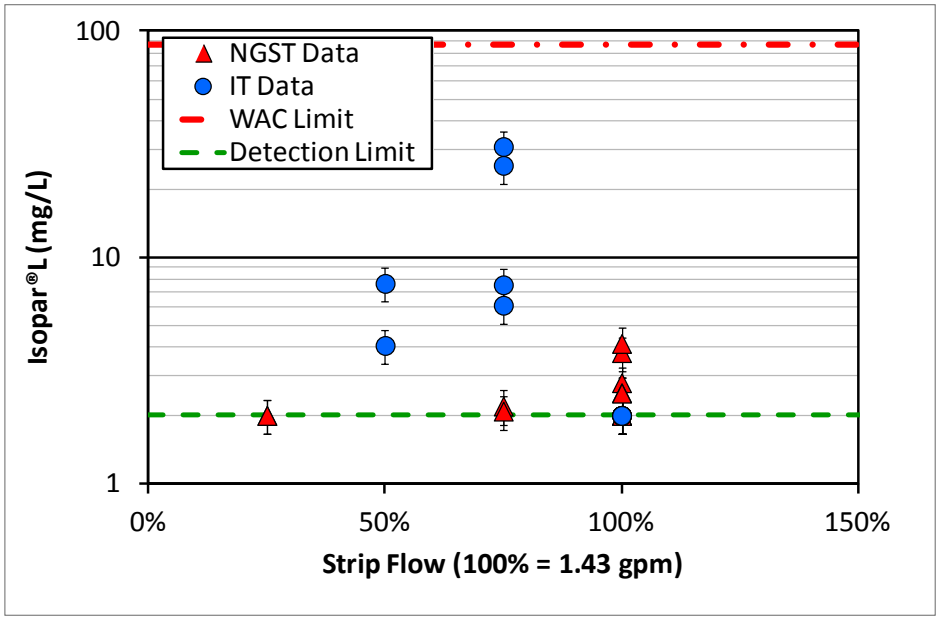
In contrast, the NGST did not experience problems associated with the SE Isopar®L concentrations approaching the WAC limit. Isopar®L concentrations exiting the SE Coalescer were in the low single digits under all conditions evaluated and were typically under the detection limit of 2 mg/L. As a result, a trend relating Isopar®L to flow could not be established; see Figure 6-4. It should be noted that during the NGST, the strip flow was held constant at 1.43 gpm when the simulant flow was ≥100%. By holding the strip flow rate constant, increased SWPF waste processing could be achieved without increasing waste feed to DWPF.

Figure 6-4. Isopar®L Concentration in the Strip Effluent for the IT and NGST



During the IT, conditions were found in which the SE Coalescer performance was more than satisfactory. Under these conditions the two tests compare more favorably, but NGS still far out performs the earlier BOBCalixC6 solvent. A comparison of the SE Coalescer performance between the best IT conditions and all NGST data can be seen in Figure 6-5.

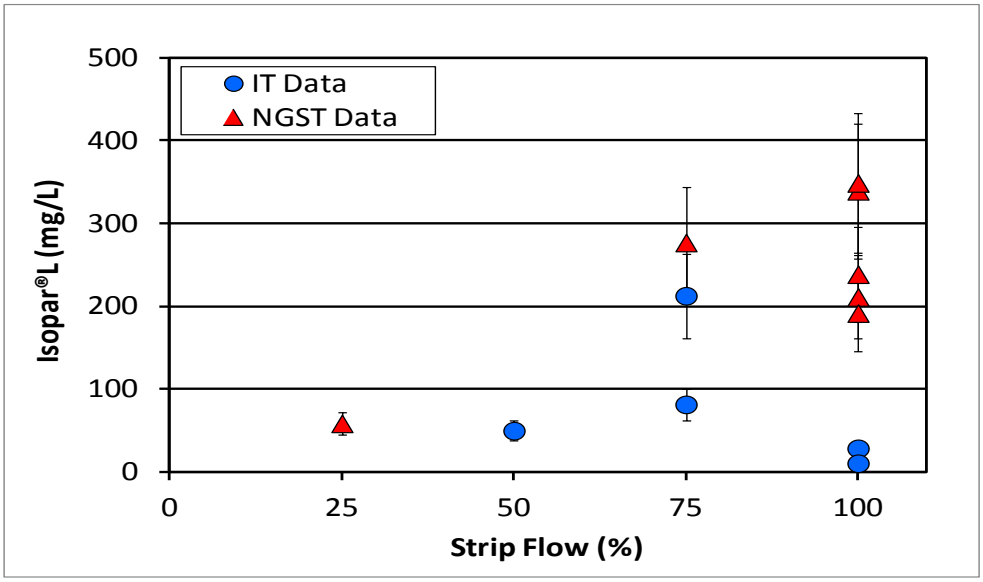
Figure 6-5. Isopar®L Concentration in the SE for the IT (Best Conditions) and NGST



Again, as with the DSS Coalescer, incoming Isopar®L concentrations to the SE Coalescer were analyzed to determine the impact on performance of the coalescer. Figure 6-6 shows the Isopar®L concentrations into the SE Coalescer while operating with optimal conditions for the IT, as well as the data for the NGST. The inlet concentrations during NGST were comparable but appear to be somewhat higher.

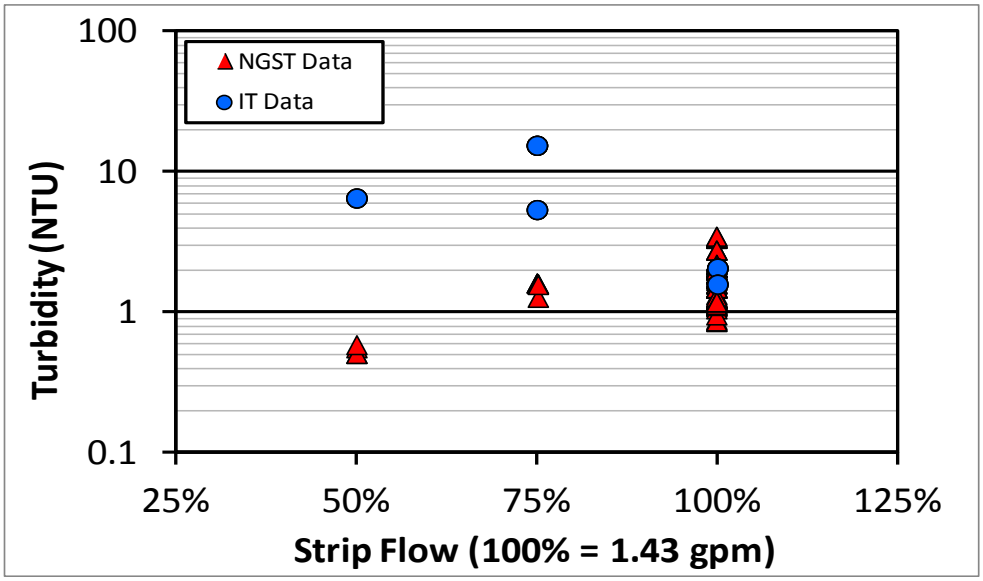
This suggests that the SE Coalescer performance was substantially improved with NGS. Similar performance improvements with the DSS Coalescer were discussed in the prior section. Again this suggests that Stokes settling is not the dominate factor in coalescer performance since the NGS was maintained at the same density as the BOBCalix solvent (0.851 ± 0.01 g/cc). The coalescer performance is likely dominated by factors that affect droplet coalescence rather than settling which include droplet size distribution and/or surface properties.

Figure 6-6. Isopar®L Concentration at Inlet to SE Coalescer



A close relationship between Isopar®L concentration and turbidity of the SE exiting the coalescer was shown during the IT. This allows for an easier and faster, yet indirect, measurement of Isopar®L. In Figure 6-7 all of the turbidity data from the IT and NGST for the SE exiting the coalescer is shown. Here it can be seen that the turbidity in the NGST was an order of magnitude lower at 50%, nearly an order of magnitude lower at 75%, and about the same at 100% flow.

Figure 6-7. Strip Effluent Turbidity for the IT and NGST



6.2.3 Hydraulic Stability

As discussed throughout this report, hydraulic stability was the primary concern during NGS testing. As long as the system was running without upset, the DF and solvent recovery performance was far beyond the minimum requirement. The main issue during the NGST was getting the system to reach stable conditions at elevated flow rates. This was accomplished by a combination of organic flow rate reduction, extraction rotor speed optimized for each flow rate, and slow and deliberate ramping-up of flows and rotor speeds.

In comparison, the BOBCalixC6 solvent was less sensitive to operating conditions in terms of extraction hydraulic stability. Previous tests[3, 16] have shown that the BOBCalixC6 solvent is not very sensitive to extraction rotor speed, with the speed having minimal effect on mass transfer, solvent recovery, or hydraulic performance.

There are three (3) main differences between BOBCalixC6 and MaxCalix solvent in terms of hydraulic performance. First there was an upper limit of organic flow established during NGS testing of 3.3 gpm. A system upset would occur whenever this organic flow limit was exceeded. No such limit was observed with BOBCalixC6 solvent and flows of 7.14 gpm were attained on regular basis with no upset.

Next the optimum extraction rotor speed using BOBCalicC6 solvent was determined to be 2400 rpm regardless of flow rate. In contrast, MaxCalix solvent required a different rotor speed for each flow rate to achieve system stability during NGS testing. See Section 4.1.5.

Finally, great care had to be taken during NGS testing when extraction rotor speeds were changed. As the flows were increased during startup, the rotor speed had to be increased as well. This could not be done in a single step. Increasing from 1200 rpm to 1700 rpm all at once would cause a loss of solvent flow through extraction and lead to a system upset. Instead the speed had to be ramped-up in 100 rpm increments, and enough time for the solvent flow through extraction to recover had to be allowed between speed changes. With BOBCalixC6 solvent changing the rotor speed by 1000 rpm at once was common during testing, and never led to an upset. These differences are summarized in Table 6-1.

Table 6-1. Comparison of Factors that Effect Hydraulic Stability for BOBCalixC6 and MaxCalix Solvent

Parameter	BOBCalixC6 Solvent	MaxCalix Solvent
Solvent Flow	No upper limit reached	Upper limit of 3.3 gpm
Extraction Rotor Speed	2400 rpm for all flows	Speed depends on flow rate
Speed Changes	Not sensitive	Max change of 100 rpm increments

7.0 HIGHER CONCENTRATION SIMULANT DEMONSTRATION RESULTS

This section presents mass transfer, solvent recovery and hydraulic data collected during HCWD formal and optional testing with 6.4M and 7.5M [Na^+] simulants. Appendix A contains all compiled analytical data collected during the HCWD.

7.1 Decontamination Factor

The measured DFs across four (4) extraction stages and the SWPF theoretical DF across 16 extraction stages with 6.4M and 7.5M [Na^+] salt simulants are presented in Table 7-1 and Table 7-2, respectively. The DFs achieved with the higher concentration simulants far exceeded the minimum required for SWPF. Theoretical SWPF DFs in the billions were achieved with the 6.4M [Na^+] simulant, and in the tens of millions with the 7.5M [Na^+] simulant.

In Table 7-1, we see that extremely high DFs were achieved with 6.4M [Na^+] simulant, extraction O:A of 1:10, and a CF of 20. When the O:A was reduced to 1:15 the DF was greatly reduced. However, a large portion of the DF performance was recovered by reducing the CF to 18 (a small increase in the strip flow rate) and reducing the simulant flow to 120%. Note the lowest DF presented in Table 7-1 exceeds the SWPF minimum by ~1,000 times and the highest by nearly 1,000,000 times.

Table 7-1. DF for 6.4M [Na^+] Tests

Flow	O:A	CF	Rotor Speed (rpm)	Measured DF*	Theoretical SWPF DF (millions)
134%	1:10	20	2200	210 ± 42	1,945
134%	1:10	20	2500	250 ± 50	3,906
134%	1:15	20	2500	76 ± 15	33
120%	1:15	18	2500	157 ± 31	608

* Measured DF for four, full-scale contactors.

Table 7-2. DF for 7.5M [Na^+] Tests

Flow	O:A	CF	Rotor Speed (rpm)	Measured DF*	Theoretical SWPF DF (millions)
134%	1:10	20	2200	9 ± 2	0.007
134%	1:13.4	20	2200	59 ± 12	12.0
134%	1:13.4	20	2200	90 ± 18	65.6
134%	1:16.7	20	2200	46 ± 9	4.5
134%	1:20	20	2400	22 ± 4	0.2
75%	1:13.4	30	1700	58 ± 12	11.3
100%	1:13.4	40	2200	55 ± 11	9.2
134%	1:13.4	40	1700	25 ± 5	0.4
134%	1:13.4	40	1900	32 ± 6	1.0
134%	1:13.4	40	2200	37 ± 7	1.9
134%	1:13.4	40	2200	36 ± 7	1.7
*Measured DF for four, full-scale contactors.					

The first series of tests conducted with the 7.5M simulant and a CF of 20 explored the effect of O:A on system performance. In Figure 7-1 the effect of extraction O:A on DF is shown. The two (2) tests conducted with an O:A of 1:13.4 had the best performance in terms of DF. These tests appear to be replicates in Table 7-2 but DF performance differs between the two. The first test had a DF of 59 and the second test had a DF of 90. However, the first test was conducted on a day with very high ambient temperatures which resulted in the extraction contactor bank operating at 24.5°F as compared to 23°F during the second test[6]. The temperature difference could explain the difference in DF performance. Small changes in extraction D_{Cs} can have substantial impacts on DF because it is compounded across four (4) extraction stages. The DF for the 1:10 case was extremely low due to excessive carryover in the extraction contactors. Similar behavior was observed in earlier tests with the 5.6M simulant. In those tests limiting the organic flow was the key to hydraulic stability. O:A ratios smaller that 1:13.4 had diminishing DF. Not surprisingly, more organic flow gives higher DF as long as the system can run in a stable manner.

Various extraction rotor speeds were tested during the final series of tests. This was primarily done in an attempt to reduce Isopar®L in the DSS (see Section 7.2.2). Figure 7-2 presents DF as

[6] Although the temperatures of these two tests differed by 1.5°F, both test were within the acceptable range of 23 ± 3°F.

a function of extraction rotor speed for the final four (4) tests all conducted with the same flow rates. It can be seen in Figure 7-2 that increased rotor speed appears to have improved DF. However, the DFs for all speeds greatly exceeded the SWPF requirement, so hydraulic stability and Isopar®L carryover were the primary drivers for optimizing rotor speed.

Figure 7-1. Effect of Extraction O:A on DF

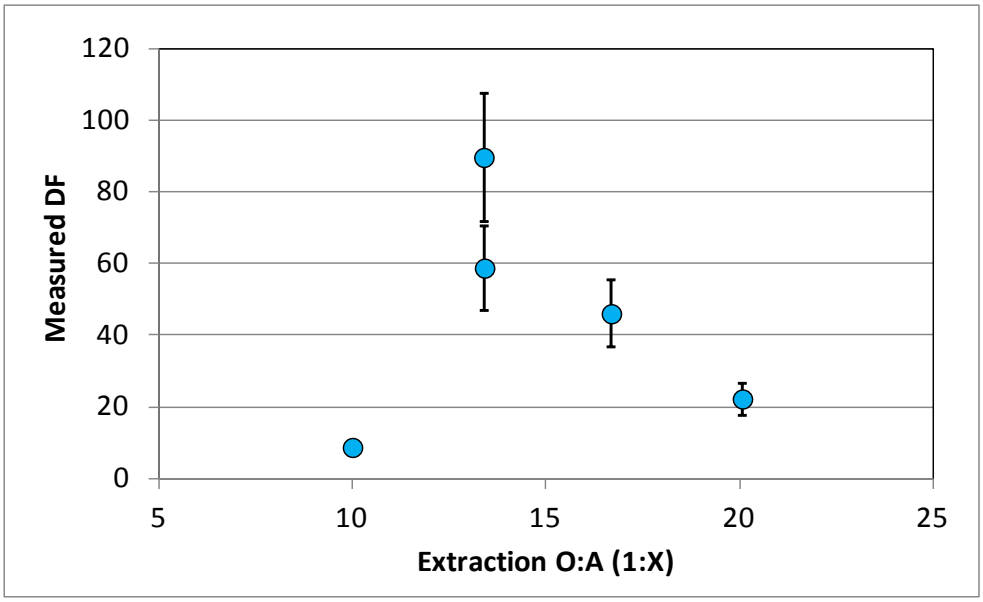
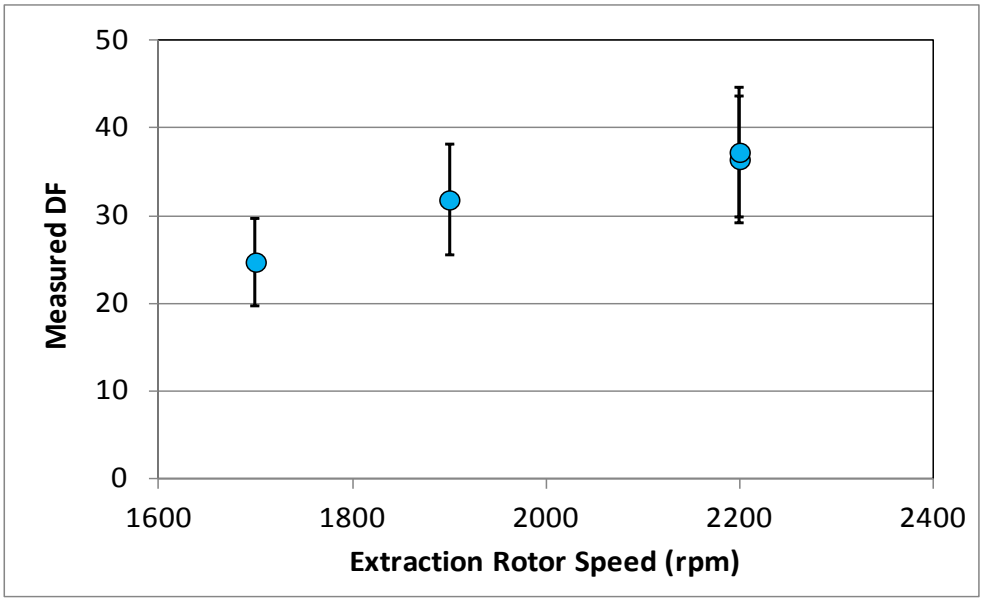


Figure 7-2. Effect of Rotor Speed on DF



7.2 Solvent Recovery

7.2.1 SE Coalescer Performance

During high [Na^+] testing 30 SE samples were analyzed in multiple batches for Isopar®L, 18 samples for the 6.4M concentration and 12 for the 7.5M concentration simulant. The majority of these samples were collected at 134% simulant flow, but 75%, 100%, and 120% flows are also represented in the sample set. None of these samples had detectable levels of Isopar®L. The detection limit for the analysis was typically 2.22 mg/L. The highest detection limit was 3.14 mg/L and the lowest was 0.6 mg/L.

7.2.2 DSS Coalescer Performance

There were three (3) observed effects on DSS Coalescer performance during the HCWDT:

1. Increased simulant flow rate resulted in higher organic carryover in the DSS Coalescer effluent.
2. Increased simulant concentrations[7] resulted in higher organic carryover in the DSS Coalescer effluent.
3. DSS Coalescer performance degraded over time with both 6.4M and 7.5M simulants. No correlation between DSS Coalescer performance and fouling was found. Temporal degradation of performance was not observed with the 5.6M simulant.

In Figure 7-3 the Isopar®L after the DSS Coalescer is shown for the 6.4M and 7.5M tests. All of the data was collected at 134% simulant flow unless otherwise specified. The concentrations are plotted against the cumulative solvent processed during the HCWDT. The Isopar®L concentration for the final 5.6M test is shown for comparison. Four (4) of the data points for the 7.5M testing are marked as “Repeats”. These four (4) tests (beginning, end, and two in middle) were conducted with the same operating parameters and process fluids with the exception of the last which was conducted with slightly diluted solvent[8]. A similar plot for the Isopar®L before the DSS Coalescer is shown in Figure 7-4.

In Figure 7-3 a general trend can be seen that reducing the simulant flow rate significantly reduced the amount of Isopar®L after the DSS Coalescer. This effect is consistent with all prior SWPF CSSX testing. A reduction in simulant flow from 134% to 100% resulted in Isopar®L concentration reduction of 21%. The 134% flow test conducted after the 100% flow test had a 50% increase in Isopar®L over the 100% flow test. A similar pattern can be seen when the flow was dropped to 75% and then increased back up to 134%. Simulant flow rate had a direct and immediate impact on the Isopar®L after the DSS Coalescer.

[7] 6.4M simulant is ~20% more concentrated (total species by volume) than 5.6M simulant. 7.5M simulant is ~15% more concentrated (total species by volume) than 6.4M simulant.

[8] The solvent during this test had a density of 0.844 g/cc which is still within the acceptable range of 0.851 ± 0.01 g/cc. It is mentioned here because it was lower than the solvent density during the other three (3) tests (~0.85 g/cc).

Increasing the simulant concentration[7] produced step changes in the DSS Coalescer effluent Isopar®L concentrations. During testing with 5.6M simulant, the Isopar®L concentration in the DSS remained near the analytical detection limit with the maximum measured value being 3.3 mg/L. The first test conducted with 6.4M simulant resulted in an Isopar®L concentration of 13.1 mg/L after the DSS Coalescer. The final tests conducted with 6.4M simulant had an Isopar®L concentration of 22.3 mg/L, and the subsequent test conducted with 7.5M simulant had a much higher 40.0 mg/L of Isopar®L in the DSS. These step changes are evident in Figure 7-3 and do not appear to be resulting from higher Isopar®L carryover from the extraction contactors. In Figure 7-4 it can be seen that the Isopar®L before the DSS Coalescer was similar for 5.6M, 6.4M, and 7.5M simulant tests. Thus increasing simulant concentration does not appear to negatively impact Isopar®L carryover from the contactors (influent to DSS Coalescer) but rather has a negative impact on coalescence of the Isopar®L.

There was also a trend of increasing Isopar®L concentration after the DSS Coalescer over the course of testing with the 6.4M and 7.5M simulants. This trend was not observable in the 5.6M test as the Isopar®L concentration was typically below the analytical detection limit. This is clear in Figure 7-3. The rate of increase in Isopar®L is about 2.5 times higher for the 7.5M simulant compared to the 6.4M. This trend was observed despite changing operational conditions from test to test in a somewhat random fashion. This tends to eliminate the operational conditions as a source for the trend. There were also tests that were conducted under similar operational conditions, one test at the beginning of the 7.5M testing, two (2) in the middle, and one (1) at the end. Despite having similar operational conditions, they all follow the upward trend. It can also be seen that the Isopar®L concentration before the DSS Coalescer does not have the same upward trend. In fact for the 6.4M testing, the Isopar®L concentration before the DSS Coalescer actually decreases with each test. There is no significant difference between the 5.6M, 6.4M, and 7.5M as far as Isopar®L concentration before the DSS Coalescer.

Figure 7-3. Isopar®L Trend for Both 6.4M and 7.5M Simulant Tests

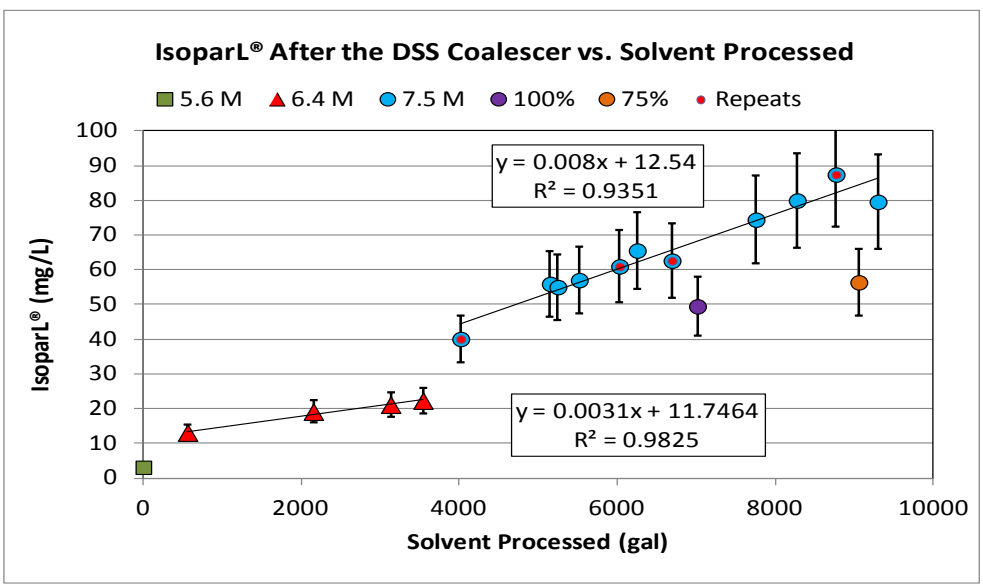
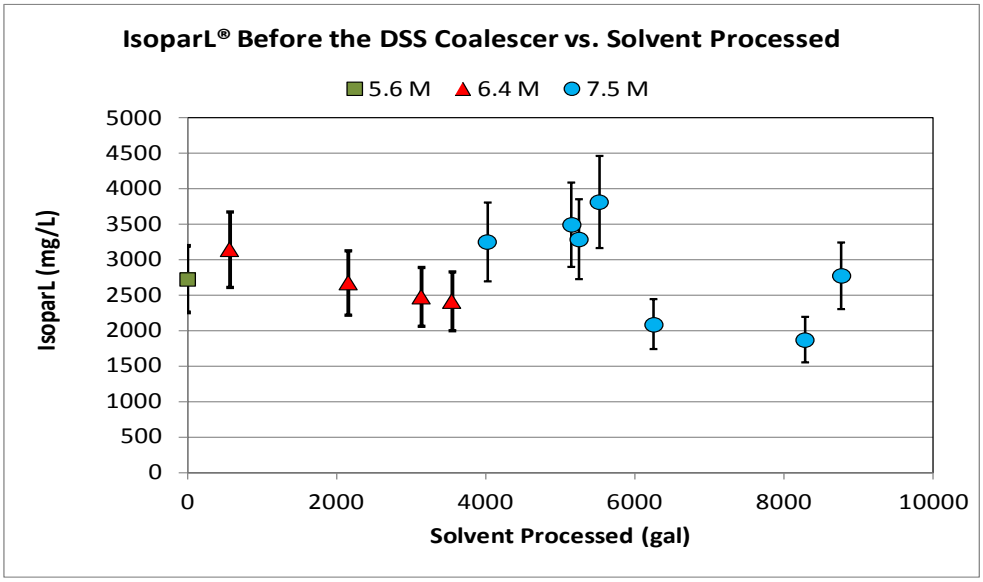


Figure 7-4. Isopar®L in the DSS Exiting the Extraction Contactor Bank



There does not appear to be a correlation between the differential pressure (dP) across the DSS Coalescer and solvent recovery performance. Figure 7-5 shows the DSS Coalescer dPs and effluent Isopar®L concentrations, chronologically, for all the 134% flow tests. The dP data presented are ten (10) minute averages taken just prior to sampling at steady-state conditions. The dP did not increase substantially over the course of testing and there is a lot of overlap between the 5.6M, 6.4M and 7.5M data sets. Figure 7-6 provides a different view of the same data set - Isopar®L as a function of DSS Coalescer dP. The Isopar®L concentrations are relatively flat with respect to dP within each data set which indicates a lack of correlation.

