TC CONSULTING SERVICES

SYSTEM OPERATION AND MAINTENANCE

Cherry Creek Basin Water Quality Authority
% Chuck Reid
CliftonLarsonAllen
8390 E. Crescent Parkway, Suite 500
Greenwood Village, Colorado 80111

March 5, 2013

Dear Messrs:

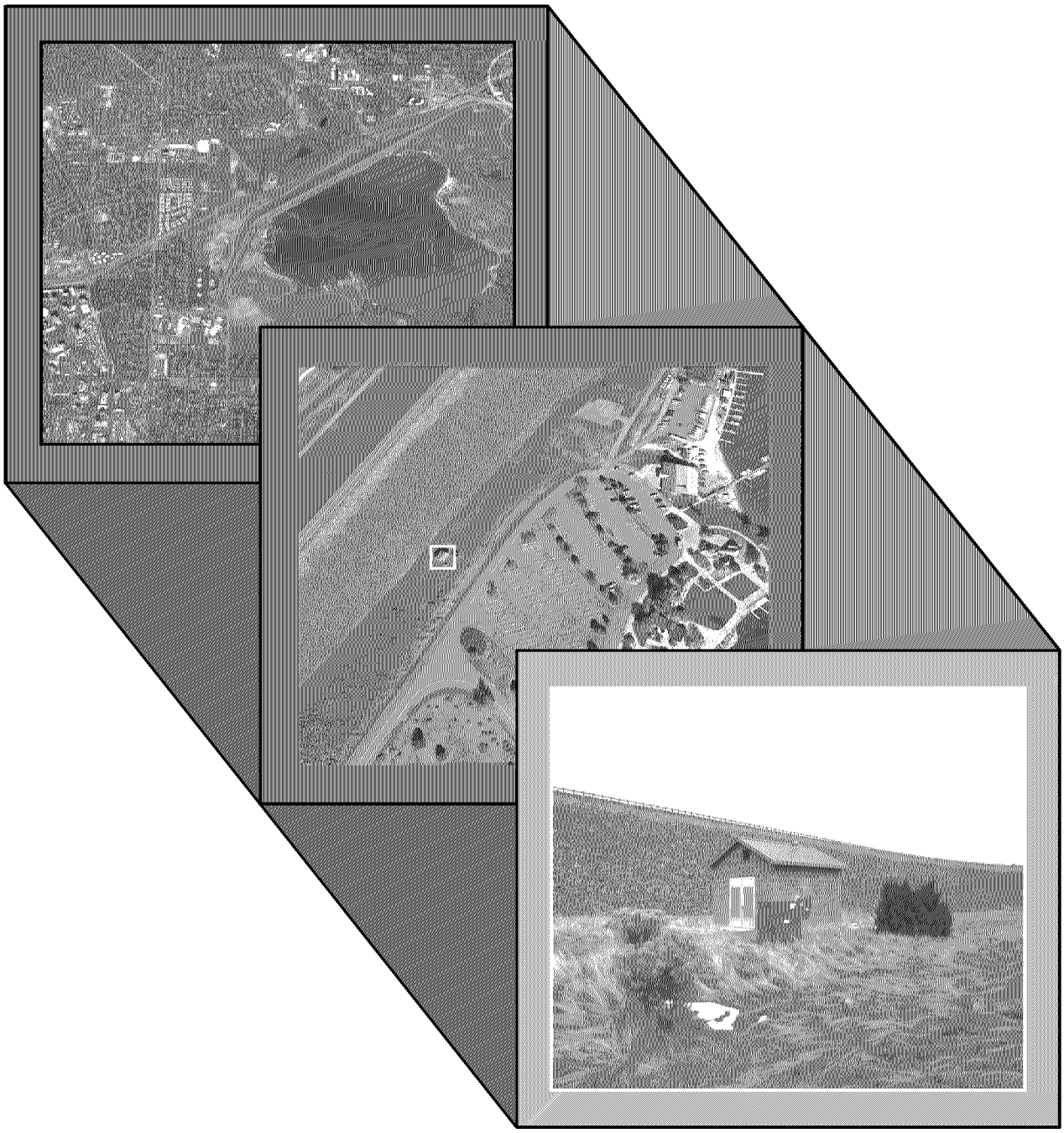
Please, find attached for your review the Cherry Creek Basin Water Quality Authority, Reservoir Destratification Facilities, Operation and Maintenance, Annual Report 2012.

