

On-Demand, Gravity Powered, Ceramic Filtration Facility: Forget What You Know About How A WTP Is Supposed To Operate

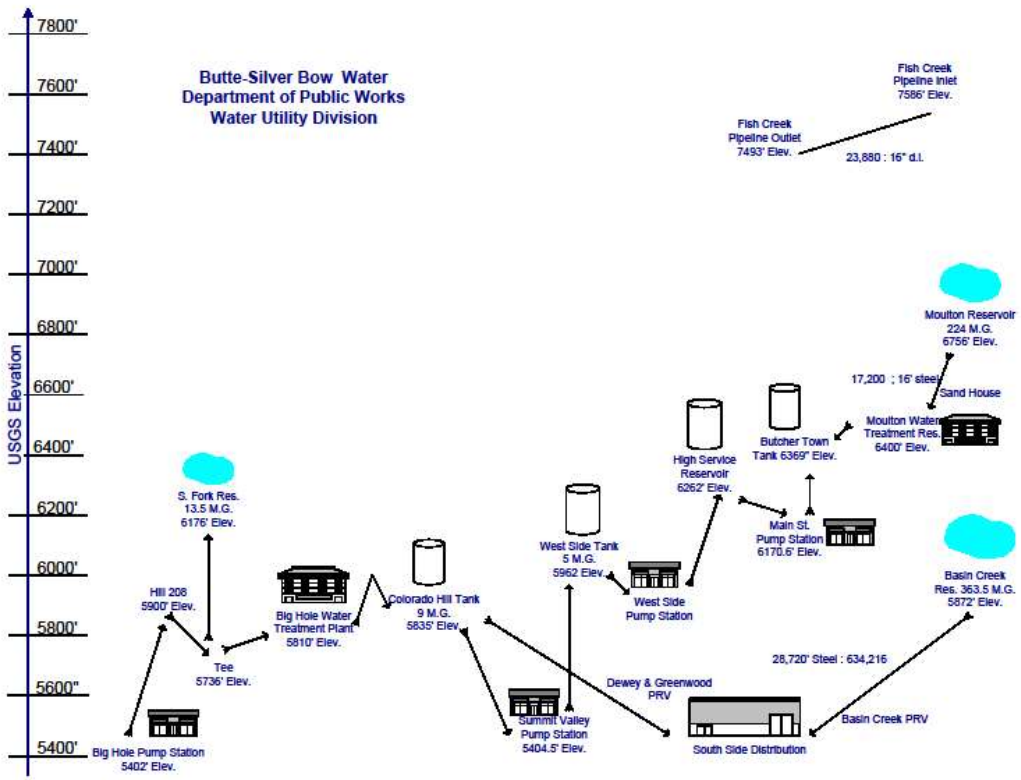

5/4/2016

Nathan Kutil, HDR

Butte Water System

Complex System

- System draws water from several separate raw water impoundments and streams
- 3 separate treated water sources:
  - Big Hole/ South Fork; Moulton; Basin Creek
- 7 different pressure zones in distribution
- 4 finished water storage reservoirs



EL. Δ 2000'

Mining

- As early as the 1860's water shortages threatened the viability of fledgling town
- Local surface waters were contaminated – unfit for consumption
- The City quickly became dependent on water sources distant from the City limits
- By 1891 Butte stood at a crossroads – needed reliable water supply

Underground Fires

- Mining properties were large consumers of water
- Underground fires required an enormous quantity of water quickly

The Butte Daily Post.

VOL. 5. NO. 138. BUTTE, MONTANA SATURDAY, JUNE 9, 1917 PRICE FIVE CENTS

33 KNOWN DEAD; 162 MISSING

GRANITE MOUNTAIN DISASTER WORST IN METAL MINING HISTORY

BUTTE STAGGERS UNDER PARALYZING EFFECT OF TERRIBLE LOSS OF LIFE. EVERY MINING OFFICIAL IN BUTTE AIDING IN THE GHASTLY RESCUE WORK

HELMET MEN BRAVING DEATH EACH MINUTE. LATE TODAY PENETRATED 2200 FOOT LEVEL OF THE MINE; THEY REPORT SCORES OF BODIES IN THE WORKINGS

Mining officials of North Butte and Anaconda Companies, after making every conceivable effort to gain access to the lowest depths of the mine and taking immeasurable risks, declare that there is almost no hope that any of the missing men below the 1800 level are alive.

Thirty-three bodies have been recovered, scores of others have been sighted by mines rescue teams and helmet men in the gas-filled workings and 162 of the 412 miners who went to work last night are still unaccounted for this afternoon as a result of the greatest disaster in the history of quartz mining, resulting from a fire of accidental origin in Granite Mountain shaft of the North Butte Copper Mining Company.

The entire mines rescue organization of the Butte district, most efficient in the world, coupled with every agency of the city government, is engaged in rescue work, but hope of finding any of the men who were cut off from escape by the smoke and gas which filled the underground workings was practically abandoned at noon, so that there is likelihood of the death toll reaching possibly more than 190.

The great loss of life, heroic efforts to quench the flames and to rescue any who might still be alive produced a condition of confusion at the mine from which it is almost impossible to get an exact summary of the situation, although it is known that the Granite Mountain shaft is caved for some distance, due to the burning of timbers and effects of the big volume of water poured into it to stop the inroads of the flames.

