Appendix 11-F

Water Quality Prediction Model

Water Quality Prediction Model

Crown Mountain Coking Coal Project, British Columbia, Canada
NWP Coal Canada Ltd.

SRK Consulting (U.S.), Inc. ▪ 1CN028.004 ▪ May 7, 2021

Water Quality Prediction Model

Crown Mountain Coking Coal Project, British Columbia, Canada

Prepared for:
NWP Coal Canada Ltd.
789 West Pender, Suite 810
Vancouver, British Columbia V6C 1H2
Canada

Prepared by:
SRK Consulting (U.S.), Inc.
1125 17th Street, Suite 600
Denver, CO 80202
United States

+1 303 985 1333
www.srk.com

Lead Author: Brent Thiele, Consultant (Geoenvironmental) **Initials:** BT
Reviewer: Dave Hoekstra, Principal Consultant **Initials:** DH

File Name:
CrownMountain-WaterQuality_Report_1CN028-004_Rev02.docx

Suggested Citation:
SRK Consulting (U.S.), Inc. 2021. Water Quality Prediction Model. . Prepared for NWP Coal Canada Ltd.: Add city, Add state. Project number: 1CN028.004. Issued May 7,. 2021.

Contents

Tables

Figures

Appendices

Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

°	degree (degrees)
°C	degrees Centigrade
BC	British Columbia
bcm	bank cubic meters
CCTA	clean coal transfer area
CMER	Coal Mining Effluent Regulations
COPC	contaminant of potential concern
dia.	diameter
EA	Environmental Assessment
EMA	Environmental Management Act
ha	hectares
km	kilometer
km^2	square kilometer
Ktonnes	thousand tonnes
kt/d	thousand tonnes per day
kt/y	thousand tonnes per year
L	liter
L/sec	liters per second
LoM	life-of-mine
Klcm	thousand loose cubic meter
m	meter
m^2	square meter
m^3	cubic meter
masl	meters above sea level
MC	moisture content (gravimetric)
mg/L	milligrams per liter
mm	millimeter
mm^2	square millimeter
mm^3	cubic millimeter
MME	Mine & Mill Engineering
Moz	million troy ounces
Mt	million tonnes

NI 43-101	Canadian National Instrument 43-101
NWP	NWP Coal Canada Ltd.
OSC	Ontario Securities Commission
%	percent
PMF	probable maximum flood
ppb	parts per billion
ppm	parts per million
Project	Crown Mountain Coking Coal Project
QA/QC	quality assurance/quality control
RoM	run-of-mine
sec	second
SG	specific gravity
t	tonne (metric ton) (2,204.6 pounds)
t/h	tonnes per hour
t/d	tonnes per day
t/y	tonnes per year
WRD	waste rock dump
y	year

Executive Summary

NWP Coal Canada Ltd. (NWP) retained SRK Consulting (Canada) to prepare the conceptual site wide water quality prediction model for the Crown Mountain Coking Coal Project (the Project) in southeast British Columbia (BC) in support of the Application for an Environmental Assessment (EA) Certificate.

The Project is an open pit coal mine project with a planned production of approximately 57.5 million tonnes (Mt) of run-of-mine (RoM) coal. Ore throughput is expected to be up to 4.0 Mt/year during the 15 year life-of-mine (LoM) with a one year start-up phase where production will be limited to 0.5 Mt/year. Generation of waste rock is variable through the life-of-mine with an average rate of 48.5 Mt/yr being generated with an average stripping ratio of 4.7 bank cubic meters (bcm):RoM.

The Project is located in close proximity of the Teck Coal's Elkview operations and the closed Coal Mountain operations, so although the Crown Mountain operation is a new, "green field" site, it is located with an area of existing coal mining operations. Experiences at the adjacent operating mining operations have guided the design and operational plans of the Project.

Storage of the projected 733 Mt of waste rock material is addressed with a single dump located in the West Alexander Drainage below the open pits. The nature of the waste rock is such that the mining activities, oxidation process, and leaching of the waste rock is expected to increase levels of Selenium, Sulphate, and Nitrate in waste rock seepage to negatively impact downstream water quality. To mitigate this impact, NWP proposes to construct the waste rock dump in a "layer cake" fashion with alternating layers of waste rock, and low permeability (to both oxygen and water) process plant rejects to inhibit oxidation of waste rock and therefore mobilization of Selenium.

SRK developed a water and load balance in the simulation software GoldSim version 12.1 to simulate the generation, movement and storage of water throughout the proposed Project. The water balance component of the model simulates the climate of the region through the use of stochastic precipitation, temperature, and solar radiation elements, developed to mimic the historical climate observed at the site and in the nearby climate monitoring station of Sparwood, BC. The uncertainty introduced by these stochastic inputs is propagated through the model with the simulation of snowpack and snow melt, icepack formation and melt, runoff, infiltration, and evaporation into the various facility of the Project. The flows of water into and out of the facilities, as well as any water stored within the facilities is calculated at least daily through pre-production, operation, and into closure. Through the application of Monte Carlo simulations, multiple realizations with different, stochastically generated climates, are used to explore the range of climatic conditions expected at the site, and thus the range of water flows and storage volumes that can be expected under typical and extreme conditions.

Within the load balance component of the model, a list of 43 different chemical constituents is associated to all water streams within the model. Source term chemistry for each chemical constituent was developed in a separate study and used to introduce chemical mass into the system. Source terms were included for both average (50th percentile) and upper (conservative 95th percentile) conditions as different scenarios in the model simulations. The chemical mass is moved and stored in the load balance model along with the water calculated in the water balance component to predict the water quality for all

43 constituents at multiple calculation nodes within the Project, primarily major facilities, ponds, and confluences of the natural drainages.

The calculation of water movement through the waste rock dump (WRD) was first simulated using the 1-dimensional unsaturated flow simulation software HYDRUS. This model was used to predict the behavior of water as it infiltrates the waste dump surface and percolates downwards. The HYDRUS model results were then duplicated in a simplified manner in the GoldSim model so that a reasonable approximation of the unsaturated flow system could be incorporated in the model in response to the stochastic climate and be associated with the load balance for the calculation of chemical mass produced by the WRD. This approach allows the dynamic nature of the waste rock dump geometry, stochastic climate inputs, water balance of the inflows, outflows, and storage of the WRD, and movement of chemical load within the WRD to be simulated in a single GoldSim model and integrated with the other water and load balance simulations of the Project.

The simulation of water quality predictions from the WRD was evaluated under two scenarios in addition to the average and upper cases water quality. The first scenario incorporates water quality predictions for the WRD layer cake approach successfully limiting oxidation of the waste rock, and a second where the layer cake is assumed to fail and allow oxidation throughout the WRD profile and produces lower quality water. Thus, a total of four modeling simulations were performed;

- Average WQ predictions, successful WRD layer cake design
- Average WQ predictions, failed WRD layer cake design
- Upper case WQ predictions, successful WRD layer cake design
- Upper case WQ predictions, failed WRD layer cake design

Water quality predictions were compared to the following water quality objectives to determine contaminants of potential concern (COPC):

- British Columbia Water Quality Guidelines for the Protection of Freshwater Aquatic Life (BC WQG FAL).
- Environmental Management Act (EMA) Permit 107517 water quality limits for Ministry Order Station locations in the Elk River (Environmental Monitoring Committee, 2017).
- Updated Coal Mining Effluent Regulations (CMER) set forth for public consultation in February 2020 (ECCC, 2020). It should be noted that these proposed regulations are currently under review and may be revised significantly in the future.

From this comparison, Chronic (30-day average) COPCs were determined as follows:

- Selenium
  - CMER Chronic Criteria 0.005 milligrams per liter (mg/L)
  - BCWQG Chronic Criteria 0.002 mg/L

- Nitrate
    - CMER Chronic Criteria 3 mg/L
    - CWQG Chronic Criteria 5 mg/L
- Sulphate
    - BCWQG Chronic Criteria 309 mg/L

While Acute (instantaneous) standards for the above species were examined, the limitations of a daily timestep model do not allow for water quality predicts to that level of resolution.

Discharges from the active mining activities are primarily directed to the South, into the West Alexander Creek Drainage. All mining discharges are collected in the WRD Sediment Pond, either the Interim pond during Mine Years 0-4 or the Ultimate pond after Mine Year 4. Water in the WRD Sediment ponds will be monitored and released into the West Alexander drainage where it will flow to the Confluences with Upper Alexander creek to form Alexander Creek, which will join with Michel Creek. Michel Creek also receives discharges from the nearby Coal Mountain coal mining operations. Michel Creek discharges into the Elk River upstream of the town of Sparwood, BC.

Additional project infrastructure is planned in the Grave Creek drainage on the North end of the site but is not anticipated to be impacted by mining activities other than withdrawals for mine water supply, limited to 7% of streamflow. Background level water quality is expected to be discharged in Grave Creek, which joins with Harmer Creek, which receives discharges from the Elkview coal mining operations. Lower Grave Creek discharges to the Elk River upstream of the confluence with Michel Creek.

The Crown Mountain Water and Load Balance predicts essentially no water quality impacts to the Grave Creek Watershed; reductions in streamflow will be limited to 7% of the flow in Grave Creek.

The model predicts that under the average, successful WRD design scenario, while water quality in the WRD Sediment pond will exceed chronic Selenium water quality standards, as shown in Figure ES-1 other parameters will be below Chronic standards. Downstream of the WRD Sediment Pond in West Alexander Creek, the water quality predictions for all species is below the chronic water quality standards of both CMER and BC WQG FAL as shown for Selenium in Figure ES-2.

Figure ES-1: Selenium Concentrations in the WRD Sediment Pond for Average Case Water Quality Predictions, Layer Cake Approach Succeeds

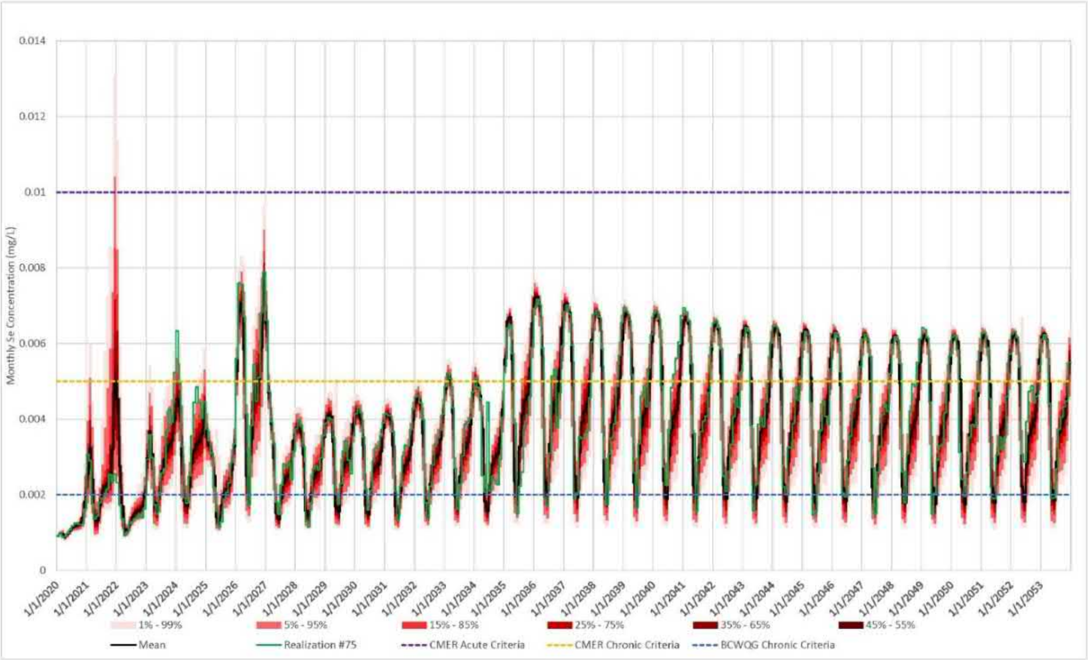
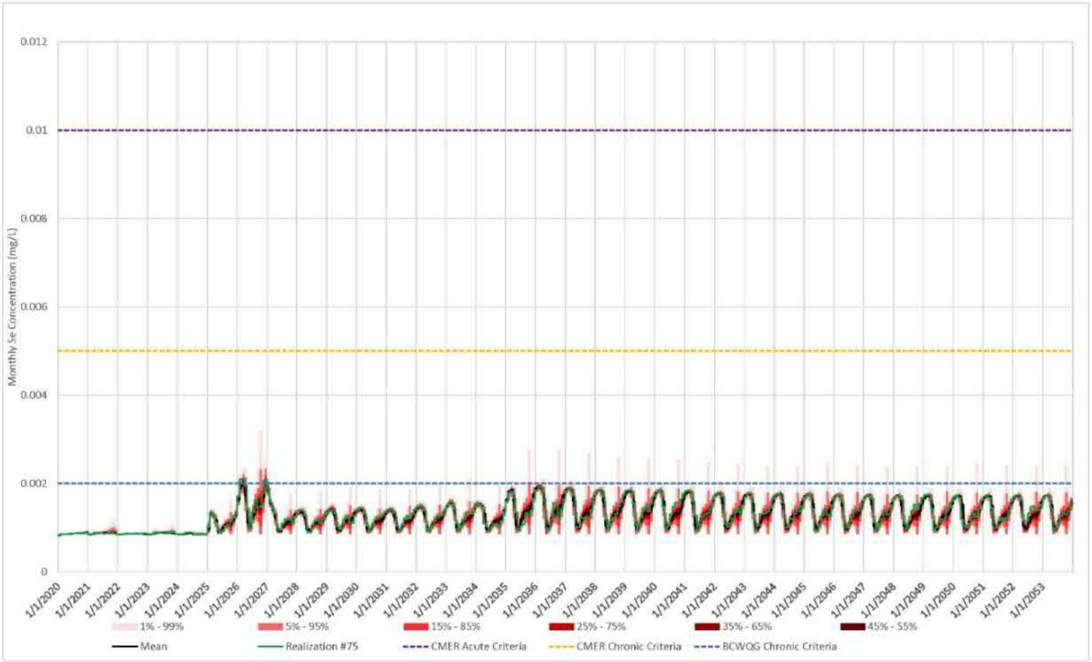


Figure ES-2: Selenium Concentrations at the West Alexander and Upper Alexander Creek Confluence for Average Case Water Quality Predictions, Layer Cake Approach Succeeds



The modeling effort demonstrates that a successful implementation of the WRD Layer Cake design to limit oxidation of the waste rock at the Project will result in compliant water quality discharges from the site.

1 Introduction and Scope of Report

NWP retained SRK Consulting (Canada) to prepare the conceptual site wide water quality prediction model for the Project in southeast BC in support of the Application for an EA Certificate.

The Crown Mountain water quality prediction model provides water and load balance and water quality predictions for the existing site, operations, and closure/post-closure phases of the Project.

1.1 Site Description

The Project is located in the Elk Valley coalfield region in the East Kootenays in southeast BC. The site is approximately 150 kilometers (km) (as the crow flies) from Calgary, or approximately 300 km by road. It is approximately 13 km to the northeast of Sparwood, BC, in a mountainous region with harsh winter seasons.

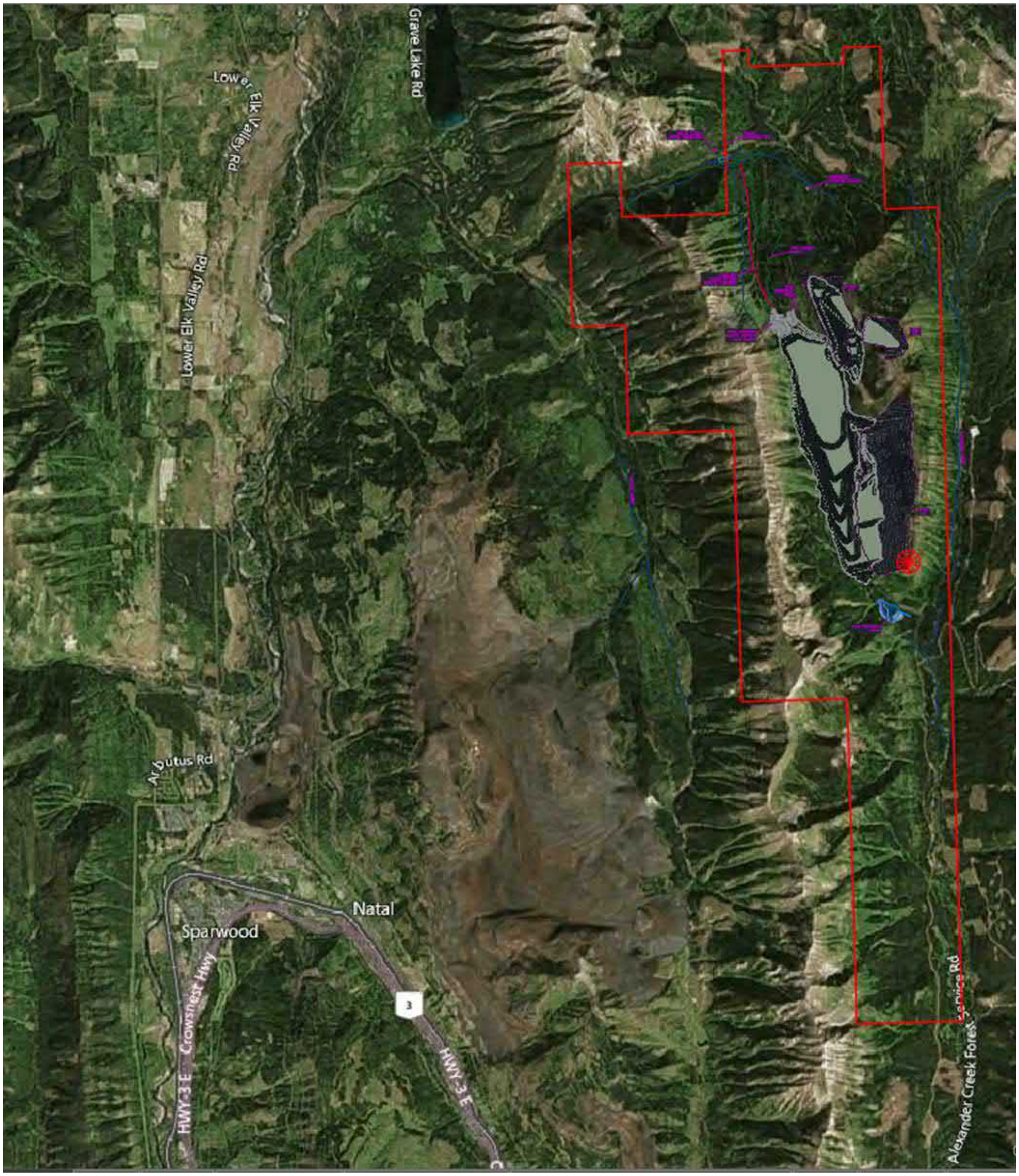
Surface mining is proposed in three open pits (North Pit, East Pit and South Pit) using conventional open pit, truck/shovel/excavator mining methods at a nominal production rate of up to 4.0 million RoM tonnes/year. The East Pit and North Pit will be mined during the first seven years of production, and the South Pit will be mined in later years of the mine life. The proposed project life will be 15 years of operations, followed by the closure and post-closure phases.

The Project’s mining footprint is primarily within the catchment area of West Alexander Creek. Other mine infrastructure, including the plant site and Coal Handling & Preparation Plant infrastructure, clean coal transfer area (CCTA), and upper haul road, are located within the catchment area of Grave Creek. The rail loadout area includes a gatehouse, security area, and parking area, which are all within a small portion of the Grave Creek catchment South of the Grave Creek and Elk River confluence.

Waste rock will initially be placed outside of the valley of West Alexander Creek in the area commonly referred to as the Moose Meadow (located between the North Pit and East Pit footprints). During the first few years, the proposed waste rock/coal rejects co-disposal design method will be evaluated to determine if co-mingling of coal rejects with waste rock successfully mitigates the mobilization of selenium and nitrate species in waste rock stockpile runoff. If the co-disposal method proves successful, placement of waste rock in later mining years will proceed in the West Alexander Creek Valley and will ultimately occupy a large portion of the creek basin.

Figure 1 shows the proposed site location in the Elk Valley. The locations of the other coal mines, operated by Teck Coal, are also shown.

Figure 1: Proposed Project Location



1.2 Objectives

The objectives of the water quality prediction modelling are as follows:

- To provide predictions of water volumes and water quality within and downstream of the Project footprint to assess the potential impact of the proposed mining operations on the aquatic environment.
- Based on the water quality predictions, to evaluate appropriate mitigation measures and assess the effectiveness of the implemented mitigations on the water quality predictions, both within and downstream of the Project footprint.

1.3 Mine Plan

The Project is an open pit coal mine project with a planned production of approximately 57.5 Mt of RoM coal. Process plant throughput is expected to be up to 4.0 Mt/year during the 15 year LoM with a one year start-up phase where production will be limited to 0.5 Mt/year (Table 1). Generation of waste is variable through the life-of-mine with an average rate of 48.5 Mt/yr being generated with an average stripping ration of 4.7 bcm:RoM. Storage of the projected 733 Mt of waste rock material is addressed with a single Dump located in the West Alexander Drainage below the open pits. The waste rock dump will be constructed in a “layer cake” fashion with alternating layers of waste rock and process plant rejects to inhibit oxidation of waste rock and, therefore, mobilization of Selenium.

Coal from the pits will be either directly fed to the truck dump hopper from the haul trucks or re-handled from the RoM stockpiles via front-end loader. RoM coal will be discharged to the coal handling and preparation plant (CHPP) via hopper, where it will be crushed and classified prior to froth flotation. Clean Coal from the process plant will be dried and then transported via an overland conveyor to the Clean Coal Transfer Area. Plant refuse and breaker rejects will subsequently be collected via heated bin and transported via haul truck to the WRD. Clean Coal is then hauled to the Rail Loadout Area where it is loaded on to rail cars.

Water supply will be addressed via the Grave Creek Reservoir that will be fed from the Upper Grave Creek Stream. Additional water demand will be supplemented by the Interim WRD sediment pond during Mine Year 0 through Year 4, Then because of both the vertical and horizontal distance between the CHPP and the Ultimate WRD sediment pond additional demand after Mine Year 4 will be satisfied by a groundwater extraction well near the North Pit.

Table 1: Production Schedule

Mine Year	Goldsim Year	RoM Coal			Rejects		Process Plant				Waste	
		Dry Basis (Ktonnes)	As Received (Ktonnes)	Moisture (%)	Ktonnes	%	Plant Feed (ar) (Ktonnes)	Product @ 7.5% MC (Ktonnes)	Pit Yield (%)	Plant Yield (%)	Thousand bcm	Klcm
Pre-Pro	Year 0	517.4	538.1	4.00	37.3	6.94	500.8	332.1	61.72	66.33	2,054.4	2,670.7
Year 1	Year 1	3,528.1	3,669.2	4.00	254.6	6.94	3,414.6	2,297.3	62.61	67.28	11,935.2	15,515.7
Year 2	Year 2	3,756.5	3,906.8	4.00	271.1	6.94	3,635.7	2,212.0	56.62	60.84	16,329.0	21,227.6
Year 3	Year 3	3,685.3	3,832.7	4.00	265.8	6.93	3,566.9	2,084.6	54.39	58.44	14,626.7	19,014.8
Year 4	Year 4	3,811.7	3,964.1	4.00	268.6	6.77	3,695.6	2,049.1	51.69	55.45	17,569.1	22,839.8
Year 5	Year 5	3,710.8	3,859.2	4.00	243.0	6.30	3,616.2	1,736.7	45.00	48.03	18,021.6	23,428.1
Year 6	Year 6	3,715.0	3,863.6	4.00	240.1	6.22	3,623.5	1,644.4	42.56	45.38	18,056.4	23,473.3
Year 7	Year 7	3,909.2	4,065.6	4.00	252.5	6.21	3,813.1	1,807.9	44.47	47.41	17,784.0	23,119.2
Year 8	Year 8	3,829.7	3,982.9	4.00	247.3	6.21	3,735.5	1,655.4	41.56	44.32	17,906.6	23,278.6
Year 9	Year 9	3,806.0	3,958.2	4.00	245.8	6.21	3,712.4	1,635.1	41.31	44.04	17,785.7	23,121.4
Year 10	Year 10	3,820.2	3,973.0	4.00	246.7	6.21	3,726.3	1,717.5	43.23	46.09	23,602.8	30,683.6
Year 11	Year 11	3,768.9	3,919.6	4.00	243.4	6.21	3,676.2	1,680.7	42.88	45.72	24,051.0	31,266.3
Year 12	Year 12	3,739.9	3,889.5	4.00	241.5	6.21	3,647.9	1,657.4	42.61	45.43	23,873.9	31,036.1
Year 13	Year 13	3,737.8	3,887.3	4.00	241.4	6.21	3,645.9	1,641.3	42.22	45.02	18,280.4	23,764.6
Year 14	Year 14	3,801.7	3,953.8	4.00	245.5	6.21	3,708.3	1,909.1	48.29	51.48	18,306.4	23,798.3
Year 15	Year 15	2,189.1	2,276.7	4.00	141.4	6.21	2,135.3	698.8	30.70	32.73	9,837.8	12,789.2

Source: Stantec, 2020

1.4 Software

The Crown Mountain site-wide water and load balance has been developed using the current release of GoldSim simulation software, version 12.1.

GoldSim is a dynamic Monte Carlo simulation software platform that helps visualize and simulate complex systems and carry out dynamic and probabilistic simulations. A model is built by describing functional relationships mathematically using “elements” that show the linkages graphically. This creates an influence diagram or flow chart that is simple to understand and follow. From these “elements” graphical output can be generated with a high degree of self-documentation. Multiple elements performing different functions are also graphically represented and the inter-relationships between elements can be displayed such that it is generally easy to visualize the model structure and cross-element relationships. The model can then create a dynamic system that evolves through time to simulate the system under future conditions and run multiple scenarios to compare how they will affect future performance.

The Goldsim model is designed as a probabilistic, dynamic simulator running continuously from preproduction to LoM and into closure/reclamation for a total simulation duration of 34 years, in a sequence of quarter day to one day time-steps with select climate inputs being allowed to vary within manually defined stochastic distributions. The model provides continuity in real time using stock elements that track the accumulation of water and solids in the modelled storage systems allowing them to influence other components of the model.

1.5 Simulating Uncertainty

While deterministic simulations (no probabilistic inputs) are useful to understand a systems response to possible changes in configurations, it falls shorts in predicting future outcomes. The model was built as a simulation of the real-world environment, and as such it must contain uncertainty. The model address this through the use of GoldSims Monte Carlo simulations that help propagate uncertainty through the model.

In a Monte Carlo simulation, each uncertain value in the case of Crown Mountains climatic inputs is varied through the use of probability distributions. The distributions, which are developed from statistically analyzing historic data, define and bound the uncertain inputs within the model. This means that while the model is designed to run as a single deterministic simulation, the Monte Carlo portion of Goldsim runs through the life cycle of the mine while continuously re-sampling the distributions to simulate daily climate variability. This cycle can be referred to as a single realization of the model. A Monte Carlo model will typically run through several hundred realizations, each with a different sample of daily climate parameters.

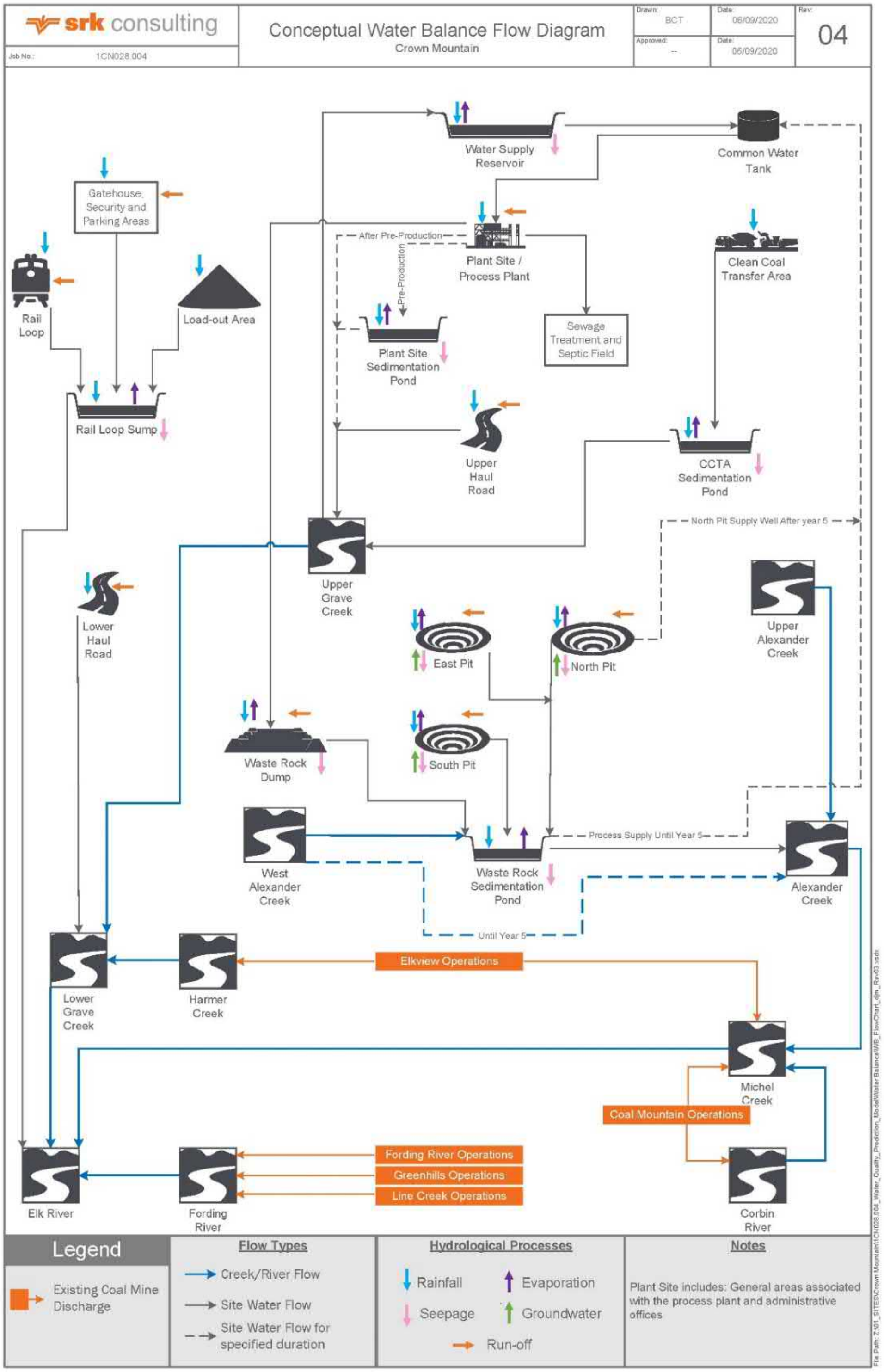
Running multiple realizations consecutively produces a larger number of independent results, each of which represent possible future outcomes. These independent results are then statistically assembled by the modelling software into probability distributions for each output. All of the uncertainty within the Crown Mountain water and load balance is generated from the climatic inputs. The probability distribution function for precipitation, temperature, and solar radiation were derived based on regional and historic records. These probability distribution functions statistically describe the variability in annual precipitation, temperature, and solar radiation for the site. An in-depth description of the development of the climatic parameters for the Crown Mountain water and load balance model can be seen in Section 3.2.

The water and load balance model was run stochastically for 250 iterations to provide a range of potential flow predictions for a variable sequence of wet and dry years. Because the load balance relies on the water balance, the uncertainties in the water balance model propagates into the load balance and the uncertainty in the flow results is reflected in the uncertainty in the predicted water quality at various flow conditions. Consequently, the results for the water and load balance model are discussed in terms of probability ranges produced through running the model stochastically.

2 Conceptual Model

The water and load balance model was developed to address all major facilities associated with the Project. Each facility has been developed as an individual module that contains all calculations performed on a sub daily time-step from Pre-Production through the projected LoM and into closure/reclamation.

Figure 2: Conceptual Flow Diagram



2.1 Available Data

Below is a partial listing of the members of the Project team that provided information that was incorporated into the model:

- Stantec
    - Auxiliary Facility Layouts & stage-storage-area relationships
    - Annual WRD designs
    - Pit Outlines & Backfilling
    - CHPP parameters, i.e. moisture contents and densities
    - Mine Plan
- MOE
    - Valley Wide Water Quality modelling
- Dillon Consulting
    - Baseline streamflow data
    - Baseline climate data from site
- SRK Vancouver
    - Water Quality Sources Terms
    - Layered WRD design

2.2 Model Structure

As discussed in Section 1.4, the Crown Mountain water and load balance was constructed using GoldSim Version 12.1. SRK organized the model using a hierarchical structure of containers. This allowed the model to be developed in a single model file containing all aspects of the modelling, including climate, geometry, physical properties, operating assumptions, summary results and internal documentation. A brief description of the model organization is presented below as well as the conceptual model and the influence diagrams inherent in GoldSim.

2.2.1 Model Components

The GoldSim model can be viewed as containing multiple levels, which are organized through the use of container elements. The top-level view of the water and load balance model (Figure 3) provides a high-level view of the model construction with each major component of the model within separate containers. These include the Climate, Model Inputs, and Runoff Models containers which represent general components that are common to many parts of the rest of the model. The Water Balance container (Figure 4) performs all calculations related to the movement and storage of water within the model. The structure of the water balance is essentially duplicated in the Mass Balance container (Figure 5), but the mass balance container performs the calculations related to the chemical mass balance part of the water and load balance. The relationship between each component can be seen by influence lines linking each container.

Figure 3: Top Model Level

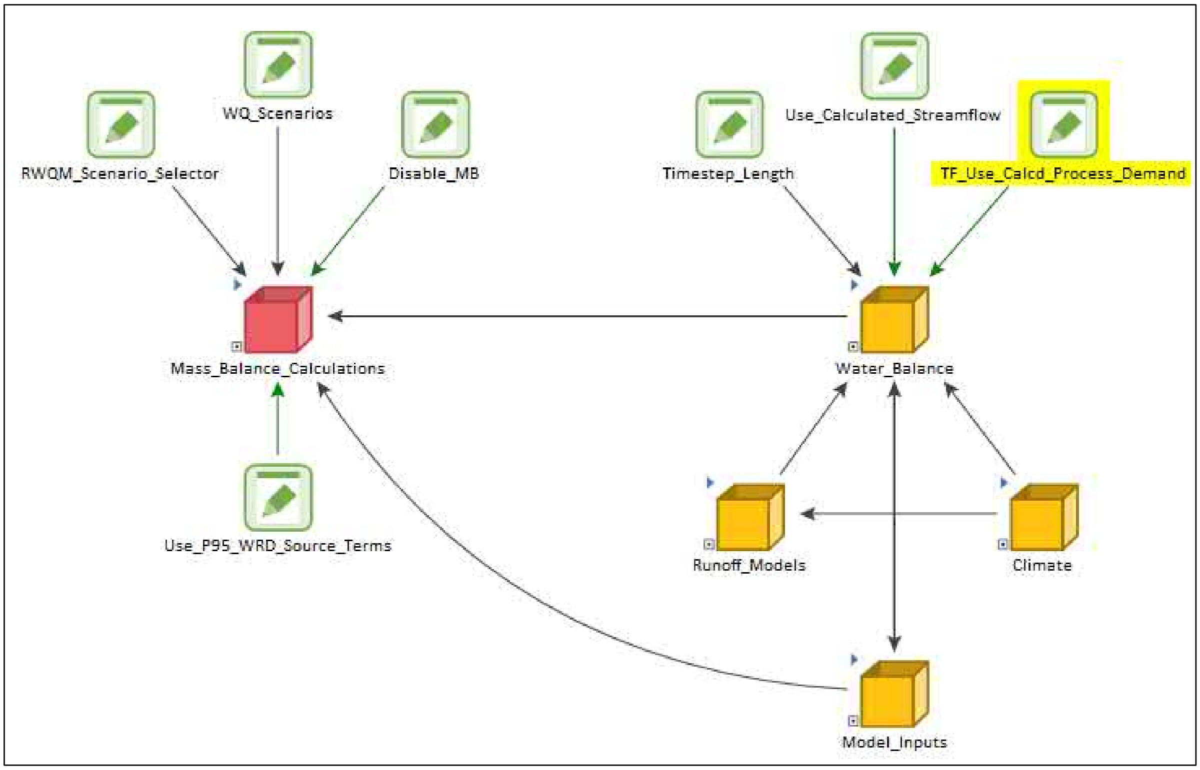


Figure 4: Water Balance Container

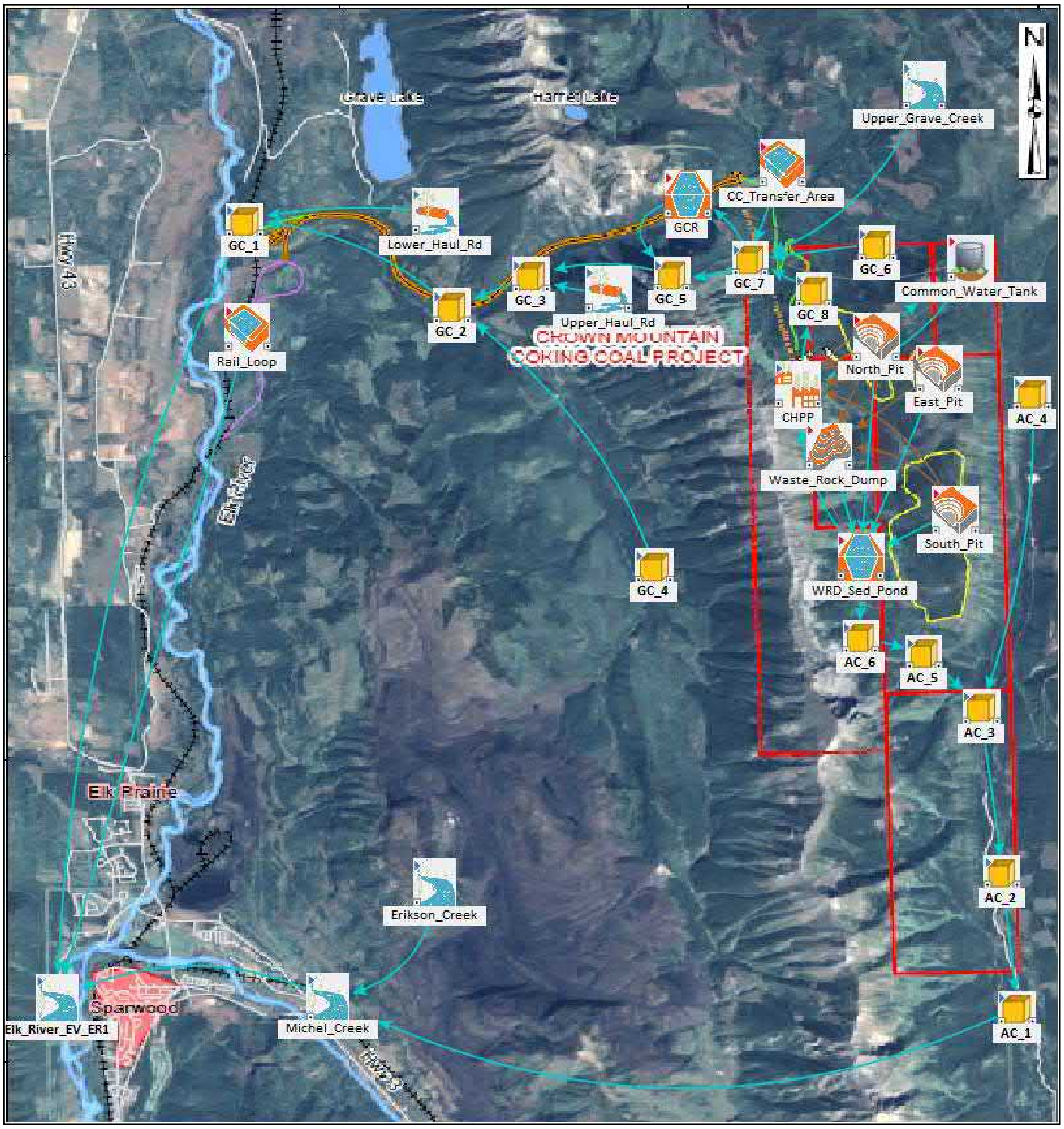
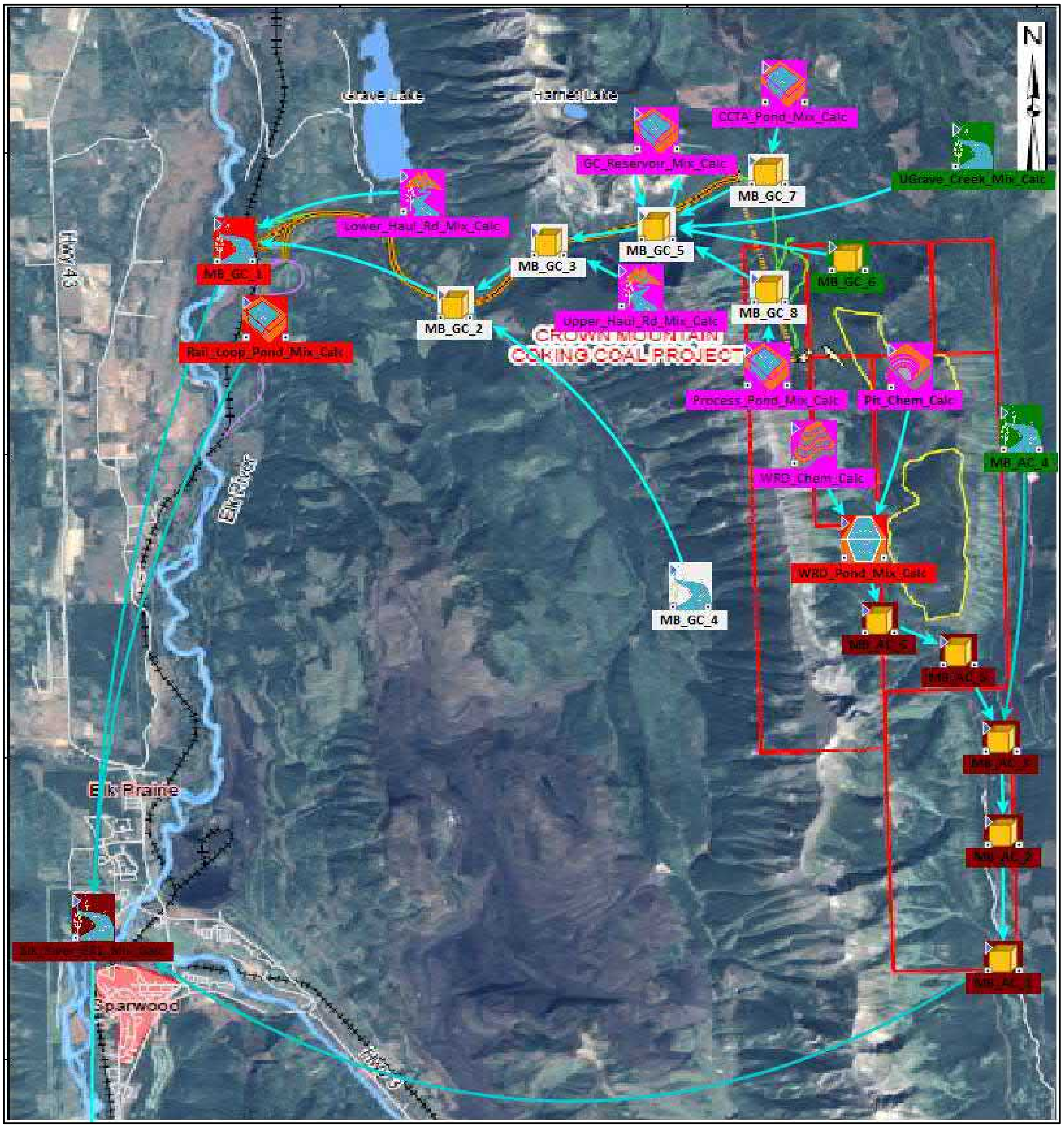


Figure 5: Mass Balance Container



Each container with the water or load balance containers represents an individual component or facility of the water and load balance. The water and load balance for the following facility components associated with the mine plan has been constructed in separate containers, one for each facility module:

- Upper Grave Creek
- Clean Coal Transfer Area (CCTA)
- Grave Creek Reservoir
- Common Water Tank
- Coal Handling & Preparation Plant (CHPP)
- Upper Haul Road
- Lower Haul Road
- North Pit
- East Pit
- South Pit
- Waste Rock Dump
- Rail Loop Loadout
- Interim/Ultimate WRD Sediment Pond

An in-depth look at each facility is presented in Section 3.3, but in general each container has been developed to calculate the generation, storage and movement of water or chemical mass in or out of each modeled facility with the functions and inputs elements available within GoldSim. Each modeled water balance component is organized in a similar fashion for ease of navigation and understanding and contains all associated water balance calculations for storage and flows as well as its own inputs which include but are not limited to geometry, stage-storage-area curves, and historical observed elevation values for calibration. Modeled load balance components are also organized similarly but tend to reference more common elements or values calculated in other modules.

2.3 Key Model Dates

The following key model dates have been used in the model (list dates as become available and agreed upon with client):

- Operations Phase: Mine Year 0 - 15
- Closure Phase: Mine Year 16
- Post-closure Phase: Mine Year 17 - 34

The above key model dates have been agreed upon with the Project team and other consultants to ensure consistency across various models (such as groundwater modelling, geochemical modelling, etc).

2.3.1 Model Timesteps

The water balance model is designed to progress through the simulation in a series of discrete timesteps. Flows calculated by the model are assumed to be constant over the duration of the timestep in order to calculate the volume of water moved. This process can cause instabilities in the model when abrupt changes in flow rates occur, such as runoff from significant precipitation events. Generally, decreasing the timestep will minimize the instabilities, although this can have a significant impact on model performance.

Initially, the model was developed to run using 1-day timesteps. However, model stability suffered, especially in the early stages of the mine. SRK iteratively adjusted the timestep and found that the model was significantly more stable at 6-hr timesteps, but this resulted in very long run times and excessively large result files. Taking advantage of the flexible time step options in GoldSim, SRK selected to simulate the model at 6-hr timesteps for the first 4 years of the simulation (where most of the instabilities were occurring), and daily thereafter.

In addition, the Rail Loadout Pond triggers ¼ day steps when it needs to drain as the pond is quite small and the resultant response is very quick.

Results are presented as monthly averages throughout.

2.3.2 Prediction Nodes and Parameters

Prediction nodes included in the model are illustrated in both Figure 4 and Figure 5. Table 2 provides the node location, and description. Model nodes include key surface water locations on the mine site, as well as locations hydraulically down-gradient of the Project site.

Parameters predicted by the water quality prediction model at each node include the following:

- Reservoir volumes for water storage structures (such as holding ponds)
- Flow rates for inflows and outflows from reservoirs
- In-stream flow rates
- Concentrations of major anions and dissolved metals

The prediction nodes selected for inclusion in the Crown Mountain water quality prediction model have been chosen to ensure that all relevant mine site locations are evaluated and sufficient resolution is available to identify potential effects in the receiving environment. Additionally, downstream prediction nodes have been selected to ensure that integration with the Elk Valley Water Quality Prediction Model can be successfully achieved.

Table 2: SWWQ Reporting Nodes

Watershed	Node	Description	Watershed	Node	Description
Grave Creek	GC-1	Grave Creek upstream of confluence with Elk River	**Alexander Creek**	AC-1	Alexander Creek Upstream of Highway 3
	GC-2	Grave Creek downstream of confluence with Harmer Creek		AC-2	Alexander Creek mid-reach (between highway 3 and West Alexander)
	GC-3	Grave Creek upstream of confluence with Harmer Creek		AC-3	Alexander Creek downstream of confluence with West Alexander
	GC-4	Harmer Creek upstream of confluence with Grave Creek		AC-4	Alexander Creek upstream of confluence with West Alexander
	GC-5	Grave Creek downstream of GCR withdrawal location		AC-5	West Alexander upstream of confluence with Alexander Creek
	GC-6	Grave Creek upstream of GCR withdrawal location		AC-6	West Alexander downstream of confluence with Alexander Creek
	GC-7	Grave Creek downstream of Clean Coal Transfer Area	**Elk Valley River**	EV_ER1	Elk River downstream of confluence with Michel Creek
	GC-8	Grave Creek downstream of CHPP		RG_ ELKORES	Elk River at Elko Reservoir
				RG_ DSELK	Lake Koocanusa south of the Elk River

2.4 Water Quality Objectives

Water quality predictions will be compared to the following water quality objectives to determine COPCs:

- British Columbia Water Quality Guidelines for the Protection of Freshwater Aquatic Life (BC WQG FAL).
- EMA Permit 107517 water quality limits for Ministry Order Station locations in the Elk River (Environmental Monitoring Committee, 2017).
- The proposed CMER set forth for public consultation in February 2020 (ECCC, 2020). It should be noted that these proposed regulations are currently under review and may be revised in the future. The proposed regulations are used as a reference for review.

2.5 Water Quality Standards

Water quality results will be presented as monthly averages and compared with acute (instantaneous) and chronic (long-term) CMER and BCWQG standards where applicable:

- **Long-term Average (Chronic):** Uses an averaging period (eg. 5 samples in 30 days), the average period must be below threshold with no instantaneous maximums above the Acute criteria.
- **Short-term Maximum (Acute):** This threshold should never be exceeded.

Since results are presented as monthly averages Acute water quality standards are generally not relevant but are presented for comparison to the Chronic water quality standards and to indicate potential exceedance issues if monthly averaged results encroach or surpass the Acute standard. The proposed CMER water quality criteria is present below in Table 3 along with BCWQG, which are presented as constant values in Table 4 and variable values that are based on Hardness and pH in Table 5.

Table 3: Proposed CMER Water Quality Standards

Deleterious Substance	Units	Existing Mines		New Mines	
		Chronic Standard	Acute Standard	Chronic Standard	Acute Standard
Suspended Solids (TSS)	mg/L	35	70	35	70
Total Selenium (Se)	µg/L	10	20	5	10
Total Nitrate (NO_3)	mg/L, as N	10	20	5	10

Table 4: BCWQC Water Quality Guidelines

Species	Chronic Guidelines	Acute Guidelines
Ag	Variable	Variable
As	0.005	N/A
B	1.2	N/A
Be	0.00013	N/A
Cd	Variable	Variable
Cl	150	600
Co	0.004	0.11
Cu	Variable	Variable
Fe	Variable	Variable
Hg	0.00002	N/A
Mn	Variable	Variable
Mo	Variable	2
Ni	Variable	N/A
NO3	3	32.8
Pb	Variable	Variable
Sb	0.009	N/A
Se	0.002	N/A
SO4	Variable	N/A
U	0.0085	N/A
Zn	Variable	Variable

Table 5: BCWQC Calculations for Variable Standards

Non-Standard Criteria Calculations				
Species	**Water Variable**	**Units**	**Acute Calculation**	**Chronic Calculation**
Al	$pH \geq 6.5$	mg/L	.1 mg/L	.05 mg/L
	$pH < 6.5$		$e(1.209 - 2.426(pH) + .286(pH\text{^}2))$	$e(1.6 - 3.327(median\ pH) + .402(median\ pH\text{^}2))$
Cd	$Hardness > 7\ mg/L < 455\ mg/L$	µg/L	$e\text{^}((1.03 * \ln(Hardness) - 5.274))$	
	$Hardness > 3.4\ mg/L < 285\ mg/L$			$e(.736 * \ln\ (Hardness) - 4.943)$
Cl⁻		mg/L	600	150
Cu		mg/L	$(.094 * Hardness + 2mg/L)\ /\ 1000$	0.002
	$Hardness > 50\ mg/L$			$.04 * Hardness\ /\ 1000$
F⁻	$Hardness \leq 10\ mg/L$	mg/L	0.4	
	$Hardness > 10\ mg/L$		$[-51.73+92.57*Log10\ (Hardness)]*\ .01]$	
Pb	$Hardness \leq 8\ mg/L$	µg/L	3	
	$Hardness > 8\ mg/L$		$e[1.273 * \ln(Hardness) - 1.46]$	$3.31 + e[1.273 * \ln(Hardness) - 4.704]$
Mn	$Hardness > 25\ mg/L < 259\ mg/L$	mg/L	$.01102(Hardness) + .54$	
	$Hardness > 37\ mg/L < 450\ mg/L$			$.0044(Hardness) + .605$
Ag	$Hardness \leq 100\ mg/L$	µg/L	0.1	0.05
	$Hardness > 100\ mg/L$		3	1.5
SO4	$Hardness \leq 30\ mg/L$	mg/L		128
	$Hardness > 30\ mg/L < 75\ mg/L$			218
	$Hardness > 75\ mg/L < 180\ mg/L$			309
	$Hardness > 180\ mg/L < 250\ mg/L$			429
	$Hardness > 250\ mg/L$			Determined on site-specific basis
Zn	$Hardness \leq 90\ mg/L$	µg/L	33	7.5
	$Hardness > 90\ mg/L$		$33 + .75(Hardness - 90)$	$7.5 + .75(Hardness - 90)$

British Columbia Approved Water Quality Guidelines

3 Physical Water and Load Balance

3.1 Water and Load Calculation Overview

The water balance component of the Project is a mass balance model for the water within the system. The GoldSim model tracks all volumetric inflows, outflows, and available storage within the GoldSim Reservoirs/Pool elements. The volume in a reservoir at a given time (t) can be simplistically represented as shown in Equation 1.

$$\mathrm{Volume_t} = \mathrm{Volume_{t-1}} + \left(\sum \mathrm{Inflows_t} - \sum \mathrm{Outflows_t}\right) \qquad \text{Equation 1}$$

The load balance component of the model has been built using GoldSim’s contaminant transport module, which is built on top of and integrated with the water balance component to generate water quality predictions. The contaminant transport module uses the GoldSim Mixing Cell elements, which have been created for all onsite water management facilities, as well as the downstream receiving environment. Mixing cells, which track the accumulation and advection of chemical mass, are linked to the reservoirs of the water balance, which track water volumes. The load balance calculates loading rates associated with individual flows by assigning concentrations to the flows calculated in the water balance to generate water quality projections (as concentrations) for both onsite and downstream locations. Similarly, water quality concentration in ponds and reservoirs are calculated using the amount of mass stored in the mixing cells and the volume of water stored in the reservoirs.

3.2 Hydrology

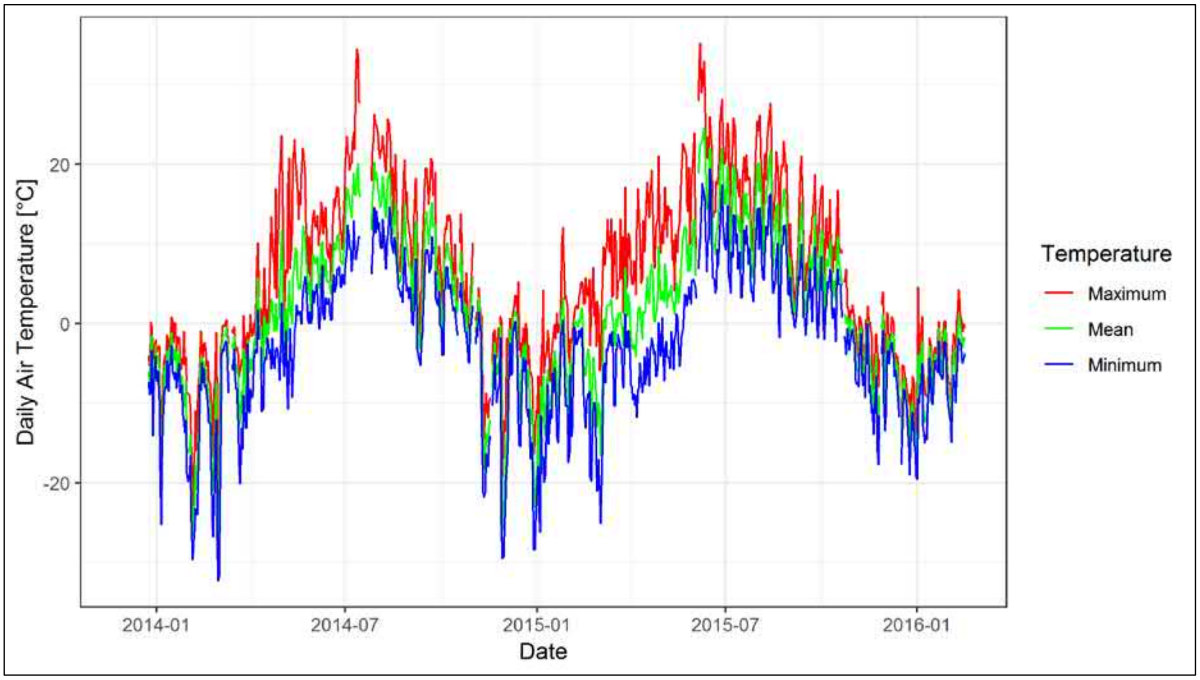
A regional analysis of air temperature and precipitation was performed to estimate the local meteorological and hydrological conditions at the Project for use in the water and load balance model. The results of the analysis were used to develop statistics for air temperature and precipitation for use in the WGEN stochastic weather generator (Richardson and Wright 1984) to allow stochastic climate predictions. The weather generator requires a minimum of 20 years of information to determine climatic conditions. The stochastically generated air temperature and precipitation were also used to predict snow accumulation, snowmelt using the degree day CemaNeige method in conjunction with the lumped parameter mode GR5J (Coron, et al, 2017 and 2019) to generate runoff and to develop site evaporation using the Penman-Monteith model (FAO, 1998).

3.2.1 Local Data

Local climate data were provided to SRK at 15-minute intervals beginning in December 2013 until February 2016 (approximately two years of data).

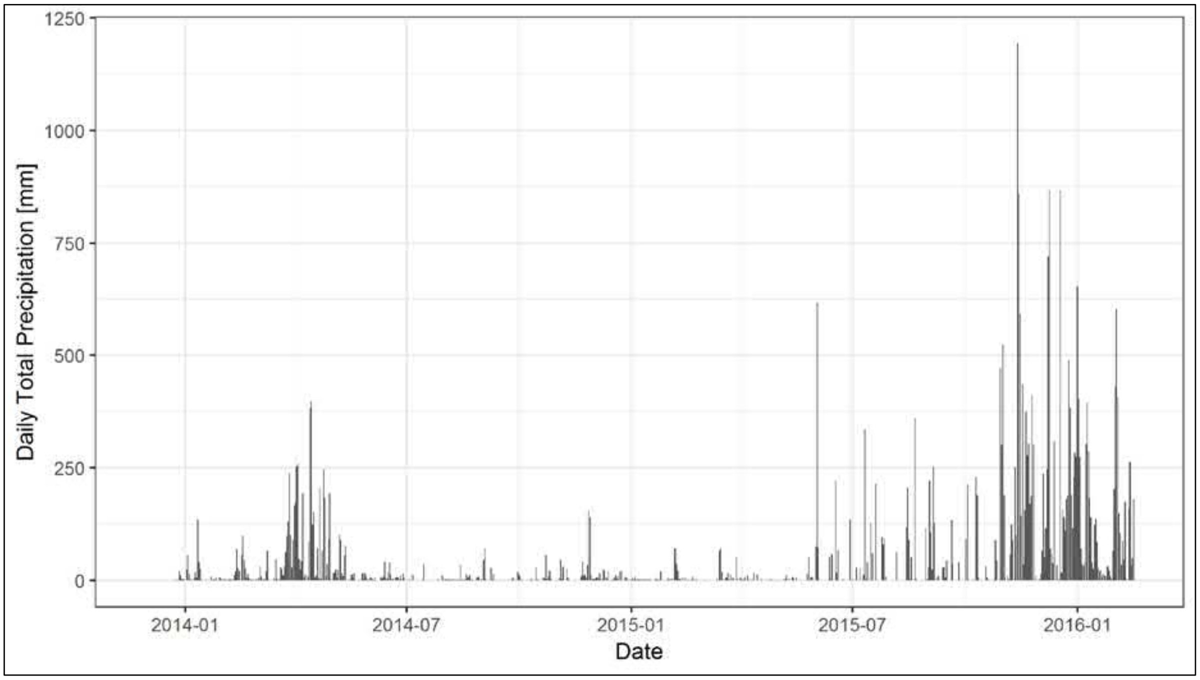
Daily mean, maximum, and minimum air temperature for this period were calculated and are presented in Figure 6. The annual average air temperature at the Project for 2014 – 2015 was 1.4°C but the instantaneous air temperature was observed to range between -32.3°C and 35.2°C.

Figure 6: Project Daily Air Temperature



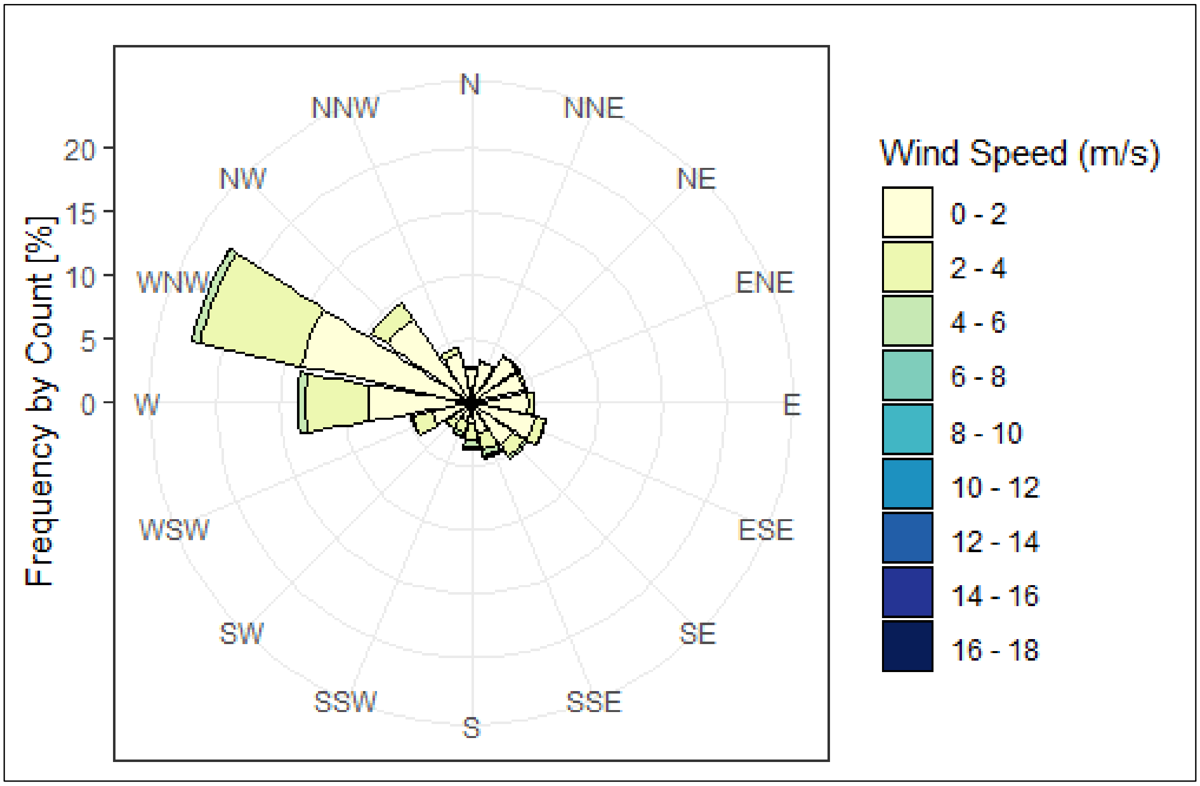
Daily total precipitation for this period was also calculated and is presented in Figure 7. The daily precipitation timeseries shows several recordings in excess of 100 mm. Because these events occur irregularly and are not isolated to the winter (i.e. snowfall events), the data were deemed unrealistic and were not used. SRK recommends recalibration of the precipitation gauge and further quality control of the data to ensure reliable measurements are provided in the future.

Figure 7: Project Daily Precipitation



A wind rose for the 15-minute wind speeds, and directions recorded at the Project is presented in Figure 8. The dominant wind direction originates from the west-northwest, as is typical for frontal systems moving from the Pacific Ocean, but the majority of wind speeds are low and range between 0 and 4 m/s. Stronger winds tend to originate from the south and may be associated with warmer frontal systems (Obedkoff 1985).

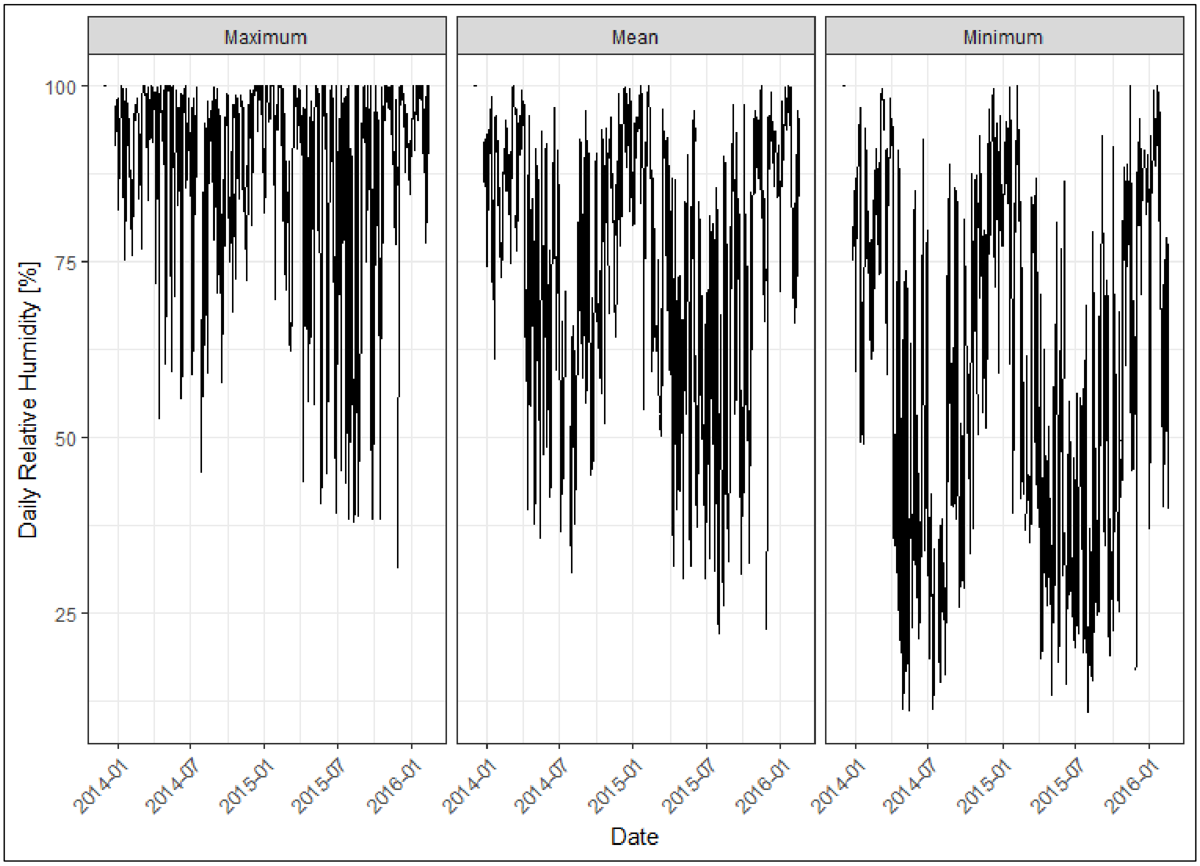
Figure 8: Wind Rose for the Project



Note: Directions indicate the wind origin.

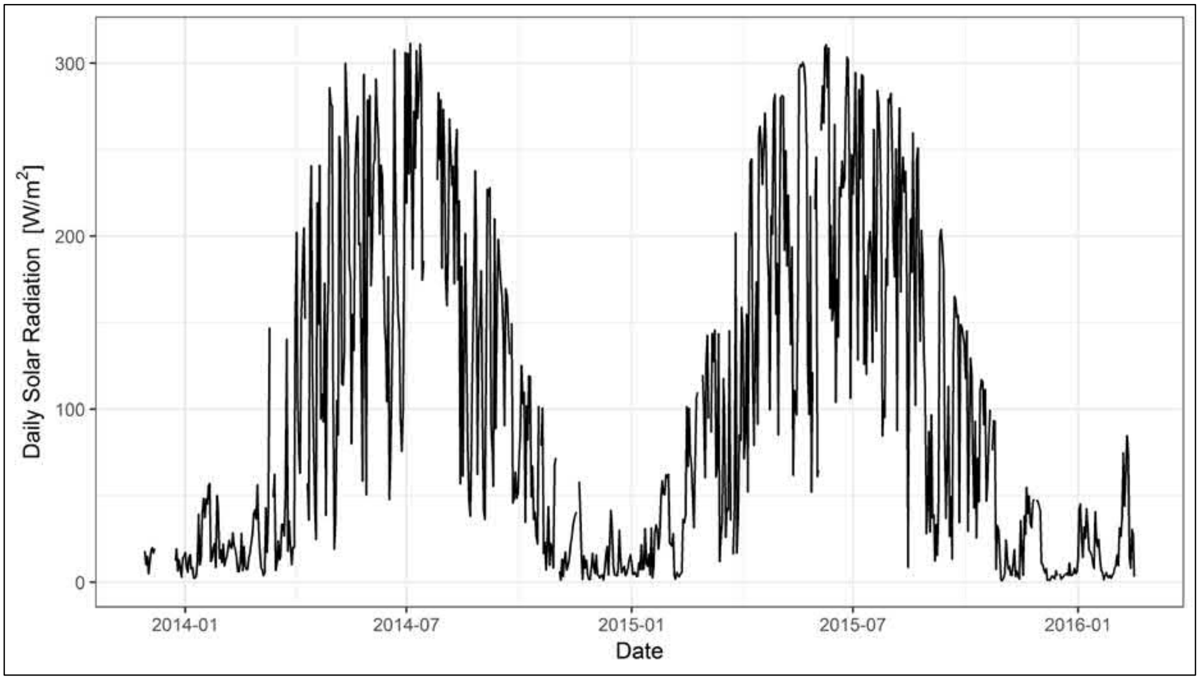
Daily maximum, minimum, and mean relative humidities were calculated for Project and are presented in Figure 9. The average annual relative humidity was measured to be 74% but has been observed to range between 11% and 100%. A seasonal cycle is seen in the timeseries with higher relative humidity in the winter and lower relative humidity in the summer.

Figure 9: Project Daily Relative Humidity



Daily average solar radiation was calculated and is presented in Figure 10. Daily solar radiation values reach as high as 311 W/m^2 in the summer to a low of 1.0 W/m^2 in the winter, with a maximum 15 minute solar radiation of 1273 W/m^2. The noise in the timeseries is typical and is the result of cloud cover. The average daylight duration ranges between 6.5 hours in December to 17 hours in June.

Figure 10: Project Daily Solar Radiation



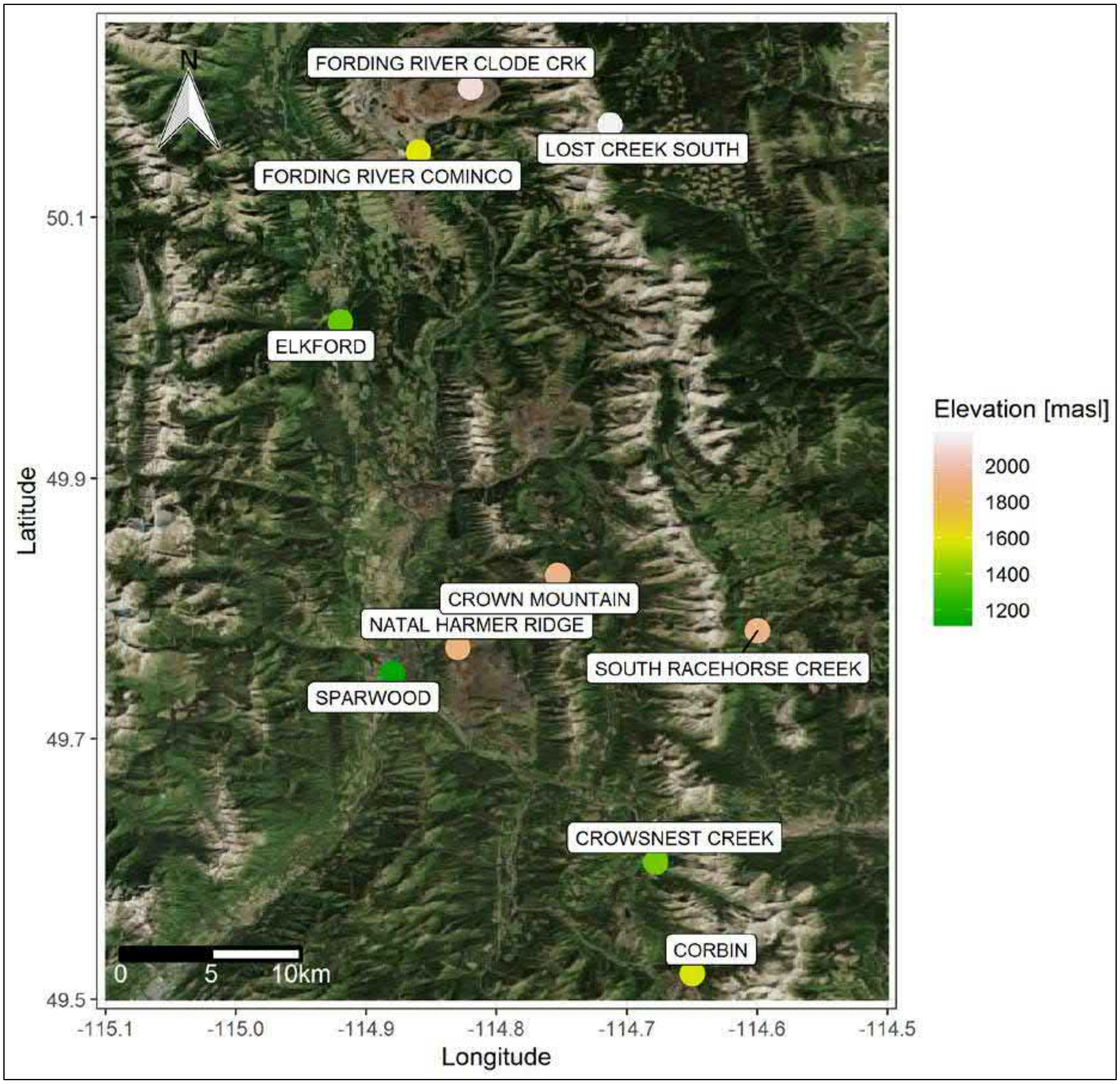
3.2.2 Regional Data

Local hydrological inputs for the water quality prediction model were estimated by developing regional regressions of meteorological data from stations situated within and immediately adjacent to the upper Elk Valley compared to observations at the Project. Meteorological data from Environment and Climate Change Canada (ECCC, 2018) and Alberta Environment and Parks (AEP, 2019) were compiled and analyzed. Local microclimates are expected for the region because of the presence of high mountains and deep valleys. Climate stations within BC were therefore limited to within the upper Elk Valley (north of Sparwood), while Alberta stations situated along the Continental Divide were selected. Stations discontinued before 1975 were excluded. The list of selected stations and their parameters are presented in Table 6. A map of all stations is shown in Figure 11.

Table 6: Regional Meteorological Stations

Station	Source	Station ID	Lat (deg)	Lon (deg)	Elevation (m)	Distance to Project (km)	Record Start	Record End	Parameters Used
Corbin	ECCC	1151915	49.52	-114.65	1,572	34.8	1977	1993	Air Temperature, Total Precipitation
Crown Mountain	-	-	49.82	-114.75	1,920	-	2013	2016	Air Temperature, Total Precipitation
Crowsnest Creek	AEP	30519N0	49.61	-114.68	1,387	25.1	1989	2018	Air Temperature, Total Precipitation
Elkford	ECCC	1152653	50.02	-114.92	1,370	24.7	1972	1993	Air Temperature, Total Precipitation
Fording River Clode Creek	ECCC	1152898	50.20	-114.82	2,100	42.0	1976	1987	Air Temperature, Total Precipitation
Fording River Cominco	ECCC	1152899	50.15	-114.86	1,585	36.9	1970	2017	Air Temperature, Total Precipitation
Lost Creek South	AEP	05BL811	50.17	-114.71	2,160	38.6	1987	2018	Air Temperature, Total Precipitation, Snow Water Equivalent
Natal Harmer Ridge	ECCC	1155402	49.77	-114.83	1,890	8.3	1971	1991	Air Temperature, Total Precipitation
Natal Kaiser Resources	ECCC	1155403	49.75	-114.88	1,128	12.4	1969	1980	Air Temperature, Total Precipitation
South Racehorse Creek	AEP	05AA817	49.78	-114.60	1,920	11.2	1992	2018	Air Temperature, Total Precipitation, Snow Water Equivalent
Sparwood	ECCC	1157630	49.75	-114.88	1,138	12.4	1980	2018	Air Temperature, Total Precipitation, Relative Humidity, Wind Speed

Figure 11: Map of Regional Stations



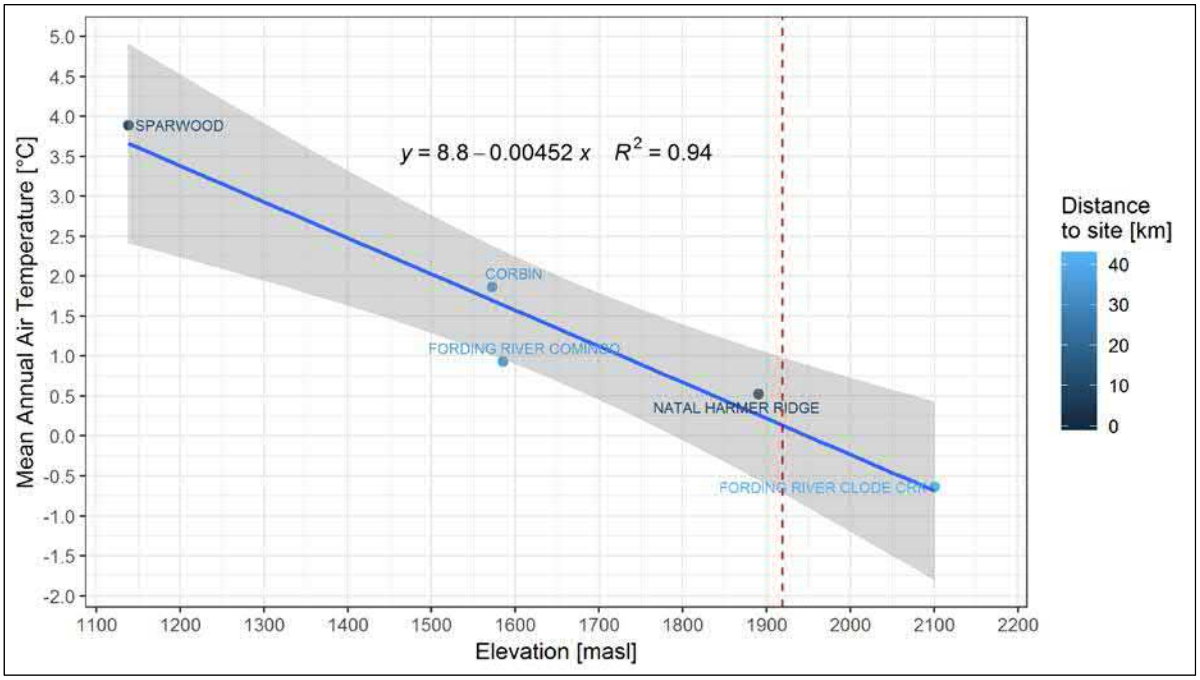
The AEP data is fully automated and not quality controlled, so large daily precipitation events (greater than 100 mm) were evaluated against measurements from nearby AEP and ECCC stations to ensure accuracy and consistency and removed as required.