Figure 7-5. Chronological DSS Coalescer dP and Isopar®L

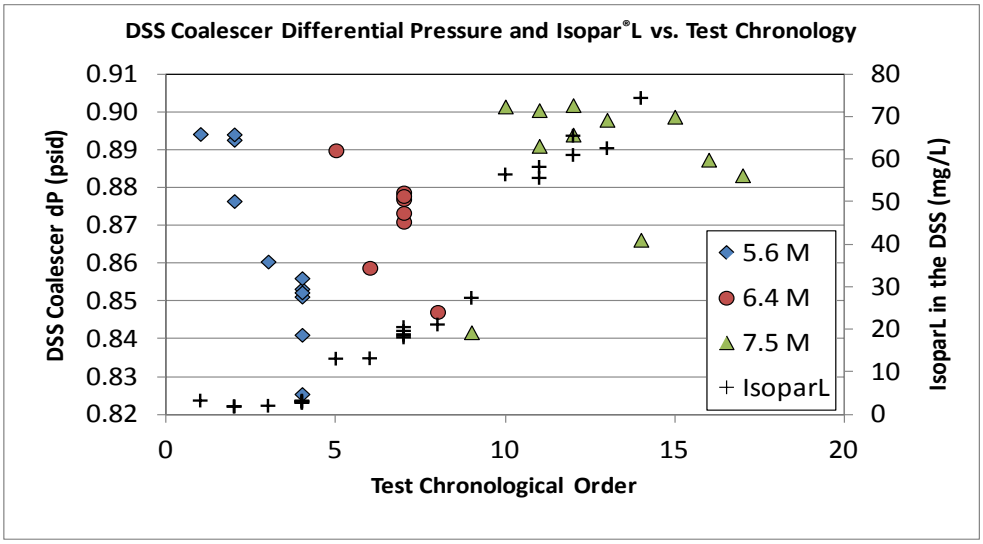
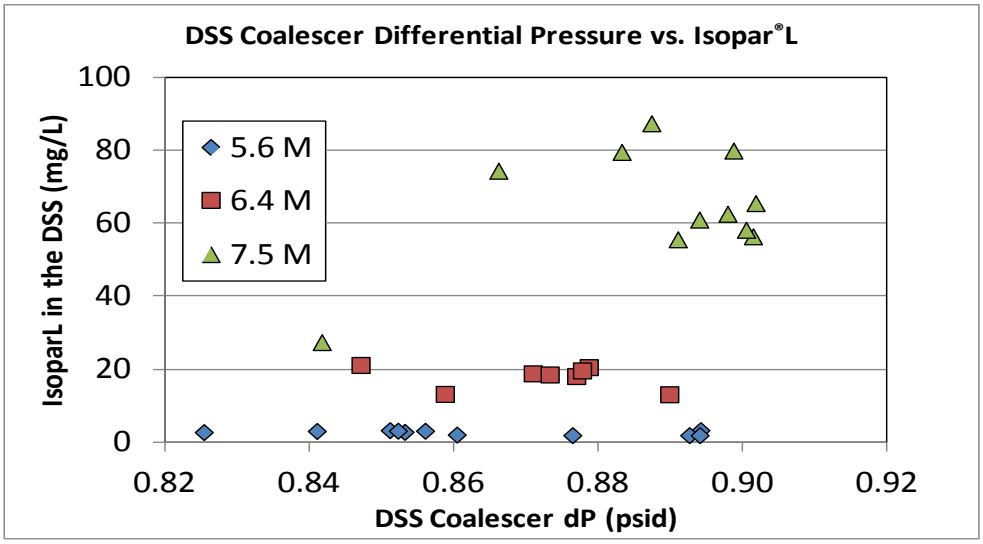


Figure 7-6. Isopar®L vs DSS Coalescer dP at 134% Flow



Plausible theories for the upward trend in Isopar®L concentration after the DSS Coalescer could be compositional changes in the solvent, compositional changes in the simulant, or mechanical degradation of the DSS Coalescer. The scope of this NGS testing program did not allow the elimination of these variables as contributing factors to the observed upward trend of Isopar®L concentration. Additional testing would be required to investigate further.

7.3 Hydraulic Performance

The hydraulic performance of the extraction contactors with higher concentration simulant was similar to that seen during testing with 5.6M simulant. Typical aqueous carryover in EXT-201A was 2% to 4% for 134% simulant flow. There were some extreme carryover cases when the operating parameters moved well beyond the extraction contactor operational envelope of 2200 to 2400 rpm rotor speeds and 1:13 to 1:20 O:As. Carryover above 25% was seen in two (2) different instances. One was when the O:A in extraction was 1:10. This is consistent with previous test in that when the organic flow rate was high hydraulic stability became a problem. The second extreme carryover event occurred when the extraction contactor rotor speed was lowered to 1700 rpm. Again this is consistent with previous tests with lower concentration simulant. During the 5.6M simulant tests it was observed that each flow rate had an operating envelope regarding rotor speed, and 1700 rpm was the lower limit of this envelope for 134% flow. Figure 7-7 and Figure 7-8 show the aqueous carryover for EXT-201A as a function of O:A ratio and rotor speed respectively. This contactor consistently had the highest carryover of all the extraction contactors during all of the NGS testing.

Figure 7-7. Effect of O:A on Hydraulic Performance for 7.5M Testing

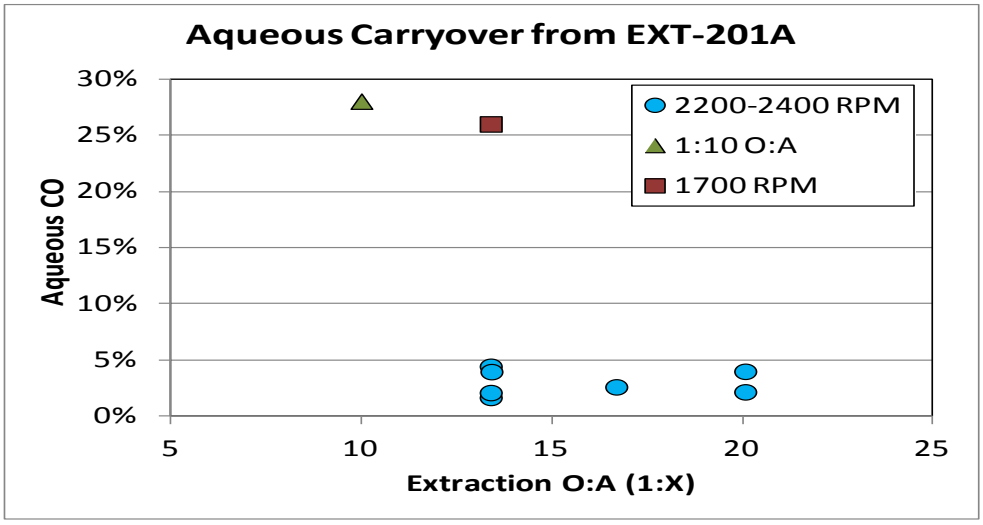
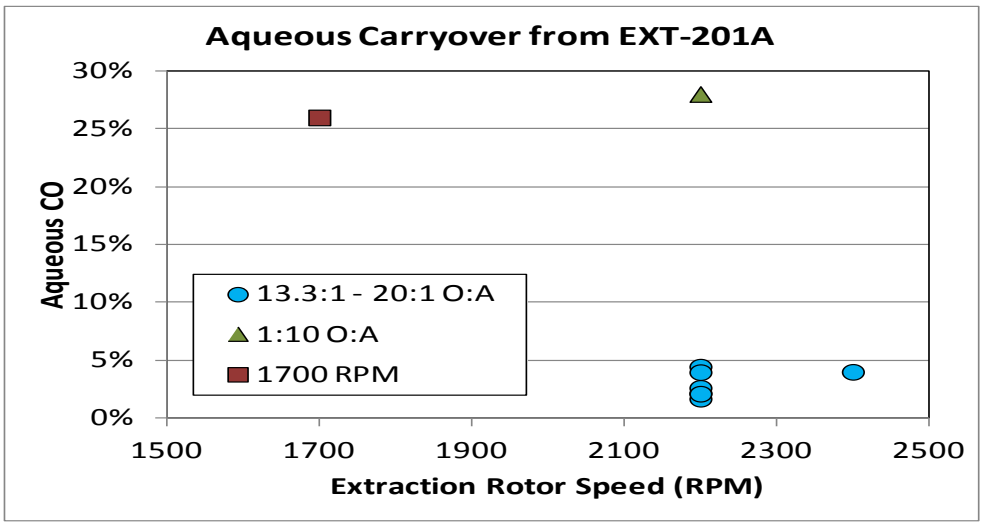


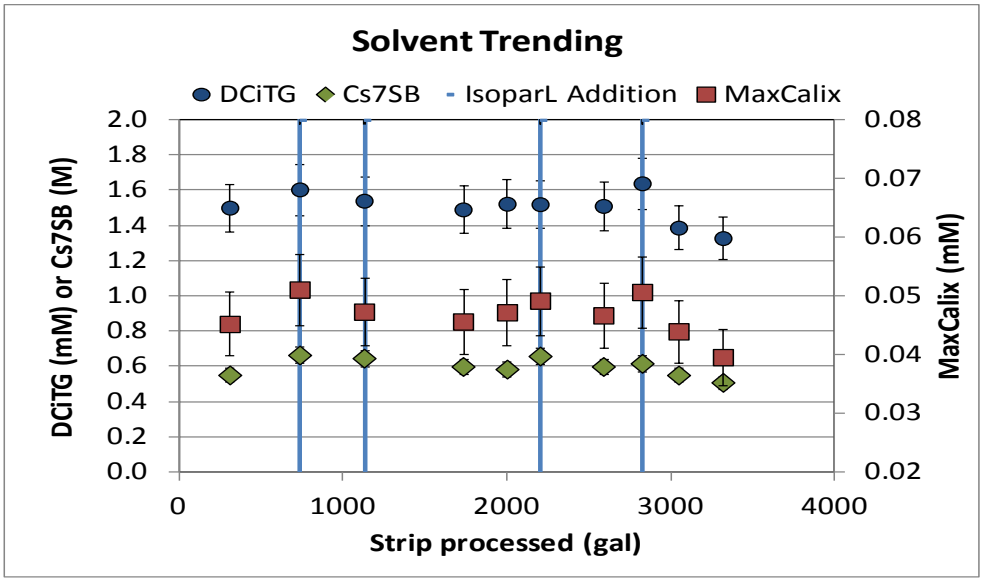
Figure 7-8. Effect of Rotor Speed on Hydraulic Performance for 7.5M Testing



7.4 Solvent Composition Trending

During the 5.6M simulant testing, there was an observed decrease in the DCiTG concentration from ~2 mM to ~1 mM after ~5000 gallons of strip processed (see Section 5.4). There was no discernible decrease in DCiTG during the High Na testing after processing about 3300 gallons of strip. This can be seen in Figure 7-9. There is a noticeable downward trend that begins just before 3000 gallons of strip processed, but this is attributed to the large Isopar®L addition to the solvent that occurred at that time. Both the MaxCalix and the Cs-7SB have the same downward trend at that time. Additionally, the DCiTG, MaxCalix, and Cs-7SB trended together over the entire span of the 7.5M test.

Figure 7-9. Solvent Composition Trend During 7.5M Simulant Testing



8.0 CONCLUSIONS

8.1 Centrifugal Contactor Hydraulic Performance

1. Simulant flow rates of up to 155% (33.22 gpm) were achieved.
2. System stability at 134% was demonstrated during a six (6) hour test.
3. There was an upper limit of 3.3 gpm solvent flow when using MaxCalix solvent.
4. MaxCalix solvent was sensitive to rotor speed.
   a) Optimum extraction rotor speed was dependent on flow rate.
   b) Hydraulic performance improved with increased extraction rotor speed until an upper limit on speed was reached.
   c) Rotor speed must be increased slowly.
5. Scrub hydraulics with NGS and related chemicals differed from prior SWPF testing with the BOBCalix flowsheet.
   a) Scrub contactors required a larger weir to reduce aqueous carryover to satisfactory levels.
   b) Scrub contactors required higher rotor speeds to reduce aqueous carryover to satisfactory levels.
6. Baseline weirs performed satisfactory in all contactors except for scrub.
7. System stability at 134% flow was demonstrated for 5.4M, 6.4M, and 7.5M simulant concentrations.

8. Simulant concentration did not have a significant effect on Isopar®L carryover from the extraction contactors to the DSS Coalescer.

8.2 Mass Transfer Performance

8.2.1 5.6M Simulant Concentration

1. DFs were extremely high under all sustainable operating conditions.
   a) Flows from 50% to 155%.
   b) O:As from 1:3 to 1:15.
2. The highest DF was attained in the flow range of 110% to 134%.

8.2.2 High Concentration Simulant

1. DFs of over 200 were achieved with 6.4M [Na^+] simulant.
2. DFs with 7.5M [Na^+] simulant at 134% flow and 1:13.4 extraction O:As were:
   a) DF ~75 at a CF = 20.
   b) DF ~33 at a CF = 40.

8.3 Solvent Recovery Performance

8.3.1 5.6M Simulant Concentration

1. The effluent stream of both the SE and DSS Coalescers had Isopar®L concentrations at least 20 times below the WAC limit for all conditions tested during the NGST.
2. A majority of Isopar®L measurements in the SE and DSS streams after the coalescers were below the 2 mg/L detection limit.
3. Emulsion in the SE was not an issue in the NGST, like it was in the IT.

8.3.2 Higher Concentration Simulant

1. Isopar®L concentration in the DSS Coalescer effluent increased with increasing flow. This is consistent with prior SWPF CSSX testing.
2. Each step change increase in simulant concentration produced a step change increase in DSS Coalescer Isopar®L concentration.
3. Isopar®L concentration in the effluent from the DSS Coalescer increased throughout high concentration simulant testing and was on a trend line approaching the WAC limit.

8.4 Chemistry Evaluation

1. There were no noticeable negative impacts to system performance associated with strip and scrub chemical changes made to accommodate NGS.

2. There were no noticeable negative impacts to system performance associated with degradation or change in composition of the solvent over the course of this test.
3. Increasing the modifier concentration in the solvent from 0.5M to 0.75M did not have a noticeable impact on hydraulic performance.

8.5 Comparison of BOBCalixC6 and MaxCalix Flowsheets

1. Waste throughput was increased by as much as 55% over BOBCalixC6 solvent.
2. Much higher DFs were achieved with MaxCalix (for flows from 50% to 155%) resulting in a larger operating margin.
3. Increased waste throughput with achieved with MaxCalix without increasing SE output (higher CF).
4. Much higher SE solvent recovery observed with MaxCalix solvent to meet DWPF Isopar®L WAC.
5. Similar DSS solvent recovery observed between the two solvents (both very good) to meet Saltstone Isopar®L WAC.
6. Reduced solvent turnover with MaxCalix solvent, which could extend the solvent life.
7. Caustic scrubbing eliminates acid-base reactions between scrub and extraction.
8. Operations with MaxCalix are more challenging in that the hydraulics are sensitive to solvent flow rate and extraction rotor speeds.

8.6 Comparison of 5.6M to Higher Concentration Simulants

1. Acceptable DFs were achieved with all simulant types, but DF was negatively impacted by increased simulant concentration.
2. Isopar®L carryover in the DSS Coalescer effluent was below detection with the 5.6M simulant, however testing with higher concentration simulants exhibited increasing levels of Isopar®L in the DSS as testing progressed.

9.0 RECOMMENDATIONS

It is recommended that funding should be provided to develop a preliminary design for implementation of NGS in SWPF for two (2) scenarios: (1) prior to CD-4 and (2) after hot operations begin.

9.1 Future Testing and Analysis

1. SWPF operations with increased waste concentrations and NGS have a lot of potential to increase the waste processing rate at the SRS. Additional testing may be warranted to mitigate technical risks associated with degradation of DSS Coalescer performance during the higher concentration simulant demonstrations in this report.

   Effectively the waste processing rate could be increased without increasing volumetric flow rates utilizing existing hardware systems. The current SWPF design basis calls for diluting the waste from 6.44M to 5.6M. Reducing the amount of dilution in the Alpha Sorption Process could allow for higher SWPF waste processing rates. Additional full-scale CSSX testing with 6.44M [Na^+] simulant salt solutions utilizing additional solvent analyses while evaluating alternative solvent washing strategies could determine the root cause of the DSS Coalescer performance degradation.

2. Evaluate why the NGS compositional changes, as compared to BOBCalixC6, demonstrates dramatically different hydraulic characteristics under full-scale extraction conditions.

   The only observed drawback of NGS observed during full-scale testing was that extraction contactor hydraulic performance was much more sensitive to operating conditions. By virtue of eliminating all other known variables (including modifier concentration), the challenging extraction contactor hydraulics encountered were likely the result of the use of the slightly different extractant at seven (7) times the previous concentration and/or the DCiTG suppressor that replaced TOA. The root cause of this phenomena could have impacts on future SWPF and MCU operation and should be a consideration in any future NGS compositional changes.

3. Fully evaluate operational conditions to define satisfactory operational envelopes.

   This primary focus of the test campaign was to demonstrate improved waste throughput by implementing NGS. While satisfactory operating conditions were demonstrated, the full range of conditions that provide satisfactory results is still not clear. For example, at 134% simulant/waste flow, the range of O:As and rotor speeds that still provide satisfactory DF and solvent recovery are unknown.

4. Develop and test a contactor rotor speed ramp function for improved hydraulic stability. Changing rotor speed, which is required for changing flow rate, was a sensitive operating parameter during NGS testing. Developing a rotor speed ramp function could reduce or eliminate hydraulic upsets caused by improper speed adjustments.

9.2 Equipment and System Modification

1. Purchase and install prototypical 10 hp motors and supporting equipment for the extraction contactors on the CSSX full scale test rig for future testing. The 7.5 hp motors now installed limited the throughput during the NGST due to exceeding the maximum current draw.

2. An in-line turbidity meter (scattered light based) should be installed between the SE Coalescer and the SE Hold Tank as a temporary modification to the SWPF. This would allow

for more accurate and real-time analysis of turbidity, and therefore Isopar®L, in the SE during commissioning of the SWPF. Additionally, this device would be the only means of evaluating process flow conditions of the SE in near real time and would likely provide valuable information to engineers during operations. This modification should be implemented regardless of the choice of solvent and should be considered for permanent application.

3. The scrub contactor weirs in the SWPF should be changed from 4.9-inch to 5.0-inch if NGS is implemented. This recommendation stands regardless if hot operations are conducted in SWPF prior to implementing NGS.
4. Engineering should evaluate SWPF equipment, including but not limited to pump and tank capacities and contactor motor current limits, to ensure the SWPF equipment can handle the increased throughputs achievable with NGS.
5. Engineering should evaluate SWPF material compatibility associated with implementing NGS (e.g. boric acid strip solution) and access if additional testing is needed prior to deployment of NGS.

9.3 Operating Configuration and Strategy

1. Limit the total NGS organic flow to less than 3.3 gpm. This was the most important operational strategy developed during NGS testing. There were no sustained runs when this limit was exceeded.
2. Solvent flow should be started at a very low flow rate until flow can be verified. Then the flow should be slowly increased in such a way as to minimize surges in the flow through the contactors.
3. The extraction contactor speeds should be increased slowly, and the solvent flow should reach steady state between each speed change. This is another effort required to reduce fluid surges within the contactors. Several hydraulic upsets occurred during NGS testing when this strategy was not followed.
4. The extraction rotor speed should be set appropriately according to the waste/simulant flow rate. See Section 4.1.5.

9.4 Solvent Composition

1. The modifier and Isopar®L concentrations in the NGS for use in SWPF should be adjusted similar to those utilized during testing to achieve a nominal density of 0.851 g/cc. This is to reduce risk associated with an untested NGS formulation. If the SWPF were to deploy a NGS formulation different from that tested at PTC, more testing would be merited.

2. The DCiTG should not be changed from the form tested during the NGST without thorough consideration to potential chemical interactions and extraction hydraulic impacts.

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Appendix A. Compiled Analytical Data

Cs Data

Date	Time	Sample Number	Weir Set[9]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	PTC Cs (mg/L) Dup.4	PTC Cs (mg/L) Dup.5	PTC Cs (mg/L) Dup.6	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
8-Dec-11	16:57	SY-TK214B-001		-	-	-	-	-	-	-	-		5.6	62.9								
8-Dec-11	16:57	SY-TK214B-002		-	-	-	-	-	-	-	-		5.6	74.7								
8-Dec-11	16:57	SY-TK214B-003		-	-	-	-	-	-	-	-		5.6	66.9								
8-Dec-11	16:57	SY-TK214B-004		-	-	-	-	-	-	-	-		5.6	75.9								
8-Dec-11	16:57	SY-TK214B-005		-	-	-	-	-	-	-	-		5.6	72.5								
8-Dec-11	16:57	SY-TK214A-006		-	-	-	-	-	-	-	-		5.6	74.4								
8-Dec-11	16:57	SY-TK214A-007		-	-	-	-	-	-	-	-		5.6	77.8								
8-Dec-11	16:57	SY-TK214A-008		-	-	-	-	-	-	-	-		5.6	69.9								
8-Dec-11	16:57	SY-TK214A-009		-	-	-	-	-	-	-	-		5.6	72.2								
8-Dec-11	16:57	SY-TK214A-010		-	-	-	-	-	-	-	-		5.6	75.3								
7-Jun-12	11:56	SYJ-186-011	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	64.79								
7-Jun-12	11:56	SYJ-186-012	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	66.49								
7-Jun-12	11:56	SYJ-09-014	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	9.11	1.103							
7-Jun-12	11:56	SYJ-09-016	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	<1	<1	0.826	0.803					
7-Jun-12	11:56	SYJ-25-017	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	1019.85								
7-Jun-12	11:56	SYJ-25-019	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	1094.41								
7-Jun-12	11:56	SYJ-17-022	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	0.01								
14-Jun-12	12:02	SYK-186-024	10	2200	1000	1000	1000	28.7	2.14	1.43	1.43	1.43	5.6	63.64								
14-Jun-12	12:02	SYK-186-025	10	2200	1000	1000	1000	28.7	2.14	1.43	1.43	1.43	5.6	64.11								
14-Jun-12	12:02	SYK-25-030	10	2200	1000	1000	1000	28.7	2.14	1.43	1.43	1.43	5.6	1523.68	1195.1	1859.13	1265.06	1398.69	1104.74	1081.01		
14-Jun-12	12:02	SYK-25-031	10	2200	1000	1000	1000	28.7	2.14	1.43	1.43	1.43	5.6	1101.25	1213.9	1301.15	1508.25	1319.54	1083.55			
19-Jun-12	10:11	SYJ-SPK-033	9	2000	1000	1000	1000	21.43	2.143	1.429	1.429	1.429	5.6	232.52								
19-Jun-12	10:11	SYK-SPK-036	10	2200	1000	1000	1000	28.7	2.14	1.43	1.43	1.43	5.6	32.88								
21-Jun-12	9:57	SYK-5-077	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	2.21	1.01	3.118						
21-Jun-12	9:57	SYK-23-083	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	834.84								

[9] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[10]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	PTC Cs (mg/L) Dup.4	PTC Cs (mg/L) Dup.5	PTC Cs (mg/L) Dup.6	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
21-Jun-12	10:29	SYK-186-108	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	58.13								
21-Jun-12	10:29	SYK-25-114	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	1065.42	1253.7							
21-Jun-12	10:29	SYK-25-115	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	1081.71								
21-Jun-12	10:29	SYK-186-119	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	58.85								
21-Jun-12	10:29	SYK-186-120	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	58.41								
21-Jun-12	10:29	SYK-25-125	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	1238.45								
21-Jun-12	10:29	SYK-25-126	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	1113.21								
21-Jun-12	10:29	SYK-186-130	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	57.19								
21-Jun-12	10:29	SYK-186-131	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	57.99								
21-Jun-12	10:29	SYK-25-136	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	1415.62								
21-Jun-12	10:29	SYK-25-137	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	1283.77								
22-Jun-12	9:23	SYK-SPK-146	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	28.05								
26-Jun-12	10:51	SYK-EQU-148	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	2.513								
26-Jun-12	10:53	SYK-EQU-149	10	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	783.31								
27-Jun-12	15:12	SYM-186-003	10	2000	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	56.235								
27-Jun-12	15:12	SYM-25-008	10	2000	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	1591.045								
3-Jul-12	9:35	SYM-186-049	10	1700	2000	1000	1000	16.07	1.607	1.072	1.072	1.072	5.6	57.534								
3-Jul-12	9:35	SYM-25-055	10	1700	2000	1000	1000	16.07	1.607	1.072	1.072	1.072	5.6	1076.045	920.68	751.44						
9-Jul-12	13:41	SYM-SPK-066	10	2000	2000	1000	1000	28.7	1.607	1.43	1.43	1.43	5.6	85.983								
9-Jul-12	13:43	SYM-SPK-068	10	1700	2000	1000	1000	16.07	1.607	1.072	1.072	1.072	5.6	1085.802	1259.2	1054.21	1017.64	973.22				
10-Jul-12	13:08	SYN-186-020	12	2200	2000	1000	1000	25.96	2.596	1.43	1.43	1.43	5.6	62.34	62.628	62.36	61.729					
10-Jul-12	13:08	SYN-186-021	12	2200	2000	1000	1000	25.96	2.596	1.43	1.43	1.43	5.6	63.04	63.69							
10-Jul-12	13:08	SYN-25-026	12	2200	2000	1000	1000	25.96	2.596	1.43	1.43	1.43	5.6	931.41								
10-Jul-12	13:08	SYN-25-027	12	2200	2000	1000	1000	25.96	2.596	1.43	1.43	1.43	5.6	901.65								
17-Jul-12	8:39	SYN-186-056	12	2200	2000	1000	1000	23.61	2.361	1.43	1.43	1.43	5.6	61.34	63.14							
17-Jul-12	8:39	SYN-186-057	12	2200	2000	1000	1000	23.61	2.361	1.43	1.43	1.43	5.6	62.2	63.6							
17-Jul-12	8:39	SYN-25-062	12	2200	2000	1000	1000	23.61	2.361	1.43	1.43	1.43	5.6	796.54								

[10] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[11]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	PTC Cs (mg/L) Dup.4	PTC Cs (mg/L) Dup.5	PTC Cs (mg/L) Dup.6	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
17-Jul-12	8:39	SYN-25-063	12	2200	2000	1000	1000	23.61	2.361	1.43	1.43	1.43	5.6	792.14								
23-Jul-12	11:05	SYN-SPK-069	12	2200	2000	1000	1000	23.61	2.361	1.43	1.43	1.43	5.6	977.5								
23-Jul-12	11:05	SYN-SPK-070	12	2200	2000	1000	1000	25.96	2.596	1.43	1.43	1.43	5.6	97.84								
24-Jul-12	8:59	SYN-SPK-077	12	2200	2000	1000	1000	25.96	2.596	1.43	1.43	1.43	5.6	10.8								
26-Jul-12	16:05	SYO-186-003	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	56.73								
26-Jul-12	16:05	SYO-9-006	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	1.254	<0.5	<0.25						
26-Jul-12	16:05	SYO-25-008	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	1299.76	1384.6							
26-Jul-12	16:05	SYO-25-009	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	1433.429								
26-Jul-12	16:05	SYO-17-010	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	39.457								
26-Jul-12	16:05	SYO-5-054	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	8.848								
26-Jul-12	16:05	SYO-23-061	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	950.181								
30-Jul-12	10:37	SYO-EQU-070	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	3.075								
30-Jul-12	10:38	SYO-EQU-071	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	904.593								
30-Jul-12	10:54	SYO-SPK-072	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	9.7	10.147							
30-Jul-12	10:55	SYO-SPK-073	12	1900	2200	1000	1000	32.14	3.214	1.43	1.43	1.43	5.6	1733.235								
31-Jul-12	16:00	F5-7-008	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.45	0.50
31-Jul-12	16:00	F5-186-019	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								55.80	55.70
31-Jul-12	16:00	F5-9-022	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.17	0.21
3-Aug-12	12:36	SYO-BSTR-084	12	2000	2000	1000	1000	21.4	2.14	1.43	1.43	1.43	5.6	15.126								
3-Aug-12	12:36	F5-186-095	12	2000	2000	1000	1000	21.4	2.14	1.43	1.43	1.43	5.6								47.70	48.20
3-Aug-12	12:36	F5-9-098	12	2000	2000	1000	1000	21.4	2.14	1.43	1.43	1.43	5.6								0.16	0.21
12-Aug-06	10:04	F5-SUB-141	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	56.302								
12-Aug-06	10:05	F5-SUB-143	12	2000	2000	1000	1000	21.4	2.14	1.43	1.43	1.43	5.6	51.065								
6-Aug-12	13:47	F1-186-025	12	1700	2000	1000	1000	16.1	1.61	1.07	1.07	1.07	5.6								50.80	51.40
6-Aug-12	13:47	F1-9-028	12	1700	2000	1000	1000	16.1	1.61	1.07	1.07	1.07	5.6								0.22	0.24
8-Aug-12	13:27	F3-186-021	12	2100	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6								54.10	51.40
8-Aug-12	13:27	F3-9-022	12	2100	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6								0.16	0.13