Sincerely,

Terry Cunningham

CHERRY CREEK RESERVOIR
DESTRATIFICATION FACILITIES

OPERATION AND MAINTENANCE
ANNUAL REPORT
2012



PREPARED FOR:

CHERRY CREEK BASIN WATER QUALITY AUTHORITY

CHERRY CREEK BASIN
WATER QUALITY AUTHORITY
% CHUCK REID
CLIFTON LARSON ALLEN
8390 E CRESCENT PARKWAY, SUITE 500
GREENWOOD VILLAGE, CO 80111
303-779-4525
chuck.reid@cliftonlarsonallen.com

PREPARED BY:

TC CONSULTING SERVICES

TC CONSULTING SERVICES
8469 PRAIRIE CLOVER WAY
PARKER, CO 80134
303-350-0611
terd@att.net

TABLE OF CONTENTS

CHERRY CREEK BASIN WATER QUALITY AUTHORITY
% Chuck Reid
CliftonLarsonAllen
8390 E. Crescent Parkway, Suite 500
Greenwood Village, Colorado 80111

CHERRY CREEK BASIN WATER QUALITY AUTHORITY
RESERVOIR DESTRATIFICATION FACILITIES
OPERATION AND MAINTENANCE
ANNUAL REPORT
2012

March 5, 2013

INTRODUCTION:

TC Consulting Services was retained in 2012 to operate and maintain the Cherry Creek Reservoir Destratification Facilities. This was the fifth consecutive year that the facilities were operated continuously during the spring, summer and fall seasons.

OPERATION PERIOD:

The compressor was started on Wednesday, February 8, 2012 at 1:15 PM to measure the audible equipment sound and noise. The sound check was performed as part of Eaton's study and evaluation of the system. The unit was operated for approximately (2) two hours. The measurement was taken after the unit reached full operating pressure and temperature.

The compressor was turned ON Wednesday, February 22, 2012 at 4:40 PM for the beginning of the usual and customary reservoir aeration season. The startup of the system was performed in a planned methodical manner to minimize the danger to physical facilities and aquatic life especially fish. The reservoir procedure was detailed in a communication to Mr. William Ruzzo dated March 8, 2012.

The compressor was turned OFF for the season on Wednesday, November 21, 2012 at 4:00 PM. The main disconnect was OPENED, the air conditioner was unplugged, the fans were turned OFF and the compressor condensate drain valve was opened to expel water that had collected. The isolation valves on the aeration zones were left in the OPEN position.

INSPECTIONS:

The facilities were inspected periodically throughout the operating season. Refer to **TABLE NO. 1 – 2012 AERATION EQUIPMENT LOG** below.

DATE	DAY OF WEEK	TIME OF DAY	ELECTRIC METER: KWHRS		UNIT HOURS				LOAD RELAY COUNTS X 1,000		% ON	UNIT STARTS	TEMPERATURE: DEGREES FAHRENHIET (°F)					OUTLET PRES-SURE (PSI)
			READING	USAGE	RUN-NING	ELAPS-ED	LOAD-ED	ELAPS-ED	TOTAL	ELAPS-ED			OUT-SIDE	AM-BIENT	OUT-LET	ELE-MENT	OIL	
02/08/12	WED	1:15 PM	32,103		24,312		10,704		3,119			307	29	31	34	30	28	49.0
02/22/12	WED	4:40 PM	32,107	4	24,314	2	10,705	1	3,119	0	50%	308	54	53	54	52	50	49.0
02/23/12	THU	7:05 AM	32,127	20	24,328	14	10,713	8	3,121	2	57%	309	29	47	61	446	102	49.0
02/23/12	THU	4:35 PM	32,142	15	24,338	10	10,719	6	3,122	1	60%	309	31	47	63	446	102	49.0
02/25/12	SAT	4:45 PM	32,260	118	24,386	48	10,754	35	3,126	4	73%	309	57	60	78	463	103	52.0
03/05/12	MON	3:50 PM	32,569	309	24,598	212	10,901	147	3,146	20	69%	309	65	78	93	510	112	52.0
03/19/12	MON	9:00 AM	32,571	2	24,598	0	10,902	1	3,146	0		310	38	44	42	46	45	0.0
03/26/12	MON	3:30 PM	32,577	6	24,601	3	10,904	2	3,147	1	67%	315	78	79	97	488	114	52.0
03/28/12	WED	3:45 PM	32,655	78	24,649	48	10,931	27	3,155	8	56%	315	77	80	103	484	117	52.0
04/13/12	FRI	1:30 PM	33,270	615	25,031	382	11,148	217	3,225	70	57%	315	64	66	88	463	107	52.0
05/07/12	MON	8:55 AM	34,041	771	25,566	535	11,383	235	3,326	101	44%	315	43	48	45	47	47	0.0
05/08/12	TUE	2:41 PM	34,092	51	25,595	29	11,402	19	3,331	5	66%	316	63	68	87	474	109	52.0
05/12/12	SAT	9:18 PM	34,226	134	25,687	92	11,442	40	3,347	16	43%	316	47	57	52	60	60	52.0
06/19/12	TUE	7:05 AM	35,533	1,307	26,572	885	11,833	391	3,510	163	44%	318	64	107	126	510	154	50.0
06/28/12	THU	10:40 AM	35,852	319	26,791	219	11,297	94	3,550	40	43%	319	87	91	111	474	133	52.0
07/06/12	FRI	3:25 PM	36,100	248	26,962	171	11,998	71	3,581	31	42%	320	85	92	117	478	140	52.0
07/17/12	TUE	7:00 AM	36,472	372	27,217	255	12,105	107	3,629	48	42%	320	62	66	88	440	119	52.0
08/02/12	THU	4:00 PM	37,038	566	27,610	393	12,267	162	3,701	72	41%	320	90	92	112	474	138	52.0
08/24/12	FRI	7:50 PM	37,795	757	28,142	532	12,481	214	3,799	98	40%	320	77	81	105	466	141	52.0
08/31/12	FRI	8:00 PM	38,033	238	28,310	168	12,548	67	3,829	30	40%	320	80	86	109	472	142	52.0
09/09/12	SUN	5:30 PM	38,333	300	28,524	214	12,632	84	3,867	38	39%	321	84	93	113	483	145	52.0
10/08/12	MON	7:10 AM	39,146	813	29,100	576	12,859	227	3,972	105	39%	321		80	111	430	148	52.0
11/08/12	THU	2:10 PM	40,193	1,047	29,852	752	13,154	295	4,109	137	39%	322	60	68	89	447	132	52.0
11/21/12	WED	4:00 PM	40,626	433	30,166	314	13,272	118	4,165	56	38%	322	67	73	96	458	136	52.0

