



**CHERRY CREEK RESERVOIR
DESTRATIFICATION SYSTEM**

**OPERATIONS AND MAINTENANCE
ANNUAL REPORT
2024**

**Prepared by:
Ricardo Goncalves, PE
January 2025**



**CHERRY CREEK BASIN WATER QUALITY AUTHORITY
RESERVOIR DESTRATIFICATION SYSTEM
OPERATION AND MAINTENANCE
ANNUAL REPORT
2024**

INTRODUCTION

RG and Associates, LLC (RGA) has been retained to manage the operation and maintenance of the compressor and aeration system commonly referred to as the Cherry Creek Reservoir Destratification System (RDS). The RDS began operation in April 2008.

RDS OPERATIONS POLICY

At its January 20, 2022, meeting, the CCBWQA Board of Directors (Board) adopted a restated amended Policy for the Operation of the RDS (Policy) by resolution 2022-1-2 which recognized that the RDS historically has shown to reduce the summer Chlorophyll *a* average by 0.8 to 4.7 ug/l. As such, the board established a new operating season of approximately mid-April through approximately the end of September.

In accordance with this policy, then, RGA started the RDS on April 16, 2024, and shut it down on October 3, 2024.

SYSTEM OPERATION

The RDS operated trouble-free in 2024, with only 24 hours of down-time, due to a power problem with Xcel, and not the RDS system itself. This was essentially the same as last year, and much less than the 9 days in 2022. Part of this was due to the fact that there were no calls during the operating season for heads inadvertently broken by boat anchors, causing a system upset, and part was due to implementation of the RMS, the remote monitoring system, whereby we and the IR team were able to get almost immediate notification that the system was not operating and allowing repair teams to get out repairs immediately make repairs or adjustments. The operating log of the system is contained in the Appendix for more information.

REPAIRS TO THE SYSTEM

There were no repairs to the system in 2024. In June, the compressor shut down for 24 hours due to an Xcel power problem, but there was no damage or repairs to the RDS system itself. At the system shutdown on October 3rd, it was determined that one of the Pressure Regulating Valves was malfunctioning, and Ingersoll Rand will be replacing it under warranty at no cost to the Authority in February 2025.

MAINTENANCE ON THE SYSTEM

Routine maintenance was performed three times on the system on-schedule by Ingersoll Rand, in February, June and October, under their PerformanceCare maintenance contract with the Authority, and intermediate maintenance to clean the oil coolers of excess accumulated dust

was done in April and August. One unscheduled maintenance event was attempted by the IR team on June 21, 2024, but it was determined that the problem was with the Xcel transformer outside the compressor building, which Xcel repaired in less than a day.

The final scheduled maintenance event was performed between September 12th and 17th by Foster Dirt and Construction Co. Foster Dirt replaced B&RW during the year due to Blair Wacha's desire to retire and transition the business to Justin Foster of Foster Dirt and Construction Co. Blair stayed on the team during the year to assist and lend his expertise to the Foster Dirt Team. During this final maintenance, a few cam levers, cam pins and flow regulators were replaced due to corrosion on the old parts and the flow regulators were cleaned, but nothing of great consequence was noted. A complete log of the maintenance performed can be found in the Appendix of this report, for more detailed information regarding this maintenance event.

2024 ELECTRICAL USAGE AND CHARGES

Xcel Energy no longer provides usage and power graphs and charts so no graphs will be shown in this year's report as was provided in the past. The energy use of the RDS decreased in 2024 as compared to 2023 as shown on the charts below by 0.6%. The 2024 season was shorter than 2023 by 1 day, when comparing startup and stop dates for each year, April 17 to October 5, 2023 (171 days) versus April 16 to October 3, 2024 (170 days), 2024 had the same one day of shutdown as 2023 due to mechanical issues. This stands to reason, since the operating time in 2024 equates to a 0.6 % decrease in operating time over 2023. Conversely, even though the usage in 2024 was less than 2023, the cost was slightly higher by 4%. The difference is negligible, so no investigation was carried out, even though the energy costs per KW-hr appear to be the same in both years. It is recommended, as was last year, that the energy usage be monitored going forward to determine whether there are any developing performance issues with the RDS.