[11] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[12]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	PTC Cs (mg/L) Dup.4	PTC Cs (mg/L) Dup.5	PTC Cs (mg/L) Dup.6	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
12-Aug-09	10:11	F1-SUB-071	12	1700	2000	1000	1000	16.1	1.61	1.07	1.07	1.07	5.6	55.506								
12-Aug-09	10:12	F3-SUB-068	12	2100	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	55.865								
9-Aug-12	11:34	O1-7-008	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								1.18	1.21
9-Aug-12	11:34	O1-186-021	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								54.20	52.30
9-Aug-12	11:34	O1-9-022	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								0.56	0.60
9-Aug-12	13:59	F4-186-021	12	2200	2000	1000	1000	26	2.6	1.43	1.43	1.43	5.6								55.80	52.50
9-Aug-12	13:59	F4-9-023	12	2200	2000	1000	1000	26	2.6	1.43	1.43	1.43	5.6								0.13	0.15
12-Aug-12	9:54	O1-SUB-065	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6	57.228	55.505							
12-Aug-12	9:54	F4-SUB-071	12	2200	2000	1000	1000	26	2.6	1.43	1.43	1.43	5.6	55.582								
23-Aug-12	14:58	F4-SPK-084	12	2200	2000	1000	1000	35.4	2	1.43	1.43	1.43	5.6	10.51	11.219							
23-Aug-12	15:02	O2-186-003	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								51.80	51.00
23-Aug-12	15:02	O2-9-004	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								0.59	0.65
28-Aug-12	16:04	O2-7-034	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								1.75	1.53
4-Sep-12	8:21	O3-186-003	12	1200	2000	1000	1000	10.71	1.071	0.714	0.714	0.714	5.6								50.10	49.30
4-Sep-12	8:21	O3-9-004	12	1200	2000	1000	1000	10.71	1.071	0.714	0.714	0.714	5.6								0.46	0.49
4-Sep-12	9:33	O3-186-030	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								52.60	50.50
4-Sep-12	9:33	O3-9-031	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.21	0.22
4-Sep-12	10:40	O3-186-057	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								52.20	54.60
4-Sep-12	10:40	O3-9-058	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.22	0.18
4-Sep-12	11:50	O3-186-115	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								45.80	45.40
4-Sep-12	11:50	O3-9-117	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.13	0.16
4-Sep-12	12:16	O3-186-162	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								46.70	45.40
4-Sep-12	12:16	O3-9-163	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.22	0.22
4-Sep-12	13:52	O3-186-189	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								53.70	50.80
4-Sep-12	13:52	O3-9-190	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.18	0.16
4-Sep-12	15:06	O3-186-248	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								49.80	51.40
4-Sep-12	15:06	O3-9-249	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.11	0.13

[12] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[13]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	PTC Cs (mg/L) Dup.4	PTC Cs (mg/L) Dup.5	PTC Cs (mg/L) Dup.6	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
20-Sep-12	9:31	O3-SPK-300	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	10.594	11.225							
20-Sep-12	9:32	O3-SPK-301	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	10.172	11.348	11.042						
20-Sep-12	9:32	O3-SPK-302	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	64.786	65.571							
12-Sep-20	12:45	O2-SUB-069	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	55.812								
12-Sep-20	12:45	O2-SUB-070	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	56.504								
12-Sep-20	12:45	O2-SUB-071	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	<0.5	0.49							
12-Sep-20	12:45	O2-SUB-072	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	<0.5	0.511							
12-Sep-20	12:45	O3-SUB-312	12	1200	2000	1000	1000	10.71	1.071	0.714	0.714	0.714	5.6	55.256								
12-Sep-20	12:45	O3-SUB-313	12	1200	2000	1000	1000	10.71	1.071	0.714	0.714	0.714	5.6	<0.5	0.491							
12-Sep-20	12:45	O3-SUB-314	12	1200	2000	1000	1000	10.71	1.071	0.714	0.714	0.714	5.6	<0.5	0.462							
12-Sep-20	12:45	O3-SUB-315	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	56.558								
12-Sep-20	12:45	O3-SUB-317	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	<0.5	-0.105	<0.25						
12-Sep-20	12:46	O3-SUB-318	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	55.287								
12-Sep-20	12:46	O3-SUB-321	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	59.113								
12-Sep-20	12:46	O3-SUB-323	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	<0.5	<0.25	-0.078						
12-Sep-20	12:46	O3-SUB-324	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	58.061								
12-Sep-20	12:46	O3-SUB-327	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	57.899								
12-Sep-20	12:46	O3-SUB-330	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6	57.137								
24-Sep-12	15:28	O3-BSIM-333	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.02	0.02
24-Sep-12	15:28	O3-BSIM-334	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.01	0.01
24-Sep-12	15:28	O3-BSIM-335	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.01	0.01
12-Sep-24	15:35	F5-SUB-147	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.14	0.15
12-Sep-24	15:36	O1-SUB-067	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								0.47	0.56
12-Sep-24	15:36	O2-SUB-073	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								0.61	0.60
24-Sep-12	15:39	F1-SPK-073	12	1700	2000	1000	1000	16.1	1.61	1.07	1.07	1.07	5.6								9.10	8.72
24-Sep-12	15:39	F3-SPK-070	12	2100	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6								58.80	56.60
24-Sep-12	15:40	F4-SPK-085	12	2200	2000	1000	1000	26	2.6	1.43	1.43	1.43	5.6								29.10	26.80

[13] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[14]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	PTC Cs (mg/L) Dup.4	PTC Cs (mg/L) Dup.5	PTC Cs (mg/L) Dup.6	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
25-Sep-12	12:46	O3-BSIM-336	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.02	0.01
25-Sep-12	12:47	F5-SPK-148	12	2000	2000	1000	1000	21.4	2.14	1.43	1.43	1.43	5.6								6.02	7.54
12-Sep-25	12:48	O3-SUB-337	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.12	0.13
4-Oct-12	9:25	F5-EQU-149	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.51	0.47
4-Oct-12	9:28	F5-EQU-150	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.54	0.55
4-Oct-12	9:29	F5-EQU-151	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								0.88	0.82
4-Oct-12	9:30	O1-EQU-068	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								0.87	0.85
4-Oct-12	9:31	O1-EQU-069	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								0.86	0.86
4-Oct-12	9:31	O1-EQU-070	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								0.85	0.81
4-Oct-12	9:32	O2-EQU-076	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								1.68	1.68
4-Oct-12	9:33	O2-EQU-077	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								1.67	1.85
4-Oct-12	9:33	O2-EQU-078	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								1.69	1.71
12-Oct-04	10:05	F5-SUB-152	12	2200	2200	1000	1000	28.7	2.87	1.43	1.43	1.43	5.6								1.97	2.13
12-Oct-04	10:05	O1-SUB-071	12	1200	2000	1000	1000	10.7	1.07	0.71	0.71	0.71	5.6								5.39	5.35
12-Oct-04	10:05	O2-SUB-079	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6								4.73	4.57

[14] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[15]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
10-Dec-12	10:02	H1-SUB-112	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4		18.023				
10-Dec-12	10:02	H1-SUB-113	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4		102.977				
10-Dec-12	10:09	H1-SUB-115	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	83.98					
10-Dec-12	10:09	H1-SUB-116	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	84.45					
10-Dec-12	10:11	H1-SUB-117	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	0.5					
10-Dec-12	10:11	H1-SPK-118	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	51.72	49.46				
10-Dec-12	10:54	H1-SUB-119	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4		1343				
10-Dec-12	10:54	H1-SUB-120	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4		218.19				
10-Dec-12	12:51	H1-BSIM-121	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	3.02					
15-Jan-13	16:08	H2-186-269	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	77.58	75.26				
1-Feb-13	8:18	H4-186-002	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	69.08					
1-Feb-13	10:36	H4-186-051	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	67.69					
1-Feb-13	12:50	H4-186-117	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	82.23					
1-Feb-13	13:44	H4-186-183	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	64.86	65.75				
1-Feb-13	15:01	H4-186-245	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	64.38					
13-Feb-13	10:22	H4-SUB-321	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	68.27					
13-Feb-13	10:23	H4-SUB-322	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	64.43					
13-Feb-13	10:32	H4-BSIM-324	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	82.77					
13-Jun-10	9:18	H5-SUB-075	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	1.43					
13-Jun-10	9:18	H5-SUB-076	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	67.36	67.43	71.83	72.18		
11-Jun-13	9:13	H6-SUB-058	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	1.21					
11-Jun-13	9:13	H6-SUB-059	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	70.74	77.35				
11-Jun-13	13:02	H5-SUB-078	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	67.78					
11-Jun-13	13:09	H6-SPK-062	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	84.81					
11-Jun-13	13:14	H6-SUB-068	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	69.59					
1-Oct-13	13:43	H9-186-020	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5					73.9	71.6

[15] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[16]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
1-Oct-13	13:43	H9-9-022	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5					3.6	3.25
2-Oct-13	8:01	H7-SUB-028	12	2200	2000	1000	1000	28.7	2.14	1.43	1.43	1.43	7.5	61.15	62.69				
2-Oct-13	8:01	H7-SUB-029	12	2200	2000	1000	1000	28.7	2.14	1.43	1.43	1.43	7.5	63.4					
2-Oct-13	8:02	H7-SUB-030	12	2200	2000	1000	1000	28.7	2.14	1.43	1.43	1.43	7.5	1.12					
2-Oct-13	8:02	H7-SUB-031	12	2200	2000	1000	1000	28.7	2.14	1.43	1.43	1.43	7.5	1.13					
2-Oct-13	8:03	H8-SUB-033	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	76.76					
2-Oct-13	8:03	H8-SUB-034	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	74.77					
2-Oct-13	8:03	H8-SUB-035	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	2.17					
2-Oct-13	8:04	H8-SUB-036	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	9.78					
2-Oct-13	8:05	H10-SUB-031	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	74.62					
2-Oct-13	8:05	H10-SUB-032	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	74.49					
2-Oct-13	8:05	H10-SUB-033	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	3.91	3.85				
2-Oct-13	8:06	H10-SUB-034	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	3.79					
2-Oct-13	8:06	H10-BLK-035	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	0.21					
2-Oct-13	8:08	H10-SPK-036	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	96.54					
13-Oct-21	10:35	H11-SUB-031	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	74.27	72.32				
13-Oct-21	10:35	H11-SUB-032	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	68.51					
13-Oct-21	10:35	H11-SUB-033	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	0.88	0.75				
13-Oct-21	10:35	H11-SUB-034	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	0.77					
13-Oct-21	10:36	H12-SUB-033	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	66.59					
13-Oct-21	10:36	H12-SUB-034	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	67.31					
13-Oct-21	10:36	H12-SUB-035	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	1.48					
13-Oct-21	10:36	H12-SUB-036	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	1.43					
21-Oct-13	10:40	H11-SPK-035	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	84					
28-Oct-13	12:12	H13-SUB-070	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	1.56					
28-Oct-13	12:12	H13-SUB-071	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	1.53					

[16] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[17]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
28-Oct-13	12:12	H13-SUB-072	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	55.94	56.29				
28-Oct-13	12:12	H13-SUB-073	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	56.59					
28-Oct-13	13:55	H13-SUB-074	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	71.32					
13-Nov-13	9:57	H14-SUB-065	12	2200	2000	1000	1000	21.43	1.6	0.5357	1.43	1.43	7.5	0.97					
13-Nov-13	9:57	H14-SUB-066	12	2200	2000	1000	1000	21.43	1.6	0.5357	1.43	1.43	7.5	0.91					
13-Nov-13	9:58	H14-SUB-067	12	2200	2000	1000	1000	21.43	1.6	0.5357	1.43	1.43	7.5	55.14	53.17				
13-Nov-13	9:58	H14-SUB-068	12	2200	2000	1000	1000	21.43	1.6	0.5357	1.43	1.43	7.5	51.74					
13-Nov-13	10:18	H14-SUB-069	12	2200	2000	1000	1000	21.43	1.6	0.5357	1.43	1.43	7.5	48.15					
14-Nov-13	12:24	H14-SPK-070	12	2200	2000	1000	1000	21.43	1.6	0.5357	1.43	1.43	7.5	66.79					
22-Nov-13	9:48	H15-SUB-068	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	54.44					
22-Nov-13	9:49	H15-SUB-069	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	52.56					
22-Nov-13	9:49	H15-SUB-070	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	57.11					
22-Nov-13	9:49	H15-SUB-071	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	2.28	2.22				
22-Nov-13	9:49	H15-SUB-072	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	2.2					
22-Nov-13	10:12	H15-SPK-077	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	73.58					
5-Dec-13	13:39	H16-9-011	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					2.73	2.46
5-Dec-13	13:39	H16-186-027	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					65.6	62.6
10-Dec-13	12:54	H17-9-010	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					1.94	1.76
10-Dec-13	12:54	H17-186-024	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					69.4	68.4
17-Dec-13	13:33	H18-9-009	12	1700	2000	1000	1000	16.07	1.2	0.5357	1.07	1.43	7.5					1.14	1.08
17-Dec-13	13:34	H18-186-016	12	1700	2000	1000	1000	16.07	1.2	0.5357	1.07	1.43	7.5					66.1	62.7
17-Dec-13	14:45	H19-186-003	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					64.2	64.3
17-Dec-13	14:45	H19-9-004	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					2.04	2
18-Dec-13	11:12	H18-SPK-055	12	1700	2000	1000	1000	16.07	1.2	0.5357	1.07	1.43	7.5						
18-Dec-13	13:47	H19-BLK-033	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5						
23-Jan-14	10:13	H19-BLK-034	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5						

[17] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Cs Data

Date	Time	Sample Number	Weir Set[18]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	PTC Cs (mg/L)	PTC Cs (mg/L) Dup.	PTC Cs (mg/L) Dup.2	PTC Cs (mg/L) Dup.3	GEL Cs (mg/L) Dup.	GEL Cs (mg/L) Dup.
23-Jan-14	10:13	H19-SPK-035	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5						
28-Jan-14	10:55	H9-DUP-034	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5						
28-Jan-14	11:02	H9-BLK-035	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					28.8	26.1
18-Feb-14	9:59	H17-SUB-079	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					0.0317	0.0306
18-Feb-14	10:00	H19-SUB-038	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5					85.5	83.5

[18] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[19]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Guanidine (mg/L)	Guanidine (mg/L)2
1-May-12	11:37	SYD-SUB-028	4	1000	1500	1000	1000	5.36	1.79	0.36	0.36	0.36	5.6	630187.2		206000	189958.12		57900	872	
2-May-12	12:35	SYE-25-015	5	1000	1500	1000	1000	5.36	1.79	0.36	0.36	0.36	5.6	58.36		39.68	44.02		1.57	0.14	
2-May-12	12:35	SYE-38-017	5	1000	1500	1000	1000	5.36	1.79	0.36	0.36	0.36	5.6	ND		21.65	25.17		ND	ND	
2-May-12	12:35	SYE-38-018	5	1000	1500	1000	1000	5.36	1.79	0.36	0.36	0.36	5.6	ND		21.85	22.37		ND	ND	
8-May-12	13:30	SYE-SPK-032	5	1000	1500	1000	1000	5.36	1.79	0.36	0.36	0.36	5.6	106.41		39.56	41.51		11.9	0.2	
6-Jun-12	10:00	SYJ-SUB-005	9	750	1000	1000	1000	5.36	1.79	0.36	0.36	0.36	5.6	619621.1		224000	225780.92		59300	802	
7-Jun-12	11:56	SYJ-38-028	9	2000	1000	1000	1000	21.43	2.14	1.43	1.43	1.43	5.6	3.79		35.23	24.09		0.26	0.07	
7-Jun-12	11:56	SYJ-35-029	9	2000	1000	1000	1000	21.43	2.14	1.43	1.43	1.43	5.6	2.48		<19.02	1.76		<0.09	<0.02	
7-Jun-12	12:56	SYJ-10-032	9	2000	1000	1000	1000	21.43	2.14	1.43	1.43	1.43	5.6	561842.9		228000	217076.14		58300	762	
14-Jun-12	12:02	SYK-186-008	10	2200	1000	1000	1000	28.70	2.14	1.43	1.43	1.43	5.6	<1.90		<19.02	1.35		<0.09	<0.02	
14-Jun-12	12:02	SYK-38-019	10	2200	1000	1000	1000	28.70	2.14	1.43	1.43	1.43	5.6	4.16		32.15	24.6		0.33	<0.02	
14-Jun-12	12:02	SYK-35-021	10	2200	1000	1000	1000	28.70	2.14	1.43	1.43	1.43	5.6	3.27		<19.02	1.88		0.21	<0.02	
19-Jun-12	10:11	SYK-SPK-040	10	2200	1000	1000	1000	28.70	2.14	1.43	1.43	1.43	5.6	141.94		41.96	44.36		11.19	0.22	
21-Jun-12	9:57	SYK-38-102	10	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.79		27.3	23.6		0.14	0.02	
21-Jun-12	9:57	SYK-35-105	10	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.26		20.66	2.05		0.19	<0.02	
21-Jun-12	9:57	SYK-35-106	10	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.31		<19.02	1.95		0.17	<0.02	
21-Jun-12	16:28	SYK-SPK-142	10	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	107.54		25.8	20.97		5.26	0.12	
25-Jun-12	10:06	SYK-SUB-147	10	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	576423.37		218000	236159.28		48600	704	
27-Jun-12	15:12	SYM-9-019	10	2000	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3230.43			1251.75			8.6	
27-Jun-12	15:12	SYM-25-021	10	2000	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	238.65			130.52			0.93	
27-Jun-12	15:12	SYM-38-025	10	2000	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.52			23.85			0.26	
27-Jun-12	15:12	SYM-38-026	10	2000	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.51			22.74			0.25	
27-Jun-12	15:12	SYM-35-027	10	2000	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.90			1.24			<0.04	
27-Jun-12	15:12	SYM-35-028	10	2000	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.90			1.19			<0.04	
3-Jul-12	9:35	SYM-9-037	10	1700	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	1801.39			723.44			4.51	
3-Jul-12	9:35	SYM-25-041	10	1700	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	276.92			155.32			0.84	
3-Jul-12	9:35	SYM-38-043	10	1700	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	2.2			22.22			0.18	
3-Jul-12	9:35	SYM-38-044	10	1700	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	2.09			23.14			0.18	

[19] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[20]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Guanidine (mg/L)	Guanidine (mg/L)2
9-Jul-12	13:57	SYM-SPK-069	10	1700	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	112.58			37.33			0.32	
9-Jul-12	14:00	SYM-SPK-071	10	1200	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	62.79			22.81			0.18	
9-Jul-12	14:02	SYM-SUB-072	10	1700	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	523741.07	584128.46	230107.92	230107.92	241367.75		1535.65	1454.69
10-Jul-12	13:08	SYN-9-007	11	2200	2000	1000	1000	25.96	2.60	1.43	1.43	1.43	5.6	2086.29			965.49				
10-Jul-12	13:08	SYN-25-011	11	2200	2000	1000	1000	25.96	2.60	1.43	1.43	1.43	5.6	339.42			168.31				
10-Jul-12	13:08	SYN-38-014	11	2200	2000	1000	1000	25.96	2.60	1.43	1.43	1.43	5.6	<2.25			27.76				
10-Jul-12	13:08	SYN-38-015	11	2200	2000	1000	1000	25.96	2.60	1.43	1.43	1.43	5.6	<2.25			25.8				
10-Jul-12	13:08	SYN-35-016	11	2200	2000	1000	1000	25.96	2.60	1.43	1.43	1.43	5.6	<2.25			1.59				
10-Jul-12	13:08	SYN-35-017	11	2200	2000	1000	1000	25.96	2.60	1.43	1.43	1.43	5.6	<2.25			1.46				
17-Jul-12	8:39	SYN-10-037	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	623785.07	560729.47		248736.5	237829.86		1462.54	
17-Jul-12	8:39	SYN-9-044	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	2229.34			975.02				
17-Jul-12	8:39	SYN-25-048	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	348.94			171.58				
17-Jul-12	8:39	SYN-38-051	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	<2.25			25.93				
17-Jul-12	8:39	SYN-38-052	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	<2.25			24.53				
17-Jul-12	8:39	SYN-35-053	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	<2.25			1.7				
17-Jul-12	8:39	SYN-35-054	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	<2.25			1.41				
23-Jul-12	11:08	SYN-SPK-072	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	139.97			48.92				
23-Jul-12	11:09	SYN-SPK-073	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	77.07			25.46				
23-Jul-12	11:09	SYN-SPK-074	11	2200	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	79.99			33				
26-Jul-12	16:05	SYO-9-020	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	2166.63			1251.853				
26-Jul-12	16:05	SYO-25-021	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	211.2			113.9				
26-Jul-12	16:05	SYO-38-024	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	<3.39			24.41				
26-Jul-12	16:05	SYO-38-025	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	<3.39			27.48				
26-Jul-12	16:05	SYO-27-030	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	60.95			38.54				
26-Jul-12	16:05	SYO-10-033	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	543646.07			230767.75			1357.24	
30-Jul-12	10:29	SYO-EQU-066											5.6	104.62			75.54				
30-Jul-12	10:30	SYO-EQU-067	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	226.95			104.49				
30-Jul-12	10:34	SYO-EQU-068	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	62.83			76.85				

[20] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[21]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Guanidine (mg/L)	Guanidine (mg/L)2
30-Jul-12	10:35	SYO-EQU-069	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	83.54			82.77				
30-Jul-12	10:57	SYO-SPK-074	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	59.26			27.58				
30-Jul-12	10:57	SYO-SPK-075	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	141.34			45.52				
30-Jul-12	11:00	SYO-SPK-077	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	69.92			28.66				
30-Jul-12	11:00	SYO-SPK-078	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	166			59.44				
31-Jul-12	16:00	F5-10-032	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	561547.26			226792			1225.31	
31-Jul-12	16:00	F5-27-033	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	198.64			91.36				
31-Jul-12	16:00	F5-9-042	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	1996.78			907.05				
31-Jul-12	16:00	F5-25-043	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	191.67			195.19				
31-Jul-12	16:00	F5-38-047	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.81			22.21				
31-Jul-12	16:00	F5-38-048	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.81			22.24				
31-Jul-12	16:00	F5-35-050	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.31			1.22				
31-Jul-12	16:00	F5-35-051	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.81			1.1				
1-Aug-12	8:30	F5-TK220B-072	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.81			0.95				
1-Aug-12	8:30	F5-TK221-074	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.81			23.4				
1-Aug-12	8:30	F5-TK221-075	12	2200	2200	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.81			23.5				
31-Jul-12	9:04	SYO-EQU-079	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	156.53			94.59				
31-Jul-12	9:06	SYO-EQU-080	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	93.22			57.78				
31-Jul-12	9:07	SYO-EQU-081	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	530.16			284.94				
31-Jul-12	9:08	SYO-EQU-082	12	1900	2200	1000	1000	32.15	3.21	1.43	1.43	1.43	5.6	162.66			126.05				
3-Aug-12	12:36	F5-10-108	12	2000	2000	1000	1000	21.40	2.14	1.43	1.43	1.43	5.6	599034.11			231066.16			1343.07	
6-Aug-12	13:47	F1-10-038	12	1700	2000	1000	1000	16.10	1.61	1.07	1.07	1.07	5.6	602001.98			236072.55			1280.52	
8-Aug-12	13:27	F3-10-032	12	2100	2000	1000	1000	23.61	2.36	1.43	1.43	1.43	5.6	626651.79			241448.22			1344.33	
9-Aug-12	11:34	O1-10-032	12	1200	2000	1000	1000	10.70	1.07	0.71	0.71	0.71	5.6	536726.72			227564.59			1211.1	
9-Aug-12	13:59	F4-10-032	12	2200	2000	1000	1000	26.00	2.60	1.43	1.43	1.43	5.6	569558.43			228397.49			1449.27	
14-Aug-12	15:11	F4-SPK-074	12	2200	2000	1000	1000	26.00	2.60	1.43	1.43	1.43	5.6	651749.51			201564			1156.99	
23-Aug-12	15:02	O2-9-017	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	3147.5			1223.24				

[21] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[22]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Guanidine (mg/L)	Guanidine (mg/L)2
23-Aug-12	15:02	O2-25-018	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	241.81			110.07				
23-Aug-12	15:02	O2-38-022	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	<1.71			19.37				
23-Aug-12	15:02	O2-38-023	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	<1.71			19.59				
23-Aug-12	15:02	O2-35-024	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	3.66			1.62				
23-Aug-12	15:02	O2-35-025	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	3.78			1.63				
4-Sep-12	8:21	O3-9-018	12	1200	2000	1000	1000	10.72	1.07	0.71	0.71	0.71	5.6	1252.91			479.94				
4-Sep-12	8:21	O3-25-019	12	1200	2000	1000	1000	10.72	1.07	0.71	0.71	0.71	5.6	166.67			87.22				
4-Sep-12	8:21	O3-38-023	12	1200	2000	1000	1000	10.72	1.07	0.71	0.71	0.71	5.6	<1.71			18.92				
4-Sep-12	8:21	O3-38-024	12	1200	2000	1000	1000	10.72	1.07	0.71	0.71	0.71	5.6	<1.71			19.29				
4-Sep-12	9:33	O3-9-045	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2525.89			978.19				
4-Sep-12	9:33	O3-25-046	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	196.44			91.91				
4-Sep-12	9:33	O3-38-050	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			21.19				
4-Sep-12	9:33	O3-38-051	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			19.67				
4-Sep-12	9:33	O3-35-052	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.71			1.34				
4-Sep-12	9:33	O3-35-053	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.77			1.34				
4-Sep-12	10:40	O3-9-072	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2715.43			1043.37				
4-Sep-12	10:40	O3-25-073	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	266.99			118.52				
4-Sep-12	10:40	O3-38-077	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			20.2				
4-Sep-12	10:40	O3-38-078	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			20.49				
4-Sep-12	10:40	O3-35-079	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.06			1.57				
4-Sep-12	10:40	O3-35-080	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.04			1.46				
4-Sep-12	11:50	O3-9-133	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2672.23			1045.75				
4-Sep-12	11:50	O3-25-134	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	230.61			105.28				
4-Sep-12	11:50	O3-38-138	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			19.26				
4-Sep-12	11:50	O3-38-139	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			20.09				
4-Sep-12	11:50	O3-35-140	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.24			1.5				
4-Sep-12	11:50	O3-35-141	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.3			1.4				
4-Sep-12	12:16	O3-9-177	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2624.03			1012.57				

[22] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[23]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Guanidine (mg/L)	Guanidine (mg/L)2
4-Sep-12	12:16	O3-25-178	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	194.44			90.31				
4-Sep-12	12:16	O3-38-182	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			18.61				
4-Sep-12	12:16	O3-38-183	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			19.46				
4-Sep-12	12:16	O3-35-184	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.9			1.65				
4-Sep-12	12:16	O3-35-185	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2.7			1.51				
4-Sep-12	13:52	O3-9-204	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2600.78			1018.84				
4-Sep-12	13:52	O3-25-205	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	298.12			137.08				
4-Sep-12	13:52	O3-38-209	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			19.18				
4-Sep-12	13:52	O3-38-210	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			20.17				
4-Sep-12	13:52	O3-35-211	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.12			1.49				
4-Sep-12	13:52	O3-35-212	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.12			1.63				
4-Sep-12	15:06	O3-9-265	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	2726.9			1039.46				
4-Sep-12	15:06	O3-25-266	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	340.59			157.9				
4-Sep-12	15:06	O3-38-270	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			20.2				
4-Sep-12	15:06	O3-38-271	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	<1.71			19.14				
4-Sep-12	15:06	O3-35-272	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.01			1.59				
4-Sep-12	15:06	O3-35-273	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	3.2			1.58				
20-Sep-12	9:51	O3-SPK-305	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	55.21			22.29				
20-Sep-12	9:52	O3-SPK-306	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	25.25			9.09				
20-Sep-12	9:52	O3-SPK-307	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	23.13			11.44				
20-Sep-12	10:08	O3-SPK-309	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	182.97			60.43				
12-Sep-20	12:43	O2-SUB-068	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	648550.31			223721.524		55000	685	
12-Sep-20	12:44	O3-SUB-310	12	1200	2000	1000	1000	10.72	1.07	0.71	0.71	0.71	5.6	669252.28			217122.429		51387.5	680	
12-Sep-20	12:44	O3-SUB-311	12	2200	2000	1000	1000	28.70	2.87	1.43	1.43	1.43	5.6	670425.115			221983.718		50100	700	
12-Dec-04	14:30	SYA-SUB-020	2	1000	1000	1000	1000	0.33	5.00	5.00	5.00		5.6	691372.39			178433.41		51000	545	
12-Dec-04	14:30	SYK-SUB-150	10	2200	1000	1000	1000	28.70	2.14	1.43	1.43	1.43	5.6	654159.99			224698.26		48050	433.5	
12-Dec-04	14:30	SYM-SUB-073	10	1200	2000	1000	1000	16.07	1.61	1.07	1.07	1.07	5.6	649765.27		236447.25			57000	580	