A summary of the annual statistics are listed in **TABLE NO. 2 – 2012 ANNUAL OPERATION SUMMARY** below.

	KWHR	RUN (HOURS)	LOAD (HOURS)	LOAD RELAY COUNT	UNIT STARTS	TEMPERATURE: DEGREES FAHRENHIET (° F)					OUTLET PRESSURE (PSI)
						OUTSIDE	AMBIENT	OUTLET	ELEMENT	OIL	
TOTAL	8,523	5,854	2,568	1,046,000	15						
MINIMUM						29	31	34	30	28	49.0
MAXIMUM						90	107	126	510	154	52.2
AVERAGE						62	70	86	381	109	51.4

COMPARATIVE OPERATION SUMMARY:

An annual comparative summary is listed in **TABLE NO. 3 – ANNUAL OPERATION COMPARATIVE SUMMARY** below.

YEAR	DAYS IN SEASON	KWHR	RUN (HOURS)	LOAD (HOURS)	LOAD RELAY COUNT	UNIT STARTS	AVERAGE TEMPERATURE: DEGREES FAHRENHIET (° F)					OUTLET PRESSURE (PSI)
							OUT-SIDE	AM-BIENT	OUT-LET	ELE-MENT	OIL	
2008	259		5,119			77	50	78	102	421	109	53.2
2009	291	7,823	6,384	3,147	571,525	90	65	73	97	445	124	52.6
2010	255	8,257	6,025	2,485	658,000	14	65	72	94	462	122	51.7
2011	272	9,121	6,427	2,727	982,000	34	74	86	101	436	127	51.4
2012	287	8,523	5,854	2,568	1,046,000	15	62	70	86	381	109	51.4

EQUIPMENT SHUTDOWNS:

The compressor shut down on March 5, 2013 at 1:38 PM due to a mechanical problem. The unloader valve solenoid base had become unsecured allowing air to escape from the air supply inlet. The screws holding the solenoid in place had loosened and wallowed out the threaded holes.

A full explanatory report detailing the cause of the fault and the repair was provided in a Technical Memorandum dated April 12, 2012, "Cherry Creek Reservoir, Destratification Equipment, 3/5/12 Compressor Fault". Repairs were completed and the unit was returned to normal continuous service on Monday, March 26, 2012 at 3:30 PM.

The length and duration of time that the unit was OFF each time is noted. The longest period of time that the equipment was OFF during the 2012 operating season was 21 days during the unloader valve solenoid repair. The shutdowns are listed in **TABLE NO. 4 – 2012 EQUIPMENT SHUTDOWNS** below.