The Sparwood and Natal Kaiser Resources stations were combined to form a single Sparwood station with a record between 1969 – 2018 because they are at the adjacent locations. The Sparwood record was chosen as an analogue to the site because of its extended record and proximity to site.

3.2.3 Air Temperature

A regression between elevation and mean annual air temperature (MAAT) was developed to determine orographic effects on air temperature. Figure 12 presents the regional air temperature gradient for stations with overlapping data within a 10-year period between 1977 and 1986. This period provides the most consistent overlapping data for the selected stations. The air temperature gradient shows a decrease of 4.5°C per kilometer of elevation. This slope is considered appropriate as it approximately equivalent to the moist adiabatic lapse rate, or the rate at which a saturated parcel of air loses temperature with altitude.

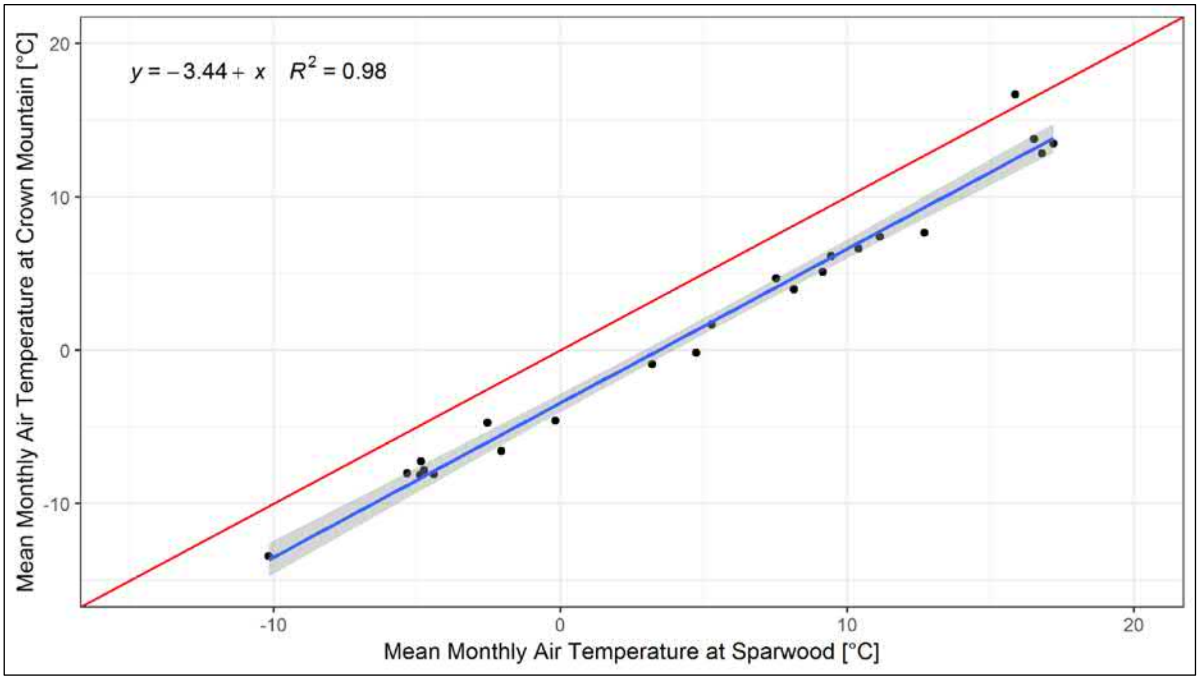
Figure 12: Regional Regressions of Elevation and Mean Annual Air Temperature for 1977 through 1986



Note: The red line indicates elevation of Crown Mountain climate station, and the gray area represents 95% confidence interval about the fitted line.

The overlapping average monthly air temperature between Sparwood and the Project data was compared for 2014 through 2015 and is shown in Figure 13. The overlapping record indicates and offset of -3.4°C between Sparwood and the Project. The resulting temperature gradation between Sparwood and the Project is a decrease of 4.4°C per kilometer of elevation which is comparable to the regional regression developed for 1977 through 1986.

Figure 13: Monthly Air Temperature Relationship between Sparwood and Site

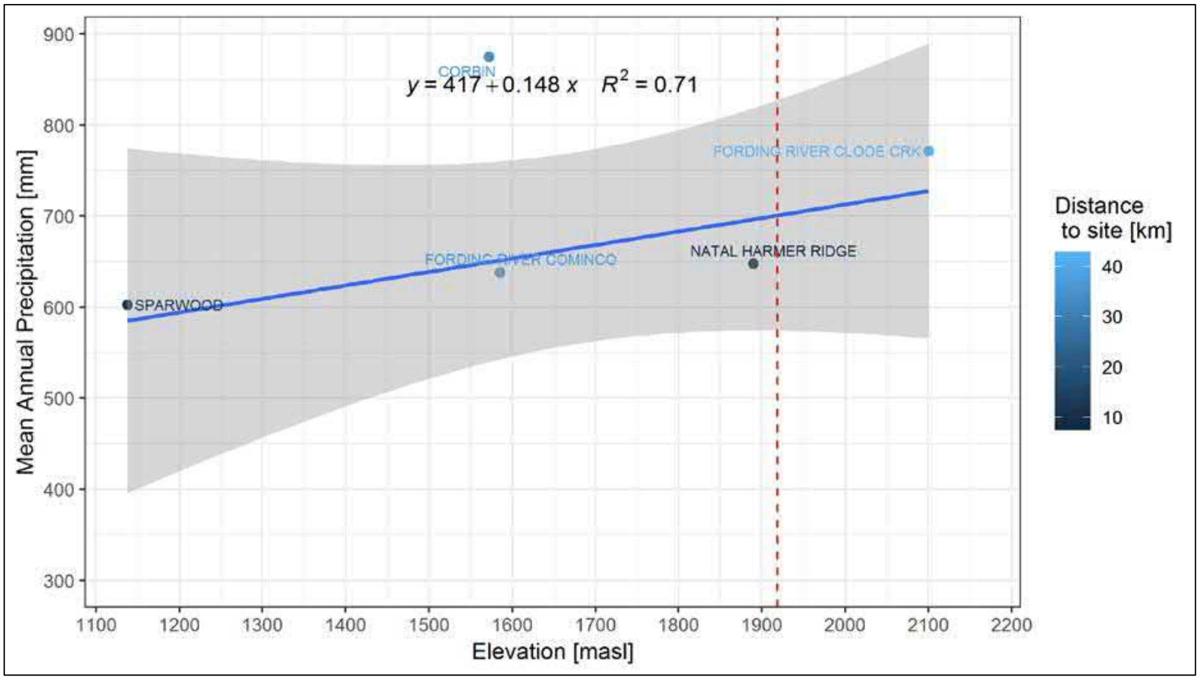


Note: The red line indicates a 1:1 relation, and the gray area represents a 95% confidence interval about the fitted line.

3.2.4 Total Precipitation

Orographic effects for mean annual precipitation (MAP) were determined using regional climate stations. Figure 14 presents the regional precipitation gradient for stations with overlapping data within a 10-year period between 1977 and 1986. This period provides the most consistent overlapping data for the selected stations. The precipitation gradient shows an increase of 148 mm per kilometer of elevation when excluding Corbin. Corbin was excluded because it is a geographical outlier not situated within the upper Elk Valley. The regression developed for 1977 – 1986 was used to correct for orographic effects on precipitation. However, precipitation should continue to be recorded at the Project to compare with measurements at nearby stations such as Sparwood and South Racehorse Creek.

Figure 14: Regional Regressions of Elevation and Mean Annual Precipitation for 1977 to 1986



Note: The red line indicates the elevation of the Project climate station. Corbin was excluded from the regression. The gray area represents a 95% confidence interval about the fitted line.

3.2.5 Extended Timeseries

The Project mean, maximum, and minimum air temperature and total precipitation daily timeseries were extended using Sparwood as the analogue record. Missing Sparwood data was patched using ERA-Interim reanalysis data (Dee et al., 2011) using linear regressions between the average monthly datasets. Climate reanalysis combines gridded global models with observed historical data to produce historical climate estimates.

3.2.6 Temperature

A temperature offset of -3.4°C was applied to the Sparwood record to adjust to the Project based on the overlapping data between Sparwood and local measurements in 2014 – 2015. This correction factor was used to adjust daily mean, maximum, and minimum air temperatures.

A resulting extended timeseries was developed for at the Project for 1971 – 2018. The monthly average air temperatures are presented in Table 7. The observed average air temperature at the Project was slightly warmer than the historical extended air temperature with summer and winter months showing the most differences.

Table 7: Monthly Average Simulated Air Temperature at the Project

Month	**Average Air Temperature (°C)**	
	1971 to 2018	**2014 to 2015**
January	-10.8	-7.6
February	-8.2	-9.0
March	-3.6	-3.6
April	1.0	0.8
May	5.6	5.6
June	9.3	12.1
July	12.6	14.7
August	12.0	13.3
September	7.1	7.0
October	1.4	4.3
November	-5.5	-6.4
December	-10.7	-8.1
Annual	**0.9**	**1.4**

The extended temperature timeseries can then be adjusted for elevation, as required for elevation bands within the water balance model, assuming a gradient of 4.5°C per kilometer of elevation.

3.2.7 Precipitation

The historical precipitation at the Project was developed by applying a daily correction coefficient to the Sparwood dataset to adjust for elevation. A daily correction coefficient of 1.14 (increase of 14%) was applied so that the mean annual precipitation value at the Project elevation matched the expected value (701 mm) determined from the regression shown in Figure 14 for the period of 1977 – 1986. An extended timeseries was then developed for total precipitation at site for the 1972–2018 water years (October – September). The monthly average total precipitation values for the complete timeseries are presented in Table 8.

Table 8: Monthly Average Simulated Precipitation Values at the Project

Month	**Total Precipitation (1972 to 2018 Water Years) (mm)**
January	59.8
February	48.6
March	57.1
April	49.3
May	67.1
June	73.1
July	52.6
August	47.1
September	51.9
October	57.4
November	81.6
December	71.1
Annual	**717**

From the extended timeseries, the historical total annual precipitation has ranged between 467 mm in 1983 and 1050 mm in 2002. A frequency analysis was performed on the total annual precipitation values to determine the recurrence of total annual precipitation amounts. The extreme annual precipitation results for a lognormal distribution are presented in Table 9.

Table 9: Extreme Annual Precipitation Amounts

Condition	Return Interval (years)	Total Precipitation (mm)
Wet	100	1,088
	50	1,034
	25	978
	10	896
	5	826
	Average	717
Dry	5	601
	10	552
	25	504
	50	475
	100	450

3.2.8 Climate Generator

The resulting extended timeseries was used to develop statistic for air temperature and precipitation for use in the WGEN weather generator (Richardson and Wright, 1984) which will be used to generate stochastic climate predictions. The weather generator requires a minimum of 20 years of information to determine climatic statistics.

The WGEN model stochastically generates daily precipitation, and minimum and maximum air temperature based on monthly statistics. WGEN generates precipitation independently of other variables and air temperature is dependent on the occurrence of rain.

The stochastic precipitation component is based off a Markov-chain model used to generate the probability of wet or dry days. A wet day is defined as having more than 0.25 mm of precipitation. The monthly probabilities of a wet day occurring after a wet day, P(W/W), or dry day, P(W/D), are given in Table 10. The precipitation amount is then generated from a gamma distribution. The monthly fitted gamma distribution parameters are given in Table 11, where α and β are the shape and scale parameters, respectively.

Table 10: Probabilities of Wet or Dry Day Occurrence

Month	P (W/W)	P (W/D)
January	0.6321	0.3089
February	0.6210	0.2251
March	0.5780	0.2521
April	0.5371	0.2794
May	0.5786	0.3220
June	0.5936	0.3883
July	0.5539	0.2521
August	0.5572	0.2585
September	0.5884	0.2017
October	0.5635	0.2343
November	0.6508	0.3096
December	0.6644	0.3173

Table 11: Precipitation Gamma Distribution Parameters

Month	α	β
January	0.3537	0.5604
February	0.2978	0.3192
March	0.8063	0.1840
April	0.6170	0.2692
May	0.6129	0.3166
June	0.5650	0.3134
July	0.7845	0.2692
August	0.6377	0.2684
September	0.7282	0.2537
October	0.6495	0.2953
November	0.5328	0.4232
December	0.5058	0.4160

Air temperature is generated based on the occurrence of precipitation and the seasonal change in the means and coefficients of variations for minimum and maximum air temperature fitted with a sinusoidal curve (Equation 2).

$$u_i = \bar{u} + C \cos\left(\frac{2\pi}{365}(i - 200)\right), i = 1, \ldots, 365 \qquad \text{Equation 2}$$

Where u_i is the air temperature or coefficient of variation value on day i, $\bar{u}$ is the mean of ui, C is the seasonal amplitude, and T is the amplitude position in days. Richardson and Wright (1984) recommends a T of 200 days. The maximum daily air temperature is highly dependent on the occurrence of precipitation; however, the minimum daily air temperature is not, and statistics were generated using both wet and dry days. These parameters are inputs to the WGEN model and are presented in Table 12.

Table 12: WGEN Air Temperature Parameters

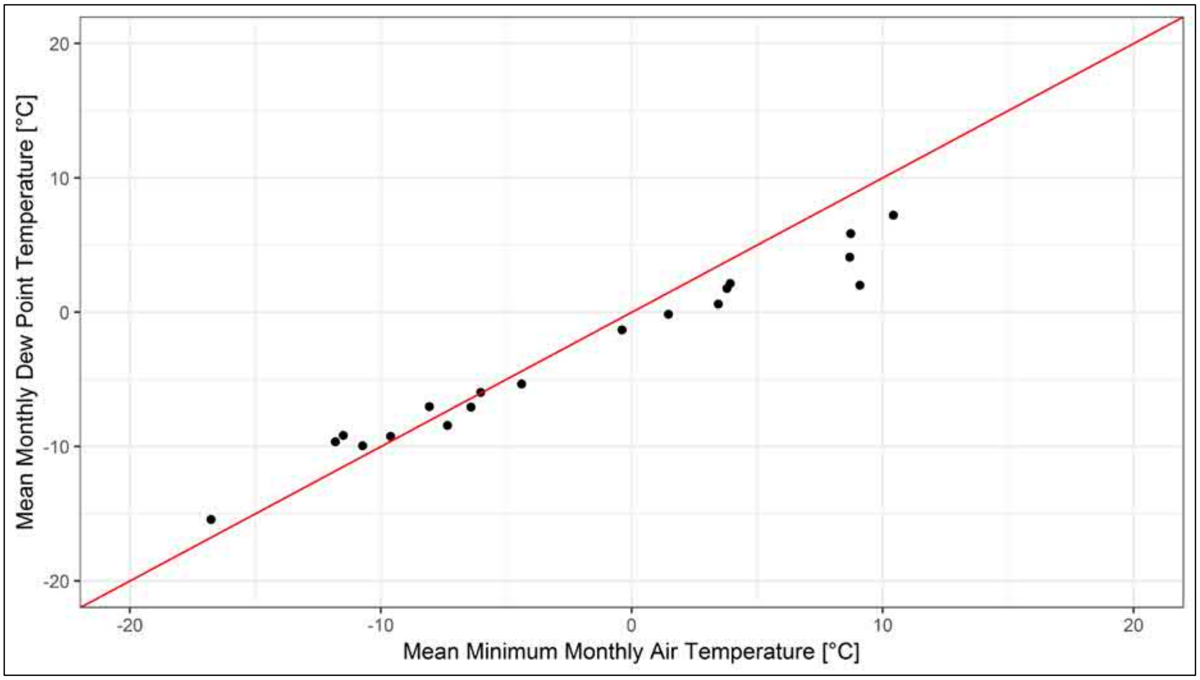
Parameter	Value
Mean of maximum air temperature (dry) (°C)	7.73
Mean of maximum air temperature (wet) (°C)	5.17
Amplitude of maximum air temperature (wet or dry) (°C)	14.82
Mean coefficient of variation of maximum air temperature (wet or dry)	0.30
Amplitude of coefficient of variation of maximum air temperature (wet or dry)	-0.27
Mean of minimum air temperature (wet or dry) (°C)	-5.54
Amplitude of minimum air temperature (wet or dry) (°C)	9.68
Mean coefficient of variation of minimum air temperature (wet or dry)	0.02
Amplitude of coefficient of variation of minimum air temperature (wet or dry)	-0.01

3.2.9 Evaporation

Potential evaporation was estimated using the Penman-Monteith evaporation model (FAO, 1998). This methodology is dependent on the net radiation from a water body and the latent heat flux, and requires inputs for air temperature, dew point temperature, wind speed, and solar radiation.

To simplify the model, the dew point temperature was assumed to be equal to the minimum daily air temperature and was used to calculate the evaporative surface temperature. A comparison of the monthly average minimum air temperature and calculated dew point temperature at the Project is shown in Figure 15. The monthly averages are approximately equivalent, so the dew point temperature can be approximated as the minimum air temperature.

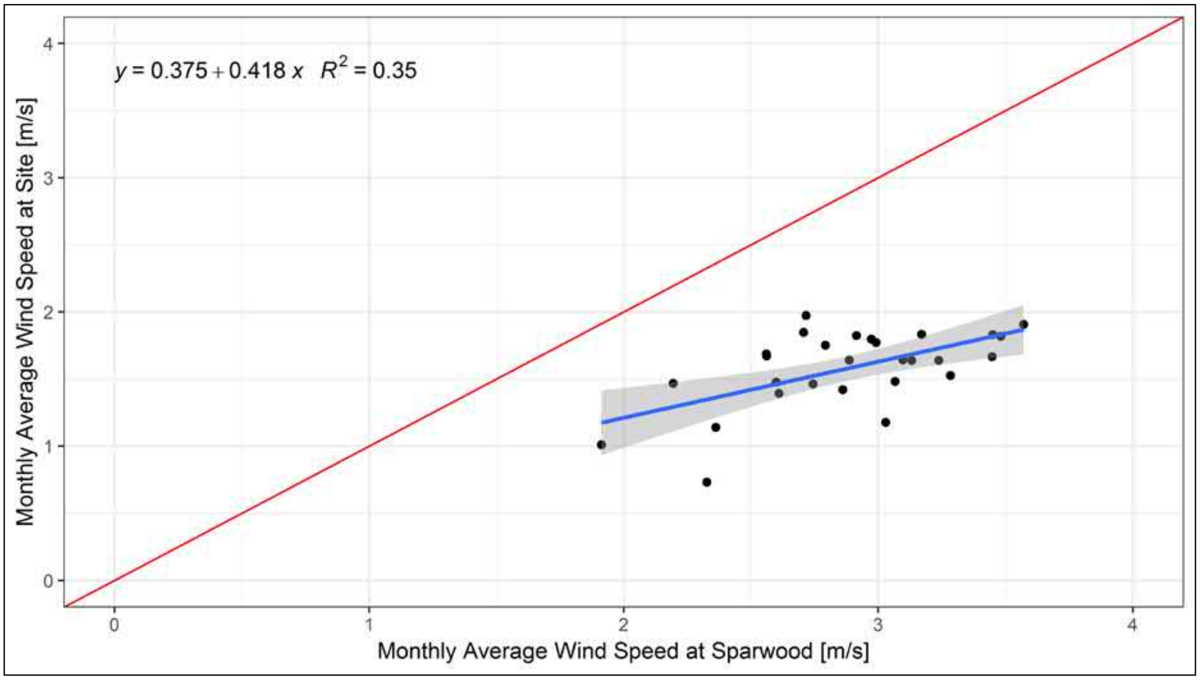
Figure 15: Monthly Relationship between Minimum Air Temperature and Dew Point Temperature at the Project



Note: The red line indicates a 1:1 relation.

Average monthly wind speeds were used in the model. The wind speed timeseries at the Project was extended from the Sparwood record for 1980–2018 by comparing the overlapping monthly average wind speeds measured at Sparwood and the Project (Figure 16). The average monthly wind speeds for the extended timeseries are presented in Table 13 and shows little variation in the average wind speeds throughout the year.

Figure 16: Monthly Wind Speed Relationship between Sparwood and the Project



Note: The red line indicates a 1:1 relation.

Table 13: Monthly Average Wind Speed at Project based on Sparwood (1980 to 2018)

Month	Average Wind Speed (m/s)
January	1.4
February	1.5
March	1.6
April	1.6
May	1.5
June	1.5
July	1.5
August	1.4
September	1.4
October	1.4
November	1.5
December	1.3

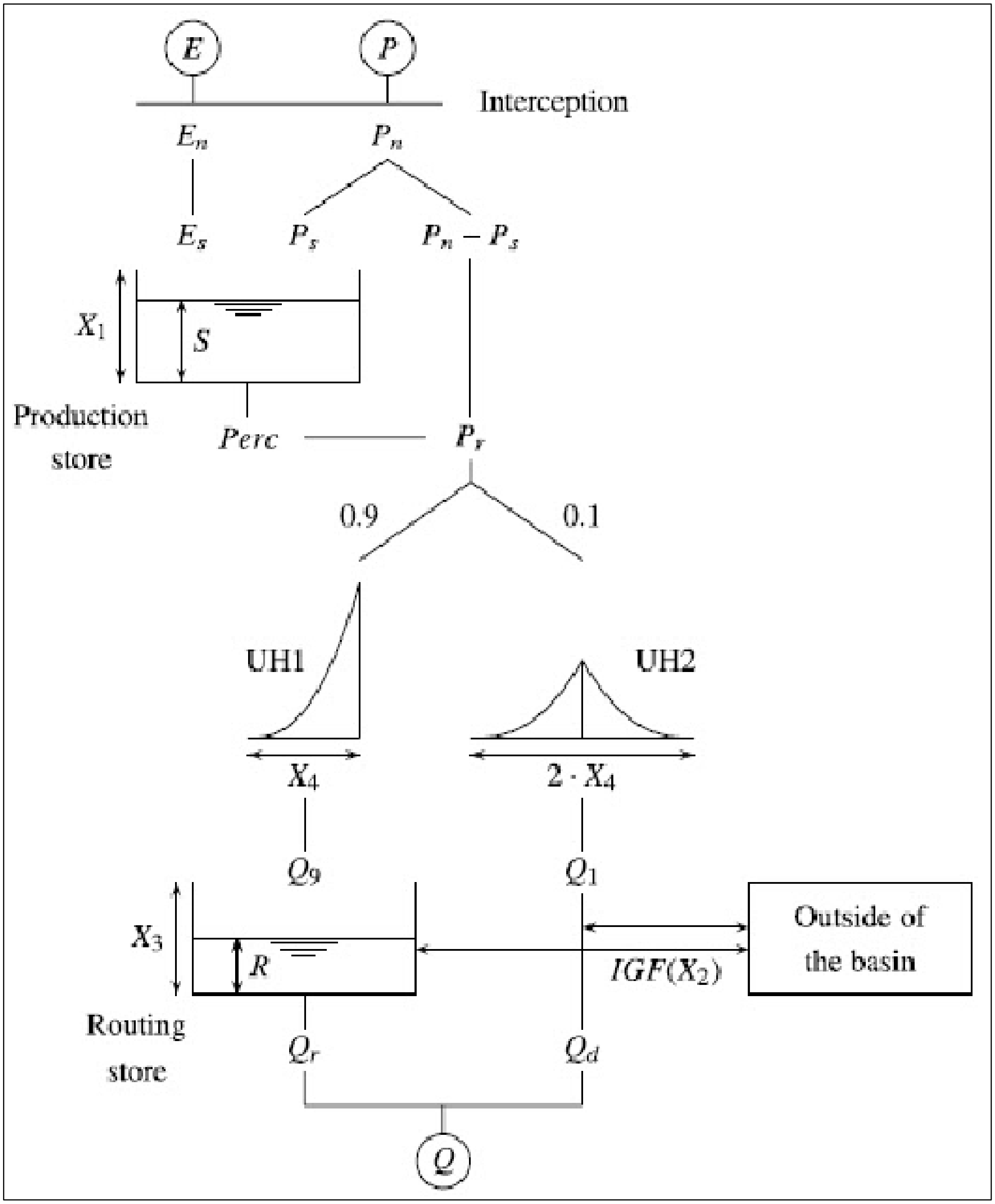
In addition to wind speed and dew point temperature, solar radiation and temperatures from the WGEN model described in Section 3.2.8 were used to produce evaporation on a daily basis.

3.2.10 Snowpack and Runoff Model

Daily runoff, snowpack accumulation and snowmelt were combined into a single lumped parameter model using the degree-day CemaNeige model for snowpack and snowmelt, and the GR5J runoff model to model runoff and the release of water from the shallow soils.

The CemaNeige model is a snowmelt model which uses only temperature and precipitation as inputs and two parameters to determine snowmelt; a melt factor based on temperature and second parameter to model the temperature inertia in the snowpack. The CemaNeige model accumulates solid precipitation which is released in the form of melt calculated using the degree-day method (X mm of melt per degree above freezing per day, adjusted by a snowpack temperature inertia term. Melt and liquid water is passed to the GR5J Runoff model, which uses 5 parameters to model interception and evaporation, runoff from a “production store”, routing and attenuation through a “Routing Store”. Additionally, the GR5J model includes the ability to add or subtract flows from the model to represent flows from outside the basin. A schematic of the model logic is presented as Figure 17.

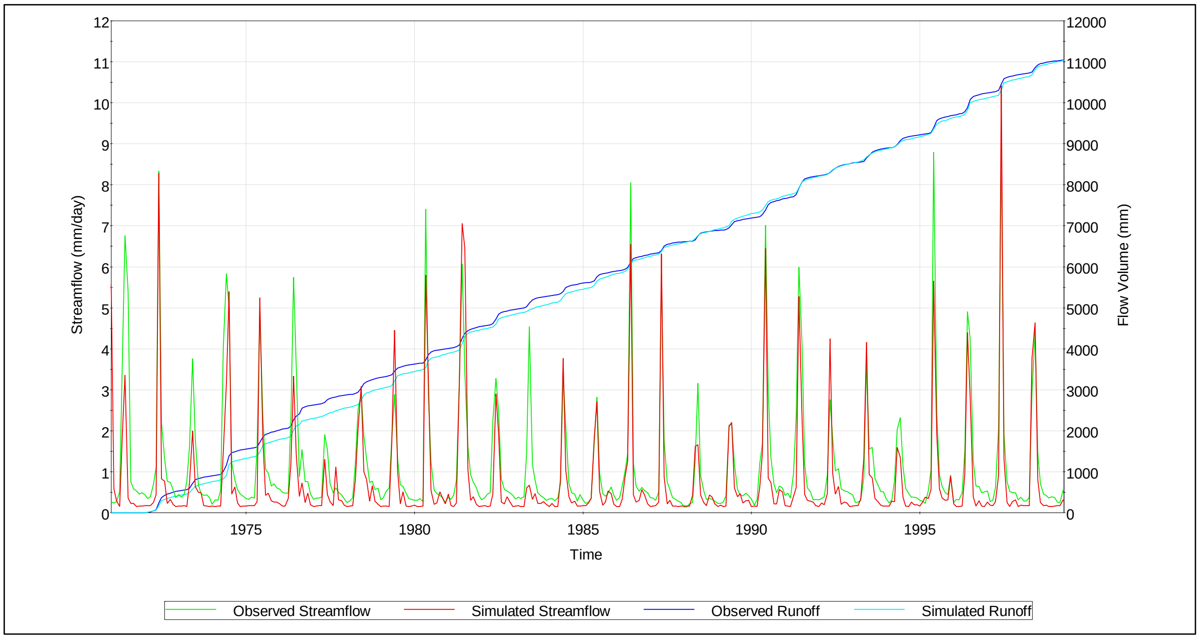
Figure 17: GR5J Model Schematic



The model was developed in GoldSim and uses the GoldSim optimizer to find the combination of 7 input parameters (2 CemaNeige and 5 GR5J) parameters that resulted in the most representative flow, using a weighted factor of Nash-Sutcliffe Efficiency (NSE) related to the flow rates and Root-Mean Square Error (RSME) on the total volume of streamflow. The combination of the two performance metrics resulted in a streamflow model that is representative of both peak flows in the system which is relevant to determining streamflow mixing, and the amount of water produced by the watershed, which is relevant to the amount of mass carried downstream.

A graphical comparison of historical versus simulated streamflow and Flow Volume is presented in Figure 18.

Figure 18: Comparison of Historical and Simulated Streamflow



The 7 model parameters used to simulate streamflow at the Crown Mountain site are presented in Table 14.

Table 14: GR5J Model Parameters

Type of Model	Model	ID Parameter	Description	Model Value
Precipitation - Runoff	GR5J	X1	Production storage capacity [mm]	0.1331 mm
Precipitation - Runoff	GR5J	X2	Coefficient of exchange between capture [mm / d]	-2.753 mm/day
Precipitation - Runoff	GR5J	X3	Routing storage capacity [mm]	158.5 mm
Precipitation - Runoff	GR5J	X4	Time constant of the unit hydrograph [d]	1.3 day
Precipitation - Runoff	GR5J	X5	Interconnection Exchange Threshold [-]	00.3278
Snow melt	CemaNeige	X6	Weighting thermal state of the snow layer [-]	0.0724
Snow melt	CemaNeige	X7	Degree-day melting coefficient [mm / ° C / d]	1.367 mm/°C-day

For the Pit Walls and the Facility areas, the Curve Number (CN) Method was used (NCRC 2010), driven by the rainfall and snowmelt produced by the CemaNeige model. The CN Method produces daily responses to runoff without considering interflow or attenuation beyond one day and is appropriate for small disturbed areas. A CN of 88 was used to produce runoff from the Pit Walls, while a CN of 74 was used to produce runoff from facility areas.

3.3 Water Management Facilities

As discussed in Section 2.2.1, the components of the water balance model were constructed in Goldsim 12.1 and organized with a container for each model section and facility. Each individual facility within the water balance utilizes a different methodology for generating flows and demands. This section describes the general methodology used to determine the flows from each type of facility. A screen capture of the main physical water balance structure as it appears in the water balance model can be referenced at Figure 4.

3.3.1 Water Supply

The Grave Creek Reservoir (GCR) will be used to store and supply fresh water. The GCR will be supplied from direct precipitation and withdrawals from Upper Grave Creek. Allocation of Upper Grave Creek streamflow are subject to minimum in-stream flow requirements to maintain aquatic health downstream and are currently capped at 7% of predicted daily streamflow. The GCR will supply fresh water to the common water tank which feeds process water, dust control, and fire water requirements. All losses including freshwater supply, seepage and evaporative losses are subtracted from the system. The model tracks the changes in storage and adjusts the elevation and surface area of the GCR accordingly.

Open water bodies at the Project, which includes the various ponds, are expected to experience ice formation in the winter and ice melt the following spring. The water balance model includes an icepack formation based on the Ashton Ice Growth Prediction Method (Ashton, 1989), and ice melt based on Ashtons Ice Decay Prediction Method (Ashton, 1983). The net effect of the icepack model is to remove water from availability during the winter and return it in the spring when temperatures rise above freezing.

The GCR model includes a spillway outlet to prevent water storage from exceeding the maximum capacity of the GCR. Spillway flow is calculated using the weir equation to determine the additional head above the spillway need to pass any additional flow from the GCR. The spillway function was implemented to improve the stability of the GoldSim model by preventing the GCR reservoir element from overflowing. Overflowing GoldSim reservoirs cause GoldSim to insert additional time steps to ensure volumetric accuracy of the water balance. However, these additional timesteps tend to negatively impact the stability of the load balance model.

Flow through the spillway will then report downstream to Grave Creek reporting node GC-3 prior to the confluence with Harmer Creek. Maximum storage capacity for the GCR is designed as 90,000m^3 at the spillway invert.

During the winter months, the GCR will not be able to supply all the water demand as required by the CHPP. A supplemental water source will be required to prevent plant shortfalls. In the early phase of the Project, the Interim WRD sediment pond will supplement water to the common water tank. The Interim Pond will supply on average 2,500 m^3/day during the winter months from Mine Year 1 – 4.

After Mine Year 4, the Interim sediment pond will be decommissioned, and due to the large distance between the Ultimate sediment pond and the CHPP, pumping and piping cost will make supply from the Ultimate sediment pond unfeasible. Groundwater extraction wells located near the North Pit will serve as the secondary supplemental source from Mine Year 5 – 16. The North Pit supply wells will send 5,250 m^3/day of water on average to the common water tank with peak pumping reaching 6,000 m^3/day.

3.3.2 Auxiliary Water Requirements

Various activities around site also require water including but not limited to dust suppression, fire suppression and potable water at the plant site and office areas. Water for dust suppression will be withdrawn from the common water tank throughout the LoM. Dust suppression will only be required between May and November with a daily demand during those months of 500 m^3/day. Water for fire suppression will be drawn as needed from the common water tank. Potable water for the plant site facilities will be withdrawn from wells drilled near the CHPP.

3.3.3 Water Management

Auxiliary mine facilities include the temporary Coal Handling and Preparation Plant (CHPP) sedimentation pond, Clean Coal Transfer Area (CCTA), upper haul and lower haul road drainage ditches and the Rail Loadout Area. Runoff from the Clean Coal Transfer Area is captured in a sediment pond with discharge from this pond reporting to reporting node GC-7 upstream of the Grave Creek Reservoir. During Mine Year 0 (Pre-Production) CHPP run-on and facility runoff is captured in a temporary sediment pond. Discharge from this sediment pond will join the drainage ditch adjacent to the upper haul road and discharge to Grave Creek above the confluence with Harmer Creek at reporting node GC-3.

Runoff from the Lower Haul Road between the confluence with Harmer Creek and reporting node GC-1 is captured in the drainage ditch running adjacent to the lower haul road. The diverted runoff is then transported along the haul road drainage ditch and discharges into Grave Creek upstream of the Elk

River confluence. Prior to discharge into Grave Creek best management practices for sediment control will be implemented.

The Rail Loadout area includes the Gatehouse, Security Area, and Parking Area. Runoff from these facilities are captured and routed into the Rail Loop Sump. The sump has been designed to be a non-discharge facility and will be built to optimize infiltration of captured surface water into the ground, the seepage calculations use the Darcy flux equation and assume it can freely drain into the ground.

Where feasible, surface water diversions will be constructed to divert clean runoff from undisturbed areas to Grave Creek or West Alexander in order to isolate clean runoff and allow it to flow by gravity to either natural water courses. Surface water that cannot be diverted is captured in sedimentation ponds. All sedimentation ponds have been sized according to the BC Ministry of Environment, Lands and Parks (BCME) guidelines for mine sedimentation pond design in the Pre-Feasibility report.

3.3.4 Coal Handling and Preparation Plant

The Coal Handling and Preparation Plant (CHPP) module in the water balance consolidates the operations of the plant into a simplistic balance based on the assumption that all water entering the CHPP must also leave the CHPP.

Water enters the CHPP though one of the following mechanisms:

- Moisture in RoM Coal
- Makeup water from the common water tank

Water can leave the CHPP through one of the following mechanisms:

- Moisture in rejects
- Clean coal drying process
- Moisture in clean coal product

Based on the known inflows and outflows at the CHPP, the model determines the total makeup required during operations as seen in Figure 19. Moisture contents for the various plant streams used in the CHPP makeup calculation can be seen in Table 15.

Figure 19: CHPP Process Water Demand

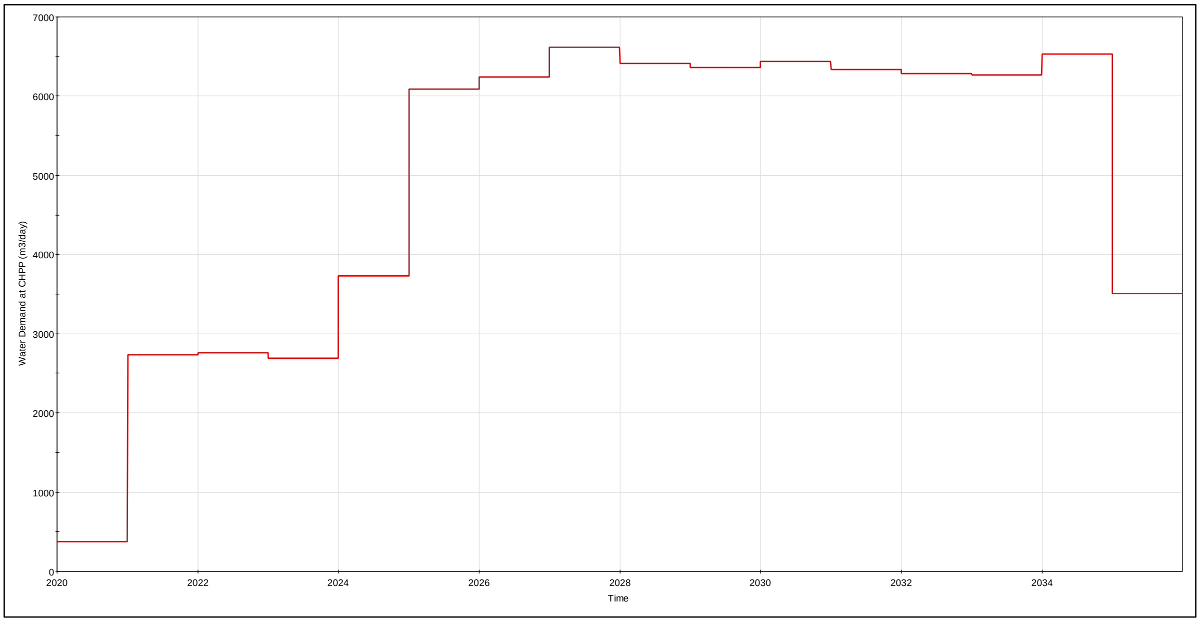


Table 15: CHPP Moisture Contents

Plant Stream	Moisture Content (%)
RoM Coal	5.0
Breaker Rejects	4.0
Coarse Rejects (CCR)	12.0
Middlings Rejects	20.0
Fine Rejects	20.0
Coal to Dryer	30.0
Clean Coal	7.5
Waste	5.0

3.3.5 Open Pits

The North, East, and South open pits will be physically located on the eastern slope of the West Alexander Basin. The North pit is expected to be actively mined from Mine Year 0 – 5, the East Pit will begin mining operations in Mine Year 3 and be actively mined until Mine Year 6. Lastly, the South Pit will begin mining operations in Mine Year 5 and will be exhausted by Mine Year 15.

During active mining of the pits, it will be necessary to dewater each pit through the use of drainage ditches, berms, sumps and pumps. Water Collected and pumped out of the North and East Pit will flow in drainage ditches and ultimately report to the Interim and Ultimate Sediment Pond, all flows collected and pumped out of the South Pit will be routed around the waste rock dump and into West Alexander until Year 5 when the Ultimate sediment pond is constructed from which Dewatering from the South Pit will report to the Ultimate Sedimentation pond. Groundwater inflow quantities can be seen in Table 16.

Table 16: Open Pit Groundwater Flux

Pit	Baseline (Pre Mining) GW Flux (m^3/d)	Life-of-Mine GW Flux (m^3/d)	Long-Term Closure GW Flux (m^3/d)
North	271	205	125
East	130	66	66
South	748	651	559

After Mining has ceased, each Pit will be backfilled with waste material which will ultimately negate the need for pumping infrastructure. Because the spill points of each Pit are located below the observed groundwater elevation, once backfilled, the pits will saturate via groundwater inflow and precipitation and eventually discharge water. Each pit will keep its original surface water routing designs.

Pit wall runoff for each of the three pits is calculated based on their annual footprint using the SCS curve number Method.

3.3.6 Waste Rock Dump Model

Description of HYDRUS 1D

The movement of water through the layered WRD was initially modelled using Hydrus 1D software package. HYDRUS is a pseudo-surface flux boundary model that numerically solves the Richards Equation for saturated and unsaturated water flow. HYDRUS can be used to solve for variably saturated flow in one-, two- and three-dimensional problems. HYDRUS-1D software was chosen for infiltration modeling because of the focus on vertical water movement and the need to keep the model relatively simple, which negated the need for the two- and three-dimensional software packages reducing complexity of the model.

Model Development

Waste rock extracted from each pit will primarily be managed via the WRD located over the West Alexander Creek Valley. Because the waste rock has a high propensity to oxidize and in turn produce soluble aqueous forms of Selenium (Selenate & Selenite) that can be readily mobilized by atmospheric percolation through the dump, a layer cake deposition strategy will be implemented. Waste rock will be deposited on the WRD in ~20m high stacks that will be continuously covered during operations with rejects from the CHPP. The reject cover layer will be placed roughly six months behind the deposited waste rock throughout the LoM. The goal of the reject layer is to create a barrier that inhibits or stops the transportation of oxygen into the waste rock material which would normally create oxidizing conditions in the waste rock dump.

The physical WRD model uses the estimated hydraulic soil properties from the hydrus 1D model simulations (Table 17) to estimate velocity and quantity of seepage. Using the 3D designs from the mine plan model, the WRD was split into 15 stations down the center line of the valley. Each Station then tracks the dump thickness and area along the width of the WRD. The stations are then further subdivided by cover type into: a) exposed waste rock, b) covered waste rock, and c) reclaimed waste rock. Each of the three WRD cover types have their own run-off model based on the SCS curve number runoff model (Table 18). Each cover type is also given an infiltration percentage from rainfall. The infiltration amount is then subtracted from the calculated runoff for each cover type. Infiltration is further divided into the amount of infiltration that will result from precipitation on side slopes (short circuit) based on the footprint of the dump slopes. Short circuit from the side slopes is subtracted from the calculated infiltration and reports as toe seepage relatively instantaneously. The WRD will be designed to include an underdrain seepage collection system to intercept the baseflow fed by the local groundwater system. Underdrain seepage quantity is assumed to be equal to pre-mining baseflow (32 mm/day) and will mix with captured runoff and toe seepage prior to reaching the Interim/Ultimate Sediment pond.

Table 17: Waste Rock Hydraulic Properties

Material Type	θ_r (vol/vol)	θ_s (vol/vol)	l (unitless)	N (unitless)	K_s (m/day)
Waste Rock	0.0	0.3	1	1.35	53.4

Table 18: WRD Runoff and Infiltration Parameters

Parameter	Exposed Waste Rock	Covered Waste Rock	Reclaimed Waste Rock
SCS CN	77	86	91
Infiltration (%)	50	15	5
Short Circuit (%)	5	3	1

The speed at which the wetting wave propagates through the remainder of the WRD is calculated via the Van Genuchten function (1980) for the water retention curve along with the Mualem pore-size distribution model (1976). The Soil Water retention equation, Ɵ(h), is shown in Equation 3.

$$\theta(h) = \begin{cases} \theta_r + \frac{\theta_s - \theta_r}{[1+|\alpha h|^n]^m} & h < 0 \\ \theta_s & h \geq 0 \\ m = 1 - \frac{1}{n} & n > 1 \end{cases} \qquad \text{Equation 3}$$

Where Ɵ is the volumetric water content at a certain pressure head h; θ_s and θ_r are the saturated and residual water contents respectively; α is related to the inverse of the air-entry pressure; and $n\ (> 1)$ is a measure of the pore size distribution; and $m = 1 - \frac{1}{n}$. The matching hydraulic conductivity function, $K(S_e)$, is shown in Equation 4.

$$K(h) = K_s S_e^l \left[1 - \left(1 - S_e^{\frac{1}{m}}\right)^m\right]^2 \qquad \text{Equation 4}$$

Where l (lower-case L) is an empirical pore-connectivity parameter that is generally estimated to be approximately 0.5 on average for many soils, which is increased to 1 for this model to replicate the potential increase in tortuosity from larger diameter waste rock material (Mualem, 1976). Effective saturation, $S_e(h)$, is then given by Equation 5.

$$S_e(h) = \frac{\theta(h) - \theta_r}{\theta_s - \theta_r} \qquad \text{Equation 5}$$

With the WRD model tracking cumulative deposited material and the total volume of water entering and leaving each station of the WRD from infiltration and seepage, respectively, the effective saturation can be calculated for each station. A delay element is then used to estimate the amount of time it takes for surface infiltration to percolate through the WRD and report as toe seepage from the previously calculated hydraulic conductivity and the pre-determined depth distribution for each of the fifteen stations. Once the percolation has been delayed the correct amount of time given the total depth and calculated unsaturated hydraulic conductivity, the flows are removed from the WRD water volume and report as seepage entering either the Interim or Ultimate Sedimentation pond.

The WRD model constructed in Goldsim was then compared to the initial modelling completed with HYDRUS 1D. Key model outputs for the validation of the Goldsim WRD model are travel time through the Layered WRD as modelled in HYDRUS-1D. A Comparison of the Goldsim and HYDRUS 1D travel time through the WRD is presented in Figure 20, showing the range of delays the Goldsim model produces based on the calculated hydraulic conductivity. The range of travel time from the GoldSim model falls in line with predicted travel times from the Hydrus 1D modelling, indicating a good fit to the Hydrus 1D model. With the range of delays matching the theoretical Hydrus 1D model, the WRD model as implemented in Goldsim was run for the full duration of mining facilities to produce a delay times for depths from 5m to 245m and associated flows based on the WRD depths during operation.

Figure 20: WRD Travel Time Validation

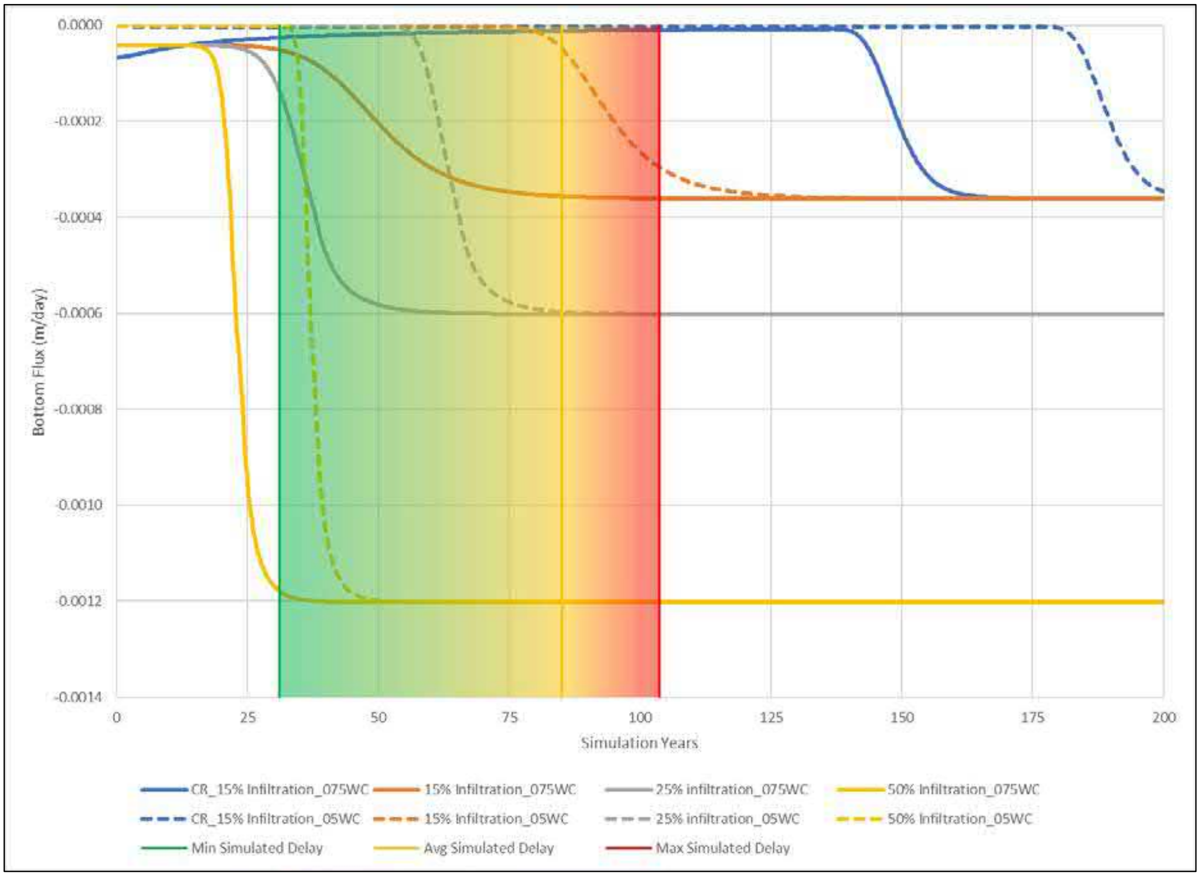


Figure 21: WRD Travel Time for Entire Depth Distribution

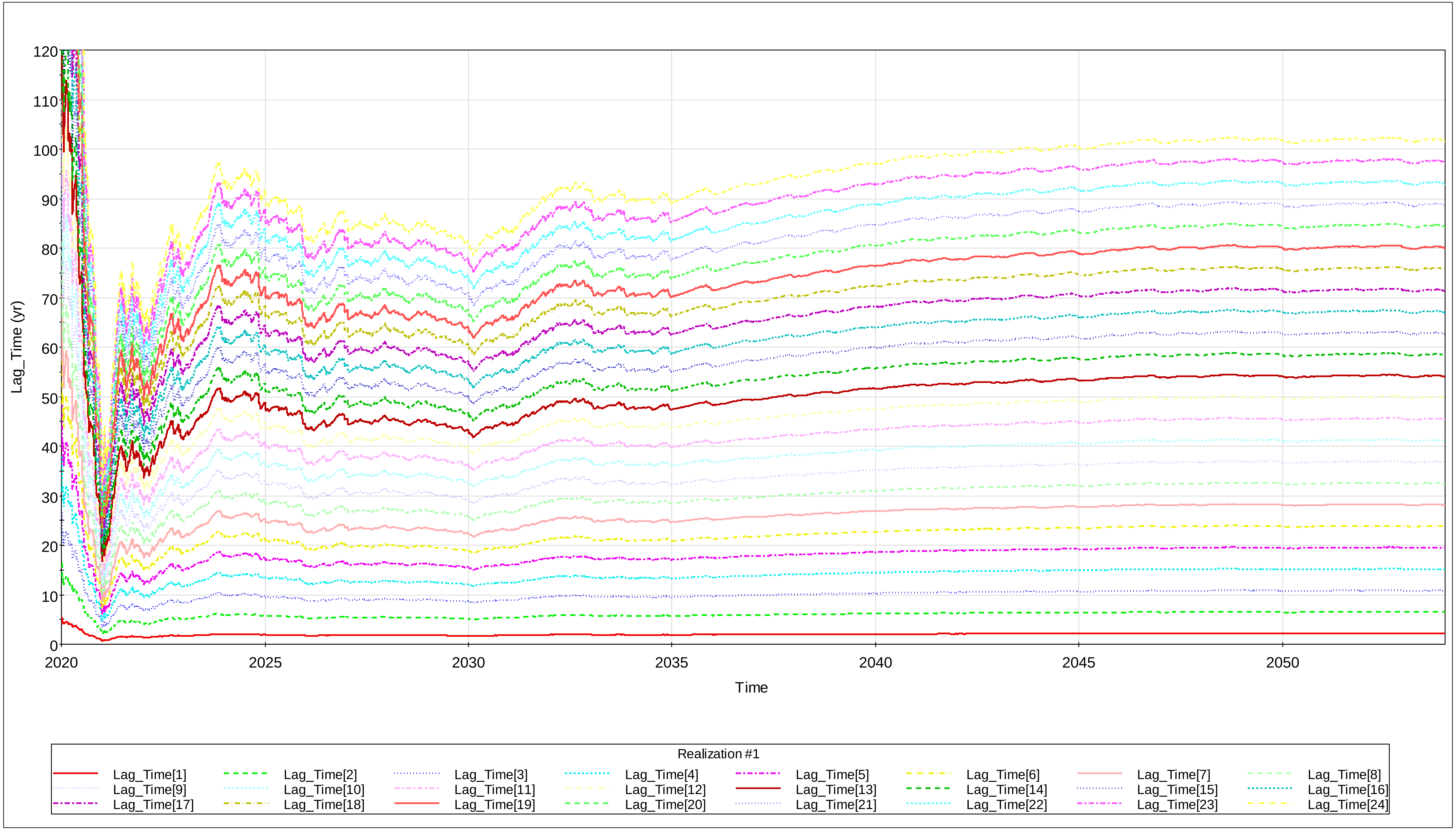
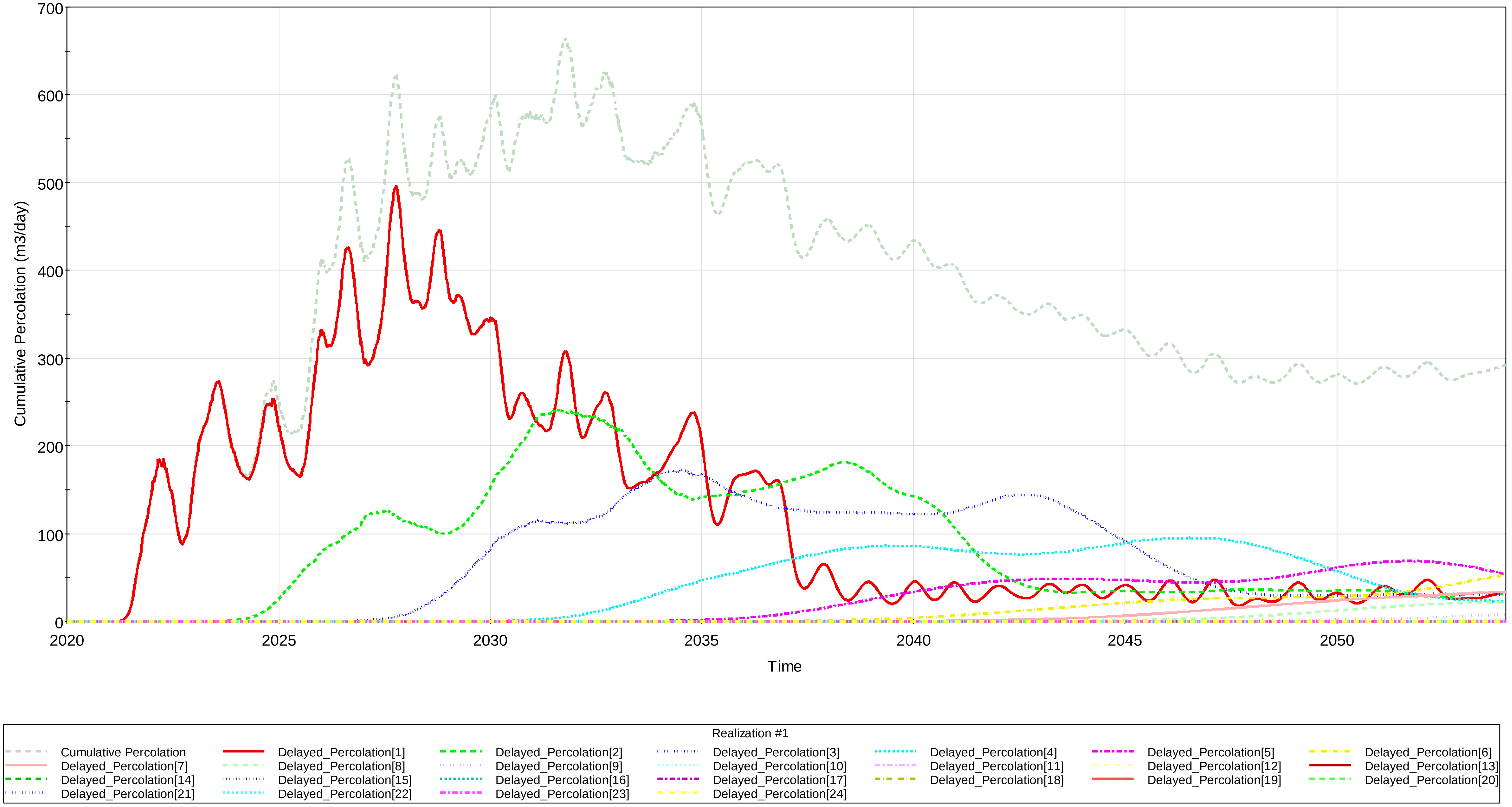


Figure 22: Estimated Seepage Based on Exposed Area, Depth and Calculated Hydraulic Conductivity



3.3.7 Waste Rock Dump Sedimentation Pond

Two sedimentation ponds will be built downstream of the WRD. Initially, the Interim Sedimentation Pond will capture seepage and runoff from the WRD with a catchment area of 537 ha and a maximum storage capacity of 87,189 m^3. During Mine Year 4 the Interim Sedimentation Pond will be decommissioned, and the Ultimate Sedimentation Pond will be built downstream of the ultimate WRD footprint. This pond will be active through LoM and reclamation, its ultimate catchment area will be 1,390 ha which is the majority of the West Alexander catchment. The storage capacity in the Ultimate pond will be limited to 173,022 m^3 with a total surface area of 83,437 m^2 once at maximum capacity. The maximum storage depth for the ultimate sediment pond will be designed at 3 m with 2 m of freeboard at the spillway. Both sedimentation ponds will be designed to remove the smallest particles in accordance with the BC Ministry of Environment, Lands and Parks (BCME) guidelines for mine sedimentation pond design.

3.4 Groundwater

Groundwater will contribute to the water and load balance through a number of pathways. Primarily, groundwater is expected to enter the open pits during active mining as described in the groundwater modeling study (SRK 2020). Groundwater inflows to each pit were provided as a function of the pit bottom elevation. As the depth of the pit increases, groundwater inflows will increase as presented in Table 19. During active mining, groundwater inflows to the open pit will have to be evacuated through pumping to permit mining activities. However, once the pits are backfilled, the groundwater inflows become seepage. Pit bottom elevations through the life of mine are presented in Table 20, with elevations of the open pit in blue and elevations of the backfilled pit in green. The model uses the dynamically simulated pit bottom elevation to determine groundwater inflows to the individual pits over the LoM as shown in Figure 23.

Groundwater is also expected to interact with the creeks and drainages within the Project area. Based on the conceptual groundwater model and observations during baseline study's, creeks and drainages in the area are expected to be both gaining and losing to the groundwater system along their lengths. This flow, overall, is expected to be net positive along the length of the drainages and was accounted for during the calibration of the runoff model as catchment baseflow.

Table 19: Groundwater inflow vs Pit Bottom Elevation

North Pit		East Pit		South Pit	
Bottom Elevation (m)	**Inflow (m^3/day)**	**Bottom Elevation (m)**	**Inflow (m^3/day)**	**Bottom Elevation (m)**	**Inflow (m^3/day)**
2150	0	2225	0	2112.5	0
2089	125	2045	66	1785	559
1940	271	1990	130	1635	748

Source: SRK, 2020

Table 20: Pit Bottom Elevations through the LoM

Mine Year	Pit Bottom Elevation (m)		
	North	East	South
0	2150	2225	2112.5
1	2095	2225	2112.5
2	2025	2225	2112.5
3	1980	2145	2112.5
4	1940	2090	2112.5
5	1985	2010	1880
6	1985	1990	1950
7	1985	1990	1950
8	2035	1990	1903.33
9	2070	2045	1876.67
10	2087.5	2045	1836.67
11	2087.5	2045	1853.33
12	2088.75	2045	1813.33
13	2088.75	2045	1783.33
14	2088.75	2045	1775
15	2088.75	2045	1785
16	2088.75	2045	1785
17	2088.75	2045	1785
18	2088.75	2045	1785

Source: Stantec, 2020

Notes:

2112.5	indicates periods when pit is being active mined
1785	Indicates periods when pit is being/has been backfilled

Figure 23: Groundwater Inflows to Pits over the LoM

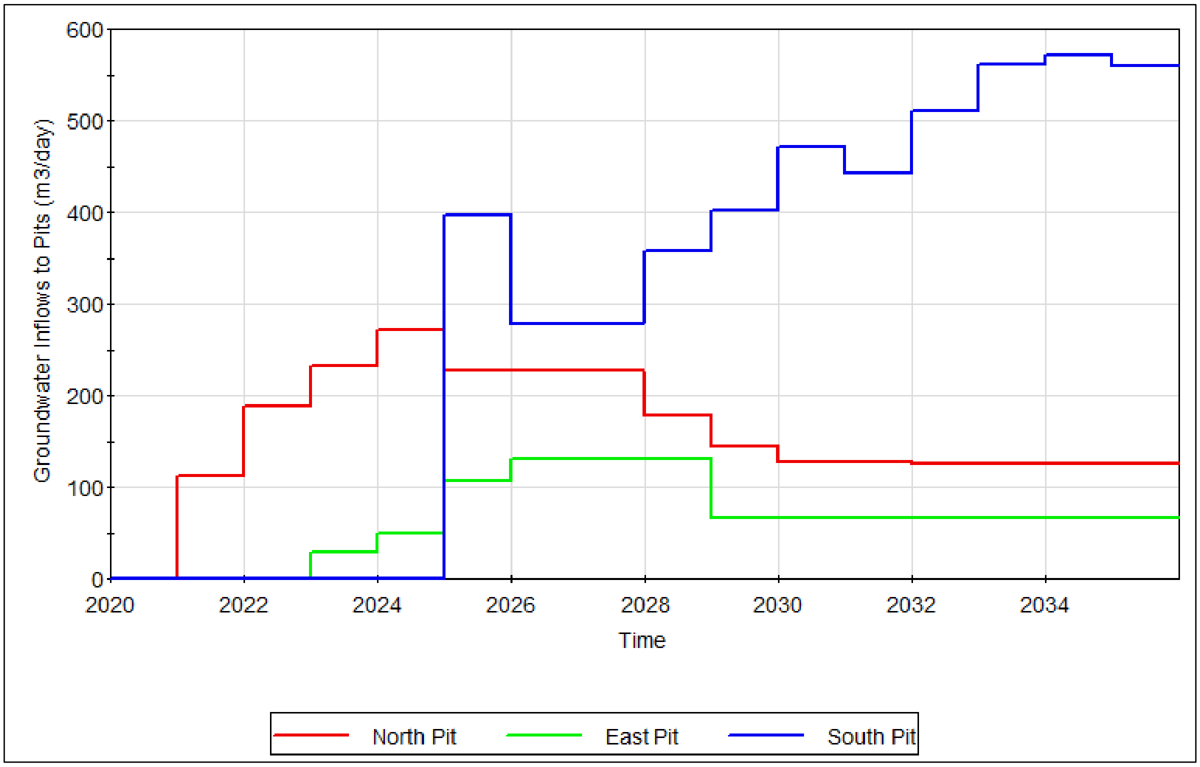
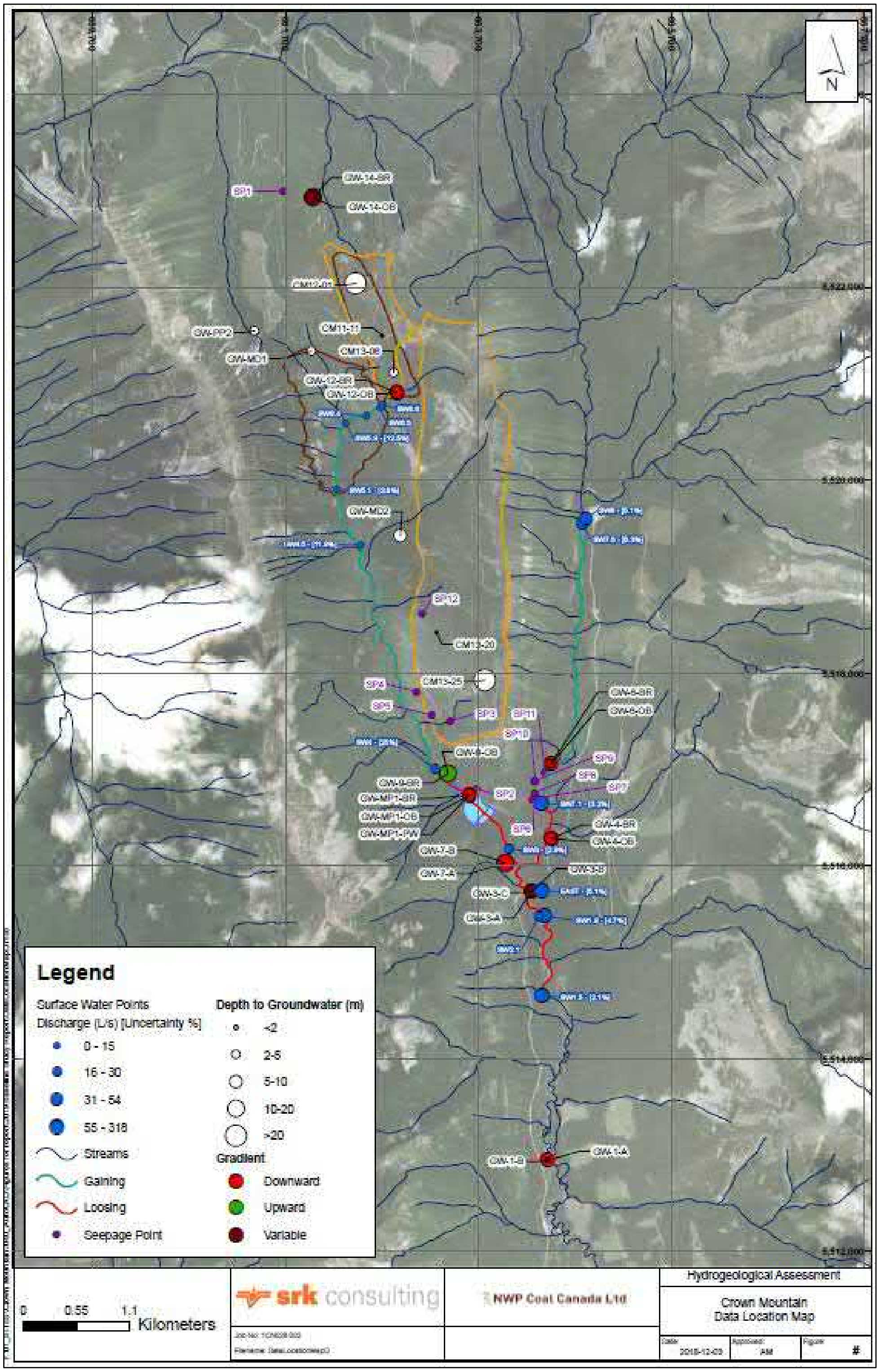


Figure 24: Groundwater Data Location Map



3.5 Load Balance

As discussed in Section 2.2, the components of the load balance model were constructed in Goldsim 12.1 and organized with a container for each facility. Each individual facility within the load balance utilizes a similar approach to develop the mass loading, and consequently the water quality, within that facility. In general, flow rates calculated by the water balance model are multiplied by the source term water quality for 43 different chemical constituents, or "Species", shown in Table 21. The resulting mass loading is assumed to be instantly mixed and combined with other streams entering that facility, as well as any existing chemical mass that facility may have from previous timesteps. The total quantity of water in the facility as determined by the water balance (or a fixed quantity of 1 m^3 if it is an instream node) is then used to determine the concentration of the chemical mass at that time and location. All water leaving the facility is assumed to do so at the calculated water quality.

The load balance calculations take advantage of the GoldSim Contaminate Transport Module (GCTM) to perform the chemical mass calculations using vector terms within the GoldSim Cell element, which internally calculates the resultant concentrations for all species simultaneously and ensure conservation of mass in the network of mixing cells.

A screen capture of the main physical load balance structure as it appears in the water and load balance model can be referenced at Figure 5.

Table 21: List of Species in the Load Balance

Species ID	Name	Species ID	Name	Species ID	Name
Alkalinity	Alkalinity	Cu	Copper	P	Phosphorus
Hardness	Hardness	F	Fluorine	Pb	Lead
Ag	Silver	Fe	Iron	S	Sulfur
Al	Aluminum	Hg	Mercury	Sb	Antimony
As	Arsenic	K	Potassium	Se	Selenium
B	Boron	Li	Lithium	Si	Silicon
Ba	Barium	Mg	Magnesium	Sn	Tin
Be	Beryllium	Mn	Manganese	SO4	Sulfate
Bi	Bismuth	Mo	Molybdenum	Sr	Strontium
Ca	Calcium	Na	Sodium	Ti	Titanium
Cd	Cadmium	NH4	Ammonium	Tl	Thallium
Cl	Chlorine	Ni	Nickel	U	Uranium
Co	Cobalt	NO2	Nitrite	V	Vanadium
Cr	Chromium	NO3	Nitrate	Zn	Zinc
				Zr	Zirconium

3.5.1 Geochemical Source Terms

Chemical mass is introduced into the model through the use of water quality source terms. Every stream of water that enters the model is assigned a water quality value as determined by the water quality study, described in the geochemical modeling report (SRK 2020). Source terms were developed for both average and upper cases, where the 50th percentile value (P_{50}), or the value where 50% of the values are below and 50% above, was used for the average scenario and the 95th percentile (P_{95}) value, or the value where 95% of the values were below and 5% above, was used for the upper scenario.

Source terms for the pit wall runoff and the seepage through the WRD were simulated dynamically, where the water quality profile would change over the LoM as a result of continued oxidation of the materials. Additionally, seepage through the WRD was simulated for two scenarios, one where the layering approach functions as intended, limiting the oxidation of the waste rock in the WRD, and a second scenario where the layering approach fails to perform as intended, and the WRD behaves as a conventional waste rock dump, allowing oxidation throughout the WRD.

Dynamic source terms used by the model for the North, South and East Pit runoff for the P_{50} and P_{95} levels through the LoM are presented in Table 22 through Table 27.

Other Source terms within the model, including runoff from natural ground and the WRD, flow in Harmer Creek, and groundwater inflows, are modeled statically, a single water quality profile for the average conditions and a second profile for the Upper Case is used for the entire LoM. These source terms are presented in Table 27.

Precipitation entering the model is assumed to carry no chemical mass, and the icepack formation and ice melt volumes also neither add nor remove chemical mass from the ponds.

3.5.2 Total Suspended Solids

Water quality predictions for the Project will be predicted as dissolved metals. Total suspended solids (TSS) does not act conservatively due to sedimentation processes and will not be accounted for in a mass balance approach. It will be assumed that the proposed onsite sedimentation ponds will be sufficient for settling of particulates. Dissolved loadings from the Project site will be added to the total loads in the downstream watercourses to provide an estimation of total concentrations for comparison to water quality guidelines.

3.5.3 Chronic Concentration Calculations

During the model simulations, water qualities are calculated on a ¼ or 1-day frequency, but as discussed in Section 2.5, are compared against the 30-day chronic standards. The model internally produces monthly average concentration for all WQ nodes which are compared against the appropriate standards. Because of the nature of the calculation, average monthly concentrations can only be presented the month after they are simulated. Thus, when viewing the WQ results presented in the GoldSim result elements, it should be noted that each average month water quality is graphed in the following month.