System power Costs 2023

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Total |
|-----------------|----------|----------|----------|----------|------------|------------|-------------|------------|------------|-------------|------------|----------|-------------|
| Charges 2022 | | \$481.62 | \$473.83 | \$486.83 | \$5,802.56 | \$8,276.05 | \$11,497.55 | \$9,826.91 | | \$8,420.90 | \$1,820.20 | \$504.77 | \$47,591.22 |
| Charges 2023 | \$546.82 | \$520.39 | \$511.15 | \$483.99 | \$4,977.13 | \$8,403.07 | \$10,340.82 | \$9,578.53 | \$8,136.47 | \$10,666.11 | \$896.45 | \$531.38 | \$55,592.31 |
| Charges 2024 | \$532.55 | | | | | | | | | | | | |
| Temp 2022 (Å°F) | | 33.06667 | 35.39655 | 40.25806 | 48.39655 | 58.13334 | 70.913795 | 74.25 | | 68.46774 | 54.06452 | 36 | |
| Temp 2023 (Å°F) | 32.25714 | 31.5 | 33.76667 | 39.03571 | 51.01724 | 59.07576 | 66.01667 | 75.5 | 74.29311 | 67.09091 | 51.48276 | 43.46875 | |
| Temp 2024 (Å°F) | 38.90625 | | | | | | | | | | | | |

2023 system power cost by month

System power Usage 2023

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Total KW-HR |
|-------------------------|----------|----------|----------|----------|----------|----------|----------|--------|----------|----------|----------|----------|-------------|
| Energy Usage 2022 (kWh) | | 800 | 760 | 800 | 26,200 | 38,240 | 41,600 | 35,160 | | 29,760 | 6,640 | 880 | 180,840 |
| Energy Usage 2023 (kWh) | 1,080 | 960 | 920 | 800 | 21,440 | 37,080 | 36,680 | 34,240 | 28,600 | 37,680 | 1,920 | 840 | 202,240 |
| Energy Usage 2024 (kWh) | 840 | | | | | | | | | | | | |
| Temp 2022 (Å°F) | | 33.06667 | 35.39655 | 40.25806 | 48.39655 | 58.13334 | 70.9138 | 74.25 | | 68.46774 | 54.06452 | 36 | |
| Temp 2023 (Å°F) | 32.25714 | 31.5 | 33.76667 | 39.03571 | 51.01724 | 59.07576 | 66.01667 | 75.5 | 74.29311 | 67.09091 | 51.48276 | 43.46875 | |

2023 system power usage by month

System power Costs and Usage 2024

| | Feb 2024 | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec | Jan 2025 | Total |
|-------------------------------|--------------------------|----------------------------|------------------------------|----------------------------|---------------------------|----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------|-------------|
| Billing Period | Jan 5, 2024- Feb 6, 2024 | Feb 6, 2024- March 6, 2024 | March 6, 2024- April 4, 2024 | April 4, 2024- May 3, 2024 | May 3, 2024- June 5, 2024 | June 5, 2024- July 3, 2024 | July 3, 2024- Aug 2, 2024 | Aug 2, 2024- Sept 3, 2024 | Sept 3, 2024- Oct 2, 2024 | Oct 2, 2024- Oct 30, 2024 | Oct 30, 2024- Dec 1, 2024 | Dec 1, 2024- Jan 1, 2025 | |
| Total Electric Usage | 840 kWh | 800 kWh | 960 kWh | 21040 kWh | 23960 kWh | 46640 kWh | 36840 kWh | 33680 kWh | 32320 kWh | 2040 kWh | 1024 kWh | 991 kWh | 201,135 kWh |
| Total Electric Charges | \$563.82 | \$555.22 | \$713.28 | \$5,565.90 | \$5,878.66 | \$13,142.85 | \$10,822.64 | \$9,819.72 | \$9,446.98 | \$1,170.15 | \$552.15 | \$322.56 | \$57,990.11 |

System power cost and usage for 2024

RDS EFFECT ON WATER QUALITY

One of the goals of the RDS is to disrupt the natural buoyancy of cyanobacteria to reduce the frequency and severity of blooms. The updates to the RDS system in 2022 which allow for a full season of operation, likely provide additional benefit during the seasonal chlorophyll-a standard assessment period (July-September) and may also have helped to more quickly disrupt blooms that typically occur later in the season.