Butte Water Company

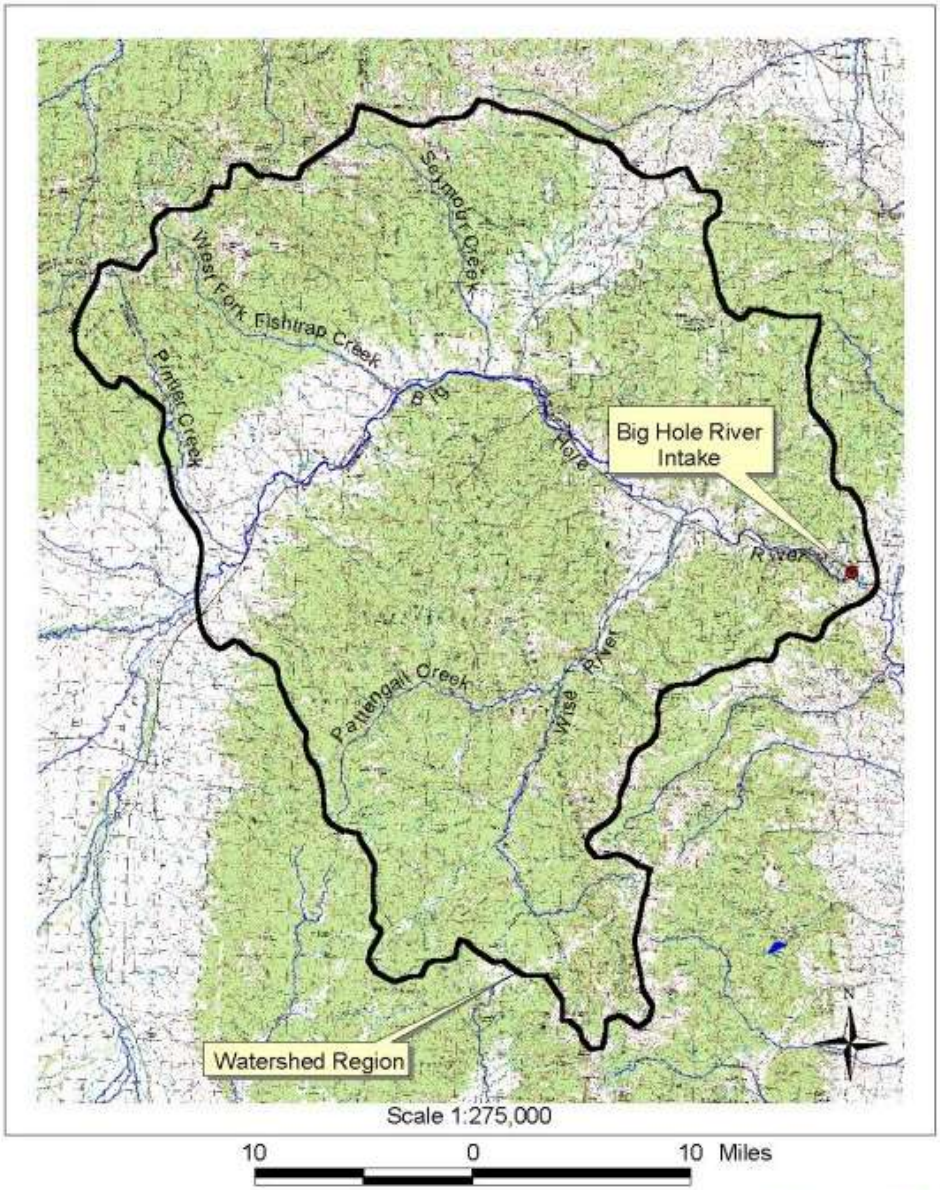
- A.S. Bigelow organized the Butte City Water Company in 1891
- May 1891 – City council granted exclusive contract to Butte City Water to deliver water to the mining properties and the City's inhabitants
- Butte City Water promised to spend $2M to develop new water sources

Basin Creek Dam

- Basin Creek Dam No.1 started early spring of 1892
- Located at the junction of Bear Creek and Basin Creek south of the City
- Elevation 5887; capacity approximately 364 million gallons
- Still didn’t provide enough water to meet demand

Big Hole River/South Fork Supply

- On the Atlantic side of the Continental Divide
- Pumping water 27 miles across the divide
- Only system at the time in the US to move water from Atlantic to Pacific Drainage
- Involved construction of South Fork Reservoir (13.4 MG Cap)
- By 1902, Big Hole/SF system provided an additional 4MGD to Butte



Prepared by Aubrey Smartt
August 2002

Moulton Supply

- Completion of system required the construction of Moulton Reservoir
- Completed in 1907 (elevation 6,756’)
- 224 million gallon capacity
- Served the City’s highest elevation pressure zone by gravity