[23] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[24]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Guanidine (mg/L)	Guanidine (mg/L)2
12-Dec-04	14:30	SYD-SUB-030	4	1000	1500	1000	1000	5.36	1.79	0.36	0.36	0.36	5.6	672427.49			179291.387		48550	478.5	
12-Dec-04	14:31	SYN-SUB-087	11	2200	2000	1000	1000	25.96	2.60	1.43	1.43	1.43	5.6	664716.51			244930.34		46300	464.5	
12-Dec-07	10:08	SYA-SUB-023	2	1000	1000	1000	1000	0.33	5.00	5.00	5.00		5.6	665623.14		169212.3633			48350	479.5	
12-Dec-07	10:08	O2-SUB-081	12	2200	2000	1000	1000	33.22	2.25	1.43	1.43	1.43	5.6	636977.79			227540.35		55500	615	

[24] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[25]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
27-Nov-12	13:48	H1-9-037	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	4622.06			1713.42		281.61		3.3	
27-Nov-12	13:48	H1-25-039	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	75.87			50.86		6.32		0.09	
27-Nov-12	13:48	H1-38-043	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	<2.24			28.75		<.49		<.02	
27-Nov-12	13:48	H1-38-044	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	<2.24			25.29		<.49		<.02	
27-Nov-12	13:48	H1-35-045	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	13.18			5.29		1.04		<.02	
27-Nov-12	13:48	H1-35-046	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	13.07			5.31		0.8		<.02	
3-Dec-12	9:35	H1-SUB-081	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	636793			237000	244500	50500	50500	720	700
3-Dec-12	9:36	H1-SPK-082	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	690113		171500			47250		535	
3-Dec-12	9:39	H1-SUB-083	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	721646		126000			28200		600	
3-Dec-12	9:39	H1-SUB-084	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	460920		397000			101000		790	
3-Dec-12	9:40	H1-SUB-085	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	705806		129500			31600		600	
3-Dec-12	9:40	H1-SUB-086	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	479983		356500			92000		675	
3-Dec-12	9:40	H1-SUB-087	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	721469		131500			35500		595	
3-Dec-12	9:41	H1-SUB-088	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	484572		138500			92000		715	
3-Dec-12	9:41	H1-SUB-089	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	703814		138500			38100		510	
3-Dec-12	9:41	H1-SUB-090	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	537358		253500			79000		645	
3-Dec-12	9:57	H1-SUB-091	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	641551		237000			50500		690	
3-Dec-12	9:57	H1-SUB-092	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	644442		219500			46150		610	
3-Dec-12	9:57	H1-SUB-093	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	641091		221000			49700		715	
3-Dec-12	9:57	H1-SUB-094	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	632894		235000			50500		705	
4-Dec-12	8:27	H1-BSIM-105	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	<2.24		<0.58			<.49		<.02	
4-Dec-12	8:28	H1-SPK-106	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	39.72			13.86		3.37		0.06	
4-Dec-12	8:28	H1-SPK-107	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	36.47		12.18			3.03		0.06	
7-Dec-12	9:51	H1-SPK-108	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	675923.6		153500	165555.1		37350		540	
7-Dec-12	10:08	H1-SUB-109	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	640757		188000	226642.5		50500		590	
10-Dec-12	10:02	H1-SUB-114	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	640273.27		233500			49850		745	
18-Dec-12	16:21	H1-MIS-122	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	602518.55		228500			48350		700	

[25] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[26]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
18-Dec-12	16:21	H1-MIS-123	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	6.4	642784.04		188000			52500		1145	
15-Jan-13	16:08	H2-9-256	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	3153.1	3193.84	1163.14	1165.15					
15-Jan-13	16:08	H2-9-257	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	3119.69		1132.37						
15-Jan-13	16:08	H2-25-258	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	188.26	190.62	87.96	89.62					
15-Jan-13	16:08	H2-38-262	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22		21.19	21.38					
15-Jan-13	16:08	H2-38-263	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			17.87					
15-Jan-13	16:08	H2-35-264	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	13.51			5.02					
15-Jan-13	16:08	H2-35-265	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	12.91			5.27					
1-Feb-13	8:18	H4-9-020	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	2662.95			950.18					
1-Feb-13	8:18	H4-25-021	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	237.19		102.91						
1-Feb-13	8:18	H4-38-025	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	1.82			21.77					
1-Feb-13	8:18	H4-38-026	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	1.52			21.38					
1-Feb-13	8:18	H4-35-027	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	18.74			6.68		0.91		0.01	
1-Feb-13	8:18	H4-35-028	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	18.97			6.71		0.73		0.01	
1-Feb-13	10:36	H4-9-068	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	2683.54			951.4					
1-Feb-13	10:36	H4-25-069	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	174.76		81.52						
1-Feb-13	10:36	H4-38-073	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			21.13					
1-Feb-13	10:36	H4-38-074	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			21.18					
1-Feb-13	10:36	H4-35-075	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	18.43			6.35		0.73		0.01	
1-Feb-13	10:36	H4-35-076	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	18.64			6.54		0.75		0.01	
1-Feb-13	12:50	H4-9-134	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	2526.96			904.8					
1-Feb-13	12:50	H4-25-135	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	182.03		86.81						
1-Feb-13	12:50	H4-38-139	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			23.67					
1-Feb-13	12:50	H4-38-140	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			17.70					
1-Feb-13	12:50	H4-35-141	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	18.13			6.36		0.76		0.01	
1-Feb-13	12:50	H4-35-142	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	18.09			6.78		1.56		0.02	
1-Feb-13	13:44	H4-9-198	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	2810.1			1007.82					

[26] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[27]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
1-Feb-13	13:44	H4-25-199	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	155.34		79.19						
1-Feb-13	13:44	H4-38-203	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			24.26					
1-Feb-13	13:44	H4-38-204	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			23.00					
1-Feb-13	13:44	H4-35-205	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	20.62			7.49		1.84		0.02	
1-Feb-13	13:44	H4-35-206	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	20.48			7.24		1.75		0.02	
1-Feb-13	15:01	H4-9-260	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	2943.9			1037.94					
1-Feb-13	15:01	H4-9-261	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	2644.05			937.64					
1-Feb-13	15:01	H4-25-262	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	171.65		81.09						
1-Feb-13	15:01	H4-25-263	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	160.42		77.4						
1-Feb-13	15:01	H4-38-266	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			20.11					
1-Feb-13	15:01	H4-38-267	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			20.98					
1-Feb-13	15:01	H4-35-268	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	19.59			7.15		1.60		0.02	
1-Feb-13	15:01	H4-35-269	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	19.72			7.20		1.69		0.02	
13-Feb-04	11:38	H2-SUB-337	12	2200	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	580880.62			210989.7		44750.00		602.50	
13-Feb-04	11:38	H4-SUB-295	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	588927.46			209759.2		41625.00		645.00	
4-Feb-13	11:40	H4-BSIM-296	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			<.56					
4-Feb-13	11:40	H4-BSTR-297	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.22			<.56					
4-Feb-13	11:41	H4-SPK-298	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	24.32			8.4		2.77		0.06	
4-Feb-13	11:41	H4-SPK-299	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	24.62			8.77		2.74		0.05	
4-Feb-13	11:44	H4-BSIM-300	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.53			<.63					
4-Feb-13	11:44	H4-BSTR-301	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	<2.53		<0.63						
4-Feb-13	11:45	H4-SPK-302	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	200.93		65.93						
4-Feb-13	11:45	H4-SPK-303	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	1250.29		402.71						
7-Jun-13	12:39	H5-9-031	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	2494.25		926.87			191.36		4.76	
7-Jun-13	12:39	H5-25-041	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	375.6		131.79			21.64		0.65	
7-Jun-13	12:39	H5-35-047	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	21.47		8.42			1.73		0.05	
7-Jun-13	12:39	H5-35-048	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	20.82		8.31			1.67		0.04	

[27] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[28]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
7-Jun-13	12:39	H5-35-049	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	3.87	3.85	8.27	8.2					
7-Jun-13	12:39	H5-38-050	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	<.6	<.6	21.21	21.58		<.48	<.48	<.01	<.01
7-Jun-13	12:39	H5-38-051	12	2500	2000	1000	1000	28.716	1.914	1.43	1.43	1.43	6.4	<.6		21.6			<.48		0.01	
10-Jun-13	13:12	H6-9-031	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	2421.95		892.82			183.48		4.56	
10-Jun-13	13:12	H6-25-036	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	360.11		121.14			21.54		0.69	
10-Jun-13	13:12	H6-35-042	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	23.04	22.31	8.45			1.71		0.04	
10-Jun-13	13:12	H6-35-043	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	22.97	23.11	8.67	8.65		1.82	1.82	0.04	0.05
10-Jun-13	13:12	H6-38-045	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	<2.31		21.38			<.48		<.01	
10-Jun-13	13:12	H6-38-046	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	<2.31		20.79			<.48		<.01	
11-Jun-13	13:02	H5-SUB-079	12	2500	2000	1000	1000	28.716	2.87	1.43	1.43	1.43	6.4	578317.62		208636.12			44600	44200	1016	980
11-Jun-13	13:08	H6-SUB-060	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	583967.43		213386.26			46400		1082	
11-Jun-13	13:11	H6-BSIM-063	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	<2.31		<.6			<.48		<.01	
11-Jun-13	13:11	H6-BSTR-064	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	<2.31		<.6			<.48		<.01	
11-Jun-13	13:11	H6-SPK-065	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	23.19		10.45			2.68		0.07	
11-Jun-13	13:11	H6-SPK-066	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	20.26		8.95			2.14		0.04	
4-Jul-13	11:05	H6-SPK-069	12	2500	2000	1000	1000	25.7	1.71	1.43	1.43	1.43	6.4	629325.57		147562.99			30200		674	
19-Sep-13	13:53	H7-35-018	12	2200	2000	1000	1000	28.7	2.14	1.43	1.43	1.43	7.5	27.42			14.76					
26-Sep-13	13:37	H8-9-003	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	9890.36			3873.68					
26-Sep-13	13:37	H8-35-010	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	56.31	54.88		22.02	22.17				
26-Sep-13	13:37	H8-35-012	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	56.54			21.94					
26-Sep-13	15:26	H8-BLK-031	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	<3.18			<.78					
26-Sep-13	15:26	H8-SPK-032	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	58.22			16.53					
1-Oct-13	13:42	H9-9-001	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	3498.19			1305.93					
1-Oct-13	13:42	H9-BLK-002	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	<3.05			<.75					
1-Oct-13	13:42	H9-SPK-004	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	77.32	74.72		21.67	21.67				
1-Oct-13	13:43	H9-35-012	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	55.9			21.11					
1-Oct-13	13:43	H9-35-013	12	2200	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	55.39			20.61					

[28] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[29]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
1-Oct-13	14:56	H10-9-003	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	3255.37			1214.87					
1-Oct-13	14:56	H10-35-010	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	57.99			22.05					
1-Oct-13	14:56	H10-35-011	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	58.37			22.46					
17-Oct-13	11:31	H11-9-001	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	3818.45			1400.93					
17-Oct-13	11:31	H11-35-010	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	60.43	61.31		23.22	23.15				
17-Oct-13	11:31	H11-35-011	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	30.48			20.65					
17-Oct-13	11:31	H11-35-012	12	2200	2000	1000	1000	28.7	2.143	1.43	1.43	1.43	7.5	61.13			22.94					
17-Oct-13	11:32	H12-35-011	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	65.1			24.31					
17-Oct-13	11:32	H12-35-012	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	65.94			24.33					
17-Oct-13	11:32	H12-9-014	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	3291.43			1192.85					
21-Oct-13	10:29	H12-BLK-031	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	<3.14			<.77					
21-Oct-13	10:31	H12-SPK-032	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	73.27			21.23					
25-Oct-13	13:03	H13-25-037	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	35.2	34.81	33.8	33.85					
25-Oct-13	13:03	H13-25-039	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	33.73		34.76						
25-Oct-13	13:03	H13-35-040	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	62.09	61.73		22.95	22.99				
25-Oct-13	13:03	H13-35-042	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	63.97			23.07					
25-Oct-13	13:03	H13-38-045	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.35	<2.35		20.8	23.7				
25-Oct-13	13:03	H13-38-047	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.35			20.55					
28-Oct-13	9:51	H13-TK220B-057	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	41.48			15.36					
28-Oct-13	9:51	H13-TK220B-059	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	41.76			15.75					
28-Oct-13	9:51	H13-TK221-061	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	9.26			22.54					
28-Oct-13	9:51	H13-TK221-063	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	7.25			20.85					
28-Oct-13	10:01	H7-SUB-033	12	2200	2000	1000	1000	28.7	2.14	1.43	1.43	1.43	7.5	568004		185800	203585		43200		608	
28-Oct-13	10:01	H8-SUB-038	12	2200	2000	1000	1000	28.7	2.87	1.43	1.43	1.43	7.5	541236		218000	216942		45200		650	

[29] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[30]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
28-Oct-13	10:01	H10-SUB-038	12	2400	2000	1000	1000	28.7	1.43	1.43	1.43	1.43	7.5	574555		218000	218075		45200		624	
28-Oct-13	10:01	H12-SUB-038	12	2200	2000	1000	1000	28.7	1.72	1.43	1.43	1.43	7.5	543949		202000	205494		44600		604	
28-Oct-13	10:01	H13-SUB-065	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	550818		199400	195000		44800	45400	620	614
28-Oct-13	10:15	H13-BLK-066	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.35			<.58					
28-Oct-13	10:16	H13-BLK-067	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.35			<.58					
28-Oct-13	10:18	H13-SPK-068	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	86.25			25.4					
28-Oct-13	10:18	H13-SPK-069	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	85.81			26.44					
31-Oct-13	13:24	H14-9-034	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	2086.63		763.59						
31-Oct-13	13:24	H14-25-037	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	33.73		40.97						
31-Oct-13	13:24	H14-25-038	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	35.71		39.45						
31-Oct-13	13:24	H14-35-040	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	50.64		17.75						
31-Oct-13	13:24	H14-35-042	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	48.26		17						
31-Oct-13	13:24	H14-38-045	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	<3.14		19.63						
31-Oct-13	13:24	H14-38-047	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	<3.14		19.37						
31-Oct-13	13:24	H14-TK220B-059	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	30.69		11.43						
31-Oct-13	13:24	H14-TK220B-060	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	27.61		10.48						
31-Oct-13	13:24	H14-TK221-063	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	2.08		21.44						
31-Oct-13	13:24	H14-TK221-064	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	2.16		21.72						
14-Nov-13	12:25	H14-BLK-071	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	<3.14		<.77						
14-Nov-13	12:25	H14-SPK-072	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	36.09		10.62						
21-Nov-13	13:44	H15-25-037	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	32.94	32.2		36.66	35.91				
21-Nov-13	13:44	H15-25-038	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	31.49			35.42					
21-Nov-13	13:44	H15-35-040	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	74.02			23.82					
21-Nov-13	13:44	H15-35-041	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	74.78			24.22					

[30] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[31]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
21-Nov-13	13:44	H15-38-044	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.23			20.6					
21-Nov-13	13:44	H15-38-045	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.23			21.12					
22-Nov-13	9:50	H15-BLK-073	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.23			<.58					
22-Nov-13	9:50	H15-BLK-074	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.23			<.58					
22-Nov-13	9:50	H15-SPK-075	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	37.51			10.64					
22-Nov-13	9:50	H15-SPK-076	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	37.58			10.16					
22-Nov-13	11:37	H15-SUB-078	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	601736		202000			44600		612	
22-Nov-13	11:37	H14-SUB-073	12	2200	2000	1000	1000	21.43	1.6	0.535	1.43	1.43	7.5	621976		222000			47000		616	
5-Dec-13	13:40	H16-25-037	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	47.15			43.77					
5-Dec-13	13:40	H16-25-038	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	32.32			35.65					
5-Dec-13	13:40	H16-35-040	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	79.51	80.04		27.72	27.67				
5-Dec-13	13:40	H16-35-041	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	80.22			28.25					
5-Dec-13	13:40	H16-38-044	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.3			21.1					
5-Dec-13	13:40	H16-38-045	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.3			21.71					
6-Dec-13	11:23	H16-BLK-068	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.3			<.6					
6-Dec-13	11:24	H16-BLK-069	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.3			<.6					
6-Dec-13	11:25	H16-SPK-070	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	42.36			13.43					
6-Dec-13	11:26	H16-SPK-071	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	48.56			15.02					
6-Dec-13	11:28	H16-SUB-073	12	1700	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	623011		208000	217160		48400		664	
10-Dec-13	12:54	H17-25-037	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	49.48		36.87						
10-Dec-13	12:54	H17-25-038	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	50.65		38.08						
10-Dec-13	12:54	H17-35-040	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	87.37	85.77	26.65	26.64					
10-Dec-13	12:54	H17-35-041	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	89.08		27.09						
10-Dec-13	12:54	H17-38-044	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.44		20.71						
10-Dec-13	12:54	H17-38-045	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.44		20.5						
11-Dec-13	10:26	H17-BLK-073	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.44		<0.63						
11-Dec-13	10:26	H17-BLK-074	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.44		<0.63						

[31] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Organic Data

Date	Time	Sample Number	Weir Set[32]	Ext RPM	Scr RPM	Str RPM	Wash RPM	Sim GPM	Org GPM	Str GPM	Scr GPM	Wash GPM	Sim. Na (M)	Isopar (mg/L)	Isopar (mg/L)2	CS7SB MS (mg/L)	CS7SB GC (mg/L)	CS7SB GC (mg/L)2	Max Calix (mg/L)	Max Calix (mg/L)2	Guanidine (mg/L)	Guanidine (mg/L)2
11-Dec-13	10:27	H17-SPK-075	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	68.55		19.04						
11-Dec-13	10:28	H17-SPK-076	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	54.31		15.72						
11-Dec-13	10:36	H17-SUB-078	12	2200	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	620082.87		185600			42000		562	
17-Dec-13	13:34	H18-9-022	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	1870.66		648.11						
17-Dec-13	13:34	H18-25-025	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	90.1	89.14	55.37	54.65					
17-Dec-13	13:34	H18-25-026	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	85.93		54.34						
17-Dec-13	13:34	H18-35-028	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	54.98		17.89						
17-Dec-13	13:34	H18-35-029	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	57.75		18.67						
17-Dec-13	13:34	H18-38-032	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	<2.13		22.65						
17-Dec-13	13:34	H18-38-033	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	<2.13		22.6						
17-Dec-13	14:45	H19-35-008	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	74.5		25.41						
17-Dec-13	14:45	H19-35-009	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	84.6		26.99						
17-Dec-13	14:45	H19-9-016	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	2777.14		909.9						
18-Dec-13	10:58	H18-SUB-049	12	1700	2000	1000	1000	16.07	1.2	0.535	1.07	1.43	7.5	624741.52		171600			37800		538	
18-Dec-13	11:08	H19-BLK-030	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.13		<.55						
18-Dec-13	11:10	H19-SPK-031	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	35.4		11.3						
18-Dec-13	11:10	H19-SPK-032	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	35.5		10.54						
23-Jan-14	10:13	H19-BLK-034	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	<2.46		<.64						
23-Jan-14	10:13	H19-SPK-035	12	1900	2000	1000	1000	28.7	2.143	0.714	1.43	1.43	7.5	36.22		11.38						

[32] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Metals Data

Date	Sample Number	Sim. Na (M)	Al (mg/L)	Ca (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	P (mg/L)	Pb (mg/L)	S (mg/L)	Si (mg/L)	Sn (mg/L)	Sr (mg/L)	Ti (mg/L)	Zn (mg/L)	Na (mg/L)
8-Dec-11	SY-TK214B-001	5.6	5316.2	16	11	<1	2.1	1246.6	<1	<1	7.5	3.7	4.8	2.3	4541.8	13.8	<1	<1	<1	10.7	113872
8-Dec-11	SY-TK214B-002	5.6	5865.6	9.4	10.5	1.4	2.8	1551.3	<1	<1	8.9	2.3	4.2	<1	4693.8	13.5	<1	<1	<1	10	110245
8-Dec-11	SY-TK214B-003	5.6	5568.9	1.3	7	1.1	2.9	1508.7	<1	<1	8.3	3.2	4.9	<1	4748.9	13.4	<1	<1	<1	6.2	110786
8-Dec-11	SY-TK214B-004	5.6	5589.5	5.2	8.8	<1	2.7	1461	<1	<1	10	3.9	5.6	<1	4790.5	13	<1	<1	<1	8.3	112413
8-Dec-11	SY-TK214B-005	5.6	5818.9	1.6	7.1	<1	2.3	1428.7	<1	<1	8.7	3.3	5	<1	4534.1	13.6	<1	<1	<1	6.7	110874
8-Dec-11	SY-TK214A-006	5.6	6075	1.2	7.9	1.2	1.2	1572.7	<1	<1	8.7	1.8	4.2	1.3	4587.7	15.2	<1	<1	<1	7	108592
8-Dec-11	SY-TK214A-007	5.6	5745.7	1.4	7.4	<1	2.6	1491.9	<1	<1	9.3	2.8	4.9	<1	4762	15.5	<1	<1	<1	6.7	109148
8-Dec-11	SY-TK214A-008	5.6	5482.5	4.3	8.5	<1	3.1	1437.9	<1	<1	6.4	3.8	4.7	<1	4803.3	14.5	<1	<1	<1	7.5	111200
8-Dec-11	SY-TK214A-009	5.6	5795.6	2	7.6	1.5	3.1	1442.3	<1	<1	7.8	3.2	4.7	<1	4663.9	15.3	<1	<1	<1	6.9	108489
8-Dec-11	SY-TK214A-010	5.6	6023.6	4.5	9.5	1.5	2.3	1546.9	<1	<1	10.5	2.4	4.2	<1	4741.5	15.5	1	<1	<1	8.8	108383
19-Apr-12	SYD-SUB-029	5.6	4790			1.42	2.87	1390			8.84					15.179	3.55			8.09	125000
14-May-12	SYF-SUB-009	5.6	4710			1.35	2.77	1410			8.67					17.721	3.5			7.92	125000
14-May-12	SYF-SUB-010	5.6	4670			1.41	2.72	1430			8.71					17.647	3.46			8.03	121000
10-Jul-12	SYN-SUB-085	5.6	4380			1.37	2.63	1330			8.13					25.384	3.21			8.19	122000
10-Jul-12	SYN-SUB-086	5.6	4430			1.41	2.69	1440			8.41					29.953	3.18			8.42	127000
23-Aug-12	O2-SUB-074	5.6	4170			1.4	2.62	1410			8.08					28.7	3.16			8.29	124000
4-Sep-12	O3-SUB-338	5.6	4200			1.44	2.65	1390			8.28					25.716	3.1			8.83	123000

Appendix A. Compiled Analytical Data (cont.)

Metals Data

Date	Sample Number	Sim. Na (M)	Al (mg/L)	Cu (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	P (mg/L)	Pb (mg/L)	S (mg/L)	Si (mg/L)	Sn (mg/L)	Sr (mg/L)	Ti (mg/L)	Zn (mg/L)	Na (mg/L)
3-Dec-12	H1-SIM-095	6.4	4460	1.52	1.92	1520			7.92					68.7	2.91			8.87	135000
3-Dec-12	H1-SIM-096	6.4	4460	1.81	1.98	1530			7.85					69.9	2.82			8.98	135000
3-Dec-12	H1-SIM-099	6.4	4370	1.51	2.19	1490			7.78					28.92	2.69			8.99	138000
3-Dec-12	H1-SIM-100	6.4	4260	1.5	2.12	1510			7.73					28.47	2.66			8.89	133000
10-Dec-12	H1-SUB-112	6.4	0.132	0.128	0.013	0.25	0.021	0.013	0.021	0.022	<.01	<.01	2.084	1.898	0.073	<.01	<.01	0.026	355.565
10-Dec-12	H1-SUB-113	6.4	14.952	0.168	0.023							<.01	21.378	2.239	0.156	<.01	<.01	0.059	1157.09
10-Dec-12	H1-SUB-119	6.4	55.144	0.172	0.029	231.891	0.013	0.0125	0.1165	0.035	<.01	<.01	106.538	2.49	0.049	<.01	<.01	0.139	1266.86
10-Dec-12	H1-SUB-120	6.4	0.437	0.019	<.01	0.25	0.015	0.013	0.014	<.01	<.01	<.01	1.135	1.393	0.012	<.01	<.01	0.02	9.342
1-Feb-13	H4-186-001	6.4	4410	1.66	3.43	1770			9.15					81.7	3.33			9.58	137000
7-Jun-13	H5-186-025	6.4	4740	1.67	ND	1790			9.3					80.85	3.36			9.91	139000
19-Sep-13	H7-186-001	7.5	4760	1.92	3.81	1950			10.4					51	3.6			11.5	155000
26-Sep-13	H8-186-018	7.5	4580	1.88	3.91	1880			10					67.8	3.57			11	148000
1-Oct-13	H9-186-020	7.5	4690	1.94	3.13	1910			10.3					70.8	3.43			11.4	157000
31-Oct-13	H14-186-027	7.5	4790	2.03	3.55	1850			10.7					92.9	3.67			11.5	162000
21-Nov-13	H15-186-027	7.5	4470	1.91	ND	1650			10.4					87.8	3.48			11.4	156000
28-Jan-14	H9-DUP-034	7.5	4800	1.95	3.5	1950			10.4					72.3	3.67			11.7	156000

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[33]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
4/10/2012		2	1	10.50	0.05	0.48%	1000	25%	2	1:3	5.6
4/10/2012		2	1	10.00	0.05	0.50%	1000	25%	2	1:3	5.6
4/10/2012		4	1	11.00	0.03	0.27%	1000	25%	2	1:3	5.6
4/10/2012		4	1	10.50	0.15	1.43%	1000	25%	2	1:3	5.6
4/10/2012		6	1	12.25	0.20	1.63%	1000	25%	2	1:3	5.6
4/10/2012		6	1	10.00	0.70	7.00%	1000	25%	2	1:3	5.6
4/10/2012		8	1	10.50	0.03	0.29%	1000	25%	2	1:3	5.6
4/10/2012		8	1	10.50	0.03	0.29%	1000	25%	2	1:3	5.6
4/10/2012		12	1	11.25	0.10	0.89%	1000	25%	2	1:3	5.6
4/10/2012		12	1	10.00	0.10	1.00%	1000	25%	2	1:3	5.6
4/10/2012		14	1	11.50	0.20	1.74%	1000	25%	2	1:3	5.6
4/10/2012		14	1	12.00	0.35	2.92%	1000	25%	2	1:3	5.6
4/10/2012		18	1	11.25	0.02	0.18%	1000	25%	2	1:3	5.6
4/10/2012		18	1	11.50	0.02	0.17%	1000	25%	2	1:3	5.6
4/10/2012		20	1	8.75	0.03	0.34%	1000	25%	2	1:3	5.6
4/10/2012		20	1	9.25	0.10	1.08%	1000	25%	2	1:3	5.6
4/10/2012		22	1	9.75	0.03	0.31%	1000	25%	2	1:3	5.6
4/10/2012		22	1	10.00	0.06	0.60%	1000	25%	2	1:3	5.6
4/10/2012		24	1	10.75	0.05	0.47%	1000	25%	2	1:3	5.6
4/10/2012		24	1	11.00	0.05	0.45%	1000	25%	2	1:3	5.6
4/10/2012		28	1	11.50	0.03	0.26%	1000	25%	2	1:3	5.6
4/10/2012		28	1	13.50	0.03	0.22%	1000	25%	2	1:3	5.6
4/10/2012		2	2	15.00	0.04	0.27%	850	25%	2	1:3	5.6
4/10/2012		2	2	15.00	0.05	0.33%	850	25%	2	1:3	5.6
4/10/2012		4	2	15.00	0.05	0.33%	850	25%	2	1:3	5.6
4/10/2012		4	2	15.00	0.05	0.33%	850	25%	2	1:3	5.6
4/10/2012		6	2	14.25	0.05	0.35%	850	25%	2	1:3	5.6
4/10/2012		6	2	15.00	0.05	0.33%	850	25%	2	1:3	5.6
4/10/2012		8	2	13.50	0.03	0.22%	850	25%	2	1:3	5.6
4/10/2012		8	2	15.00	0.03	0.20%	850	25%	2	1:3	5.6
4/10/2012		12	2	14.00	0.20	1.43%	850	25%	2	1:3	5.6
4/10/2012		12	2	15.00	0.20	1.33%	850	25%	2	1:3	5.6
4/10/2012		14	2	15.00	0.50	3.33%	850	25%	2	1:3	5.6
4/10/2012		14	2	15.00	0.50	3.33%	850	25%	2	1:3	5.6
4/10/2012		18	2	15.00	0.03	0.20%	850	25%	2	1:3	5.6
4/10/2012		18	2	14.50	0.03	0.21%	850	25%	2	1:3	5.6
4/10/2012		20	2	13.50	0.03	0.22%	850	25%	2	1:3	5.6
4/10/2012		20	2	14.00	0.03	0.21%	850	25%	2	1:3	5.6
4/10/2012		22	2	14.25	0.05	0.35%	850	25%	2	1:3	5.6
4/10/2012		22	2	14.50	0.05	0.34%	850	25%	2	1:3	5.6
4/10/2012		24	2	14.00	0.05	0.36%	850	25%	2	1:3	5.6
4/10/2012		24	2	14.00	0.05	0.36%	850	25%	2	1:3	5.6
4/10/2012		28	2	14.50	0.03	0.21%	850	25%	2	1:3	5.6
4/10/2012		28	2	15.00	0.03	0.20%	850	25%	2	1:3	5.6
4/11/2012		2	1	14.50	0.07	0.48%	1000	25%	2	1:3	5.6
4/11/2012		2	1	13.75	0.05	0.36%	1000	25%	2	1:3	5.6
4/11/2012		4	1	14.50	0.15	1.03%	1000	25%	2	1:3	5.6
4/11/2012		4	1	14.00	0.15	1.07%	1000	25%	2	1:3	5.6
4/11/2012		6	1	12.25	0.10	0.82%	1000	25%	2	1:3	5.6
4/11/2012		6	1	13.75	0.10	0.73%	1000	25%	2	1:3	5.6
4/11/2012		8	1	12.50	0.03	0.24%	1000	25%	2	1:3	5.6