Table 22: Dynamic Source Term Water Quality for the North Pit Wall Runoff

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
Alkalinity	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hardness	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ag	p_{50}	1.60E-06	1.60E-06	1.60E-06	1.60E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06	1.61E-06
	p_{95}	1.60E-06	1.60E-06	1.60E-06	1.60E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06
Al	p_{50}	0.0367	0.0367	0.0367	0.0367	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366	0.0366
	p_{95}	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367
As	p_{50}	9.23E-06	9.23E-06	9.23E-06	9.23E-06	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
	p_{95}	9.23E-06	9.23E-06	9.23E-06	9.23E-06	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05	2.01E-05
B	p_{50}	0.000995	0.000995	0.000995	0.000995	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123	0.00123
	p_{95}	0.000995	0.000995	0.000995	0.000995	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124
Ba	p_{50}	2.09E-04	2.09E-04	2.09E-04	2.09E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04
	p_{95}	2.09E-04	2.09E-04	2.09E-04	2.09E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04	6.50E-04
Be	p_{50}	8.48E-05	8.48E-05	8.48E-05	8.48E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05	8.42E-05
	p_{95}	8.48E-05	8.48E-05	8.48E-05	8.48E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05	8.81E-05
Bi	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ca	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cd	p_{50}	1.97E-04	1.97E-04	1.97E-04	1.97E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04	1.95E-04
	p_{95}	1.97E-04	1.97E-04	1.97E-04	1.97E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04	2.18E-04
Cl	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Co	p_{50}	0.00220	0.00220	0.00220	0.00220	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219	0.00219
	p_{95}	0.00220	0.00220	0.00220	0.00220	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264	0.00264
Cr	p_{50}	3.15E-05	3.15E-05	3.15E-05	3.15E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05
	p_{95}	3.15E-05	3.15E-05	3.15E-05	3.15E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05	3.31E-05
Cu	p_{50}	0.00128	0.00128	0.00128	0.00128	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127
	p_{95}	0.00128	0.00128	0.00128	0.00128	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133	0.00133
F	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fe	p_{50}	0.0420	0.0420	0.0420	0.0420	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418	0.0418
	p_{95}	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420
Hg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Li	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mn	p_{50}	0.0282	0.0282	0.0282	0.0282	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280	0.0280
	p_{95}	0.0282	0.0282	0.0282	0.0282	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291
Mo	p_{50}	1.84E-06	1.84E-06	1.84E-06	1.84E-06	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05	5.44E-05
	p_{95}	1.84E-06	1.84E-06	1.84E-06	1.84E-06	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04	1.43E-04
Na	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH4	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ni	p_{50}	0.00881	0.00881	0.00881	0.00881	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876	0.00876
	p_{95}	0.00881	0.00881	0.00881	0.00881	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
NO2	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NO3	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pb	p_{50}	4.98E-05	4.98E-05	4.98E-05	4.98E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05	4.99E-05
	p_{95}	4.98E-05	4.98E-05	4.98E-05	4.98E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05	5.18E-05
S	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sb	p_{50}	3.49E-07	3.49E-07	3.49E-07	3.49E-07	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06	5.85E-06
	p_{95}	3.49E-07	3.49E-07	3.49E-07	3.49E-07	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05
Se	p_{50}	7.01E-05	7.01E-05	7.01E-05	7.01E-05	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04	1.05E-04
	p_{95}	7.01E-05	7.01E-05	7.01E-05	7.01E-05	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04	1.61E-04
Si	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sn	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO4	p_{50}	2.86	2.86	2.86	2.86	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91
	p_{95}	2.86	2.86	2.86	2.86	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08
Sr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ti	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tl	p_{50}	2.09E-05	2.09E-05	2.09E-05	2.09E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05	2.08E-05
	p_{95}	2.09E-05	2.09E-05	2.09E-05	2.09E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05	2.13E-05
U	p_{50}	9.18E-05	9.18E-05	9.18E-05	9.18E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05	9.33E-05
	p_{95}	9.18E-05	9.18E-05	9.18E-05	9.18E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05	9.94E-05
V	p_{50}	3.84E-06	3.84E-06	3.84E-06	3.84E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06	5.04E-06
	p_{95}	3.84E-06	3.84E-06	3.84E-06	3.84E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06	9.93E-06
Zn	p_{50}	0.0292	0.0292	0.0292	0.0292	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290	0.0290
	p_{95}	0.0292	0.0292	0.0292	0.0292	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293	0.0293
Zr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 23: Dynamic Source Term Water Quality for the East Pit Wall Runoff

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
Alkalinity	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hardness	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ag	p_{50}	0.0	0.0	0.0	0.0	1.92E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06	1.94E-06
	p_{95}	0.0	0.0	0.0	0.0	1.97E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06	2.57E-06
Al	p_{50}	0.0	0.0	0.0	0.0	0.0367	0.0347	0.0347	0.0347	0.0347	0.0347	0.0347	0.0347	0.0347	0.0347	0.0347	0.0347	0.0347
	p_{95}	0.0	0.0	0.0	0.0	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367
As	p_{50}	0.0	0.0	0.0	0.0	1.71E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05	3.21E-05
	p_{95}	0.0	0.0	0.0	0.0	1.73E-05	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04	2.69E-04
B	p_{50}	0.0	0.0	0.0	0.0	0.00572	0.00761	0.00761	0.00761	0.00761	0.00761	0.00761	0.00761	0.00761	0.00761	0.00761	0.00761	0.00761
	p_{95}	0.0	0.0	0.0	0.0	0.00600	0.00795	0.00795	0.00795	0.00795	0.00795	0.00795	0.00795	0.00795	0.00795	0.00795	0.00795	0.00795
Ba	p_{50}	0.0	0.0	0.0	0.0	0.00450	0.00778	0.00778	0.00778	0.00778	0.00778	0.00778	0.00778	0.00778	0.00778	0.00778	0.00778	0.00778
	p_{95}	0.0	0.0	0.0	0.0	0.00543	0.0118	0.0118	0.0118	0.0118	0.0118	0.0118	0.0118	0.0118	0.0118	0.0118	0.0118	0.0118
Be	p_{50}	0.0	0.0	0.0	0.0	7.25E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05	6.62E-05
	p_{95}	0.0	0.0	0.0	0.0	7.25E-05	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04	1.59E-04
Bi	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ca	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cd	p_{50}	0.0	0.0	0.0	0.0	1.67E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04	1.57E-04
	p_{95}	0.0	0.0	0.0	0.0	1.67E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04	6.94E-04
Cl	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Co	p_{50}	0.0	0.0	0.0	0.0	0.00186	0.00188	0.00188	0.00188	0.00188	0.00188	0.00188	0.00188	0.00188	0.00188	0.00188	0.00188	0.00188
	p_{95}	0.0	0.0	0.0	0.0	0.00187	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Cr	p_{50}	0.0	0.0	0.0	0.0	3.96E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05	3.92E-05
	p_{95}	0.0	0.0	0.0	0.0	4.21E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05	7.16E-05
Cu	p_{50}	0.0	0.0	0.0	0.0	0.00111	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103
	p_{95}	0.0	0.0	0.0	0.0	0.00111	0.00241	0.00241	0.00241	0.00241	0.00241	0.00241	0.00241	0.00241	0.00241	0.00241	0.00241	0.00241
F	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fe	p_{50}	0.0	0.0	0.0	0.0	0.0390	0.0363	0.0363	0.0363	0.0363	0.0363	0.0363	0.0363	0.0363	0.0363	0.0363	0.0363	0.0363
	p_{95}	0.0	0.0	0.0	0.0	0.0414	0.0419	0.0419	0.0419	0.0419	0.0419	0.0419	0.0419	0.0419	0.0419	0.0419	0.0419	0.0419
Hg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Li	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mn	p_{50}	0.0	0.0	0.0	0.0	0.0241	0.0229	0.0229	0.0229	0.0229	0.0229	0.0229	0.0229	0.0229	0.0229	0.0229	0.0229	0.0229
	p_{95}	0.0	0.0	0.0	0.0	0.0243	0.0482	0.0482	0.0482	0.0482	0.0482	0.0482	0.0482	0.0482	0.0482	0.0482	0.0482	0.0482
Mo	p_{50}	0.0	0.0	0.0	0.0	0.000631	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139
	p_{95}	0.0	0.0	0.0	0.0	0.00103	0.00357	0.00357	0.00357	0.00357	0.00357	0.00357	0.00357	0.00357	0.00357	0.00357	0.00357	0.00357
Na	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH4	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ni	p_{50}	0.0	0.0	0.0	0.0	0.00746	0.00720	0.00720	0.00720	0.00720	0.00720	0.00720	0.00720	0.00720	0.00720	0.00720	0.00720	0.00720
	p_{95}	0.0	0.0	0.0	0.0	0.00747	0.0429	0.0429	0.0429	0.0429	0.0429	0.0429	0.0429	0.0429	0.0429	0.0429	0.0429	0.0429
NO2	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
NO3	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pb	p_{50}	0.0	0.0	0.0	0.0	4.84E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05	5.34E-05
	p_{95}	0.0	0.0	0.0	0.0	4.97E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05	9.81E-05
S	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sb	p_{50}	0.0	0.0	0.0	0.0	4.62E-05	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04
	p_{95}	0.0	0.0	0.0	0.0	5.26E-05	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04	3.22E-04
Se	p_{50}	0.0	0.0	0.0	0.0	2.52E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04	9.48E-04
	p_{95}	0.0	0.0	0.0	0.0	0.000402	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230
Si	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sn	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO4	p_{50}	0.0	0.0	0.0	0.0	3.89	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23
	p_{95}	0.0	0.0	0.0	0.0	4.60	8.41	8.41	8.41	8.41	8.41	8.41	8.41	8.41	8.41	8.41	8.41	8.41
Sr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ti	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tl	p_{50}	0.0	0.0	0.0	0.0	1.84E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05	1.76E-05
	p_{95}	0.0	0.0	0.0	0.0	1.86E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05
U	p_{50}	0.0	0.0	0.0	0.0	1.02E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04
	p_{95}	0.0	0.0	0.0	0.0	1.09E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04	2.76E-04
V	p_{50}	0.0	0.0	0.0	0.0	3.72E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05	3.99E-05
	p_{95}	0.0	0.0	0.0	0.0	4.63E-05	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04	1.58E-04
Zn	p_{50}	0.0	0.0	0.0	0.0	0.0247	0.0228	0.0228	0.0228	0.0228	0.0228	0.0228	0.0228	0.0228	0.0228	0.0228	0.0228	0.0228
	p_{95}	0.0	0.0	0.0	0.0	0.0247	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306	0.0306
Zr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 24: Dynamic Source Term Water Quality for the South Pit Wall Runoff

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
Alkalinity	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hardness	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ag	p_{50}	0.0	0.0	0.0	0.0	0.0	1.60E-06	1.70E-06	1.90E-06	1.86E-06	1.82E-06	1.77E-06	1.73E-06	1.75E-06	1.81E-06	1.91E-06	1.87E-06	1.87E-06
	p_{95}	0.0	0.0	0.0	0.0	0.0	1.60E-06	1.93E-06	2.59E-06	2.48E-06	2.33E-06	2.16E-06	2.04E-06	2.07E-06	2.19E-06	2.44E-06	2.35E-06	2.35E-06
Al	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0367	0.0359	0.0345	0.0347	0.0351	0.0354	0.0357	0.0357	0.0355	0.0351	0.0352	0.0352
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367	0.0367
As	p_{50}	0.0	0.0	0.0	0.0	0.0	9.23E-06	1.72E-05	3.29E-05	3.02E-05	2.68E-05	2.27E-05	1.98E-05	2.04E-05	2.31E-05	2.90E-05	2.69E-05	2.69E-05
	p_{95}	0.0	0.0	0.0	0.0	0.0	9.23E-06	1.06E-04	2.99E-04	2.66E-04	2.24E-04	1.74E-04	1.38E-04	1.41E-04	1.64E-04	2.26E-04	2.06E-04	2.06E-04
B	p_{50}	0.0	0.0	0.0	0.0	0.0	0.000995	0.00308	0.00723	0.00651	0.00563	0.00454	0.00377	0.00412	0.00510	0.00692	0.00623	0.00623
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.000995	0.00319	0.00755	0.00679	0.00586	0.00472	0.00390	0.00428	0.00531	0.00723	0.00650	0.00650
Ba	p_{50}	0.0	0.0	0.0	0.0	0.0	0.000209	0.00269	0.00763	0.00677	0.00572	0.00442	0.00350	0.00384	0.00486	0.00689	0.00615	0.00615
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.000209	0.00414	0.0120	0.0106	0.00893	0.00688	0.00542	0.00585	0.00731	0.0104	0.00926	0.00926
Be	p_{50}	0.0	0.0	0.0	0.0	0.0	8.48E-05	7.89E-05	6.70E-05	6.91E-05	7.16E-05	7.47E-05	7.69E-05	7.60E-05	7.33E-05	6.82E-05	7.01E-05	7.01E-05
	p_{95}	0.0	0.0	0.0	0.0	0.0	8.48E-05	1.14E-04	1.71E-04	1.61E-04	1.49E-04	1.34E-04	1.23E-04	1.23E-04	1.28E-04	1.45E-04	1.40E-04	1.40E-04
Bi	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ca	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cd	p_{50}	0.0	0.0	0.0	0.0	0.0	1.97E-04	1.84E-04	1.60E-04	1.64E-04	1.69E-04	1.76E-04	1.80E-04	1.78E-04	1.72E-04	1.61E-04	1.65E-04	1.65E-04
	p_{95}	0.0	0.0	0.0	0.0	0.0	1.97E-04	3.86E-04	7.62E-04	6.97E-04	6.17E-04	5.18E-04	4.48E-04	4.50E-04	4.90E-04	6.08E-04	5.71E-04	5.71E-04
Cl	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Co	p_{50}	0.0	0.0	0.0	0.0	0.0	0.00220	0.00211	0.00192	0.00196	0.00200	0.00204	0.00208	0.00206	0.00200	0.00190	0.00194	0.00194
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.00220	0.00609	0.0138	0.0125	0.0108	0.00880	0.00736	0.00743	0.00828	0.0107	0.00995	0.00995
Cr	p_{50}	0.0	0.0	0.0	0.0	0.0	3.15E-05	3.37E-05	3.81E-05	3.73E-05	3.64E-05	3.52E-05	3.44E-05	3.50E-05	3.64E-05	3.86E-05	3.77E-05	3.77E-05
	p_{95}	0.0	0.0	0.0	0.0	0.0	3.15E-05	4.57E-05	7.39E-05	6.90E-05	6.30E-05	5.56E-05	5.03E-05	5.13E-05	5.57E-05	6.58E-05	6.24E-05	6.24E-05
Cu	p_{50}	0.0	0.0	0.0	0.0	0.0	0.00128	0.00120	0.00105	0.00107	0.00111	0.00115	0.00118	0.00116	0.00113	0.00106	0.00109	0.00109
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.00128	0.00172	0.00260	0.00244	0.00226	0.00203	0.00187	0.00187	0.00195	0.00221	0.00213	0.00213
F	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fe	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0420	0.0401	0.0363	0.0370	0.0378	0.0388	0.0395	0.0392	0.0385	0.0370	0.0375	0.0375
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0419	0.0418	0.0419	0.0419
Hg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Li	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mn	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0282	0.0265	0.0233	0.0239	0.0246	0.0254	0.0260	0.0257	0.0249	0.0235	0.0240	0.0240
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0282	0.0360	0.0516	0.0489	0.0456	0.0415	0.0386	0.0385	0.0399	0.0445	0.0431	0.0431
Mo	p_{50}	0.0	0.0	0.0	0.0	0.0	0.00000184	0.000470	0.00140	0.00124	0.00104	0.000797	0.000623	0.000674	0.000849	0.00121	0.00108	0.00108
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.00000184	0.00126	0.00375	0.00331	0.00278	0.00213	0.00167	0.00176	0.00216	0.00306	0.00275	0.00275
Na	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH4	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ni	p_{50}	0.0	0.0	0.0	0.0	0.0	0.00881	0.00832	0.00734	0.00751	0.00772	0.00798	0.00816	0.00806	0.00780	0.00735	0.00753	0.00753
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.00881	0.0217	0.0474	0.0429	0.0375	0.0307	0.0259	0.0262	0.0289	0.0370	0.0345	0.0345
NO2	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
NO3	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pb	p_{50}	0.0	0.0	0.0	0.0	0.0	4.98E-05	5.12E-05	5.42E-05	5.37E-05	5.30E-05	5.23E-05	5.17E-05	5.17E-05	5.19E-05	5.27E-05	5.24E-05	5.24E-05
	p_{95}	0.0	0.0	0.0	0.0	0.0	4.98E-05	6.80E-05	1.04E-04	9.78E-05	9.01E-05	8.06E-05	7.39E-05	7.43E-05	7.84E-05	9.00E-05	8.63E-05	8.63E-05
S	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sb	p_{50}	0.0	0.0	0.0	0.0	0.0	3.49E-07	4.94E-05	1.47E-04	1.30E-04	1.09E-04	8.36E-05	6.54E-05	6.95E-05	8.55E-05	1.22E-04	1.09E-04	1.09E-04
	p_{95}	0.0	0.0	0.0	0.0	0.0	3.49E-07	1.17E-04	3.48E-04	3.08E-04	2.59E-04	1.98E-04	1.55E-04	1.61E-04	1.93E-04	2.73E-04	2.46E-04	2.46E-04
Se	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0000701	0.000385	0.00101	0.000901	0.000767	0.000604	0.000487	0.000506	0.000597	0.000817	0.000742	0.000742
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0000701	0.000882	0.00250	0.00221	0.00187	0.00145	0.00115	0.00119	0.00141	0.00196	0.00178	0.00178
Si	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sn	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO4	p_{50}	0.0	0.0	0.0	0.0	0.0	2.86	3.29	4.14	3.99	3.81	3.59	3.43	3.51	3.71	4.09	3.95	3.95
	p_{95}	0.0	0.0	0.0	0.0	0.0	2.86	4.80	8.65	7.98	7.16	6.15	5.43	5.59	6.21	7.63	7.14	7.14
Sr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ti	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tl	p_{50}	0.0	0.0	0.0	0.0	0.0	2.09E-05	1.99E-05	1.78E-05	1.82E-05	1.86E-05	1.91E-05	1.95E-05	1.93E-05	1.88E-05	1.79E-05	1.83E-05	1.83E-05
	p_{95}	0.0	0.0	0.0	0.0	0.0	2.09E-05	2.45E-05	3.17E-05	3.05E-05	2.89E-05	2.71E-05	2.57E-05	2.56E-05	2.62E-05	2.83E-05	2.77E-05	2.77E-05
U	p_{50}	0.0	0.0	0.0	0.0	0.0	9.18E-05	1.05E-04	1.30E-04	1.26E-04	1.20E-04	1.14E-04	1.09E-04	1.10E-04	1.14E-04	1.23E-04	1.20E-04	1.20E-04
	p_{95}	0.0	0.0	0.0	0.0	0.0	9.18E-05	1.60E-04	2.94E-04	2.71E-04	2.42E-04	2.07E-04	1.82E-04	1.84E-04	2.02E-04	2.47E-04	2.32E-04	2.32E-04
V	p_{50}	0.0	0.0	0.0	0.0	0.0	3.84E-06	1.46E-05	3.59E-05	3.22E-05	2.76E-05	2.21E-05	1.81E-05	2.05E-05	2.65E-05	3.68E-05	3.28E-05	3.28E-05
	p_{95}	0.0	0.0	0.0	0.0	0.0	3.84E-06	5.82E-05	1.66E-04	1.47E-04	1.24E-04	9.60E-05	7.59E-05	7.99E-05	9.68E-05	1.36E-04	1.22E-04	1.22E-04
Zn	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0292	0.0272	0.0232	0.0239	0.0247	0.0258	0.0265	0.0262	0.0252	0.0235	0.0242	0.0242
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0292	0.0301	0.0319	0.0316	0.0312	0.0307	0.0304	0.0301	0.0299	0.0300	0.0300	0.0300
Zr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 25: Dynamic Source Term Water Quality for the Successful Layer Approach WRD Seepage

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
Alkalinity	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hardness	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ag	p_{50}	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04
	p_{95}	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04
Al	p_{50}	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370
	p_{95}	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370
As	p_{50}	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390
	p_{95}	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390
B	p_{50}	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
	p_{95}	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Ba	p_{50}	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540
	p_{95}	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540
Be	p_{50}	9.17E-04	9.17E-04	3.00E-04	3.51E-04	3.32E-04	3.15E-04	4.07E-04	3.02E-04	3.02E-04	3.07E-04	3.03E-04	3.01E-04	3.04E-04	3.20E-04	3.14E-04	3.16E-04	3.16E-04
	p_{95}	0.00249	0.00249	0.000426	0.000597	0.000534	0.000477	0.000786	0.000435	0.000434	0.000449	0.000438	0.000430	0.000441	0.000496	0.000474	0.000480	0.000480
Bi	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ca	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cd	p_{50}	0.00270	0.00270	0.00164	0.00215	0.00197	0.00180	0.00270	0.00167	0.00167	0.00171	0.00168	0.00166	0.00169	0.00185	0.00179	0.00181	0.00181
	p_{95}	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270
Cl	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Co	p_{50}	0.103	0.103	0.0344	0.0401	0.0380	0.0361	0.0463	0.0347	0.0347	0.0352	0.0348	0.0345	0.0349	0.0367	0.0360	0.0362	0.0362
	p_{95}	0.150	0.150	0.119	0.150	0.150	0.146	0.150	0.124	0.124	0.131	0.126	0.121	0.127	0.150	0.144	0.147	0.147
Cr	p_{50}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
	p_{95}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
Cu	p_{50}	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710
	p_{95}	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710
F	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fe	p_{50}	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420
	p_{95}	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420
Hg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Li	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mn	p_{50}	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
	p_{95}	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
Mo	p_{50}	0.210	0.210	0.0793	0.100	0.0925	0.0856	0.123	0.0804	0.0804	0.0822	0.0808	0.0798	0.0812	0.0878	0.0852	0.0859	0.0859
	p_{95}	0.210	0.210	0.124	0.188	0.165	0.144	0.210	0.128	0.128	0.133	0.129	0.126	0.130	0.151	0.143	0.145	0.145
Na	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH4	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ni	p_{50}	0.281	0.281	0.0753	0.0924	0.0861	0.0805	0.111	0.0762	0.0762	0.0777	0.0765	0.0757	0.0769	0.0823	0.0801	0.0807	0.0807
	p_{95}	0.380	0.380	0.314	0.380	0.380	0.380	0.380	0.327	0.326	0.347	0.331	0.319	0.336	0.380	0.380	0.380	0.380
NO2	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
NO3	p_{50}	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	p_{95}	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
P	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pb	p_{50}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
	p_{95}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
S	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sb	p_{50}	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150
	p_{95}	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150
Se	p_{50}	0.261	0.261	0.0218	0.0415	0.0343	0.0277	0.0633	0.0228	0.0227	0.0245	0.0231	0.0222	0.0235	0.0298	0.0273	0.0280	0.0280
	p_{95}	0.547	0.547	0.0446	0.0862	0.0710	0.0572	0.132	0.0468	0.0467	0.0504	0.0475	0.0456	0.0484	0.0616	0.0564	0.0578	0.0578
Si	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sn	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO4	p_{50}	1490	1490	429	517	485	455	614	433	433	441	435	431	437	465	454	457	457
	p_{95}	2000	2000	486	629	577	530	787	494	494	506	496	490	499	545	527	532	532
Sr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ti	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tl	p_{50}	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05
	p_{95}	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05
U	p_{50}	0.0180	0.0180	0.00556	0.00663	0.00624	0.00588	0.00780	0.00562	0.00561	0.00571	0.00563	0.00558	0.00565	0.00600	0.00586	0.00590	0.00590
	p_{95}	0.0180	0.0180	0.00935	0.0140	0.0123	0.0108	0.0180	0.00960	0.00958	0.00999	0.00968	0.00946	0.00977	0.0113	0.0107	0.0108	0.0108
V	p_{50}	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120
	p_{95}	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120
Zn	p_{50}	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410
	p_{95}	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410
Zr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 26: Dynamic Source Term Water Quality for the Failed Layer Approach WRD Seepage

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
Alkalinity	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hardness	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ag	p_{50}	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04
	p_{95}	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04	1.40E-04
Al	p_{50}	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370
	p_{95}	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370	0.0370
As	p_{50}	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390
	p_{95}	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390	0.00390
B	p_{50}	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
	p_{95}	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Ba	p_{50}	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540
	p_{95}	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540
Be	p_{50}	0.000691	0.000691	0.000452	0.000529	0.000640	0.000700	0.000633	0.000555	0.000601	0.000652	0.000704	0.000781	0.000855	0.000921	0.000970	0.00103	0.00103
	p_{95}	0.00232	0.00232	0.00151	0.00177	0.00215	0.00235	0.00212	0.00186	0.00201	0.00219	0.00236	0.00262	0.00287	0.00309	0.00325	0.00344	0.00344
Bi	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ca	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cd	p_{50}	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270
	p_{95}	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270
Cl	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Co	p_{50}	0.0766	0.0766	0.0501	0.0586	0.0709	0.0776	0.0701	0.0615	0.0666	0.0722	0.0780	0.0865	0.0948	0.102	0.107	0.114	0.114
	p_{95}	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150
Cr	p_{50}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
	p_{95}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
Cu	p_{50}	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710
	p_{95}	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710	0.00710
F	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fe	p_{50}	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420
	p_{95}	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420	0.0420
Hg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
K	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Li	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mg	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mn	p_{50}	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
	p_{95}	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270	0.270
Mo	p_{50}	0.210	0.210	0.184	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210
	p_{95}	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210	0.210
Na	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH4	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ni	p_{50}	0.230	0.230	0.151	0.176	0.213	0.233	0.211	0.185	0.200	0.217	0.235	0.260	0.285	0.307	0.323	0.342	0.342
	p_{95}	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380
NO2	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Species	Level	Mine Year 0	Mine Year 1	Mine Year 2	Mine Year 3	Mine Year 4	Mine Year 5	Mine Year 6	Mine Year 7	Mine Year 8	Mine Year 9	Mine Year 10	Mine Year 11	Mine Year 12	Mine Year 13	Mine Year 14	Mine Year 15	Mine Year 16
NO3	p_{50}	0.0	0.0	0.0	0.0	3.18	16.5	23.2	22.2	26.2	29.2	31.4	32.7	33.5	33.7	36.6	39.0	39.0
	p_{95}	0.0	0.0	0.0	0.0	3.18	16.5	23.2	22.2	26.2	29.2	31.4	32.7	33.5	33.7	36.6	39.0	39.0
P	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pb	p_{50}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
	p_{95}	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130	0.00130
S	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sb	p_{50}	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150
	p_{95}	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150	0.0150
Se	p_{50}	0.268	0.268	0.175	0.205	0.248	0.271	0.245	0.215	0.233	0.252	0.272	0.302	0.331	0.356	0.375	0.397	0.397
	p_{95}	0.563	0.563	0.368	0.430	0.521	0.570	0.515	0.451	0.489	0.530	0.573	0.636	0.696	0.749	0.789	0.834	0.834
Si	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sn	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO4	p_{50}	1190	1190	778	911	1100	1210	1090	955	1030	1120	1210	1350	1470	1590	1670	1770	1770
	p_{95}	1930	1930	1260	1480	1790	1960	1770	1550	1680	1820	1970	2000	2000	2000	2000	2000	2000
Sr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ti	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tl	p_{50}	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05
	p_{95}	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05	6.90E-05
U	p_{50}	0.0145	0.0145	0.00945	0.0111	0.0134	0.0146	0.0132	0.0116	0.0126	0.0136	0.0147	0.0163	0.0179	0.0180	0.0180	0.0180	0.0180
	p_{95}	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180	0.0180
V	p_{50}	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120
	p_{95}	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120	0.00120
Zn	p_{50}	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410
	p_{95}	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410	0.0410
Zr	p_{50}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	p_{95}	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 27: Static Source Term Water Quality for the Runoff and Groundwater Inflow

Species	Exceedance Level	Natural Ground Runoff	Waste Rock Dump Runoff	Flow in Harmer Creek	Groundwater Flux into North Pit	Groundwater Flux into South Pit	Groundwater Flux into East Pit
Alkalinity	p_{50}	106	115	191	106	106	106
	p_{95}	115	124	213	115	115	115
Hardness	p_{50}	121	137	385	121	121	121
	p_{95}	137	154	443	137	137	137
Ag	p_{50}	5.24E-06	5.00E-06	0.0	5.24E-06	5.24E-06	5.24E-06
	p_{95}	5.00E-06	4.76E-06	0.0	5.00E-06	5.00E-06	5.00E-06
Al	p_{50}	0.00245	0.00677	0.0	0.00245	0.00245	0.00245
	p_{95}	0.00677	0.0111	0.0100	0.00677	0.00677	0.00677
As	p_{50}	1.06E-04	1.25E-04	0.0	1.06E-04	1.06E-04	1.06E-04
	p_{95}	1.25E-04	1.44E-04	0.0	1.25E-04	1.25E-04	1.25E-04
B	p_{50}	0.0327	0.0500	0.0100	0.0327	0.0327	0.0327
	p_{95}	0.0500	0.0673	0.0100	0.0500	0.0500	0.0500
Ba	p_{50}	0.0300	0.0360	0.0600	0.0300	0.0300	0.0300
	p_{95}	0.0360	0.0421	0.0700	0.0360	0.0360	0.0360
Be	p_{50}	1.17E-05	1.00E-05	0.0	1.17E-05	1.17E-05	1.17E-05
	p_{95}	1.00E-05	8.27E-06	0.0	1.00E-05	1.00E-05	1.00E-05
Bi	p_{50}	5.89E-06	5.05E-06	0.0	5.89E-06	5.89E-06	5.89E-06
	p_{95}	5.05E-06	4.20E-06	0.0	5.05E-06	5.05E-06	5.05E-06
Ca	p_{50}	31.3	35.1	82.9	31.3	31.3	31.3
	p_{95}	35.1	38.9	93.2	35.1	35.1	35.1
Cd	p_{50}	7.02E-06	1.18E-05	0.0	7.02E-06	7.02E-06	7.02E-06
	p_{95}	1.18E-05	1.65E-05	0.0	1.18E-05	1.18E-05	1.18E-05
Cl	p_{50}	0.560	0.795	1.18	0.560	0.560	0.560
	p_{95}	0.795	1.03	2.10	0.795	0.795	0.795
Co	p_{50}	9.69E-06	1.63E-05	0.0	9.69E-06	9.69E-06	9.69E-06
	p_{95}	1.63E-05	2.28E-05	0.0	1.63E-05	1.63E-05	1.63E-05
Cr	p_{50}	2.91E-04	3.75E-04	0.0	2.91E-04	2.91E-04	2.91E-04
	p_{95}	3.75E-04	4.58E-04	0.0	3.75E-04	3.75E-04	3.75E-04
Cu	p_{50}	1.81E-04	5.67E-04	0.0	1.81E-04	1.81E-04	1.81E-04
	p_{95}	5.67E-04	9.52E-04	0.0	5.67E-04	5.67E-04	5.67E-04
F	p_{50}	0.131	0.180	0.0	0.131	0.131	0.131
	p_{95}	0.180	0.229	0.0	0.180	0.180	0.180
Fe	p_{50}	0.00230	0.00605	0.0100	0.00230	0.00230	0.00230
	p_{95}	0.00605	0.00979	0.0100	0.00605	0.00605	0.00605
Hg	p_{50}	4.81E-06	1.00E-05	0.0	4.81E-06	4.81E-06	4.81E-06
	p_{95}	1.00E-05	1.52E-05	0.0	1.00E-05	1.00E-05	1.00E-05
K	p_{50}	0.199	0.252	0.900	0.199	0.199	0.199
	p_{95}	0.252	0.305	0.970	0.252	0.252	0.252
Li	p_{50}	0.000545	0.000874	0.0100	0.000545	0.000545	0.000545
	p_{95}	0.000874	0.00120	0.0100	0.000874	0.000874	0.000874
Mg	p_{50}	10.9	13.0	45.0	10.9	10.9	10.9
	p_{95}	13.0	15.2	49.7	13.0	13.0	13.0
Mn	p_{50}	7.72E-05	1.96E-04	0.0	7.72E-05	7.72E-05	7.72E-05
	p_{95}	0.000196	0.000315	0.0100	0.000196	0.000196	0.000196
Mo	p_{50}	5.53E-04	8.95E-04	0.0	5.53E-04	5.53E-04	5.53E-04
	p_{95}	0.000895	0.00124	0.0	0.000895	0.000895	0.000895
Na	p_{50}	0.226	0.248	1.61	0.226	0.226	0.226
	p_{95}	0.248	0.271	1.74	0.248	0.248	0.248
NH4	p_{50}	0.0139	0.0263	0.0	0.0139	0.0139	0.0139
	p_{95}	0.0263	0.0388	0.0	0.0263	0.0263	0.0263
Ni	p_{50}	1.32E-04	2.37E-04	0.0	1.32E-04	1.32E-04	1.32E-04
	p_{95}	2.37E-04	3.42E-04	0.0	2.37E-04	2.37E-04	2.37E-04
NO2	p_{50}	0.00483	0.00500	0.0	0.00483	0.00483	0.00483
	p_{95}	0.00500	0.00517	0.0100	0.00500	0.00500	0.00500

Species	Exceedance Level	Natural Ground Runoff	Waste Rock Dump Runoff	Flow in Harmer Creek	Groundwater Flux into North Pit	Groundwater Flux into South Pit	Groundwater Flux into East Pit
NO3	p_{50}	0.0488	0.0999	0.920	0.0488	0.0488	0.0488
	p_{95}	0.0999	0.151	1.25	0.0999	0.0999	0.0999
P	p_{50}	0.000962	0.0	0.0100	0.000962	0.000962	0.000962
	p_{95}	0.0	0.0	0.0100	0.0	0.0	0.0
Pb	p_{50}	1.29E-05	2.86E-05	0.0	1.29E-05	1.29E-05	1.29E-05
	p_{95}	2.86E-05	4.43E-05	0.0	2.86E-05	2.86E-05	2.86E-05
S	p_{50}	6.53	10.0	69.1	6.53	6.53	6.53
	p_{95}	10.0	13.5	79.9	10.0	10.0	10.0
Sb	p_{50}	2.32E-05	3.09E-05	0.0	2.32E-05	2.32E-05	2.32E-05
	p_{95}	3.09E-05	3.86E-05	0.0	3.09E-05	3.09E-05	3.09E-05
Se	p_{50}	0.000853	0.00151	0.0400	0.000853	0.000853	0.000853
	p_{95}	0.00151	0.00218	0.0500	0.00151	0.00151	0.00151
Si	p_{50}	1.61	2.04	2.02	1.61	1.61	1.61
	p_{95}	2.04	2.47	2.21	2.04	2.04	2.04
Sn	p_{50}	2.05E-04	2.00E-04	0.0	2.05E-04	2.05E-04	2.05E-04
	p_{95}	2.00E-04	1.95E-04	0.0	2.00E-04	2.00E-04	2.00E-04
SO4	p_{50}	16.5	28.7	184	16.5	16.5	16.5
	p_{95}	28.7	40.8	232	28.7	28.7	28.7
Sr	p_{50}	0.0313	0.0384	0.120	0.0313	0.0313	0.0313
	p_{95}	0.0384	0.0454	0.140	0.0384	0.0384	0.0384
Ti	p_{50}	0.000496	0.000500	0.0100	0.000496	0.000496	0.000496
	p_{95}	0.000500	0.000504	0.0100	0.000500	0.000500	0.000500
Tl	p_{50}	2.75E-06	3.18E-06	0.0	2.75E-06	2.75E-06	2.75E-06
	p_{95}	3.18E-06	3.61E-06	0.0	3.18E-06	3.18E-06	3.18E-06
U	p_{50}	5.43E-04	7.64E-04	0.0	5.43E-04	5.43E-04	5.43E-04
	p_{95}	7.64E-04	9.84E-04	0.0	7.64E-04	7.64E-04	7.64E-04
V	p_{50}	2.12E-04	2.67E-04	0.0	2.12E-04	2.12E-04	2.12E-04
	p_{95}	2.67E-04	3.22E-04	0.0	2.67E-04	2.67E-04	2.67E-04
Zn	p_{50}	0.000661	0.00213	0.0	0.000661	0.000661	0.000661
	p_{95}	0.00213	0.00360	0.0	0.00213	0.00213	0.00213
Zr	p_{50}	9.92E-05	1.00E-04	0.0	9.92E-05	9.92E-05	9.92E-05
	p_{95}	1.00E-04	1.01E-04	0.0	1.00E-04	1.00E-04	1.00E-04

3.6 Integration with Elk Valley Water Quality Prediction Model

The Elk Valley Regional Water Quality Model (RWQM) was provided by the Ministry of the Environment (MOE) as per the Data Use Agreement (Appendix D).

There are three watercourses that will have cumulative effects from multiple mines in the Elk Valley:

- Harmer Creek (Harmer Creek flows into Grave Creek to the North of the Project downstream of the Grave Creek Reservoir, and is also impacted by Teck Coal's Elkview Operations).
- Michel Creek (West Alexander Creek to the south of the Project flows into Michel Creek, is also impacted by Teck Coal's Coal Mountain Operations).
- Elk River (Elk River receives runoff from all five current and past producing Teck Coal Operations, and several proposed coal projects).

The following three Ministry Order Stations are located downstream of the Project in the Elk River:

- EV_ER1: confluence of Elk River and Michel Creek, near Sparwood
- RG_ELKORES: Elk River at Elko Reservoir;
- RG_DSELK: Koocanusa River south of the Elk River.

The RWQM predictions for the above Ministry Order Stations include the following

- 1 in 10 year dry, average, and 1 in 10 year wet weekly flow rates (reported as monthly flow rates in model output)
- Monthly selenium, nitrate (as N), sulphate and hardness concentrations for the low flow, average flow and high flow conditions

To evaluate cumulative effects from the Project, the average flow rates and concentrations provided by the RWQM at Order Station EV_ER1 were used as model inputs. These flows (volume/time) and concentrations (mass/volume) were converted into loading rates (mass/time). Due to differences in the development of hydrological inputs between the RWQM and Crown Mountain water quality prediction model, it was concluded that average flow conditions would be most suitable for integration of the two models.

To determine the contribution from the undeveloped Crown Mountain site to the RWQM results at EV_ER1, the calculated 50th and 95th percentile from observed Harmer Creek was compared to the baseline loading and flow contributions from Crown Mountain. This helped determine what fraction of the total loadings at Grave Creek originated from the undeveloped Crown Mountain.

Once the above baseline calculations were completed, the loading contributions from the developed Crown Mountain site to EV_ER1 were evaluated. In order to prevent double-counting of loadings originating from Crown Mountain at EV_ER1, the calculated Crown Mountain baseline loadings (i.e. from the undeveloped site) were subtracted from the RWQM output results prior to adding the Crown Mountain loading predictions for the developed site back in. The difference in concentrations at EV_ER1 (reflecting current, undeveloped Crown Mountain) was compared with the predicted developed Crown Mountain site loadings added to the RWQM predictions to evaluate the impact of the developed Crown Mountain site at this Order Station.

The impact of the additional loading contributions from Crown Mountain at the RG_ELKORES and RG_DSELK Order Stations were evaluated by comparing the Crown Mountain water quality prediction model to the RWQM predictions. Water quality results and model comparisons for each of the three downstream stations are included in Appendix A.

3.7 Model QA/QC

The Crown Mountain water quality prediction model was reviewed. The review process included the following steps:

- Checking for modelling errors and inconsistencies.
- Checking that data sources are documented.
- Verifying loadings rates are correctly located and allocated to the right source and sink.
- Cross checking of loadings to ensure they have not been duplicated or missed.
- Verifying model functions and expressions to ensure they are working as intended.
- Using professional judgement and experience to evaluate if results reflect the understanding of the Project and model inputs.
- Documenting quality control procedures and results.

3.8 Limitations

The Crown Mountain Water and Load balance model is based on a series of expected and conservative assumptions developed to be representative of the water and chemical mass conditions observed at the current, undeveloped site or conditions expected during future development of the Project.

The water and load balance by necessity include the simplification of a number of complex natural phenomena, including but not limited to climate, runoff, snow melt, ice formation, infiltration, and seepage attenuation. The model uses physical models that are only representation of the processes, calibrated to observed baseline data where possible, but many of these processes do not exist in the current, undeveloped conditions and future behavior cannot be predicted with precision.

For climatic inputs, the model addresses the uncertainty of the physical process through the inclusion of stochastic inputs for precipitation, temperature, and solar radiation. The impact on the overall system is evaluated through multiple realizations in a Monte-Carlo approach. This approach is expected to explore the full range of climatic conditions expected to be experienced in the future but cannot predict the actual conditions that will be experienced in the next 30 years.

Water quality inputs to the model were developed from geochemistry modeling developed in a separate study (SRK 2020) and is based on a limited number of samples of a large mass of rock that will ultimately produce the impacted runoff and seepage flows. The model explores the possible range of water quality expected in the Project through the use of both average and upper case water quality inputs, but they are only estimations of the water quality that will be experienced by the Project.

A key component of the model is the integration of the Crown Mountain Water and Load Balance with the Elk Valley Regional Water Quality Model. The RWQM was developed separately from the Crown Mountain Water and Load Balance Model and uses different approximations of physical models, methodologies, and time scales. Integrating these two models was performed using average values to form the best alignment and thus will be unable to capture the extreme events that may be experienced in the future by either model.

The WRD layer design is based on conceptual models of the final WRD configuration incorporate the behavior predicted by other models of both hydraulic and geochemical behavior. The model explores the expected scenario where the layering configuration works as expected and limits the oxidation of the waste rock, as well as a failed condition where the layering approach fails to control oxidation. The limited real-world experience of this waste dump configuration means that the actual WRD performance cannot be known with a high degree of certainty.

Understanding that the model is only an estimation of the actual behavior that will occur in the future, the use of the model should be paired with the observational methodology, where observed behavior of physical processes and system behavior as the Project is being developed is compared with the modeling results to refine the model, physical processes, and inputs to improve the model performance as the Project is developed.

4 Results

4.1 Model Calibration

Because the Project is in the feasibility phase, there is no historic data for the mine site to use in model calibration. Instead baseline streamflow data from Grave Creek was used to calibrate the surface water model and can be reviewed in Section 3.2.10 and the Waste Rock Dump model was calibrated to HYDRUS 1D simulation results which can be reviewed in Section 3.3.6.

4.2 Model Results

The water quality predictions for the life-of-mine will be presented below as monthly average concentrations of:

- Selenium (Se)
- Nitrate (NO_3)
- Sulphate (SO_4)

Results for final discharge and receiving environment locations will be compared to the CMER and BC WQG FAL where applicable.

4.2.1 Low-Impact Mining Facilities

This section presents the results of the water balance components for low-impact facilities and unimpacted watersheds in the water quality prediction model. These Facilities only capture natural runoff from disturbed and none disturbed areas, natural stream flow, natural groundwater, and low-impact facility runoff, Table 28 identifies the specific low-impact facilities and unimpacted watersheds. The water balance and water quality model results will show the range of surface water volumes and flow rates along with critical discharge concentrations for Selenium (Se), Nitrate (NO_3) and Sulphate (SO_4) as times series for the full model duration. Variability in the presented results is based on the input distributions used in the stochastic climate module, is generally in-line with baseline results, as shown in Figure 25. Results for other Low-Impact Facilities and Unimpacted Watersheds are included as Appendix B.

Figure 25: Typical Low-Impact Mining Facility Water Quality Prediction (Reporting Node GC_7)

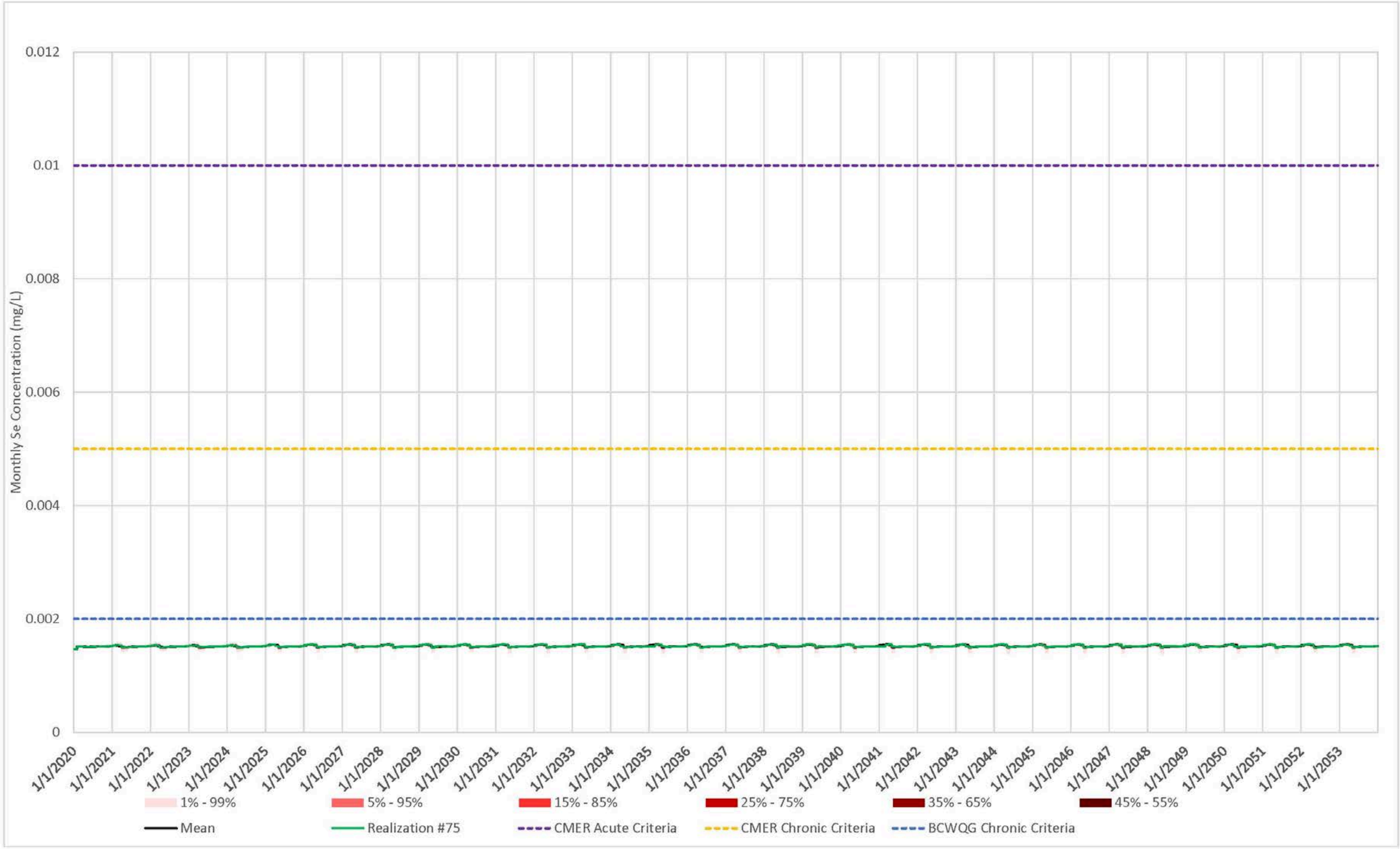


Table 28: Low Impact Facilities

Low-Impact Facilities	Unimpacted Watersheds
Clean Coal Transfer Area Grave Creek Reservoir Coal Handling and Preparation Plant Haul Road Runoff Rail Loadout	Upper Grave Creek Harmer Creek Upper Alexander Creek

4.2.2 Key Impacted Mining Facilities & Waterways

This section presents key results from the water and load balance model for impacted mining facilities and watersheds, primarily all locations downstream of the WRD and WRD Sedimentation Ponds. These Facilities were identified as key areas of interest because of their potential impact to downstream waterways. The results will show the range of flows, volumes and associated water quality that is produced by the WRD and subsequently captured by the Interim and Ultimate WRD Sedimentation Ponds that are active from Year 0 – Year 4 and Year 5 – Closure, respectively. Downstream flows and water quality from West Alexander Creek, Alexander Creek, and EV_ER1 Station at Sparwood are also included to assess the impact of the Waste Rock Dump on immediate downstream creeks and overall Project impact downstream.

Results presented below will be grouped by chemical species then modelled component, each of the modeled components in this section will then also include results for the following two scenarios:

- Average(P_{50}) Case – WRD Layering Succeeds
- Average (P_{50} Case – WRD Layering Fails

Results for Upper Case (P_{95}) Case scenarios for WRD layering succeeds and WRD layering fails are be included in Appendix C.

Modelled Flow Rates

Figure 26: **Lower Grave Creek (GC_1)**

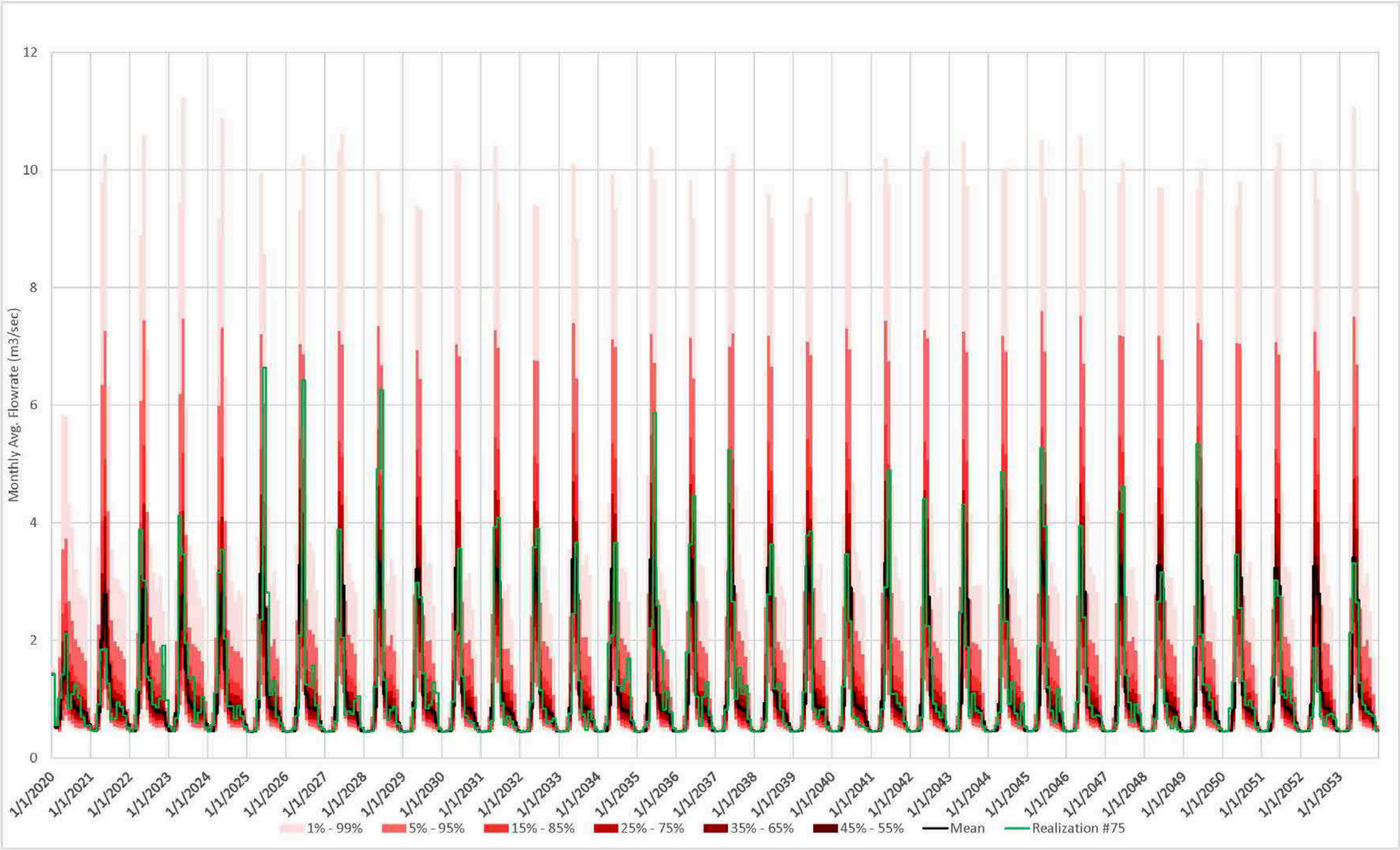


Figure 27: Interim & Ultimate WRD Sedimentation Pond Outflow

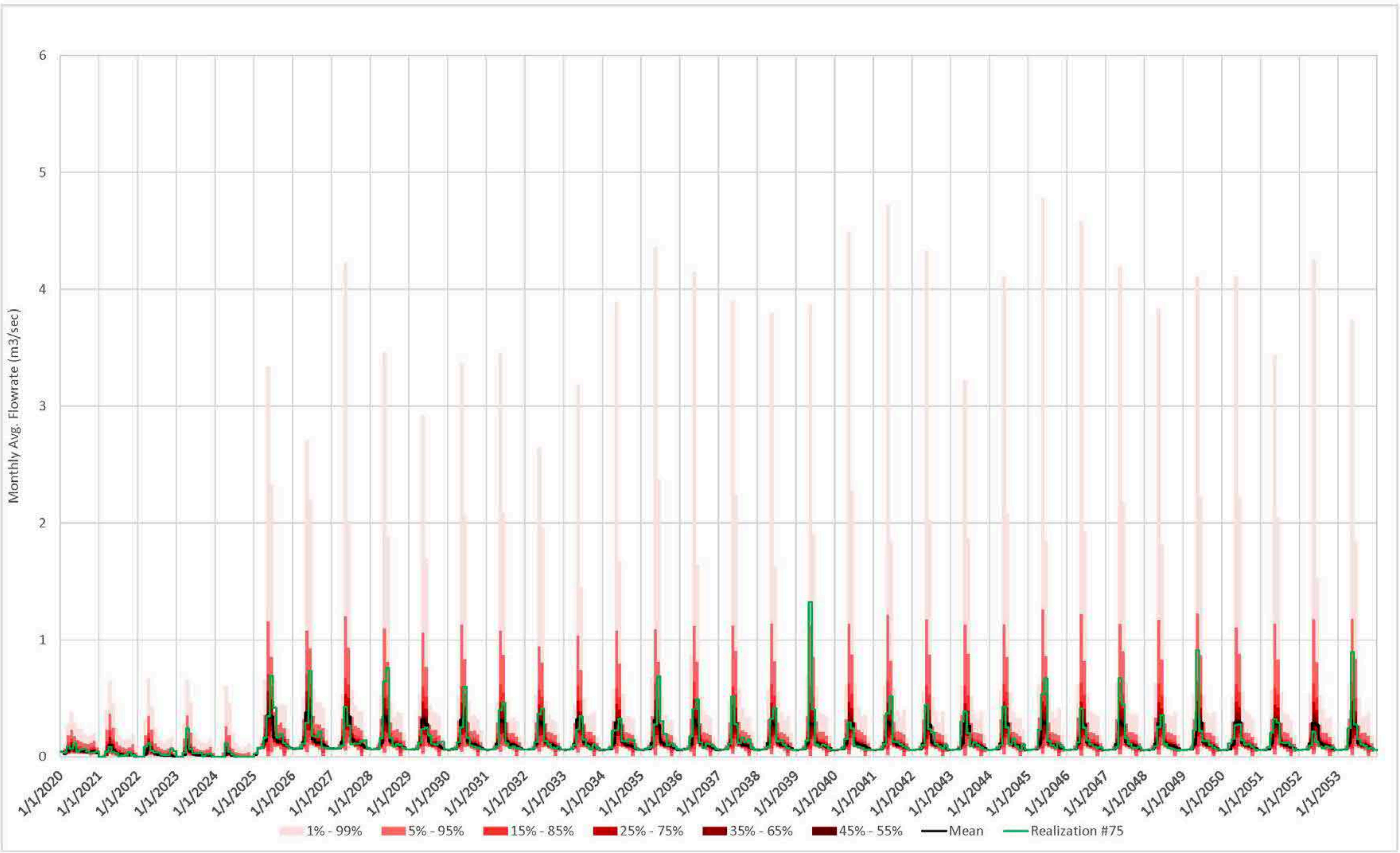


Figure 28: West Alexander and Upper Alexander Confluence (AC_3)

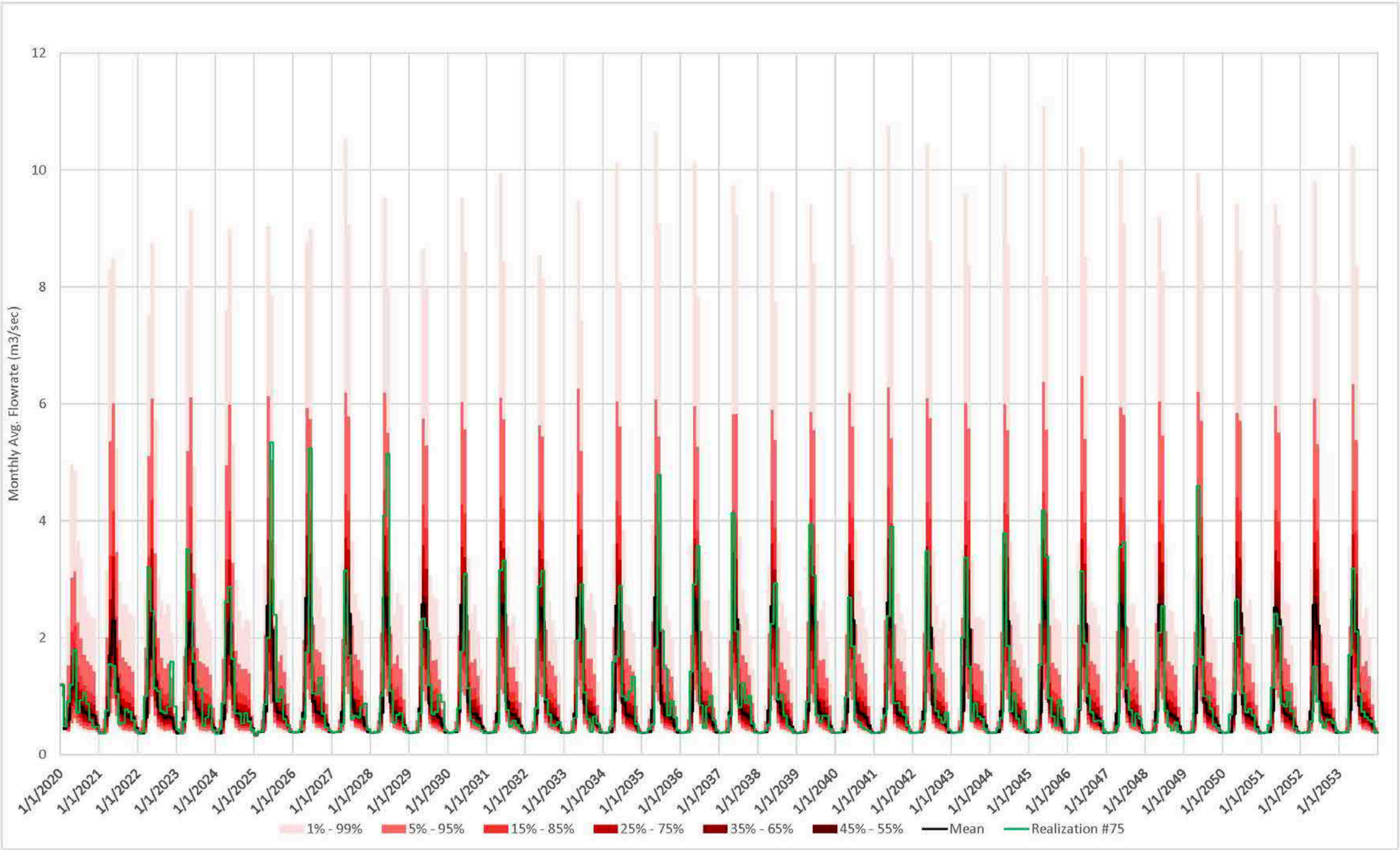


Figure 29: **Alexander Creek (AC_1)**

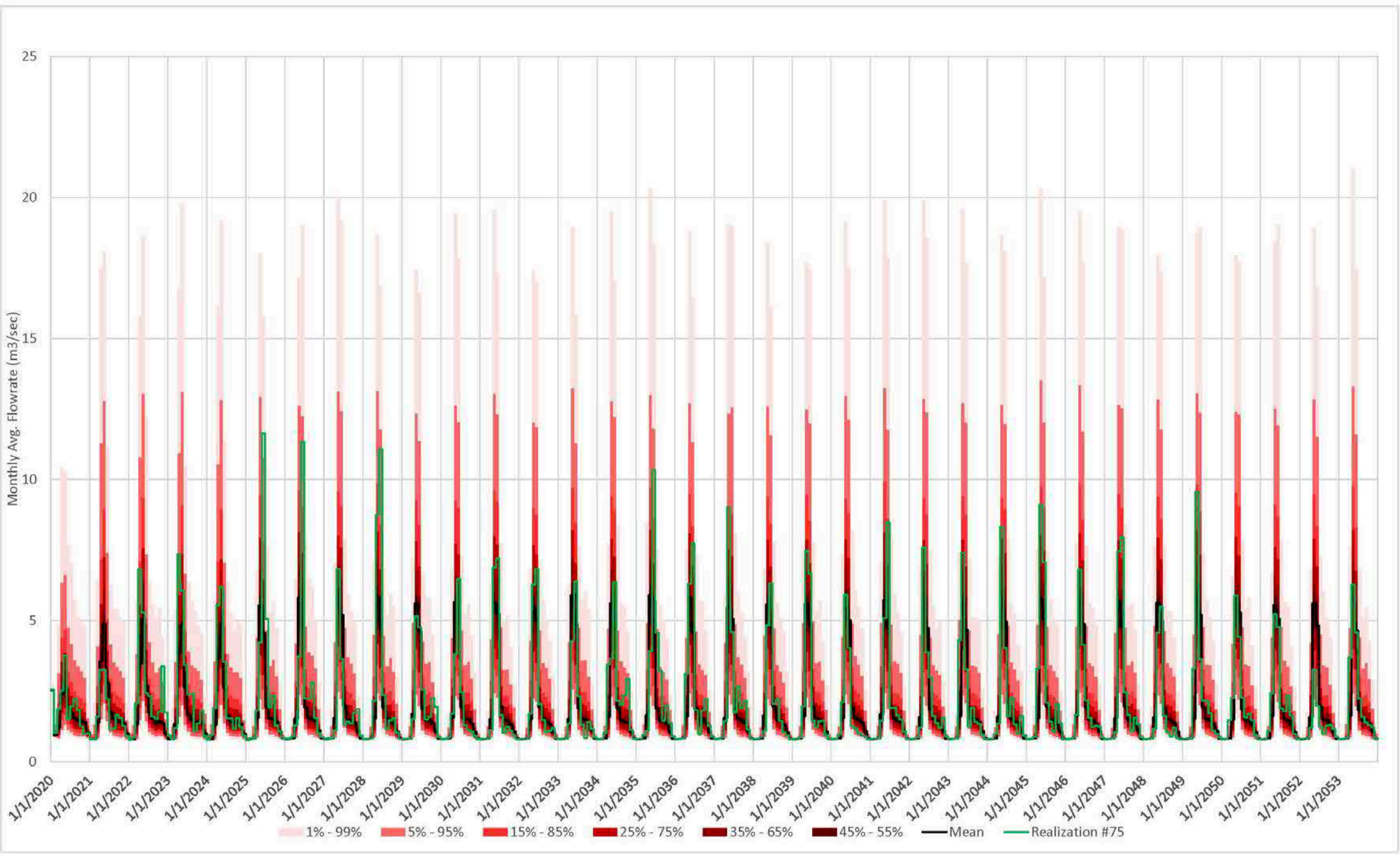
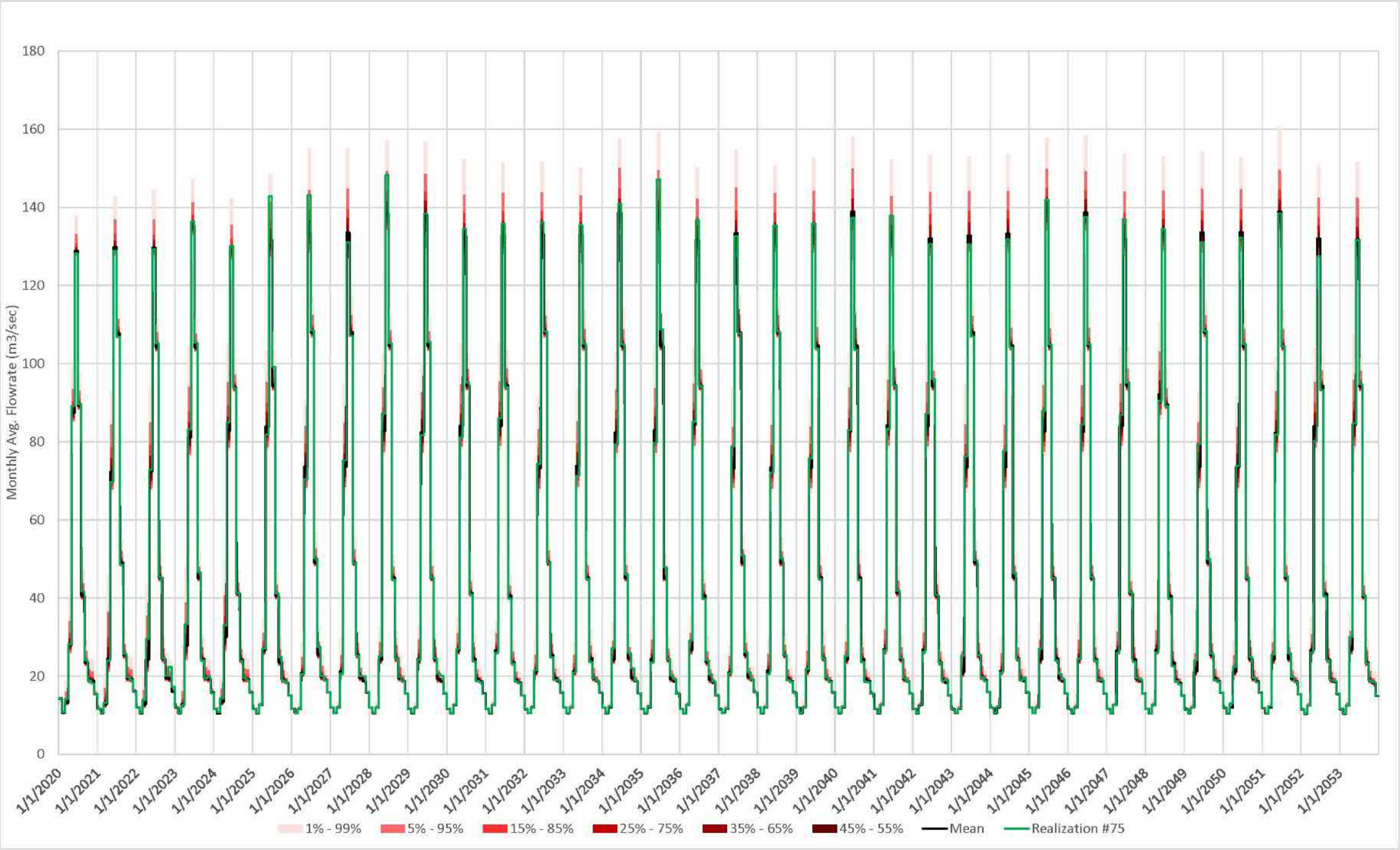


Figure 30: EV_ER1 Station Flow Rate



Modelled Selenium (SE) Concentrations

Lower Grave Creek (GC-1)

Figure 31: Lower Grave Creek (GC-1) WQ Avg. Case, WRD Layering Succeeds

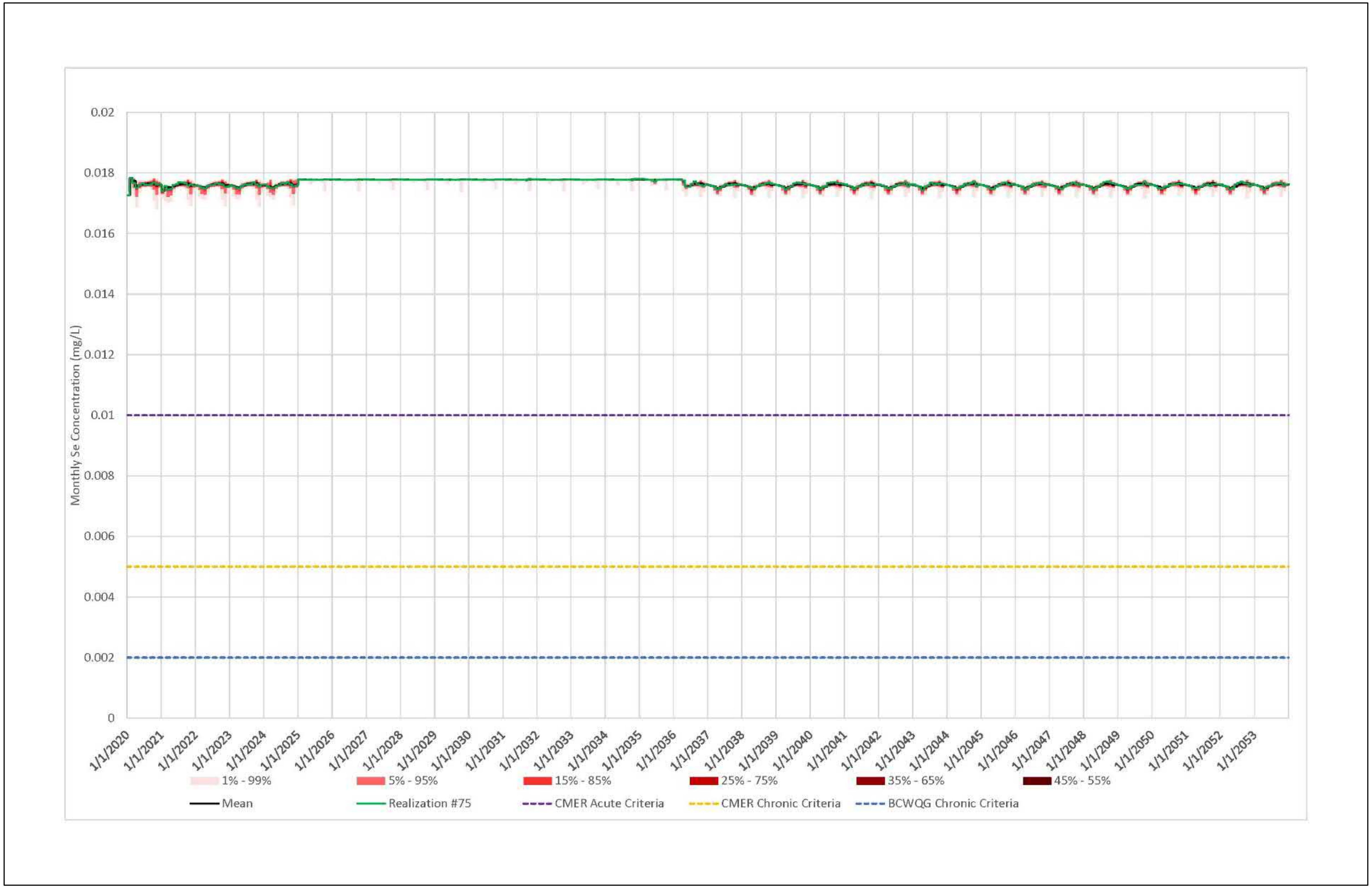
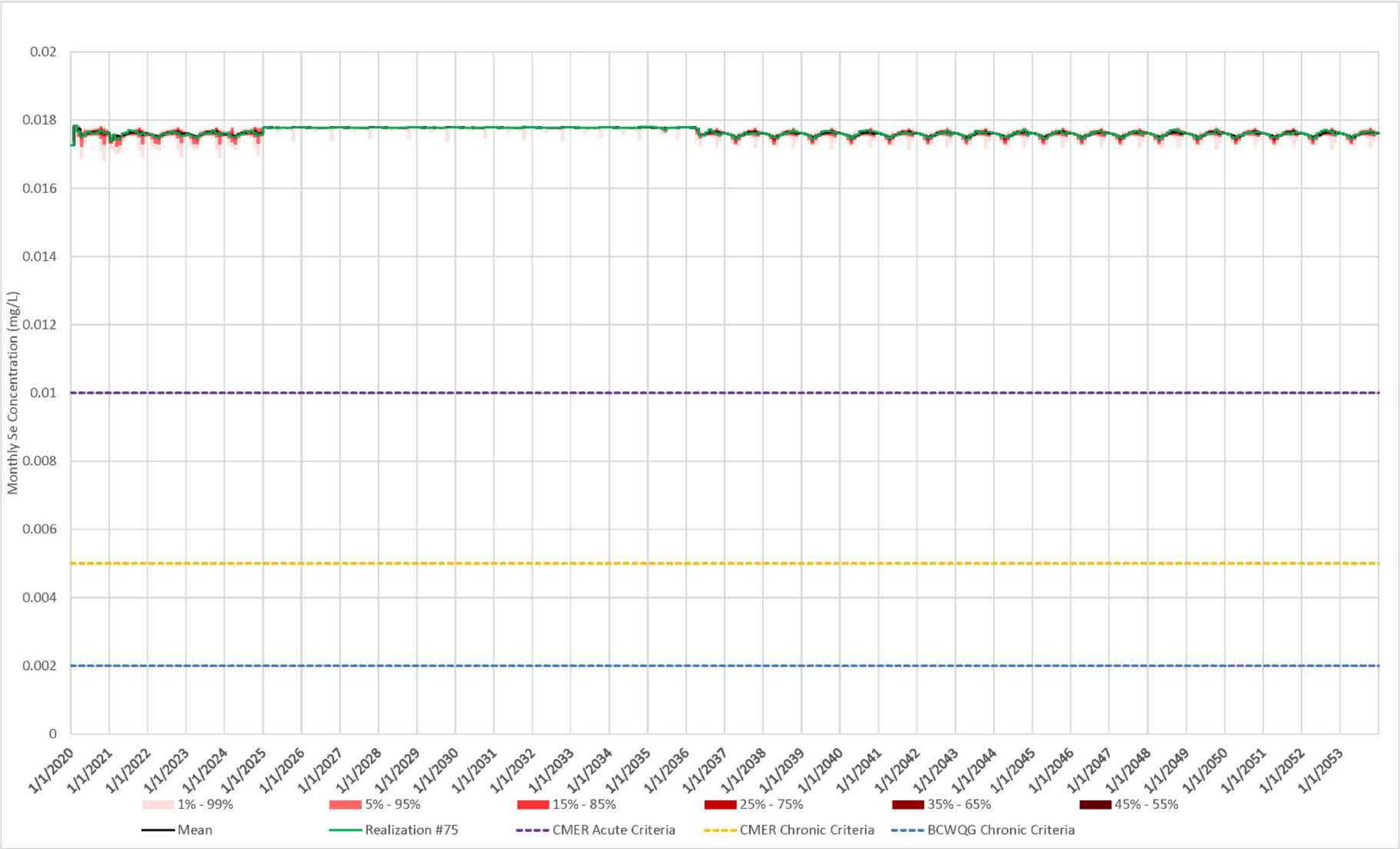


Figure 32: Lower Grave Creek (GC-1) WQ Avg. Case, WRD Layering Fails



Interim & Ultimate WRD Sedimentation Pond

Figure 33: Interim & Ultimate WRD Sedimentation Pond WQ Avg. Case, Layering Succeeds

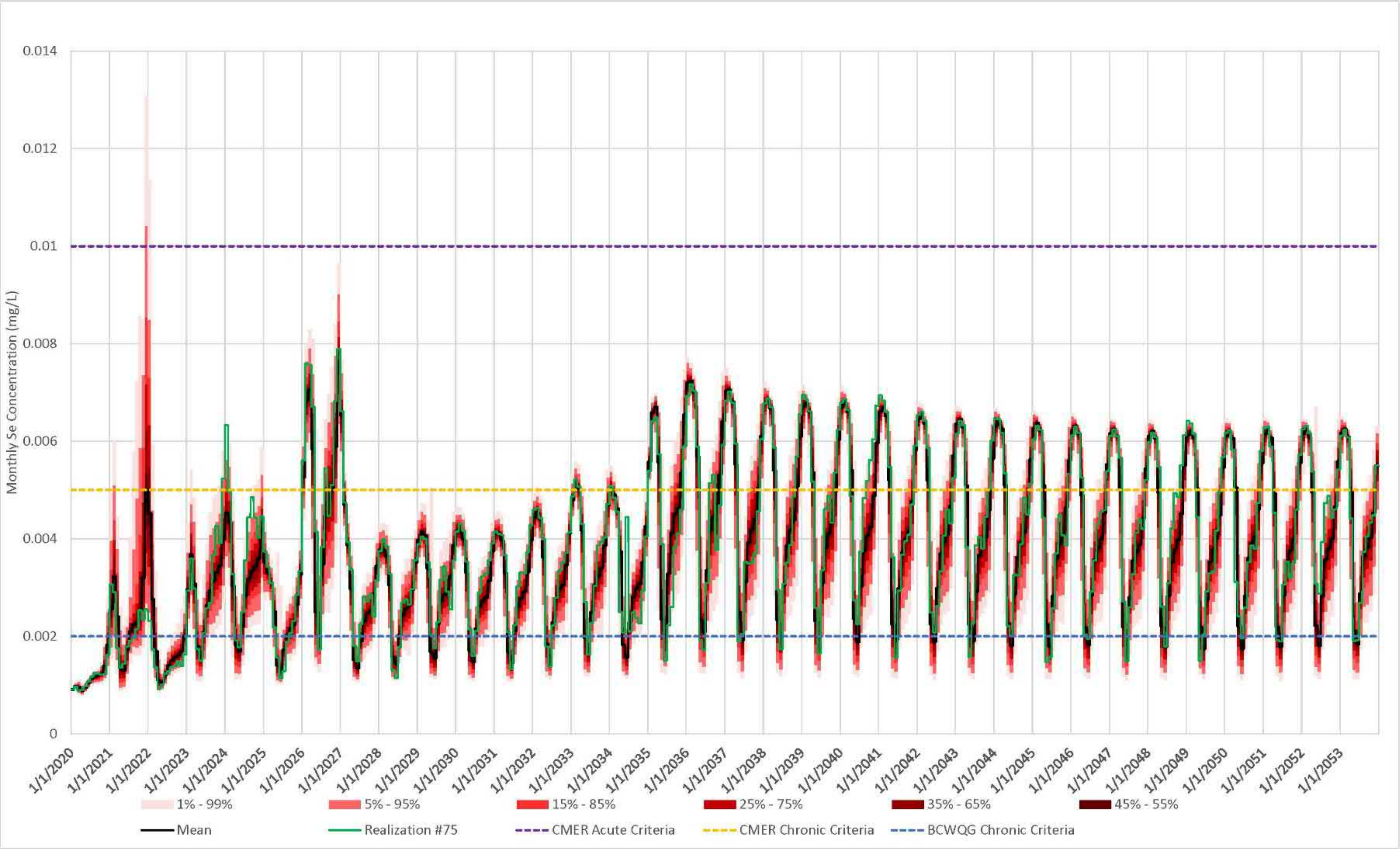
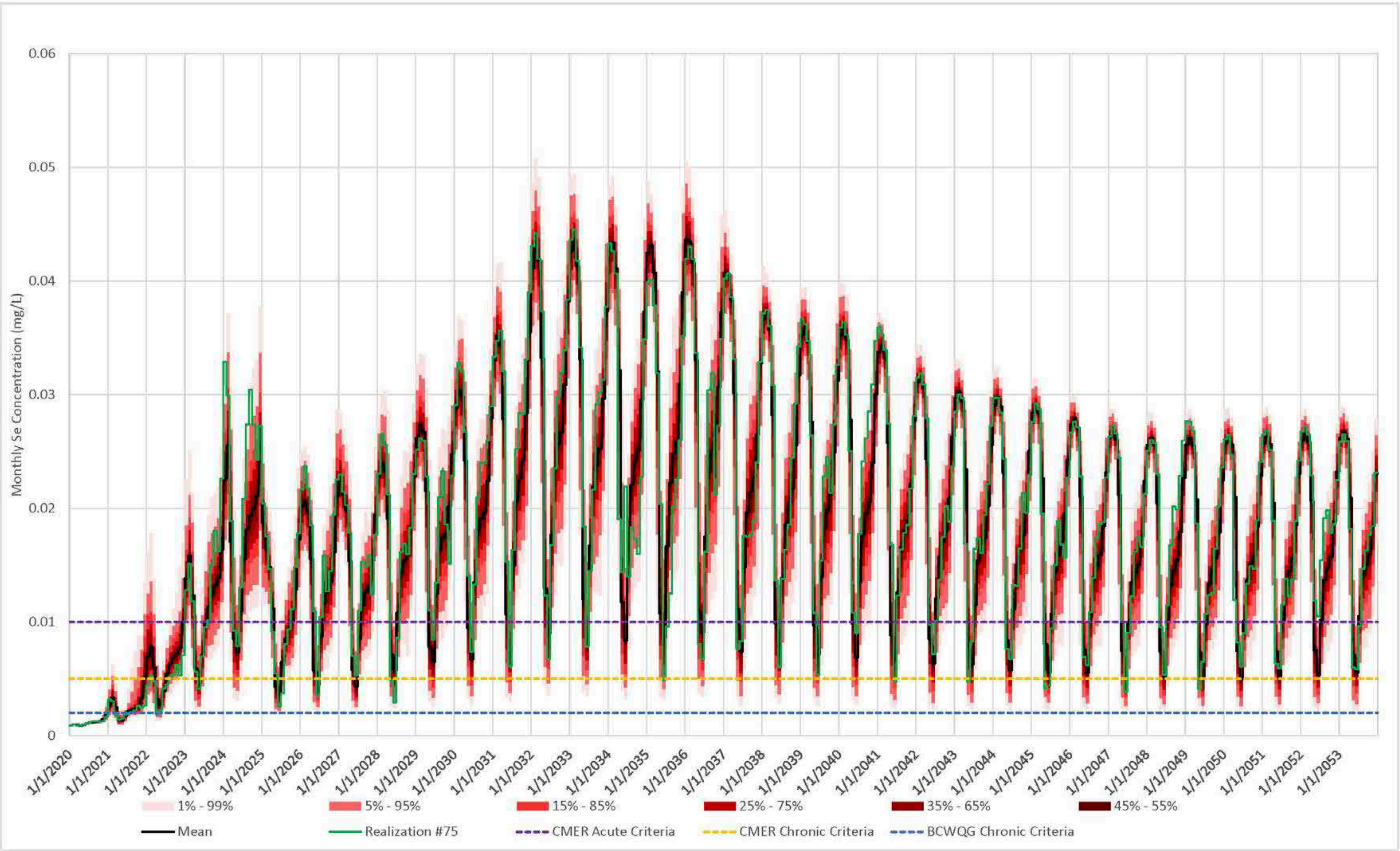


Figure 34: Interim & Ultimate WRD Sedimentation Pond WQ Avg. Case, Layering Fails



West Alexander Upper Alexander Confluence (AC_3)

Figure 35: West Alexander and Upper Alexander Creek (AC_3) WQ Avg. Case, Layering Succeeds