Moulton WTP

- 2 MGD Capacity
- Averages < 1 MGD
- Highest Pressure Zone
- Direct Filtration

Big Hole WTP

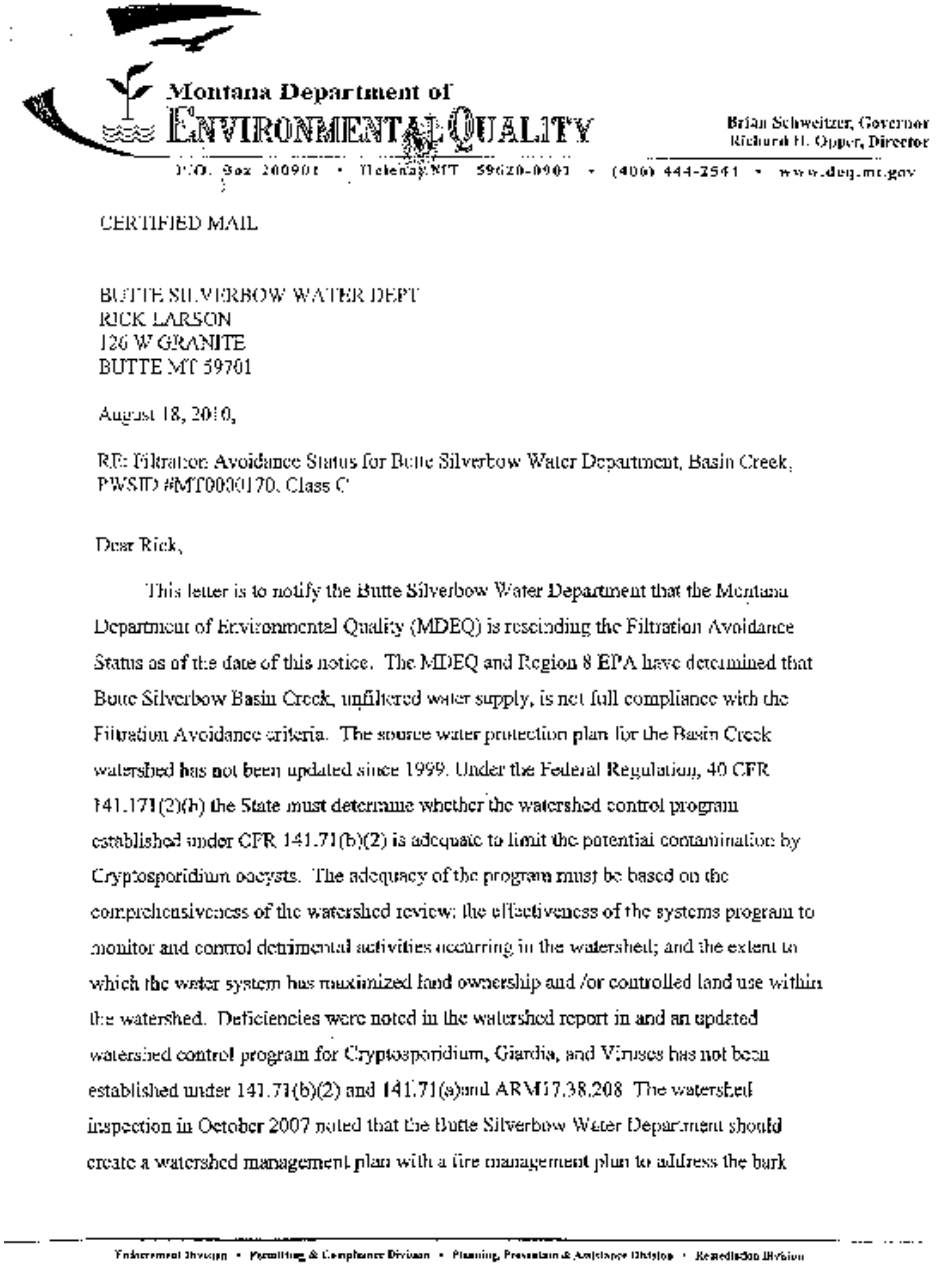
- Commissioned in 1995
- Rated at 16 MGD, but can only produce a max of about 12 MGD under best conditions
- Treats water from Big Hole River and South Fork Reservoir
- Struggles to meet demand and treatment goals in spring

Basin Creek

- Basin Creek source is an unfiltered surface water supply
- Basin Creek supplies up to 40% of Butte's annual water use
- Currently, water flows to town by gravity

Basin Creek Filtration

- On December 31, 1991 MDHES determined that filtration of Basin Creek supply was not required
- On August 18, 2010 MDEQ issued BSB notice that filtration avoidance was being rescinded
- Montana DEQ now requires it to be filtered
  - Protect against waterborne pathogens like *cryptosprodium*
  - Reduce the formation of disinfection byproducts



Montana Department of
ENVIRONMENTAL QUALITY

Brian Schweitzer, Governor
Richard H. Opper, Director

P.O. Box 200901 • Helena, MT 59620-0901 • (406) 444-2544 • www.deq.mt.gov

CERTIFIED MAIL

BUTTE SILVERBOW WATER DEPT
RICK LARSON
126 W GRANITE
BUTTE MT 59701

August 18, 2010,

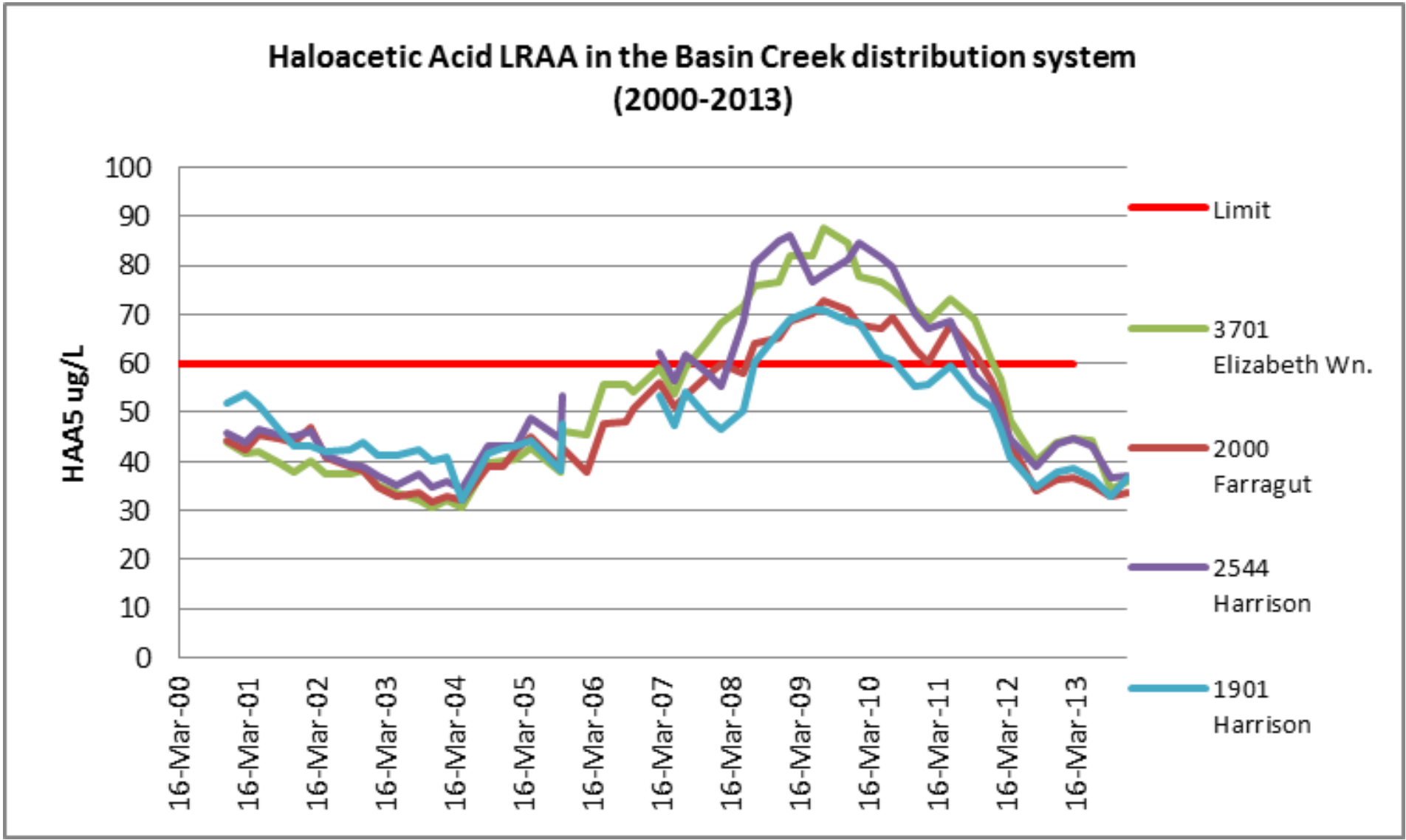
RE: Filtration Avoidance Status for Butte Silverbow Water Department, Basin Creek, PWSID #MT0000170, Class C