RESERVOIR WATER QUALITY

- Cyanobacteria blooms are variable
- Species responsible for closures due to toxin production occur but not every year
- 2024 - Cyano bloom in late July tested positive for toxin and affected areas were closed to contact for few days (Microcystis - non N-fixer)

| Year | Bloom | Toxin/ Closure |
|------|----------------|-----------------------|
| 2014 | Yes - Severe | Yes/ Yes |
| 2015 | Yes - Moderate | Not Detected/ No |
| 2016 | Yes - Severe | Yes/ Yes |
| 2017 | Yes | - / No |
| 2018 | Yes - Mild | Not Detected/ No |
| 2019 | Yes - Moderate | Not Detected/ Caution |
| 2020 | Yes - Severe | Yes/ extended |
| 2021 | No | |
| 2022 | Yes - multiple | Yes/ Yes |
| 2023 | Yes - multiple | Yes/ Yes |
| 2024 | Yes - Moderate | Yes/ Yes |



Cyanobacteria Activity – Courtesy of LRE Water

OVERALL HEALTH OF THE SYSTEM

Generally, the RDS is in sound condition, especially since the compressor was replaced in January of 2020, five years ago. The life of a system like that should be upwards of 20-30 years, with the compressor being the most sensitive to wear and tear. The compressor is the only active part of the system and is only three years into its life span. The aerators and piping are passive parts, meaning they have no moving parts, and in the opinion of Foster Dirt and Construction Co., the aeration system is a “Cadillac” system, and should have at least another four to nine years of life left. The only problems that we have had with the aeration system is from corrosion of the stainless-steel parts, and some wear and tear on the air hoses. While the system may have another 4-9 years, some of the parts, especially the air hoses, may need to be replaced during that time period.

RECOMMENDATIONS

The following recommendations are provided for consideration to improve system operation.

- As an additional prevention of the compressor oil coolers from clogging with dust and overheating, even though the Authority contracted for additional maintenance dates in April and August last year, it is recommended to install dust filters on the doorway louvers in 2025 at a cost of less than \$1,000.
- It is recommended to continue monitoring the annual energy consumption and look for any trends that may point to developing issues or concerns with the compressor.
- It is recommended that the Authority replace 45 feet of air hose near aerator #105 in 2025.
- It is recommended that the Authority begin testing of the non-aeration head mainlines in 2026
- It is recommended that the Authority purchase the following list of spare parts for aerator maintenance later this year:
 - 25 cam pins
 - 50 cam levers
 - 20 plastic protective cones
 - 200 linear ft +/- hydraulic hose, each size 1" & 1/4", specs stamped on existing hose

Appendix

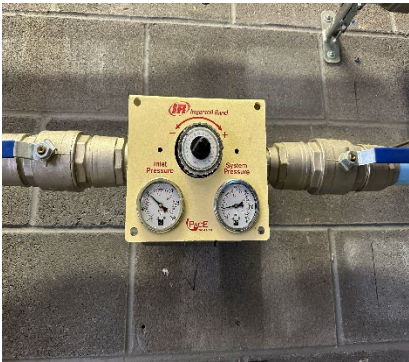
SUMMARY of 2024 OPERATIONS DETAILS, REPAIRS and MAINTENANCE