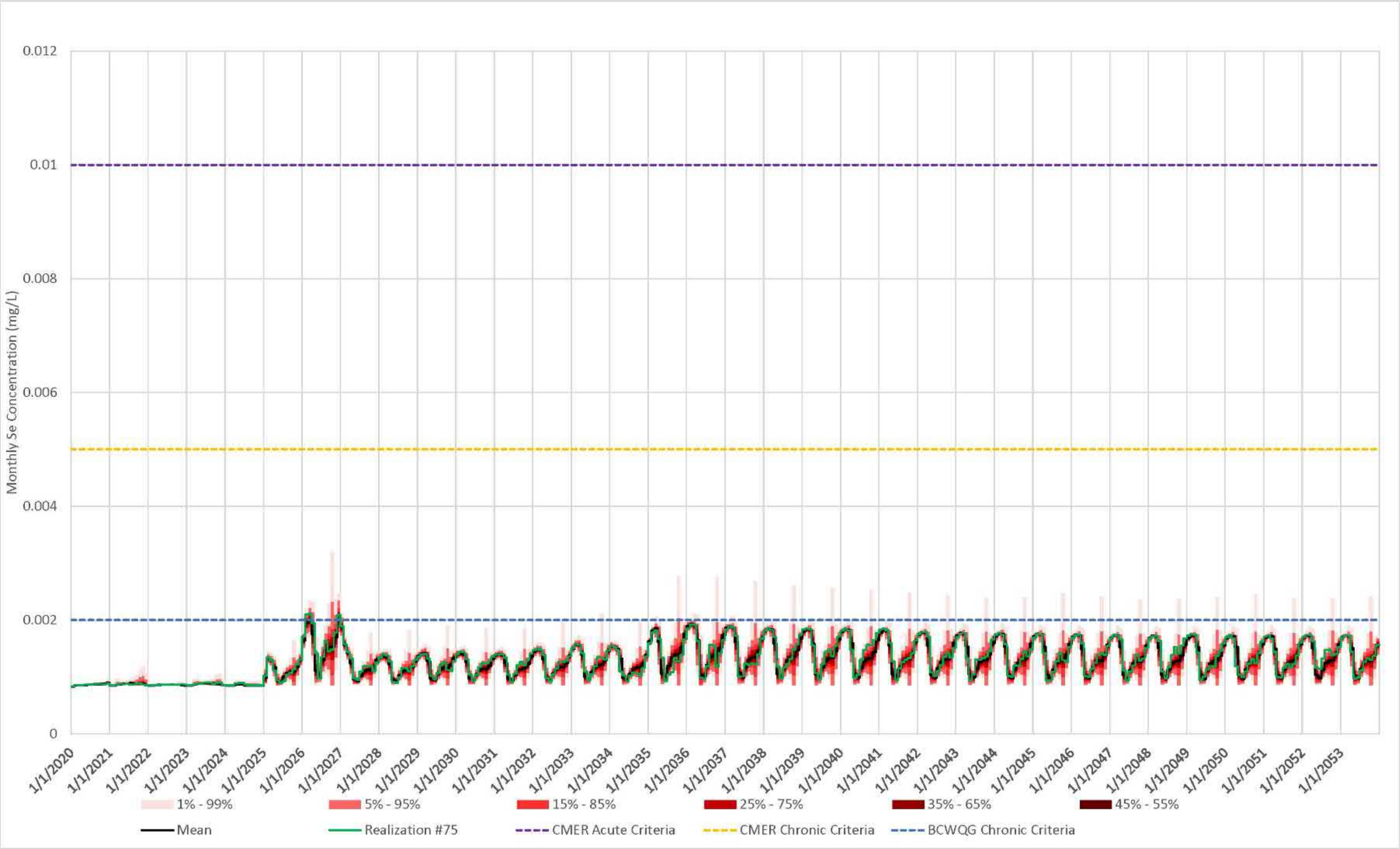
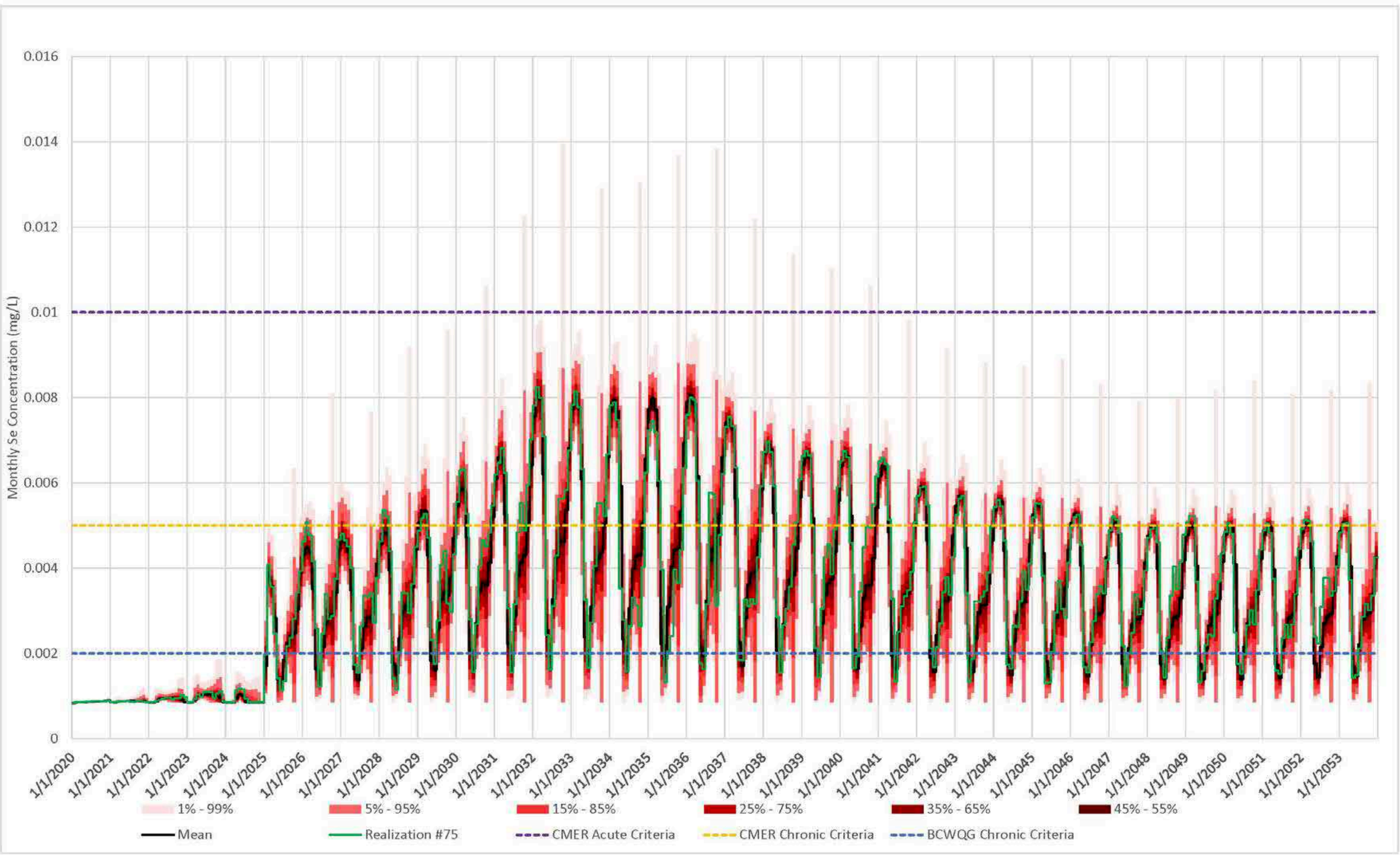


Figure 36: West Alexander and Upper Alexander Creek (AC_3) WQ Avg. Case, Layering Fails



Alexander Creek (AC_1)

Figure 37: Alexander Creek (AC_1) WQ Avg. Case, Layering Succeeds

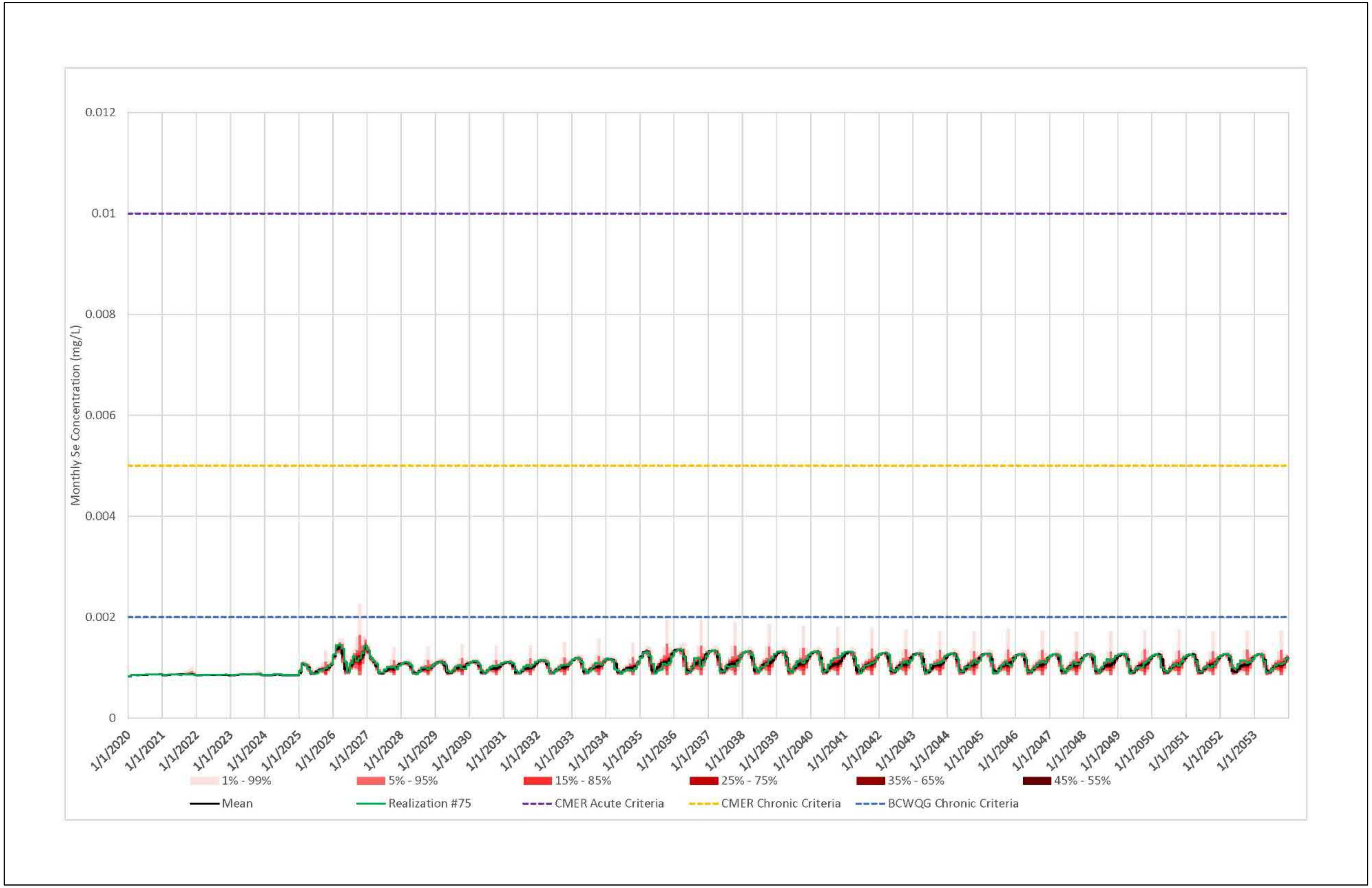
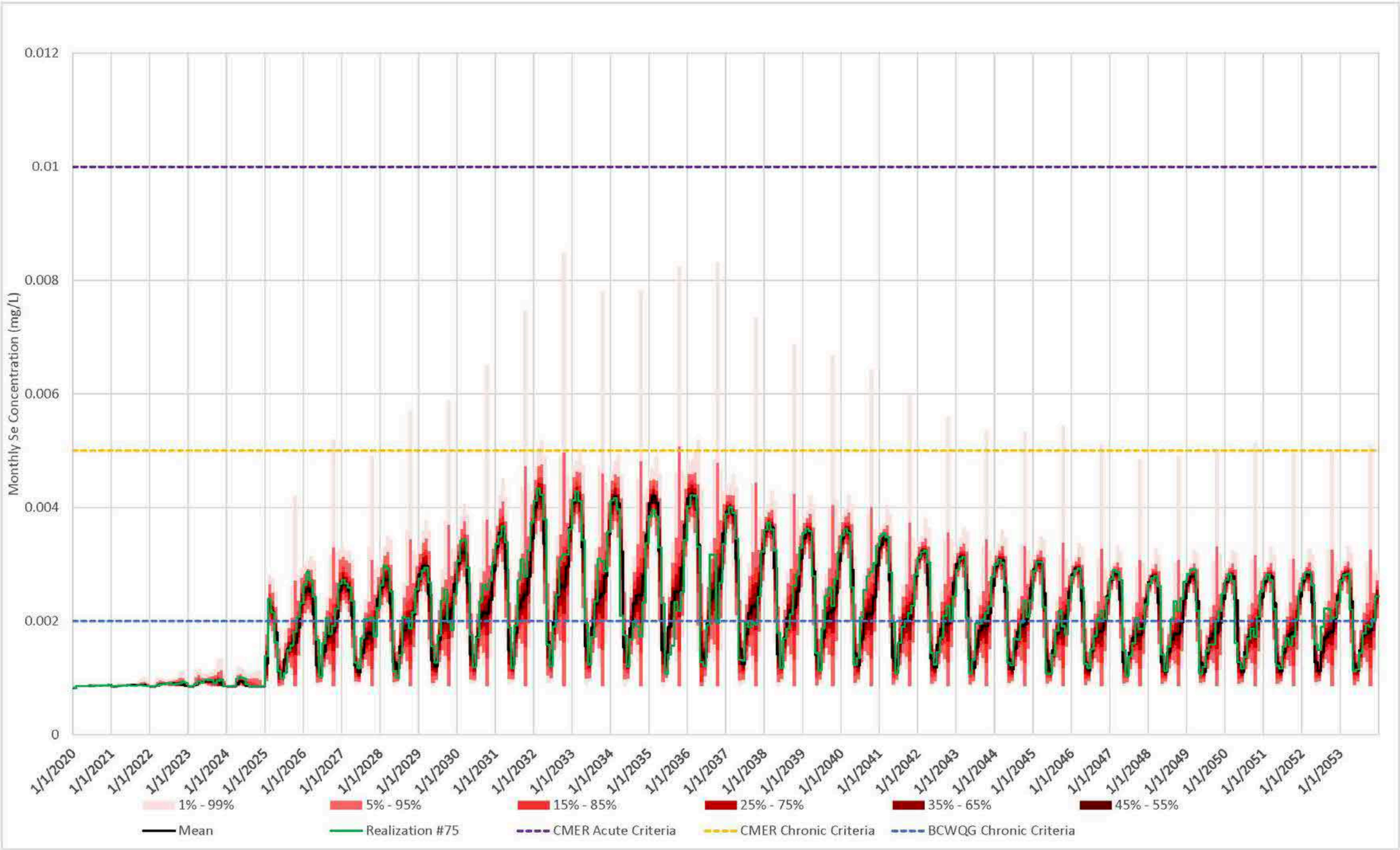


Figure 38: **Alexander Creek (AC_1) WQ Avg. Case, Layering Fails**



EV_ER1 Station

Figure 39: EV_ER1 WQ Avg. Case, Layering Succeeds

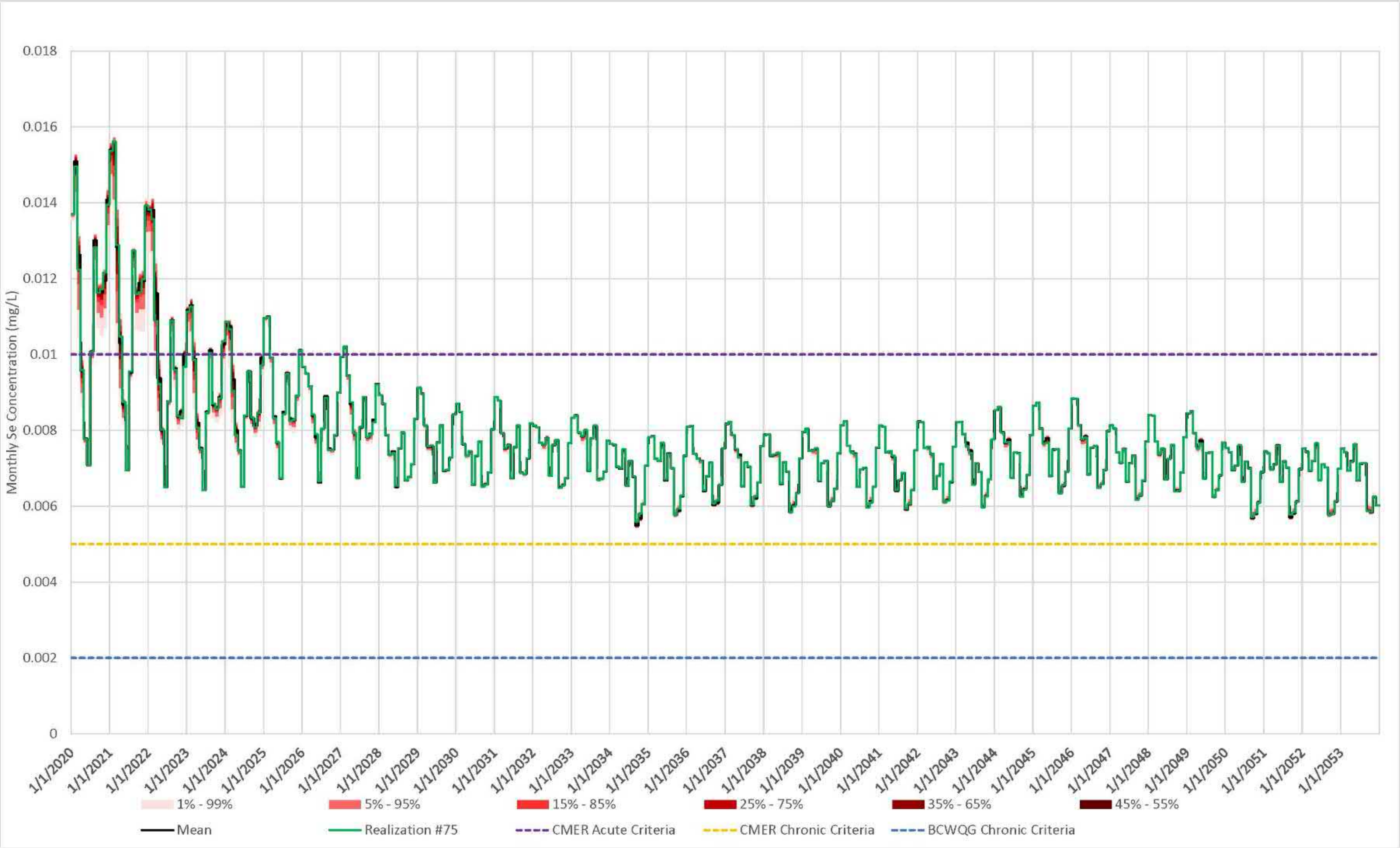
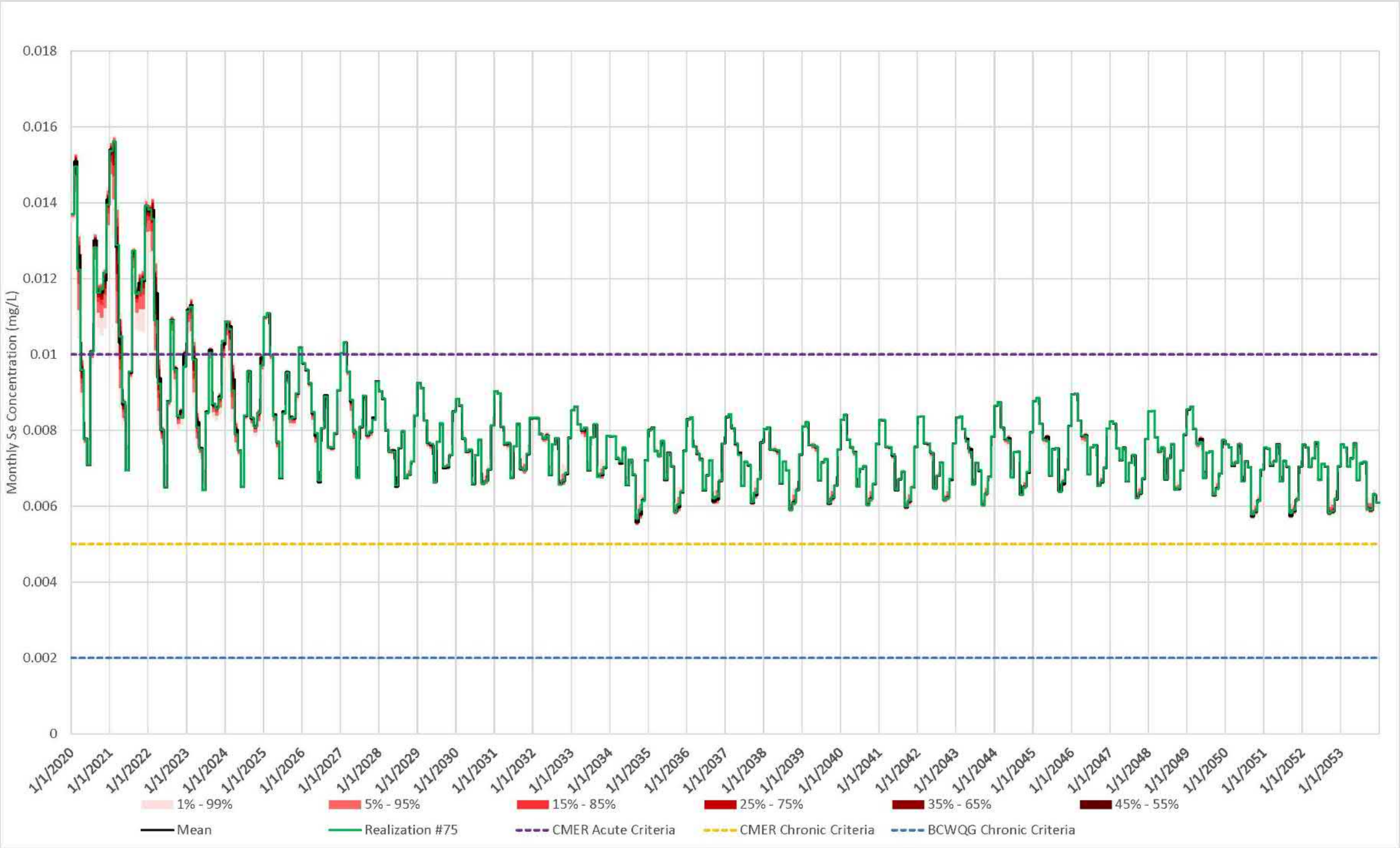


Figure 40: EV_ER1 WQ Avg. Case, Layering Fails



Modelled Nitrate (NO_3) Concentrations

Lower Grave Creek (GC-1)

Figure 41: **Lower Grave Creek (GC-1) WQ Avg. Case, WRD Layering Succeeds**

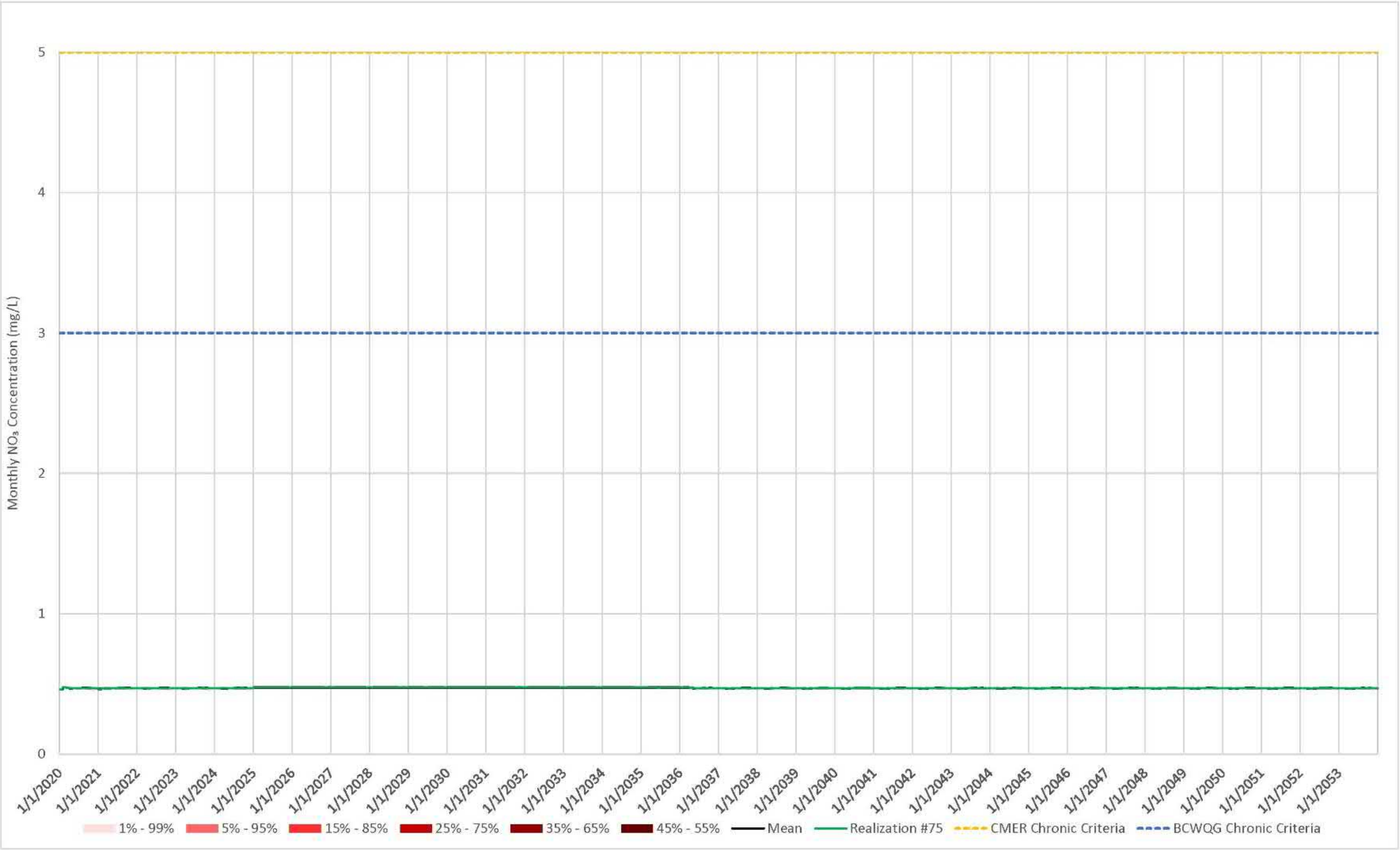
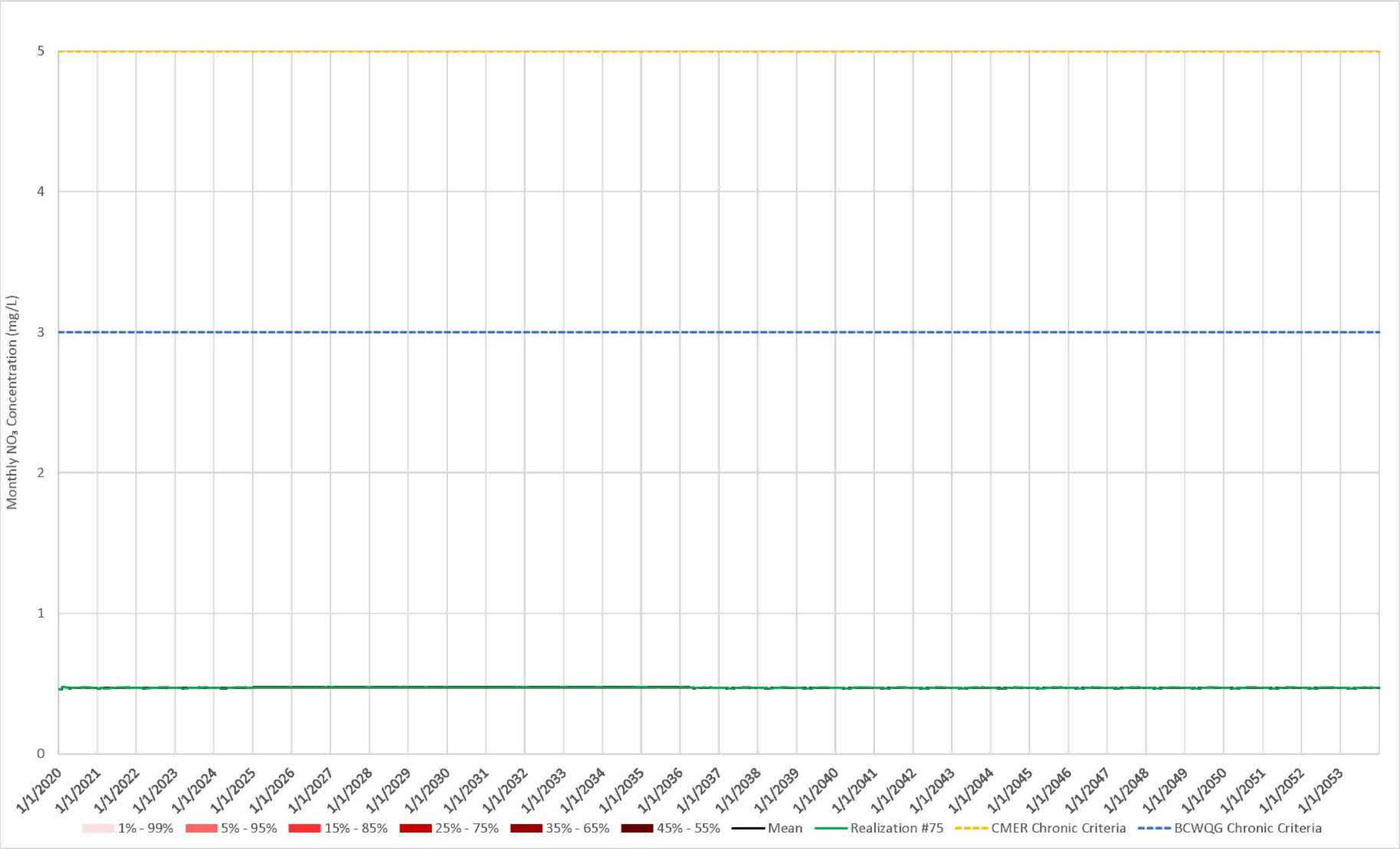


Figure 42: **Lower Grave Creek (GC-1) WQ Avg. Case, WRD Layering Fails**



Interim & Ultimate WRD Sedimentation Pond

Figure 43: **Interim & Ultimate WRD Sedimentation Pond WQ Avg. Case, Layering Succeeds**

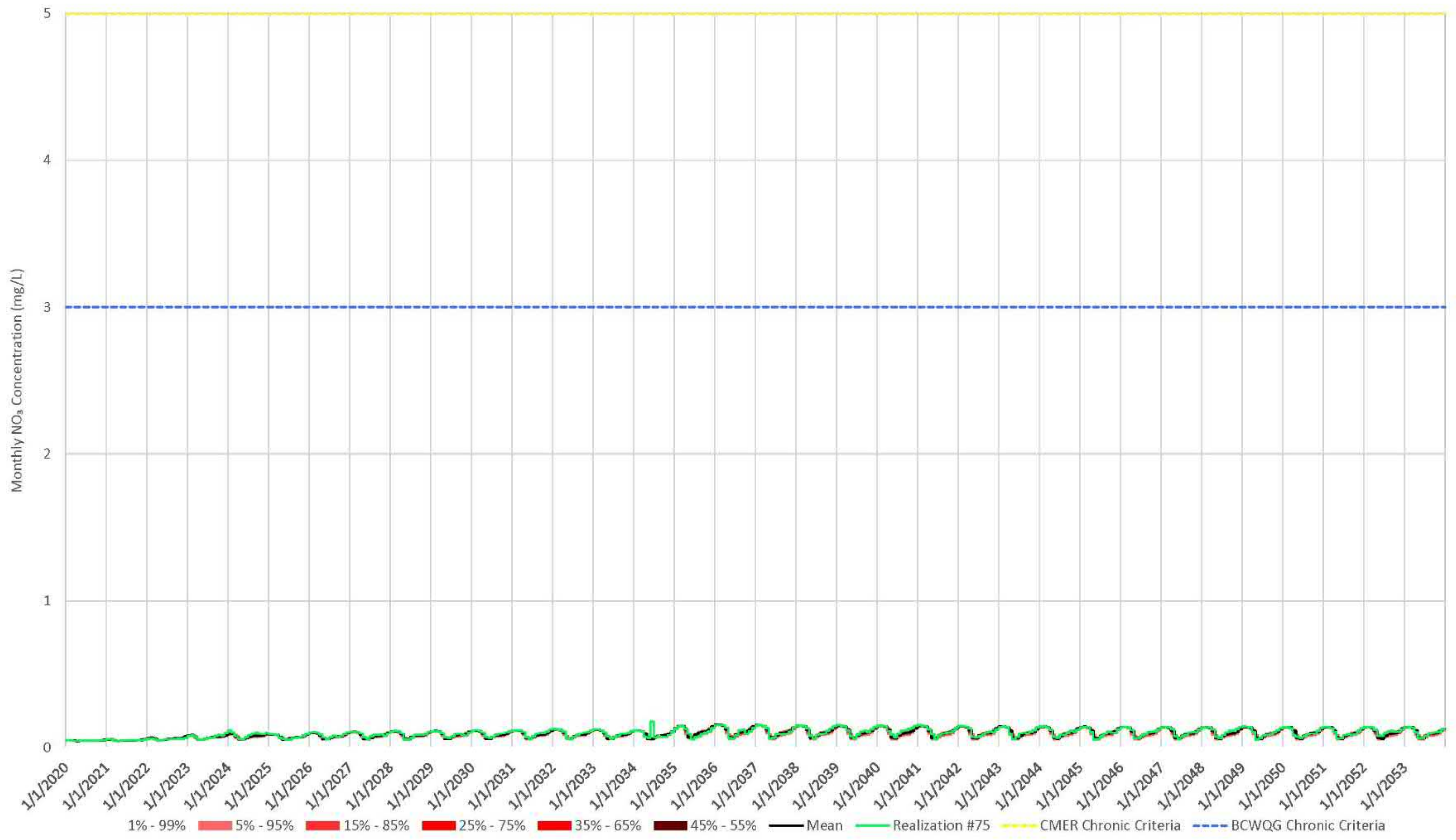
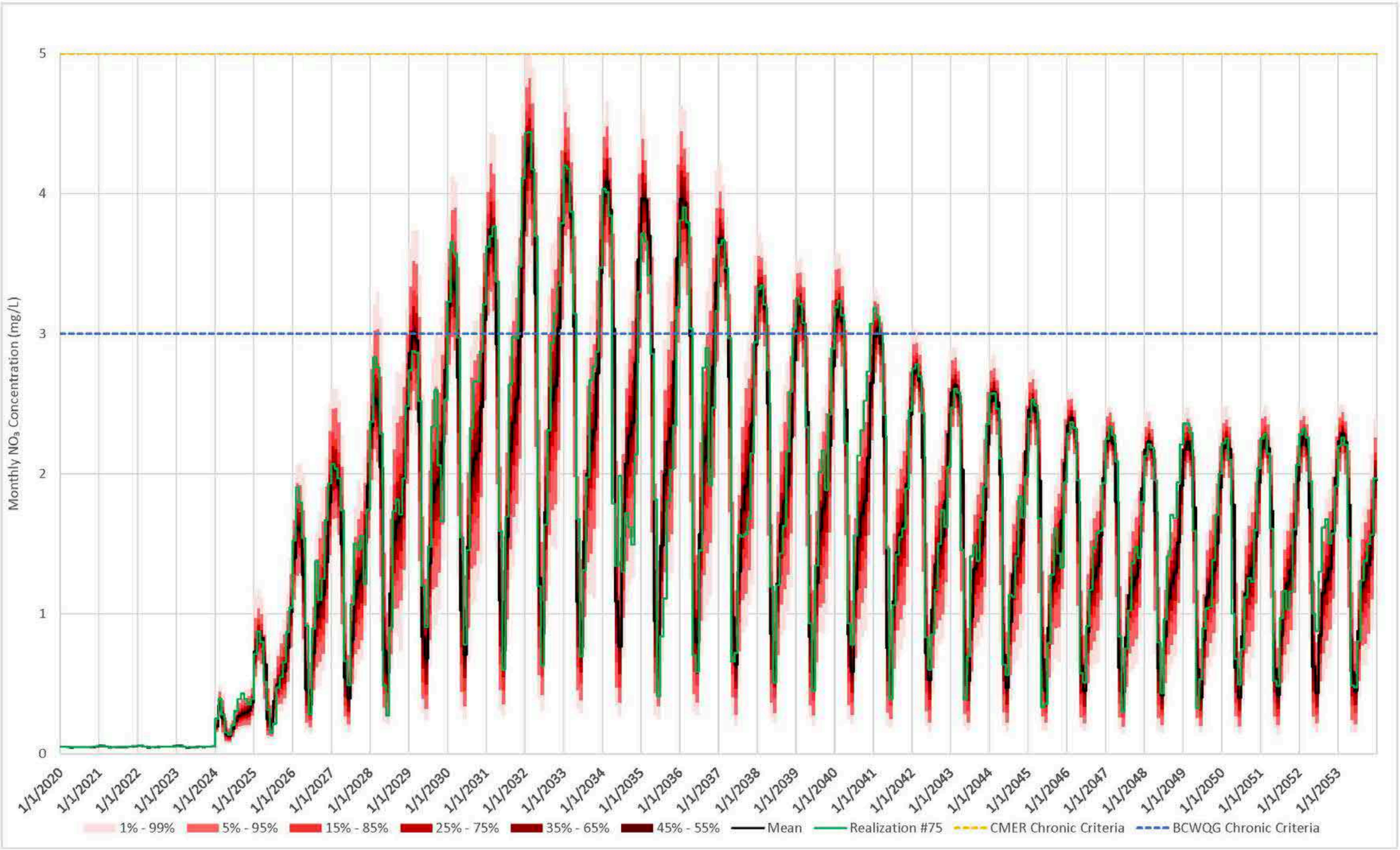


Figure 44: Interim & Ultimate WRD Sedimentation Pond WQ Avg. Case, Layering Fails



West Alexander and Upper Alexander Confluence (AC_3)

Figure 45: West Alexander and Upper Alexander Creek (AC_3) WQ Avg. Case, Layering Succeeds

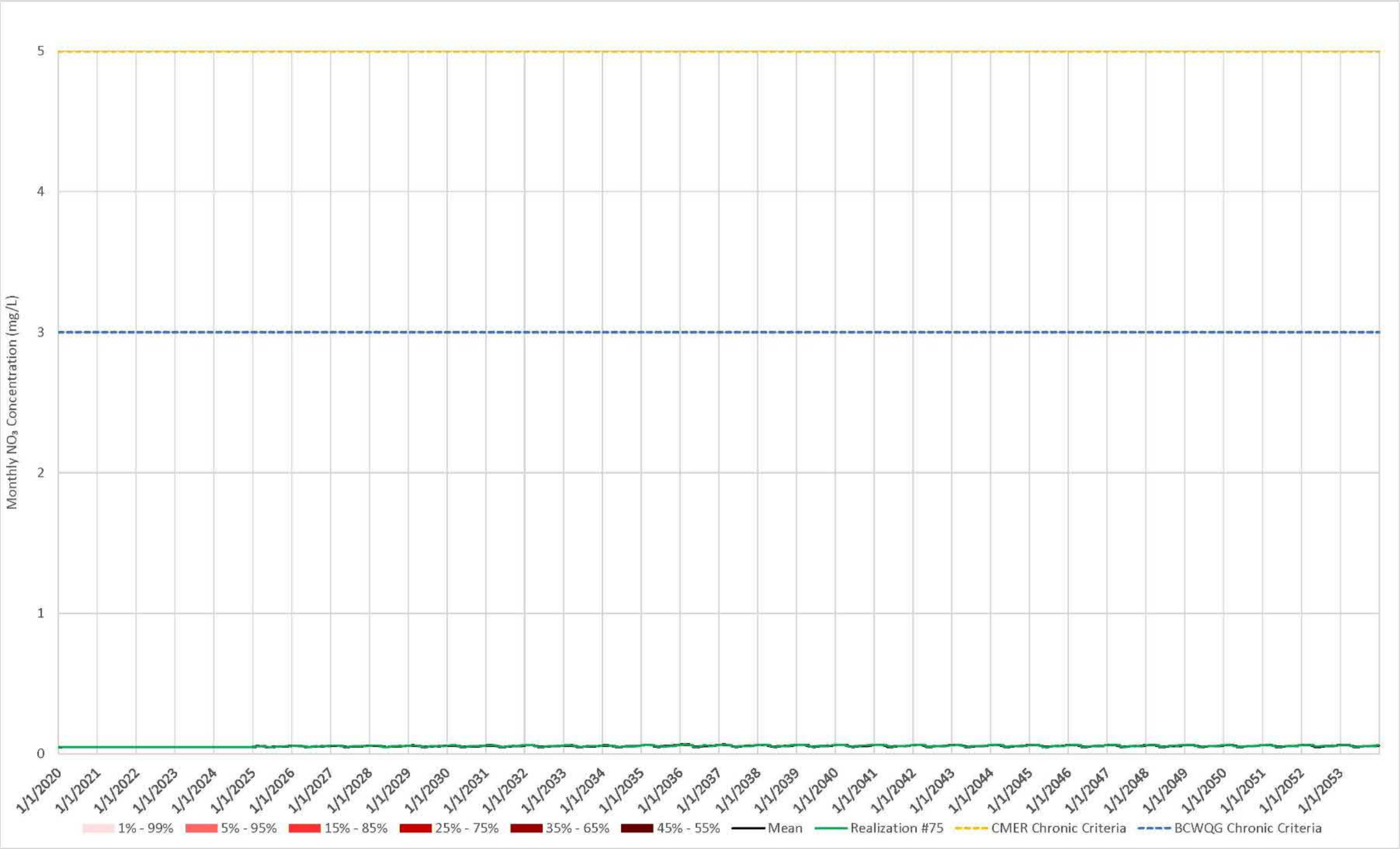
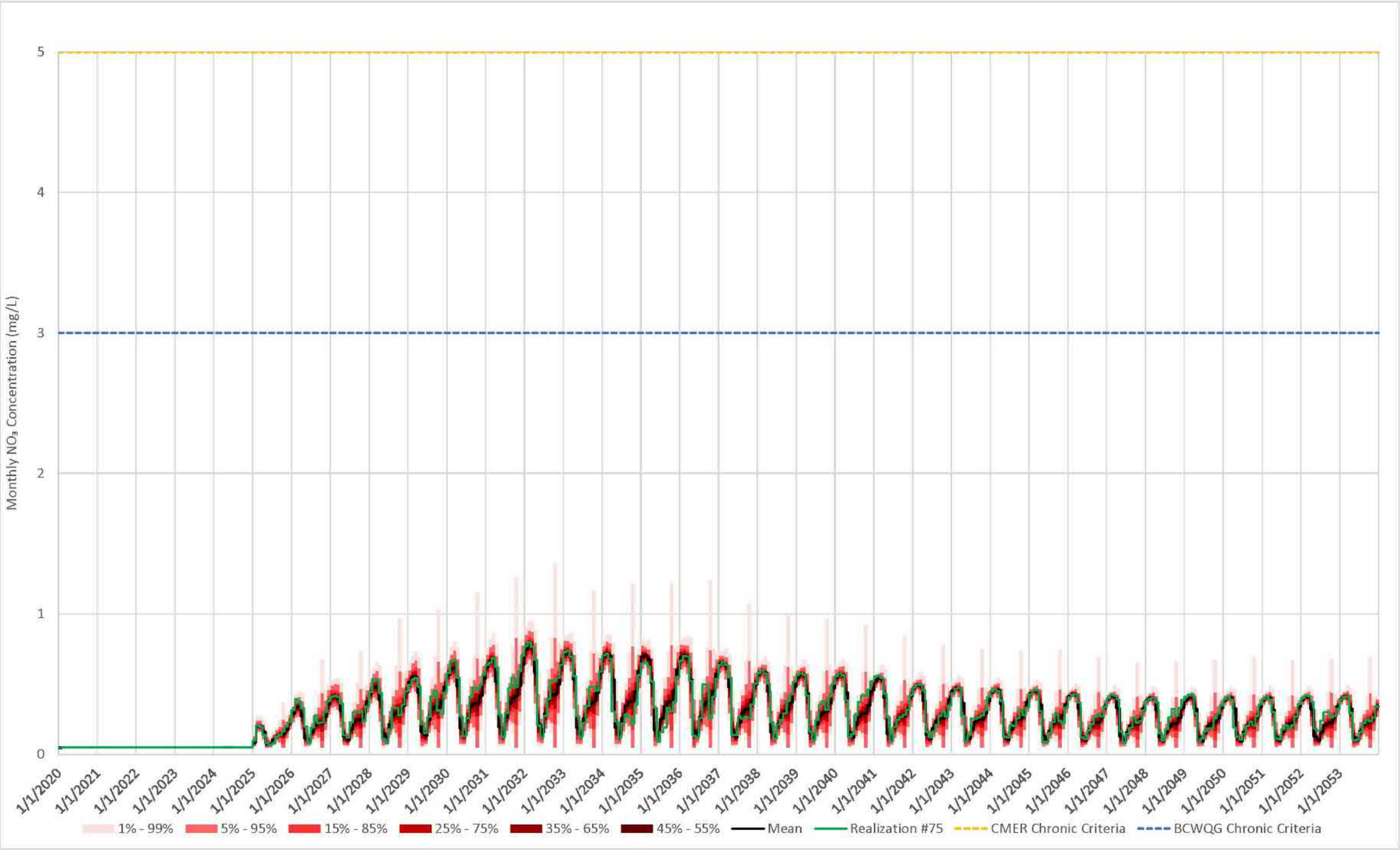


Figure 46: West Alexander and Upper Alexander Creek (AC_3) WQ Avg. Case, Layering Fails



Alexander Creek (AC_1)

Figure 47: Alexander Creek (AC_1) WQ Avg. Case, Layering Succeeds

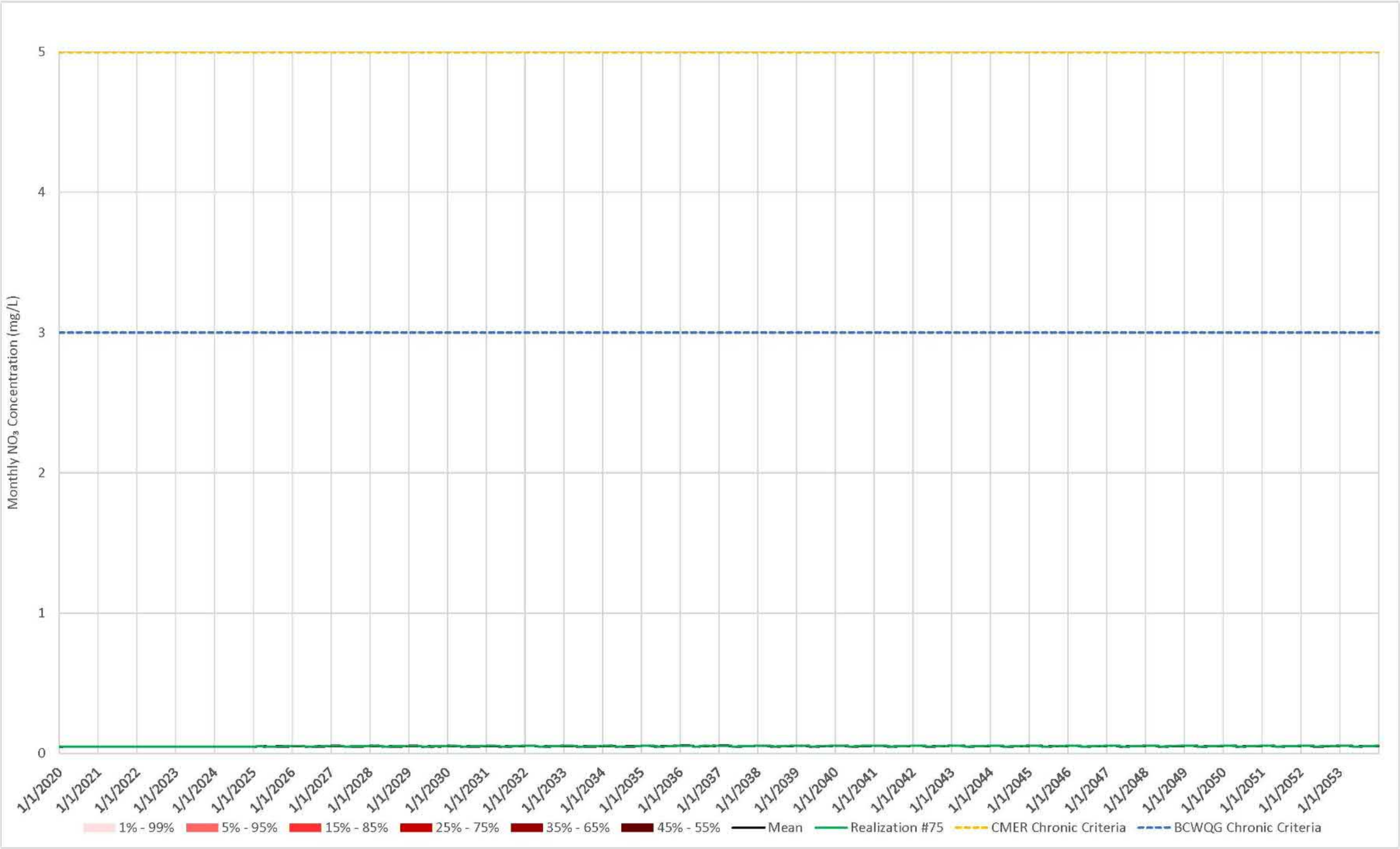
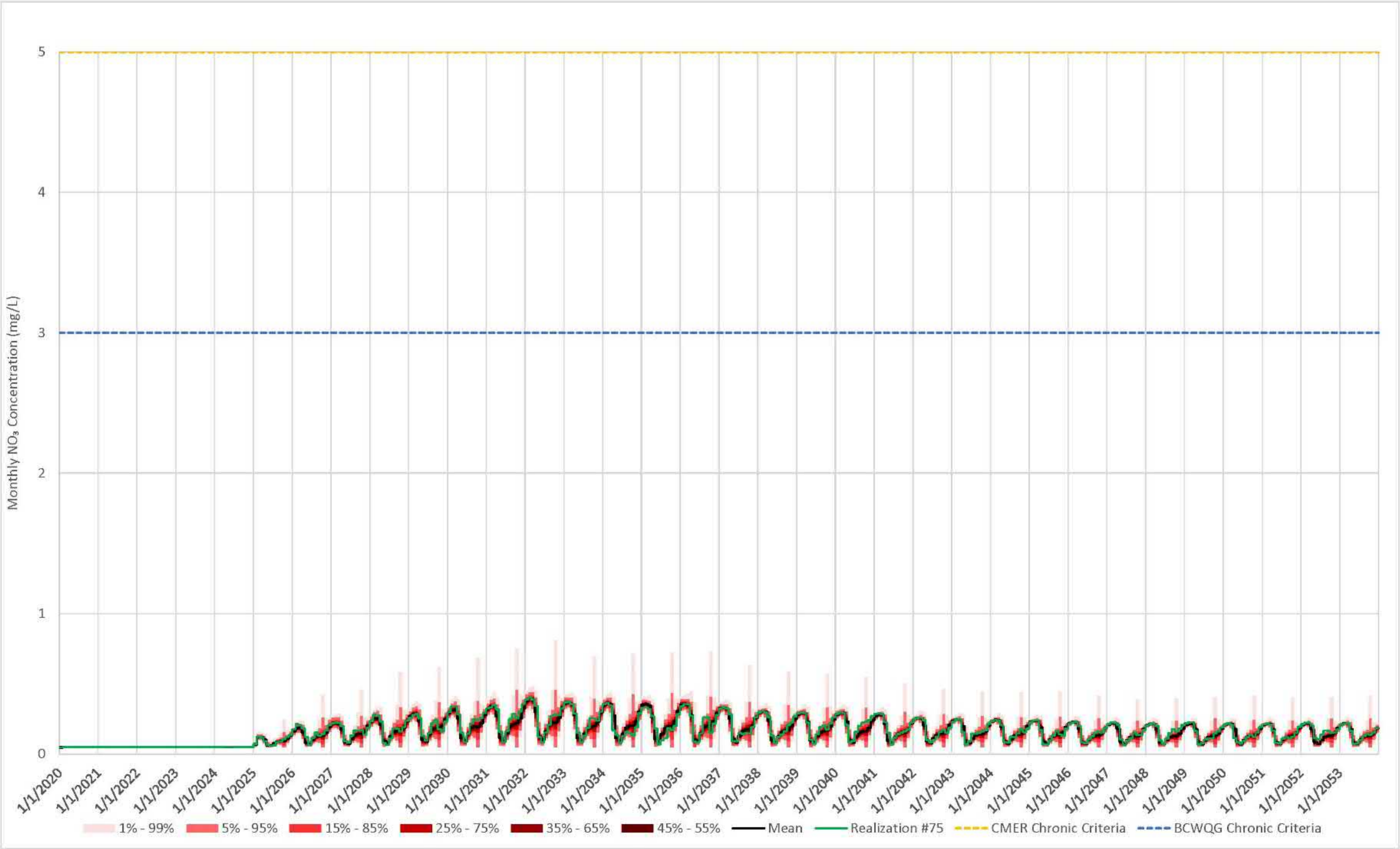


Figure 48: **Alexander Creek (AC_1) WQ Avg. Case, Layering Fails**



EV_EVR1 Station

Figure 49: **EV_ER1 WQ Avg. Case, Layering Succeeds**

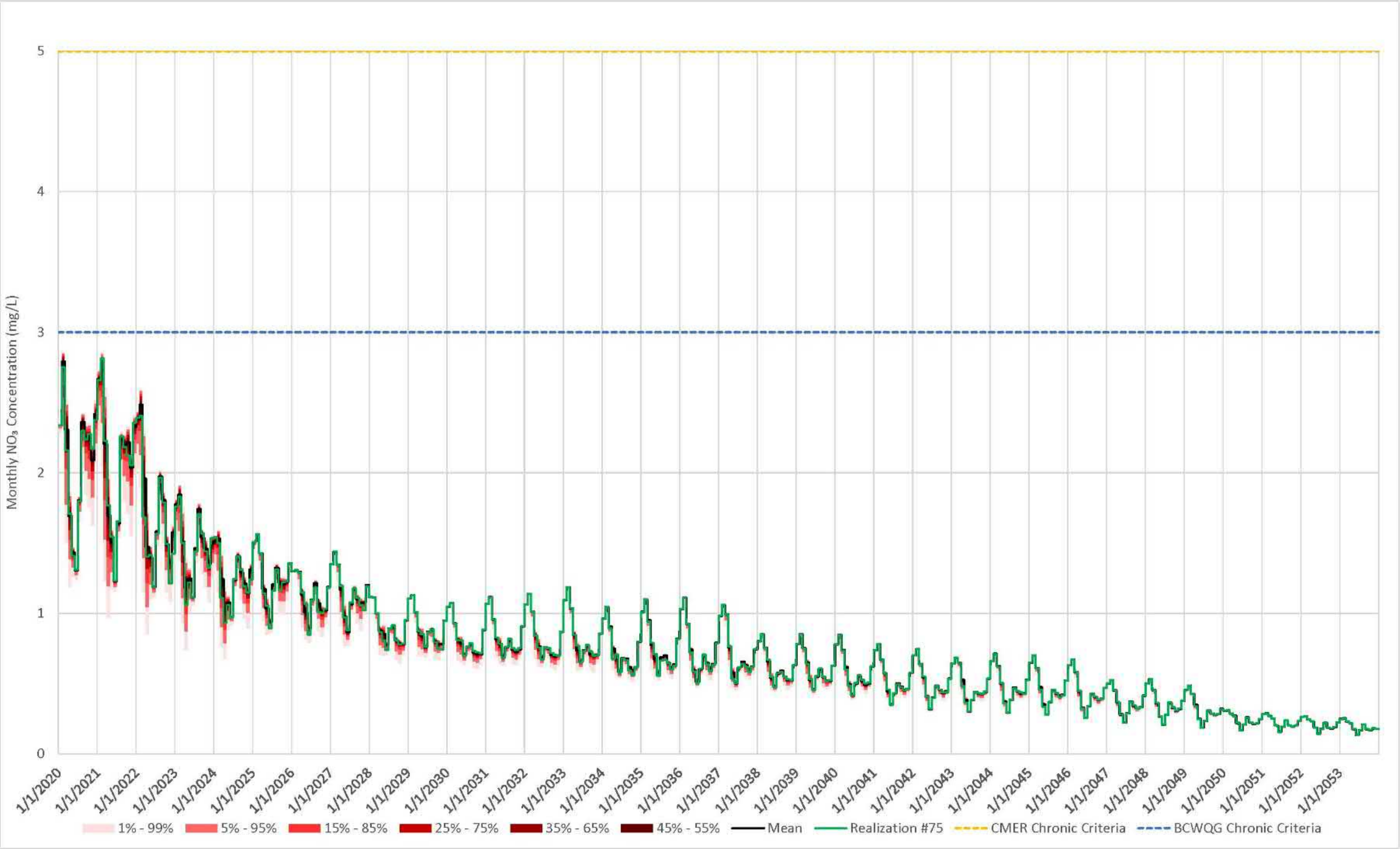
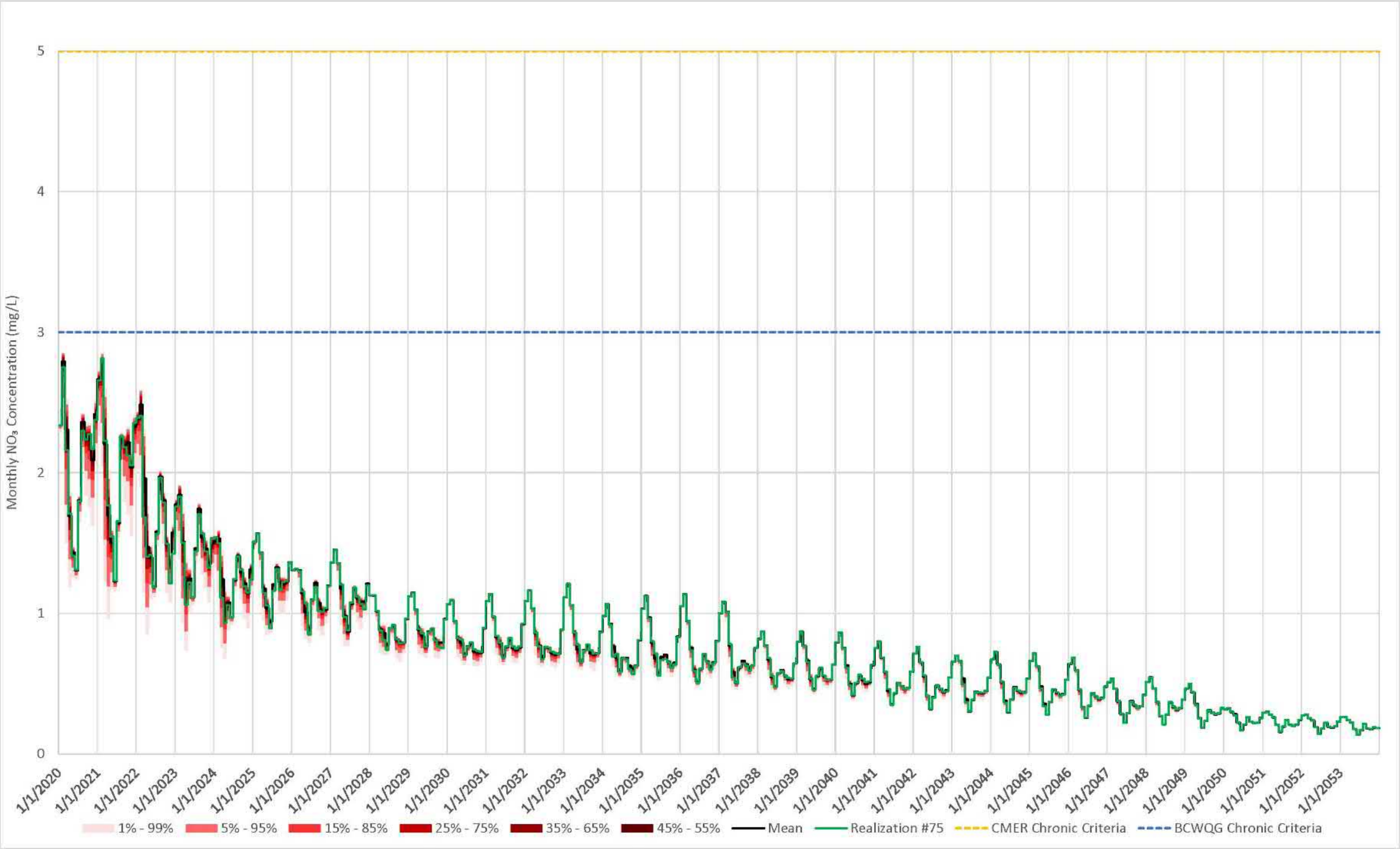


Figure 50: EV_ER1 WQ Avg. Case, Layering Fails



Modelled Sulphate (SO_4) Concentrations

Lower Grave Creek (GC-1)

Figure 51: Lower Grave Creek (GC-1) WQ Avg. Case, WRD Layering Succeeds

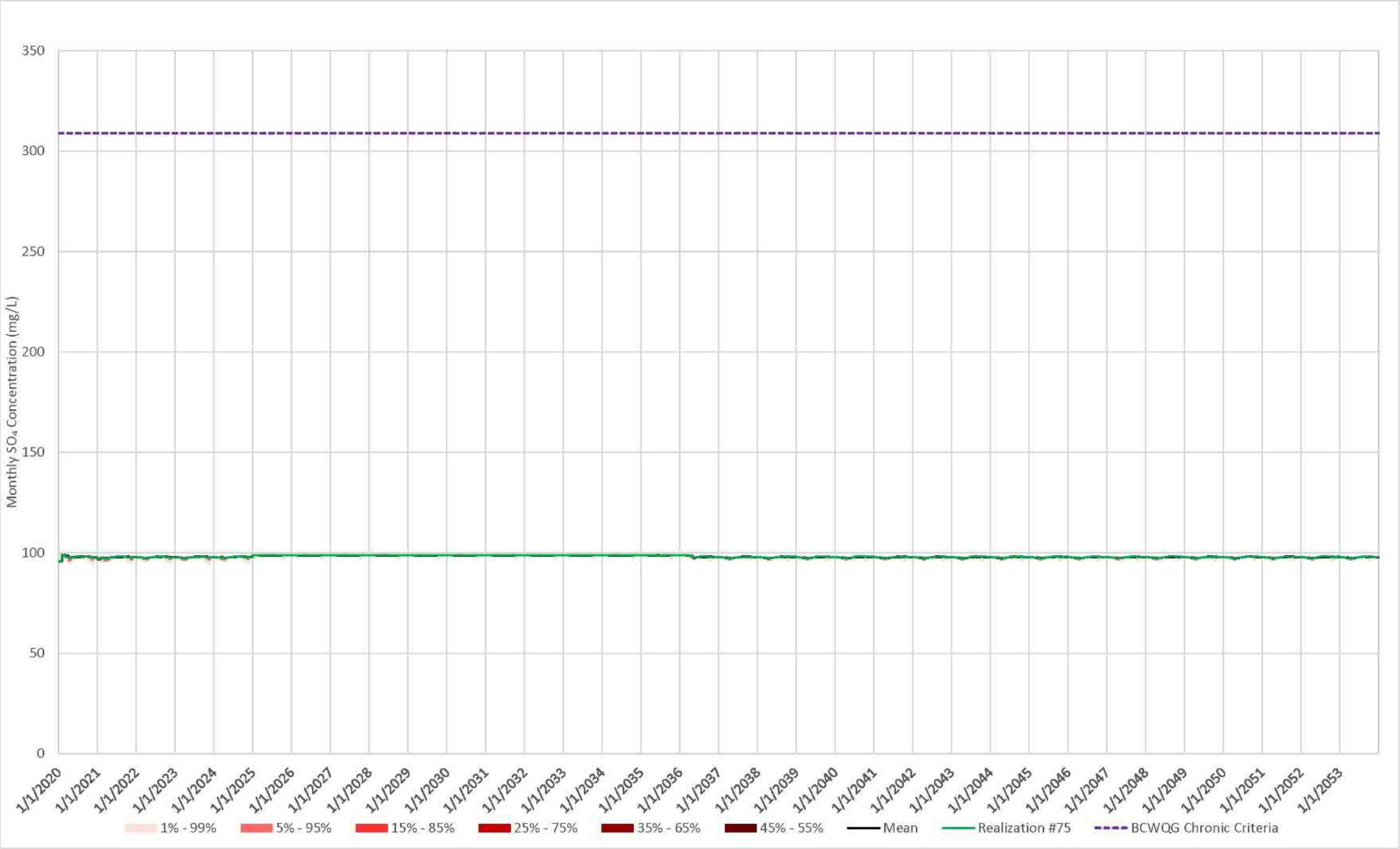
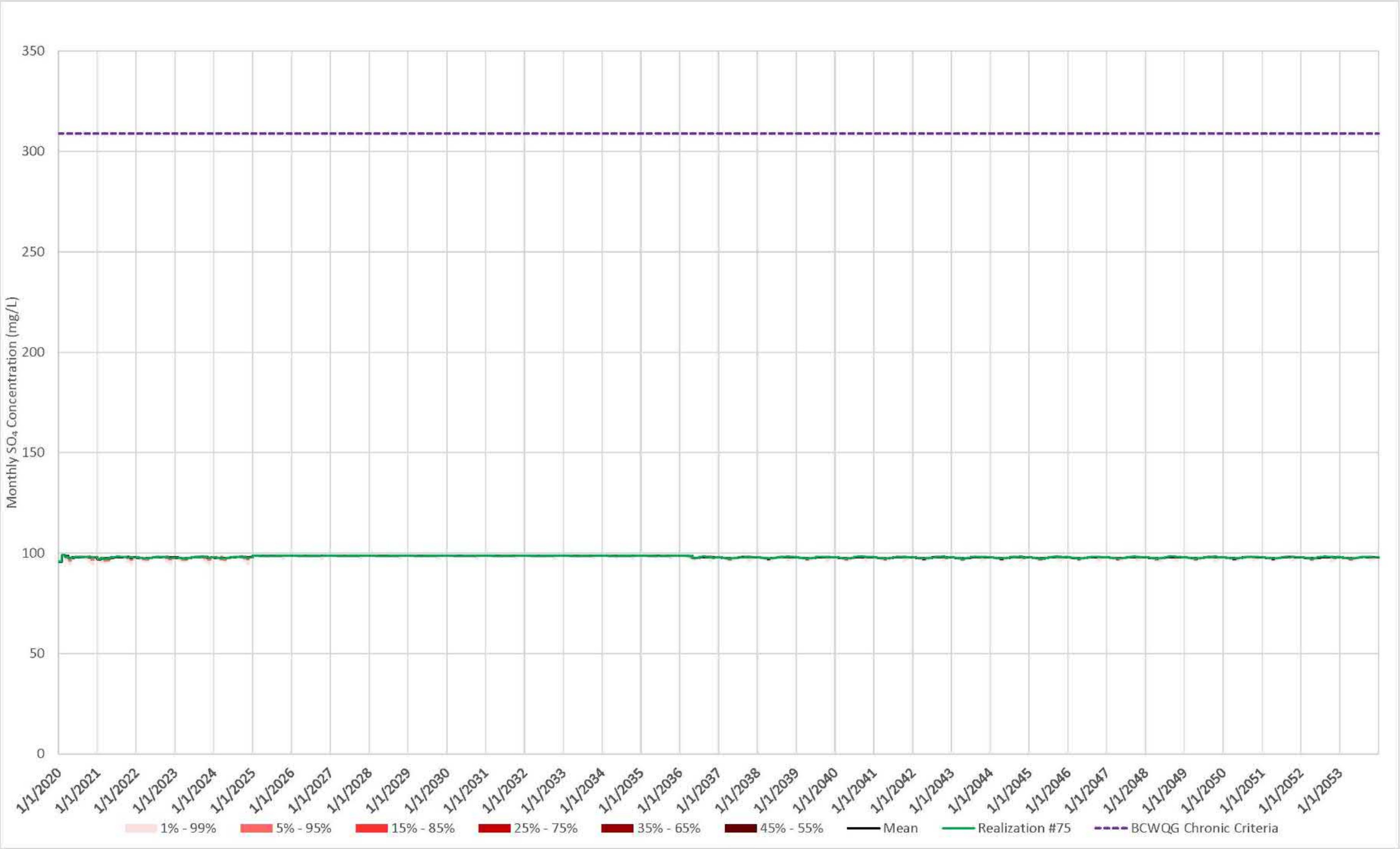


Figure 52: Lower Grave Creek (GC-1) WQ Avg. Case, WRD Layering Fails



Interim & Ultimate WRD Sedimentation Pond

Figure 53: **Interim & Ultimate WRD Sedimentation Pond WQ Avg. Case, Layering Succeeds**

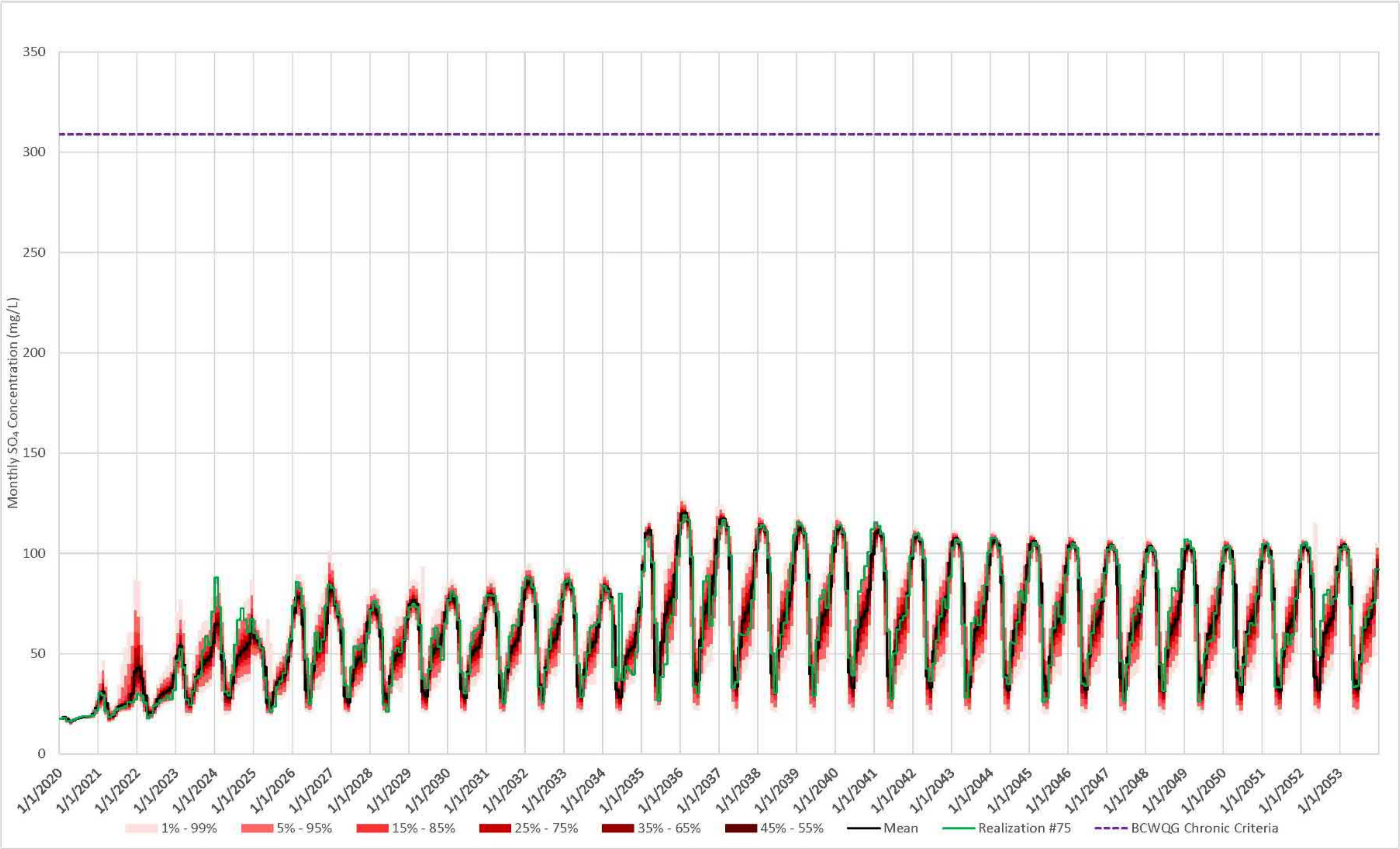
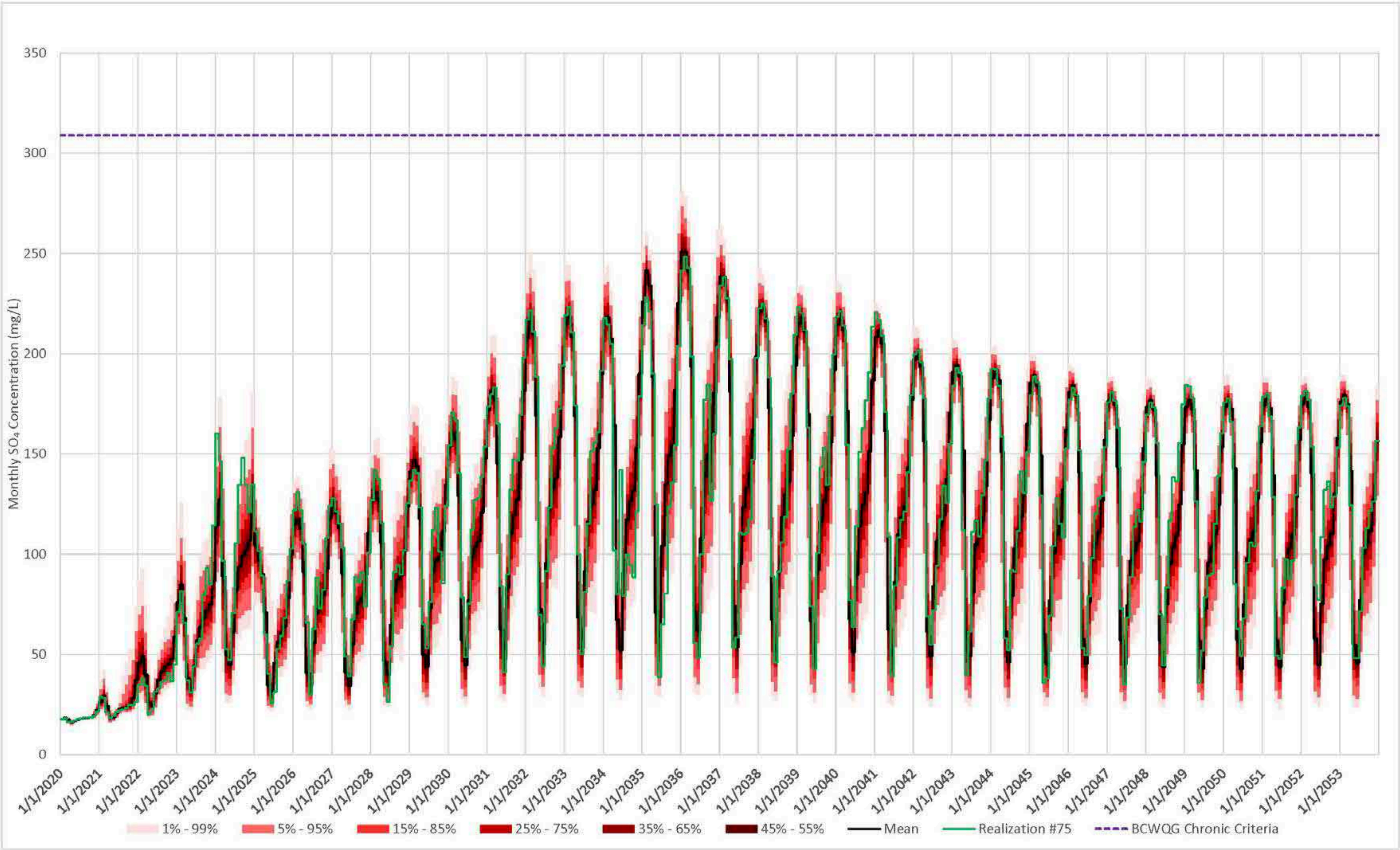


Figure 54: Interim & Ultimate WRD Sedimentation Pond WQ Avg. Case, Layering Fails



West Alexander and Upper Alexander Confluence (AC_3)

Figure 55: **West Alexander and Upper Alexander Creek (AC_3) WQ Avg. Case, Layering Succeeds**

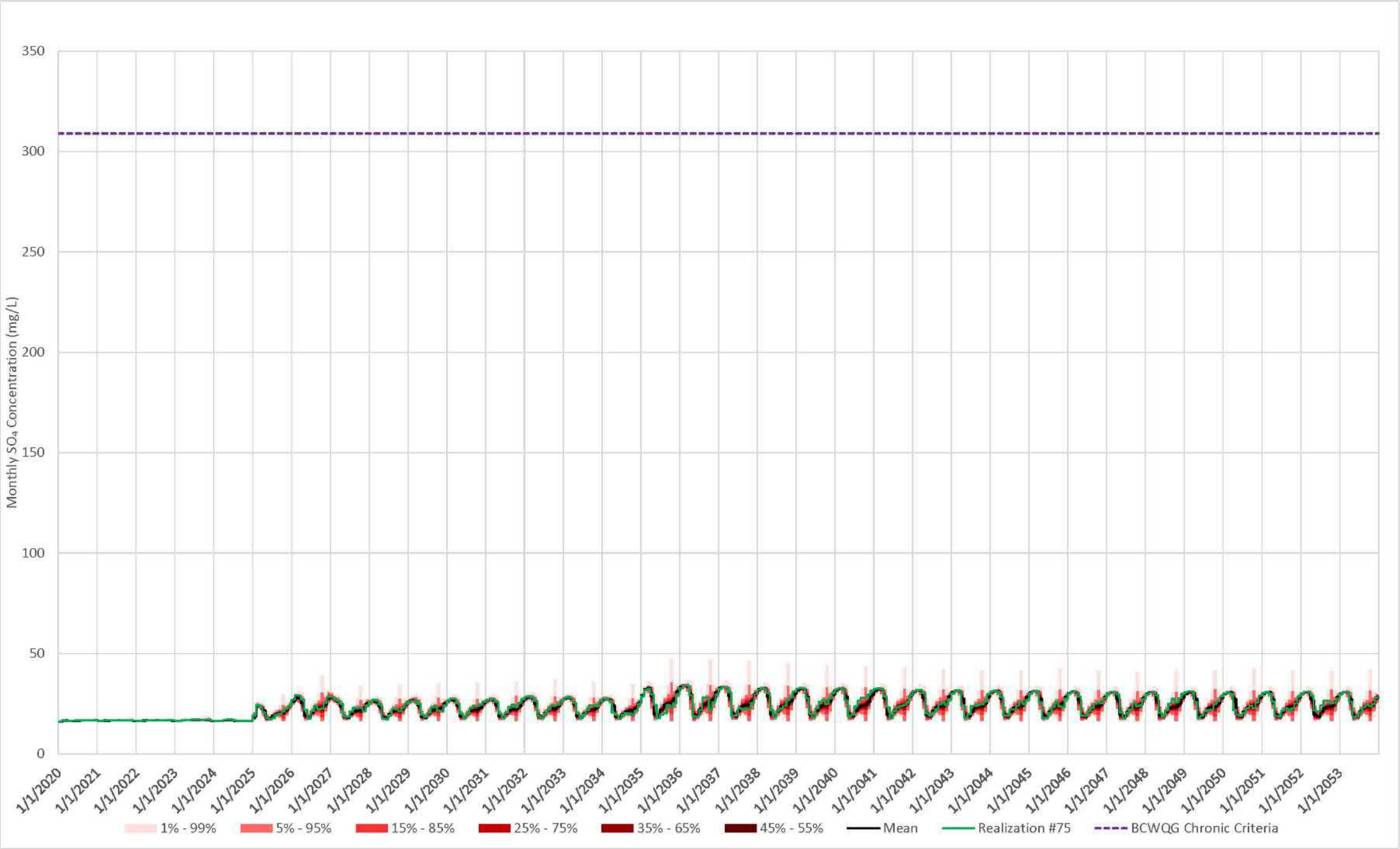
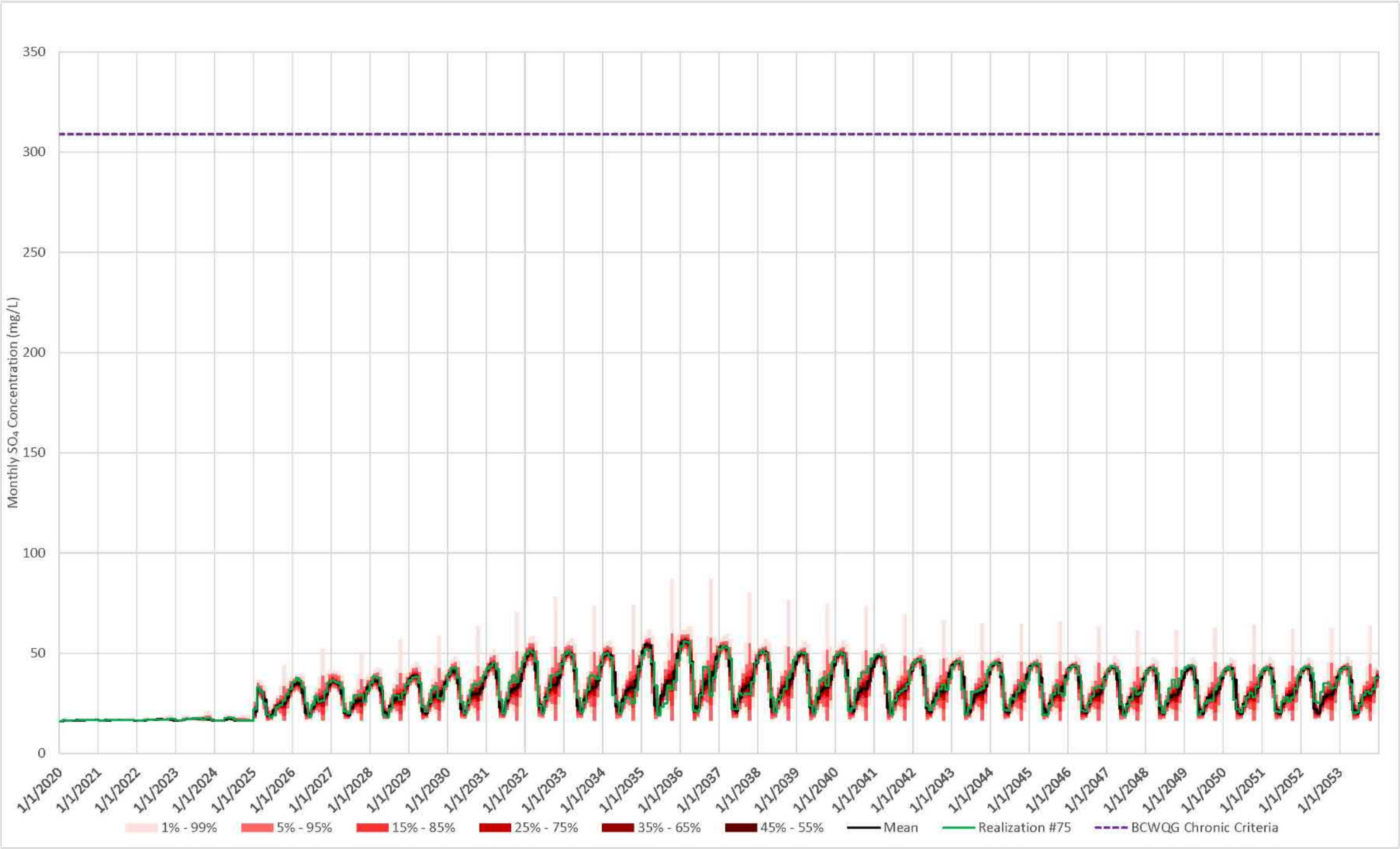