Dear Rick,

This letter is to notify the Butte Silverbow Water Department that the Montana Department of Environmental Quality (MDEQ) is rescinding the Filtration Avoidance Status as of the date of this notice. The MDEQ and Region 8 EPA have determined that Butte Silverbow Basin Creek, unfiltered water supply, is not full compliance with the Filtration Avoidance criteria. The source water protection plan for the Basin Creek watershed has not been updated since 1999. Under the Federal Regulation, 40 CFR 141.171(2)(h) the State must determine whether the watershed control program established under CFR 141.71(b)(2) is adequate to limit the potential contamination by Cryptosporidium oocysts. The adequacy of the program must be based on the comprehensiveness of the watershed review; the effectiveness of the systems program to monitor and control detrimental activities occurring in the watershed; and the extent to which the water system has maximized land ownership and /or controlled land use within the watershed. Deficiencies were noted in the watershed report in and an updated watershed control program for Cryptosporidium, Giardia, and Viruses has not been established under 141.71(b)(2) and 141.71(a)and ARM17.38.208 The watershed inspection in October 2007 noted that the Butte Silverbow Water Department should create a watershed management plan with a fire management plan to address the bark

Enforcement Division • Permitting & Compliance Division • Planning, Prevention & Assistance Division • Remediation Division

Disinfection Byproducts (DBPs)



Steps Taken by BSB to Control DBPs

- Improve total organic carbon (TOC) Removal:
  - Switched primary coagulant at both filtration plants from proprietary blend to alum
  - Introduced CO_2 at Big Hole WTP to lower pH
  - Implemented UV-254 monitoring

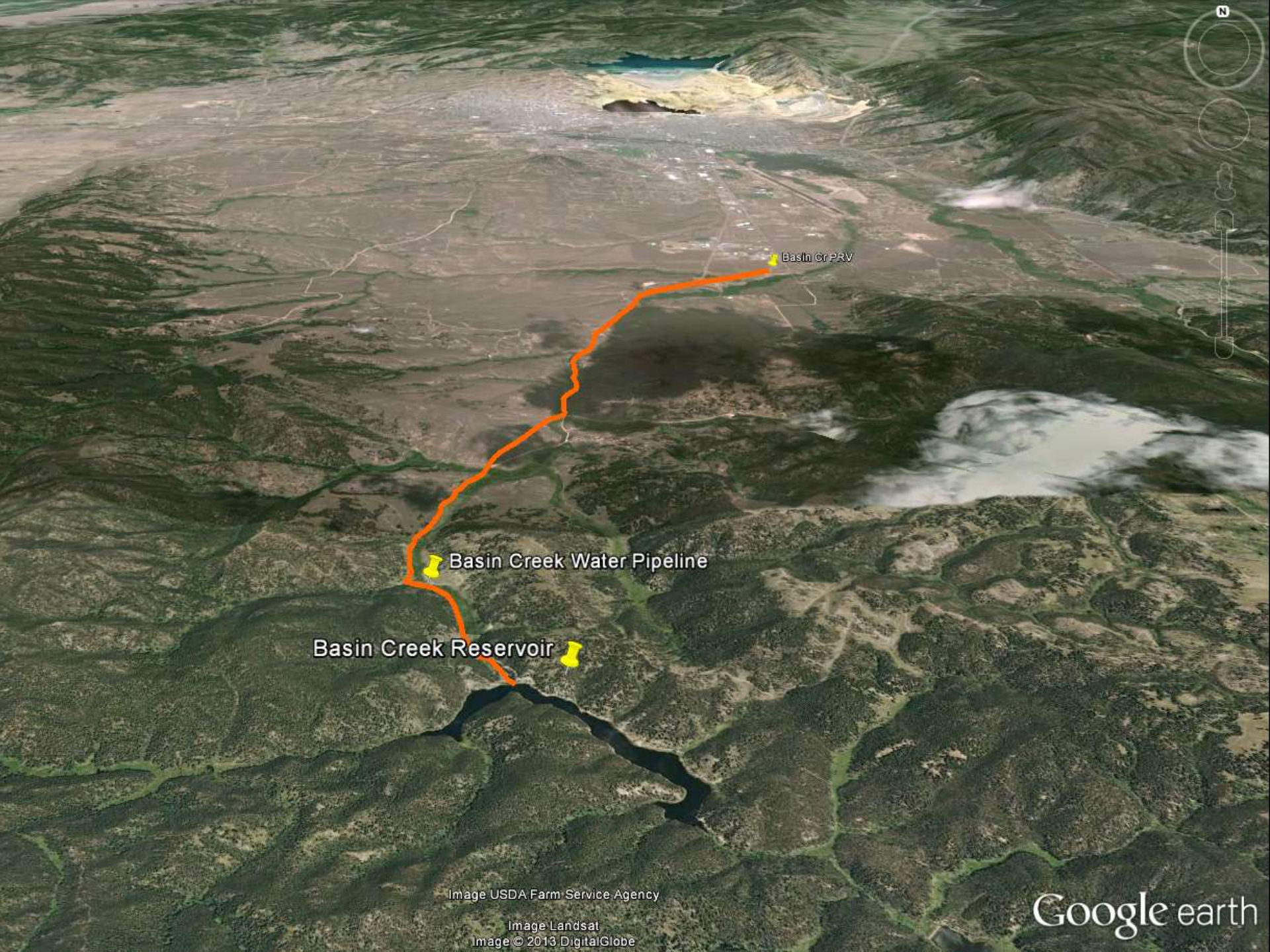
- Control Raw Water TOC
  - Preemptive application of algaecide