March 28-

- I arrived at the compressor building to de-winterize the system and to do a startup test to check for system integrity.
- After verifying startup procedures with Ingersoll Rand, I started the compressor with no issues.
- I walked to the distribution manholes to check for correct pressures and any indications of any leaks out in the system
- All pressures were normal at the compressor building and at the manholes
- I toured the aerator field by boat with Erin Stewart to check for any broken aerators
- Finding no aerator issues, I returned to the compressor building and shut the system down to wait until mid-April for the season startup

April 16-

- Started the compressor at 2:00 pm in the prescribed manner, starting at 45 psi
- Checked the distribution manholes for consistent pressure-all ok
- The aerators in the reservoir were all operating well
- Stopped by again at 6:00 pm to adjust the pressure to 50 psi



Starting pressure at 45 psi



Normal aeration plumes

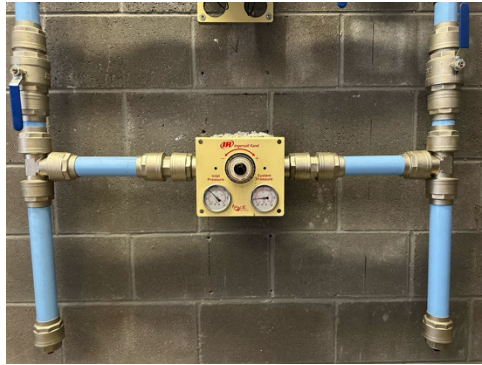


Normal compressor operating pressure

April 17-

- Stopped by to check the aerators and compressor pressure and to make final adjust pressure adjustment to 55psi

- System was operating normally



Final pressure at 55 psi

June 21-

- I received a notice from IR on the RMS that the compressor was receiving faults
- I made a call to Jeff Handley, who said system was undergoing upgrade and that I might be receiving faulty information
- Around noon, still receiving no meaningful readings, I decided to make a site visit to visually check the system to see if it was still running.
- Arrived at the reservoir site at 2:10 and could see the bubble plumes out in the reservoir, indicating that the compressor was running
- I entered the building at 2:20 and found that the compressor had just faulted off at 2:14
- Called IR rep, Jeff Handley, who assisted me in going through all the diagnostic checks
- Not being able to resolve anything, Jeff said he would have his technician come out to check the system and I left
- At 5:30, I got a call from the IR technician, who indicated that the problem was not with the compressor, but with the transformer outside giving out of phase power which would not allow operation of the compressor and that he could not fix the problem
- I contacted Piper Electric who checked out the transformer that evening, and related back that they would need a special suit to check out the transformer and would have to do it the next day

June 22-

- Got a call from Piper Electric at 8:18 am who said that the problem with the transformer was that one phase was putting out too much power, that they couldn't fix it and that Xcel would have to fix the problem, as it was their transformer
- I then called Xcel, who said they would get the problem resolved ASAP
- Got a call from Xcel about 11:30 am who said that the problem was with a blown fuse at another transformer on the system near Cherry Creek High School, and that the problem was resolved
- I went out to the Compressor Building, and started the compressor back up at 2:05
- The compressor had been shut down 9 minutes shy of 24 hours
- The only cost for the down time was \$1,800 to Piper Electric for their emergency service

July 11-

- I was notified by the IR team who was out for their normal maintenance, that the oil coolers were excessively dusty and did I want them to clean them?
- I said “yes” and it was done.
- Discussed solution with Jeff Handley about putting filters on the door louvers that wouldn't detrimentally affect airflow to the compressor, but that would keep dust from entering the building
- Made plans to install filters for operation in 2026

September 12-17-

- The yearly inspection and maintenance of the aeration system was done and completed on September 17, 2024, by Foster, Dirt and Construction. Its full inspection report is contained in the Appendix of this report.
- Cleaning, disassembly, inspection and reassembly of all 115 aerator heads was done
- In general,
 - The heads in zones 2-5 showed less corrosion than any year, since the system was installed
 - Zone 1 required about the same or slightly more repairs to the system
 - Corrosion, probably due to electrolysis, is continuing to be noticeable in machined stainless-steel parts, a few to the point of requiring replacement to properly seal. (See photos below)