[33] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[34]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
4/11/2012		8	1	13.00	0.03	0.23%	1000	25%	2	1:3	5.6
4/11/2012		12	1	13.00	0.15	1.15%	1000	25%	2	1:3	5.6
4/11/2012		12	1	12.00	0.10	0.83%	1000	25%	2	1:3	5.6
4/11/2012		14	1	12.00	0.25	2.08%	1000	25%	2	1:3	5.6
4/11/2012		14	1	13.00	0.25	1.92%	1000	25%	2	1:3	5.6
4/11/2012		18	1	12.00	0.03	0.25%	1000	25%	2	1:3	5.6
4/11/2012		18	1	12.00	0.03	0.25%	1000	25%	2	1:3	5.6
4/11/2012		20	1	14.00	0.03	0.21%	1000	25%	2	1:3	5.6
4/11/2012		20	1	12.75	0.03	0.24%	1000	25%	2	1:3	5.6
4/11/2012		22	1	12.25	0.03	0.24%	1000	25%	2	1:3	5.6
4/11/2012		22	1	15.00	0.05	0.33%	1000	25%	2	1:3	5.6
4/11/2012		24	1	13.75	0.05	0.36%	1000	25%	2	1:3	5.6
4/11/2012		24	1	13.00	0.05	0.38%	1000	25%	2	1:3	5.6
4/11/2012		28	1	14.00	0.03	0.21%	1000	25%	2	1:3	5.6
4/11/2012		28	1	11.00	0.03	0.27%	1000	25%	2	1:3	5.6
4/12/2012		2	1	13.25	0.25	1.89%	850	50%	2	1:3	5.6
4/12/2012		2	1	13.75	0.30	2.18%	850	50%	2	1:3	5.6
4/12/2012		4	1	13.75	0.40	2.91%	850	50%	2	1:3	5.6
4/12/2012		4	1	12.00	0.35	2.92%	850	50%	2	1:3	5.6
4/12/2012		6	1	15.00	0.40	2.67%	850	50%	2	1:3	5.6
4/12/2012		6	1	15.00	0.50	3.33%	850	50%	2	1:3	5.6
4/12/2012		8	1	15.00	8.00	53.33%	850	50%	2	1:3	5.6
4/12/2012		8	1	15.00	7.75	51.67%	850	50%	2	1:3	5.6
4/12/2012		8	2	10.75	3.00	27.91%	850	50%	2	1:3	5.6
4/12/2012		8	3	11.00	3.00	27.27%	850	50%	2	1:3	5.6
4/12/2012		8	4	11.00	5.75	52.27%	850	50%	2	1:3	5.6
4/12/2012		8	5	11.50	6.50	56.52%	850	50%	2	1:3	5.6
4/12/2012		8	6	11.25	6.50	57.78%	850	50%	2	1:3	5.6
4/17/2012		2	1	11.50	0.05	0.43%	1000	25%	3	1:3	5.6
4/17/2012		2	1	9.75	0.08	0.77%	1000	25%	3	1:3	5.6
4/17/2012		4	1	12.00	0.10	0.83%	1000	25%	3	1:3	5.6
4/17/2012		4	1	11.50	0.10	0.87%	1000	25%	3	1:3	5.6
4/17/2012		6	1	10.75	0.03	0.28%	1000	25%	3	1:3	5.6
4/17/2012		6	1	11.50	0.04	0.35%	1000	25%	3	1:3	5.6
4/17/2012		8	1	10.50	0.05	0.48%	1000	25%	3	1:3	5.6
4/17/2012		8	1	11.75	0.05	0.43%	1000	25%	3	1:3	5.6
4/17/2012		12	1	9.50	0.10	1.05%	1000	25%	3	1:3	5.6
4/17/2012		12	1	11.00	0.10	0.91%	1000	25%	3	1:3	5.6
4/17/2012		14	1	11.25	0.20	1.78%	1000	25%	3	1:3	5.6
4/17/2012		14	1	12.75	0.20	1.57%	1000	25%	3	1:3	5.6
4/17/2012		18	1	8.00	0.01	0.13%	1000	25%	3	1:3	5.6
4/17/2012		18	1	10.50	0.02	0.19%	1000	25%	3	1:3	5.6
4/17/2012		20	1	9.25	0.02	0.22%	1000	25%	3	1:3	5.6
4/17/2012		20	1	11.50	0.03	0.26%	1000	25%	3	1:3	5.6
4/17/2012		22	1	9.00	0.03	0.33%	1000	25%	3	1:3	5.6
4/17/2012		22	1	9.00	0.03	0.33%	1000	25%	3	1:3	5.6
4/17/2012		24	1	11.75	0.03	0.26%	1000	25%	3	1:3	5.6
4/17/2012		24	1	13.00	0.05	0.38%	1000	25%	3	1:3	5.6
4/17/2012		28	1	10.50	0.03	0.29%	1000	25%	3	1:3	5.6
4/17/2012		28	1	13.50	0.03	0.22%	1000	25%	3	1:3	5.6
4/18/2012		2	1	14.50	0.08	0.52%	1000	50%	3	1:3	5.6

[34] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[35]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
4/18/2012		2	1	15.00	0.08	0.50%	1000	50%	3	1:3	5.6
4/18/2012		4	1	15.00	0.10	0.67%	1000	50%	3	1:3	5.6
4/18/2012		4	1	14.25	0.10	0.70%	1000	50%	3	1:3	5.6
4/18/2012		6	1	15.00	0.35	2.33%	1000	50%	3	1:3	5.6
4/18/2012		6	1	13.25	0.30	2.26%	1000	50%	3	1:3	5.6
4/18/2012		8	1	15.00	8.25	55.00%	1000	50%	3	1:3	5.6
4/18/2012		8	1	14.00	7.75	55.36%	1000	50%	3	1:3	5.6
4/18/2012		12	1	13.50	0.10	0.74%	1000	50%	3	1:3	5.6
4/18/2012		12	1	11.50	0.08	0.65%	1000	50%	3	1:3	5.6
4/18/2012		14	1	15.00	0.15	1.00%	1000	50%	3	1:3	5.6
4/18/2012		14	1	13.50	0.15	1.11%	1000	50%	3	1:3	5.6
4/18/2012		18	1	11.50	0.02	0.17%	1000	50%	3	1:3	5.6
4/18/2012		18	1	9.50	0.02	0.21%	1000	50%	3	1:3	5.6
4/18/2012		20	1	10.75	0.04	0.37%	1000	50%	3	1:3	5.6
4/18/2012		20	1	11.00	0.04	0.36%	1000	50%	3	1:3	5.6
4/18/2012		22	1	11.25	0.04	0.36%	1000	50%	3	1:3	5.6
4/18/2012		22	1	10.50	0.03	0.29%	1000	50%	3	1:3	5.6
4/18/2012		24	1	13.75	0.05	0.36%	1000	50%	3	1:3	5.6
4/18/2012		24	1	12.50	0.05	0.40%	1000	50%	3	1:3	5.6
4/18/2012		28	1	11.00	0.03	0.27%	1000	50%	3	1:3	5.6
4/18/2012		28	1	9.75	0.02	0.21%	1000	50%	3	1:3	5.6
4/18/2012		8	2	12.25	0.30	2.45%	1000	50%	3	1:3	5.6
4/18/2012		8	3	11.50	0.15	1.30%	1000	50%	3	1:3	5.6
4/18/2012		8	4	12.25	0.25	2.04%	1000	50%	3	1:3	5.6
4/18/2012		8	5	12.00	0.35	2.92%	1000	50%	3	1:3	5.6
4/18/2012		8	6	12.00	0.70	5.83%	1000	50%	3	1:3	5.6
4/18/2012		8	7	12.00	1.25	10.42%	1000	50%	3	1:3	5.6
4/18/2012		8	8	13.00	3.00	23.08%	1000	50%	3	1:3	5.6
4/18/2012		8	9	15.00	9.50	63.33%	1000	50%	3	1:3	5.6
5/2/2012		2	1	13.50	0.30	2.22%	1000	50%	5	1:3	5.6
5/2/2012		4	1	12.50	0.25	2.00%	1000	50%	5	1:3	5.6
5/2/2012		6	1	11.00	0.10	0.91%	1000	50%	5	1:3	5.6
5/2/2012		8	1	12.00	0.35	2.92%	1000	50%	5	1:3	5.6
5/2/2012		2	2	13.50	0.10	0.74%	1000	50%	5	1:3	5.6
5/2/2012		4	2	13.50	0.10	0.74%	1000	50%	5	1:3	5.6
5/2/2012		6	2	11.75	0.10	0.85%	1000	50%	5	1:3	5.6
5/2/2012		8	2	12.00	0.10	0.83%	1000	50%	5	1:3	5.6
5/2/2012		2	3	13.00	0.04	0.31%	1000	50%	5	1:3	5.6
5/2/2012		4	3	13.00	0.10	0.77%	1000	50%	5	1:3	5.6
5/2/2012		6	3	12.50	0.10	0.80%	1000	50%	5	1:3	5.6
5/2/2012		8	3	12.25	0.08	0.61%	1000	50%	5	1:3	5.6
5/2/2012		2	4	13.00	0.03	0.23%	1000	50%	5	1:3	5.6
5/2/2012		4	4	13.25	0.10	0.75%	1000	50%	5	1:3	5.6
5/2/2012		6	4	12.25	0.15	1.22%	1000	50%	5	1:3	5.6
5/2/2012		8	4	12.25	0.05	0.41%	1000	50%	5	1:3	5.6
5/2/2012		2	5	11.75	0.05	0.43%	1000	50%	5	1:3	5.6
5/2/2012		4	5	13.00	0.10	0.77%	1000	50%	5	1:3	5.6
5/2/2012		6	5	13.50	0.15	1.11%	1000	50%	5	1:3	5.6
5/2/2012		8	5	12.50	0.05	0.40%	1000	50%	5	1:3	5.6
5/2/2012		2	6	13.00	0.08	0.58%	1000	50%	5	1:3	5.6
5/2/2012		4	6	13.50	0.10	0.74%	1000	50%	5	1:3	5.6

[35] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[36]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
5/2/2012		6	6	12.00	0.15	1.25%	1000	50%	5	1:3	5.6
5/2/2012		8	6	11.00	0.05	0.45%	1000	50%	5	1:3	5.6
5/2/2012		2	7	12.50	0.08	0.60%	1000	50%	5	1:3	5.6
5/2/2012		4	7	12.75	0.10	0.78%	1000	50%	5	1:3	5.6
5/2/2012		6	7	11.00	0.15	1.36%	1000	50%	5	1:3	5.6
5/2/2012		8	7	11.75	0.03	0.26%	1000	50%	5	1:3	5.6
5/2/2012		2	8	10.50	0.05	0.48%	1000	50%	5	1:3	5.6
5/2/2012		2	8	11.50	0.05	0.43%	1000	50%	5	1:3	5.6
5/2/2012		4	8	12.75	0.25	1.96%	1000	50%	5	1:3	5.6
5/2/2012		4	8	12.75	0.30	2.35%	1000	50%	5	1:3	5.6
5/2/2012		6	8	12.50	1.50	12.00%	1000	50%	5	1:3	5.6
5/2/2012		6	8	11.50	1.25	10.87%	1000	50%	5	1:3	5.6
5/2/2012		8	8	12.75	1.75	13.73%	1000	50%	5	1:3	5.6
5/2/2012		8	8	13.00	2.00	15.38%	1000	50%	5	1:3	5.6
5/2/2012		12	8	12.25	0.10	0.82%	1000	50%	5	1:3	5.6
5/2/2012		12	8	11.50	0.10	0.87%	1000	50%	5	1:3	5.6
5/2/2012		14	8	13.25	0.20	1.51%	1000	50%	5	1:3	5.6
5/2/2012		14	8	12.00	0.20	1.67%	1000	50%	5	1:3	5.6
5/2/2012		18	8	12.75	0.03	0.24%	1000	50%	5	1:3	5.6
5/2/2012		18	8	12.25	0.03	0.24%	1000	50%	5	1:3	5.6
5/2/2012		20	8	11.00	0.04	0.36%	1000	50%	5	1:3	5.6
5/2/2012		20	8	10.00	0.03	0.30%	1000	50%	5	1:3	5.6
5/2/2012		22	8	10.50	0.03	0.29%	1000	50%	5	1:3	5.6
5/2/2012		22	8	11.25	0.03	0.27%	1000	50%	5	1:3	5.6
5/2/2012		24	8	10.25	0.03	0.29%	1000	50%	5	1:3	5.6
5/2/2012		24	8	12.75	0.05	0.39%	1000	50%	5	1:3	5.6
5/2/2012		28	8	11.50	0.03	0.26%	1000	50%	5	1:3	5.6
5/2/2012		28	8	11.00	0.03	0.27%	1000	50%	5	1:3	5.6
5/14/2012		2	3	9.00	0.02	0.22%	1000	25%	6	1:3	5.6
5/14/2012		2	3	8.75	0.02	0.23%	1000	25%	6	1:3	5.6
5/14/2012		4	3	12.00	0.09	0.75%	1000	25%	6	1:3	5.6
5/14/2012		4	3	12.25	0.09	0.73%	1000	25%	6	1:3	5.6
5/14/2012		6	3	10.75	0.04	0.37%	1000	25%	6	1:3	5.6
5/14/2012		6	3	10.25	0.04	0.39%	1000	25%	6	1:3	5.6
5/14/2012		8	3	10.75	0.02	0.19%	1000	25%	6	1:3	5.6
5/14/2012		8	3	12.25	0.02	0.16%	1000	25%	6	1:3	5.6
5/15/2012		2	1	11.75	0.10	0.85%	1000	25%	7	1:3	5.6
5/15/2012		2	1	13.50	0.15	1.11%	1000	25%	7	1:3	5.6
5/15/2012		4	1	11.75	0.15	1.28%	1000	25%	7	1:3	5.6
5/15/2012		4	1	12.50	0.20	1.60%	1000	25%	7	1:3	5.6
5/15/2012		6	1	12.00	0.15	1.25%	1000	25%	7	1:3	5.6
5/15/2012		6	1	12.50	0.20	1.60%	1000	25%	7	1:3	5.6
5/15/2012		8	1	11.00	0.05	0.45%	1000	25%	7	1:3	5.6
5/15/2012		8	1	13.00	0.05	0.38%	1000	25%	7	1:3	5.6
5/17/2012		2	1	11.25	0.02	0.18%	750	25%	8	1:3	5.6
5/17/2012		2	1	9.00	0.02	0.22%	750	25%	8	1:3	5.6
5/17/2012	13:27	3	1	2.38	0.06	2.63%	1000	50%	8	1:3	5.6
5/17/2012		4	1	13.00	0.02	0.15%	750	25%	8	1:3	5.6
5/17/2012		4	1	13.00	0.02	0.15%	750	25%	8	1:3	5.6
5/17/2012	13:27	4	1	14.00	0.50	3.57%	1000	50%	8	1:3	5.6
5/17/2012	13:27	5	1	2.81	0.19	6.84%	1000	50%	8	1:3	5.6

[36] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[37]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
5/17/2012		6	1	10.50	0.02	0.19%	750	25%	8	1:3	5.6
5/17/2012		6	1	12.75	0.04	0.31%	750	25%	8	1:3	5.6
5/17/2012	13:26	6	1	12.50	1.25	10.00%	1000	50%	8	1:3	5.6
5/17/2012	13:26	7	1	2.50	0.03	1.25%	1000	50%	8	1:3	5.6
5/17/2012		8	1	13.25	0.02	0.15%	750	25%	8	1:3	5.6
5/17/2012		8	1	13.00	0.02	0.15%	750	25%	8	1:3	5.6
5/17/2012	13:26	8	1	12.75	0.60	4.71%	1000	50%	8	1:3	5.6
5/17/2012	13:26	9	1	2.75	0.03	1.14%	1000	50%	8	1:3	5.6
5/17/2012	13:29	3	2	2.81	0.06	2.22%	1000	50%	8	1:3	5.6
5/17/2012	13:29	5	2	2.50	0.19	7.50%	1000	50%	8	1:3	5.6
5/17/2012	13:28	6	2	14.25	2.00	14.04%	1000	50%	8	1:3	5.6
5/17/2012	13:28	7	2	2.88	0.19	6.52%	1000	50%	8	1:3	5.6
5/17/2012	13:28	9	2	3.75	1.13	30.00%	1000	50%	8	1:3	5.6
5/17/2012	13:30	6	3	13.50	0.40	2.96%	1000	50%	8	1:3	5.6
5/17/2012	13:30	7	3	3.13	0.25	8.00%	1000	50%	8	1:3	5.6
5/17/2012	13:30	9	3	3.25	1.00	30.77%	1000	50%	8	1:3	5.6
5/17/2012	13:31	6	4	13.25	0.25	1.89%	1000	50%	8	1:3	5.6
5/17/2012	13:31	7	4	3.25	0.25	7.69%	1000	50%	8	1:3	5.6
5/17/2012	13:31	9	4	3.25	1.00	30.77%	1000	50%	8	1:3	5.6
5/17/2012	13:32	6	5	13.00	0.30	2.31%	1000	50%	8	1:3	5.6
5/17/2012	13:32	7	5	3.00	0.25	8.33%	1000	50%	8	1:3	5.6
5/17/2012	13:32	9	5	3.38	1.00	29.63%	1000	50%	8	1:3	5.6
5/17/2012	13:33	6	6	13.25	0.30	2.26%	1000	50%	8	1:3	5.6
5/29/2012		2	1	13.00	0.03	0.23%	750	25%	8	1:3	5.6
5/29/2012		2	1	13.80	0.02	0.14%	750	25%	8	1:3	5.6
5/29/2012		4	1	14.50	0.13	0.86%	750	25%	8	1:3	5.6
5/29/2012		4	1	14.25	0.18	1.26%	750	25%	8	1:3	5.6
5/29/2012		6	1	14.00	0.06	0.43%	750	25%	8	1:3	5.6
5/29/2012		6	1	14.20	0.06	0.42%	750	25%	8	1:3	5.6
5/29/2012		8	1	13.90	0.08	0.58%	750	25%	8	1:3	5.6
5/29/2012		8	1	14.50	0.09	0.59%	750	25%	8	1:3	5.6
5/30/2012		2	1	14.10	0.20	1.42%	750	50%	8	1:3	5.6
5/30/2012		4	1	13.75	0.40	2.91%	750	50%	8	1:3	5.6
5/30/2012		6	1	12.90	0.50	3.88%	750	50%	8	1:3	5.6
5/30/2012		8	1	11.90	0.42	3.53%	750	50%	8	1:3	5.6
5/30/2012		2	2	13.50	0.75	5.56%	750	50%	8	1:3	5.6
5/30/2012		4	2	13.50	0.43	3.19%	750	50%	8	1:3	5.6
5/30/2012		6	2	12.80	0.50	3.91%	750	50%	8	1:3	5.6
5/30/2012		8	2	11.50	0.38	3.26%	750	50%	8	1:3	5.6
5/30/2012		2	3	14.50	0.08	0.55%	750	50%	8	1:3	5.6
5/30/2012		4	3	12.50	0.28	2.24%	750	50%	8	1:3	5.6
5/30/2012		6	3	14.25	2.00	14.04%	750	50%	8	1:3	5.6
5/30/2012		8	3	13.00	2.30	17.69%	750	50%	8	1:3	5.6
5/30/2012		2	4	14.30	0.07	0.49%	750	50%	8	1:3	5.6
5/30/2012		4	4	12.75	0.31	2.43%	750	50%	8	1:3	5.6
5/30/2012		6	4	14.50	3.40	23.45%	750	50%	8	1:3	5.6
5/30/2012		8	4	11.45	2.75	24.02%	750	50%	8	1:3	5.6
5/30/2012		2	5	13.40	0.06	0.45%	750	50%	8	1:3	5.6
5/30/2012		4	5	12.10	0.30	2.48%	750	50%	8	1:3	5.6
5/30/2012		6	5	14.50	3.50	24.14%	750	50%	8	1:3	5.6
5/30/2012		8	5	12.50	3.00	24.00%	750	50%	8	1:3	5.6

[37] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[38]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
5/30/2012		2	6	14.00	0.07	0.50%	750	50%	8	1:3	5.6
5/30/2012		4	6	11.25	0.32	2.84%	750	50%	8	1:3	5.6
5/30/2012		6	6	13.80	3.45	25.00%	750	50%	8	1:3	5.6
5/30/2012		8	6	11.75	3.00	25.53%	750	50%	8	1:3	5.6
5/30/2012		2	1	13.25	0.02	0.15%	750	25%	8	1:3	5.6
5/30/2012		2	1	14.10	0.02	0.14%	750	25%	8	1:3	5.6
5/30/2012		4	1	13.25	0.12	0.91%	750	25%	8	1:3	5.6
5/30/2012		4	1	15.00	0.09	0.60%	750	25%	8	1:3	5.6
5/30/2012		6	1	13.75	0.03	0.22%	750	25%	8	1:3	5.6
5/30/2012		6	1	14.00	0.02	0.14%	750	25%	8	1:3	5.6
5/30/2012		8	1	13.25	0.05	0.38%	750	25%	8	1:3	5.6
5/30/2012		8	1	14.70	0.10	0.68%	750	25%	8	1:3	5.6
6/5/2012	15:00	2	1	13.00	0.01	0.08%	750	25%	9	1:3	5.6
6/5/2012	15:00	2	1	13.75	0.02	0.15%	750	25%	9	1:3	5.6
6/5/2012	15:00	4	1	11.50	0.07	0.61%	750	25%	9	1:3	5.6
6/5/2012	15:00	4	1	12.50	0.06	0.48%	750	25%	9	1:3	5.6
6/5/2012	15:00	6	1	12.25	0.15	1.22%	750	25%	9	1:3	5.6
6/5/2012	15:00	6	1	13.00	0.05	0.38%	750	25%	9	1:3	5.6
6/5/2012	15:00	8	1	13.50	0.03	0.22%	750	25%	9	1:3	5.6
6/5/2012	15:00	8	1	13.00	0.02	0.15%	750	25%	9	1:3	5.6
6/5/2012	15:30	4	2	12.00	0.01	0.08%	750	25%	9	1:3	5.6
6/5/2012	15:30	6	2	13.50	0.02	0.15%	750	25%	9	1:3	5.6
6/5/2012	15:30	4	3	15.00	0.01	0.06%	750	25%	9	1:3	5.6
6/5/2012	15:30	6	3	14.75	0.02	0.14%	750	25%	9	1:3	5.6
6/5/2012	15:30	4	4	14.00	0.01	0.06%	750	25%	9	1:3	5.6
6/5/2012	15:30	6	4	14.25	0.02	0.14%	750	25%	9	1:3	5.6
6/5/2012	15:30	4	5	13.50	0.01	0.07%	750	25%	9	1:3	5.6
6/5/2012	15:30	6	5	13.50	0.03	0.22%	750	25%	9	1:3	5.6
6/5/2012	15:30	4	6	12.75	0.01	0.07%	750	25%	9	1:3	5.6
6/5/2012	15:30	6	6	15.00	0.02	0.13%	750	25%	9	1:3	5.6
6/5/2012	15:30	4	7	14.50	0.01	0.06%	750	25%	9	1:3	5.6
6/5/2012	15:30	6	7	13.00	0.02	0.15%	750	25%	9	1:3	5.6
6/5/2012	15:30	4	8	14.50	0.01	0.06%	750	25%	9	1:3	5.6
6/5/2012	15:30	6	8	14.50	0.02	0.14%	750	25%	9	1:3	5.6
6/5/2012	17:00	2	9	14.00	0.05	0.36%	750	50%	9	1:3	5.6
6/5/2012	17:00	4	9	14.55	4.20	28.87%	750	50%	9	1:3	5.6
6/5/2012	17:00	6	9	13.75	3.50	25.45%	750	50%	9	1:3	5.6
6/5/2012	17:00	8	9	14.55	3.40	23.37%	750	50%	9	1:3	5.6
6/5/2012	17:00	2	10	13.35	3.20	23.97%	750	50%	9	1:3	5.6
6/5/2012	17:00	4	10	14.70	5.75	39.12%	750	50%	9	1:3	5.6
6/5/2012	17:00	6	10	13.75	4.70	34.18%	750	50%	9	1:3	5.6
6/5/2012	17:00	8	10	13.45	3.50	26.02%	750	50%	9	1:3	5.6
6/5/2012	17:00	2	11	14.35	0.36	2.51%	750	50%	9	1:3	5.6
6/5/2012	17:00	4	11	15.00	5.60	37.33%	750	50%	9	1:3	5.6
6/5/2012	17:00	6	11	14.10	5.75	40.78%	750	50%	9	1:3	5.6
6/5/2012	17:00	8	11	15.00	4.25	28.33%	750	50%	9	1:3	5.6
6/5/2012	17:00	2	12	14.00	0.90	6.43%	750	50%	9	1:3	5.6
6/5/2012	17:00	4	12	15.00	6.00	40.00%	750	50%	9	1:3	5.6
6/5/2012	17:00	6	12	14.50	5.90	40.69%	750	50%	9	1:3	5.6
6/5/2012	17:00	8	12	14.00	4.00	28.57%	750	50%	9	1:3	5.6
6/5/2012	17:00	2	13	15.00	0.55	3.67%	750	50%	9	1:3	5.6