- Manage Water Age
  - Cycle tank levels constantly
  - Improvements to the largest tank

- Chlorine Dosing
  - Reduction in chlorine demand resulted in lower dosing
  - Chlorinator at BC now operates on flow rather than residuals

Goals

- Maintain existing Basin Creek source - 1892
- Meet MDEQ requirements for filtration
- Retain as much gravity character of existing system as possible to:
  - Reduce operating costs and
  - Enhance reliability
- Minimize waste / maximize recovery
- Design automated system
- Cost less than $30M
- Prevent DBP formation
- Displace water from BH source when its toughest to treat


Basin Cr PRV
Basin Creek Water Pipeline
Basin Creek Reservoir
Image USDA Farm Service Agency
Image Landsat
Image © 2013 DigitalGlobe
Google earth

Membrane Filtration Process Selected

- Membrane Procurement
  - Pressurized ceramic membrane filtration selected
  - Serial #001 in the United States
  - Several advantages including higher pressures, longer run times, warranty

City and County of Butte-Silver Bow
BSB, Montana

Basin Creek Water Treatment Plant

Membrane Filtration Goods and Services Procurement Documents

January 2013

HDR

HDR Project No. 214585

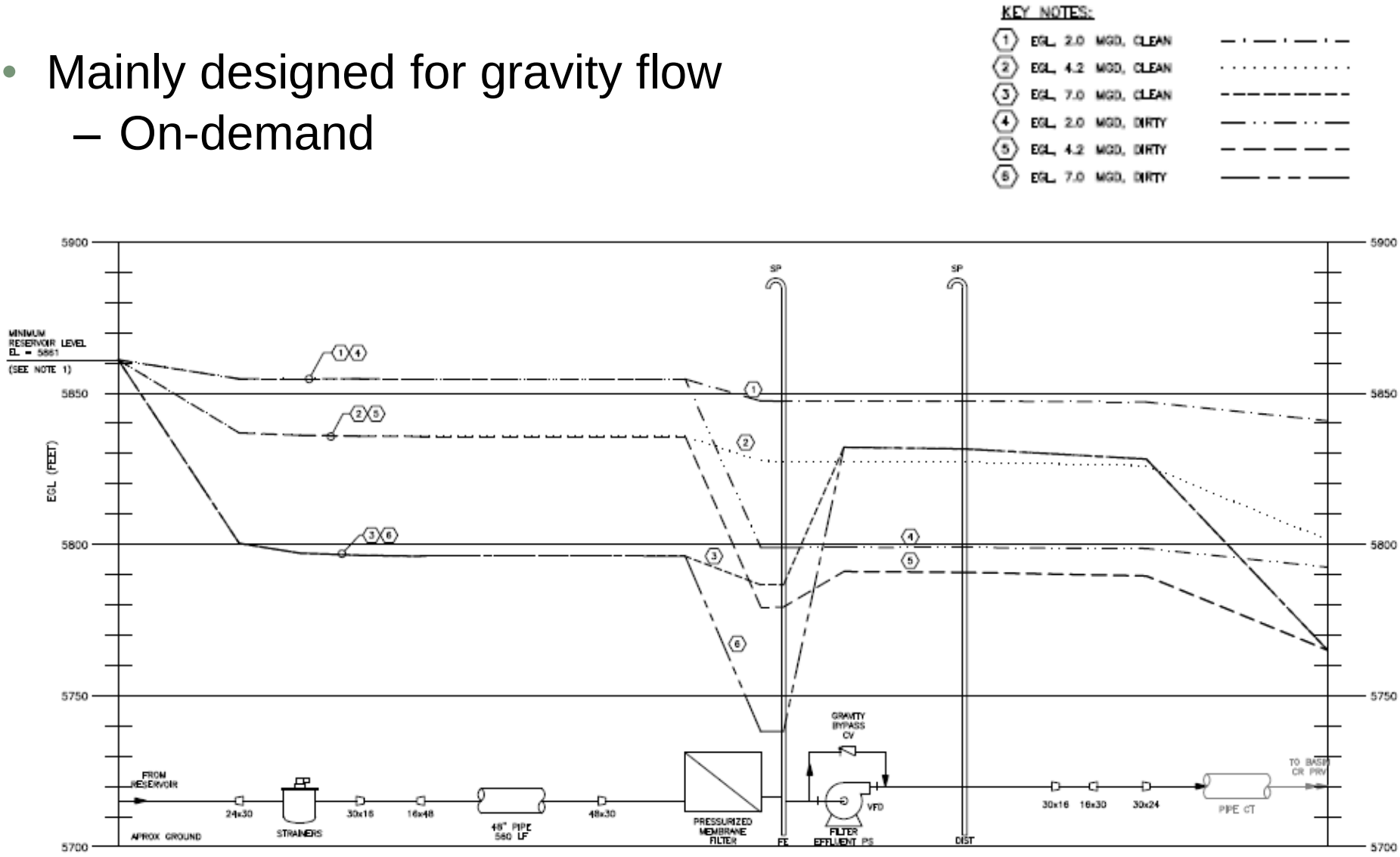
Facility Locations

- Many potential locations were narrowed down based on the following:
  - Proximity to power
  - Proximity to sewer
  - Availability/price of land
  - Access roads
  - Wetlands/floodplains
  - Elevation

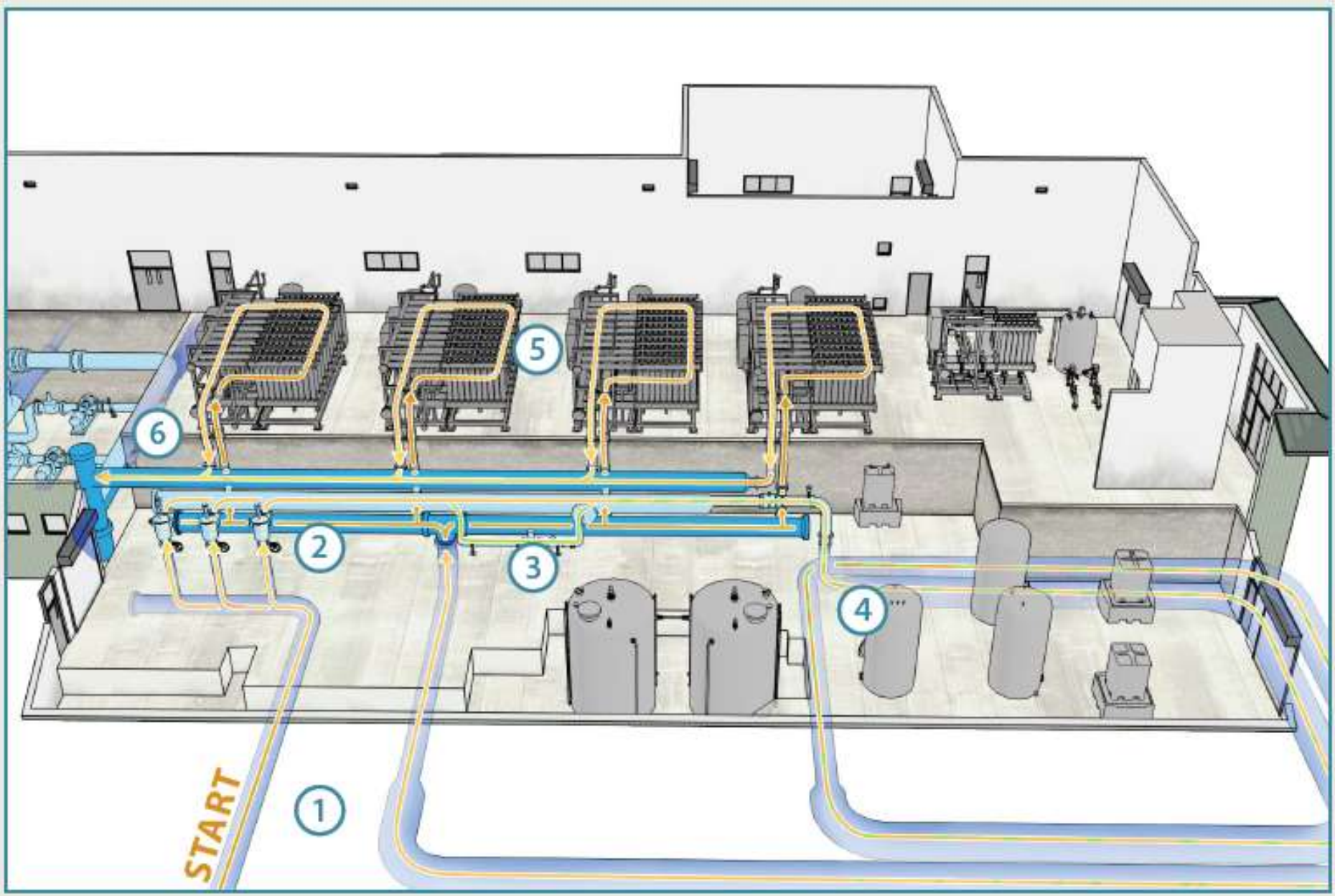

Herman Gulch Site
Image USDA Farm Service Agency
Image © 2013 DigitalGlobe
Image Landsat
ate: 4/9/2013
1996
45°53'07.22" N 112°32'19.77" W elev 5741 ft