Figure 56: **West Alexander and Upper Alexander Creek (AC_3) WQ Avg. Case, Layering Fails**



Alexander Creek (AC_1)

Figure 57: Alexander Creek (AC_1) WQ Avg. Case, Layering Succeeds

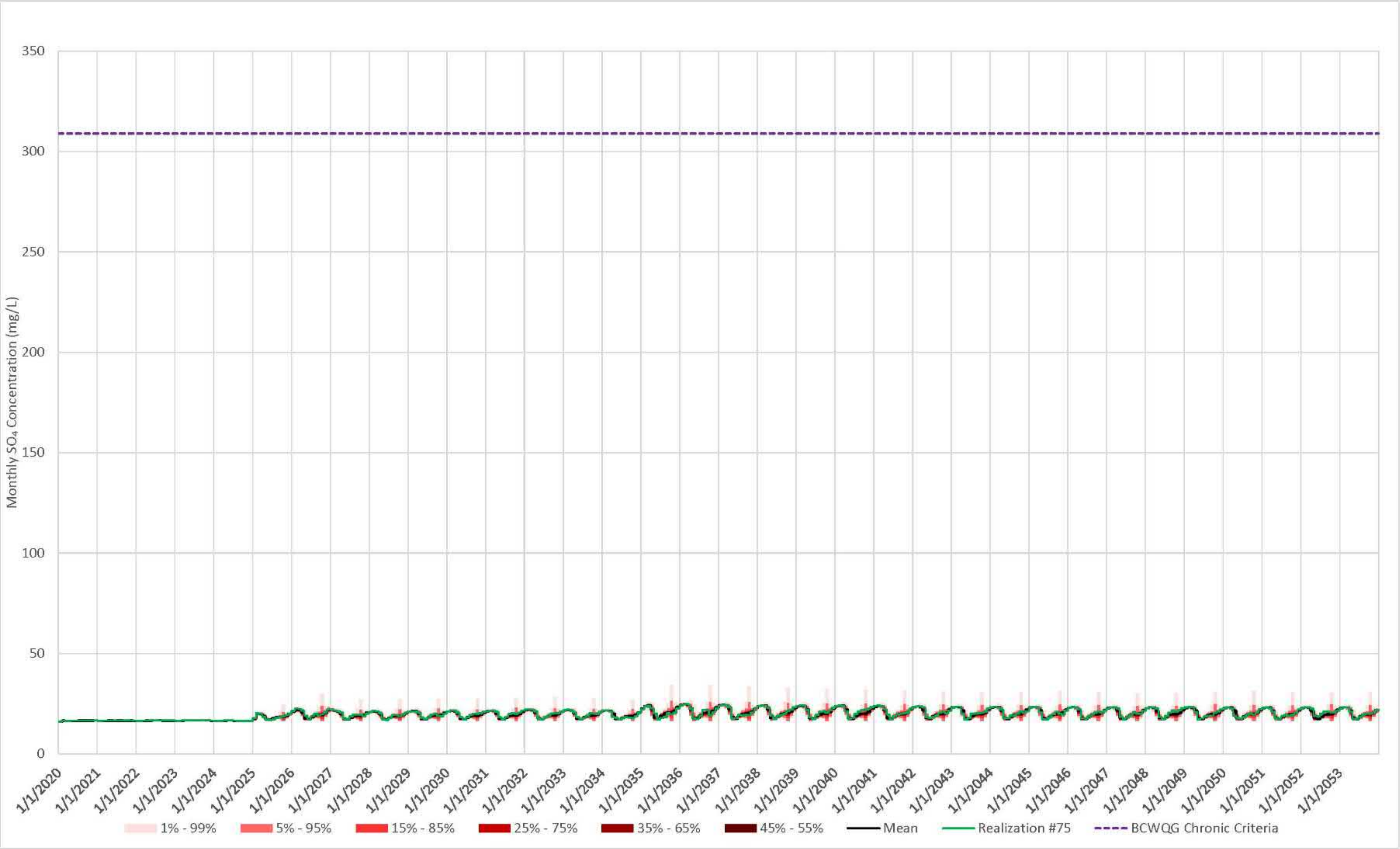
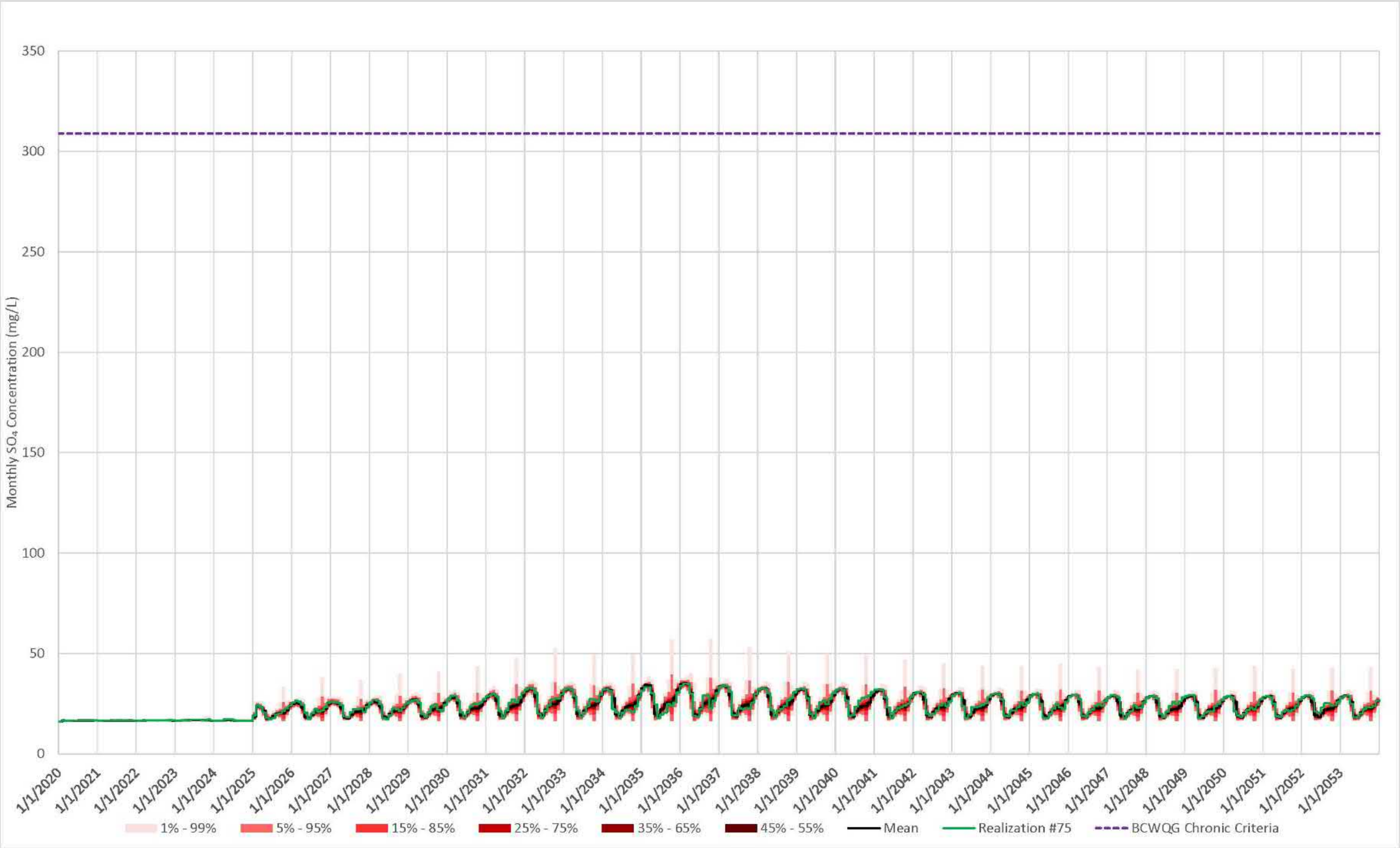


Figure 58: **Alexander Creek (AC_1) WQ Avg. Case, Layering Fails**



EV_ER1 Station

Figure 59: **EV_ER1 WQ Avg. Case, Layering Succeeds**

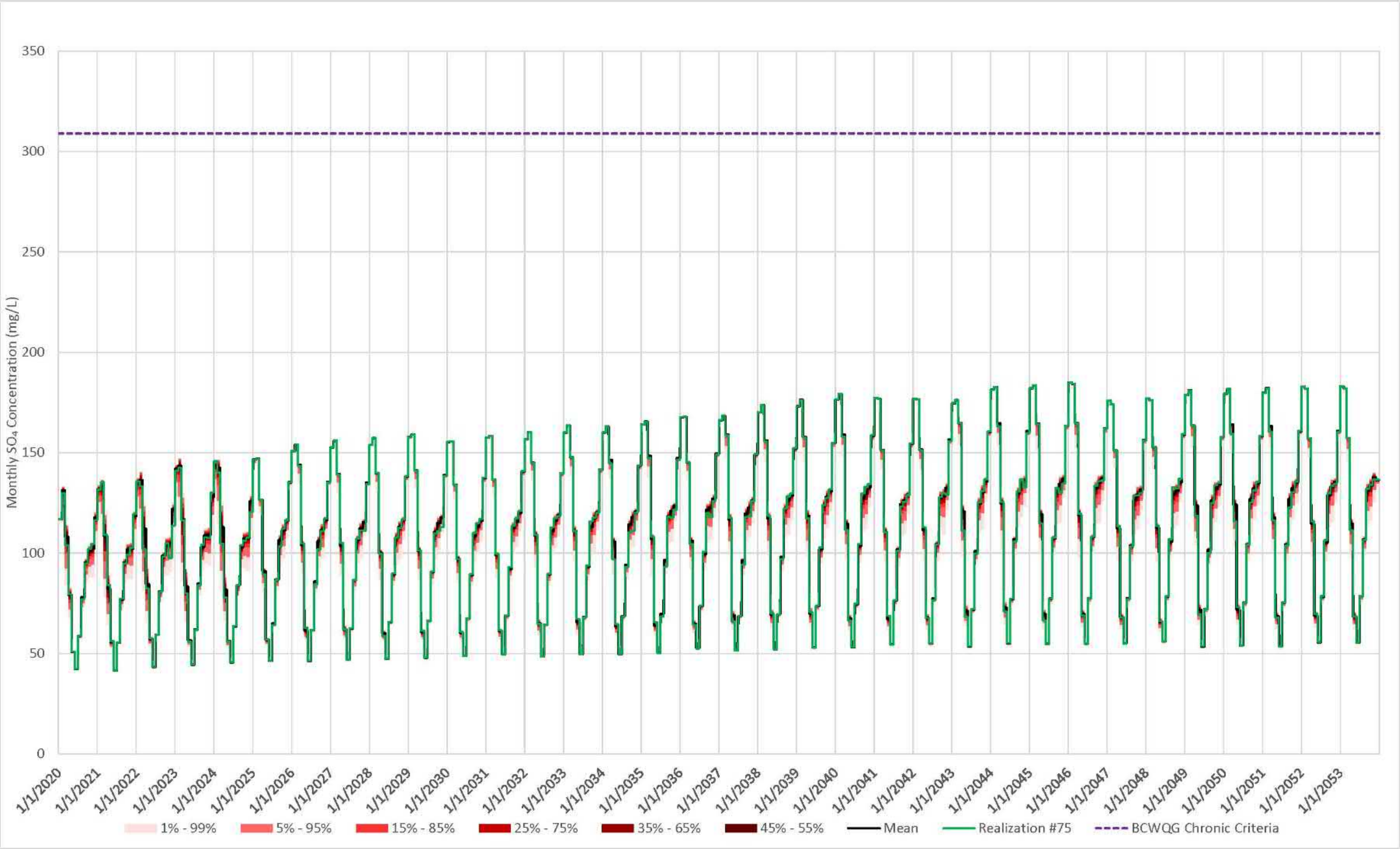
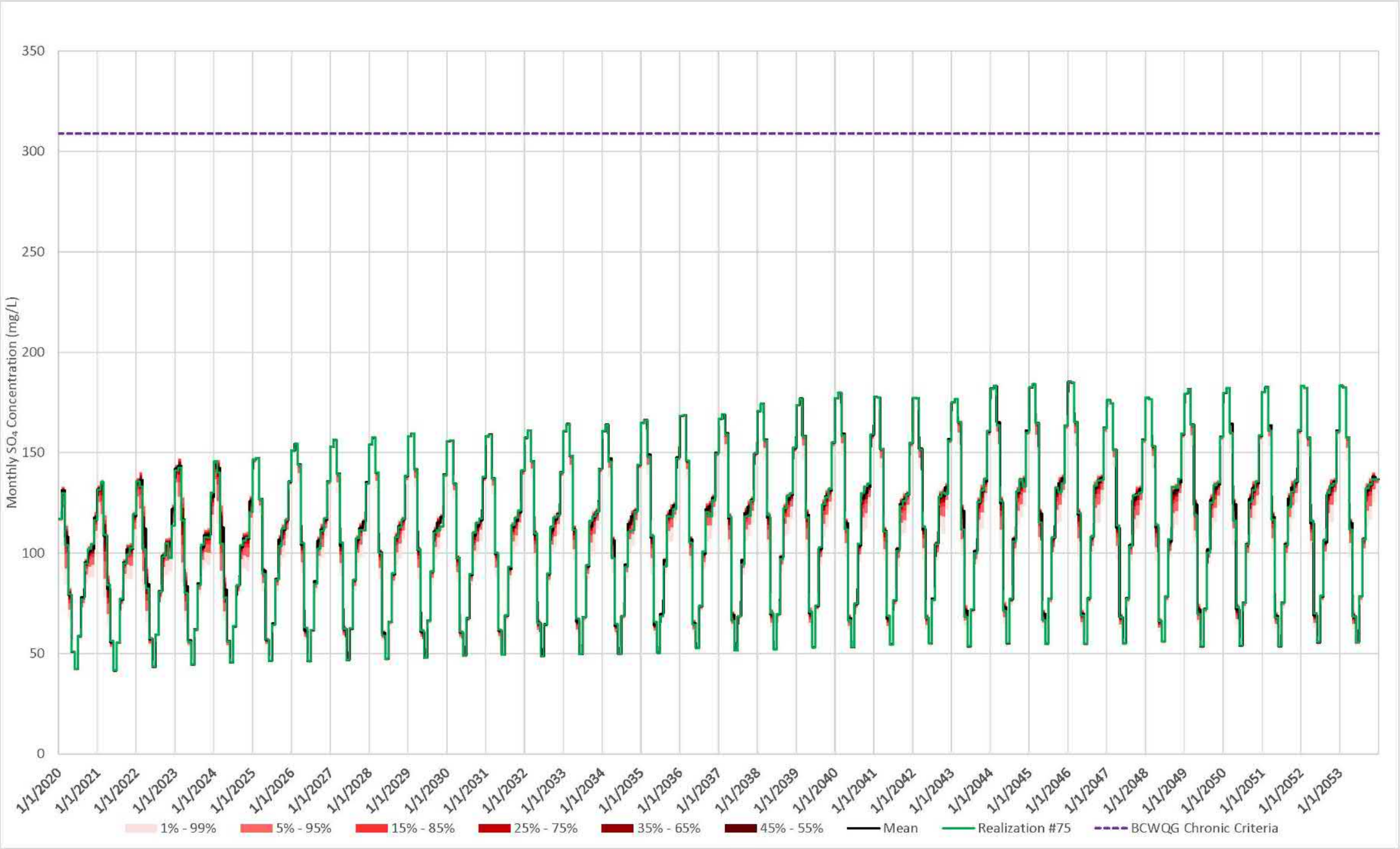


Figure 60: EV_ER1 WQ Avg. Case, Layering Fail



5 Conclusions and Recommendations

The Goldsim surface water balance shows good calibration to historic streamflow in Grave Creek and the WRD model shows it is able to reproduce hydraulic conductivities and therefore travel times that match well with the theoretical WRD design modelling completed in HYDRUS 1D. This means the mass balance, since it is built in parallel with the water balance, should provide reasonably accurate estimations of water quality exiting the mine property.

Based on the results and the conceptual model, the main area of concern for discharge into the natural environment is from the Interim and Ultimate Sedimentation Ponds on the southernmost end of the mine property. Discharge from various facilities along Grave Creek indicate very little impact to local stream quality until the confluence of Grave Creek and Harmer creek where discharge from the Elk View Coal mine intermingles with Grave Creek streamflow.

The WRD Sedimentation Pond flows into the tail end of the West Alexander Creek and Upper Alexander Creek Confluence, which feeds Alexander Creek. The load balance indicates for the average case WRD layering succeeds and layering fails that Nitrate concentrations do not exceed 5 mg/L and Sulphate concentrations do not exceed 300 mg/L. There are some early instances where Selenium concentrations exceed 0.01 mg/L for the layering succeeds case, but these are likely due to the relatively high ratio of surface area to WRD depth in the first few years of mine life.

Through the LoM the annual oscillations seen in water quality of the Ultimate WRD Sedimentation Pond are caused by cryo-concentration in the winter, as winter icepack formation temporarily removes water from the sedimentation ponds without removing chemical mass, effectively concentrating the chemistry of the sedimentation pond. This cryo-concentration then causes the successful layering scenario to exceed 0.01 mg/L for a short period until the pond ice pack melts. The modeled ice formation model assumes that no mass is bound in the icepack, which is conservative as some chemical mass will be encapsulated in the ice pack during formation and thus is likely to overestimate the impact of cryo-concentration.

Although the failed WRD layering scenario experiences the same winter cryo-concentration, exceedances are observed for longer period of time because of the lower water quality from WRD seepage in this scenario. Conversely, downstream concentrations in the main body of Alexander Creek below the WRD Sedimentation Pond are shown to stay under 0.01 mg/L.

In summary, the Water Quality predictions from the Water and Load Balance model predict that a successful implementation of the WRD Layer Cake design will result in acceptable water quality in West Alexander Creek and Alexander Creek assuming expected water quality predictions (P_{50}). Under the more conservative water quality assumptions (P_{95}), the BC WQG FAL chronic standard for Selenium is exceeded on a seasonal basis in West Alexander Creek and Alexander Creek. Other parameters were predicted to be under the standard.

Closure

This report, Water Quality Prediction Model, was prepared by

<Original signed by>

Brent Thiele, BS Sustainability
Consultant (Geoenvironmental)

and reviewed by

<Original signed by>

David Hoekstra, BS, PE, NCEES, SME-RM
Principal Consultant (Water Resource Engineering)

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

References

Ashton, George, 1983. *Predicting lake ice decay.* Snow and Ice Branch, U.S. Army Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers Hanover, New Hampshire. Special report 83-19, June 1983.

Ashton, George, 1989. *Thin Ice Growth.* U.S. Army Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers Hanover, New Hampshire. Water Resources Research, Vol. 25, No 3, March 1989.

Ministry of Environment & Climate Change Strategy. Water Protection & Sustainability Branch. (2019, August). British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf

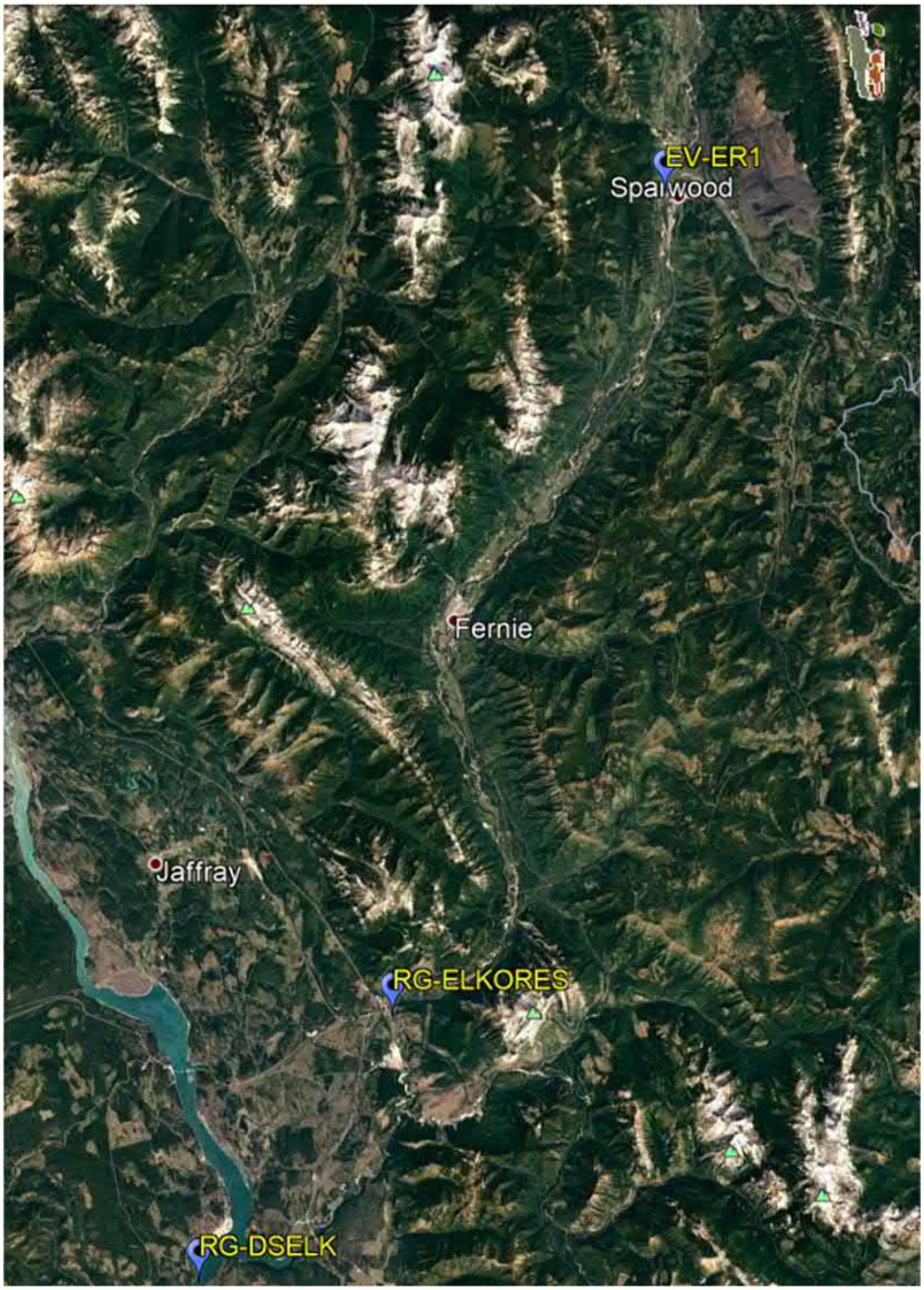
Mualem, Y., 1976, A new model predicting the hydraulic conductivity of unsaturated porous media, Water Resources Research, v. 12, p. 513-522.

SRK Consulting, 2020a, Hydrogeological Assessment

SRK Consulting, 2020b, Geochemical Characterization Report

Van Genuchten, M.Th., 1980, A closed-form equation for predicting the hydraulic conductivity of unsaturated soils, Soil Science Society of American Journal, v. 44, p. 892-898.

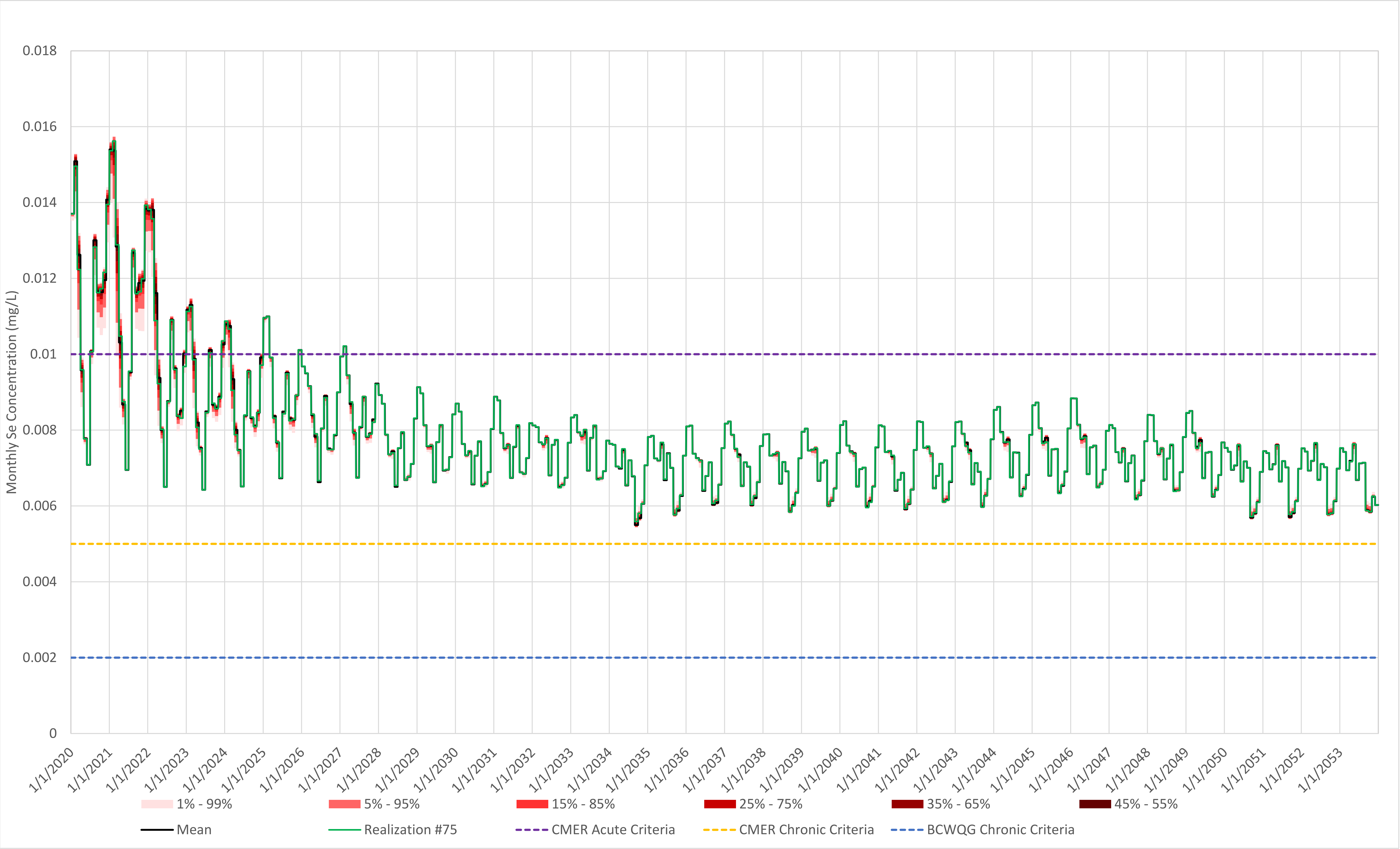
Appendix A Comparison of Crown Mtn WQ with Elk Valley WQ

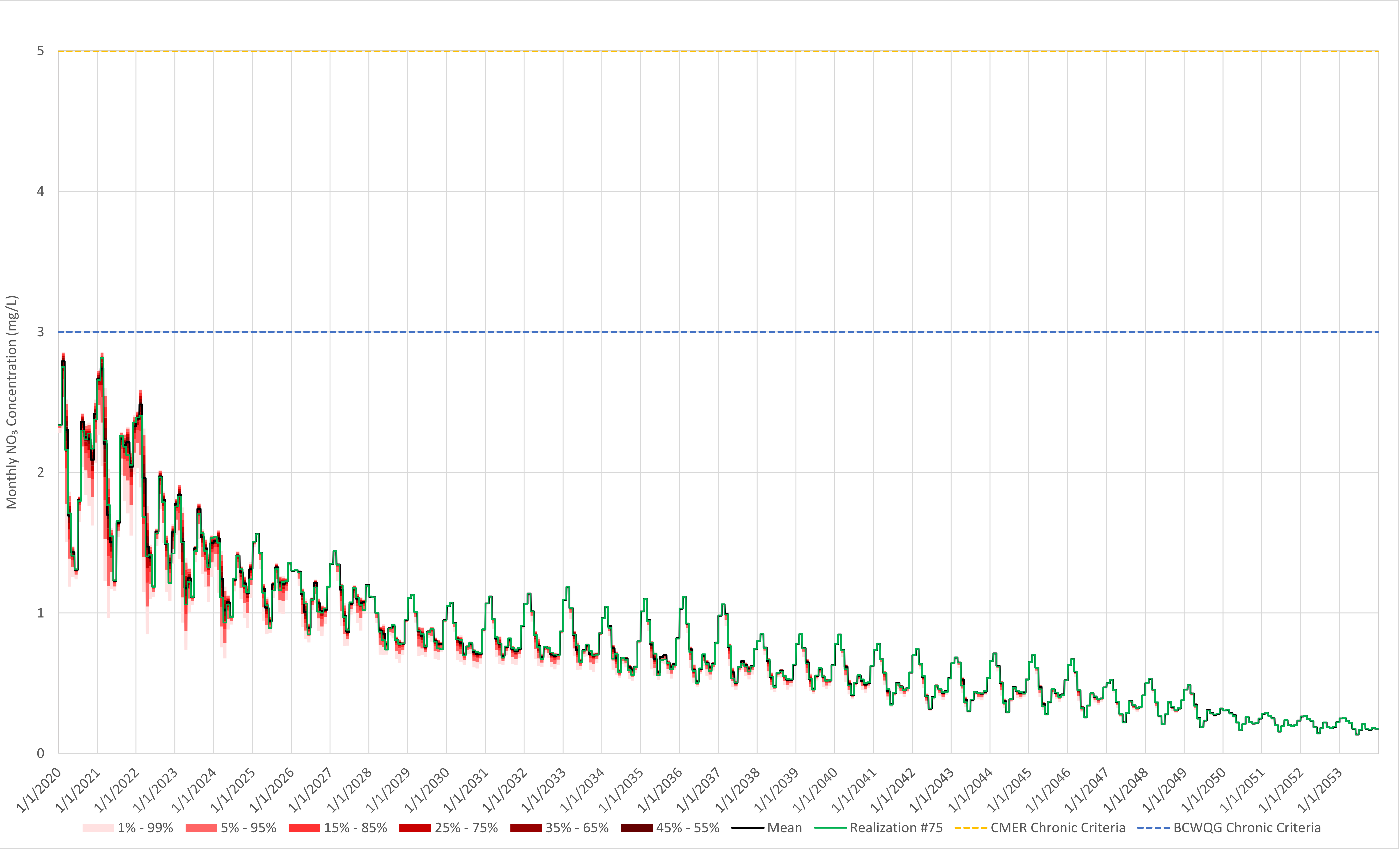


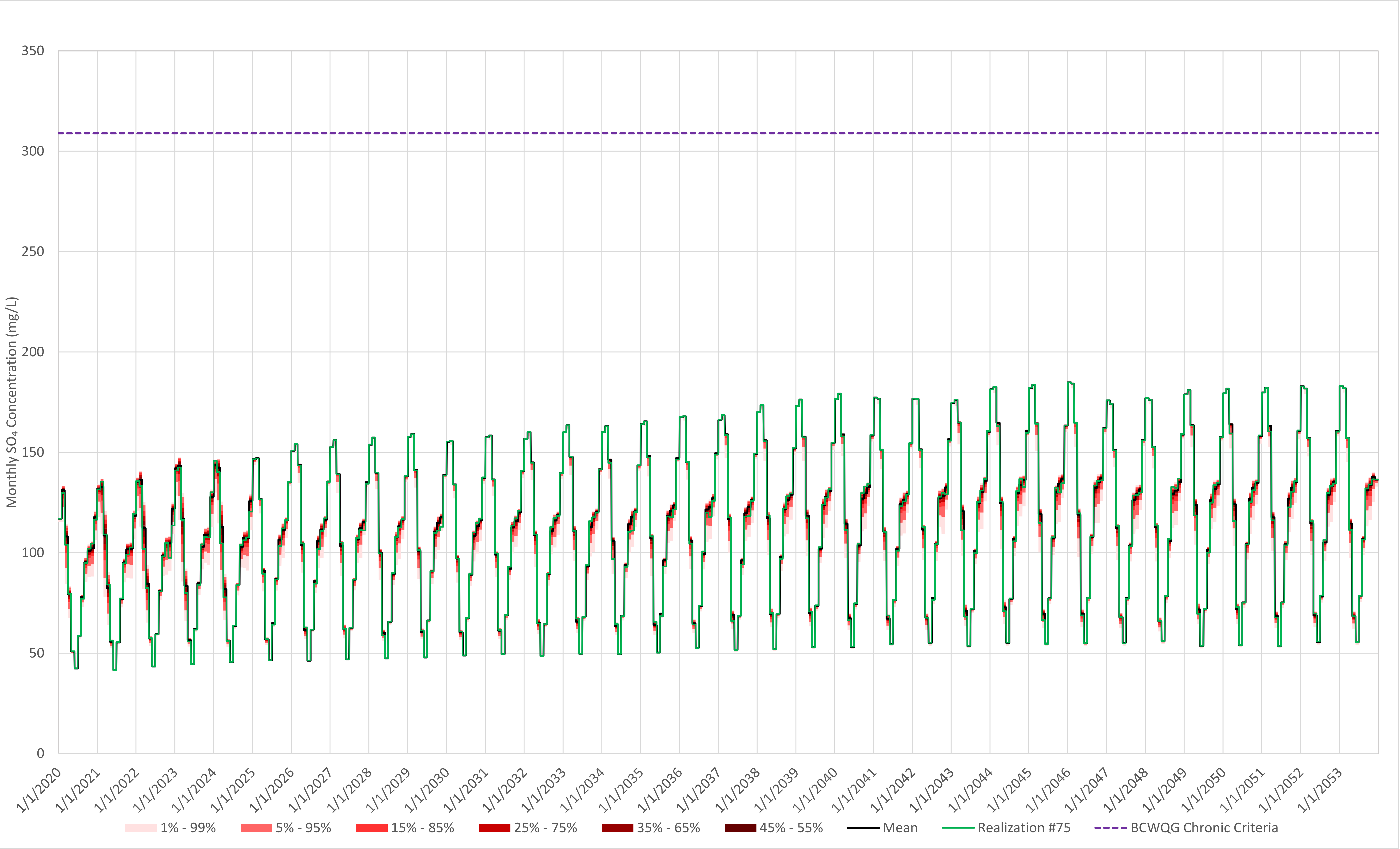
Elk Valley Reporting Stations

Elk Valley Station: EV_ER1

Scenario: Average Case (P_{50}) Layering Succeeds


0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

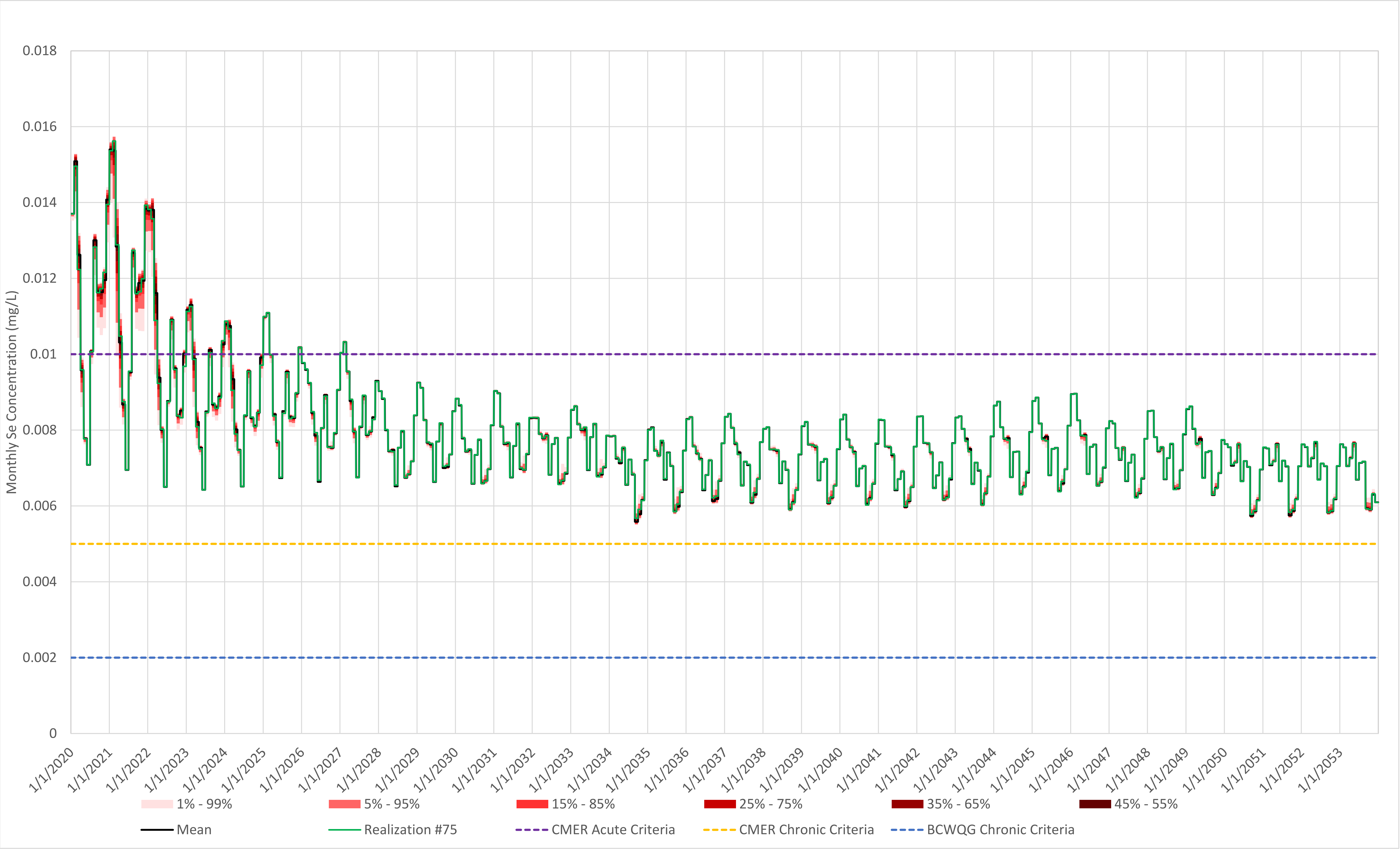

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

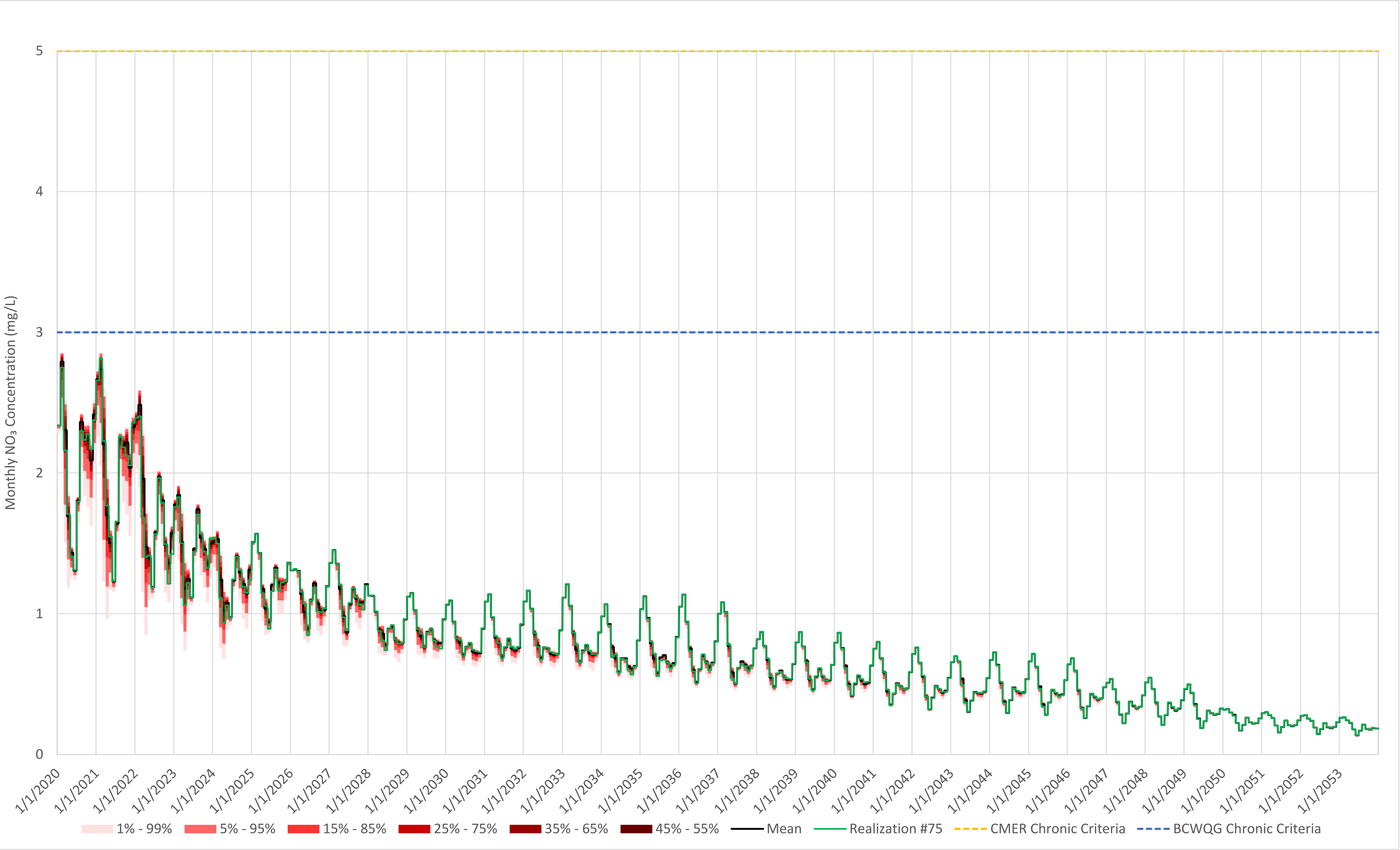


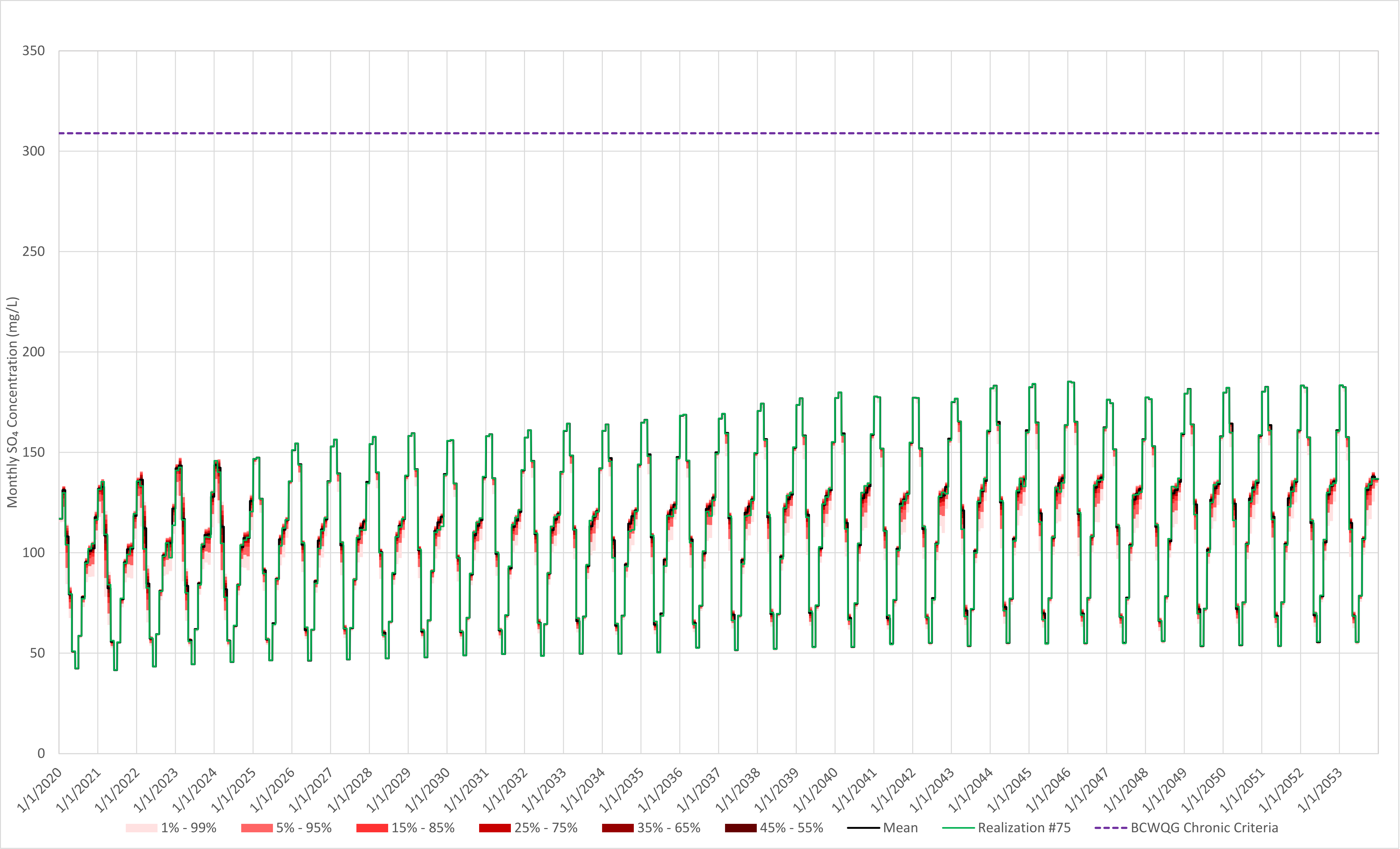
Monthly SO$_4$ Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: EV_ER1

Scenario: Average Case (P_{50}) Layering Fails

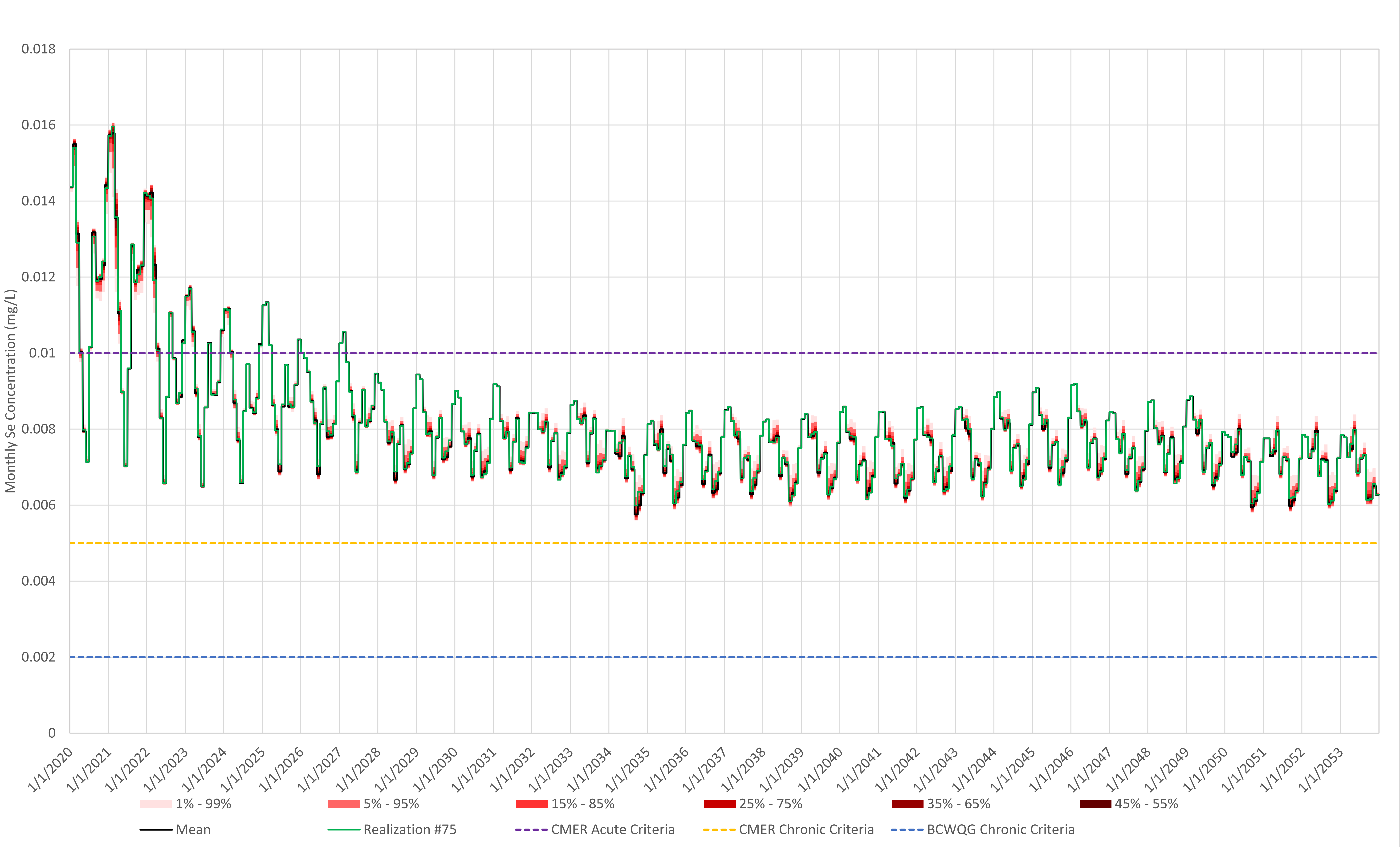

0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

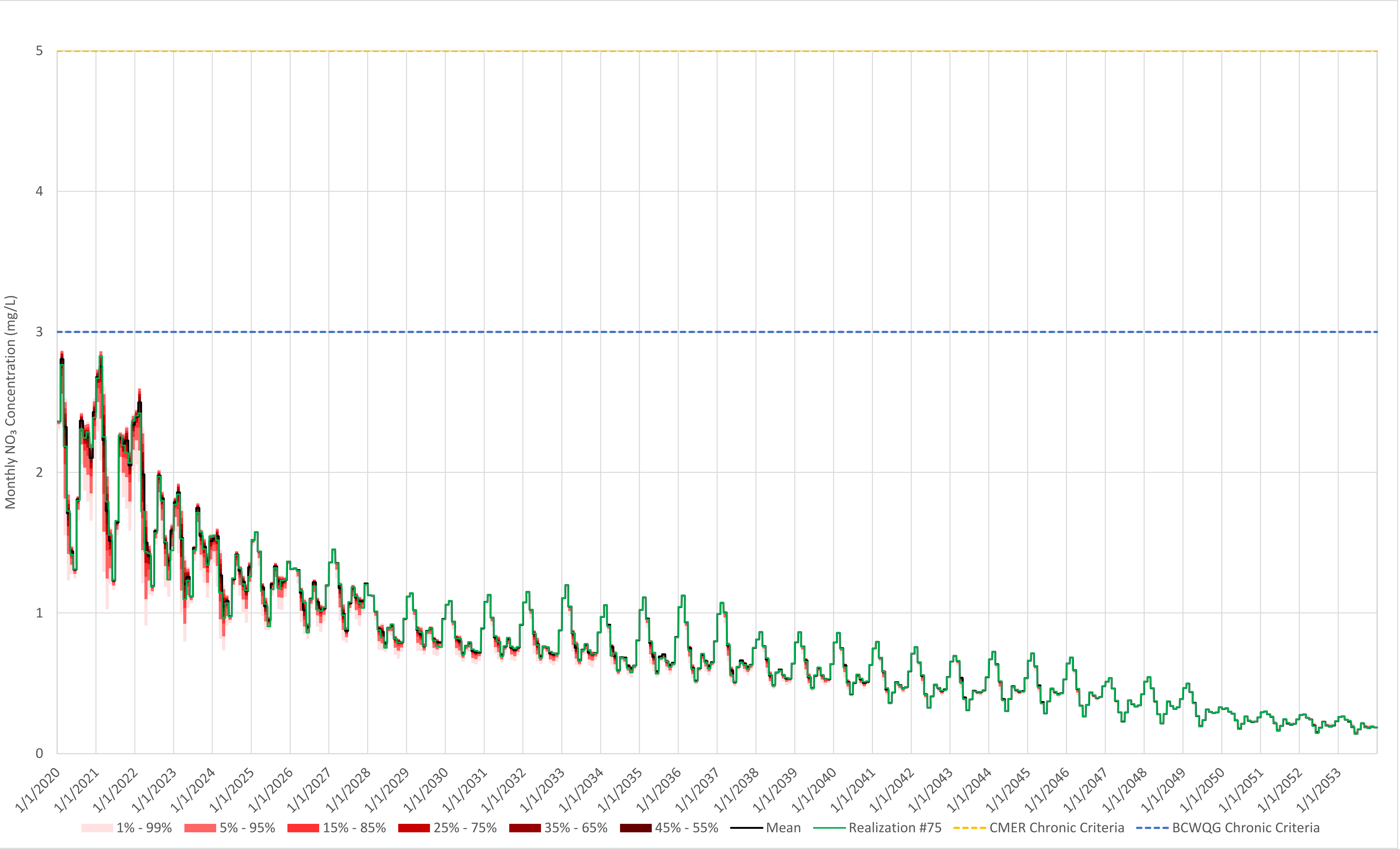

5
4
3
2
1
0
Monthly NO$_3$ Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

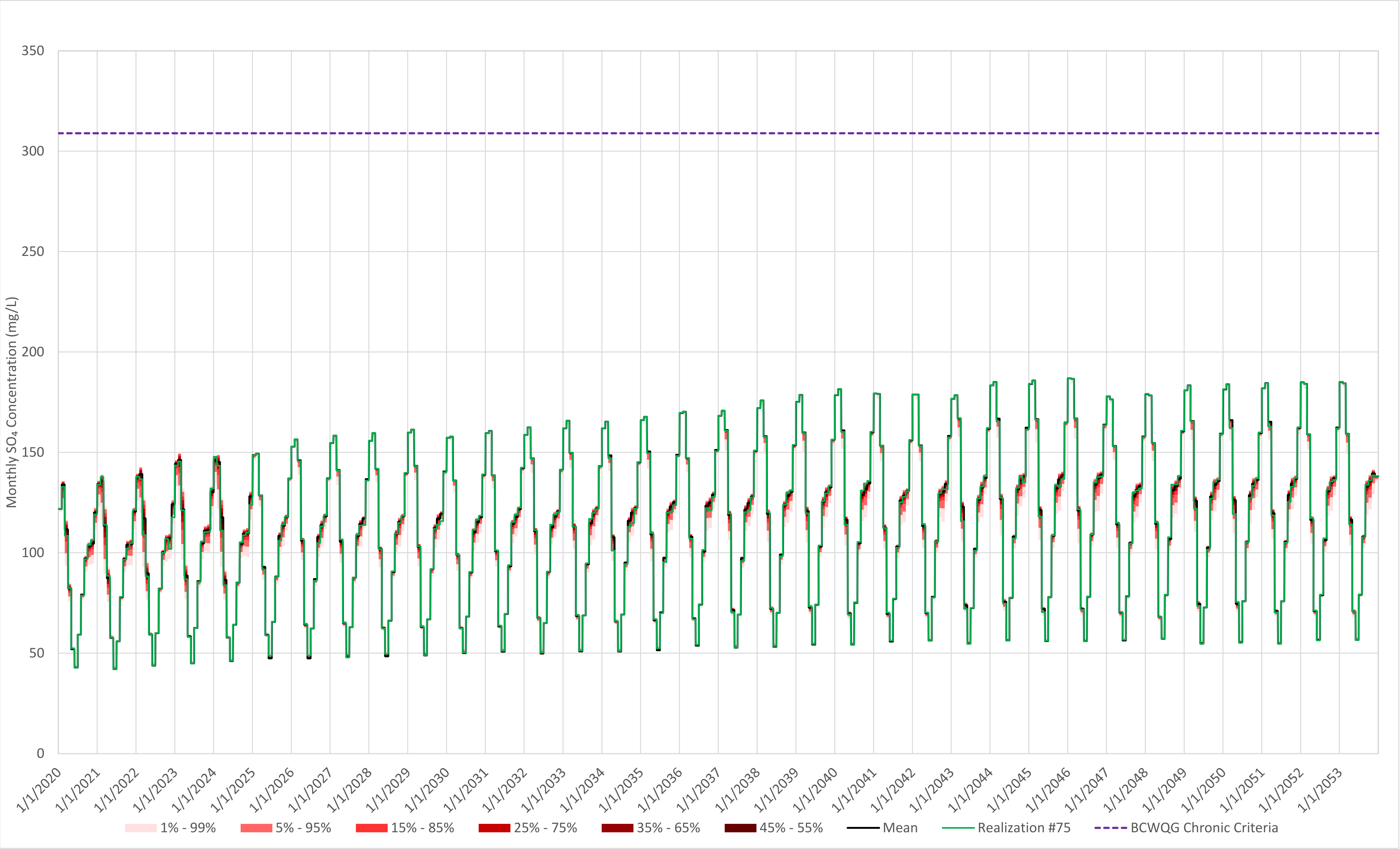

Monthly SO$_4$ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: EV_ER1

Scenario: Average Case (P_{95}) Layering Succeeds

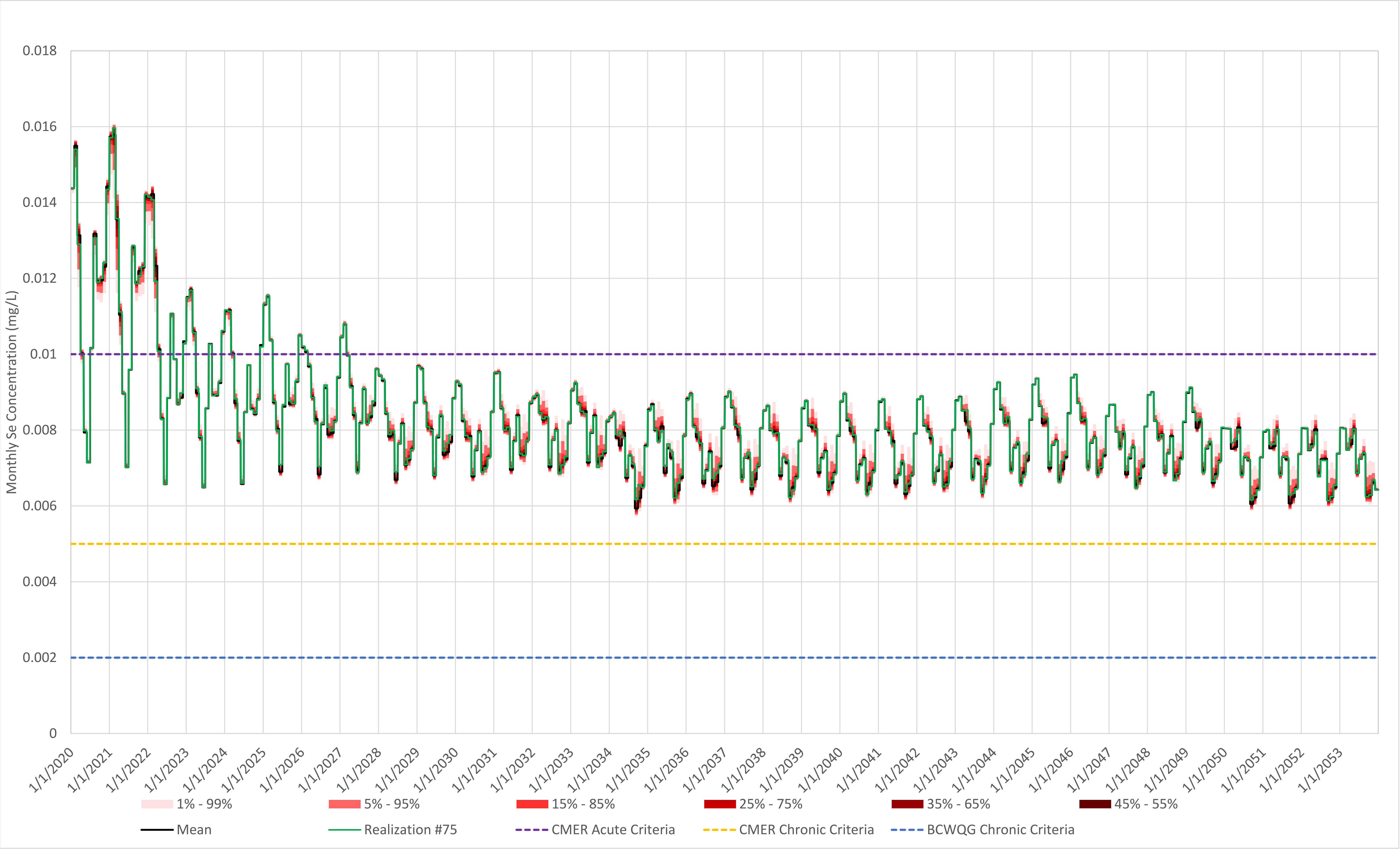

0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly NO₃ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

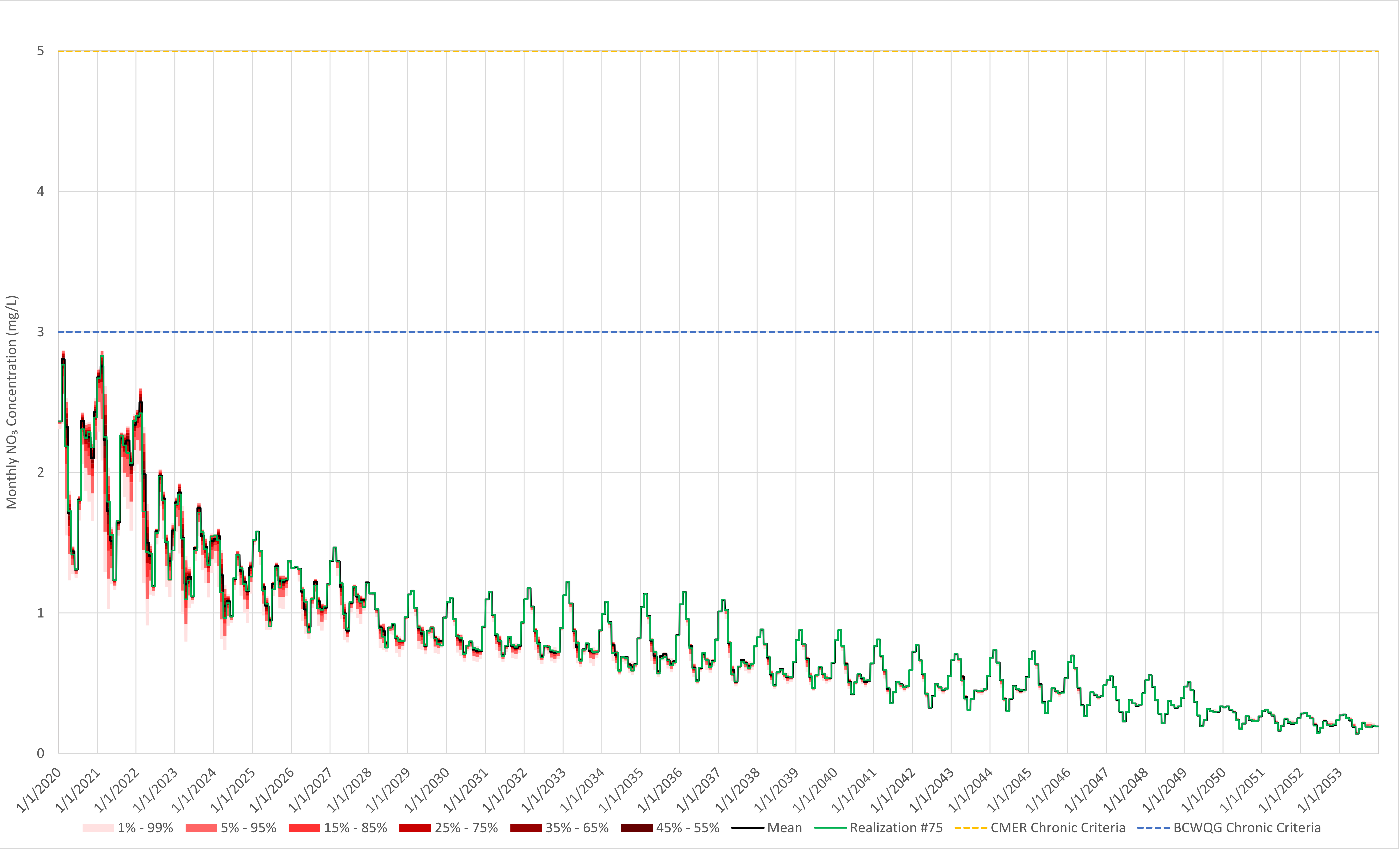

Monthly SO$_4$ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

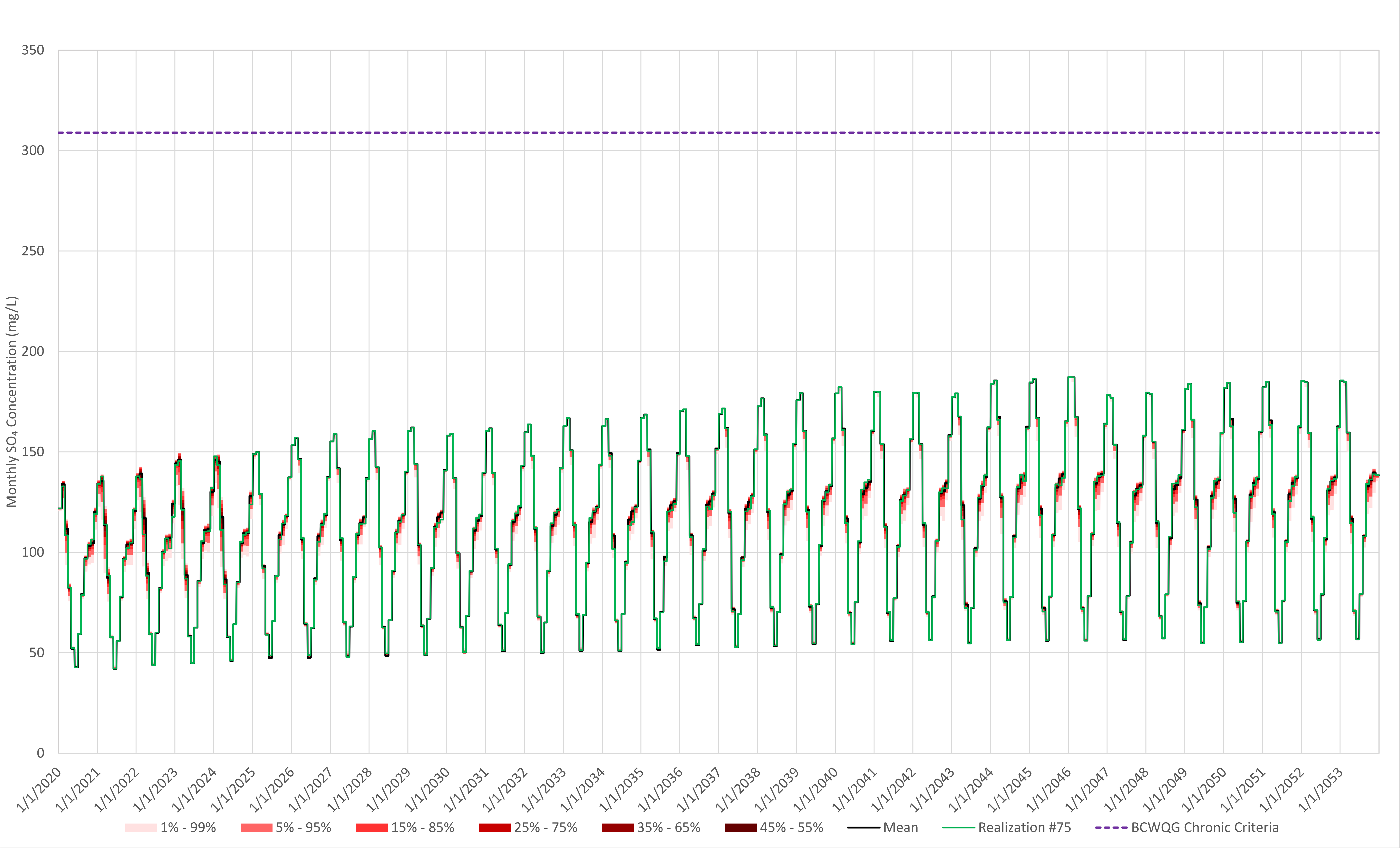
Elk Valley Station: EV_ER1

Scenario: Average Case (P_{95}) Layering Fails



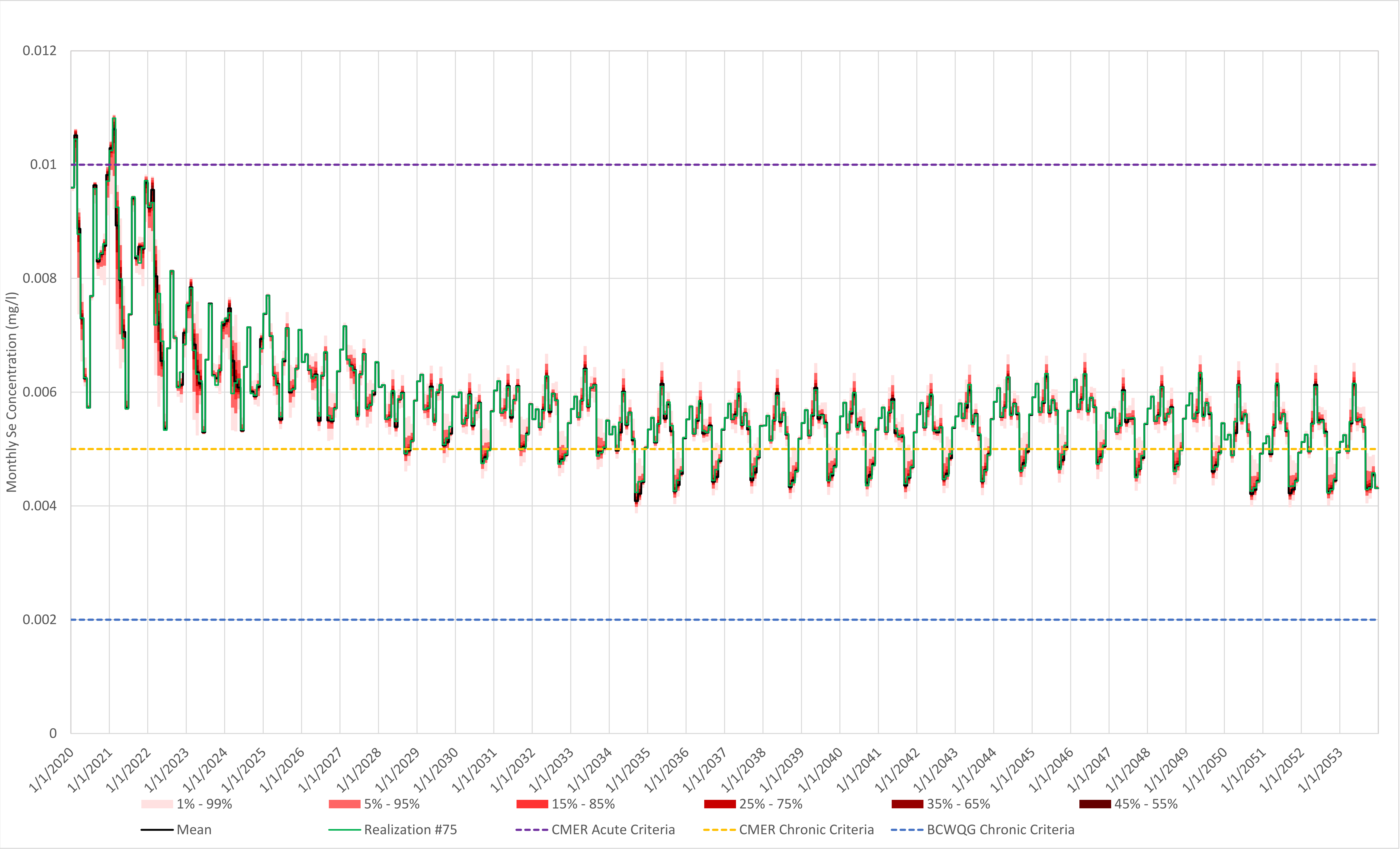
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

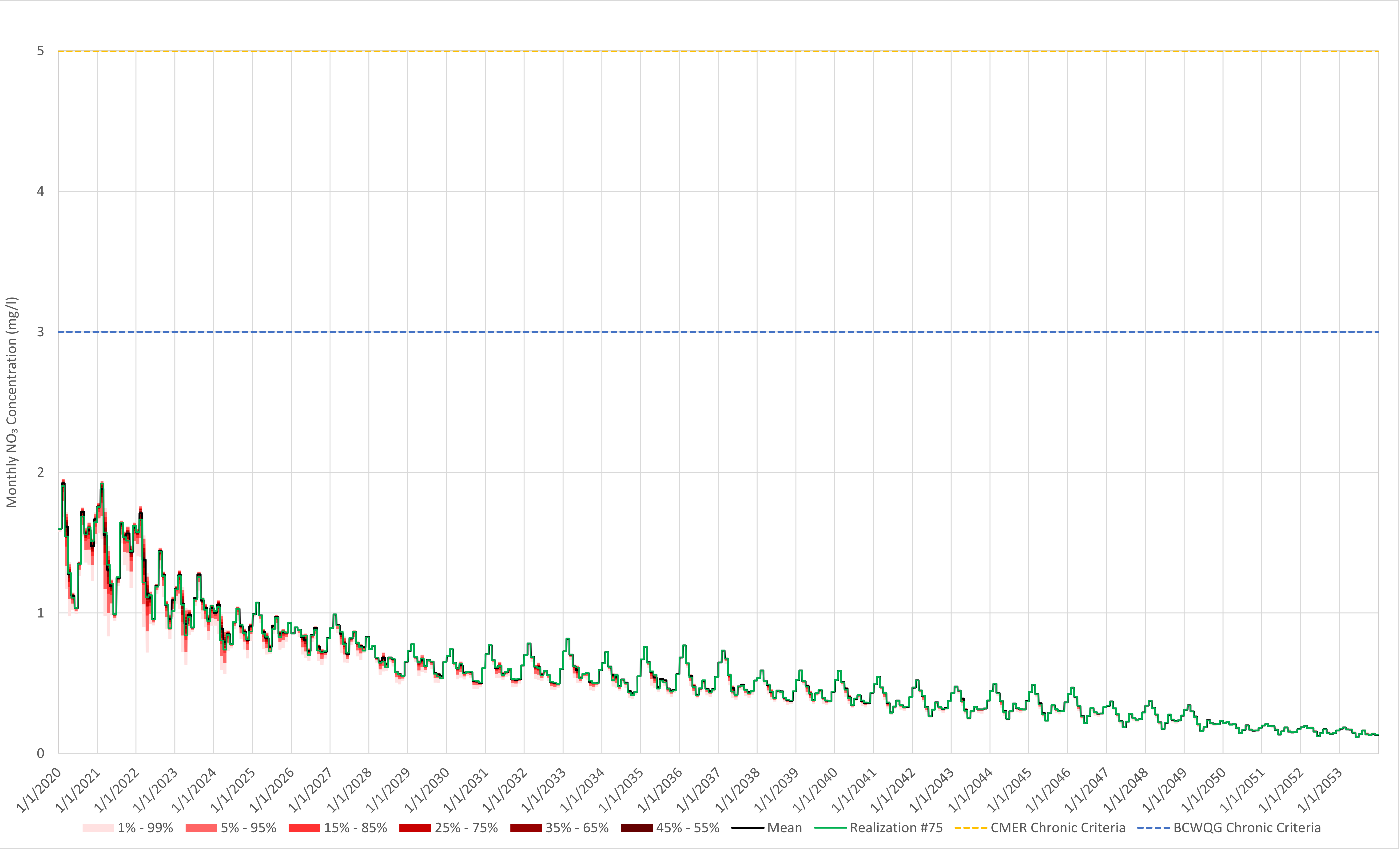

Monthly NO₃ Concentration (mg/L)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