- Damage to the hydraulic lines that make up the aeration system is becoming apparent due to fatigue and aging of the system.
- One section of the hose, about 45 feet, has some boat anchor damage, with torn rubber and rusty steel reinforcing and should be replaced next year
- Hoses were showing some signs of aging, this being the first year of aging becoming evident, and we should be prepared to have spare hoses for replacements into the future.
- In general hoses have a useful life of about 20 years, depending on conditions and water quality.
- Consideration should be given to pulling up and inspecting the non-aeration head hose in the system within the next 5 years



- Parts required for continuing operation next year(s):
 - 25 cam pins
 - 50 cam levers
 - 20 plastic protective cones
 - 200 linear ft +/- hydraulic hose, each size 1" & 1 ¼", specs stamped on existing hose

Those parts have been budgeted, and in the process of being ordered

October 3-

- On October 3, 2024, the process for compressor was shut down in accordance with Authority Policies and Procedures was begun. .
- Water was blown off from the compressor, the aeration drip legs and the regulator tank.
- The procedure whereby the air discharge valves downstream of the pressure reducers were shut down very slowly while the compressor was still running to shut off the air to the aeration system gradually to prevent sudden back pressure on the aeration system heads that has caused some of the O-rings to blow out in the past, was followed.

- After the valves were shut, the compressor was shut down for the winter at 8:15 am.



- It was noted that the lower air pressure regulating valve was malfunctioning, just prior to shutdown, and Jeff Handley indicated that IR would replace it at the February 2025 compressor maintenance trip.

Footnote-

- It was noted by the Water Quality Monitoring group, LRE, that right after the RDS was shut down for the year, that the reservoir experienced a cyano-bacteria bloom, which was unusual for that time of year, but was assumed to have occurred because of the unusually warm temperatures in late September and early October.
- It was thought by the Authority Staff that the bloom could have been avoided or minimized if the compressor had been allowed to continue operating beyond the Authority Compressor Shut Down Policy time of shut down “approximately the end of September”
- As a consequence, it was decided to amend the Compressor Shut Down policy by having the RDS Manager obtain a consensus of the Authority Staff that either shut down should occur, or if operation should be continued to a later date.
- This amended policy will be put into effect next year.