[38] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[39]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
6/5/2012	17:00	4	13	14.70	5.45	37.07%	750	50%	9	1:3	5.6
6/5/2012	17:00	6	13	13.80	6.00	43.48%	750	50%	9	1:3	5.6
6/5/2012	17:00	8	13	14.50	4.15	28.62%	750	50%	9	1:3	5.6
6/5/2012	18:21	8	14	13.25	5.50	41.51%	750	100%	9	1:10	5.6
6/5/2012	18:21	8	14	15.00	6.25	41.67%	750	100%	9	1:10	5.6
6/5/2012	18:21	2	14	13.50	0.20	1.48%	750	100%	9	1:10	5.6
6/5/2012	18:21	2	14	15.00	0.25	1.67%	750	100%	9	1:10	5.6
6/5/2012	18:42	8	15	13.50	1.50	11.11%	1200	100%	9	1:10	5.6
6/5/2012	18:42	8	15	13.25	1.45	10.94%	1200	100%	9	1:10	5.6
6/5/2012	18:42	2	15	13.25	0.30	2.26%	1200	100%	9	1:10	5.6
6/5/2012	18:42	2	15	12.50	0.30	2.40%	1200	100%	9	1:10	5.6
6/6/2012	16:20	2	1	12.50	0.10	0.80%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	2	1	12.50	0.10	0.80%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	4	1	11.50	0.20	1.74%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	4	1	11.75	0.20	1.70%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	6	1	11.00	0.15	1.36%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	6	1	10.50	0.18	1.67%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	6	1	9.50	0.20	2.11%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	6	1	9.75	0.15	1.54%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	8	1	11.50	0.20	1.74%	1200	50%	9	1:4.1	5.6
6/6/2012	16:20	8	1	11.00	0.20	1.82%	1200	50%	9	1:4.1	5.6
6/7/2012	10:51	2	1	11.50	0.25	2.17%	1250	100%	9	1:10	5.6
6/7/2012	10:51	2	1	11.60	0.25	2.16%	1250	100%	9	1:10	5.6
6/7/2012	10:51	4	1	11.78	0.70	5.94%	1250	100%	9	1:10	5.6
6/7/2012	10:51	4	1	11.40	0.70	6.14%	1250	100%	9	1:10	5.6
6/7/2012	10:51	6	1	10.30	0.65	6.31%	1250	100%	9	1:10	5.6
6/7/2012	10:51	6	1	9.50	0.60	6.32%	1250	100%	9	1:10	5.6
6/7/2012	10:51	8	1	12.80	1.40	10.94%	1250	100%	9	1:10	5.6
6/7/2012	10:51	8	1	12.00	1.40	11.67%	1250	100%	9	1:10	5.6
6/7/2012	11:05	2	2	11.00	0.10	0.91%	1500	100%	9	1:10	5.6
6/7/2012	11:05	2	2	11.80	0.10	0.85%	1500	100%	9	1:10	5.6
6/7/2012	11:05	4	2	12.90	0.53	4.07%	1500	100%	9	1:10	5.6
6/7/2012	11:05	4	2	12.00	0.50	4.17%	1500	100%	9	1:10	5.6
6/7/2012	11:05	6	2	11.00	0.50	4.55%	1500	100%	9	1:10	5.6
6/7/2012	11:05	6	2	11.00	0.50	4.55%	1500	100%	9	1:10	5.6
6/7/2012	11:05	8	2	11.60	1.00	8.62%	1500	100%	9	1:10	5.6
6/7/2012	11:05	8	2	11.80	1.00	8.47%	1500	100%	9	1:10	5.6
6/7/2012	11:21	2	3	10.20	0.03	0.29%	1750	100%	9	1:10	5.6
6/7/2012	11:21	2	3	10.45	0.03	0.29%	1750	100%	9	1:10	5.6
6/7/2012	11:21	4	3	10.20	0.18	1.72%	1750	100%	9	1:10	5.6
6/7/2012	11:21	4	3	11.40	0.20	1.75%	1750	100%	9	1:10	5.6
6/7/2012	11:21	6	3	8.00	0.30	3.75%	1750	100%	9	1:10	5.6
6/7/2012	11:21	6	3	7.20	0.30	4.17%	1750	100%	9	1:10	5.6
6/7/2012	11:21	8	3	11.00	0.60	5.45%	1750	100%	9	1:10	5.6
6/7/2012	11:21	8	3	11.40	0.65	5.70%	1750	100%	9	1:10	5.6
6/7/2012	11:43	2	4	10.70	0.02	0.19%	2000	100%	9	1:10	5.6
6/7/2012	11:43	2	4	11.25	0.03	0.27%	2000	100%	9	1:10	5.6
6/7/2012	11:43	4	4	11.70	0.07	0.60%	2000	100%	9	1:10	5.6
6/7/2012	11:43	4	4	10.90	0.05	0.46%	2000	100%	9	1:10	5.6
6/7/2012	11:43	6	4	11.15	0.10	0.90%	2000	100%	9	1:10	5.6
6/7/2012	11:43	6	4	9.80	0.10	1.02%	2000	100%	9	1:10	5.6

[39] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[40]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
6/7/2012	11:43	8	4	10.50	0.40	3.81%	2000	100%	9	1:10	5.6
6/7/2012	11:43	8	4	10.75	0.39	3.63%	2000	100%	9	1:10	5.6
6/8/2012	14:20	8	1	11.00	0.20	1.82%	1000	50%	9	1:10	5.6
6/8/2012	14:20	8	1	12.00	0.20	1.67%	1000	50%	9	1:10	5.6
6/8/2012	14:20	6	1	12.50	0.08	0.64%	1000	50%	9	1:10	5.6
6/8/2012	14:20	6	1	12.25	0.08	0.65%	1000	50%	9	1:10	5.6
6/8/2012	14:20	4	1	13.25	0.04	0.30%	1000	50%	9	1:10	5.6
6/8/2012	14:20	4	1	12.50	0.03	0.24%	1000	50%	9	1:10	5.6
6/8/2012	14:20	2	1	12.50	0.02	0.16%	1000	50%	9	1:10	5.6
6/8/2012	14:20	2	1	12.50	0.02	0.16%	1000	50%	9	1:10	5.6
6/8/2012	15:00	8	2	13.75	0.08	0.58%	1200	50%	9	1:10	5.6
6/8/2012	15:00	8	2	12.50	0.08	0.64%	1200	50%	9	1:10	5.6
6/8/2012	15:00	6	2	12.50	0.03	0.20%	1200	50%	9	1:10	5.6
6/8/2012	15:00	6	2	13.00	0.03	0.19%	1200	50%	9	1:10	5.6
6/8/2012	15:00	4	2	14.25	0.02	0.14%	1200	50%	9	1:10	5.6
6/8/2012	15:00	4	2	12.50	0.02	0.16%	1200	50%	9	1:10	5.6
6/8/2012	15:00	2	2	12.25	0.02	0.16%	1200	50%	9	1:10	5.6
6/8/2012	15:00	2	2	12.00	0.02	0.17%	1200	50%	9	1:10	5.6
6/8/2012	15:30	8	3	10.75	0.30	2.79%	2000	100%	9	1:10	5.6
6/8/2012	15:30	8	3	10.50	0.25	2.38%	2000	100%	9	1:10	5.6
6/8/2012	15:30	6	3	9.00	0.02	0.22%	2000	100%	9	1:10	5.6
6/8/2012	15:30	6	3	9.25	0.03	0.32%	2000	100%	9	1:10	5.6
6/8/2012	15:30	4	3	11.00	0.03	0.27%	2000	100%	9	1:10	5.6
6/8/2012	15:30	4	3	11.00	0.03	0.27%	2000	100%	9	1:10	5.6
6/8/2012	15:30	2	3	8.50	0.02	0.24%	2000	100%	9	1:10	5.6
6/8/2012	15:30	2	3	10.50	0.02	0.19%	2000	100%	9	1:10	5.6
6/11/2012	15:40	8	1	14.75	0.03	0.20%	1200	50%	9	1:10	5.6
6/11/2012	15:40	8	1	11.75	0.03	0.26%	1200	50%	9	1:10	5.6
6/11/2012	15:40	6	1	11.25	0.03	0.27%	1200	50%	9	1:10	5.6
6/11/2012	15:40	6	1	12.25	0.03	0.24%	1200	50%	9	1:10	5.6
6/11/2012	15:40	4	1	11.75	0.04	0.30%	1200	50%	9	1:10	5.6
6/11/2012	15:40	4	1	12.50	0.03	0.24%	1200	50%	9	1:10	5.6
6/11/2012	15:40	2	1	11.75	0.05	0.43%	1200	50%	9	1:10	5.6
6/11/2012	15:40	2	1	12.75	0.05	0.39%	1200	50%	9	1:10	5.6
6/12/2012	15:40	8	1	13.25	0.02	0.15%	1200	50%	1	1:10	5.6
6/12/2012	15:40	8	1	13.00	0.02	0.15%	1200	50%	1	1:10	5.6
6/12/2012	15:40	6	1	11.50	0.02	0.17%	1200	50%	1	1:10	5.6
6/12/2012	15:40	6	1	11.00	0.02	0.18%	1200	50%	1	1:10	5.6
6/12/2012	15:40	4	1	13.00	0.02	0.17%	1200	50%	1	1:10	5.6
6/12/2012	15:40	4	1	13.25	0.02	0.17%	1200	50%	1	1:10	5.6
6/12/2012	15:40	2	1	12.00	0.03	0.21%	1200	50%	1	1:10	5.6
6/12/2012	15:40	2	1	10.50	0.03	0.24%	1200	50%	1	1:10	5.6
6/12/2012	16:00	8	2	11.50	0.60	5.22%	1200	100%	1	1:10	5.6
6/12/2012	16:00	8	2	11.75	0.70	5.96%	1200	100%	1	1:10	5.6
6/12/2012	16:00	6	2	10.00	0.60	6.00%	1200	100%	1	1:10	5.6
6/12/2012	16:00	6	2	10.25	0.55	5.37%	1200	100%	1	1:10	5.6
6/12/2012	16:00	4	2	12.50	0.60	4.80%	1200	100%	1	1:10	5.6
6/12/2012	16:00	4	2	11.50	0.50	4.35%	1200	100%	1	1:10	5.6
6/12/2012	16:00	2	2	11.75	0.30	2.55%	1200	100%	1	1:10	5.6
6/12/2012	16:00	2	2	11.25	0.30	2.67%	1200	100%	1	1:10	5.6
6/12/2012	16:40	8	3	12.00	0.10	0.83%	2000	100%	1	1:10	5.6

[40] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[41]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
6/12/2012	16:40	8	3	11.00	0.09	0.82%	2000	100%	1	1:10	5.6
6/12/2012	16:40	6	3	10.25	0.05	0.49%	2000	100%	1	1:10	5.6
6/12/2012	16:40	6	3	9.50	0.05	0.53%	2000	100%	1	1:10	5.6
6/12/2012	16:40	4	3	11.25	0.06	0.53%	2000	100%	1	1:10	5.6
6/12/2012	16:40	4	3	12.50	0.06	0.48%	2000	100%	1	1:10	5.6
6/12/2012	16:40	2	3	11.00	0.02	0.18%	2000	100%	1	1:10	5.6
6/12/2012	16:40	2	3	11.75	0.02	0.17%	2000	100%	1	1:10	5.6
6/13/2012	10:45	8	1	10.50	0.09	0.86%	2200	100%	1	1:10	5.6
6/13/2012	10:45	8	1	11.50	0.10	0.87%	2200	100%	1	1:10	5.6
6/13/2012	10:45	6	1	10.25	0.05	0.49%	2200	100%	1	1:10	5.6
6/13/2012	10:45	6	1	8.50	0.04	0.47%	2200	100%	1	1:10	5.6
6/13/2012	10:45	4	1	12.50	0.05	0.40%	2200	100%	1	1:10	5.6
6/13/2012	10:45	4	1	12.00	0.05	0.42%	2200	100%	1	1:10	5.6
6/13/2012	10:45	2	1	11.00	0.03	0.23%	2200	100%	1	1:10	5.6
6/13/2012	10:45	2	1	10.25	0.02	0.20%	2200	100%	1	1:10	5.6
6/13/2012	11:12	8	2	11.00	0.18	1.64%	2200	110%	1	1:11	5.6
6/13/2012	11:12	8	2	11.50	0.19	1.65%	2200	110%	1	1:11	5.6
6/13/2012	11:12	6	2	11.50	0.10	0.87%	2200	110%	1	1:11	5.6
6/13/2012	11:12	6	2	11.00	0.10	0.91%	2200	110%	1	1:11	5.6
6/13/2012	11:12	4	2	11.25	0.10	0.89%	2200	110%	1	1:11	5.6
6/13/2012	11:12	4	2	11.00	0.10	0.91%	2200	110%	1	1:11	5.6
6/13/2012	11:12	2	2	12.25	0.03	0.24%	2200	110%	1	1:11	5.6
6/13/2012	11:12	2	2	11.50	0.03	0.26%	2200	110%	1	1:11	5.6
6/13/2012	11:45	8	3	9.25	0.30	3.24%	2200	121%	1	1:21.1	5.6
6/13/2012	11:45	8	3	10.00	0.30	3.00%	2200	121%	1	1:21.1	5.6
6/13/2012	11:45	6	3	10.25	0.15	1.46%	2200	121%	1	1:21.1	5.6
6/13/2012	11:45	6	3	10.00	0.15	1.50%	2200	121%	1	1:21.1	5.6
6/13/2012	11:45	4	3	10.00	0.12	1.20%	2200	121%	1	1:21.1	5.6
6/13/2012	11:45	4	3	10.50	0.12	1.14%	2200	121%	1	1:21.1	5.6
6/13/2012	11:45	2	3	11.00	0.06	0.55%	2200	121%	1	1:21.1	5.6
6/13/2012	11:45	2	3	9.50	0.06	0.63%	2200	121%	1	1:21.1	5.6
6/13/2012	12:11	2	4	8.00	0.04	0.50%	2200	134%	1	1:13.4	5.6
6/13/2012	12:11	2	4	9.50	0.04	0.42%	2200	134%	1	1:13.4	5.6
6/13/2012	12:11	4	4	10.50	0.13	1.24%	2200	134%	1	1:13.4	5.6
6/13/2012	12:11	4	4	10.75	0.13	1.21%	2200	134%	1	1:13.4	5.6
6/13/2012	12:11	6	4	10.00	0.12	1.20%	2200	134%	1	1:13.4	5.6
6/13/2012	12:11	6	4	9.00	0.10	1.11%	2200	134%	1	1:13.4	5.6
6/13/2012	12:11	8	4	9.00	0.20	2.22%	2200	134%	1	1:13.4	5.6
6/13/2012	12:11	8	4	9.00	0.20	2.22%	2200	134%	1	1:13.4	5.6
6/19/2012	12:10	2	1	9.50	0.03	0.32%	2000	100%	1	1:10	5.6
6/19/2012	12:10	2	1	10.25	0.03	0.29%	2000	100%	1	1:10	5.6
6/19/2012	12:10	4	1	11.00	0.20	1.82%	2000	100%	1	1:10	5.6
6/19/2012	12:10	4	1	9.50	0.18	1.84%	2000	100%	1	1:10	5.6
6/19/2012	12:10	6	1	9.00	0.10	1.11%	2000	100%	1	1:10	5.6
6/19/2012	12:10	6	1	9.75	0.10	1.03%	2000	100%	1	1:10	5.6
6/19/2012	12:10	8	1	9.25	0.15	1.62%	2000	100%	1	1:10	5.6
6/19/2012	12:10	8	1	8.50	0.15	1.76%	2000	100%	1	1:10	5.6
6/19/2012	12:10	12	1	9.75	0.18	1.79%	2000	100%	1	1:10	5.6
6/19/2012	12:10	12	1	10.00	0.18	1.75%	2000	100%	1	1:10	5.6
6/19/2012	12:10	14	1	11.25	0.20	1.78%	2000	100%	1	1:10	5.6
6/19/2012	12:10	14	1	10.75	0.20	1.86%	2000	100%	1	1:10	5.6

[41] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[42]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
6/19/2012	12:10	20	1	12.00	0.02	0.17%	2000	100%	1	1:10	5.6
6/19/2012	12:10	20	1	12.25	0.02	0.16%	2000	100%	1	1:10	5.6
6/19/2012	12:10	22	1	11.00	0.02	0.18%	2000	100%	1	1:10	5.6
6/19/2012	12:10	22	1	11.00	0.02	0.18%	2000	100%	1	1:10	5.6
6/19/2012	12:10	24	1	12.50	0.03	0.24%	2000	100%	1	1:10	5.6
6/19/2012	12:10	24	1	11.25	0.02	0.18%	2000	100%	1	1:10	5.6
6/19/2012	12:10	18	1	12.25	0.02	0.12%	2000	100%	1	1:10	5.6
6/19/2012	12:10	18	1	12.25	0.02	0.16%	2000	100%	1	1:10	5.6
6/19/2012	12:10	28	1	12.00	0.02	0.17%	2000	100%	1	1:10	5.6
6/19/2012	12:10	28	1	11.75	0.02	0.17%	2000	100%	1	1:10	5.6
6/19/2012	13:57	2	2	9.00	0.09	1.00%	2000	134%	1	1:13.4	5.6
6/19/2012	13:57	2	2	9.75	0.09	0.92%	2000	134%	1	1:13.4	5.6
6/19/2012	13:57	4	2	9.00	0.25	2.78%	2000	134%	1	1:13.4	5.6
6/19/2012	13:57	4	2	10.00	0.30	3.00%	2000	134%	1	1:13.4	5.6
6/19/2012	13:57	6	2	8.75	0.15	1.71%	2000	134%	1	1:13.4	5.6
6/19/2012	13:57	6	2	9.50	0.15	1.58%	2000	134%	1	1:13.4	5.6
6/19/2012	13:57	8	2	9.00	0.70	7.78%	2000	134%	1	1:13.4	5.6
6/19/2012	13:57	8	2	9.50	0.70	7.37%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	2	3	8.25	0.03	0.36%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	2	3	10.25	0.04	0.39%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	4	3	10.50	0.15	1.43%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	4	3	9.50	0.15	1.58%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	6	3	9.25	0.15	1.62%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	6	3	9.25	0.15	1.62%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	8	3	9.00	0.20	2.22%	2000	134%	1	1:13.4	5.6
6/19/2012	15:05	8	3	9.00	0.25	2.78%	2000	134%	1	1:13.4	5.6
6/19/2012	15:20	2	4	10.75	0.03	0.28%	2200	134%	1	1:13.4	5.6
6/19/2012	15:20	2	4	9.75	0.03	0.31%	2200	134%	1	1:13.4	5.6
6/19/2012	15:20	4	4	10.50	0.10	0.95%	2200	134%	1	1:13.4	5.6
6/19/2012	15:20	4	4	9.75	0.10	1.03%	2200	134%	1	1:13.4	5.6
6/19/2012	15:20	6	4	10.00	0.15	1.50%	2200	134%	1	1:13.4	5.6
6/19/2012	15:20	6	4	8.50	0.12	1.41%	2200	134%	1	1:13.4	5.6
6/19/2012	15:20	8	4	10.50	0.20	1.90%	2200	134%	1	1:13.4	5.6
6/19/2012	15:20	8	4	8.75	0.20	2.29%	2200	134%	1	1:13.4	5.6
6/19/2012	16:00	12	5	10.00	0.10	1.00%	2200	134%	1	1:13.4	5.6
6/19/2012	16:00	12	5	11.00	0.10	0.91%	2200	134%	1	1:13.4	5.6
6/19/2012	16:00	14	5	9.50	0.08	0.84%	2200	134%	1	1:13.4	5.6
6/19/2012	16:00	14	5	9.00	0.08	0.89%	2200	134%	1	1:13.4	5.6
6/19/2012	16:30	2	6	10.50	0.04	0.38%	2200	134%	1	1:10	5.6
6/19/2012	16:30	2	6	10.00	0.03	0.30%	2200	134%	1	1:10	5.6
6/19/2012	16:30	4	6	9.25	0.08	0.86%	2200	134%	1	1:10	5.6
6/19/2012	16:30	4	6	9.00	0.07	0.78%	2200	134%	1	1:10	5.6
6/19/2012	16:30	6	6	9.25	0.09	0.97%	2200	134%	1	1:10	5.6
6/19/2012	16:30	6	6	8.75	0.09	1.03%	2200	134%	1	1:10	5.6
6/19/2012	16:30	8	6	9.75	0.25	2.56%	2200	134%	1	1:10	5.6
6/19/2012	16:30	8	6	9.50	0.25	2.63%	2200	134%	1	1:10	5.6
6/19/2012	16:50	2	7	9.75	0.07	0.72%	2200	134%	1	1:20	5.6
6/19/2012	16:50	2	7	10.25	0.08	0.78%	2200	134%	1	1:20	5.6
6/19/2012	16:50	4	7	10.25	0.15	1.46%	2200	134%	1	1:20	5.6
6/19/2012	16:50	4	7	10.50	0.15	1.43%	2200	134%	1	1:20	5.6
6/19/2012	16:50	6	7	10.00	0.08	0.80%	2200	134%	1	1:20	5.6

[42] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[43]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
6/19/2012	16:50	6	7	9.25	0.07	0.76%	2200	134%	1	1:20	5.6
6/19/2012	16:50	8	7	10.50	0.10	0.95%	2200	134%	1	1:20	5.6
6/19/2012	16:50	8	7	9.00	0.10	1.11%	2200	134%	1	1:20	5.6
6/20/2012	16:50	12	2	10.00	0.12	1.20%	2200	134%	1	1:10	5.6
6/20/2012	16:50	12	2	9.00	0.10	1.11%	2200	134%	1	1:10	5.6
6/20/2012	16:50	14	2	9.50	0.10	1.05%	2200	134%	1	1:10	5.6
6/20/2012	16:50	14	2	9.25	0.10	1.08%	2200	134%	1	1:10	5.6
6/21/2012	11:44	2	1	10.00	0.05	0.50%	2200	134%	10	1:10	5.6
6/21/2012	11:44	2	1	10.00	0.05	0.50%	2200	134%	10	1:10	5.6
6/21/2012	11:44	4	1	9.50	0.11	1.16%	2200	134%	10	1:10	5.6
6/21/2012	11:44	4	1	9.50	0.11	1.16%	2200	134%	10	1:10	5.6
6/21/2012	11:44	6	1	9.25	0.18	1.95%	2200	134%	10	1:10	5.6
6/21/2012	11:44	6	1	9.25	0.17	1.84%	2200	134%	10	1:10	5.6
6/21/2012	11:44	8	1	8.75	0.30	3.43%	2200	134%	10	1:10	5.6
6/21/2012	11:44	8	1	10.00	0.35	3.50%	2200	134%	10	1:10	5.6
6/21/2012	12:00	2	2	10.25	0.06	0.59%	2200	134%	10	1:10	5.6
6/21/2012	12:00	2	2	10.75	0.06	0.56%	2200	134%	10	1:10	5.6
6/21/2012	12:00	4	2	10.25	0.17	1.66%	2200	134%	10	1:10	5.6
6/21/2012	12:00	4	2	9.50	0.32	3.37%	2200	134%	10	1:10	5.6
6/21/2012	12:00	6	2	8.25	0.12	1.45%	2200	134%	10	1:10	5.6
6/21/2012	12:00	6	2	10.75	0.22	2.05%	2200	134%	10	1:10	5.6
6/21/2012	12:00	8	2	9.50	0.40	4.21%	2200	134%	10	1:10	5.6
6/21/2012	12:00	8	2	8.50	0.12	1.41%	2200	134%	10	1:10	5.6
6/21/2012	12:22	2	3	11.25	0.05	0.44%	2200	134%	10	1:10	5.6
6/21/2012	12:22	2	3	11.00	0.05	0.45%	2200	134%	10	1:10	5.6
6/21/2012	12:22	4	3	10.40	0.20	1.92%	2200	134%	10	1:10	5.6
6/21/2012	12:22	4	3	10.50	0.18	1.71%	2200	134%	10	1:10	5.6
6/21/2012	12:22	6	3	11.75	0.27	2.30%	2200	134%	10	1:10	5.6
6/21/2012	12:22	6	3	12.00	0.28	2.33%	2200	134%	10	1:10	5.6
6/21/2012	12:22	8	3	11.10	0.45	4.05%	2200	134%	10	1:10	5.6
6/21/2012	12:22	8	3	11.00	0.45	4.09%	2200	134%	10	1:10	5.6
6/21/2012	12:22	12	3	8.50	0.12	1.41%	2200	134%	10	1:10	5.6
6/21/2012	12:22	12	3	9.00	0.08	0.89%	2200	134%	10	1:10	5.6
6/21/2012	12:22	14	3	9.50	0.11	1.16%	2200	134%	10	1:10	5.6
6/21/2012	12:22	14	3	9.00	0.10	1.11%	2200	134%	10	1:10	5.6
6/21/2012	12:22	18	3	10.00	0.02	0.20%	2200	134%	10	1:10	5.6
6/21/2012	12:22	18	3	11.50	0.03	0.22%	2200	134%	10	1:10	5.6
6/21/2012	12:22	20	3	9.25	0.03	0.32%	2200	134%	10	1:10	5.6
6/21/2012	12:22	20	3	10.25	0.03	0.29%	2200	134%	10	1:10	5.6
6/21/2012	12:22	22	3	10.00	0.03	0.30%	2200	134%	10	1:10	5.6
6/21/2012	12:22	22	3	10.25	0.04	0.39%	2200	134%	10	1:10	5.6
6/21/2012	12:22	24	3	11.50	0.10	0.87%	2200	134%	10	1:10	5.6
6/21/2012	12:22	24	3	11.00	0.08	0.73%	2200	134%	10	1:10	5.6
6/21/2012	12:22	28	3	11.25	0.03	0.27%	2200	134%	10	1:10	5.6
6/21/2012	12:22	28	3	9.75	0.03	0.26%	2200	134%	10	1:10	5.6
6/27/2012	13:53	2	1	10.00	0.03	0.30%	2000	134%	10	1:10	5.6
6/27/2012	13:53	2	1	10.00	0.03	0.30%	2000	134%	10	1:10	5.6
6/27/2012	13:53	4	1	8.00	0.09	1.13%	2000	134%	10	1:10	5.6
6/27/2012	13:53	4	1	9.50	0.10	1.05%	2000	134%	10	1:10	5.6
6/27/2012	13:53	6	1	8.00	0.08	1.00%	2000	134%	10	1:10	5.6
6/27/2012	13:53	6	1	8.25	0.08	0.97%	2000	134%	10	1:10	5.6

[43] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[44]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
6/27/2012	13:53	8	1	7.75	0.15	1.94%	2000	134%	10	1:10	5.6
6/27/2012	13:53	8	1	7.25	0.15	2.07%	2000	134%	10	1:10	5.6
6/27/2012	15:35	2	2	10.25	0.05	0.49%	2000	134%	10	1:10	5.6
6/27/2012	15:35	2	2	9.75	0.05	0.51%	2000	134%	10	1:10	5.6
6/27/2012	15:35	4	2	10.00	0.15	1.50%	2000	134%	10	1:10	5.6
6/27/2012	15:35	4	2	8.50	0.15	1.76%	2000	134%	10	1:10	5.6
6/27/2012	15:35	6	2	10.00	0.10	1.00%	2000	134%	10	1:10	5.6
6/27/2012	15:35	6	2	9.75	0.10	1.03%	2000	134%	10	1:10	5.6
6/27/2012	15:35	8	2	8.75	0.40	4.57%	2000	134%	10	1:10	5.6
6/27/2012	15:35	8	2	9.25	0.35	3.78%	2000	134%	10	1:10	5.6
6/27/2012	15:35	12	2	9.75	0.13	1.33%	2000	134%	10	1:10	5.6
6/27/2012	15:35	12	2	9.10	0.12	1.32%	2000	134%	10	1:10	5.6
6/27/2012	15:35	14	2	9.40	0.11	1.17%	2000	134%	10	1:10	5.6
6/27/2012	15:35	14	2	8.50	0.10	1.18%	2000	134%	10	1:10	5.6
6/27/2012	15:35	18	2	9.85	0.02	0.20%	2000	134%	10	1:10	5.6
6/27/2012	15:35	18	2	11.50	0.03	0.26%	2000	134%	10	1:10	5.6
6/27/2012	15:35	20	2	9.50	0.02	0.21%	2000	134%	10	1:10	5.6
6/27/2012	15:35	20	2	10.80	0.03	0.28%	2000	134%	10	1:10	5.6
6/27/2012	15:35	22	2	10.75	0.04	0.33%	2000	134%	10	1:10	5.6
6/27/2012	15:35	22	2	10.10	0.04	0.35%	2000	134%	10	1:10	5.6
6/27/2012	15:35	24	2	11.10	0.08	0.68%	2000	134%	10	1:10	5.6
6/27/2012	15:35	24	2	11.50	0.08	0.65%	2000	134%	10	1:10	5.6
6/27/2012	15:35	28	2	11.20	0.03	0.27%	2000	134%	10	1:10	5.6
6/27/2012	15:35	28	2	10.75	0.03	0.28%	2000	134%	10	1:10	5.6
6/27/2012	16:12	2	3	10.25	0.05	0.49%	2200	134%	10	1:10	5.6
6/27/2012	16:12	2	3	9.75	0.05	0.51%	2200	134%	10	1:10	5.6
6/27/2012	16:12	4	3	8.75	0.07	0.80%	2200	134%	10	1:10	5.6
6/27/2012	16:12	4	3	9.75	0.10	0.97%	2200	134%	10	1:10	5.6
6/27/2012	16:12	6	3	8.75	0.13	1.43%	2200	134%	10	1:10	5.6
6/27/2012	16:12	6	3	9.25	0.13	1.35%	2200	134%	10	1:10	5.6
6/27/2012	16:12	8	3	8.75	0.28	3.14%	2200	134%	10	1:10	5.6
6/27/2012	16:12	8	3	8.75	0.30	3.43%	2200	134%	10	1:10	5.6
7/2/2012	15:00	2	1	14.00	0.90	6.43%	1200	75%	10	1:10	5.6
7/2/2012	15:00	2	1	13.00	0.80	6.15%	1200	75%	10	1:10	5.6
7/2/2012	15:00	4	1	12.90	0.45	3.49%	1200	75%	10	1:10	5.6
7/2/2012	15:00	4	1	12.80	0.40	3.13%	1200	75%	10	1:10	5.6
7/2/2012	15:00	6	1	12.75	0.45	3.53%	1200	75%	10	1:10	5.6
7/2/2012	15:00	6	1	13.75	0.45	3.27%	1200	75%	10	1:10	5.6
7/2/2012	15:00	8	1	14.60	0.25	1.71%	1200	75%	10	1:10	5.6
7/2/2012	15:00	8	1	12.60	0.20	1.59%	1200	75%	10	1:10	5.6
7/3/2012	11:09	2	1	10.50	0.03	0.29%	1500	75%	10	1:10	5.6
7/3/2012	11:09	2	1	9.25	0.03	0.32%	1500	75%	10	1:10	5.6
7/3/2012	11:09	4	1	10.00	0.20	2.00%	1500	75%	10	1:10	5.6
7/3/2012	11:09	4	1	9.00	0.20	2.22%	1500	75%	10	1:10	5.6
7/3/2012	11:09	6	1	9.75	0.15	1.54%	1500	75%	10	1:10	5.6
7/3/2012	11:09	6	1	10.00	0.15	1.50%	1500	75%	10	1:10	5.6
7/3/2012	11:09	8	1	9.25	0.30	3.24%	1500	75%	10	1:10	5.6
7/3/2012	11:09	8	1	10.50	0.35	3.33%	1500	75%	10	1:10	5.6
7/3/2012	11:09	12	1	11.25	0.08	0.71%	1500	75%	10	1:10	5.6
7/3/2012	11:09	12	1	11.00	0.08	0.73%	1500	75%	10	1:10	5.6
7/3/2012	11:09	14	1	11.00	0.08	0.73%	1500	75%	10	1:10	5.6