Selected Hydraulic Scenarios

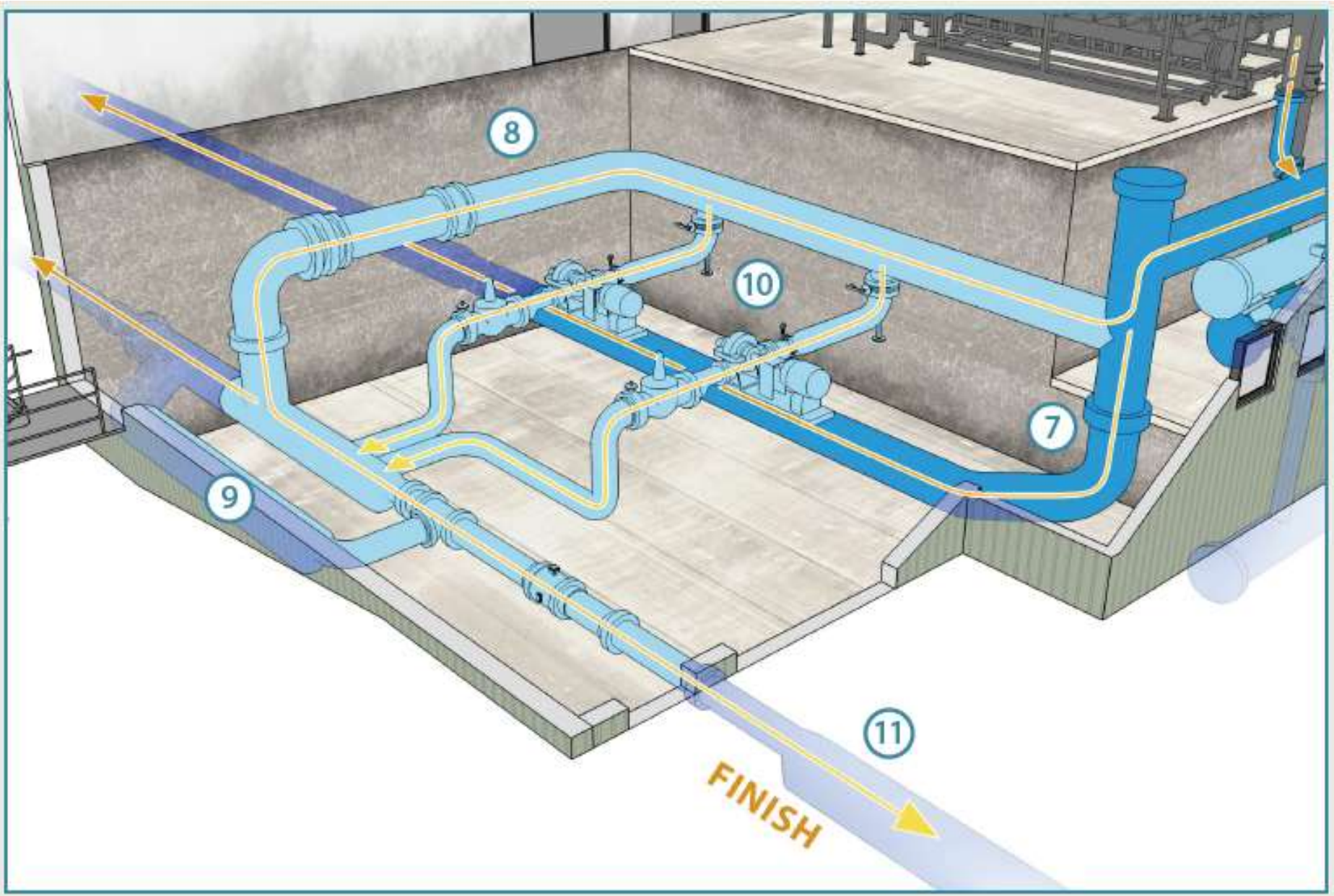
- Mainly designed for gravity flow
  - On-demand