Foster Dirt Report from 2024 Annual Maintenance

| September 2024 repairs to Cherry Creek aereation system | | | | | | | | | | | | |
|---|---------------|---|-------------------------|-------------------------|-------------------------|--------------------|----------------|----------------------------|--------------------------------------|--|---|--|
| 1 | Head location | Clean head & adjust position, check fitting tightness | Clean or replace filter | Upper cam pins replaced | Lower cam pins replaced | Replace cam levers | Replace O Ring | Replace other broken parts | Actual latitude N 39 deg, xx.xxx min | Actual longitude W 104 deg, xx.xxx min | Stainless Steel Band Clamp Thickness (new .025") / End of Line Blow Off Valve Pressure (distribution vault pressure 47 psi) | Notes |
| 2 | | | | | | | | | | | | |
| 3 | 101 | x | clean | 0 | 1 | 0 | 0 | 1 | 38.509 | 51.911 | | Replace riser hose, tighten SS fittings, replace 2 ss clamps, difficult to clean |
| 4 | 102 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.478 | 51.895 | | |
| 5 | 103 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.447 | 51.881 | | |
| 6 | 104 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.415 | 51.868 | | |
| 7 | 105 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.374 | 51.877 | | Severe tears in outer hydraulic hose, likely by dragging boat anchor, 45 in ft +/- |
| 8 | 106 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.359 | 51.898 | | |
| 9 | 107 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.339 | 51.933 | | |
| 10 | 108 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.324 | 51.964 | | |
| 11 | 109 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.368 | 51.822 | | |
| 12 | 110 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.335 | 51.831 | | |
| 13 | 111 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.322 | 51.845 | | |
| 14 | 112 | x | replace | 0 | 0 | 0 | 0 | 0 | 38.296 | 51.871 | | |
| 15 | 113 | x | clean | 0 | 2 | 0 | 0 | 0 | 38.270 | 51.891 | | Blow off |
| 16 | 114 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.350 | 51.793 | | |
| 17 | 115 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.341 | 51.746 | | |
| 18 | 116 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.336 | 51.718 | | |
| 19 | 117 | x | clean | 0 | 2 | 1 lower | 0 | 0 | 38.329 | 51.676 | | |
| 20 | 118 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.321 | 51.634 | | |
| 21 | 119 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.313 | 51.592 | | |
| 22 | 120 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.307 | 51.557 | | Blow off |
| 23 | 121 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.478 | 51.999 | | |
| 24 | 122 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.456 | 52.045 | | Electrolysis damage to upper fitting, replaced |
| 25 | 123 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.434 | 52.075 | | |
| 26 | 124 | x | x | x | x | x | x | x | | | | Previously abandoned |
| 27 | Head location | Clean head & adjust position, check fitting tightness | Clean or replace filter | Upper cam pins replaced | Lower cam pins replaced | Replace cam levers | Replace O Ring | Replace other broken parts | Actual latitude N 39 deg, xx.xxx min | Actual longitude W 104 deg, xx.xxx min | Stainless Steel Band Clamp Thickness/ End of Line Blow Off Valve Pressure (distribution vault pressure 47 psi) | Notes |
| 28 | 201 | x | clean | 0 | 0 | 0 | 0 | 1 | 38.543 | 51.835 | | Replace upper stainless steel fitting / electrolysis damage |
| 29 | 202 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.514 | 51.811 | | |
| 30 | 203 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.485 | 51.791 | | |
| 31 | 204 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.463 | 51.764 | | |
| 32 | 205 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.437 | 51.740 | | |
| 33 | 206 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.416 | 51.709 | | |
| 34 | 207 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.386 | 51.670 | | |
| 35 | 208 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.360 | 51.610 | | |
| 36 | 209 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.347 | 51.554 | | |
| 37 | 210 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.332 | 51.486 | | |
| 38 | 211 | x | replace | 0 | 0 | 0 | 0 | 0 | 38.331 | 51.424 | | |
| 39 | 212 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.360 | 51.295 | | Significantly dragged by anchor |
| 40 | 213 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.390 | 51.243 | | Significantly dragged by anchor |
| 41 | 214 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.434 | 51.191 | | |
| 42 | 215 | x | replace | 0 | 0 | 0 | 0 | 0 | 38.474 | 51.142 | | |
| 43 | 216 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.514 | 51.098 | | difficult to clean |
| 44 | 217 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.552 | 51.061 | | |
| 45 | 218 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.602 | 51.026 | | difficult to clean, blow off |