DATE	DAY OF WEEK	TIME OF DAY	SHUTDOWN DESCRIPTION	DURATION OFF
03/05/12	MON	1:38 PM	"High Element Temperature", 510 °F - Loader/Unloader Solenoid Valve Failed	
03/26/12	MON	3:30 PM	Complete Repairs and Perform 16,000 Hour Service	21 Days
05/07/12	MON	8:55 AM	Unit Found Not Running – Cause Unknown	5 Hours
06/18/12	MON	6:19 PM	"High Element Temperature", 510 °F – Turned Air Conditioner ON	13 Hours
10/03/12	WED	5:45 PM	"Overload Fan Motor" – Cause Unknown	4.5 Days
11/21/12	WED	4:00 PM	Unit Turned OFF For The Season	

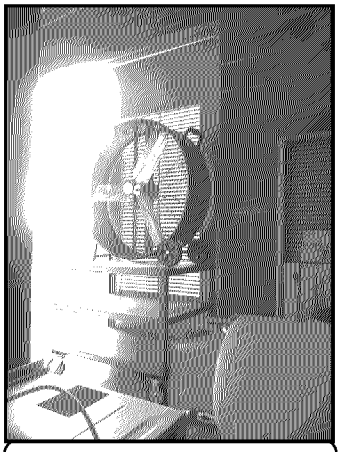
EQUIPMENT REPAIRS AND MAINTENANCE:

ROUTINE SERVICE

A 16,000 hour service was performed on the equipment on March 19, 2012. This service was performed at the same time the unit was being repaired due to the solenoid failure on March 3, 2012. The manufacturer's prescribed interval for service is every 8,000 hours of operation.

FLOOR FAN REPLACEMENT

It was discovered on May 7, 2012 that (1) one of the (2) two existing 20" diameter floor fans had stopped working. A 36" diameter fan was purchased as a replacement and installed on May 8, 2012. The 36" diameter fan has a manufacturer's rated capacity of 12,000 CFM (cubic feet per minute). The larger fan was selected based on information gathered by Eaton. Atlas Copco, the manufacturer of the compressor, had provided a report that revised the cooling requirements for this unit when installed indoors. It was expressed that a minimum of 12,000 CFM be provided for proper ventilation of the unit. The fan was placed on top of the cart used for the water storage container. The fan and the cart were positioned in front of the door louver. The fan is shown in **PHOTOGRAPH NO. 1 – NEW 36" DIAMETER FAN**.



PHOTOGRAPH NO. 1 -
NEW 36" DIAMETER FAN

The frequency of the compressor "loading" and "unloading" was calculated and is presented in TABLE **NO. 5 – LOADING AND UNLOADING FREQUENCY COMPARATIVE SUMMARY** below.

YEAR	UNIT OPERATION AVERAGE DURATION (SECONDS)		TIME		CYCLES PER MINUTE	AVERAGE DISCHARGE PRESSURE (PSI)
	LOADED	UNLOADED	% ON	% OFF		
2009	21	27	44	56	1.3	52.6
2010	22	20	48	52	1.8	51.7
2011	14	17	46	54	1.9	51.3
2012	7	13	35	65	3.0	52.0

EQUIPMENT PARAMETER CHECKS

The voltage and amperage draw of the motor was measured and recorded. The measurements are listed in **TABLE NO. 6 – 2012 ELECTRICAL MONITORING** below.

DATE	DAY OF WEEK	TIME OF DAY	MOTOR VOLTAGE		MOTOR AMPERAGE			UNIT OPERATION DURATION (SEC)		TIME		CYCLES PER MINUTE
			PHASE	VAC	PHASE	LOADED	UNLOADED	LOAD	UNLOAD	ON	OFF	
03/26/12	MON	1:30 PM	L_1 - L_2	501	L_1	124		49.0 PSI 7	52.0 PSI 13	35 %	65 %	3.0
			L_1 – L_3	496	L_2	119						
			L_2 – L_3	501	L_3	117						
11/21/12	WED	4:00 PM	L_1 – L_2	486	L_1	104	59	49.0 PSI 7	52.0 PSI 13	35 %	65 %	3.0
			L_1 – L_3	485	L_2	114	64					
			L_2 – L_3	482	L_3	111	58					

RECOMMENDATIONS:

The following recommendations are provided for consideration to improve system notification and operation:

- Install a meter to measure and monitor the total volume and rate of air flow.
- Install a pressure switch on the discharge pipeline. The switch initiates an alarm when the discharge pressure decreases to a minimum setpoint.
- Incorporate the air conditioner or a form of mechanical cooling for the oil heat exchanger on a permanent basis.
- Purchase and inventory a spare relay contact for the load/unload solenoid.

Sincerely,

Terry Cunningham