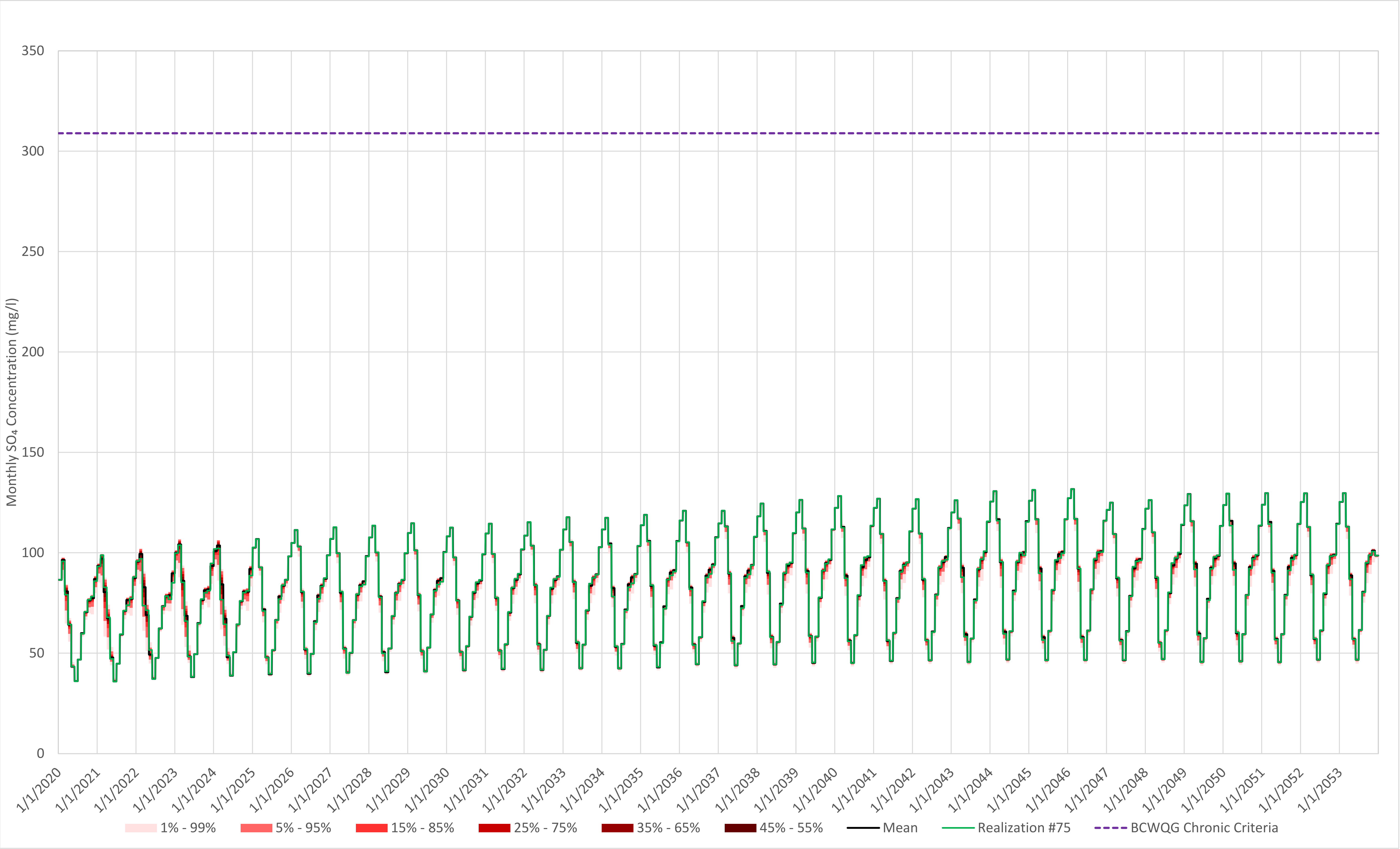

Monthly SO_4 Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: RG_ELKORES

Scenario: Average Case (P_{50}) Layering Succeeds


0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

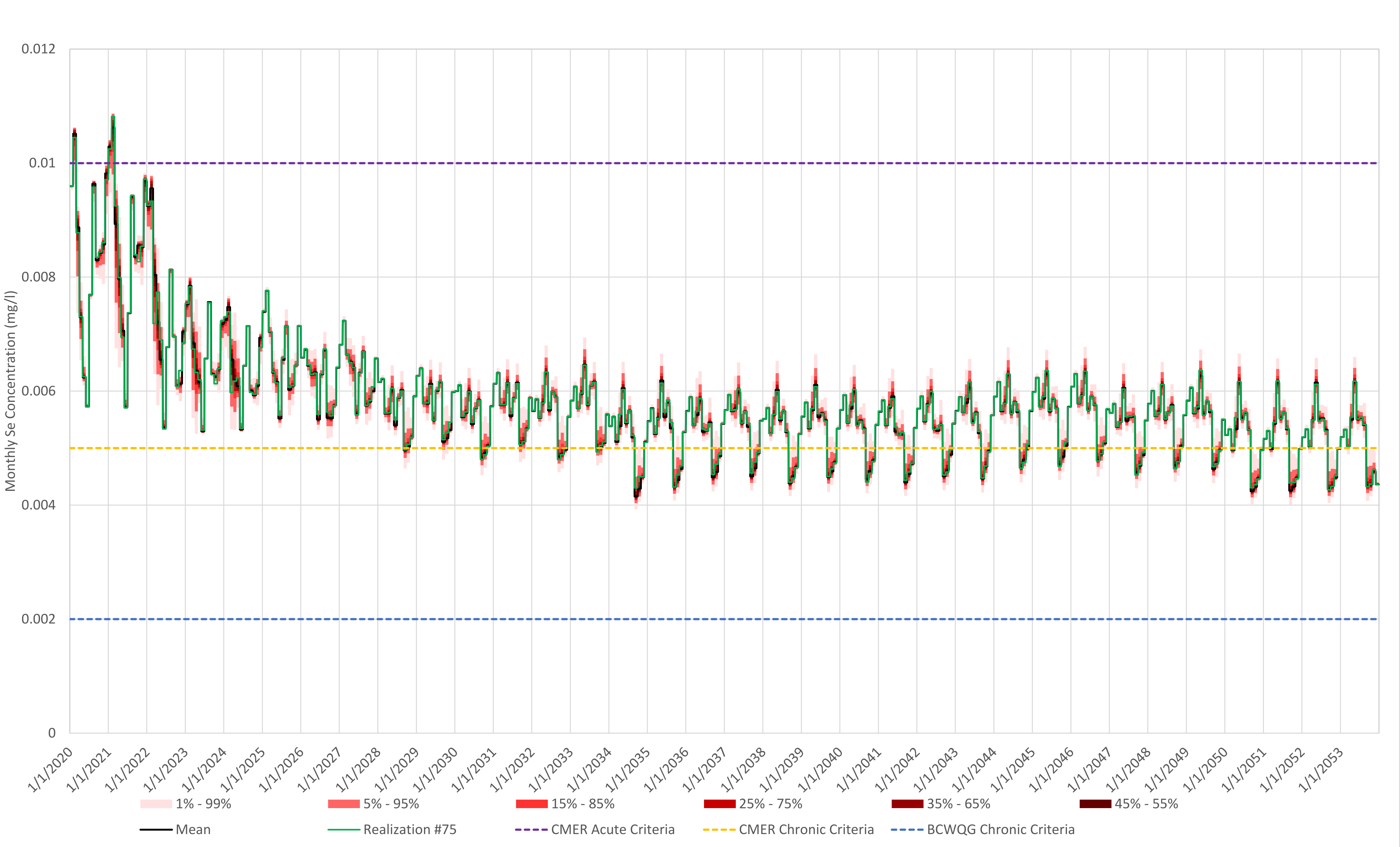

Monthly NO$_3$ Concentration (mg/l)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

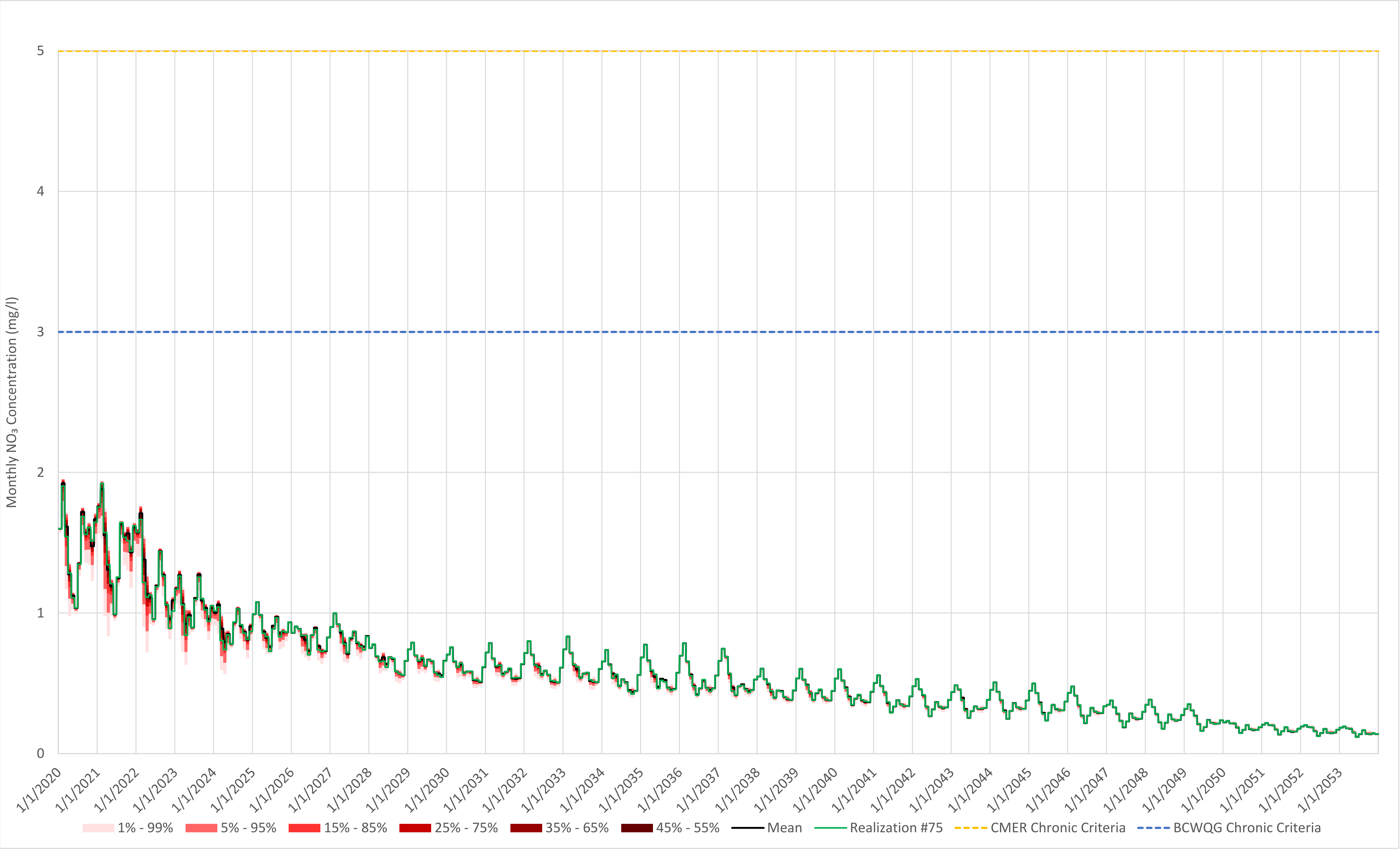


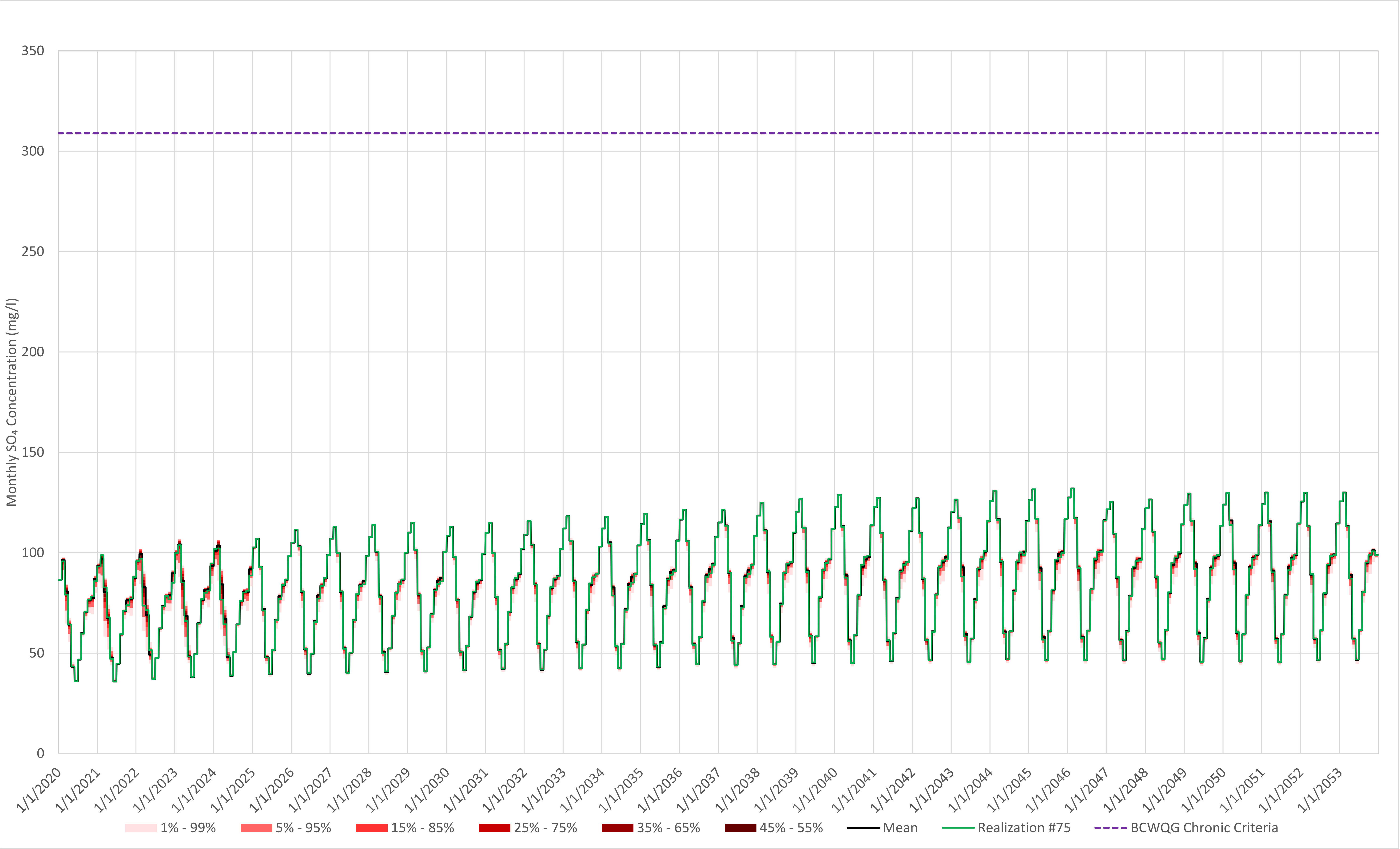
350
300
250
200
150
100
50
0
Monthly SO₄ Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: RG_ELKORES

Scenario: Average Case (P_{50}) Layering Fails

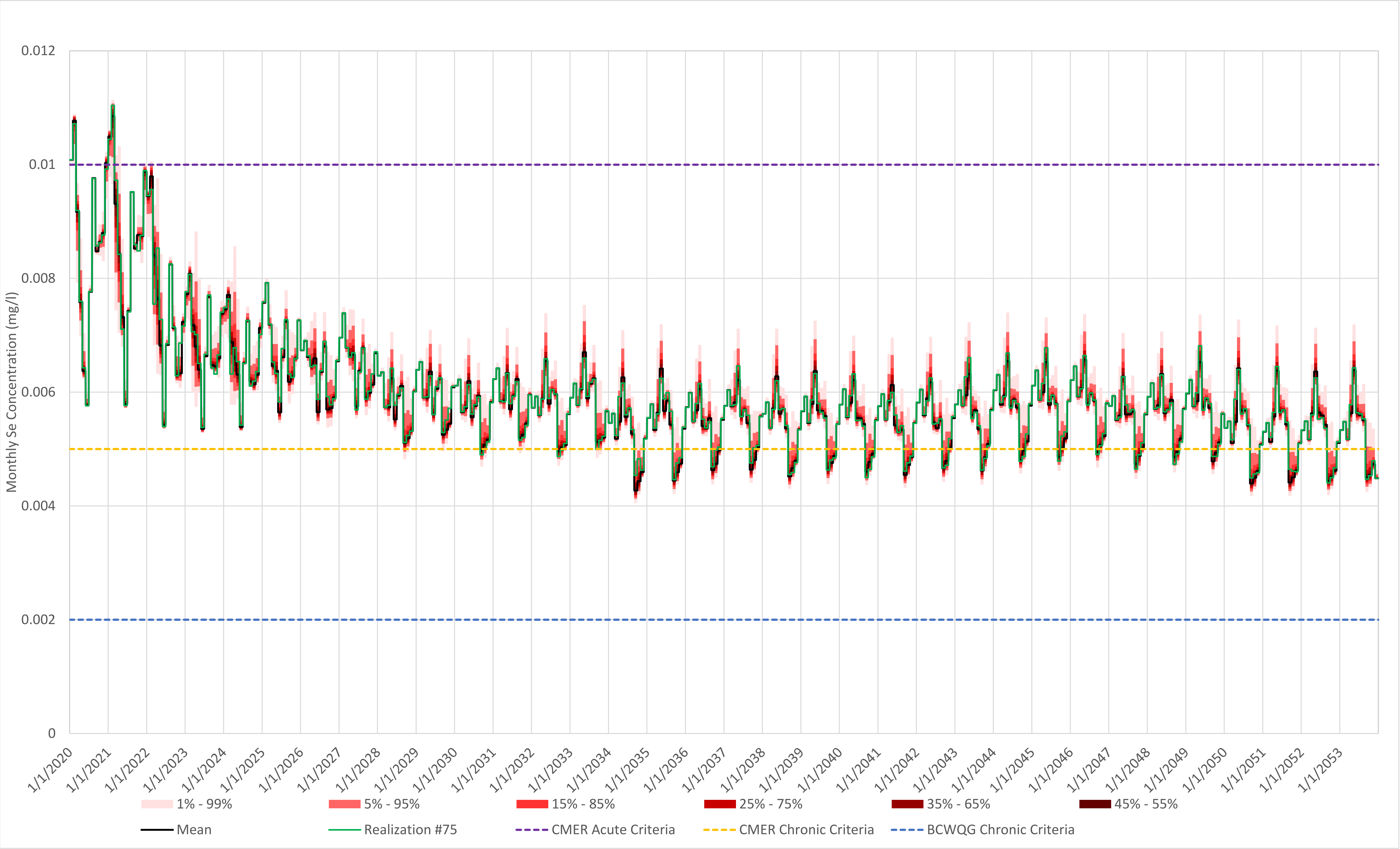

Monthly Se Concentration (mg/l)
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

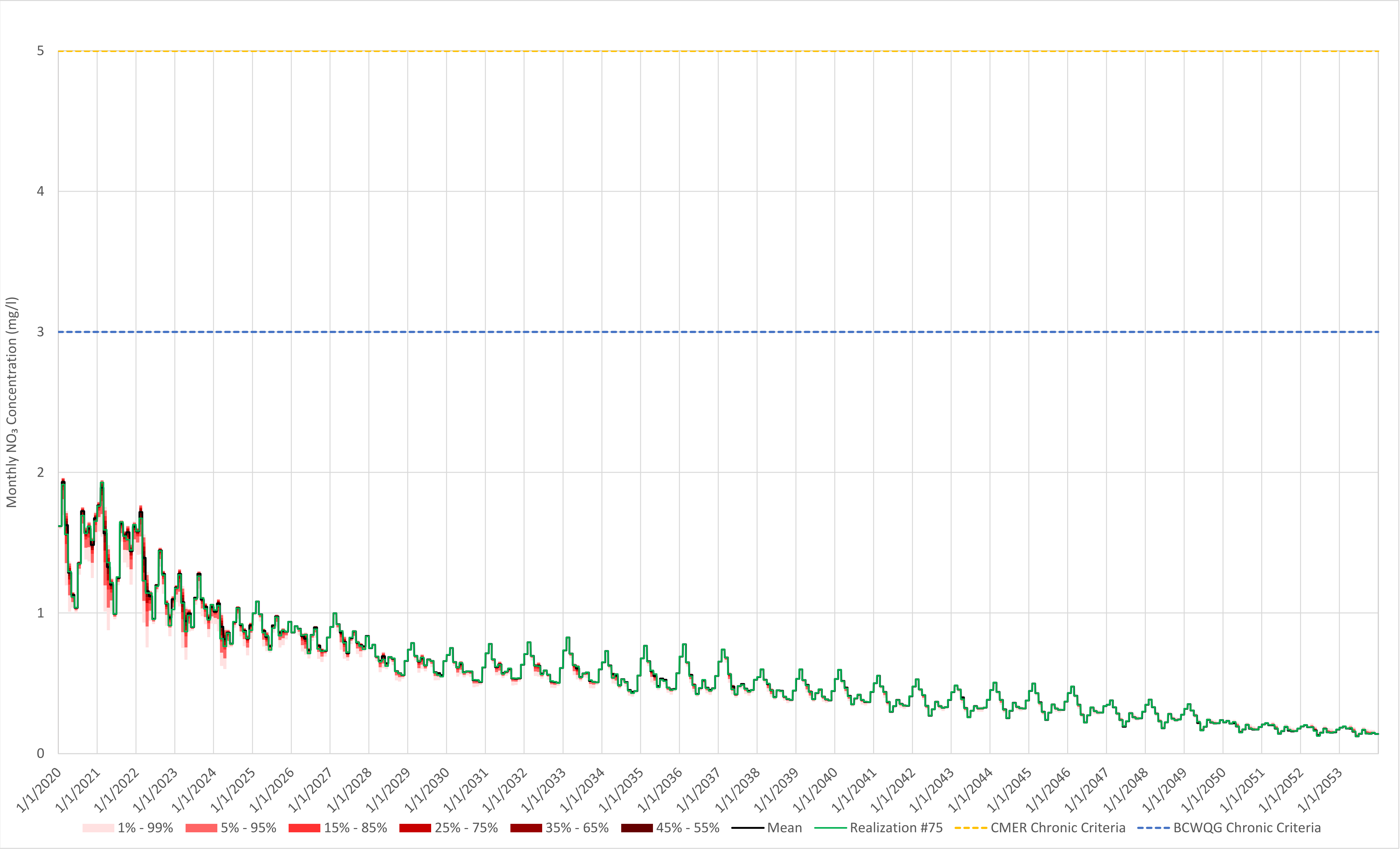

Monthly NO$_3$ Concentration (mg/l)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

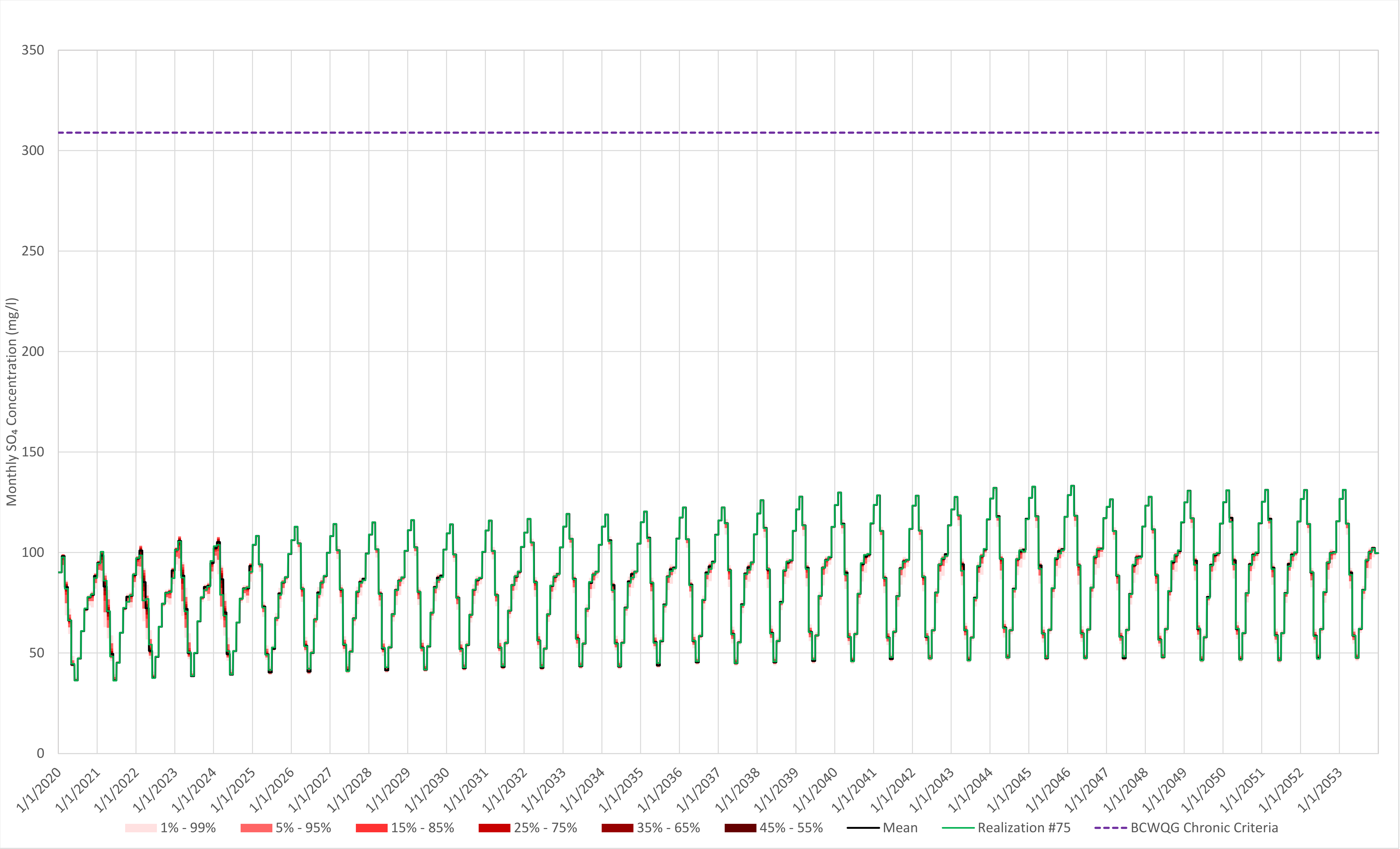

Monthly SO$_4$ Concentration (mg/l)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: RG_ELKORES

Scenario: Average Case (P_{95}) Layering Succeeds

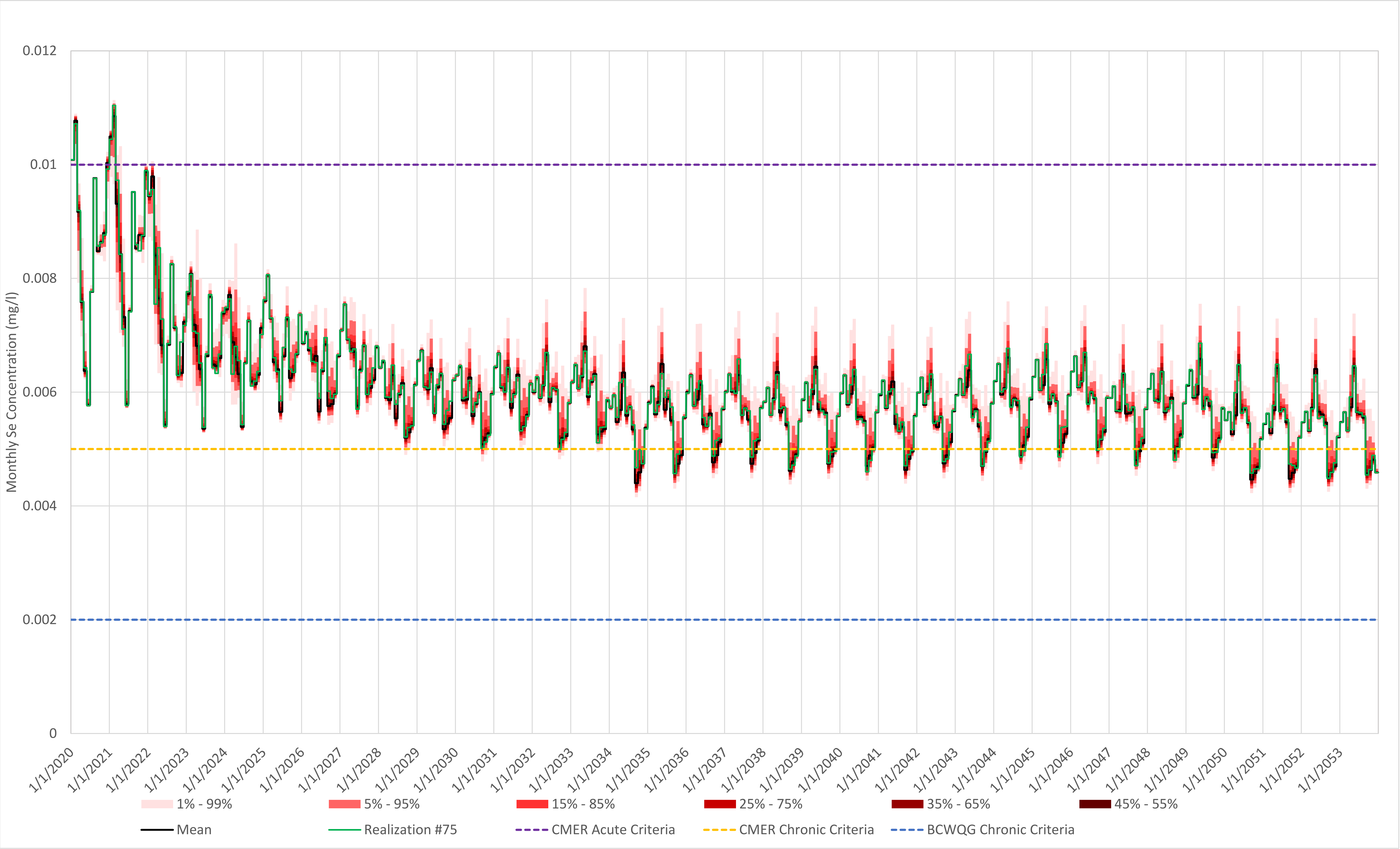

0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

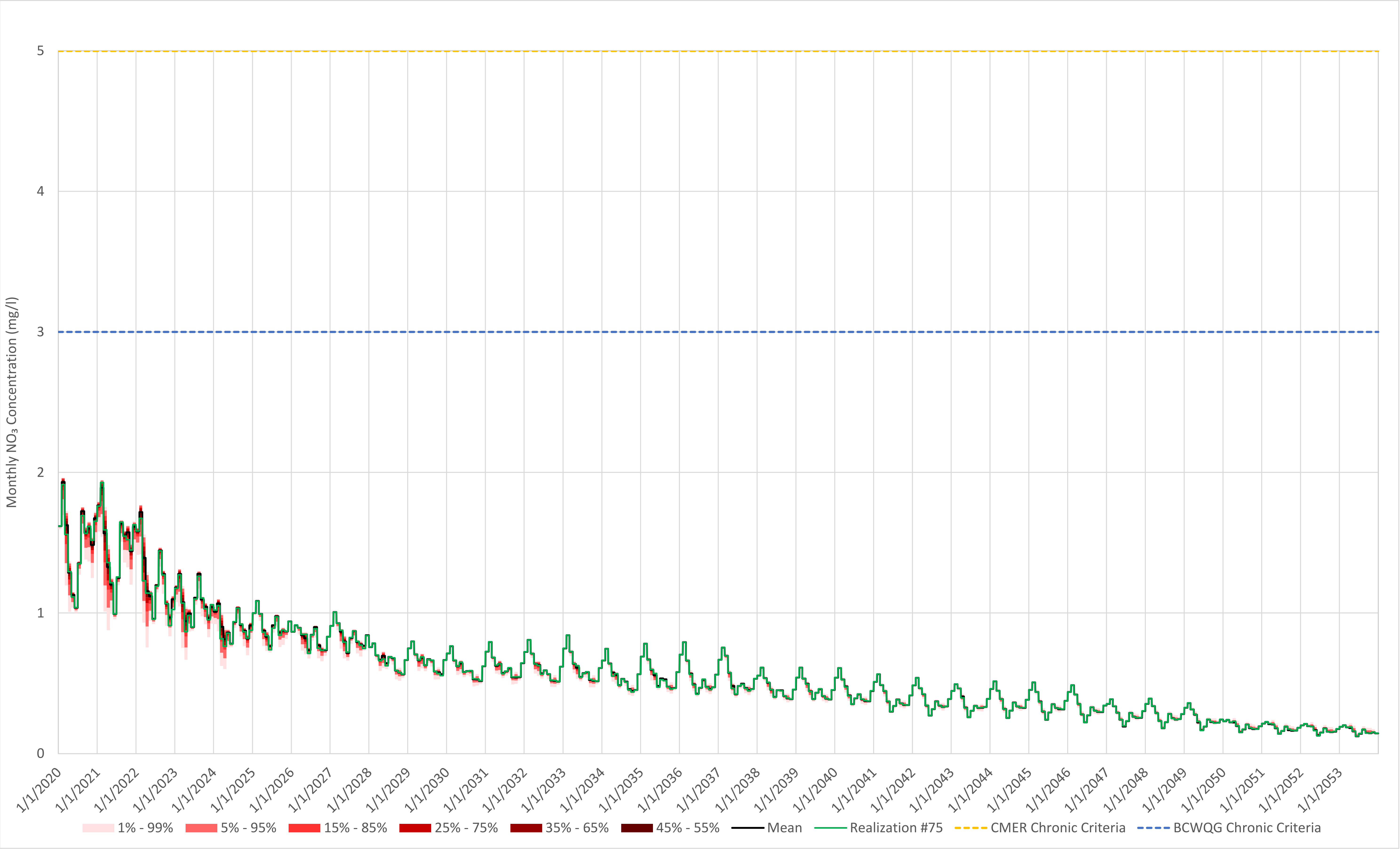

Monthly NO₃ Concentration (mg/l)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

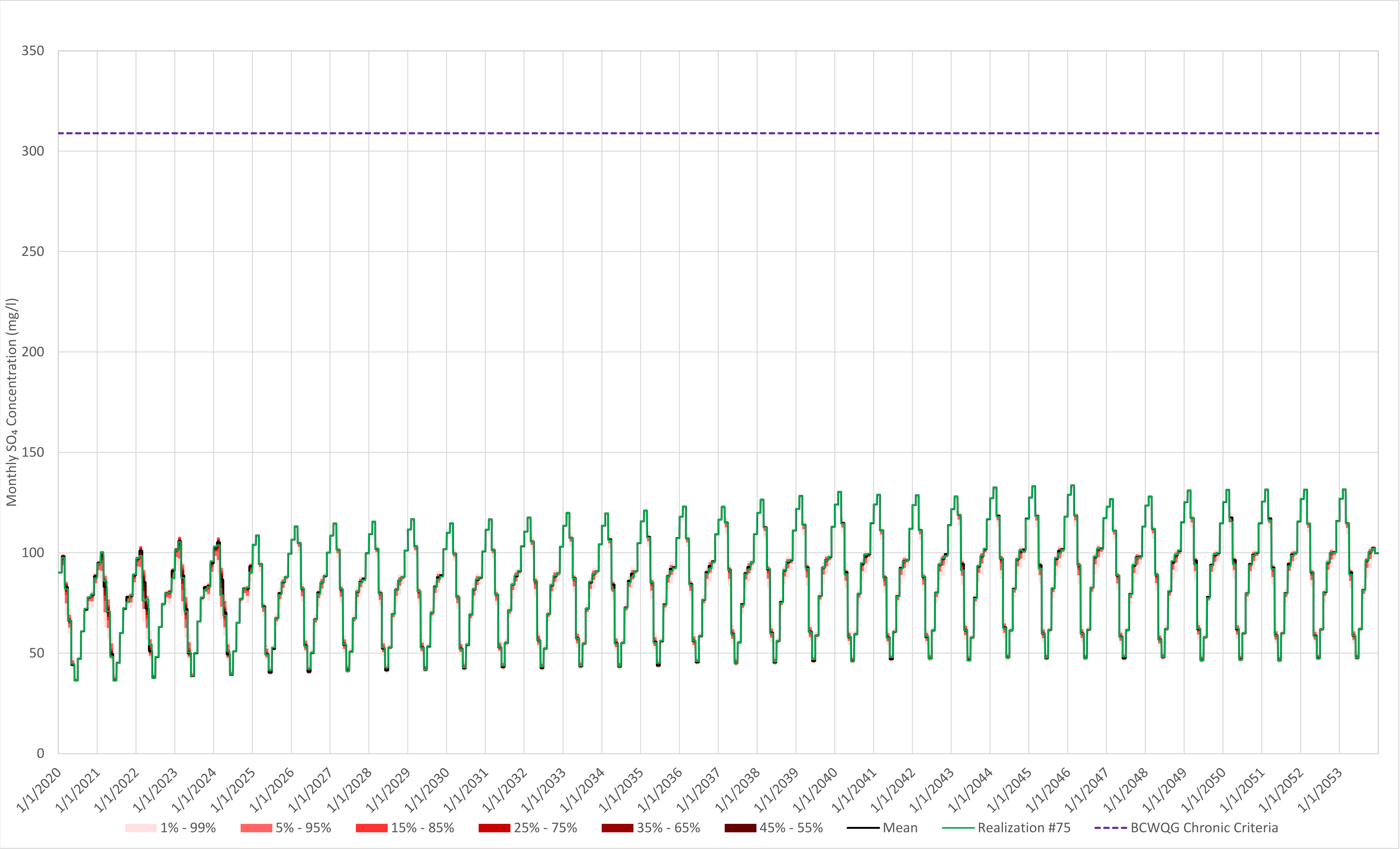

Monthly SO$_4$ Concentration (mg/l)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: RG_ELKORES

Scenario: Average Case (P_{95}) Layering Fails

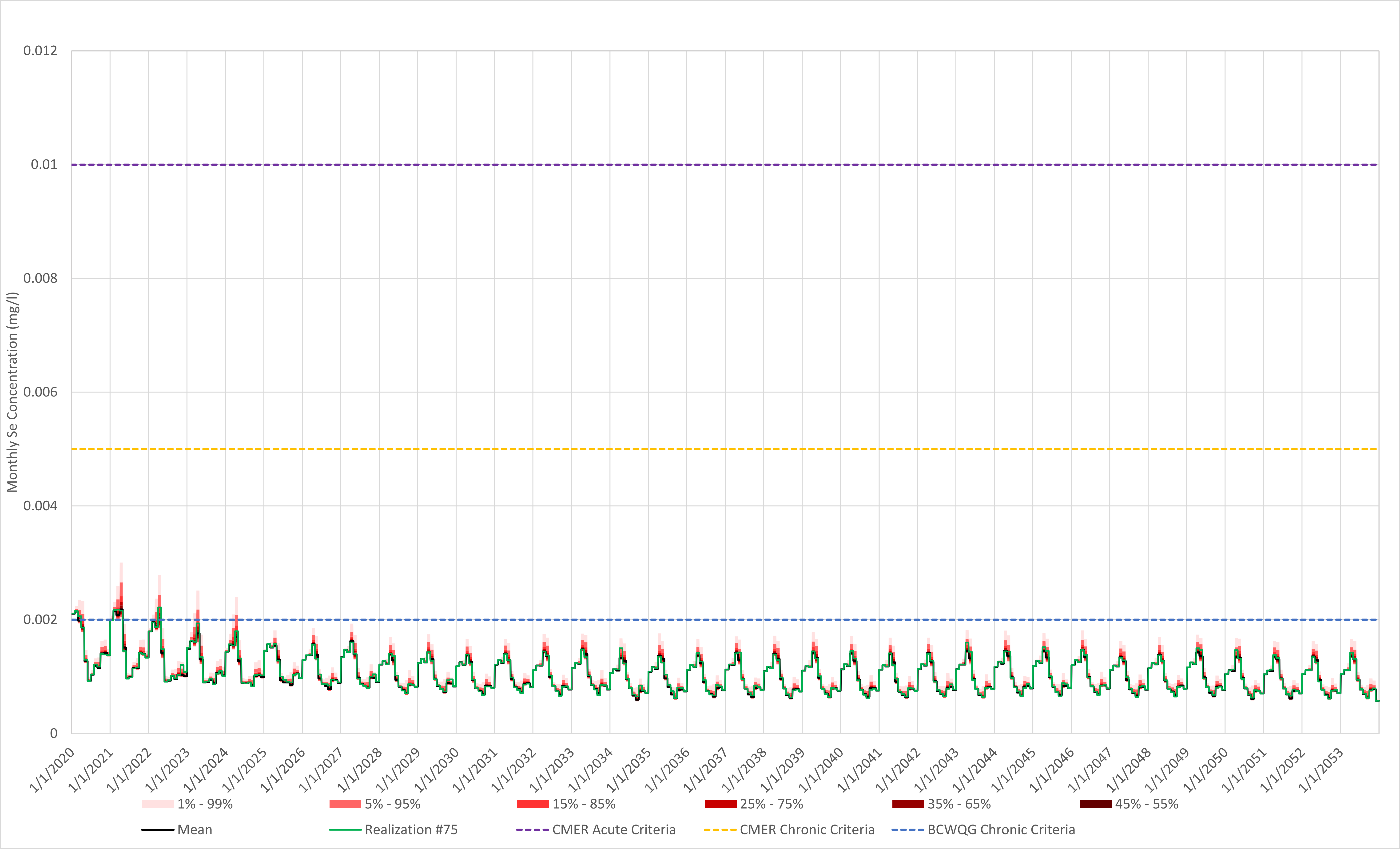

Monthly Se Concentration (mg/l)
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

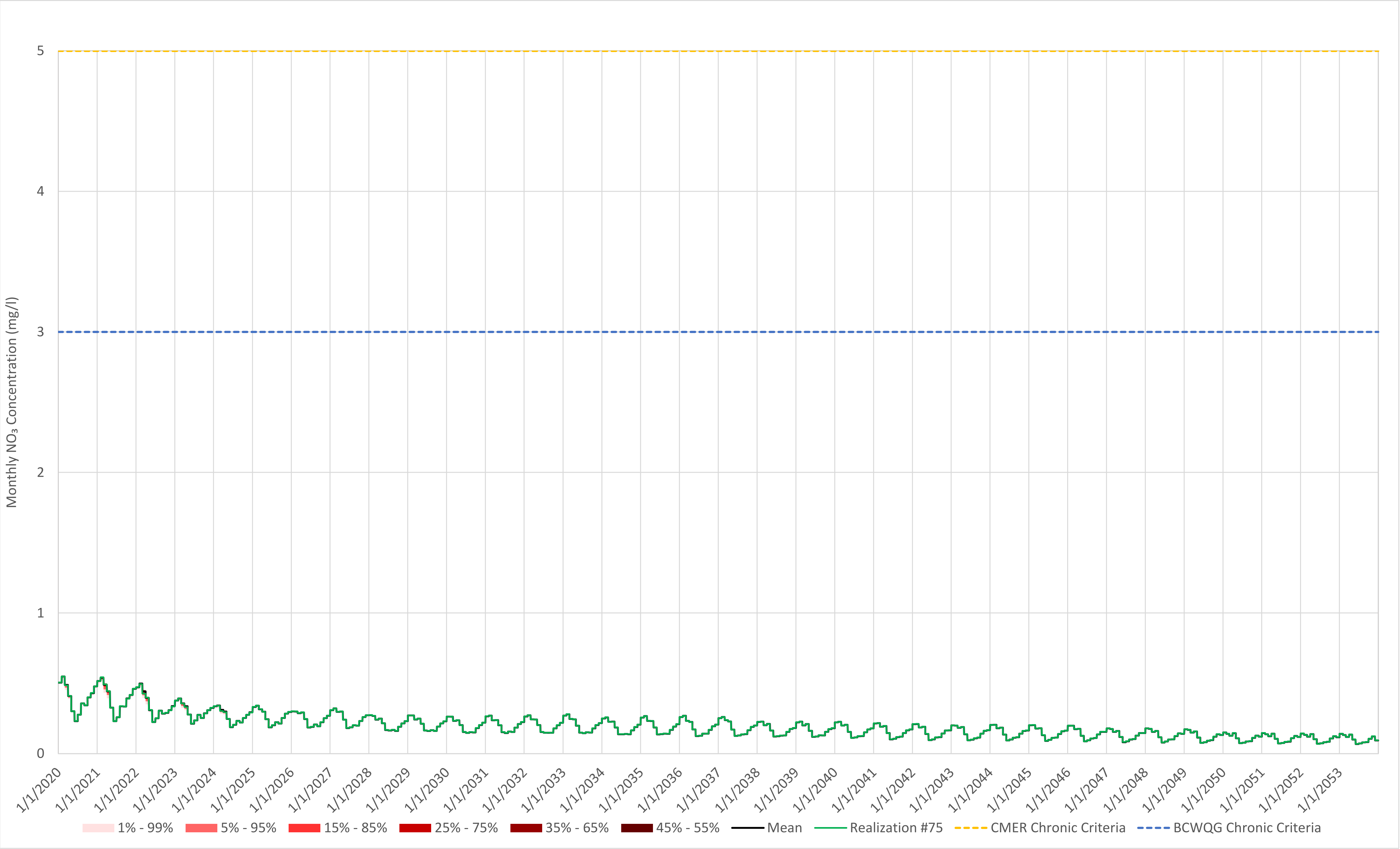

Monthly NO$_3$ Concentration (mg/l)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

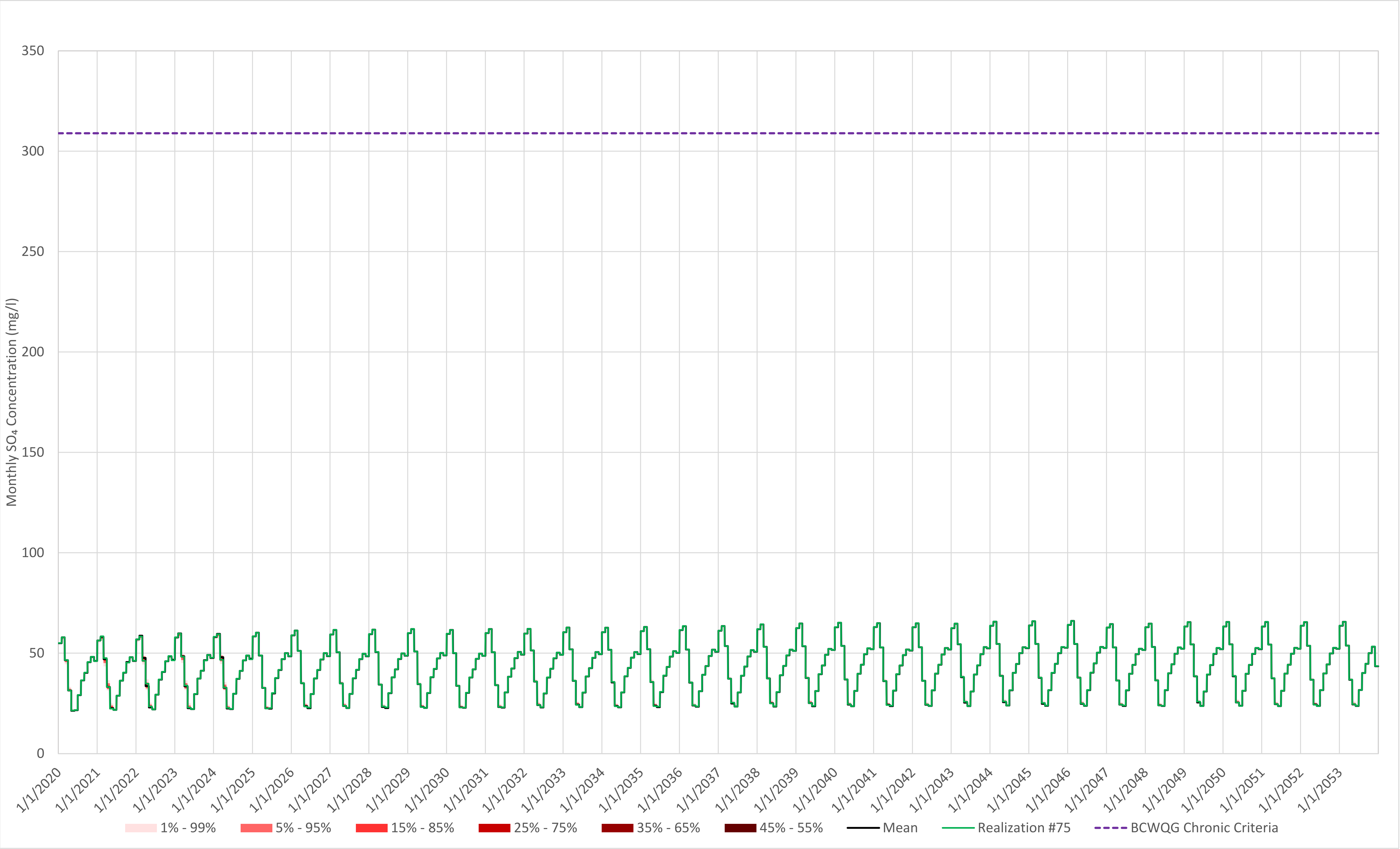

350
300
250
200
150
100
50
0
Monthly SO$_4$ Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: RG_DSELK

Scenario: Average Case (P_{50}) Layering Succeeds

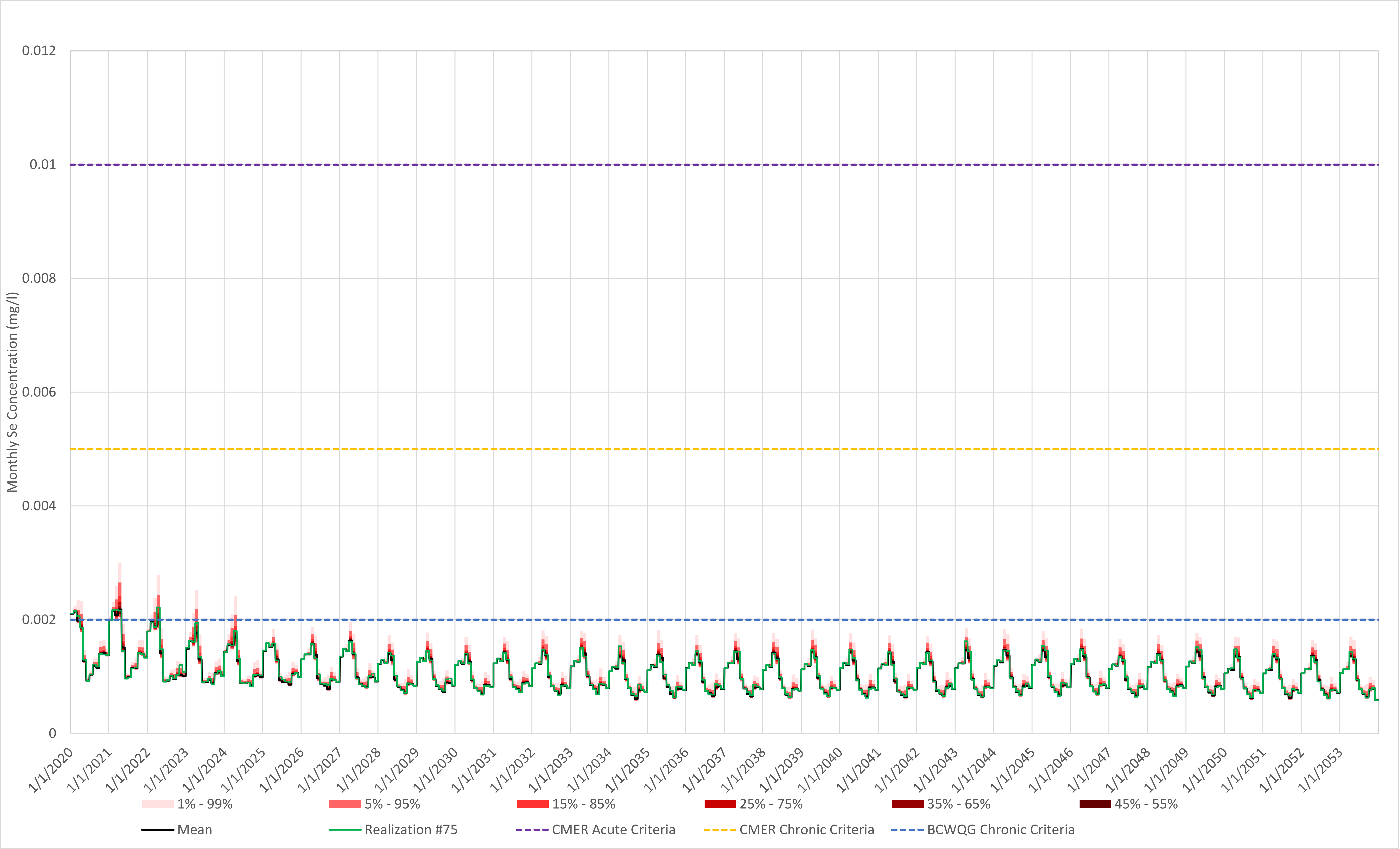

Monthly Se Concentration (mg/l)
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

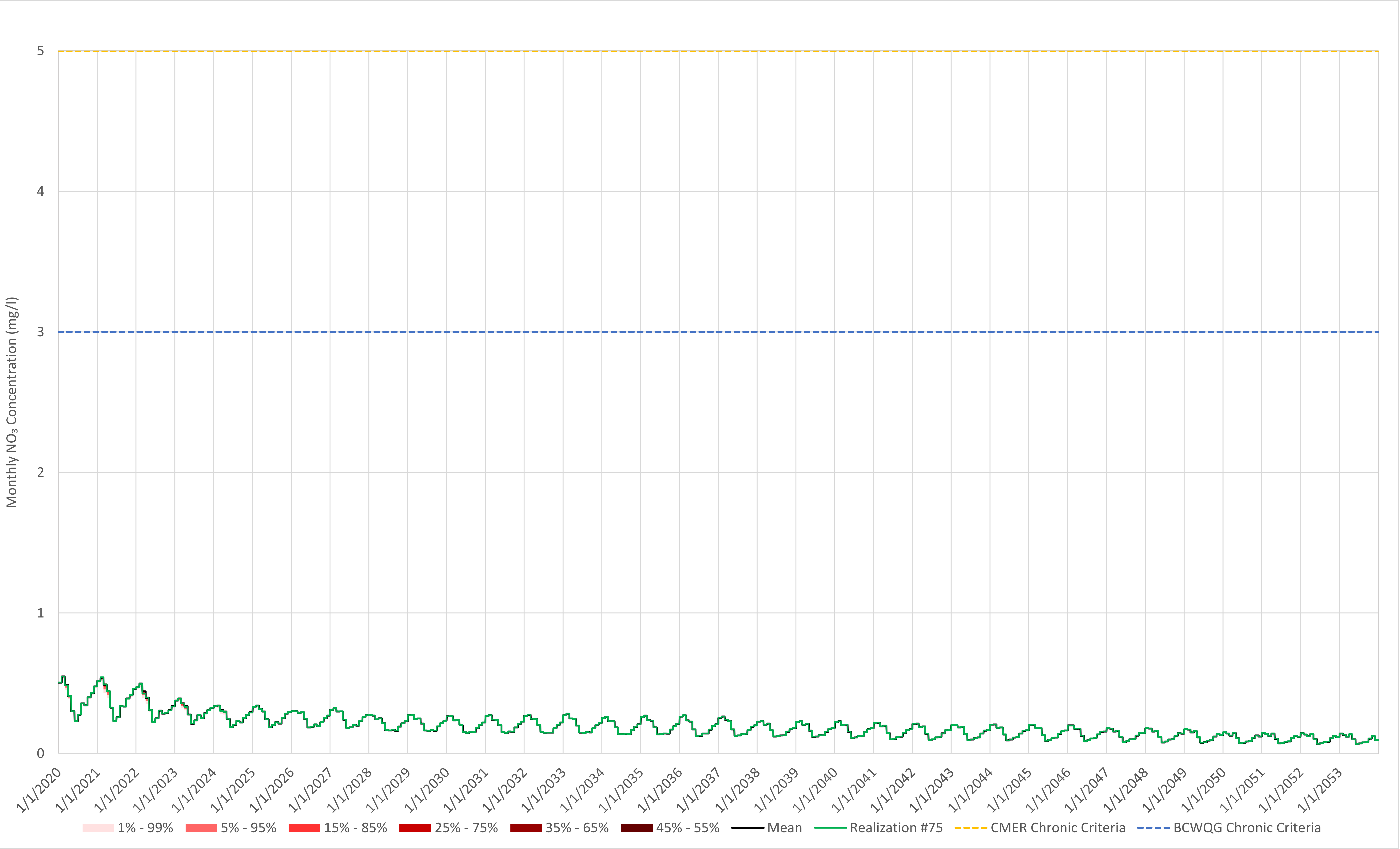

Monthly NO₃ Concentration (mg/l)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

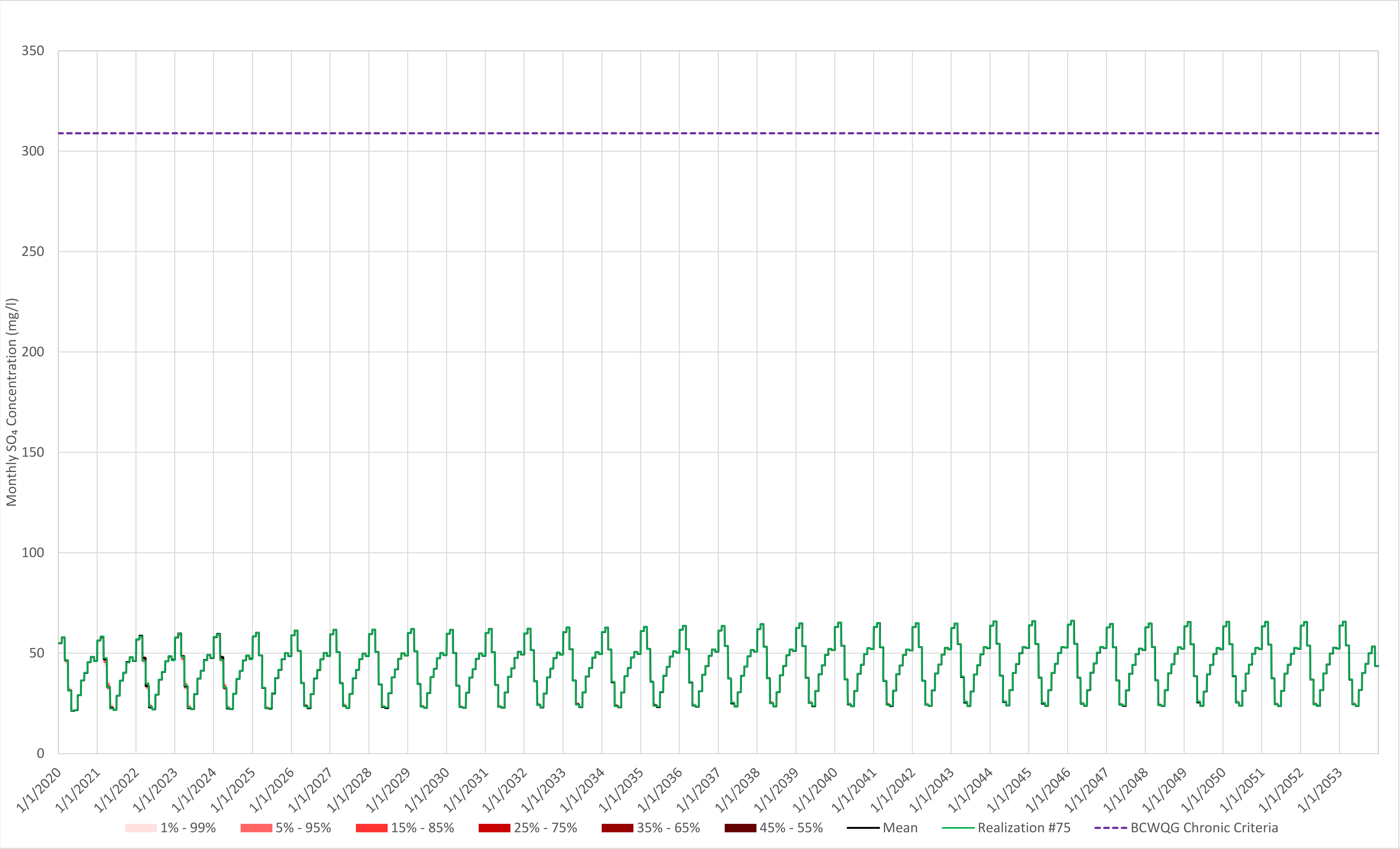

Monthly SO₄ Concentration (mg/l)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: RG_DSELK

Scenario: Average Case (P_{50}) Layering Fails


0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

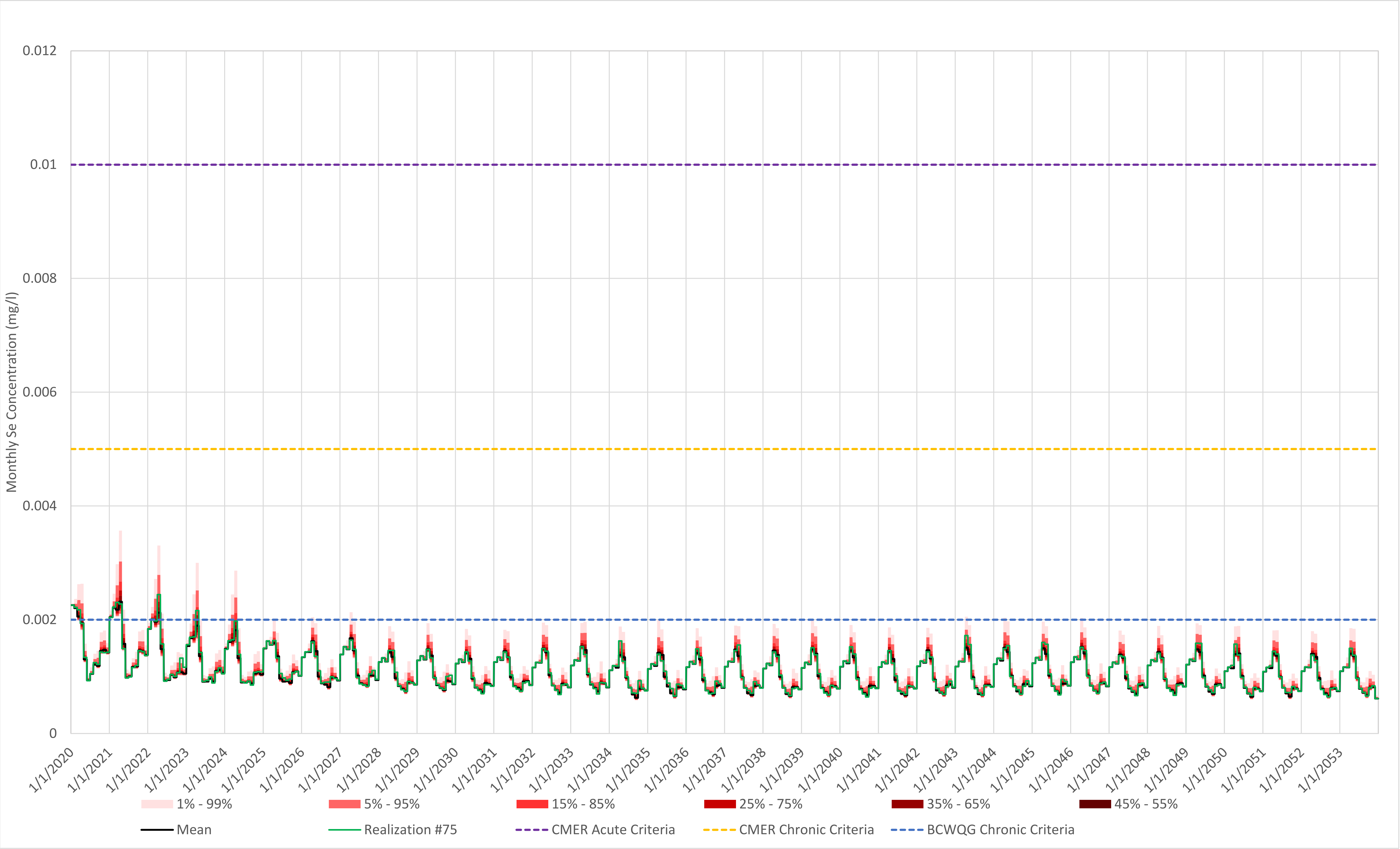

Monthly NO$_3$ Concentration (mg/l)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

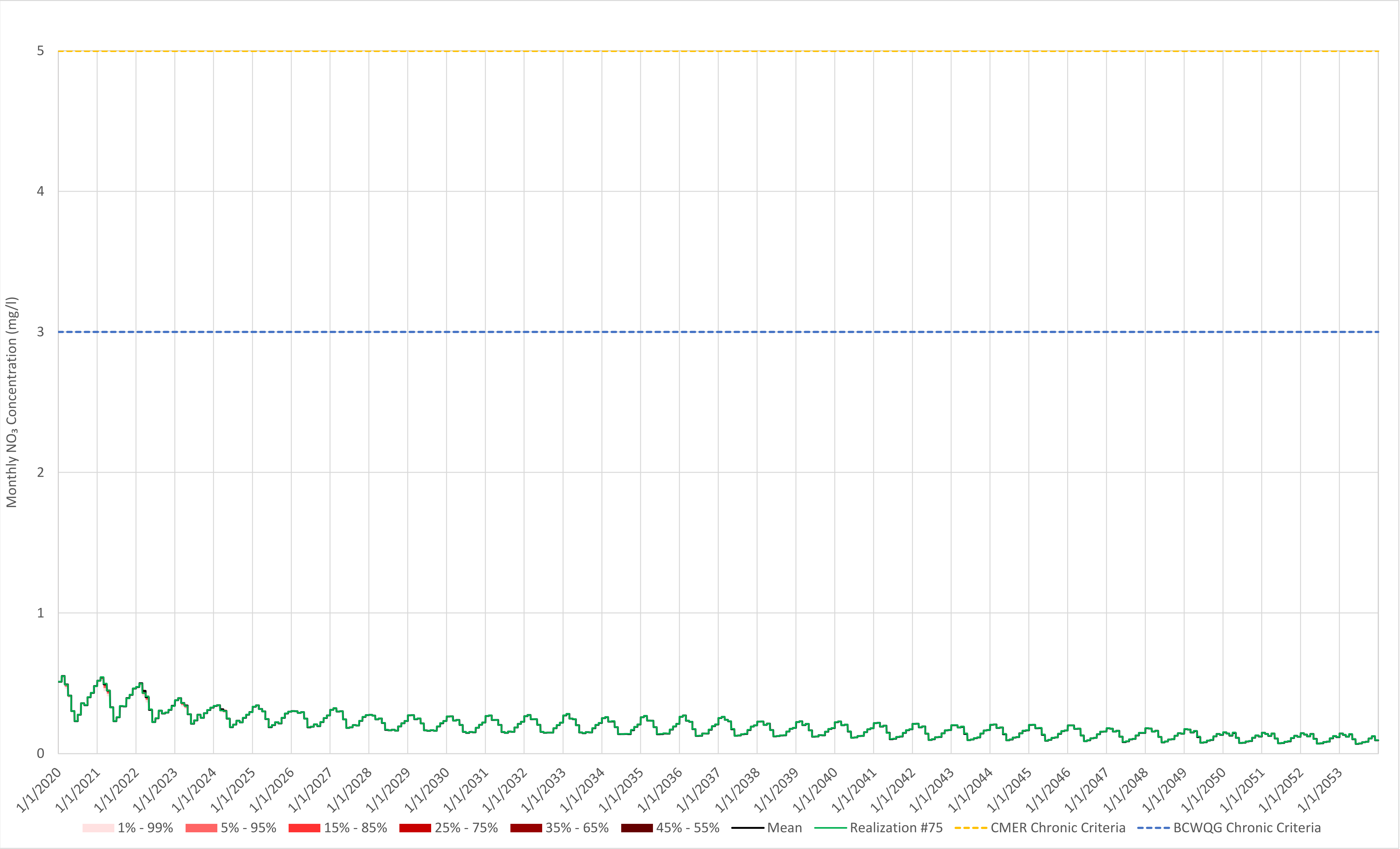


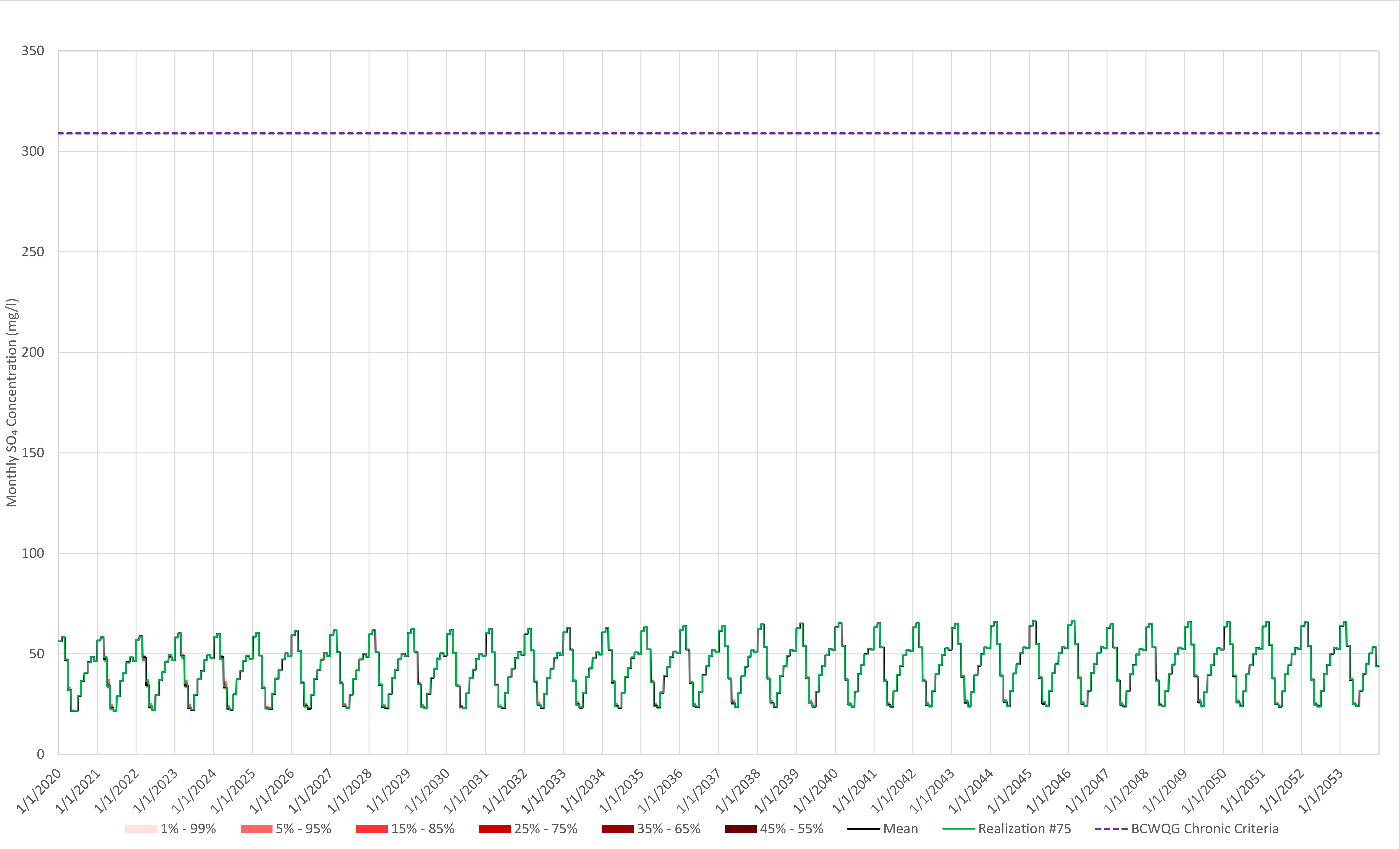
Monthly SO₄ Concentration (mg/l)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Elk Valley Station: RG_DSELK

Scenario: Average Case (P_{95}) Layering Succeeds


0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

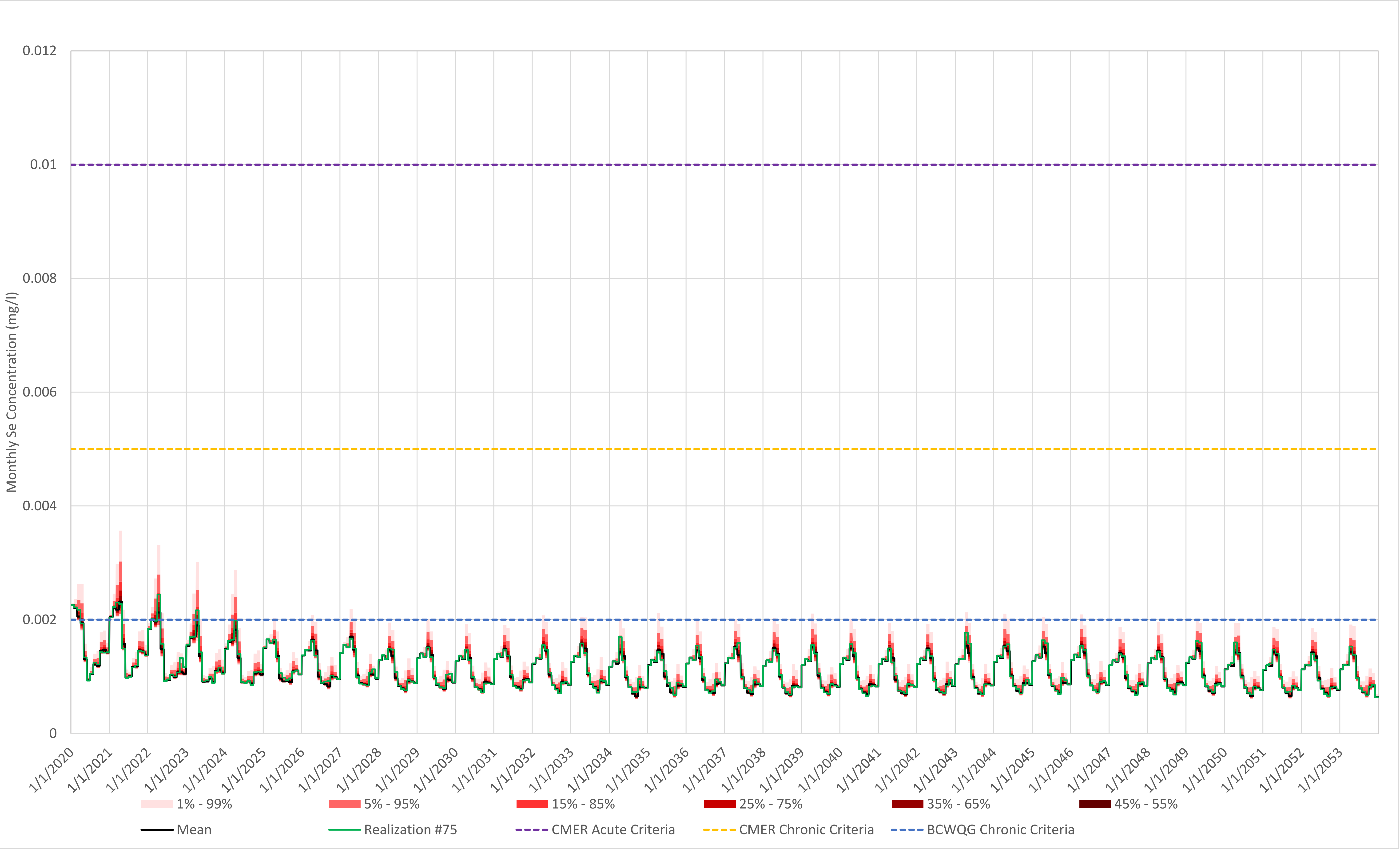

Monthly NO₃ Concentration (mg/l)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria



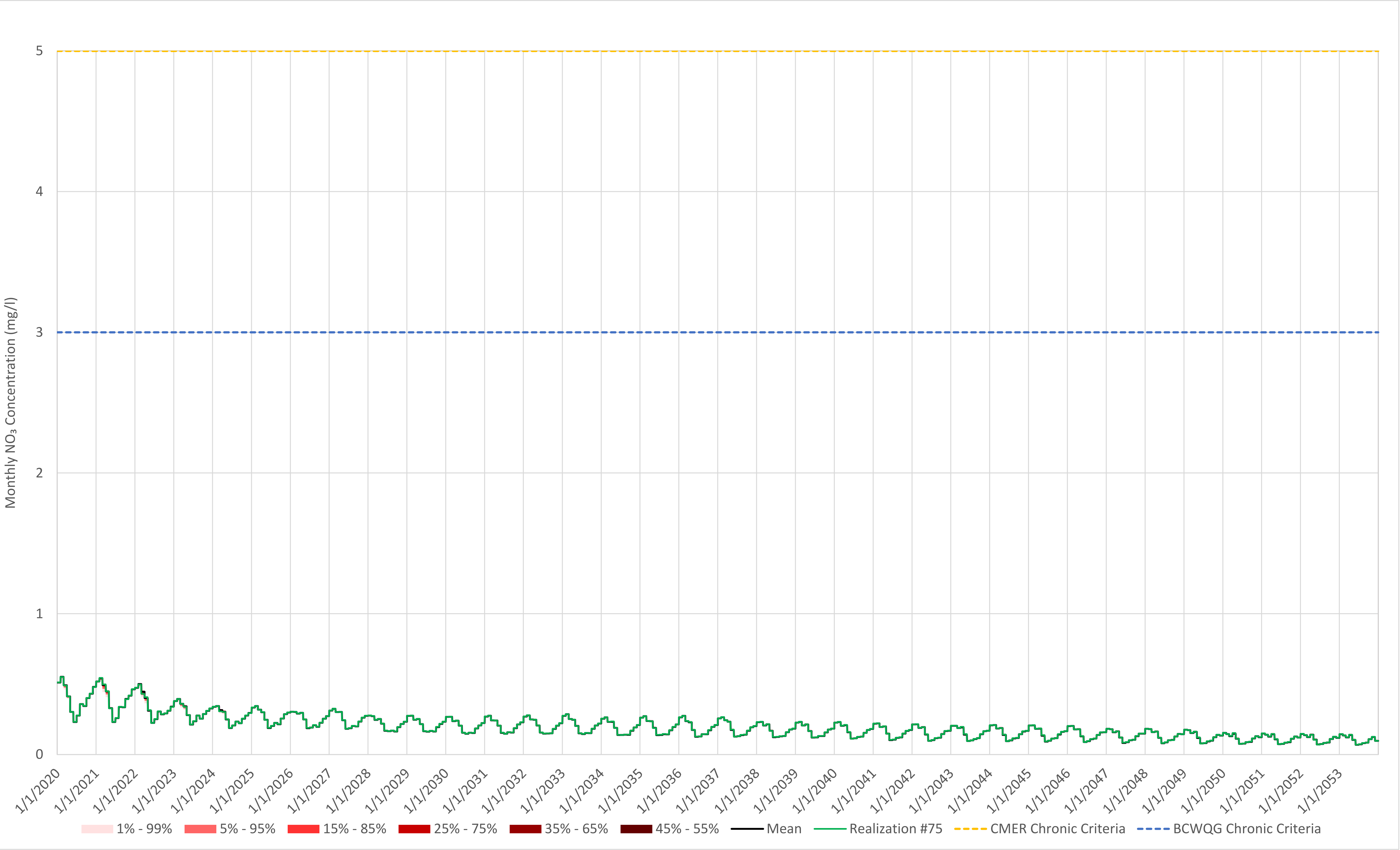
350
300
250
200
150
100
50
0
Monthly SO₄ Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