| | Head location | Clean head & adjust position, check fitting tightness | Clean or replace filter | Upper cam pins replaced | Lower cam pins replaced | Replace cam levers | Replace O Ring | Replace other broken parts | Actual latitude N 39 deg. xx.xxx min | Actual longitude W 104 deg. xx.xxx min | Stainless Steel Band Clamp Thickness/ End of Line Blow Off Valve Pressure (distribution vault pressure 47 psi) | Notes |
|----|---------------|---|-------------------------|-------------------------|-------------------------|--------------------|----------------|----------------------------|--------------------------------------|--|--|--|
| 46 | | | | | | | | | | | | |
| 47 | 301 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.427 | 51.578 | | |
| 48 | 302 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.448 | 51.528 | | |
| 49 | 303 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.473 | 51.476 | | Replace cone |
| 50 | 304 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.435 | 51.432 | | Significantly moved |
| 51 | 305 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.406 | 51.412 | | Significantly moved, blow off |
| 52 | 306 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.488 | 51.436 | | |
| 53 | 307 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.475 | 51.380 | | |
| 54 | 308 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.436 | 51.357 | | |
| 55 | 309 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.399 | 51.325 | | Blow off |
| 56 | 310 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.509 | 51.367 | | |
| 57 | 311 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.487 | 51.327 | | |
| 58 | 312 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.448 | 51.294 | | Blow off |
| 59 | 313 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.540 | 51.324 | | |
| 60 | 314 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.570 | 51.279 | | |
| 61 | 315 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.601 | 51.223 | | |
| 62 | 316 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.628 | 51.172 | | Blow off |
| | Head location | Clean head & adjust position, check fitting tightness | Clean or replace filter | Upper cam pins replaced | Lower cam pins replaced | Replace cam levers | Replace O Ring | Replace other broken parts | Actual latitude N 39 deg. xx.xxx min | Actual longitude W 104 deg. xx.xxx min | Stainless Steel Band Clamp Thickness/ End of Line Blow Off Valve Pressure (distribution vault pressure 15 psi) | Notes |
| 63 | | | | | | | | | | | | |
| 64 | 401 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.528 | 51.635 | | |
| 65 | 402 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.537 | 51.601 | | |
| 66 | 403 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.557 | 51.559 | | |
| 67 | 404 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.578 | 51.511 | | |
| 68 | 405 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.606 | 51.460 | | |
| 69 | 406 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.634 | 51.406 | | |
| 70 | 407 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.663 | 51.347 | | |
| 71 | 408 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.687 | 51.299 | | |
| 72 | 409 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.710 | 51.251 | | |
| 73 | 410 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.740 | 51.194 | | |
| 74 | 411 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.764 | 51.140 | | Blow off |
| 75 | 412 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.491 | 51.573 | | |
| 76 | 413 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.503 | 51.548 | | |
| 77 | 414 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.530 | 51.490 | | |
| 78 | 415 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.547 | 51.453 | | |
| 79 | 416 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.576 | 51.393 | | |
| 80 | 417 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.602 | 51.342 | | |
| 81 | 418 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.630 | 51.293 | | |
| 82 | 419 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.662 | 51.240 | | |
| 83 | 420 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.686 | 51.180 | | |
| 84 | 421 | x | clean | 0 | 0 | 0 | 0 | 1 | 38.707 | 51.137 | | Replace broken head |
| 85 | 422 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.539 | 51.680 | | Blow off |
| 86 | 423 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.563 | 51.628 | | |
| 87 | 424 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.583 | 51.574 | | |
| 88 | 425 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.609 | 51.521 | | Tighten stainless steel fitting joints |
| 89 | 426 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.638 | 51.467 | | |
| 90 | 427 | x | clean | 0 | 0 | 0 | 0 | 1 | 38.664 | 51.415 | | Replace lost head, electrolysis/wear damaged cam |
| 91 | 428 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.692 | 51.363 | | |
| 92 | 429 | x | clean | 0 | 0 | 1 lower | 0 | 0 | 38.718 | 51.307 | | |
| 93 | 430 | x | clean | 0 | 1 | 0 | 0 | 0 | 38.744 | 51.253 | | |
| 94 | 431 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.769 | 51.201 | | Blow off |