[44] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[45]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
7/3/2012	11:09	14	1	10.75	0.08	0.74%	1500	75%	10	1:10	5.6
7/3/2012	11:48	2	2	9.75	0.02	0.21%	1700	75%	10	1:10	5.6
7/3/2012	11:48	2	2	10.00	0.02	0.20%	1700	75%	10	1:10	5.6
7/3/2012	11:48	4	2	8.75	0.15	1.71%	1700	75%	10	1:10	5.6
7/3/2012	11:48	4	2	9.25	0.15	1.62%	1700	75%	10	1:10	5.6
7/3/2012	11:48	6	2	9.40	0.10	1.06%	1700	75%	10	1:10	5.6
7/3/2012	11:48	6	2	9.75	0.10	1.03%	1700	75%	10	1:10	5.6
7/3/2012	11:48	8	2	9.50	0.25	2.63%	1700	75%	10	1:10	5.6
7/3/2012	11:48	8	2	9.50	0.25	2.63%	1700	75%	10	1:10	5.6
7/3/2012	13:45	2	3	10.50	0.02	0.19%	1700	75%	10	1:10	5.6
7/3/2012	13:45	2	3	11.00	0.02	0.18%	1700	75%	10	1:10	5.6
7/3/2012	13:45	4	3	11.25	0.09	0.80%	1700	75%	10	1:10	5.6
7/3/2012	13:45	4	3	11.75	0.09	0.77%	1700	75%	10	1:10	5.6
7/3/2012	13:45	6	3	7.50	0.06	0.80%	1700	75%	10	1:10	5.6
7/3/2012	13:45	6	3	10.25	0.06	0.59%	1700	75%	10	1:10	5.6
7/3/2012	13:45	8	3	10.75	0.13	1.16%	1700	75%	10	1:10	5.6
7/3/2012	13:45	8	3	11.25	0.13	1.11%	1700	75%	10	1:10	5.6
7/3/2012	13:45	12	3	10.50	0.09	0.86%	1700	75%	10	1:10	5.6
7/3/2012	13:45	12	3	8.50	0.08	0.94%	1700	75%	10	1:10	5.6
7/3/2012	13:45	14	3	9.75	0.08	0.82%	1700	75%	10	1:10	5.6
7/3/2012	13:45	14	3	10.25	0.08	0.78%	1700	75%	10	1:10	5.6
7/3/2012	13:45	18	3	11.50	0.02	0.17%	1700	75%	10	1:10	5.6
7/3/2012	13:45	18	3	12.25	0.03	0.20%	1700	75%	10	1:10	5.6
7/3/2012	13:45	20	3	11.75	0.02	0.17%	1700	75%	10	1:10	5.6
7/3/2012	13:45	20	3	10.25	0.02	0.20%	1700	75%	10	1:10	5.6
7/3/2012	13:45	22	3	11.50	0.03	0.22%	1700	75%	10	1:10	5.6
7/3/2012	13:45	22	3	10.25	0.02	0.20%	1700	75%	10	1:10	5.6
7/3/2012	13:45	24	3	13.50	0.07	0.52%	1700	75%	10	1:10	5.6
7/3/2012	13:45	24	3	9.75	0.03	0.31%	1700	75%	10	1:10	5.6
7/3/2012	13:45	28	3	10.25	0.02	0.20%	1700	75%	10	1:10	5.6
7/3/2012	13:45	28	3	13.25	0.02	0.15%	1700	75%	10	1:10	5.6
7/10/2012	15:45	2	1	9.50	0.03	0.32%	2200	121%	11	1:10	5.6
7/10/2012	15:45	2	1	9.25	0.03	0.32%	2200	121%	11	1:10	5.6
7/10/2012	15:45	4	1	9.25	0.10	1.08%	2200	121%	11	1:10	5.6
7/10/2012	15:45	4	1	8.50	0.09	1.06%	2200	121%	11	1:10	5.6
7/10/2012	15:45	6	1	8.50	0.10	1.18%	2200	121%	11	1:10	5.6
7/10/2012	15:45	6	1	9.50	0.10	1.05%	2200	121%	11	1:10	5.6
7/10/2012	15:45	8	1	9.00	0.30	3.33%	2200	121%	11	1:10	5.6
7/10/2012	15:45	8	1	9.75	0.30	3.08%	2200	121%	11	1:10	5.6
7/10/2012	15:45	12	1	8.75	0.10	1.14%	2200	121%	11	1:10	5.6
7/10/2012	15:45	12	1	7.00	0.08	1.14%	2200	121%	11	1:10	5.6
7/10/2012	15:45	14	1	9.00	0.10	1.11%	2200	121%	11	1:10	5.6
7/10/2012	15:45	14	1	9.50	0.10	1.05%	2200	121%	11	1:10	5.6
7/10/2012	15:45	18	1	10.75	0.03	0.23%	2200	121%	11	1:10	5.6
7/10/2012	15:45	18	1	11.50	0.03	0.22%	2200	121%	11	1:10	5.6
7/10/2012	15:45	20	1	10.20	0.03	0.29%	2200	121%	11	1:10	5.6
7/10/2012	15:45	20	1	11.50	0.04	0.30%	2200	121%	11	1:10	5.6
7/10/2012	15:45	22	1	10.25	0.03	0.24%	2200	121%	11	1:10	5.6
7/10/2012	15:45	22	1	9.00	0.03	0.28%	2200	121%	11	1:10	5.6
7/10/2012	15:45	24	1	11.50	0.07	0.61%	2200	121%	11	1:10	5.6
7/10/2012	15:45	24	1	11.25	0.07	0.62%	2200	121%	11	1:10	5.6

[45] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[46]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
7/10/2012	15:45	28	1	12.50	0.03	0.24%	2200	121%	11	1:10	5.6
7/10/2012	15:45	28	1	9.00	0.03	0.33%	2200	121%	11	1:10	5.6
7/17/2012	10:49	2	1	9.75	0.03	0.31%	2200	110%	11	1:10	5.6
7/17/2012	10:49	2	1	10.00	0.03	0.30%	2200	110%	11	1:10	5.6
7/17/2012	10:49	4	1	9.25	0.10	1.08%	2200	110%	11	1:10	5.6
7/17/2012	10:49	4	1	9.75	0.10	1.03%	2200	110%	11	1:10	5.6
7/17/2012	10:49	6	1	9.50	0.15	1.58%	2200	110%	11	1:10	5.6
7/17/2012	10:49	6	1	9.75	0.15	1.54%	2200	110%	11	1:10	5.6
7/17/2012	10:49	8	1	9.25	0.30	3.24%	2200	110%	11	1:10	5.6
7/17/2012	10:49	8	1	9.25	0.35	3.78%	2200	110%	11	1:10	5.6
7/17/2012	10:49	12	1	8.00	0.10	1.25%	2200	110%	11	1:10	5.6
7/17/2012	10:49	12	1	9.25	0.10	1.08%	2200	110%	11	1:10	5.6
7/17/2012	10:49	14	1	8.75	0.10	1.14%	2200	110%	11	1:10	5.6
7/17/2012	10:49	14	1	8.50	0.10	1.18%	2200	110%	11	1:10	5.6
7/17/2012	10:49	18	1	11.75	0.03	0.21%	2200	110%	11	1:10	5.6
7/17/2012	10:49	18	1	11.00	0.03	0.23%	2200	110%	11	1:10	5.6
7/17/2012	10:49	20	1	11.00	0.03	0.27%	2200	110%	11	1:10	5.6
7/17/2012	10:49	20	1	10.50	0.03	0.29%	2200	110%	11	1:10	5.6
7/17/2012	10:49	22	1	11.75	0.03	0.26%	2200	110%	11	1:10	5.6
7/17/2012	10:49	22	1	10.00	0.03	0.30%	2200	110%	11	1:10	5.6
7/17/2012	10:49	24	1	10.25	0.05	0.49%	2200	110%	11	1:10	5.6
7/17/2012	10:49	24	1	10.25	0.04	0.39%	2200	110%	11	1:10	5.6
7/17/2012	10:49	28	1	10.75	0.02	0.19%	2200	110%	11	1:10	5.6
7/17/2012	10:49	28	1	11.00	0.02	0.18%	2200	110%	11	1:10	5.6
7/17/2012	12:30	2	2	8.30	0.03	0.36%	2200	150%	11	1:10	5.6
7/17/2012	12:30	2	2	8.50	0.02	0.24%	2200	150%	11	1:10	5.6
7/17/2012	12:30	4	2	9.25	0.10	1.08%	2200	150%	11	1:10	5.6
7/17/2012	12:30	4	2	8.00	0.08	0.94%	2200	150%	11	1:10	5.6
7/17/2012	12:30	6	2	9.65	0.15	1.55%	2200	150%	11	1:10	5.6
7/17/2012	12:30	6	2	9.75	0.15	1.54%	2200	150%	11	1:10	5.6
7/17/2012	12:30	8	2	8.50	0.20	2.35%	2200	150%	11	1:10	5.6
7/17/2012	12:30	8	2	9.25	0.20	2.16%	2200	150%	11	1:10	5.6
7/17/2012	12:50	2	2	11.00	0.04	0.36%	2200	160%	11	1:10.7	5.6
7/17/2012	12:50	2	2	11.50	0.04	0.35%	2200	160%	11	1:10.7	5.6
7/17/2012	12:50	4	2	11.75	0.13	1.06%	2200	160%	11	1:10.7	5.6
7/17/2012	12:50	4	2	10.40	0.13	1.20%	2200	160%	11	1:10.7	5.6
7/17/2012	12:50	6	2	10.90	0.23	2.06%	2200	160%	11	1:10.7	5.6
7/17/2012	12:50	6	2	11.40	0.20	1.75%	2200	160%	11	1:10.7	5.6
7/17/2012	12:50	8	2	10.75	0.35	3.26%	2200	160%	11	1:10.7	5.6
7/17/2012	12:50	8	2	10.50	0.33	3.10%	2200	160%	11	1:10.7	5.6
7/26/2012	14:15	14	1	8.90	0.09	1.01%	1500	100%	12	1:10	5.6
7/26/2012	14:15	14	1	9.25	0.09	0.97%	1500	100%	12	1:10	5.6
7/26/2012	14:15	12	1	8.70	0.09	1.03%	1500	100%	12	1:10	5.6
7/26/2012	14:15	12	1	9.75	0.10	1.03%	1500	100%	12	1:10	5.6
7/26/2012	14:22	14	2	11.50	0.20	1.74%	1500	100%	12	1:10	5.6
7/26/2012	14:22	14	2	11.00	0.20	1.82%	1500	100%	12	1:10	5.6
7/26/2012	14:22	12	2	10.50	0.13	1.24%	1500	100%	12	1:10	5.6
7/26/2012	14:22	12	2	8.30	0.10	1.20%	1500	100%	12	1:10	5.6
7/26/2012	14:35	14	3	10.80	0.14	1.30%	1500	100%	12	1:10	5.6
7/26/2012	14:35	14	3	11.00	0.15	1.36%	1500	100%	12	1:10	5.6
7/26/2012	14:35	12	3	10.25	0.15	1.46%	1500	100%	12	1:10	5.6

[46] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[47]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
7/26/2012	14:35	12	3	10.75	0.15	1.40%	1500	100%	12	1:10	5.6
7/26/2012	14:51	14	4	7.00	0.08	1.07%	1500	100%	12	1:10	5.6
7/26/2012	14:51	14	4	9.50	0.10	1.05%	1500	100%	12	1:10	5.6
7/26/2012	14:51	12	4	8.50	0.08	0.88%	1500	100%	12	1:10	5.6
7/26/2012	14:51	12	4	10.00	0.09	0.90%	1500	100%	12	1:10	5.6
7/31/2012	16:30	2	1	8.75	0.04	0.46%	2200	134%	12	1:10	5.6
7/31/2012	16:30	2	1	8.25	0.04	0.48%	2200	134%	12	1:10	5.6
7/31/2012	16:30	4	1	8.75	0.10	1.14%	2200	134%	12	1:10	5.6
7/31/2012	16:30	4	1	9.50	0.10	1.05%	2200	134%	12	1:10	5.6
7/31/2012	16:30	6	1	10.50	0.20	1.90%	2200	134%	12	1:10	5.6
7/31/2012	16:30	6	1	9.00	0.15	1.67%	2200	134%	12	1:10	5.6
7/31/2012	16:30	8	1	8.75	0.25	2.86%	2200	134%	12	1:10	5.6
7/31/2012	16:30	8	1	7.25	0.25	3.45%	2200	134%	12	1:10	5.6
7/31/2012	16:30	12	1	7.50	0.10	1.33%	2200	134%	12	1:10	5.6
7/31/2012	16:30	12	1	8.25	0.13	1.52%	2200	134%	12	1:10	5.6
7/31/2012	16:30	14	1	9.00	0.18	1.94%	2200	134%	12	1:10	5.6
7/31/2012	16:30	14	1	8.00	0.15	1.88%	2200	134%	12	1:10	5.6
8/3/2012	14:04	2	1	8.50	0.03	0.29%	2000	100%	12	1:10	5.6
8/3/2012	14:04	2	1	9.00	0.03	0.28%	2000	100%	12	1:10	5.6
8/3/2012	14:04	4	1	10.75	0.09	0.84%	2000	100%	12	1:10	5.6
8/3/2012	14:04	4	1	10.00	0.09	0.90%	2000	100%	12	1:10	5.6
8/3/2012	14:04	6	1	8.25	0.08	0.91%	2000	100%	12	1:10	5.6
8/3/2012	14:04	6	1	8.50	0.08	0.88%	2000	100%	12	1:10	5.6
8/3/2012	14:04	8	1	9.25	0.20	2.16%	2000	100%	12	1:10	5.6
8/3/2012	14:04	8	1	8.50	0.20	2.35%	2000	100%	12	1:10	5.6
8/3/2012	14:04	12	1	10.50	0.10	0.95%	2000	100%	12	1:10	5.6
8/3/2012	14:04	12	1	10.50	0.10	0.95%	2000	100%	12	1:10	5.6
8/3/2012	14:04	14	1	9.50	0.09	0.95%	2000	100%	12	1:10	5.6
8/3/2012	14:04	14	1	9.50	0.09	0.95%	2000	100%	12	1:10	5.6
8/6/2012	14:20	2	1	11.00	0.03	0.27%	1700	75%	12	1:10	5.6
8/6/2012	14:20	2	1	10.00	0.03	0.30%	1700	75%	12	1:10	5.6
8/6/2012	14:20	4	1	10.25	0.15	1.46%	1700	75%	12	1:10	5.6
8/6/2012	14:20	4	1	10.50	0.15	1.43%	1700	75%	12	1:10	5.6
8/6/2012	14:20	6	1	11.50	0.08	0.65%	1700	75%	12	1:10	5.6
8/6/2012	14:20	6	1	9.25	0.08	0.81%	1700	75%	12	1:10	5.6
8/6/2012	14:20	8	1	11.50	0.20	1.74%	1700	75%	12	1:10	5.6
8/6/2012	14:20	8	1	11.00	0.20	1.82%	1700	75%	12	1:10	5.6
8/6/2012	14:20	12	1	11.00	0.08	0.73%	1700	75%	12	1:10	5.6
8/6/2012	14:20	12	1	11.00	0.08	0.73%	1700	75%	12	1:10	5.6
8/6/2012	14:20	14	1	9.25	0.04	0.43%	1700	75%	12	1:10	5.6
8/6/2012	14:20	14	1	10.25	0.04	0.39%	1700	75%	12	1:10	5.6
8/8/2012	14:00	2	1	10.00	0.05	0.50%	2100	110%	12	1:10	5.6
8/8/2012	14:00	2	1	10.75	0.05	0.47%	2100	110%	12	1:10	5.6
8/8/2012	14:00	4	1	10.25	0.13	1.22%	2100	110%	12	1:10	5.6
8/8/2012	14:00	4	1	9.25	0.13	1.35%	2100	110%	12	1:10	5.6
8/8/2012	14:00	6	1	9.50	0.13	1.32%	2100	110%	12	1:10	5.6
8/8/2012	14:00	6	1	8.25	0.13	1.52%	2100	110%	12	1:10	5.6
8/8/2012	14:00	8	1	8.00	0.25	3.13%	2100	110%	12	1:10	5.6
8/8/2012	14:00	8	1	10.75	0.30	2.79%	2100	110%	12	1:10	5.6
8/8/2012	14:00	12	1	12.00	0.13	1.04%	2100	110%	12	1:10	5.6
8/8/2012	14:00	12	1	10.50	0.10	0.95%	2100	110%	12	1:10	5.6

[47] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[48]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
8/8/2012	14:00	14	1	10.50	0.10	0.95%	2100	110%	12	1:10	5.6
8/8/2012	14:00	14	1	9.50	0.10	1.05%	2100	110%	12	1:10	5.6
8/9/2012	12:36	2	1	11.50	0.03	0.26%	1200	50%	12	1:10	5.6
8/9/2012	12:36	2	1	12.50	0.28	2.20%	1200	50%	12	1:10	5.6
8/9/2012	12:36	4	1	12.75	0.09	0.71%	1200	50%	12	1:10	5.6
8/9/2012	12:36	4	1	12.75	0.09	0.71%	1200	50%	12	1:10	5.6
8/9/2012	12:36	6	1	13.25	0.09	0.68%	1200	50%	12	1:10	5.6
8/9/2012	12:36	6	1	12.25	0.09	0.73%	1200	50%	12	1:10	5.6
8/9/2012	12:36	8	1	10.50	0.08	0.76%	1200	50%	12	1:10	5.6
8/9/2012	12:36	8	1	13.25	0.10	0.75%	1200	50%	12	1:10	5.6
8/9/2012	12:36	12	1	11.75	0.05	0.43%	1200	50%	12	1:10	5.6
8/9/2012	12:36	12	1	11.25	0.05	0.44%	1200	50%	12	1:10	5.6
8/9/2012	12:36	14	1	11.00	0.04	0.36%	1200	50%	12	1:10	5.6
8/9/2012	12:36	14	1	11.75	0.04	0.34%	1200	50%	12	1:10	5.6
8/9/2012	15:48	2	1	8.00	0.03	0.38%	2200	121%	12	1:10	5.6
8/9/2012	15:48	2	1	9.50	0.03	0.32%	2200	121%	12	1:10	5.6
8/9/2012	15:48	4	1	9.50	0.08	0.79%	2200	121%	12	1:10	5.6
8/9/2012	15:48	4	1	9.50	0.08	0.79%	2200	121%	12	1:10	5.6
8/9/2012	15:48	6	1	7.80	0.05	0.64%	2200	121%	12	1:10	5.6
8/9/2012	15:48	6	1	8.50	0.05	0.59%	2200	121%	12	1:10	5.6
8/9/2012	15:48	8	1	9.50	0.20	2.11%	2200	121%	12	1:10	5.6
8/9/2012	15:48	8	1	9.10	0.20	2.20%	2200	121%	12	1:10	5.6
8/9/2012	15:48	12	1	9.50	0.10	1.05%	2200	121%	12	1:10	5.6
8/9/2012	15:48	12	1	9.25	0.10	1.08%	2200	121%	12	1:10	5.6
8/9/2012	15:48	14	1	8.00	0.08	1.00%	2200	121%	12	1:10	5.6
8/9/2012	15:48	14	1	9.00	0.10	1.11%	2200	121%	12	1:10	5.6
9/4/2012	10:40	14	1	9.25	0.20	2.16%	2200	134%	12	1:10	5.6
9/4/2012	10:40	12	1	10.50	0.20	1.90%	2200	134%	12	1:10	5.6
9/4/2012	10:40	14	1	10.50	0.20	1.90%	2200	134%	12	1:10	5.6
9/4/2012	10:40	8	1	10.00	0.55	5.50%	2200	134%	12	1:10	5.6
9/4/2012	10:40	12	1	9.25	0.20	2.16%	2200	134%	12	1:10	5.6
9/4/2012	10:40	8	1	10.50	0.60	5.71%	2200	134%	12	1:10	5.6
9/4/2012	11:50	6	2	10.00	0.01	0.1%	2200	134%	12	1:10	5.6
9/4/2012	11:50	8	2	9.90	0.40	4.04%	2200	134%	12	1:10	5.6
9/4/2012	11:50	2	2	11.75	0.90	7.66%	2200	134%	12	1:10	5.6
9/4/2012	11:50	14	2	10.25	0.15	1.46%	2200	134%	12	1:10	5.6
9/4/2012	11:50	8	2	7.75	0.30	3.87%	2200	134%	12	1:10	5.6
9/4/2012	11:50	14	2	9.50	0.10	1.05%	2200	134%	12	1:10	5.6
9/4/2012	11:50	4	2	10.25	0.10	0.98%	2200	134%	12	1:10	5.6
9/4/2012	11:50	2	2	11.50	0.05	0.43%	2200	134%	12	1:10	5.6
9/4/2012	11:50	4	2	11.00	0.15	1.36%	2200	134%	12	1:10	5.6
9/4/2012	11:50	12	2	11.25	0.15	1.33%	2200	134%	12	1:10	5.6
9/4/2012	11:50	4	2	9.25	0.10	1.08%	2200	134%	12	1:10	5.6
9/4/2012	11:50	6	2	12.00	0.15	1.25%	2200	134%	12	1:10	5.6
9/4/2012	11:50	12	2	11.00	0.20	1.82%	2200	134%	12	1:10	5.6
9/4/2012	15:15	14	3	9.25	0.15	1.62%	2200	134%	12	1:10	5.6
9/4/2012	15:15	2	3	10.25	0.03	0.29%	2200	134%	12	1:10	5.6
9/4/2012	15:15	2	3	10.50	0.05	0.48%	2200	134%	12	1:10	5.6
9/4/2012	15:15	8	3	10.00	0.30	3.00%	2200	134%	12	1:10	5.6
9/4/2012	15:15	8	3	9.75	0.30	3.08%	2200	134%	12	1:10	5.6
9/4/2012	15:15	6	3	9.50	0.10	1.05%	2200	134%	12	1:10	5.6

[48] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[49]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
9/4/2012	15:15	4	3	11.50	0.10	0.87%	2200	134%	12	1:10	5.6
9/4/2012	15:15	14	3	9.00	0.10	1.11%	2200	134%	12	1:10	5.6
9/4/2012	15:15	12	3	10.50	0.15	1.43%	2200	134%	12	1:10	5.6
9/4/2012	15:15	6	3	11.25	0.10	0.89%	2200	134%	12	1:10	5.6
11/8/2012	14:33	2	1	8.75	0.03	0.29%	2000	100%	12	1:10	6.4
11/8/2012	14:33	2	1	9.25	0.03	0.27%	2000	100%	12	1:10	6.4
11/8/2012	14:33	4	1	9.50	0.05	0.53%	2000	100%	12	1:10	6.4
11/8/2012	14:33	4	1	10.50	0.05	0.48%	2000	100%	12	1:10	6.4
11/8/2012	14:33	6	1	9.25	0.05	0.54%	2000	100%	12	1:10	6.4
11/8/2012	14:33	6	1	9.50	0.05	0.53%	2000	100%	12	1:10	6.4
11/8/2012	14:33	8	1	10.00	0.07	0.70%	2000	100%	12	1:10	6.4
11/8/2012	14:33	8	1	9.00	0.07	0.78%	2000	100%	12	1:10	6.4
11/8/2012	15:41	2	2	10.00	0.04	0.35%	2200	134%	12	1:10	6.4
11/8/2012	15:41	2	2	9.75	0.04	0.36%	2200	134%	12	1:10	6.4
11/8/2012	15:41	4	2	8.75	0.06	0.69%	2200	134%	12	1:10	6.4
11/8/2012	15:41	4	2	8.50	0.06	0.71%	2200	134%	12	1:10	6.4
11/8/2012	15:41	6	2	8.25	0.06	0.73%	2200	134%	12	1:10	6.4
11/8/2012	15:41	6	2	8.75	0.06	0.69%	2200	134%	12	1:10	6.4
11/8/2012	15:41	8	2	9.00	0.25	2.78%	2200	134%	12	1:10	6.4
11/8/2012	15:41	8	2	9.00	0.25	2.78%	2200	134%	12	1:10	6.4
11/27/2012	12:51	2	1	10.00	0.07	0.70%	2200	134%	12	1:10	6.4
11/27/2012	12:51	4	1	8.50	0.08	0.88%	2200	134%	12	1:10	6.4
11/27/2012	12:51	6	1	9.75	0.08	0.77%	2200	134%	12	1:10	6.4
11/27/2012	12:51	8	1	8.00	0.10	1.25%	2200	134%	12	1:10	6.4
11/27/2012	14:34	2	2	10.40	0.09	0.87%	2200	134%	12	1:10	6.4
11/27/2012	14:34	2	2	9.75	0.09	0.92%	2200	134%	12	1:10	6.4
11/27/2012	14:34	4	2	10.90	0.12	1.10%	2200	134%	12	1:10	6.4
11/27/2012	14:34	4	2	9.30	0.10	1.08%	2200	134%	12	1:10	6.4
11/27/2012	14:34	6	2	9.90	1.20	12.12%	2200	134%	12	1:10	6.4
11/27/2012	14:34	6	2	10.80	1.20	11.11%	2200	134%	12	1:10	6.4
11/27/2012	14:34	8	2	9.90	0.90	9.09%	2200	134%	12	1:10	6.4
11/27/2012	14:34	8	2	8.80	0.85	9.66%	2200	134%	12	1:10	6.4
11/27/2012	14:34	12	2	8.10	0.20	2.47%	2200	134%	12	1:10	6.4
11/27/2012	14:34	12	2	8.80	0.20	2.27%	2200	134%	12	1:10	6.4
11/27/2012	14:34	14	2	9.25	0.15	1.62%	2200	134%	12	1:10	6.4
11/27/2012	14:34	14	2	8.70	0.15	1.72%	2200	134%	12	1:10	6.4
11/27/2012	14:34	20	2	9.20	0.03	0.33%	2200	134%	12	1:10	6.4
11/27/2012	14:34	20	2	10.40	0.03	0.29%	2200	134%	12	1:10	6.4
11/27/2012	14:34	22	2	9.40	0.05	0.53%	2200	134%	12	1:10	6.4
11/27/2012	14:34	22	2	10.20	0.05	0.49%	2200	134%	12	1:10	6.4
11/27/2012	14:34	24	2	10.90	0.15	1.38%	2200	134%	12	1:10	6.4
11/27/2012	14:34	24	2	10.20	0.12	1.18%	2200	134%	12	1:10	6.4
1/15/2013	15:15	2	1	9.00	0.05	0.56%	2200	134%	12	1:10	6.4
1/15/2013	15:15	4	1	7.00	0.06	0.86%	2200	134%	12	1:10	6.4
1/15/2013	15:15	6	1	9.00	0.03	0.33%	2200	134%	12	1:10	6.4
1/15/2013	15:15	8	1	9.50	0.06	0.63%	2200	134%	12	1:10	6.4
1/15/2013	15:15	12	1	9.50	0.20	2.11%	2200	134%	12	1:10	6.4
1/15/2013	15:15	14	1	10.00	0.17	1.70%	2200	134%	12	1:10	6.4
1/15/2013	15:35	2	2	9.75	0.05	0.51%	2200	134%	12	1:10	6.4
1/15/2013	15:35	4	2	9.75	0.10	1.03%	2200	134%	12	1:10	6.4
1/15/2013	15:35	6	2	10.00	0.04	0.40%	2200	134%	12	1:10	6.4
1/15/2013	15:35	8	2	9.50	0.08	0.79%	2200	134%	12	1:10	6.4