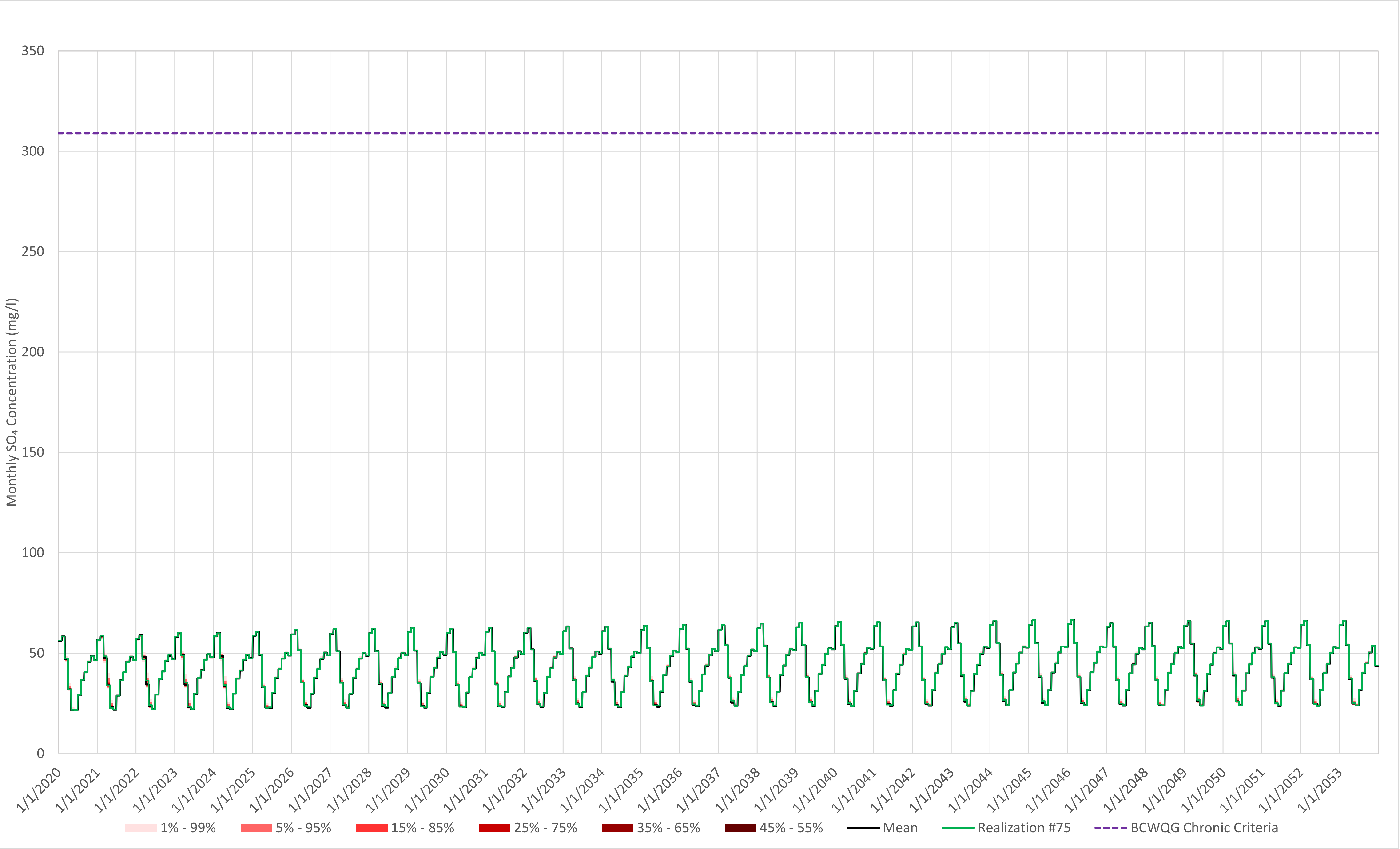
Elk Valley Station: RG_DSELK

Scenario: Average Case (P_{95}) Layering Fails

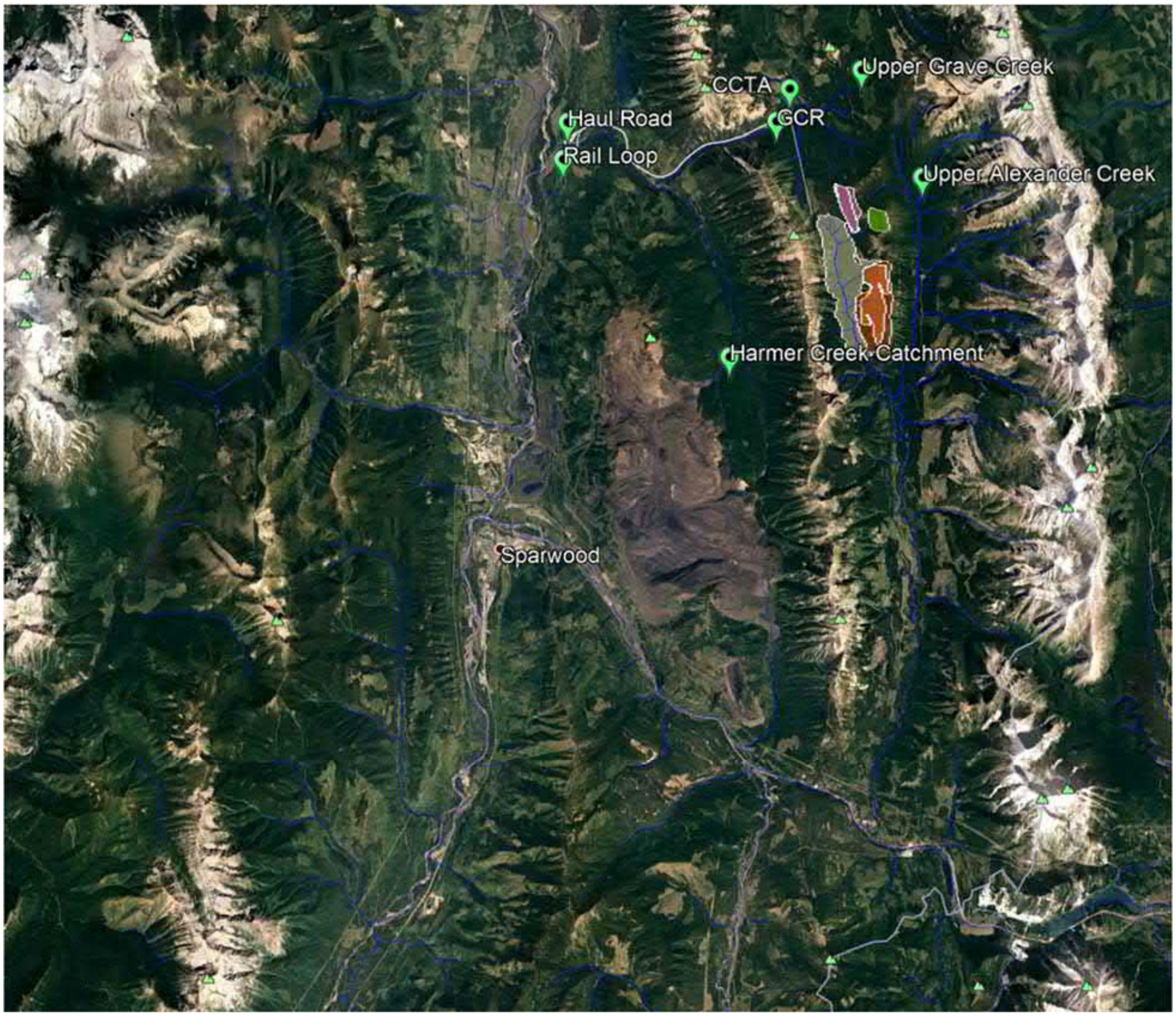


0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/l)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly NO$_3$ Concentration (mg/l)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly SO₄ Concentration (mg/l)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Appendix B Water Quality Results for Low Impact Facilities and Unimpacted Watershed



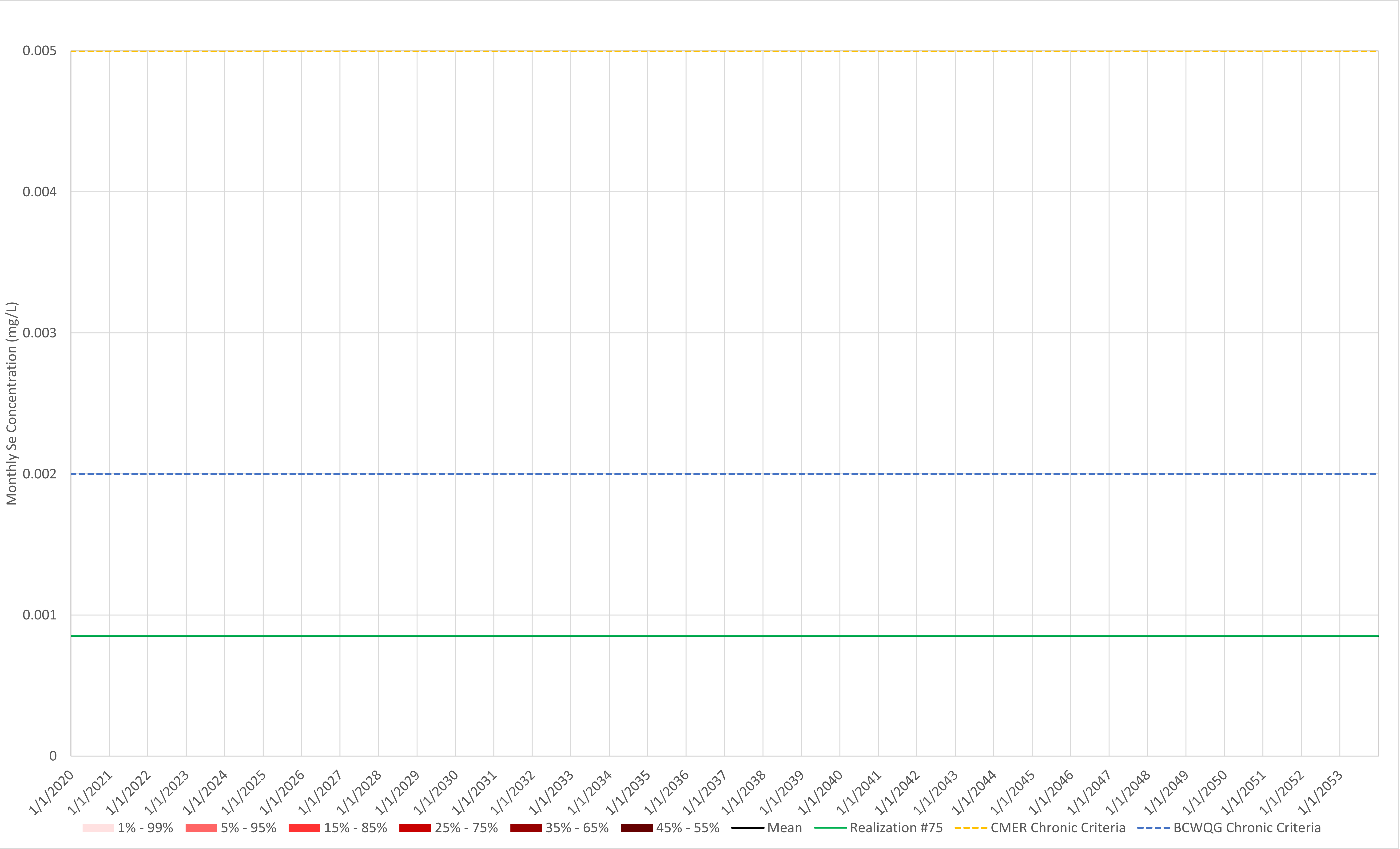
Low Impact Facilities & Unimpacted Watersheds

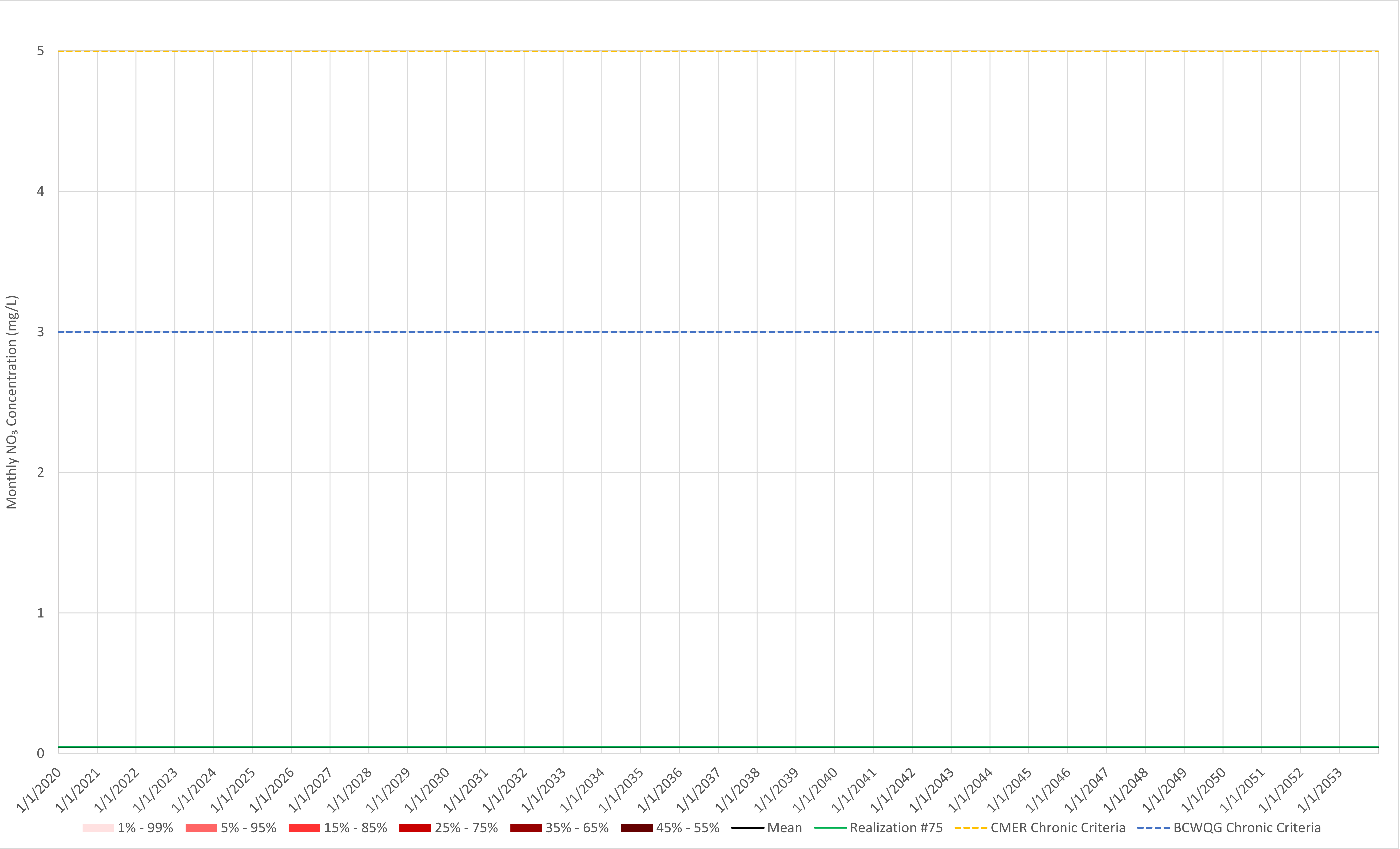
Average Case (P_{50}) Scenarios &

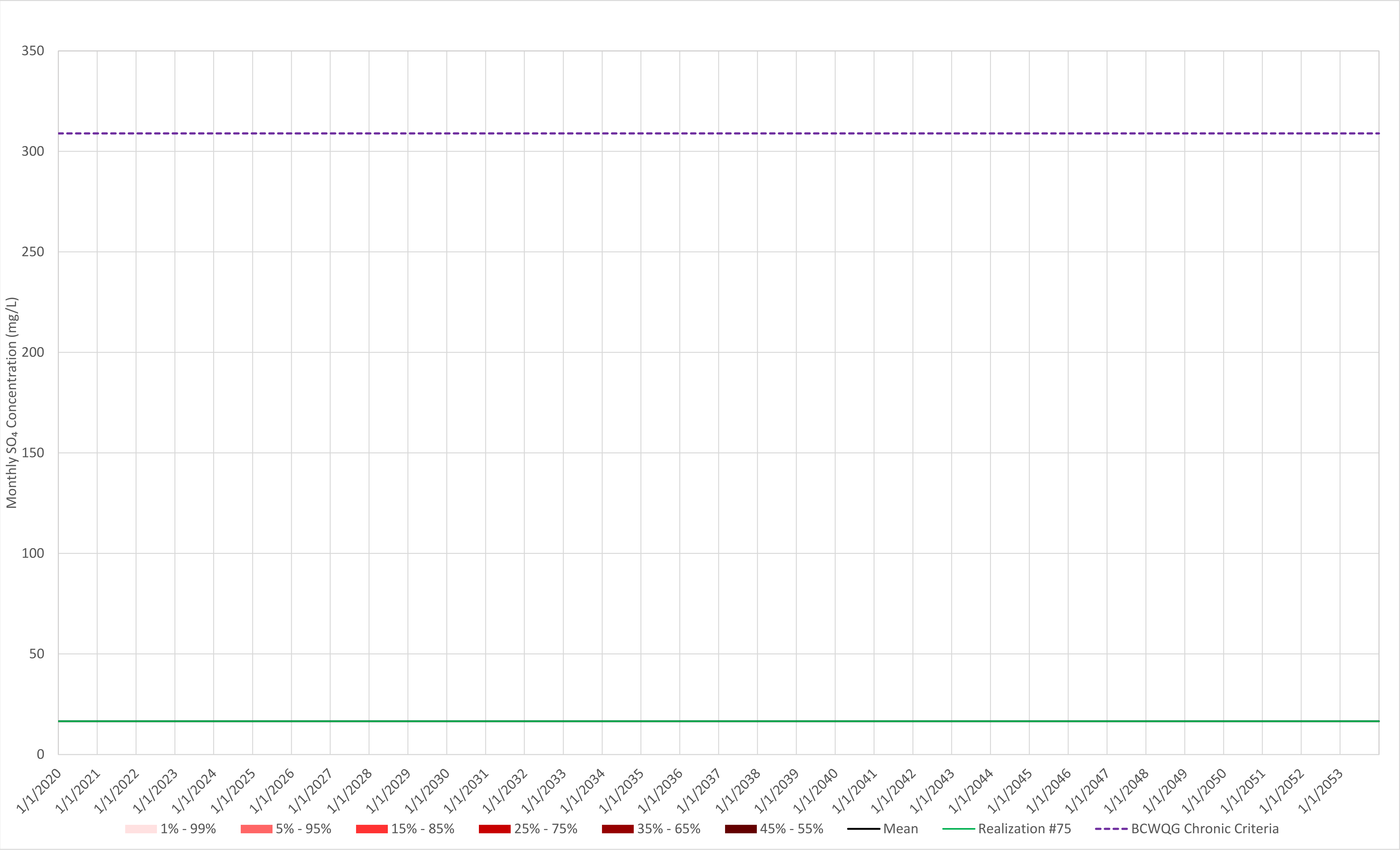
Upper Case (P_{95}) Scenarios

Reporting Location: Upper Grave & Alexander Creek

Scenario: Average Case (P_{50}) Layering Succeeds

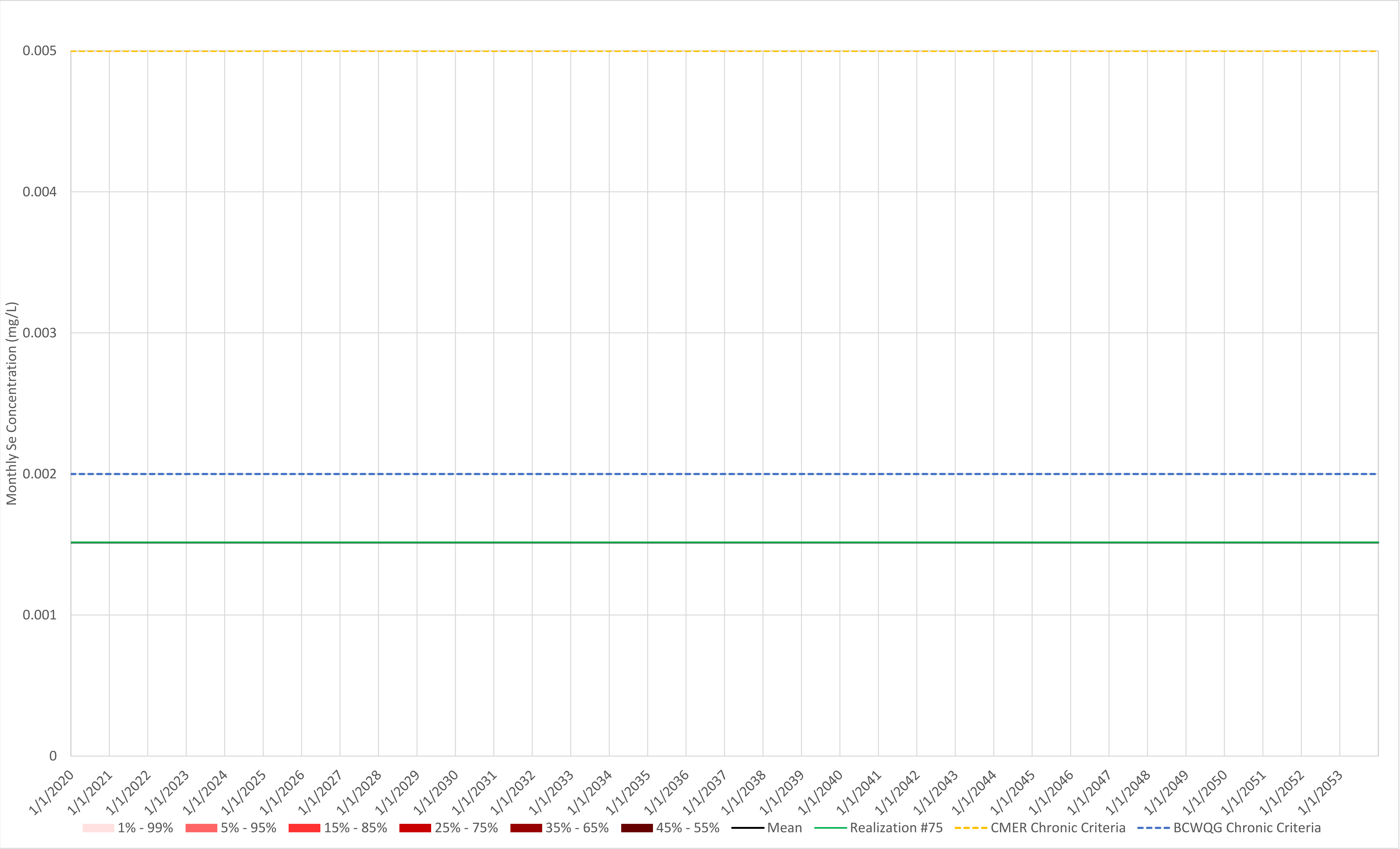

Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

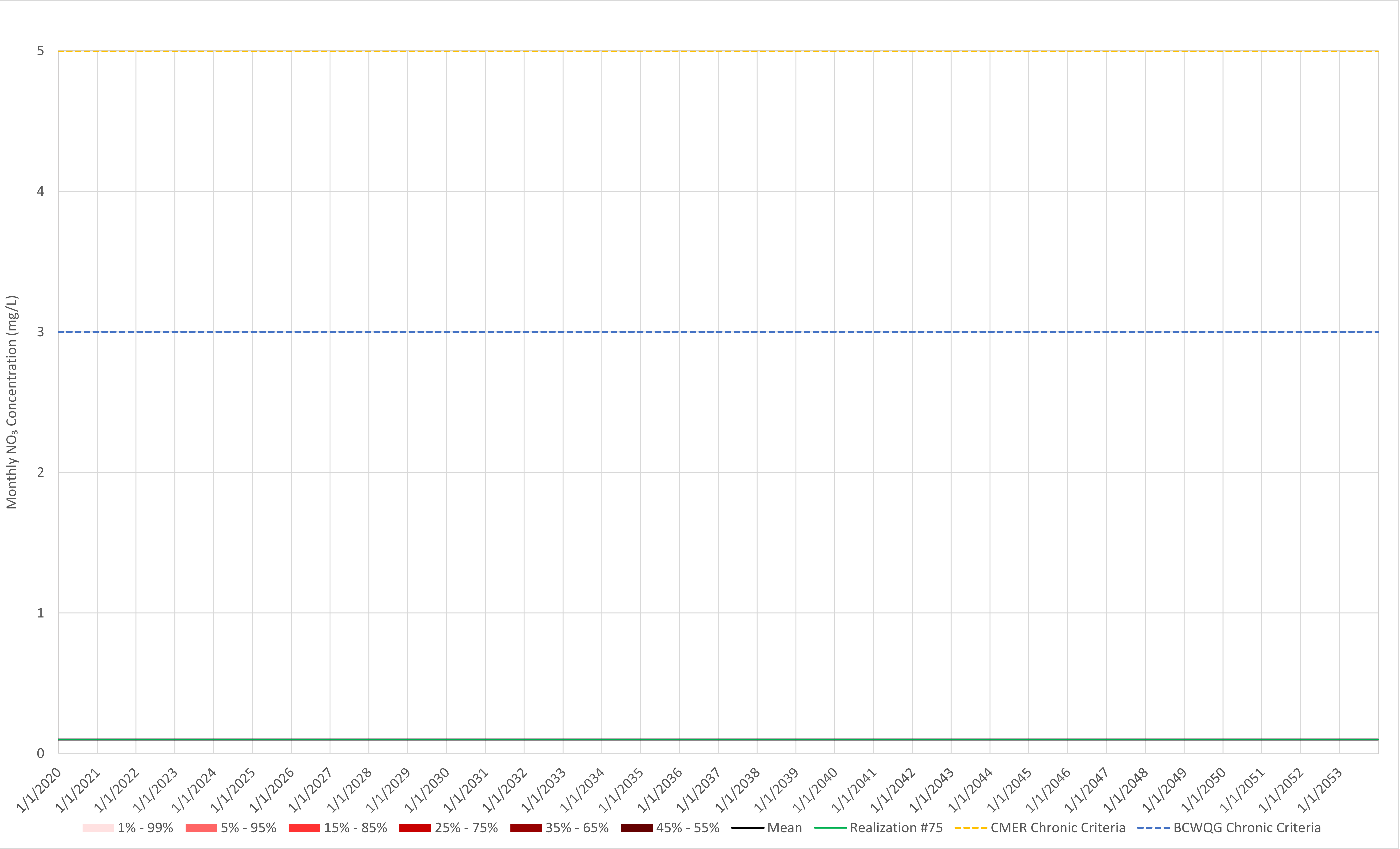

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

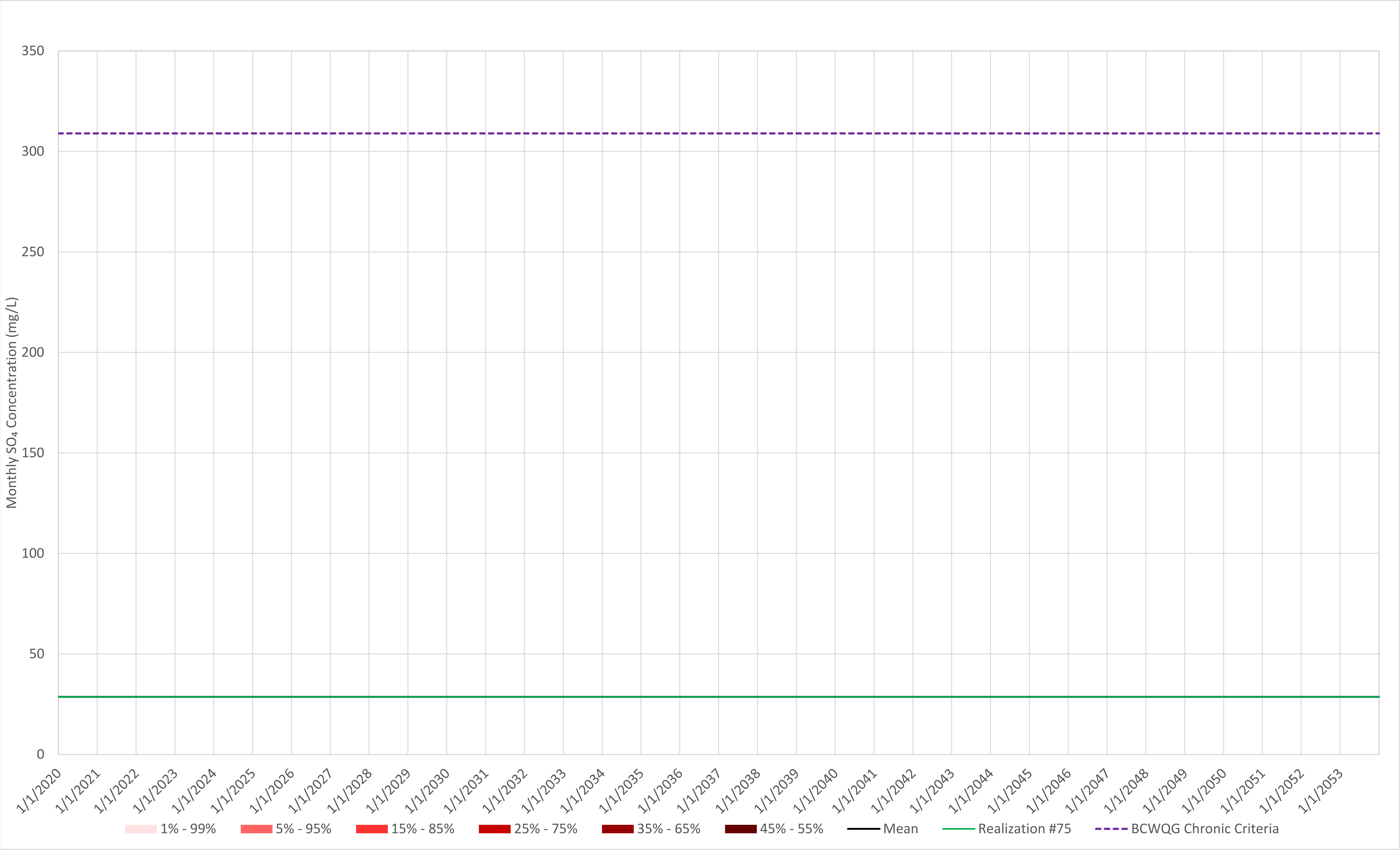

350
300
250
200
150
100
50
0
Monthly SO_4 Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Upper Grave & Alexander Creek

Scenario: Upper Case (P_{95}) Layering Fails

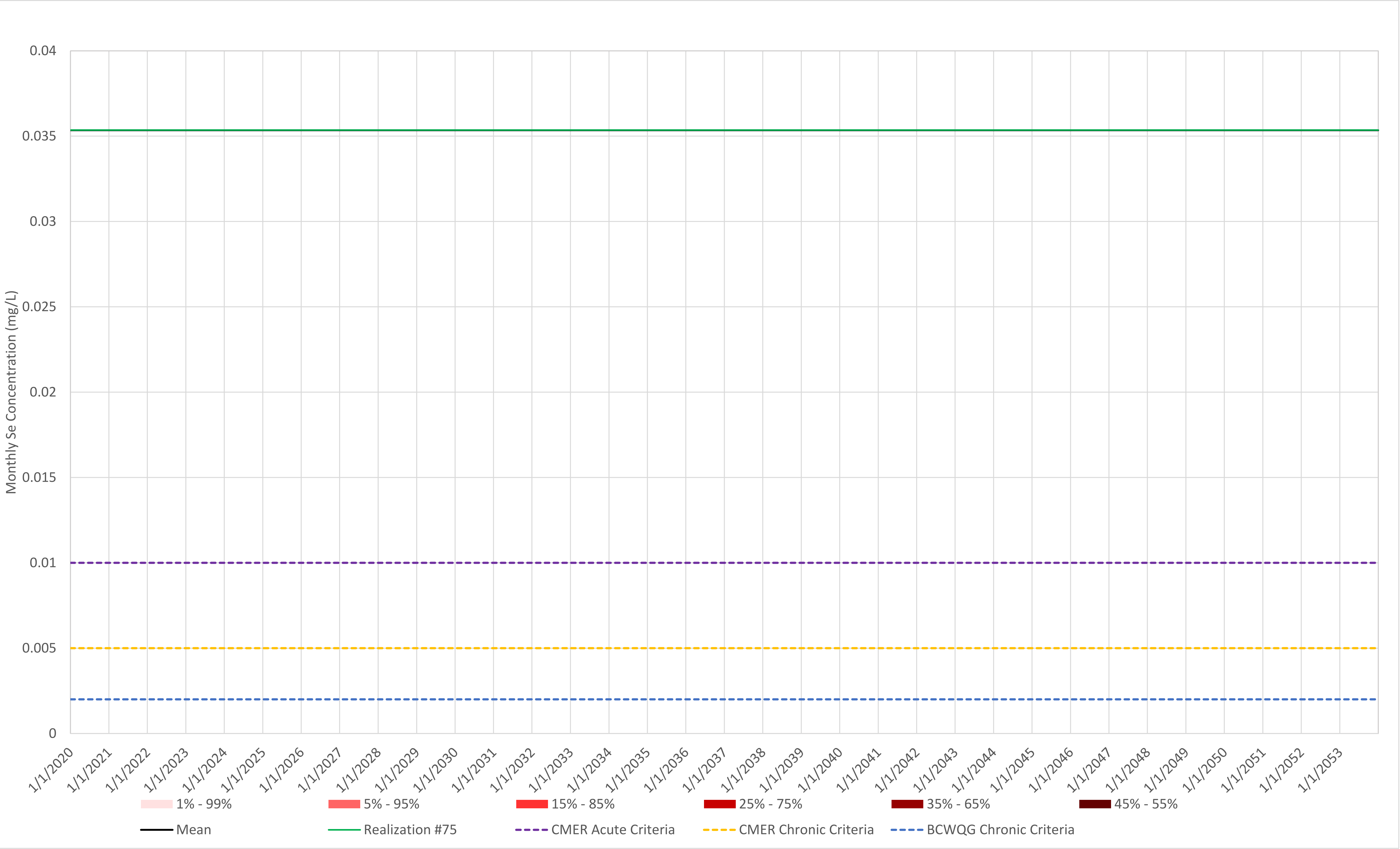

Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

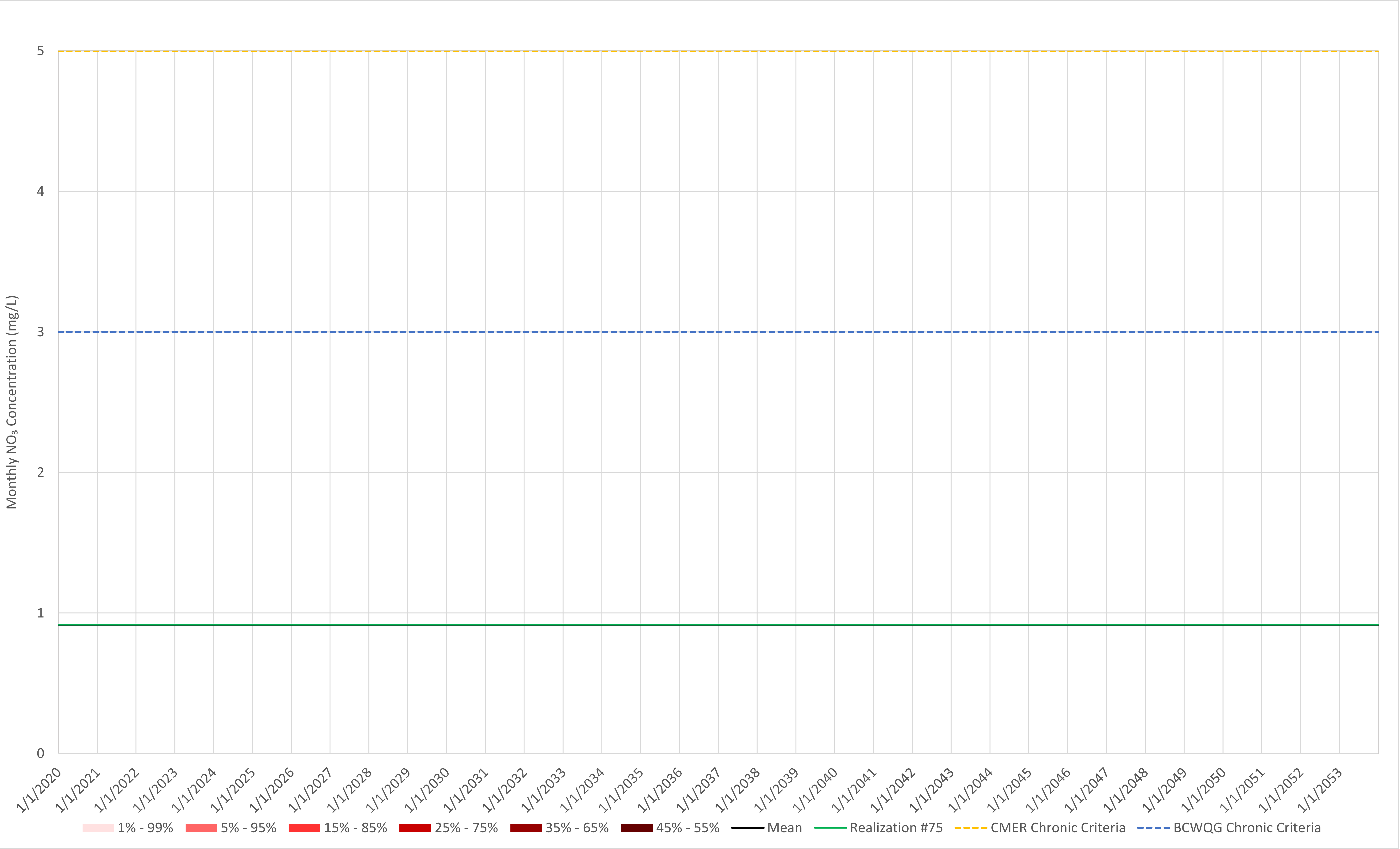

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

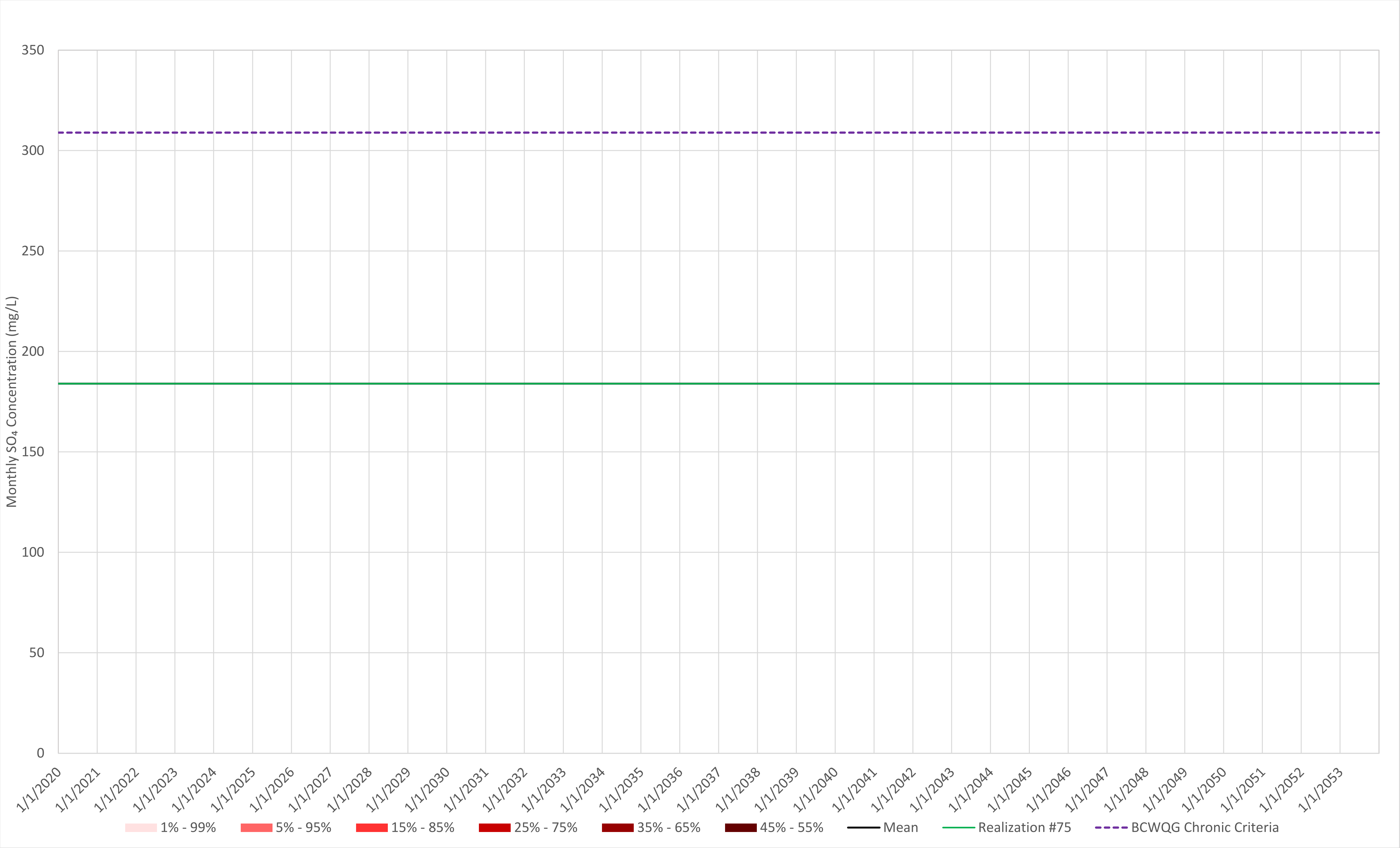

Monthly SO$_4$ Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Harmer Creek

Scenario: Average Case (P_{50}) Layering Succeeds

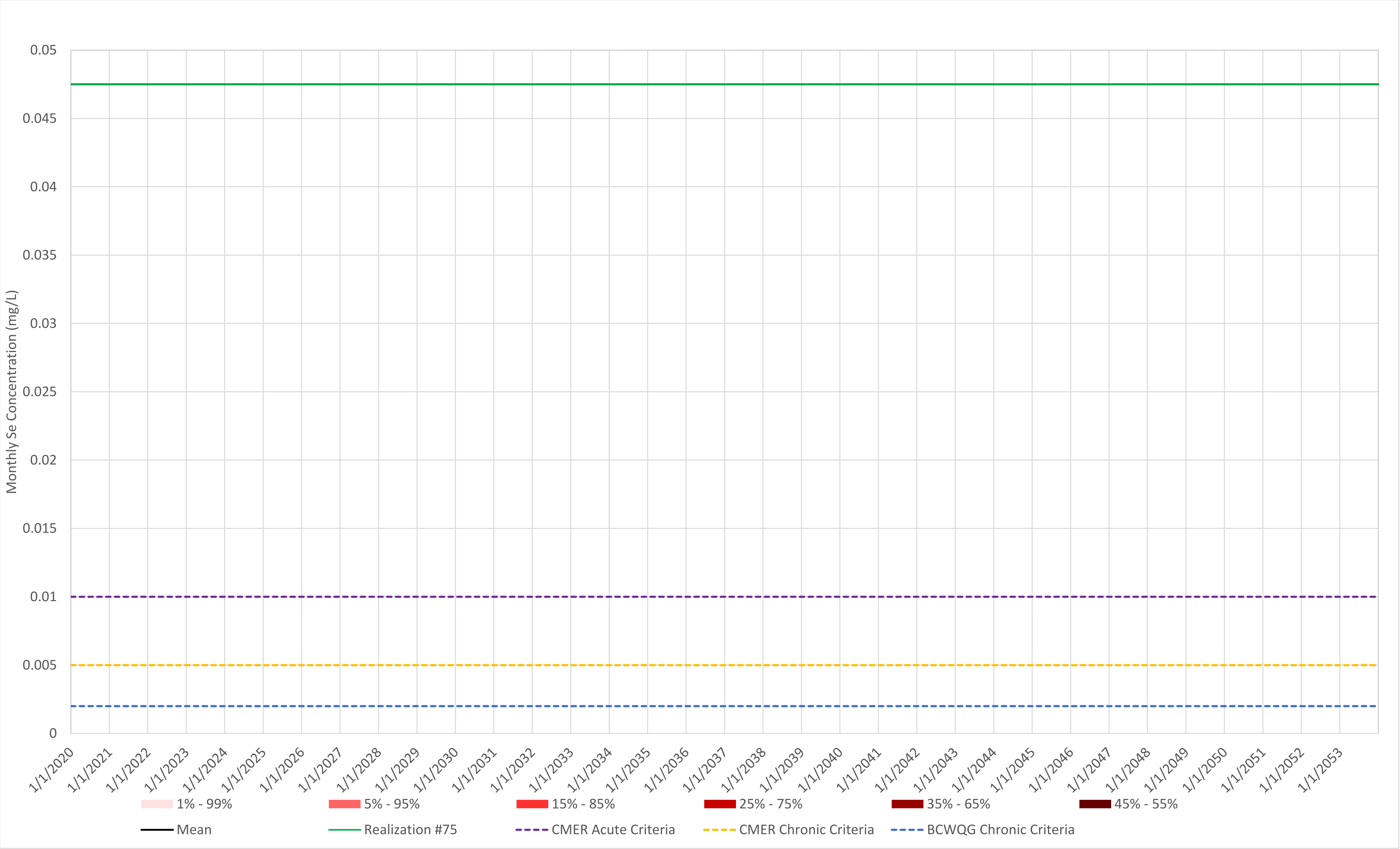

Monthly Se Concentration (mg/L)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

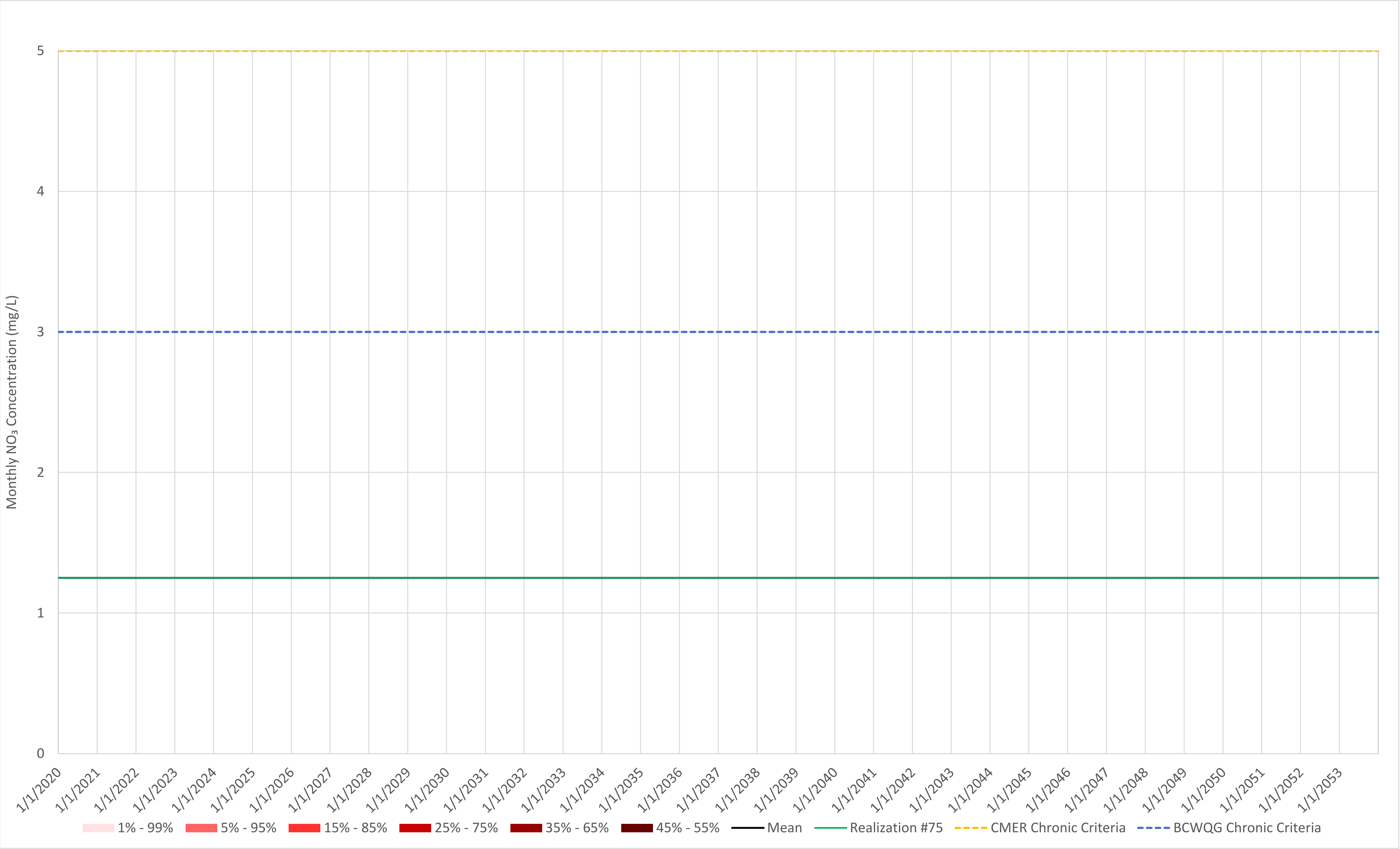

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

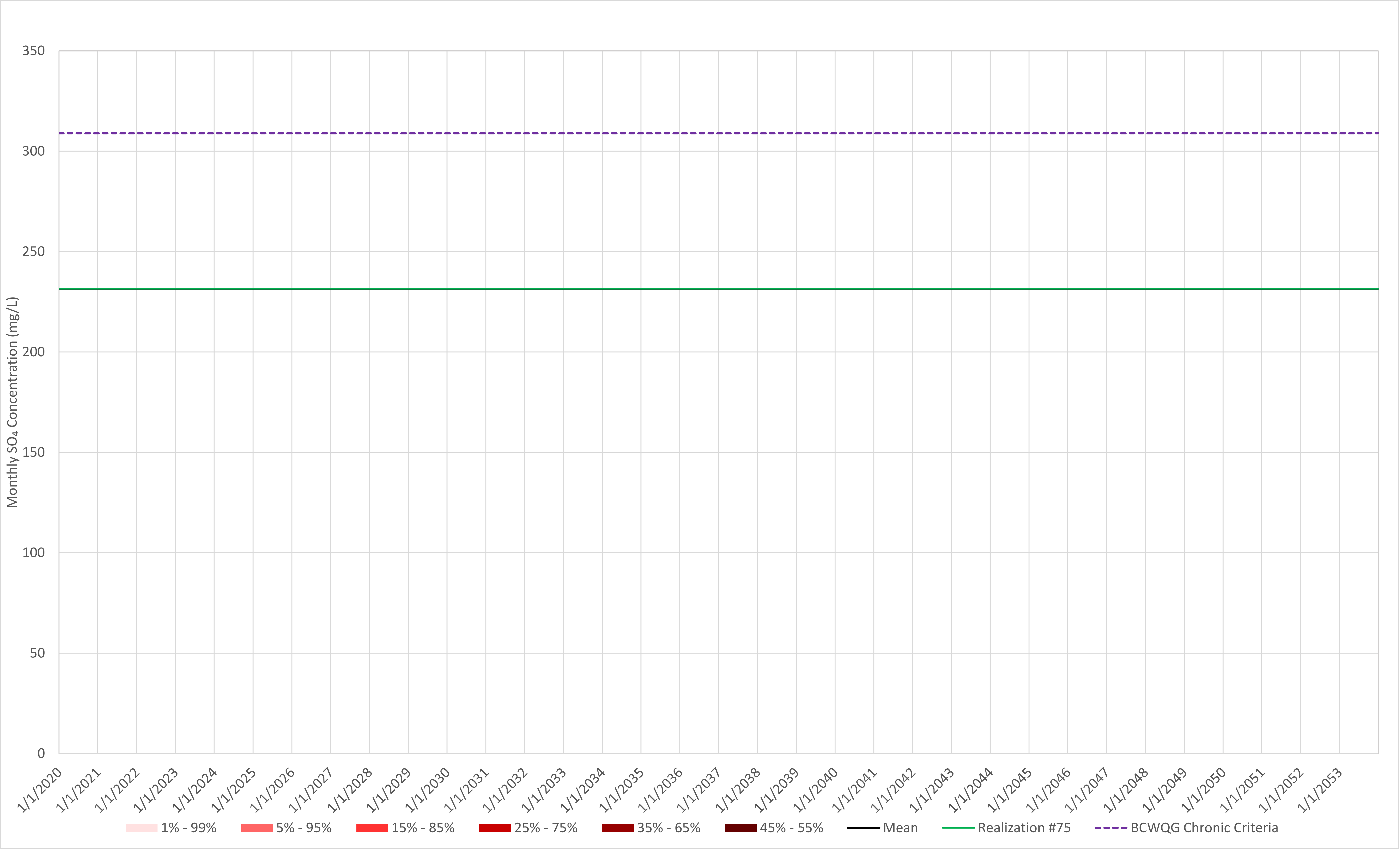

Monthly SO_4 Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Harmer Creek

Scenario: Upper Case (P_{95}) Layering Fails

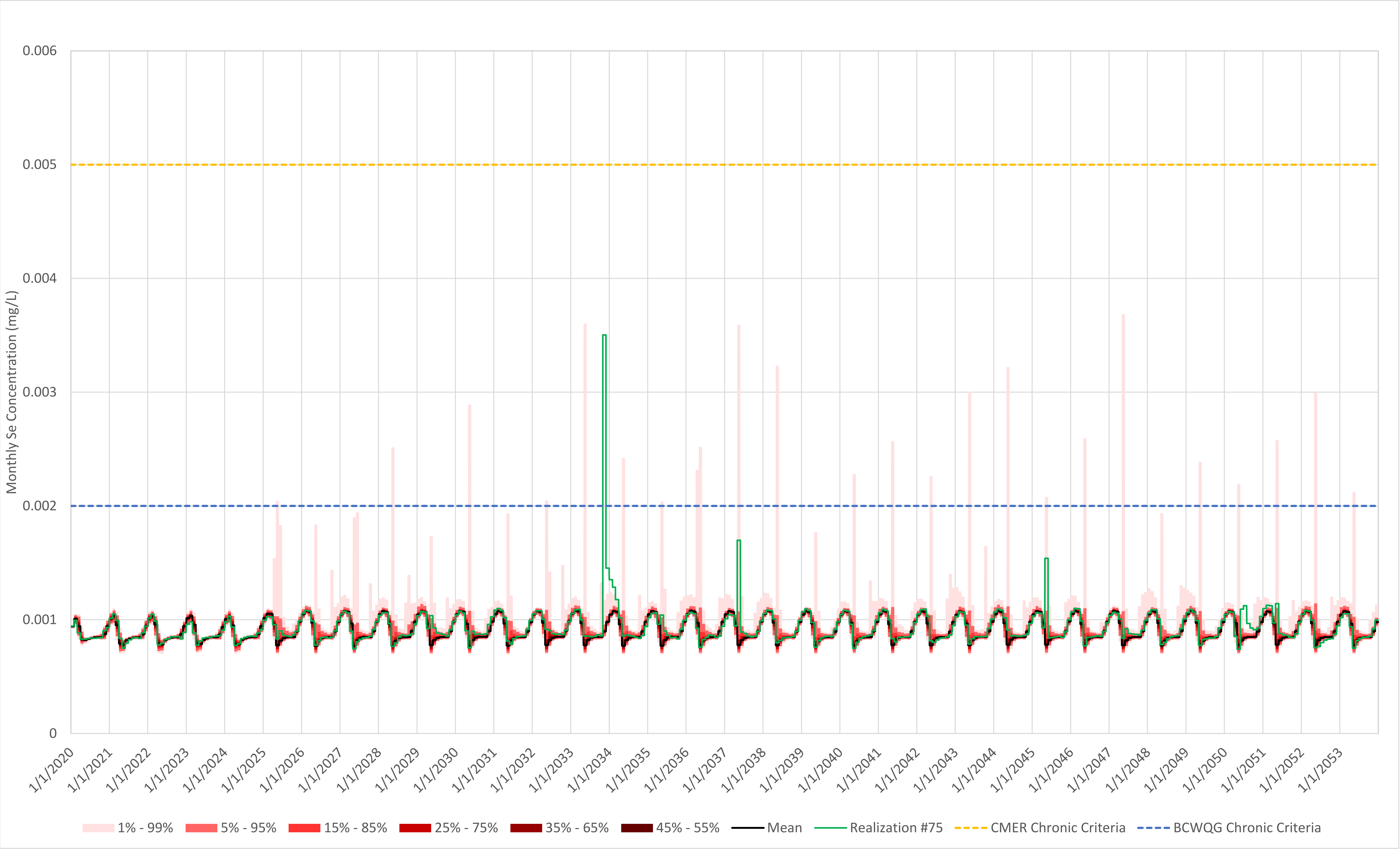

0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

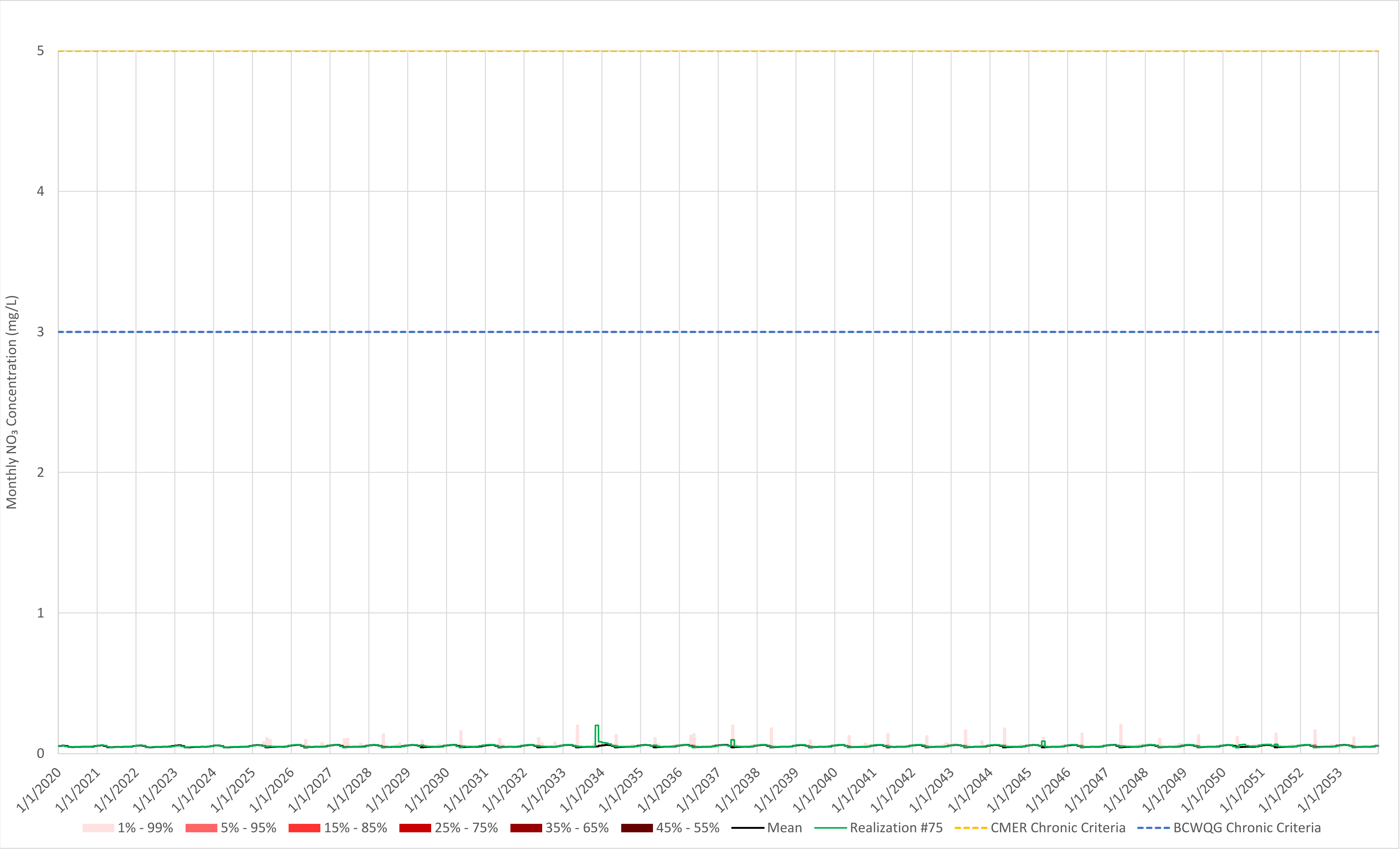

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

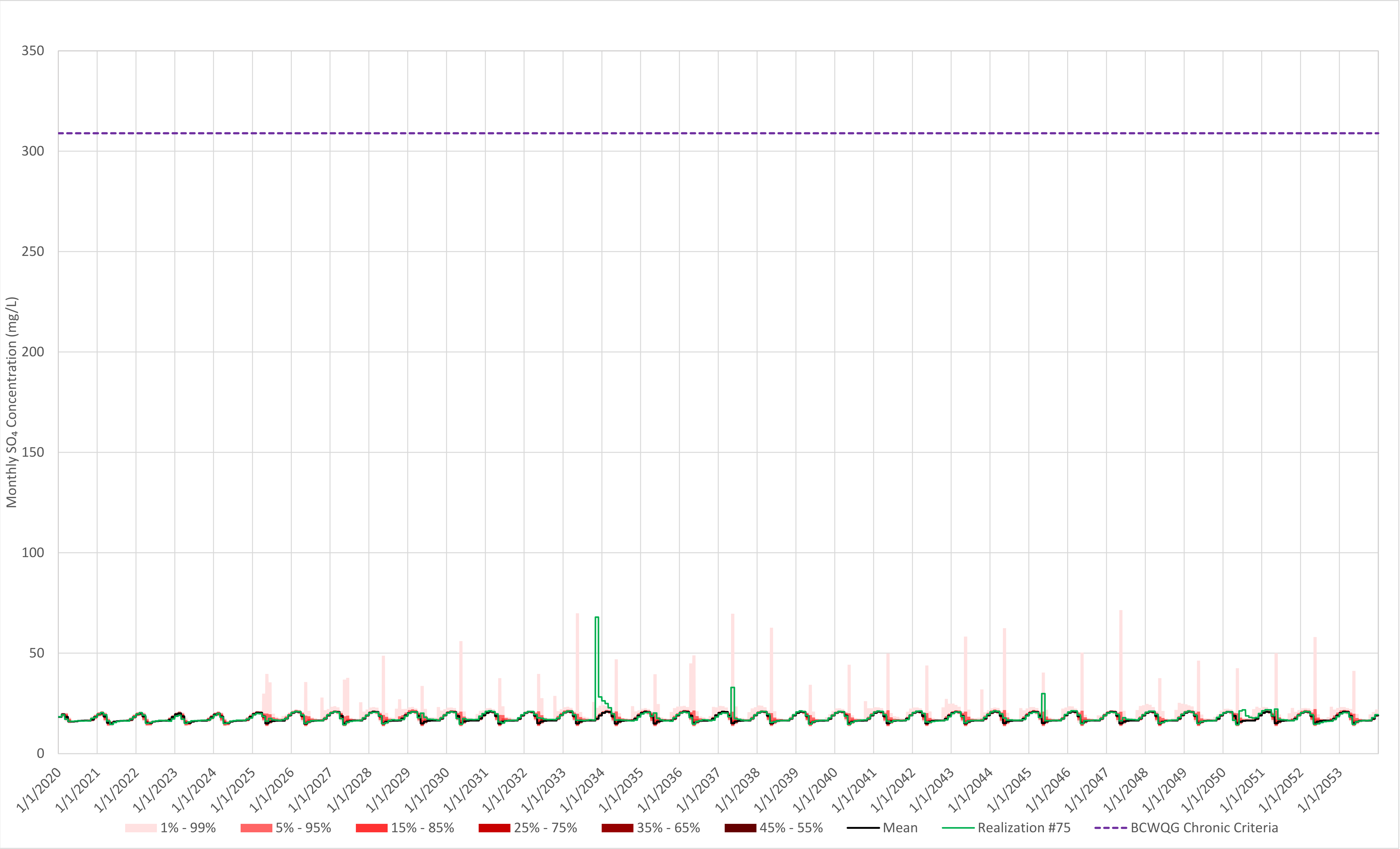

350
300
250
200
150
100
50
0
Monthly SO_4 Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Clean Coal Transfer Area

Scenario: Average Case (P_{50}) Layering Succeeds


0.006
0.005
0.004
0.003
0.002
0.001
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

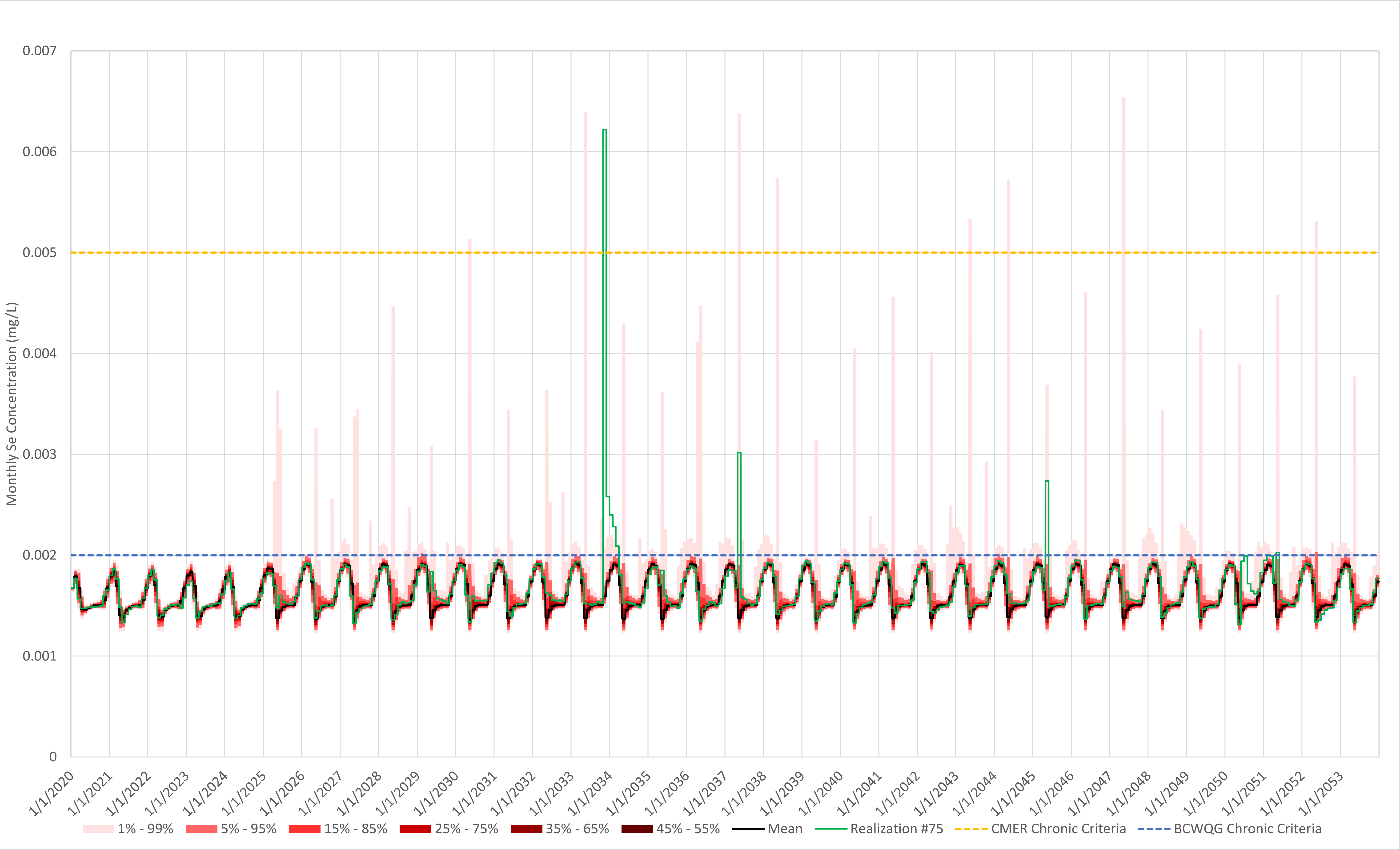

Monthly NO$_3$ Concentration (mg/L)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

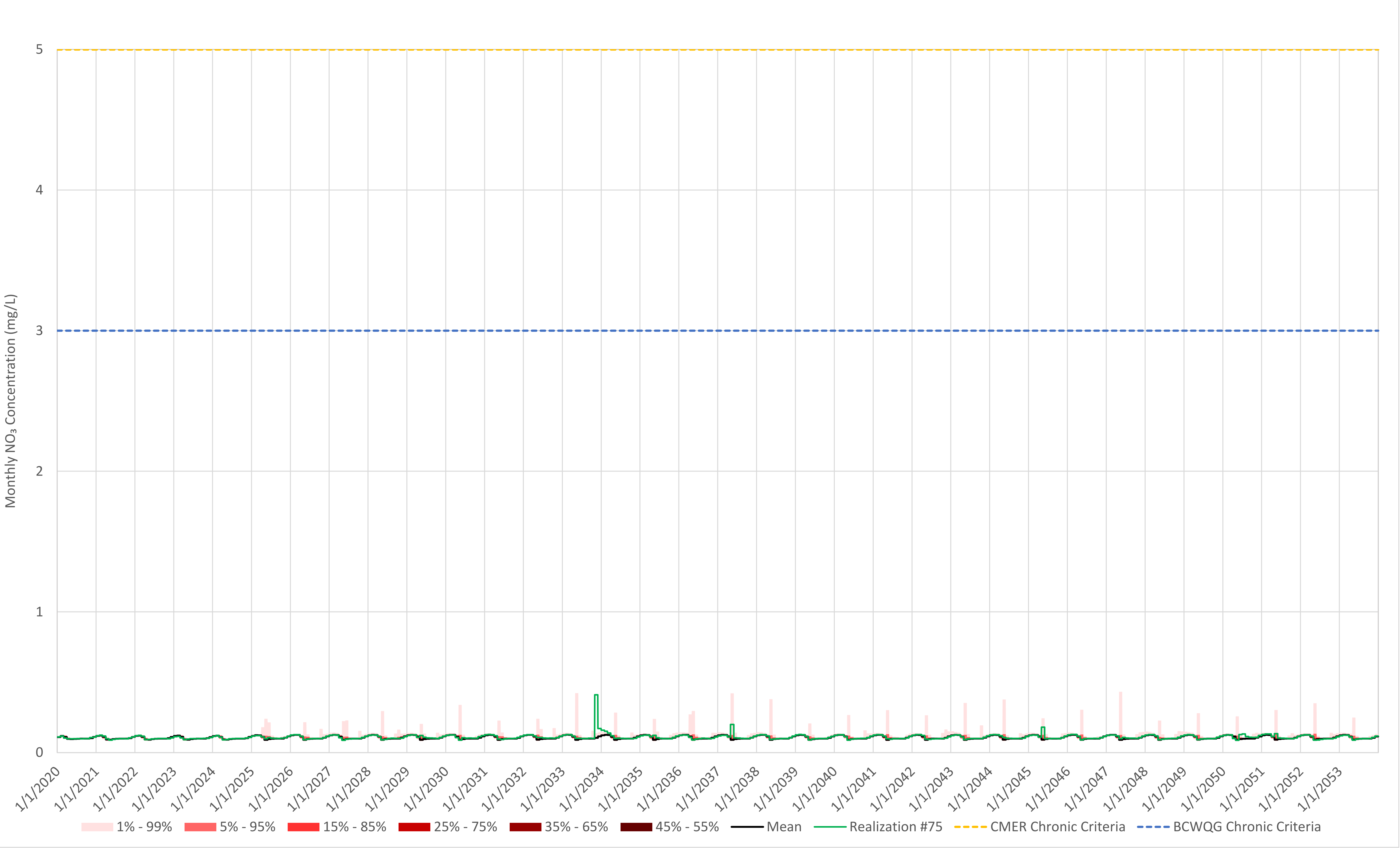


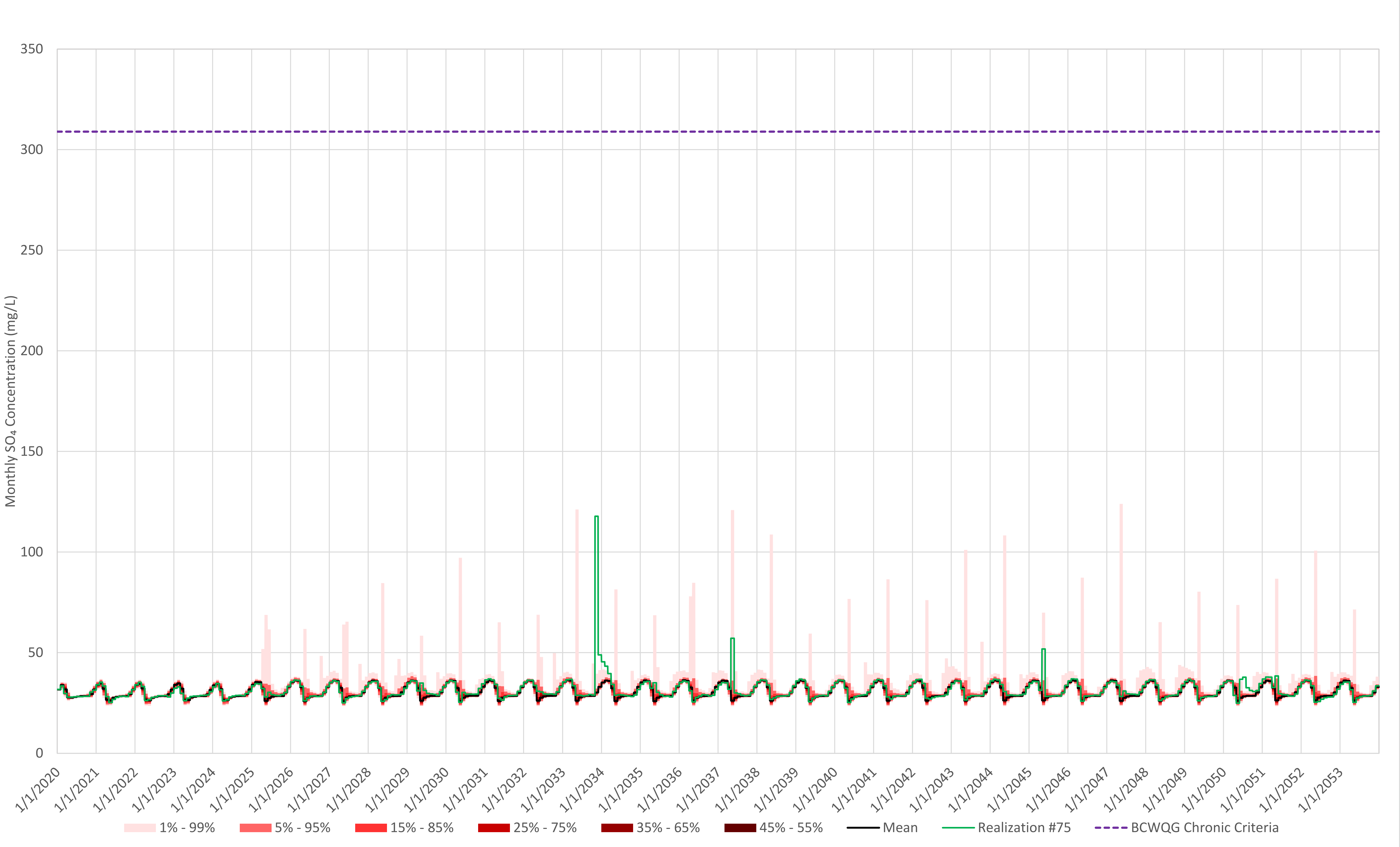
Monthly SO₄ Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Clean Coal Transfer Area