| | Head location | Clean head & adjust position, check fitting tightness | Clean or replace filter | Upper cam pins replaced | Lower cam pins replaced | Replace cam levers | Replace O Ring | Replace other broken parts | Actual latitude N 39 deg. xx.xxx min | Actual longitude W 104 deg. xx.xxx min | Stainless Steel Band Clamp Thickness/ End of Line Blow Off Valve Pressure (distribution vault pressure 47 psi) | Notes |
|-----|---------------|---|-------------------------|-------------------------|-------------------------|--------------------|----------------|----------------------------|--------------------------------------|--|--|--|
| 95 | | | | | | | | | | | | |
| 96 | 501 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.607 | 51.716 | | |
| 97 | 502 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.646 | 51.652 | | |
| 98 | 503 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.683 | 51.581 | | |
| 99 | 504 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.707 | 51.534 | | |
| 100 | 505 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.731 | 51.487 | | |
| 101 | 506 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.756 | 51.441 | | |
| 102 | 507 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.776 | 51.394 | | |
| 103 | 508 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.809 | 51.321 | | |
| 104 | 509 | x | replace | 0 | 0 | 0 | 0 | 0 | 38.829 | 51.271 | | |
| 105 | 510 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.851 | 51.227 | | |
| 106 | 511 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.829 | 51.110 | | |
| 107 | 512 | x | clean | 0 | 0 | 0 | 0 | 1 | 38.616 | 51.117 | | Replace riser hose, likely damaged by anchor |
| 108 | 513 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.581 | 51.146 | | |
| 109 | 514 | x | clean | 0 | 0 | 0 | 0 | 1 | 38.554 | 51.152 | | cam corroded thru electrolysis, lost & replaced head & ss neck |
| 110 | 515 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.531 | 51.235 | | |
| 111 | 516 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.503 | 51.270 | | Blow off |
| 112 | 517 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.573 | 51.680 | | |
| 113 | 518 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.590 | 51.635 | | |
| 114 | 519 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.615 | 51.591 | | |
| 115 | 520 | x | clean | 0 | 0 | 0 | 0 | 1 | 38.640 | 51.533 | | replace cone |
| 116 | 521 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.663 | 51.489 | | |
| 117 | 522 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.692 | 51.432 | | |
| 118 | 523 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.721 | 51.368 | | |
| 119 | 524 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.742 | 51.323 | | |
| 120 | 525 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.773 | 51.268 | | |
| 121 | 526 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.800 | 51.217 | | |
| 122 | 527 | x | clean | 0 | 0 | 0 | 0 | 0 | 38.824 | 51.167 | | Blow off |
| 123 | | | | | | | | | | | | |

Foster Dirt Aeration Maintenance Activity Report

Our maintenance & inspection crew spent 4 days between September 12th – 17th, cleaning, disassembly, inspection and reassembly, of all 115 aerator heads in the Cherry Creek Reservoir Basin. The specific cleaning and repair details are attached as an Excel file.

In general, we determined or performed the following:

- The heads in zones 2-5 showed less corrosion than any year, since the system was installed
- Zone 1 required about the same or slightly more repairs to the system
- Corrosion, probably due to electrolysis, is continuing to be noticeable in machined stainless steel parts, a few to the point of requiring replacement to properly seal. (See photos below)



- Damage to the hydraulic lines that make up the aeration system is becoming apparent due to fatigue and aging of the system. One of the crew, Blair Wacha, has had extensive experience diving in Cherry Creek Reservoir and has done numerous repairs to hydraulic outlet gates throughout the state, says that hydraulic hoses used which are submerged in water, generally have a useful life of about 20 years, depending on conditions and water quality. Prior to failure, hoses will start to show bubbles, abrasions, or rust on the exterior of the hose. This is the first year for that to be evident. One area in particular, immediately west of head 105 was apparently raked by a boat anchor in a generally western direction, causing tears to the outer layer of rubber hose and rusting of the outer layer of steel reinforcement. The damaged area was about 45 feet in length. I suggest replacing this area of line prior to start up next year. It is also recommended to have about 200 feet of both 1" diameter and 1 ¼" diameter hose available for repairs next year. This size hose is likely not in stock in Denver, so time should be allowed to procure it. Our normal maintenance includes pulling the heads to the surface, gives the opportunity to view the hose condition in a very limited area. Consideration should be given to pulling up and inspecting all the hose condition in the entire system, which includes over 6 miles of hoses, within the next 5 years. These early signs of fatiguing, likely mean that boat anchor damage in the future is more likely, and failures more common in upcoming years.



Parts required for continuing operation next year(s):

- 25 cam pins, better off to get 200 to last for several years
- 50 cam levers
- Pin & cam samples left on shelves of compressor building for sizing
- 20 plastic protective cones
- 200 lin ft +/- hydraulic hose, each size 1" & 1 ¼", specs stamped on existing hose