Selected Treatment Process

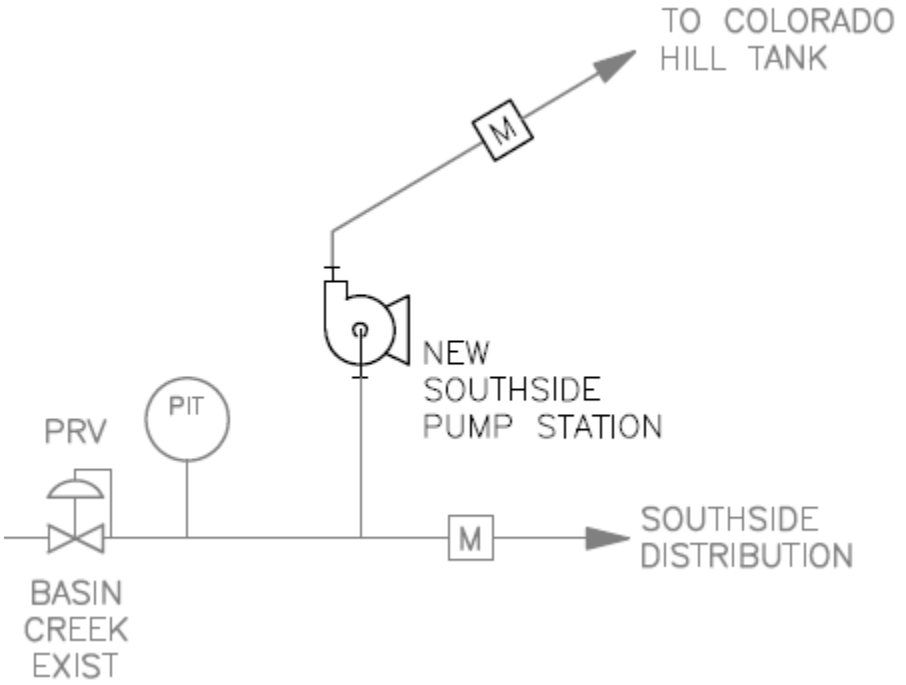


Selected Treatment Process



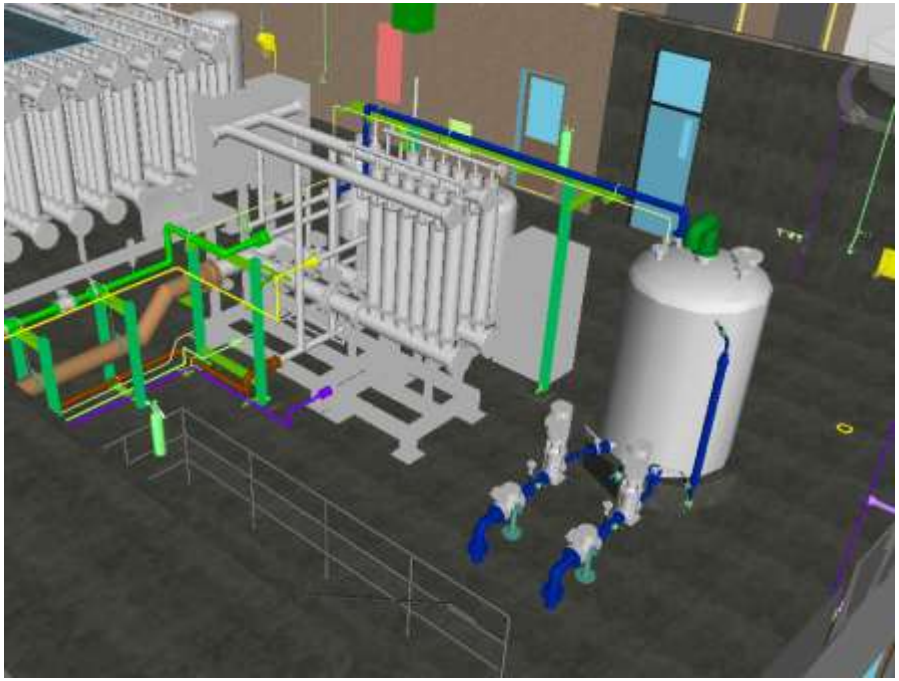
Setting Demand – Southside Pump Station

- Transfer water from the lowest zone to upper zones and storage tanks
  - Water into southside zone is metered
  - SSPS run on VFD to make up difference for desired daily Q
  - Stable operation of WTP
  - Maximize good cheap water

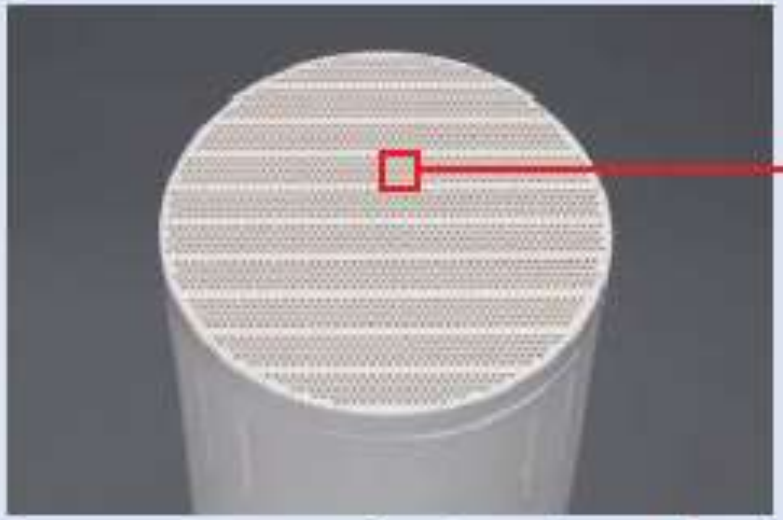


Backwash Recovery

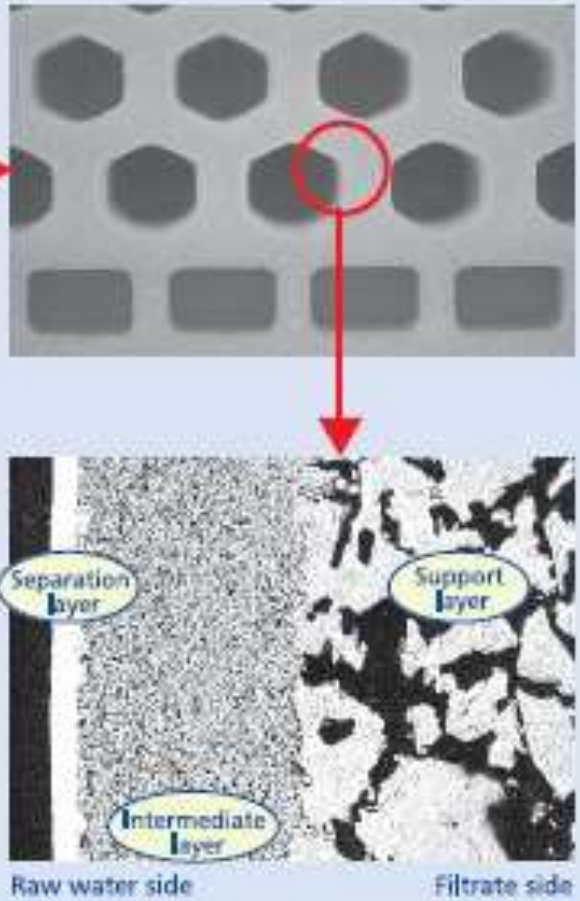
- Recovery Membrane Filter
  - 99.95% recovery
  - Ability to use polymer
- Turn over standpipes daily



Ceramic Membrane



Ceramic membrane element



Membrane Element Specifications

Type: Inner pressure monolithic
Material: Ceramics
Nominal pore size: 0.1 μm
Outer diameter x Length: O.D.180mm x 1,500mmL
Membrane cell inner diameter: approx. 2.5mm
Membrane area: 25m^2

Summary of Highlights

- New membrane technology
  - 6 month CIP interval
  - 99.95% recovery
  - Ability to use polymer
- On-demand gravity flow
- Setting demand



Butte-Silver Bow Basin Creek WTP will Advance Montana to National Forefront


Questions?

Nathan Kutil, HDR

Colors

- Text
- Text
  - Text

119 149 91	75 50 65	120 120 120	220 217 184	193 190 60	62 78 48