[49] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[50]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
1/15/2013	15:35	12	2	10.00	0.20	2.00%	2200	134%	12	1:10	6.4
1/15/2013	15:35	14	2	10.50	0.18	1.71%	2200	134%	12	1:10	6.4
1/15/2013	15:55	2	3	9.50	0.05	0.53%	2200	134%	12	1:10	6.4
1/15/2013	15:55	4	3	9.50	0.10	1.05%	2200	134%	12	1:10	6.4
1/15/2013	15:55	6	3	7.00	0.03	0.43%	2200	134%	12	1:10	6.4
1/15/2013	15:55	8	3	9.00	0.08	0.83%	2200	134%	12	1:10	6.4
1/15/2013	15:55	12	3	10.00	0.22	2.20%	2200	134%	12	1:10	6.4
1/15/2013	15:55	14	3	10.00	0.17	1.70%	2200	134%	12	1:10	6.4
1/15/2013	16:16	2	4	9.50	0.08	0.79%	2200	134%	12	1:10	6.4
1/15/2013	16:16	4	4	8.00	0.07	0.88%	2200	134%	12	1:10	6.4
1/15/2013	16:16	6	4	7.25	0.04	0.55%	2200	134%	12	1:10	6.4
1/15/2013	16:16	8	4	8.00	0.05	0.63%	2200	134%	12	1:10	6.4
1/15/2013	16:16	12	4	8.25	0.18	2.12%	2200	134%	12	1:10	6.4
1/15/2013	16:16	14	4	11.25	0.20	1.78%	2200	134%	12	1:10	6.4
1/15/2013	16:35	2	5	9.50	0.06	0.63%	2200	134%	12	1:10	6.4
1/15/2013	16:35	4	5	9.75	0.09	0.92%	2200	134%	12	1:10	6.4
1/15/2013	16:35	6	5	9.50	0.07	0.74%	2200	134%	12	1:10	6.4
1/15/2013	16:35	8	5	9.50	0.10	1.05%	2200	134%	12	1:10	6.4
1/15/2013	16:35	12	5	9.75	0.20	2.05%	2200	134%	12	1:10	6.4
1/15/2013	16:35	14	5	8.50	0.15	1.76%	2200	134%	12	1:10	6.4
1/15/2013	16:56	2	6	9.25	0.05	0.54%	2200	134%	12	1:10	6.4
1/15/2013	16:56	4	6	9.00	0.10	1.11%	2200	134%	12	1:10	6.4
1/15/2013	16:56	6	6	9.50	0.08	0.84%	2200	134%	12	1:10	6.4
1/15/2013	16:56	8	6	8.75	0.13	1.49%	2200	134%	12	1:10	6.4
1/15/2013	16:56	12	6	8.75	0.18	2.06%	2200	134%	12	1:10	6.4
1/15/2013	16:56	14	6	7.50	0.15	2.00%	2200	134%	12	1:10	6.4
1/15/2013	17:15	2	7	9.25	0.05	0.54%	2200	134%	12	1:10	6.4
1/15/2013	17:15	4	7	8.75	0.10	1.14%	2200	134%	12	1:10	6.4
1/15/2013	17:15	6	7	9.00	0.10	1.11%	2200	134%	12	1:10	6.4
1/15/2013	17:15	8	7	10.75	0.17	1.58%	2200	134%	12	1:10	6.4
1/15/2013	17:15	12	7	6.50	0.17	2.62%	2200	134%	12	1:10	6.4
1/15/2013	17:15	14	7	9.75	0.20	2.05%	2200	134%	12	1:10	6.4
1/22/2013	15:13	6	1	11.00	0.10	0.91%	2200	134%	12	1:10	6.4
1/22/2013	15:13	6	1	10.50	0.10	0.95%	2200	134%	12	1:10	6.4
1/22/2013	15:13	8	1	10.50	0.17	1.62%	2200	134%	12	1:10	6.4
1/22/2013	15:13	8	1	10.50	0.17	1.62%	2200	134%	12	1:10	6.4
1/22/2013	15:31	6	2	10.75	0.10	0.93%	2400	134%	12	1:10	6.4
1/22/2013	15:31	6	2	11.25	0.10	0.89%	2400	134%	12	1:10	6.4
1/22/2013	15:31	8	2	9.25	0.12	1.30%	2400	134%	12	1:10	6.4
1/22/2013	15:31	8	2	11.00	0.13	1.18%	2400	134%	12	1:10	6.4
1/22/2013	15:43	6	3	10.25	0.08	0.78%	2500	134%	12	1:10	6.4
1/22/2013	15:43	6	3	11.50	0.08	0.70%	2500	134%	12	1:10	6.4
1/22/2013	15:43	8	3	11.50	0.06	0.52%	2500	134%	12	1:10	6.4
1/22/2013	15:43	8	3	11.50	0.06	0.52%	2500	134%	12	1:10	6.4
1/22/2013	15:52	6	4	12.00	0.07	0.58%	2600	134%	12	1:10	6.4
1/22/2013	15:52	6	4	10.25	0.06	0.59%	2600	134%	12	1:10	6.4
1/22/2013	15:52	8	4	9.75	0.06	0.62%	2600	134%	12	1:10	6.4
1/22/2013	15:52	8	4	10.50	0.07	0.67%	2600	134%	12	1:10	6.4
1/22/2013	16:04	6	5	11.25	0.05	0.44%	2700	134%	12	1:10	6.4
1/22/2013	16:04	6	5	11.50	0.05	0.43%	2700	134%	12	1:10	6.4
1/22/2013	16:04	8	5	9.75	0.06	0.62%	2700	134%	12	1:10	6.4

[50] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[51]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
1/22/2013	16:04	8	5	10.00	0.06	0.60%	2700	134%	12	1:10	6.4
2/1/2013	12:20	2	1	11.50	0.08	0.70%	2500	134%	12	1:10	6.4
2/1/2013	12:20	2	1	11.00	0.08	0.73%	2500	134%	12	1:10	6.4
2/1/2013	12:20	4	1	10.00	0.09	0.90%	2500	134%	12	1:10	6.4
2/1/2013	12:20	4	1	9.50	0.09	0.95%	2500	134%	12	1:10	6.4
2/1/2013	12:20	6	1	10.75	0.11	1.02%	2500	134%	12	1:10	6.4
2/1/2013	12:20	6	1	11.00	0.07	0.64%	2500	134%	12	1:10	6.4
2/1/2013	12:20	8	1	9.50	0.05	0.53%	2500	134%	12	1:10	6.4
2/1/2013	12:20	8	1	9.00	0.05	0.56%	2500	134%	12	1:10	6.4
2/1/2013	12:20	12	1	10.25	0.20	1.95%	2500	134%	12	1:10	6.4
2/1/2013	12:20	12	1	10.00	0.19	1.90%	2500	134%	12	1:10	6.4
2/1/2013	12:20	14	1	11.00	0.18	1.64%	2500	134%	12	1:10	6.4
2/1/2013	12:20	14	1	8.50	0.16	1.88%	2500	134%	12	1:10	6.4
2/1/2013	12:49	2	2	10.00	0.07	0.70%	2500	134%	12	1:10	6.4
2/1/2013	12:49	2	2	10.00	0.07	0.70%	2500	134%	12	1:10	6.4
2/1/2013	12:49	4	2	10.00	0.09	0.90%	2500	134%	12	1:10	6.4
2/1/2013	12:49	4	2	10.00	0.09	0.90%	2500	134%	12	1:10	6.4
2/1/2013	12:49	6	2	8.25	0.04	0.48%	2500	134%	12	1:10	6.4
2/1/2013	12:49	6	2	10.50	0.05	0.48%	2500	134%	12	1:10	6.4
2/1/2013	12:49	8	2	10.25	0.04	0.39%	2500	134%	12	1:10	6.4
2/1/2013	12:49	8	2	10.00	0.04	0.40%	2500	134%	12	1:10	6.4
2/1/2013	12:49	12	2	9.00	0.13	1.44%	2500	134%	12	1:10	6.4
2/1/2013	12:49	12	2	9.50	0.13	1.37%	2500	134%	12	1:10	6.4
2/1/2013	12:49	14	2	10.25	0.18	1.76%	2500	134%	12	1:10	6.4
2/1/2013	12:49	14	2	9.75	0.18	1.85%	2500	134%	12	1:10	6.4
2/1/2013	13:17	2	3	10.00	0.07	0.70%	2500	134%	12	1:10	6.4
2/1/2013	13:17	2	3	9.75	0.07	0.72%	2500	134%	12	1:10	6.4
2/1/2013	13:17	4	3	7.75	0.06	0.77%	2500	134%	12	1:10	6.4
2/1/2013	13:17	4	3	9.50	0.07	0.74%	2500	134%	12	1:10	6.4
2/1/2013	13:17	6	3	9.50	0.06	0.63%	2500	134%	12	1:10	6.4
2/1/2013	13:17	6	3	9.00	0.06	0.67%	2500	134%	12	1:10	6.4
2/1/2013	13:17	8	3	9.75	0.04	0.41%	2500	134%	12	1:10	6.4
2/1/2013	13:17	8	3	10.75	0.04	0.37%	2500	134%	12	1:10	6.4
2/1/2013	13:17	12	3	11.00	0.13	1.18%	2500	134%	12	1:10	6.4
2/1/2013	13:17	12	3	9.75	0.13	1.33%	2500	134%	12	1:10	6.4
2/1/2013	13:17	14	3	8.50	0.18	2.12%	2500	134%	12	1:10	6.4
2/1/2013	13:17	14	3	8.75	0.18	2.06%	2500	134%	12	1:10	6.4
2/1/2013	13:47	2	4	10.00	0.07	0.70%	2500	134%	12	1:10	6.4
2/1/2013	13:47	2	4	10.00	0.07	0.70%	2500	134%	12	1:10	6.4
2/1/2013	13:47	4	4	10.50	0.08	0.76%	2500	134%	12	1:10	6.4
2/1/2013	13:47	4	4	10.25	0.08	0.78%	2500	134%	12	1:10	6.4
2/1/2013	13:47	6	4	11.00	0.08	0.73%	2500	134%	12	1:10	6.4
2/1/2013	13:47	6	4	11.25	0.08	0.71%	2500	134%	12	1:10	6.4
2/1/2013	13:47	8	4	10.25	0.04	0.39%	2500	134%	12	1:10	6.4
2/1/2013	13:47	8	4	9.75	0.04	0.41%	2500	134%	12	1:10	6.4
2/1/2013	13:47	12	4	11.00	0.13	1.18%	2500	134%	12	1:10	6.4
2/1/2013	13:47	12	4	10.25	0.13	1.27%	2500	134%	12	1:10	6.4
2/1/2013	13:47	14	4	9.50	0.18	1.89%	2500	134%	12	1:10	6.4
2/1/2013	13:47	14	4	10.50	0.18	1.71%	2500	134%	12	1:10	6.4
2/1/2013	14:17	2	5	11.00	0.07	0.64%	2500	134%	12	1:10	6.4
2/1/2013	14:17	2	5	10.25	0.07	0.68%	2500	134%	12	1:10	6.4

[51] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[52]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
2/1/2013	14:17	4	5	10.50	0.07	0.67%	2500	134%	12	1:10	6.4
2/1/2013	14:17	4	5	10.00	0.07	0.70%	2500	134%	12	1:10	6.4
2/1/2013	14:17	6	5	10.50	0.08	0.76%	2500	134%	12	1:10	6.4
2/1/2013	14:17	6	5	10.50	0.08	0.76%	2500	134%	12	1:10	6.4
2/1/2013	14:17	8	5	9.75	0.07	0.72%	2500	134%	12	1:10	6.4
2/1/2013	14:17	8	5	9.00	0.07	0.78%	2500	134%	12	1:10	6.4
2/1/2013	14:17	12	5	11.00	0.18	1.64%	2500	134%	12	1:10	6.4
2/1/2013	14:17	12	5	10.75	0.18	1.67%	2500	134%	12	1:10	6.4
2/1/2013	14:17	14	5	10.00	0.10	1.00%	2500	134%	12	1:10	6.4
2/1/2013	14:17	14	5	9.50	0.10	1.05%	2500	134%	12	1:10	6.4
2/1/2013	14:47	2	6	10.00	0.06	0.60%	2500	134%	12	1:10	6.4
2/1/2013	14:47	2	6	11.00	0.06	0.55%	2500	134%	12	1:10	6.4
2/1/2013	14:47	4	6	9.00	0.08	0.89%	2500	134%	12	1:10	6.4
2/1/2013	14:47	4	6	9.75	0.08	0.82%	2500	134%	12	1:10	6.4
2/1/2013	14:47	6	6	10.00	0.10	1.00%	2500	134%	12	1:10	6.4
2/1/2013	14:47	6	6	10.50	0.10	0.95%	2500	134%	12	1:10	6.4
2/1/2013	14:47	8	6	8.75	0.05	0.57%	2500	134%	12	1:10	6.4
2/1/2013	14:47	8	6	9.00	0.05	0.56%	2500	134%	12	1:10	6.4
2/1/2013	14:47	12	6	9.75	0.13	1.33%	2500	134%	12	1:10	6.4
2/1/2013	14:47	12	6	10.50	0.13	1.24%	2500	134%	12	1:10	6.4
2/1/2013	14:47	14	6	9.00	0.18	2.00%	2500	134%	12	1:10	6.4
2/1/2013	14:47	14	6	9.75	0.18	1.85%	2500	134%	12	1:10	6.4
2/1/2013	15:17	2	7	9.50	0.06	0.63%	2500	134%	12	1:10	6.4
2/1/2013	15:17	2	7	11.25	0.06	0.53%	2500	134%	12	1:10	6.4
2/1/2013	15:17	4	7	9.25	0.08	0.86%	2500	134%	12	1:10	6.4
2/1/2013	15:17	4	7	9.25	0.08	0.86%	2500	134%	12	1:10	6.4
2/1/2013	15:17	6	7	9.50	0.10	1.05%	2500	134%	12	1:10	6.4
2/1/2013	15:17	6	7	10.50	0.11	1.05%	2500	134%	12	1:10	6.4
2/1/2013	15:17	8	7	10.00	0.06	0.60%	2500	134%	12	1:10	6.4
2/1/2013	15:17	8	7	9.75	0.05	0.51%	2500	134%	12	1:10	6.4
2/1/2013	15:17	12	7	10.75	0.13	1.21%	2500	134%	12	1:10	6.4
2/1/2013	15:17	12	7	10.75	0.13	1.21%	2500	134%	12	1:10	6.4
2/1/2013	15:17	14	7	9.00	0.18	2.00%	2500	134%	12	1:10	6.4
2/1/2013	15:17	14	7	8.50	0.18	2.12%	2500	134%	12	1:10	6.4
2/1/2013	15:47	2	8	10.25	0.06	0.59%	2500	134%	12	1:10	6.4
2/1/2013	15:47	2	8	10.25	0.06	0.59%	2500	134%	12	1:10	6.4
2/1/2013	15:47	4	8	9.00	0.09	1.00%	2500	134%	12	1:10	6.4
2/1/2013	15:47	4	8	9.50	0.09	0.95%	2500	134%	12	1:10	6.4
2/1/2013	15:47	6	8	10.75	0.11	1.02%	2500	134%	12	1:10	6.4
2/1/2013	15:47	6	8	10.50	0.11	1.05%	2500	134%	12	1:10	6.4
2/1/2013	15:47	8	8	9.50	0.06	0.63%	2500	134%	12	1:10	6.4
2/1/2013	15:47	8	8	9.50	0.06	0.63%	2500	134%	12	1:10	6.4
2/1/2013	15:47	12	8	10.00	0.13	1.30%	2500	134%	12	1:10	6.4
2/1/2013	15:47	12	8	10.50	0.13	1.24%	2500	134%	12	1:10	6.4
2/1/2013	15:47	14	8	8.50	0.18	2.12%	2500	134%	12	1:10	6.4
2/1/2013	15:47	14	8	9.00	0.20	2.22%	2500	134%	12	1:10	6.4
2/1/2013	16:15	2	9	12.00	0.07	0.58%	2500	134%	12	1:10	6.4
2/1/2013	16:15	2	9	12.50	0.07	0.56%	2500	134%	12	1:10	6.4
2/1/2013	16:15	4	9	11.00	0.08	0.73%	2500	134%	12	1:10	6.4
2/1/2013	16:15	4	9	12.50	0.08	0.64%	2500	134%	12	1:10	6.4
2/1/2013	16:15	6	9	10.50	0.09	0.86%	2500	134%	12	1:10	6.4

[52] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[53]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
2/1/2013	16:15	6	9	11.00	0.09	0.82%	2500	134%	12	1:10	6.4
2/1/2013	16:15	8	9	12.00	0.08	0.67%	2500	134%	12	1:10	6.4
2/1/2013	16:15	8	9	11.50	0.08	0.70%	2500	134%	12	1:10	6.4
2/1/2013	16:15	12	9	10.75	0.18	1.67%	2500	134%	12	1:10	6.4
2/1/2013	16:15	12	9	11.50	0.19	1.65%	2500	134%	12	1:10	6.4
2/1/2013	16:15	14	9	11.00	0.12	1.09%	2500	134%	12	1:10	6.4
2/1/2013	16:15	14	9	11.50	0.12	1.04%	2500	134%	12	1:10	6.4
6/5/2013		8	1	10.75	0.20	1.86%	2500	134%	12	1:12.5	6.4
6/5/2013		8	1	9.25	0.19	2.05%	2500	134%	12	1:12.5	6.4
6/5/2013		8	2	10.50	0.30	2.86%	2500	134%	12	1:12.5	6.4
6/5/2013		8	2	11.25	0.30	2.67%	2500	134%	12	1:12.5	6.4
6/5/2013		8	3	11.50	0.40	3.48%	2200	134%	12	1:12.5	6.4
6/5/2013		8	3	11.50	0.40	3.48%	2200	134%	12	1:12.5	6.4
6/5/2013		8	4	11.00	0.50	4.55%	2200	134%	12	1:15	6.4
6/5/2013		8	4	12.00	0.55	4.58%	2200	134%	12	1:15	6.4
6/5/2013		8	5	12.00	0.60	5.00%	2200	134%	12	1:15	6.4
6/5/2013		8	5	12.00	0.60	5.00%	2200	134%	12	1:15	6.4
6/5/2013		8	6	12.25	0.30	2.45%	2200	134%	12	1:15	6.4
6/5/2013		8	6	11.75	0.27	2.30%	2200	134%	12	1:15	6.4
6/5/2013		8	7	11.50	0.20	1.74%	2500	134%	12	1:15	6.4
6/5/2013		8	7	11.00	0.20	1.82%	2500	134%	12	1:15	6.4
6/5/2013		8	8	11.00	0.20	1.82%	2600	134%	12	1:15	6.4
6/5/2013		8	8	11.50	0.20	1.74%	2600	134%	12	1:15	6.4
6/5/2013		8	9	12.50	0.19	1.52%	2500	134%	12	1:20	6.4
6/5/2013		8	9	12.50	0.17	1.36%	2500	134%	12	1:20	6.4
6/5/2013		8	10	12.50	0.55	4.40%	2200	134%	12	1:20	6.4
6/5/2013		8	10	12.50	0.60	4.80%	2200	134%	12	1:20	6.4
6/5/2013		2	11	13.50	0.07	0.52%	2500	115%	12	1:20	6.4
6/5/2013		2	11	14.00	0.07	0.50%	2500	115%	12	1:20	6.4
6/5/2013		4	11	12.75	0.10	0.78%	2500	115%	12	1:20	6.4
6/5/2013		4	11	12.25	0.10	0.82%	2500	115%	12	1:20	6.4
6/5/2013		6	11	11.75	0.12	1.02%	2500	115%	12	1:20	6.4
6/5/2013		6	11	11.50	0.11	0.96%	2500	115%	12	1:20	6.4
6/5/2013		8	11	12.00	0.20	1.67%	2500	115%	12	1:20	6.4
6/5/2013		8	11	12.75	0.20	1.57%	2500	115%	12	1:20	6.4
6/10/2013		2	1	14.25	0.07	0.49%	2500	110%	12	1:15	6.4
6/10/2013		2	1	14.25	0.07	0.49%	2500	110%	12	1:15	6.4
6/10/2013		4	1	13.50	0.12	0.89%	2500	110%	12	1:15	6.4
6/10/2013		4	1	13.50	0.11	0.81%	2500	110%	12	1:15	6.4
6/10/2013		6	1	11.50	0.07	0.61%	2500	110%	12	1:15	6.4
6/10/2013		6	1	13.50	0.08	0.59%	2500	110%	12	1:15	6.4
6/10/2013		8	1	12.00	0.17	1.42%	2500	110%	12	1:15	6.4
6/10/2013		8	1	13.00	0.18	1.38%	2500	110%	12	1:15	6.4
9/18/2013		4	1	13.00	0.30	2.31%	1700	100%	12	1:10	7.5
9/18/2013		8	1	12.50	0.30	2.40%	1700	100%	12	1:10	7.5
9/18/2013		4	2	13.00	0.20	1.54%	2000	100%	12	1:10	7.5
9/18/2013		8	2	11.50	0.15	1.30%	2000	100%	12	1:10	7.5
9/18/2013		4	3	12.50	0.10	0.80%	2200	100%	12	1:10	7.5
9/18/2013		8	3	12.25	0.20	1.63%	2200	100%	12	1:10	7.5
9/18/2013		4	4	13.00	0.13	0.96%	2400	100%	12	1:10	7.5
9/18/2013		8	4	12.50	0.20	1.60%	2400	100%	12	1:10	7.5
9/18/2013		4	5	11.00	0.15	1.36%	2400	134%	12	1:13	7.5

[53] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Aqueous Carryover Data

Date	Time	Location	Weir Set[54]	Total	Aqueous	CO%	Ext. RPM	Flow Rate	Weir Set	Ext. O:A	Sim. Na (M)
9/18/2013		8	5	12.00	0.30	2.50%	2400	134%	12	1:13	7.5
9/18/2013		4	6	12.50	0.20	1.60%	2200	134%	12	1:13	7.5
9/18/2013		8	6	12.50	0.33	2.60%	2200	134%	12	1:13	7.5
9/19/2013		4	1	12.50	0.20	1.60%	2200	134%	12	1:13	7.5
9/19/2013		4	1	13.75	0.30	2.18%	2200	134%	12	1:13	7.5
9/19/2013		8	1	12.25	0.50	4.08%	2200	134%	12	1:13	7.5
9/19/2013		8	1	13.00	0.50	3.85%	2200	134%	12	1:13	7.5
9/26/2013		4	1	13.50	2.25	16.67%	2200	134%	12	1:10	7.5
9/26/2013		4	1	13.50	2.50	18.52%	2200	134%	12	1:10	7.5
9/26/2013		8	1	12.25	3.40	27.76%	2200	134%	12	1:10	7.5
9/26/2013		8	1	13.25	3.75	28.30%	2200	134%	12	1:10	7.5
10/1/2013		4	1	14.25	0.20	1.40%	2200	134%	12	1:20	7.5
10/1/2013		4	1	13.50	0.20	1.48%	2200	134%	12	1:20	7.5
10/1/2013		8	1	13.00	0.50	3.85%	2200	134%	12	1:20	7.5
10/1/2013		8	1	14.50	0.60	4.14%	2200	134%	12	1:20	7.5
10/1/2013		4	1	14.25	0.15	1.05%	2400	134%	12	1:20	7.5
10/1/2013		4	1	14.00	0.15	1.07%	2400	134%	12	1:20	7.5
10/1/2013		8	1	14.25	0.30	2.11%	2400	134%	12	1:20	7.5
10/1/2013		8	1	13.50	0.30	2.22%	2400	134%	12	1:20	7.5
10/25/2013		2	1	12.75	0.10	0.78%	2200	134%	12	1:13	7.5
10/25/2013		2	1	14.50	0.12	0.83%	2200	134%	12	1:13	7.5
10/25/2013		4	1	14.00	0.18	1.29%	2200	134%	12	1:13	7.5
10/25/2013		4	1	13.25	0.18	1.36%	2200	134%	12	1:13	7.5
10/25/2013		6	1	13.50	0.08	0.59%	2200	134%	12	1:13	7.5
10/25/2013		6	1	11.75	0.07	0.60%	2200	134%	12	1:13	7.5
10/25/2013		8	1	10.25	0.20	1.95%	2200	134%	12	1:13	7.5
10/25/2013		8	1	11.25	0.25	2.22%	2200	134%	12	1:13	7.5
10/31/2013		2	1	13.25	0.08	0.60%	2200	100%	12	1:13	7.5
10/31/2013		2	1	12.25	0.08	0.65%	2200	100%	12	1:13	7.5
10/31/2013		4	1	13.00	0.05	0.38%	2200	100%	12	1:13	7.5
10/31/2013		4	1	14.00	0.05	0.36%	2200	100%	12	1:13	7.5
10/31/2013		6	1	12.00	0.15	1.25%	2200	100%	12	1:13	7.5
10/31/2013		6	1	12.75	0.15	1.18%	2200	100%	12	1:13	7.5
10/31/2013		8	1	15.00	0.05	0.33%	2200	100%	12	1:13	7.5
10/31/2013		8	1	11.50	0.03	0.26%	2200	100%	12	1:13	7.5
11/21/2013		2	1	13.00	0.09	0.69%	2200	134%	12	1:13	7.5
11/21/2013		2	1	13.50	0.10	0.74%	2200	134%	12	1:13	7.5
11/21/2013		4	1	12.00	0.20	1.67%	2200	134%	12	1:13	7.5
11/21/2013		4	1	11.50	0.15	1.30%	2200	134%	12	1:13	7.5
11/21/2013		6	1	10.75	0.17	1.58%	2200	134%	12	1:13	7.5
11/21/2013		6	1	12.75	0.18	1.41%	2200	134%	12	1:13	7.5
11/21/2013		8	1	11.25	0.50	4.44%	2200	134%	12	1:13	7.5
11/21/2013		8	1	11.25	0.50	4.44%	2200	134%	12	1:13	7.5
12/10/2013		2	1	13.00	0.05	0.38%	2200	134%	12	1:13	7.5
12/10/2013		2	1	13.25	0.05	0.38%	2200	134%	12	1:13	7.5
12/10/2013		4	1	13.50	0.10	0.74%	2200	134%	12	1:13	7.5
12/10/2013		4	1	11.00	0.09	0.82%	2200	134%	12	1:13	7.5
12/10/2013		6	1	11.25	0.05	0.44%	2200	134%	12	1:13	7.5
12/10/2013		6	1	12.00	0.07	0.58%	2200	134%	12	1:13	7.5
12/10/2013		8	1	11.50	0.20	1.74%	2200	134%	12	1:13	7.5
12/10/2013		8	1	12.00	0.20	1.67%	2200	134%	12	1:13	7.5

[54] Weir configurations for each set number are shown in the last table of this appendix.

Appendix A. Compiled Analytical Data (cont.)

Weir Configurations

Set	EXT-201A Weir	EXT-201B Weir	EXT-201C Weir	EXT-201D Weir	EXT-202A Weir	EXT-202B Weir	EXT-203A Weir	EXT-203B Weir	EXT-203C Weir	EXT-203D Weir	EXT-204A Weir
1	5.4	5.4	5.4	5.7	4.7	4.7	4.7	4.8	4.9	4.7	4.7
2	5.3	5.4	5.5	5.7	4.7	4.7	4.7	4.8	4.9	4.7	4.7
3	5.6	5.7	5.8	5.7	4.9	4.9	4.7	4.8	4.9	4.7	4.7
4	5.8	5.7	5.8	5.7	4.9	4.9	4.7	4.8	4.9	4.7	4.7
5	5.8	5.8	5.8	5.8	4.9	4.9	4.7	4.8	4.9	4.7	4.7
6	6.3	6.3	6.1	6.1	4.9	4.9	4.7	4.8	4.9	4.7	4.7
7	6.0	6.0	6.1	6.1	4.9	4.9	4.7	4.8	4.9	4.7	4.7
8	5.9	5.9	6.1	6.1	4.9	4.9	4.7	4.8	4.9	4.7	4.7
9	5.7	5.7	5.7	5.7	4.9	4.9	4.7	4.8	4.9	4.7	4.7
10	5.4	5.4	5.4	5.7	4.9	4.9	4.7	4.8	4.9	4.7	4.7
11	5.4	5.4	5.4	5.7	4.9	4.9	4.7	4.7	4.7	4.9	4.7
12	5.4	5.4	5.4	5.7	5	5	4.7	4.7	4.7	4.9	4.7