Scenario: Upper Case (P_{95}) Layering Fails

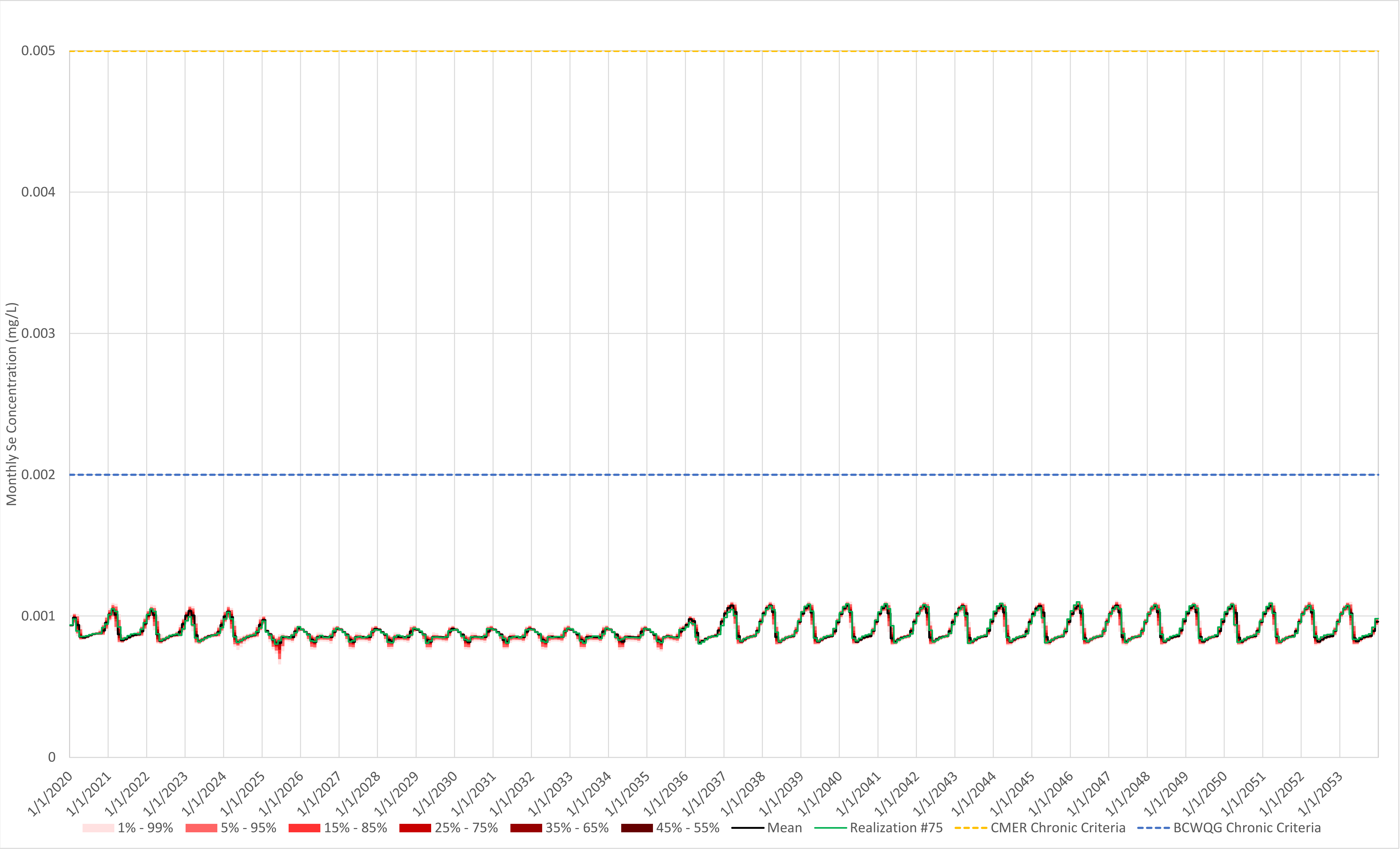

0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

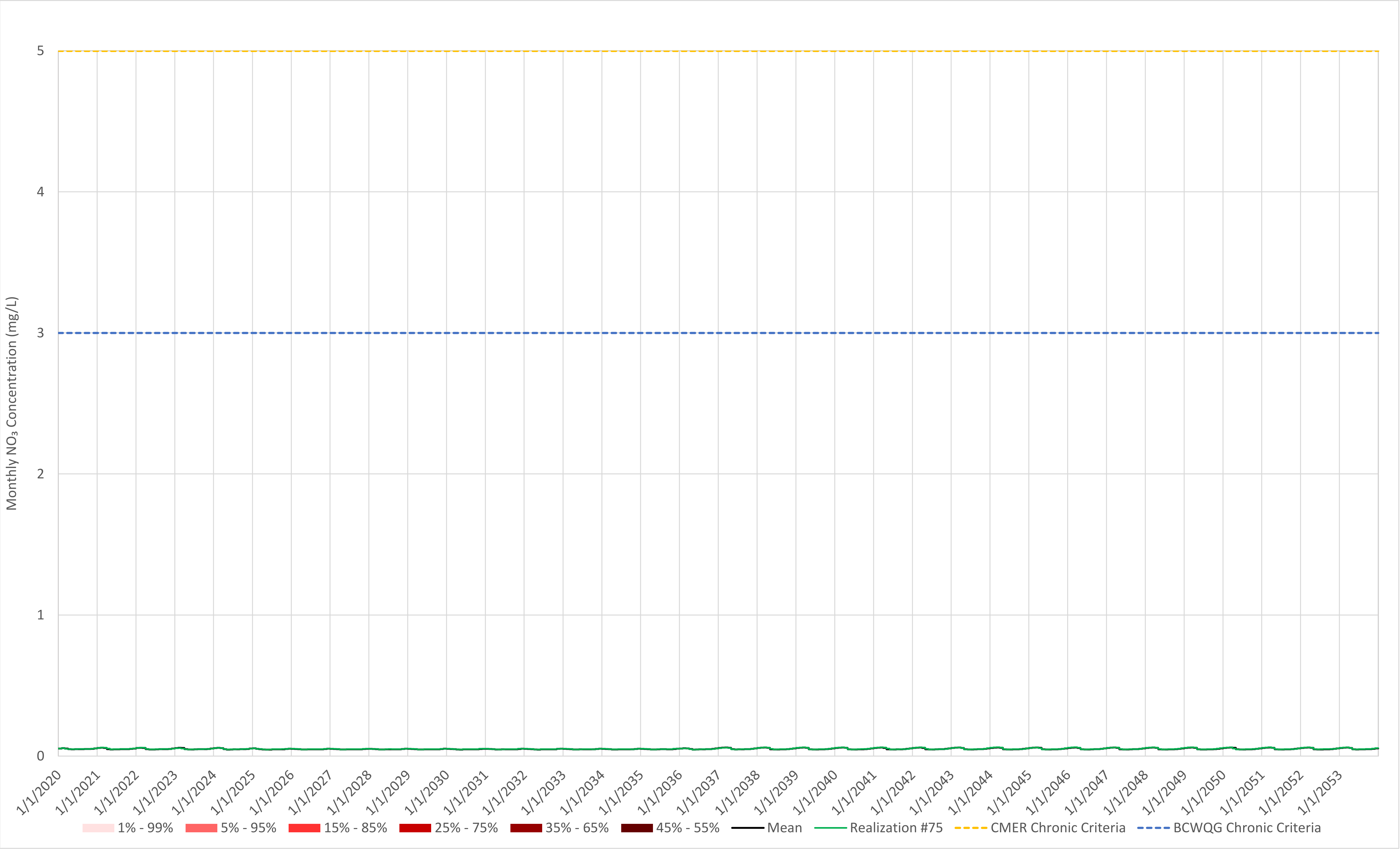

Monthly SO$_4$ Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

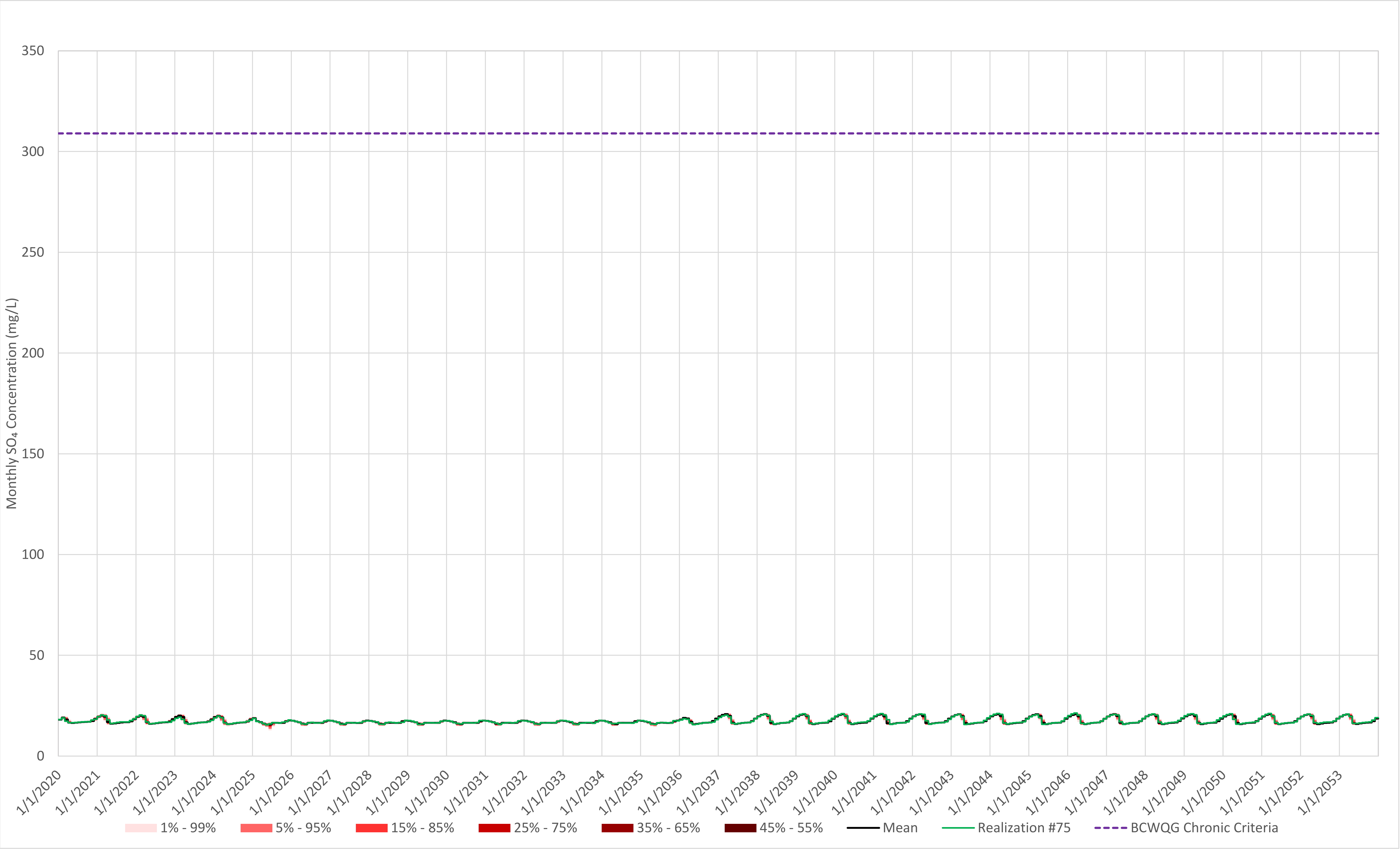
Reporting Location: Grave Creek Reservoir

Scenario: Average Case (P_{50}) Layering Succeeds



Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

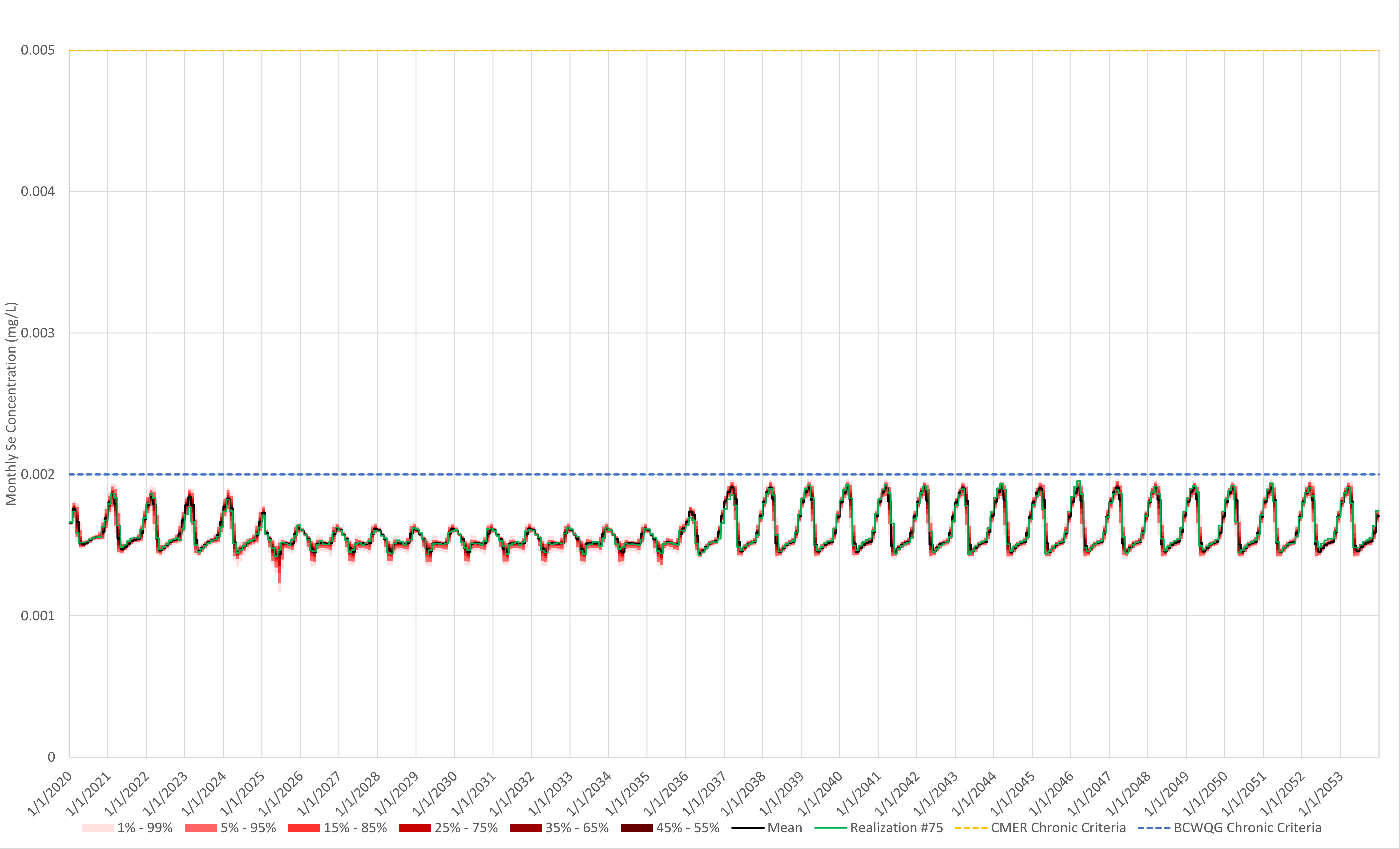

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

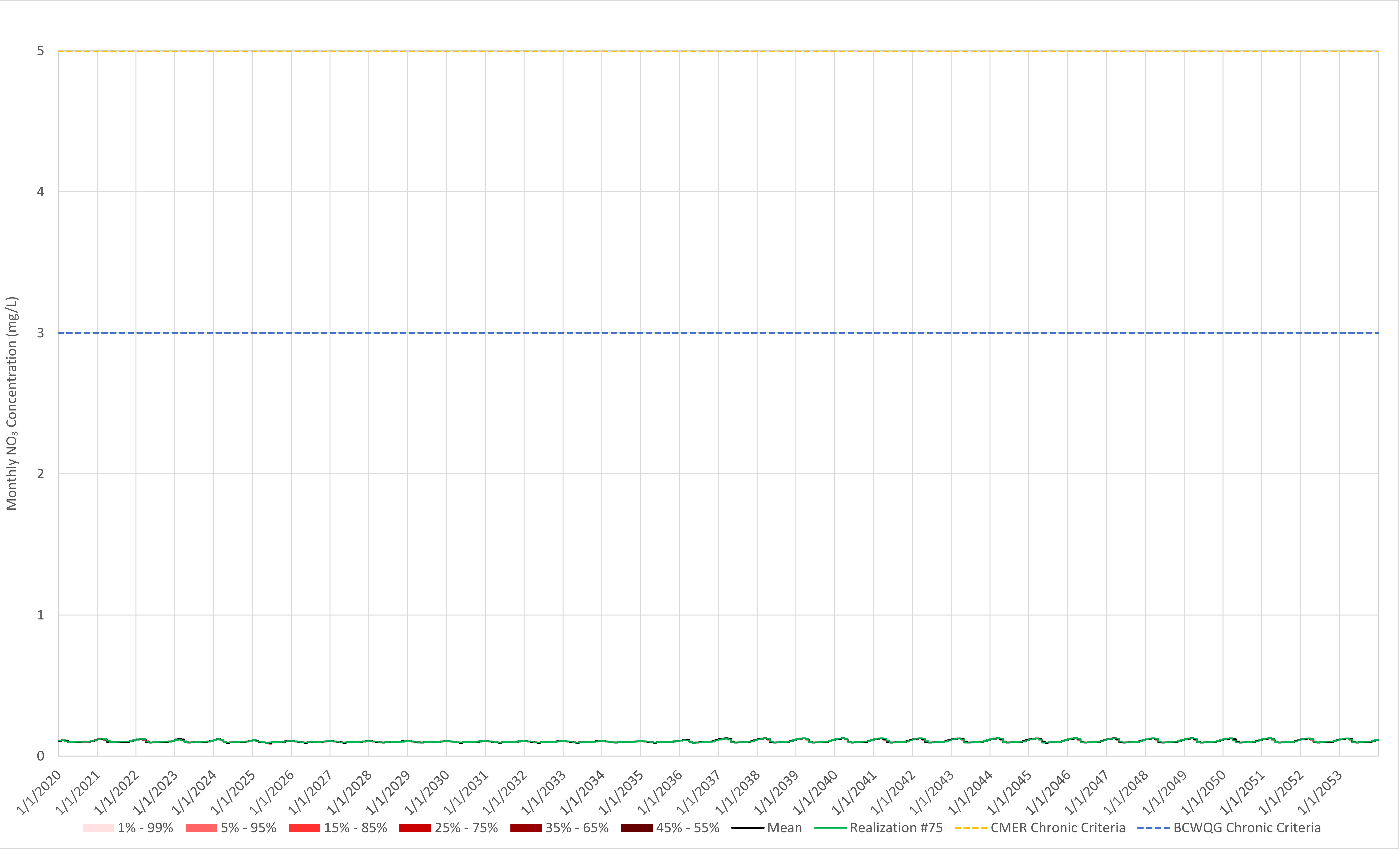


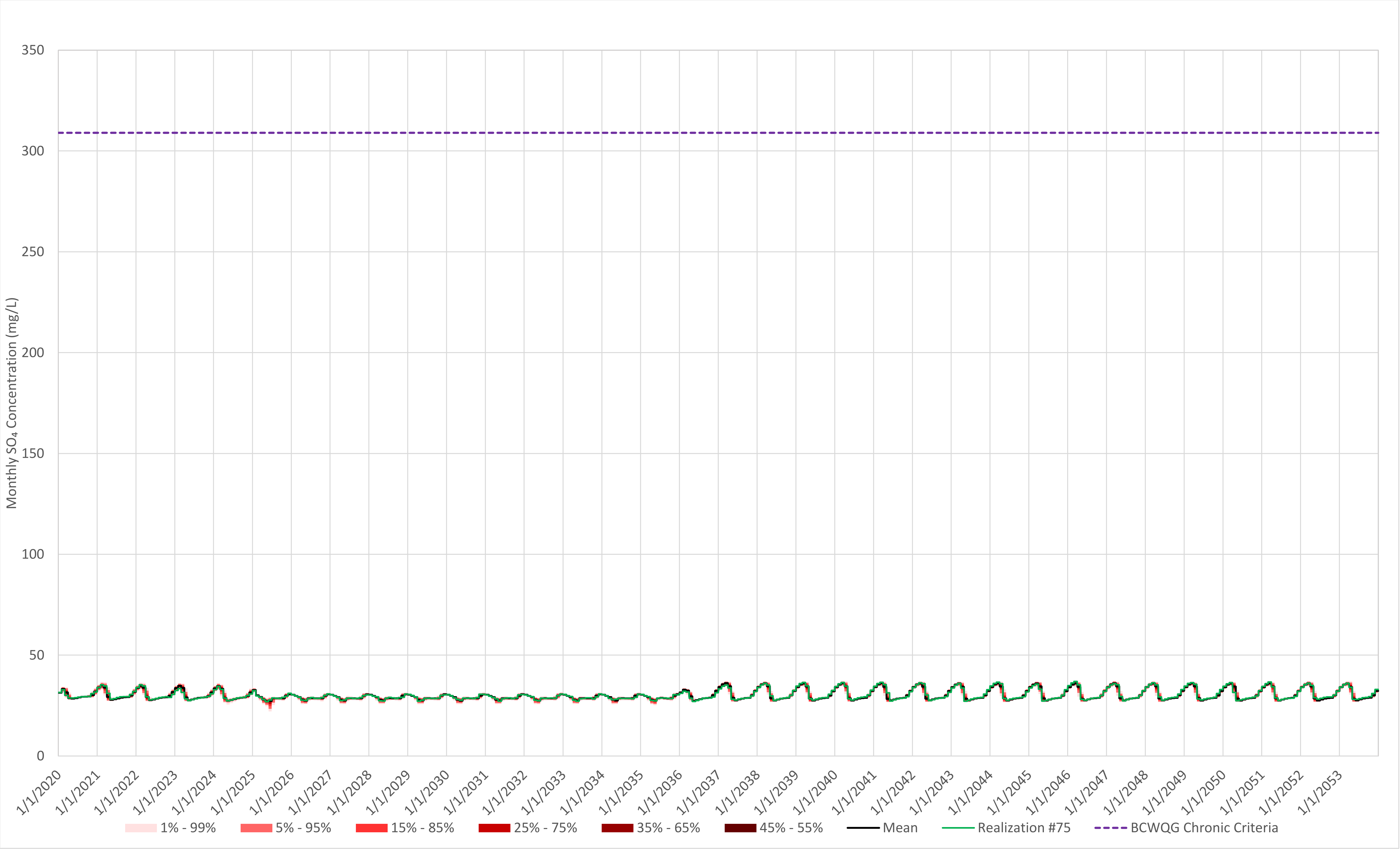
350
300
250
200
150
100
50
0
Monthly SO₄ Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Grave Creek Reservoir

Scenario: Upper Case (P_{95}) Layering Fails

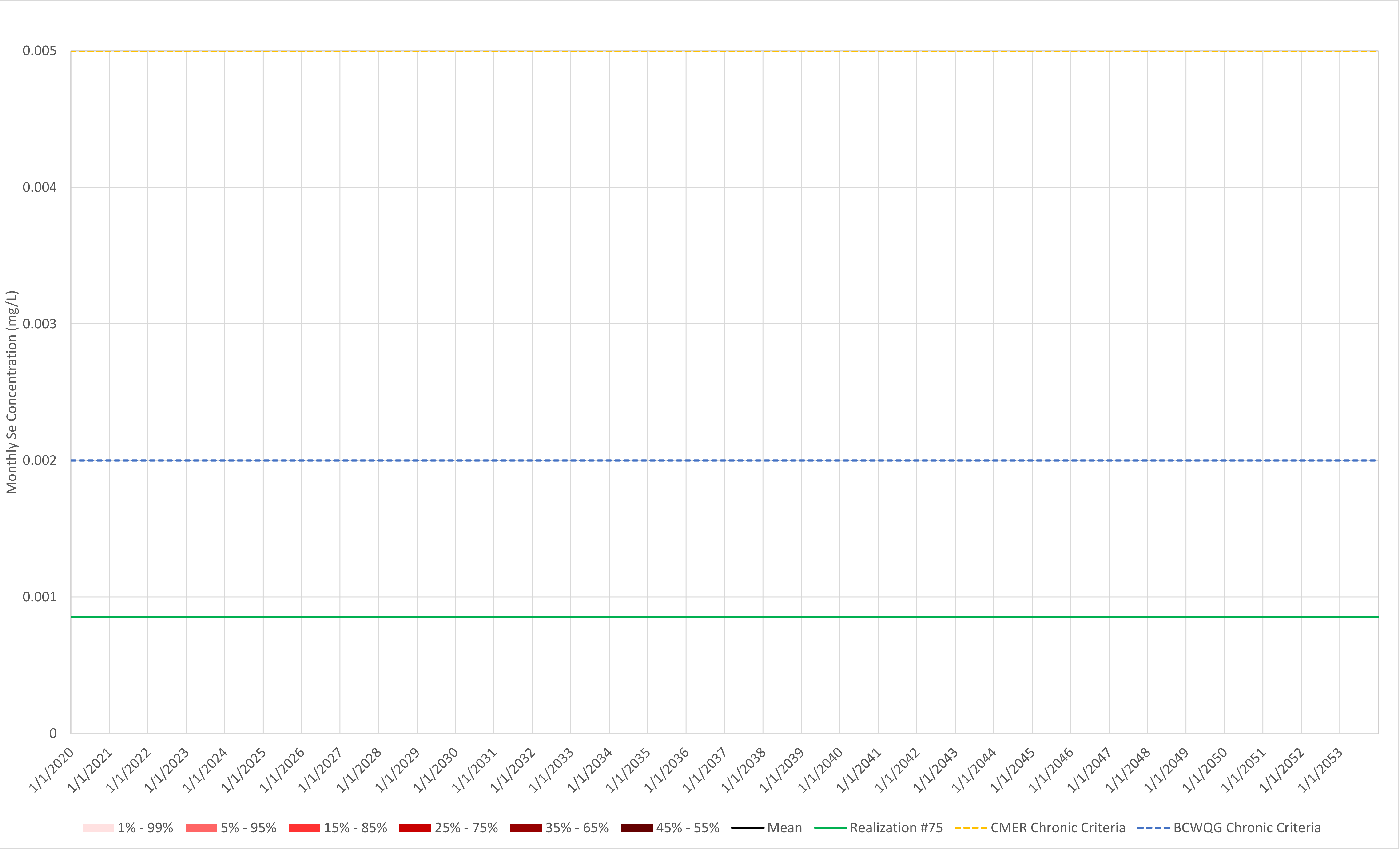

Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

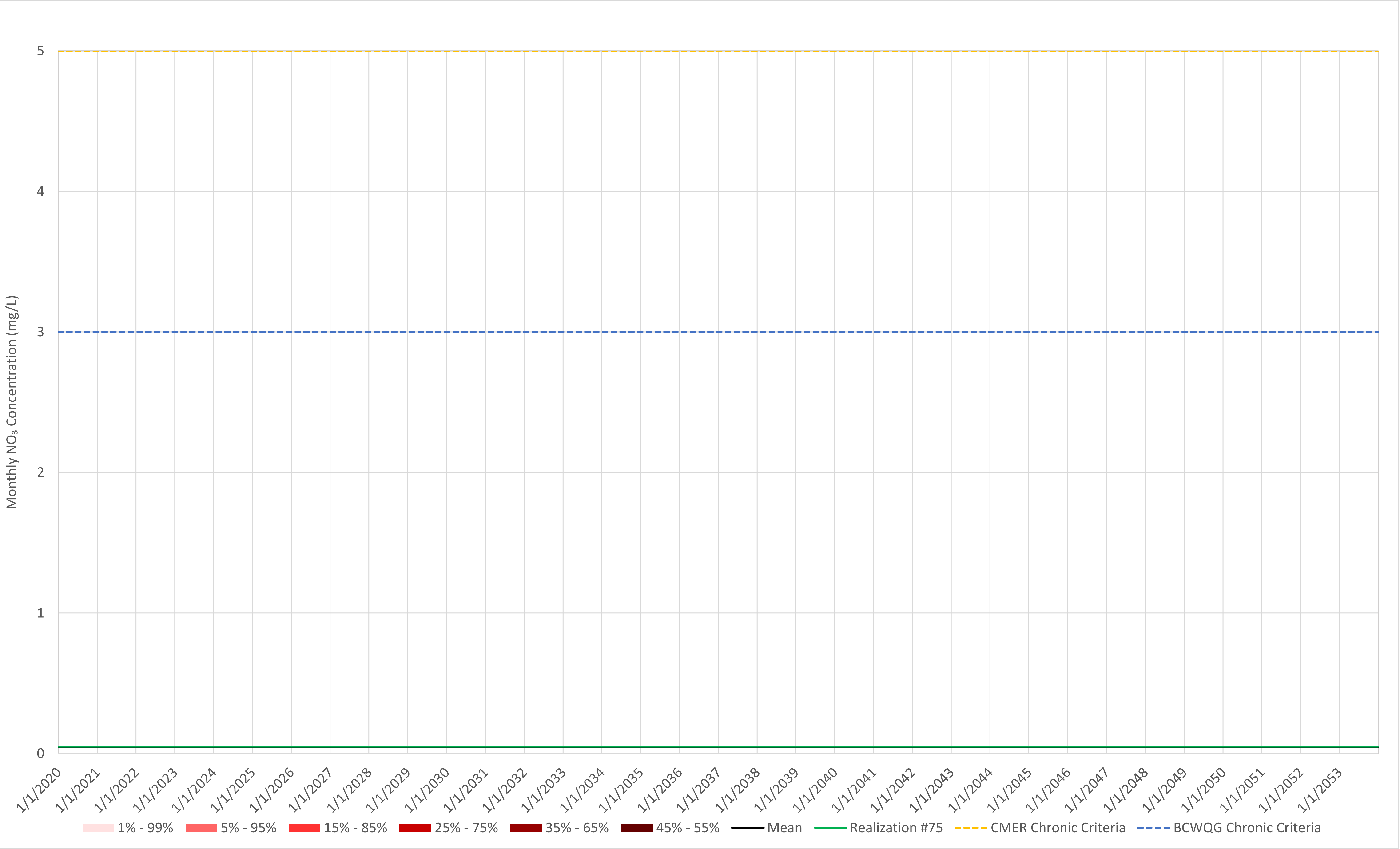

Monthly NO3 Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

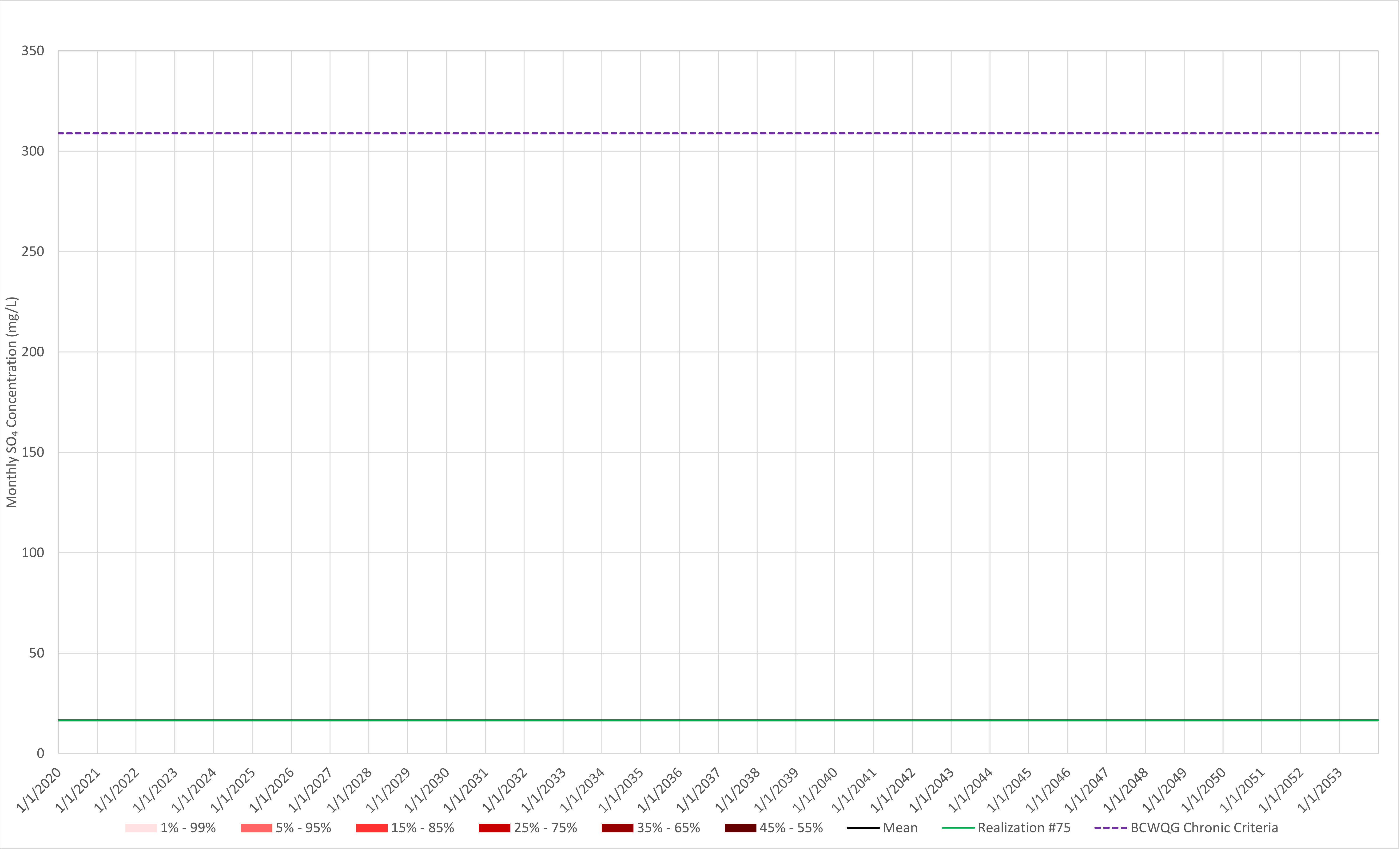

Monthly SO_4 Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Clean Coal Haul Road

Scenario: Average Case (P_{50}) Layering Succeeds

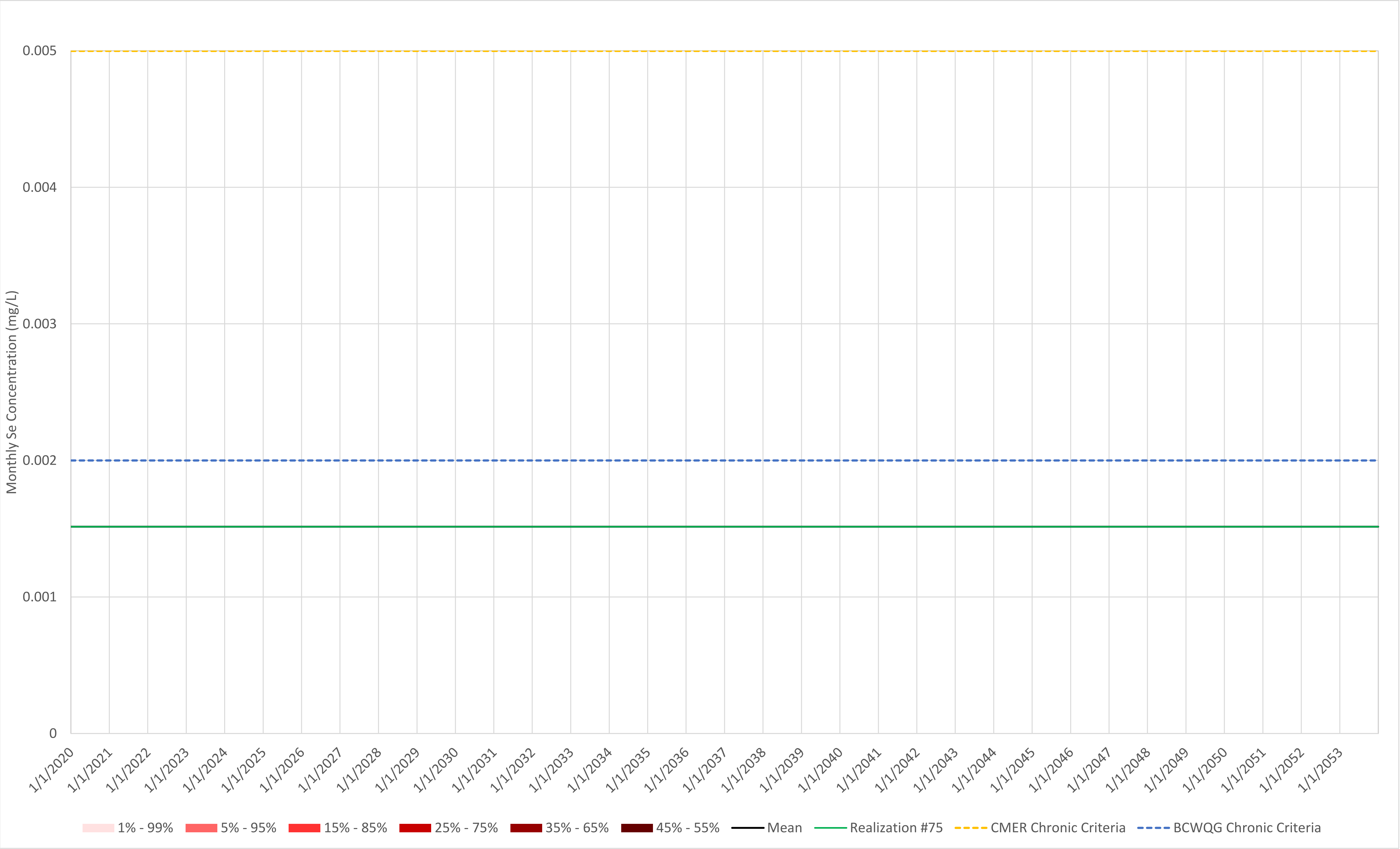

Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

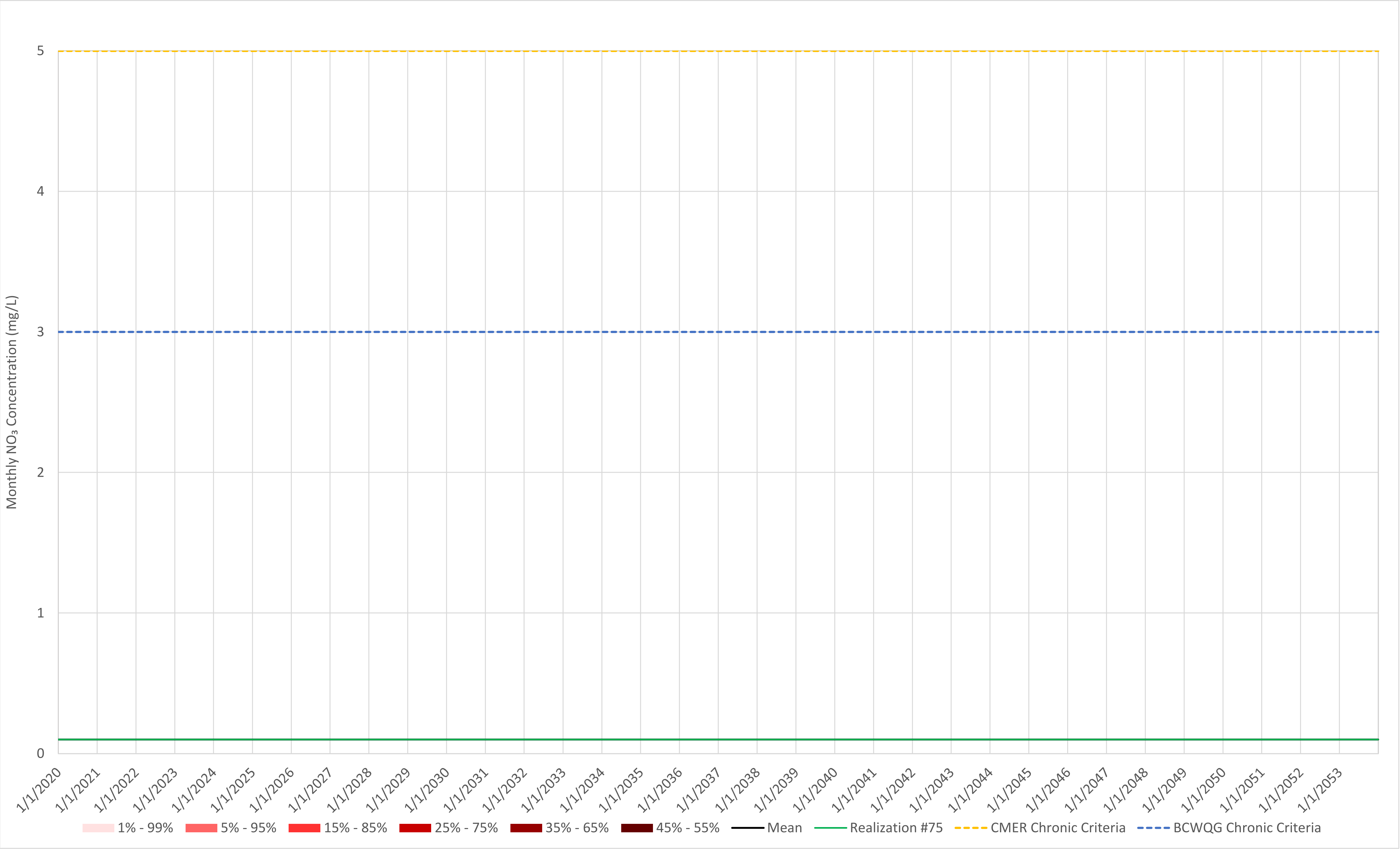

Monthly NO_3 Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

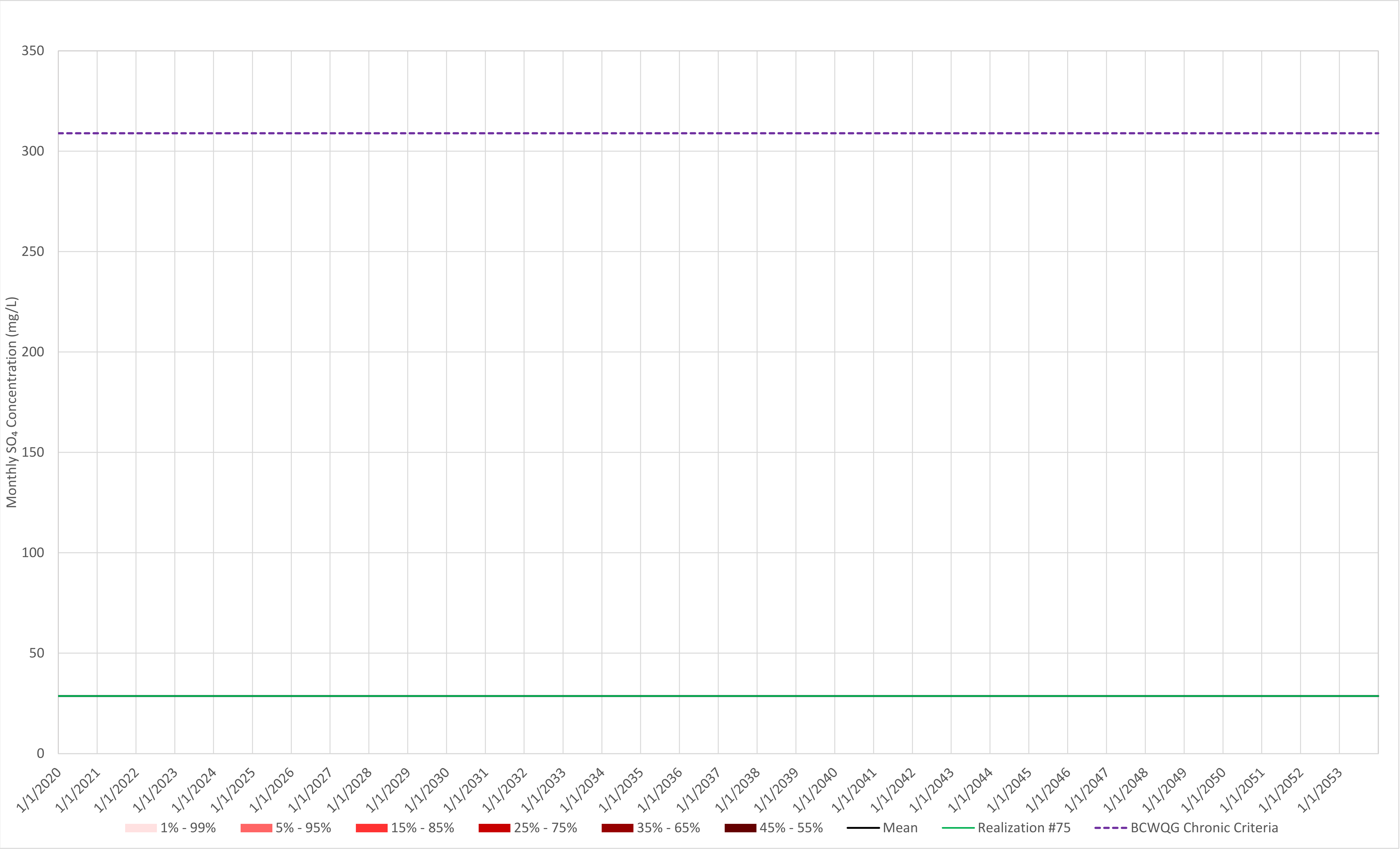

Monthly SO$_4$ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Clean Coal Haul Road

Scenario: Upper Case (P_{95}) Layering Fails

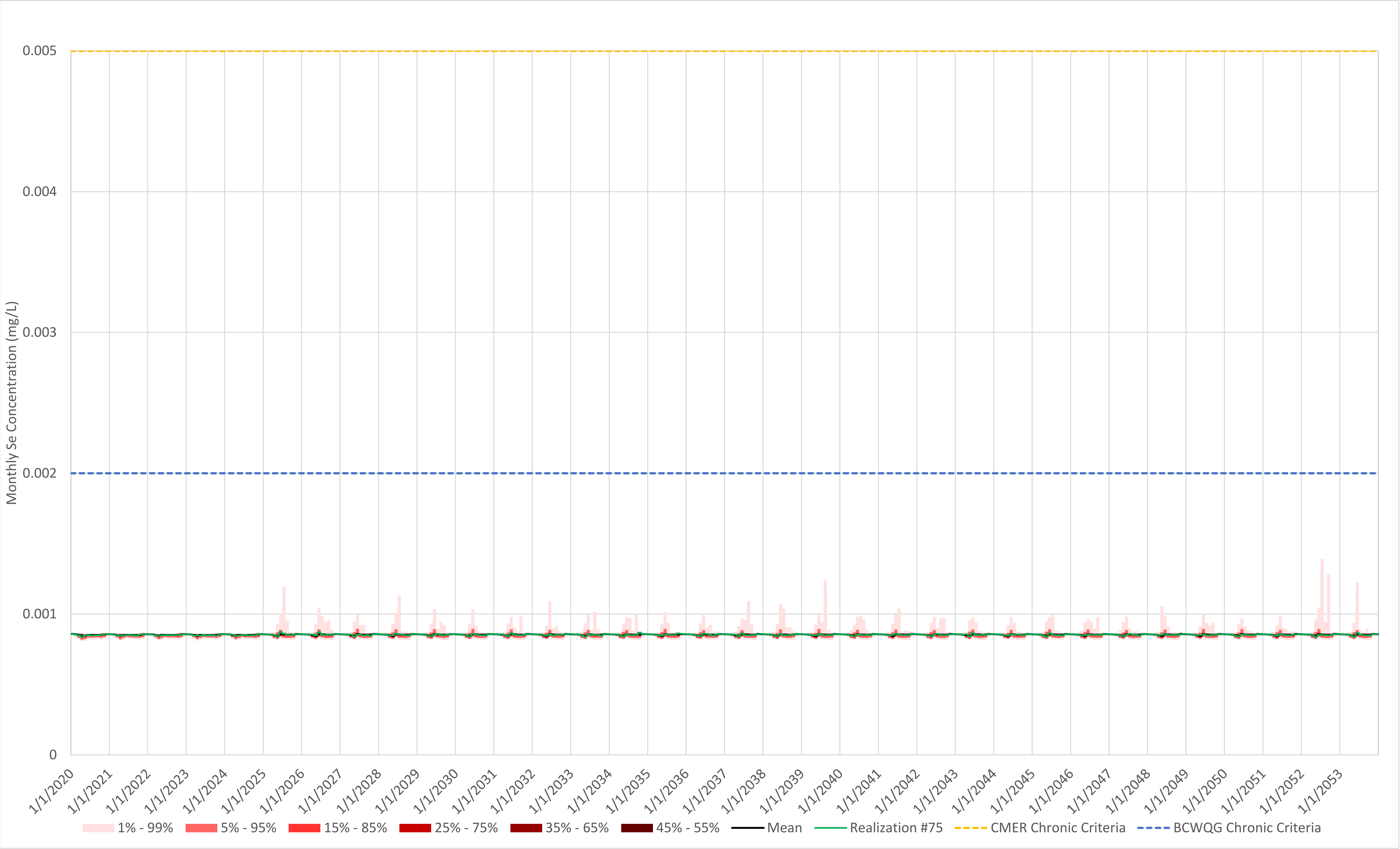

Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

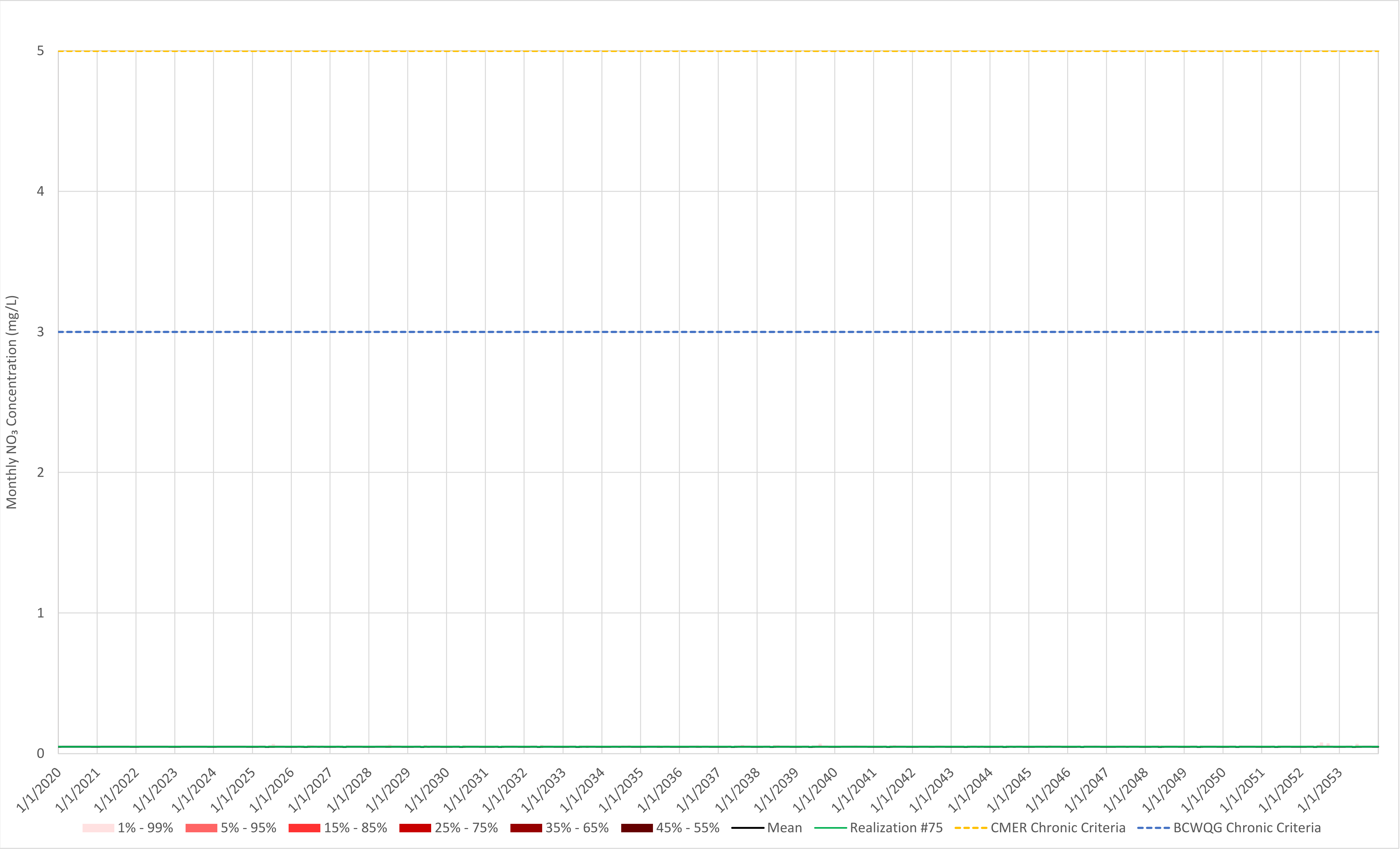

Monthly NO_3 Concentration (mg/L)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

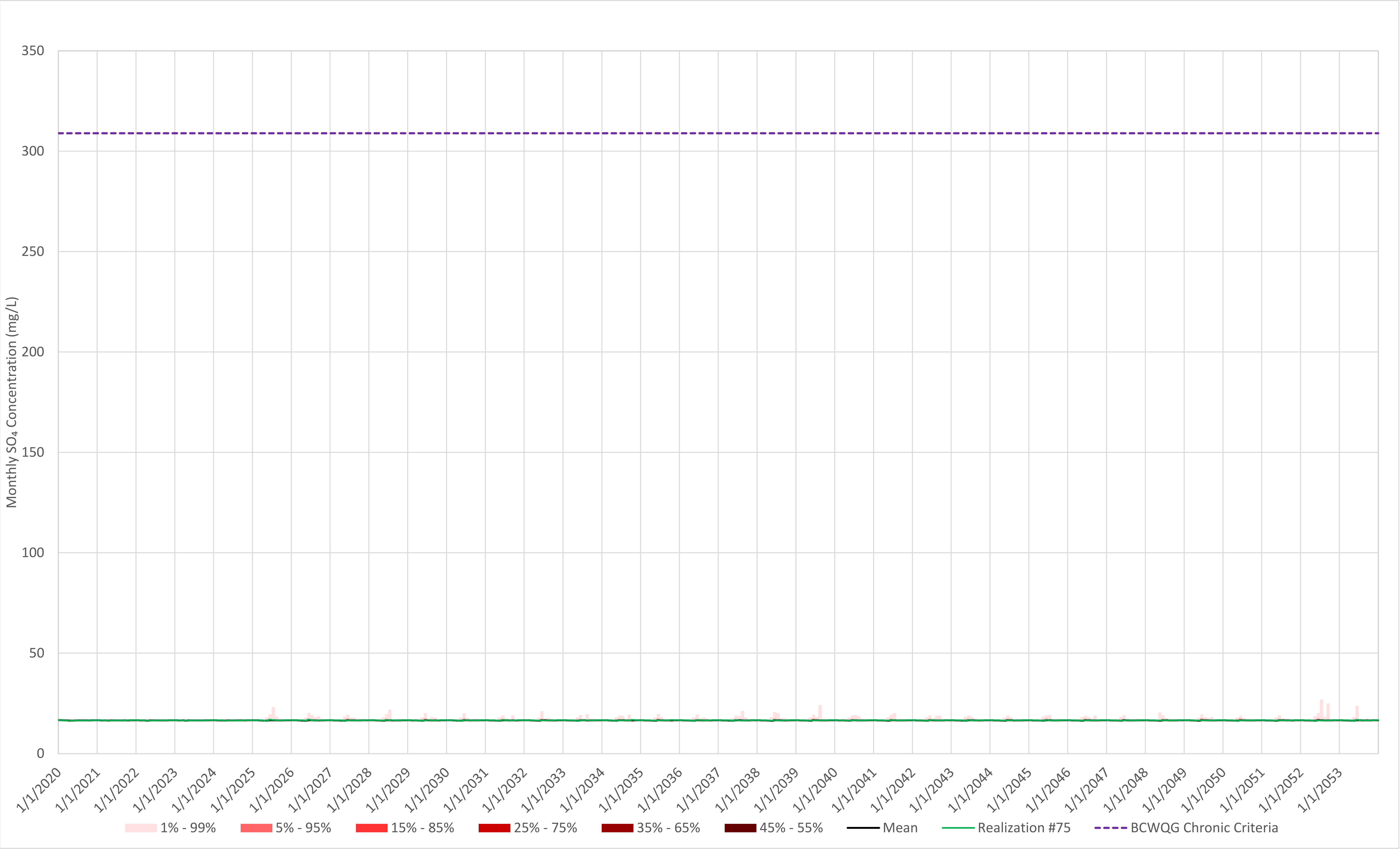

Monthly SO_4 Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Rail Loop Sump

Scenario: Average Case (P_{50}) Layering Succeeds

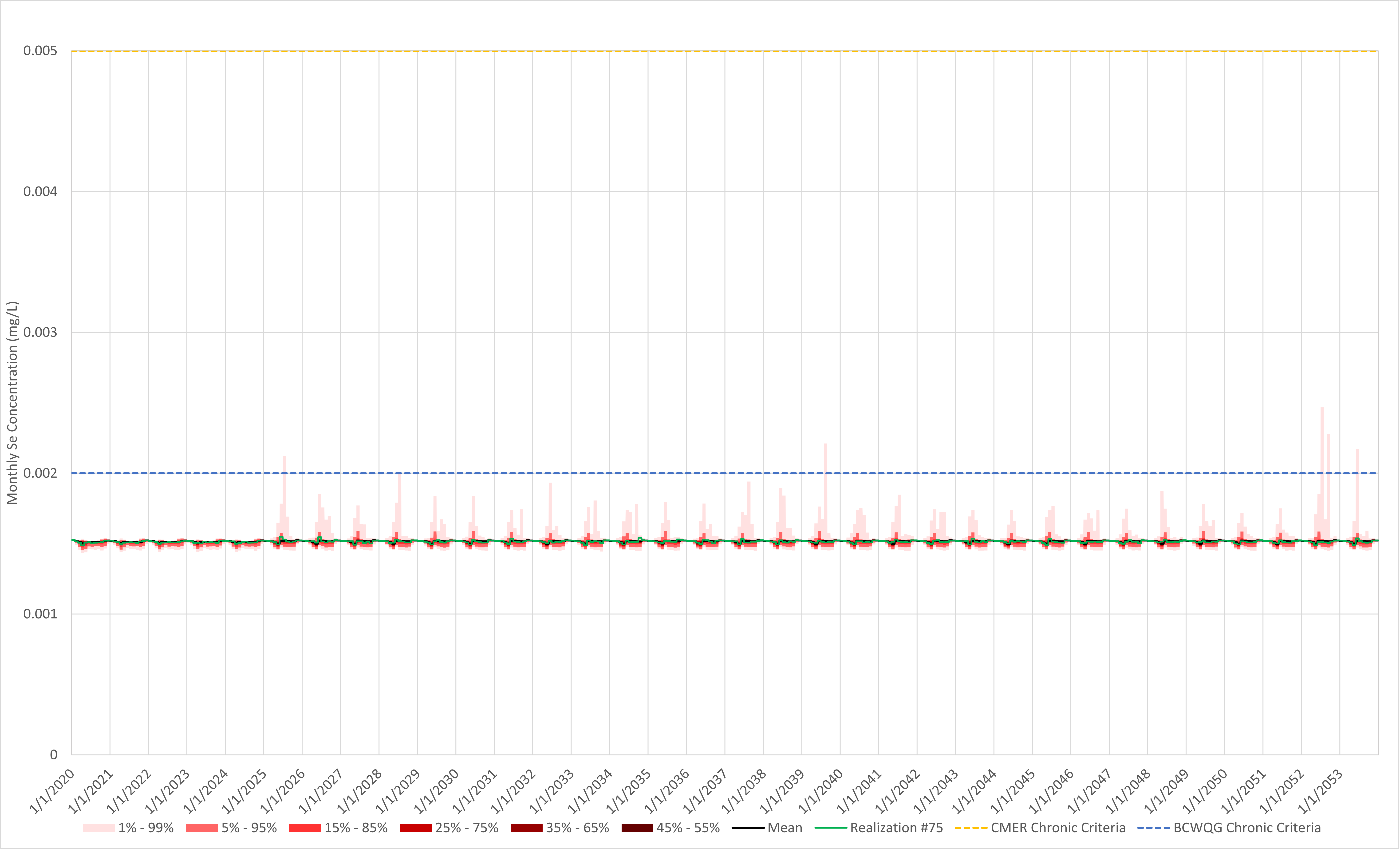

Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

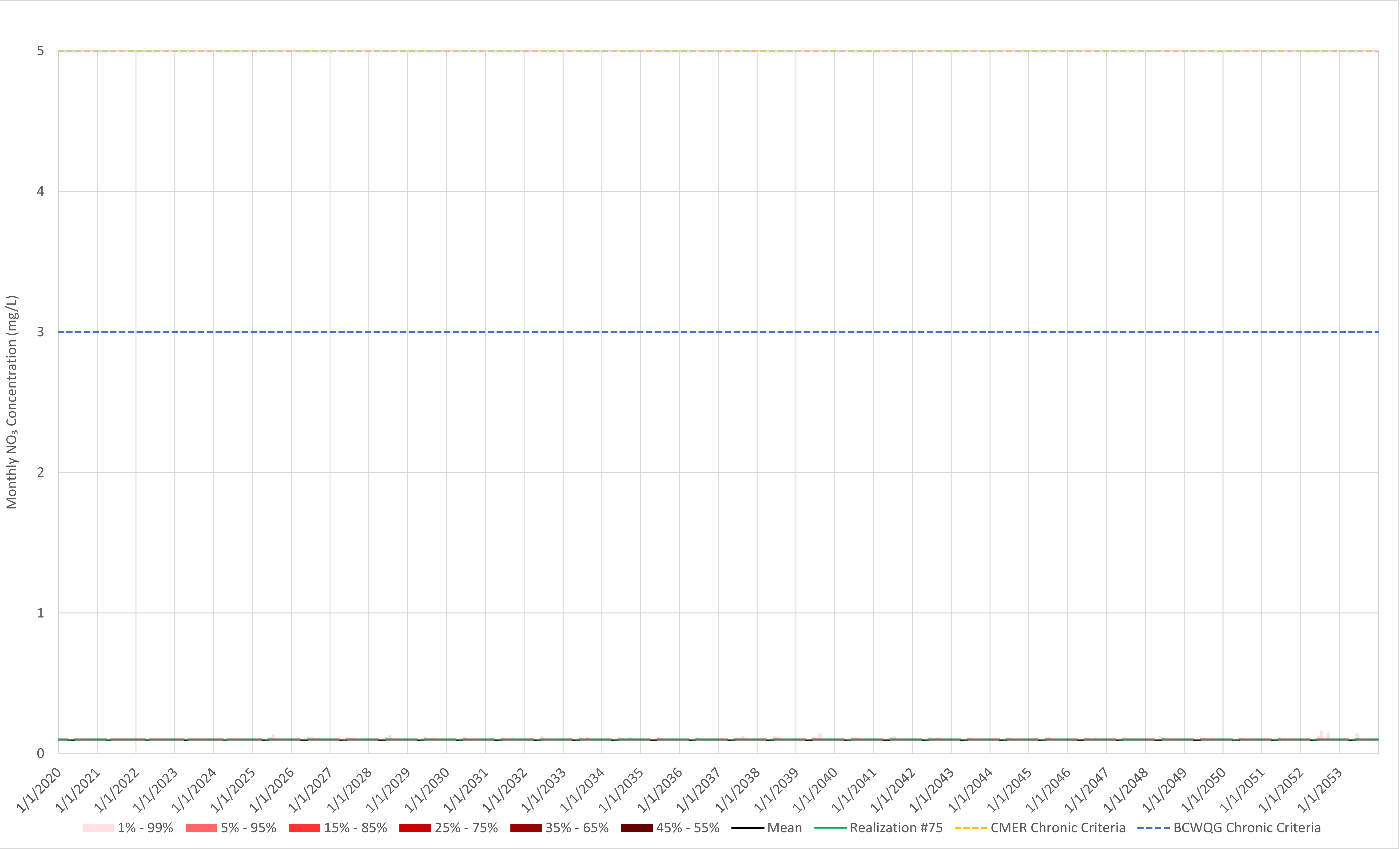

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

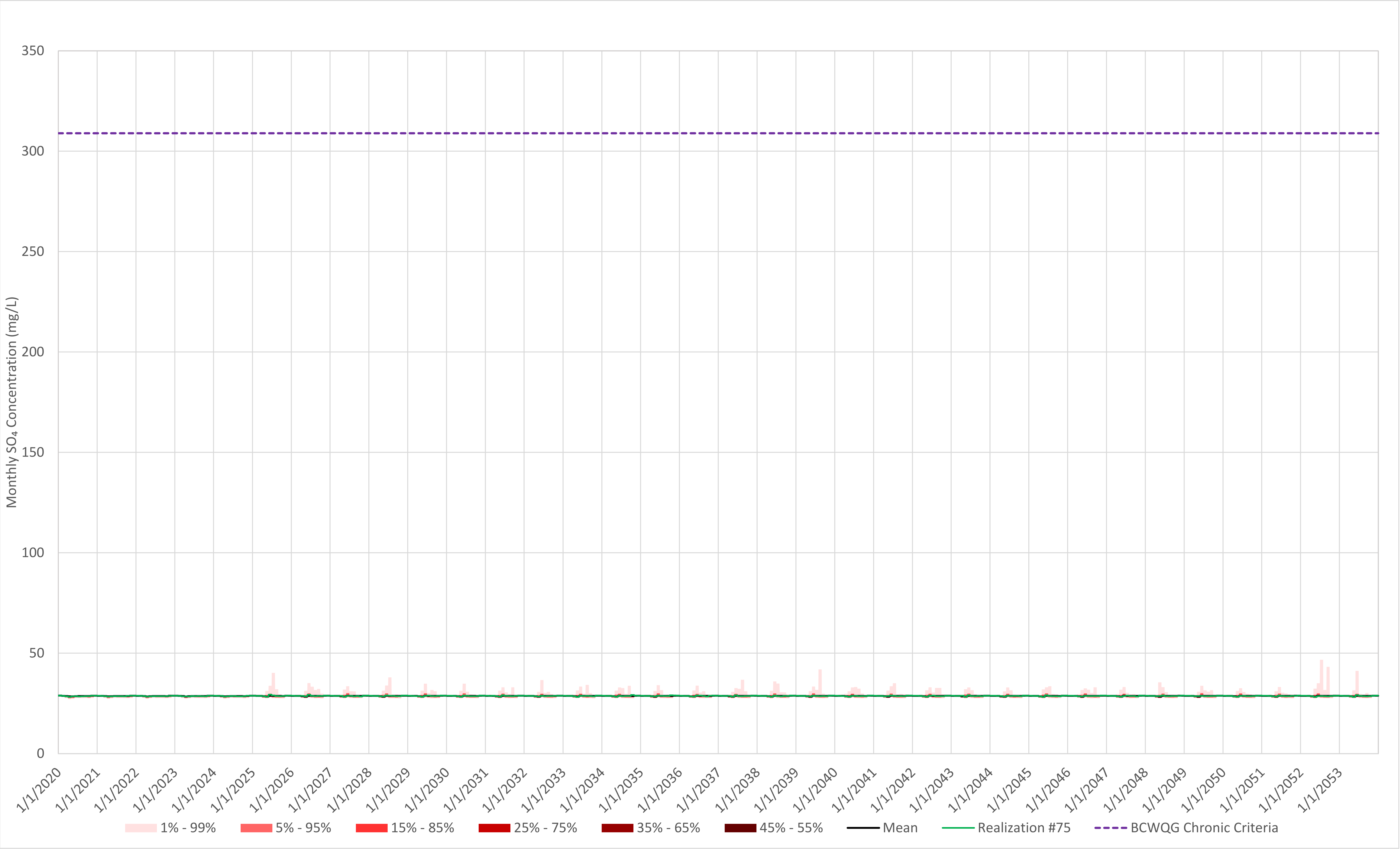

Monthly SO₄ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: Rail Loop Sump

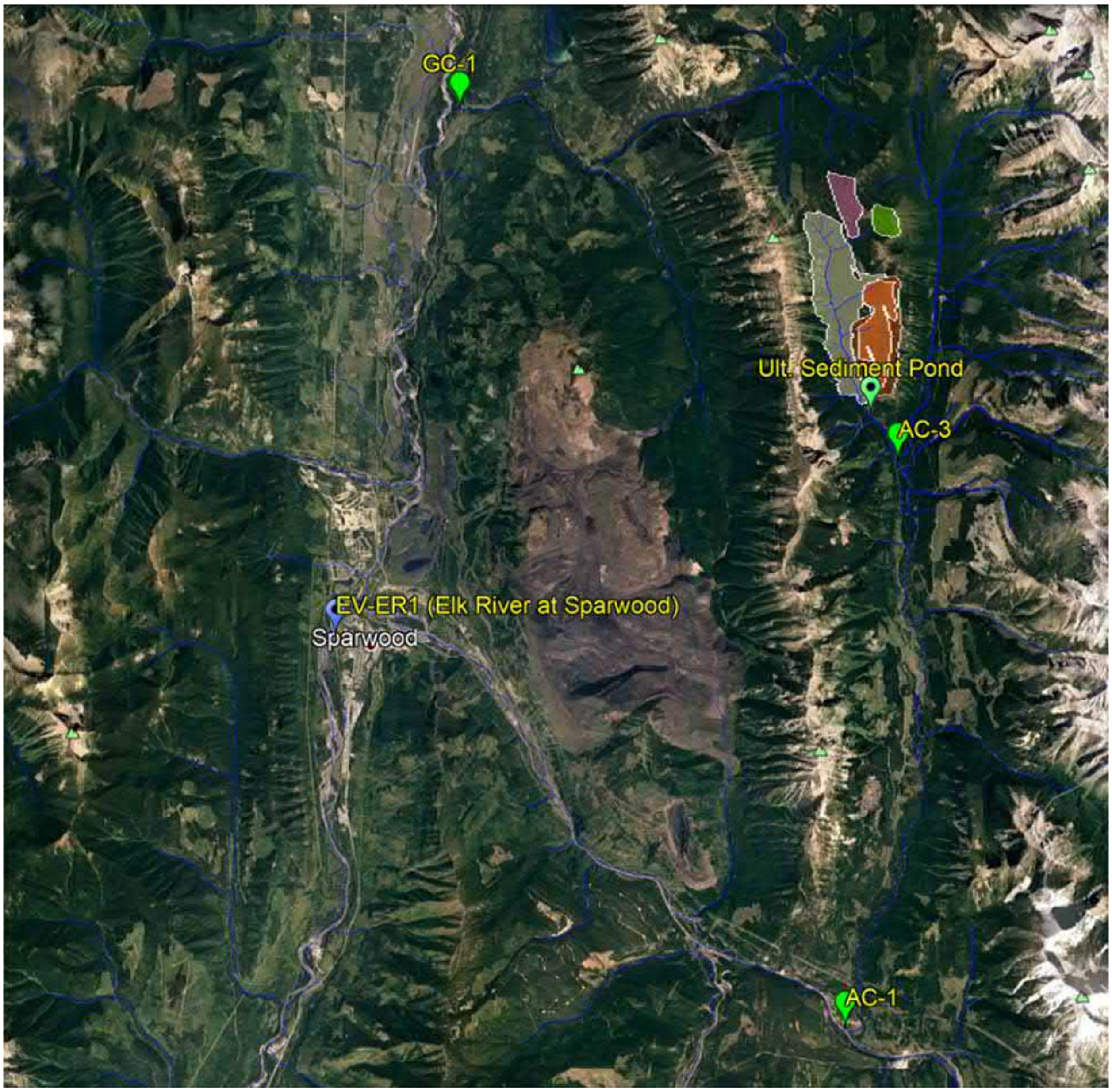
Scenario: Upper Case (P_{95}) Layering Fails


Monthly Se Concentration (mg/L)
0.005
0.004
0.003
0.002
0.001
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly SO$_4$ Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Appendix C Water Quality Results for Impacted Facilities Upper Case (P95) Case Scenarios

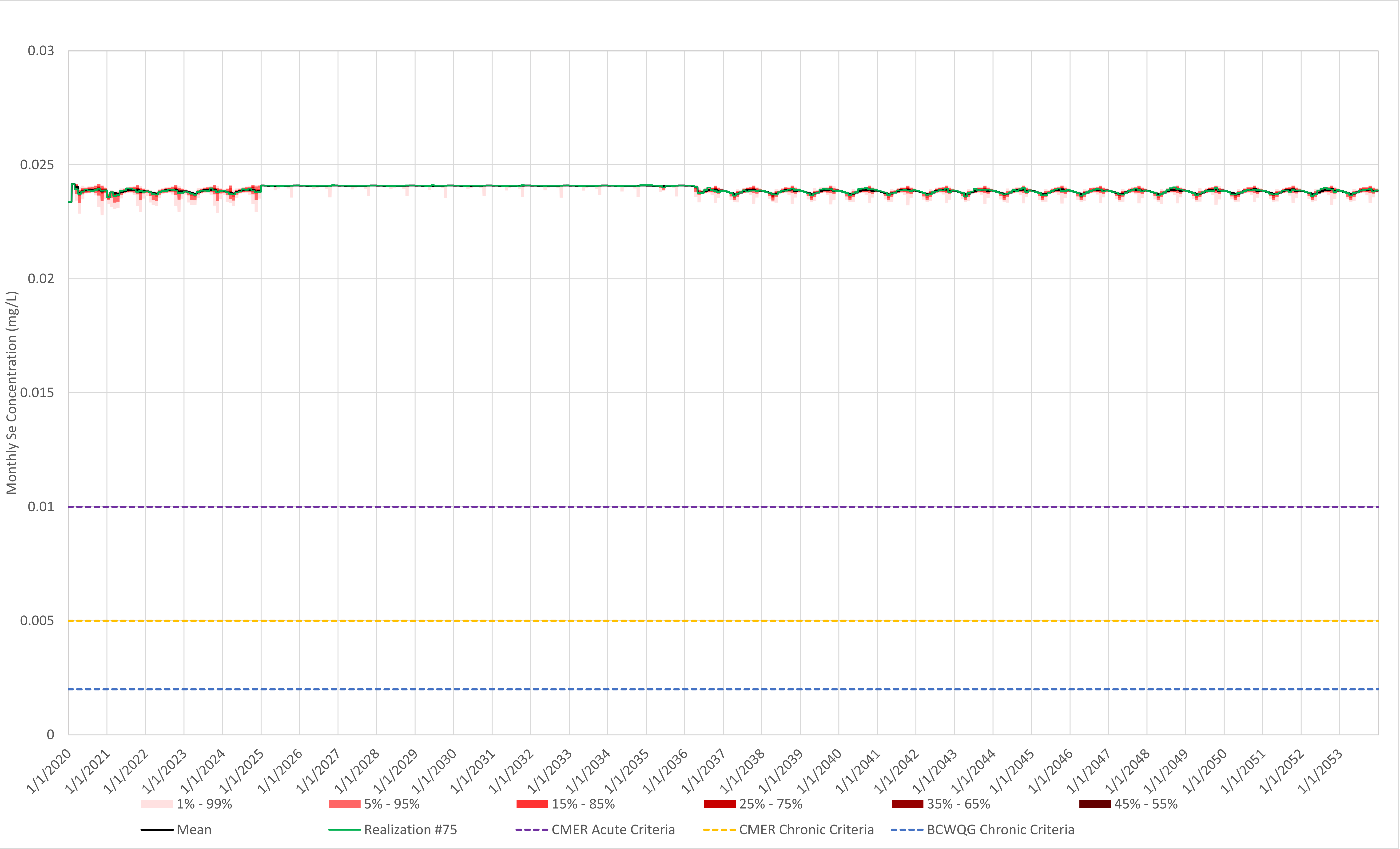


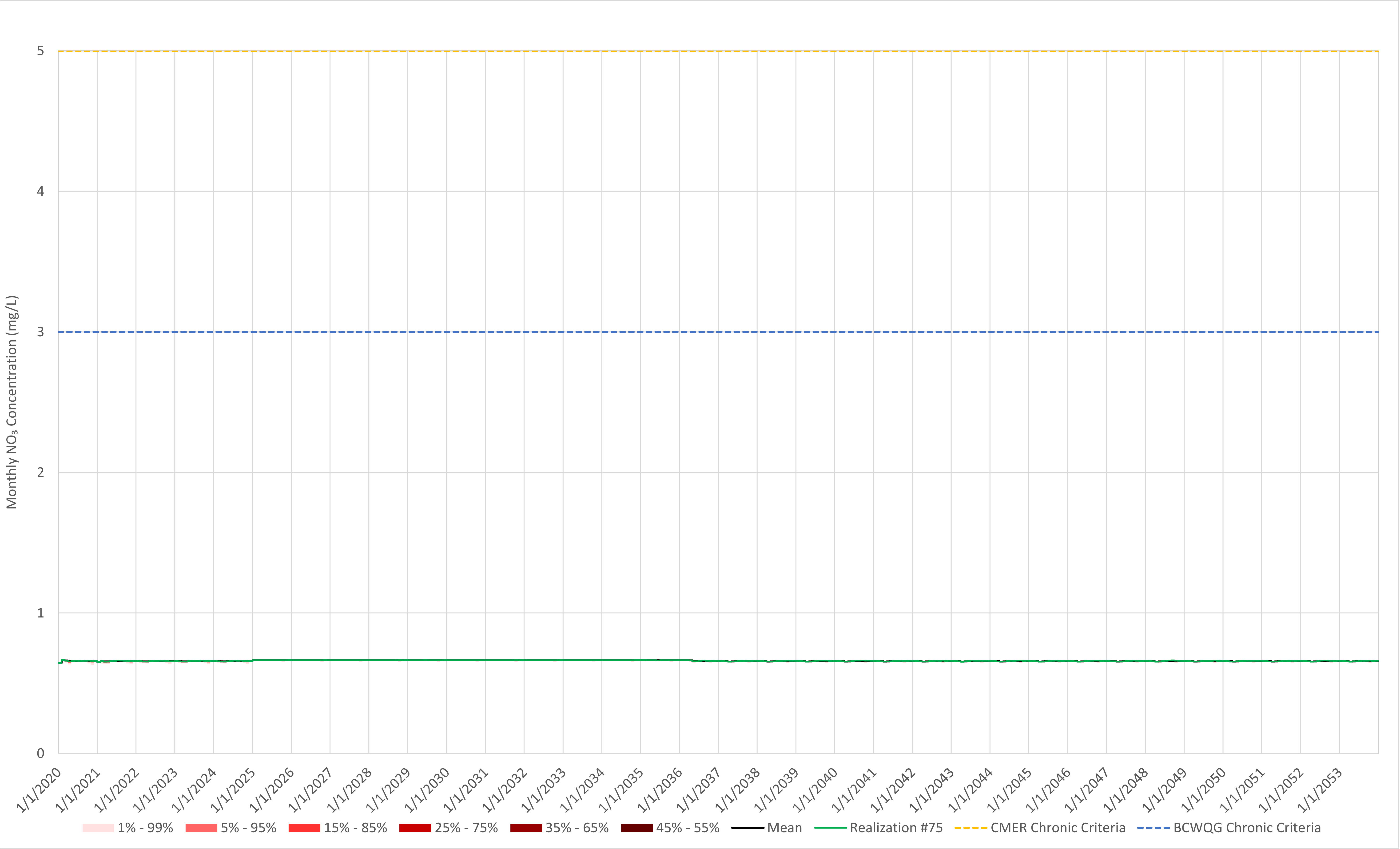
Key Impacted Mining Facilities & Waterways

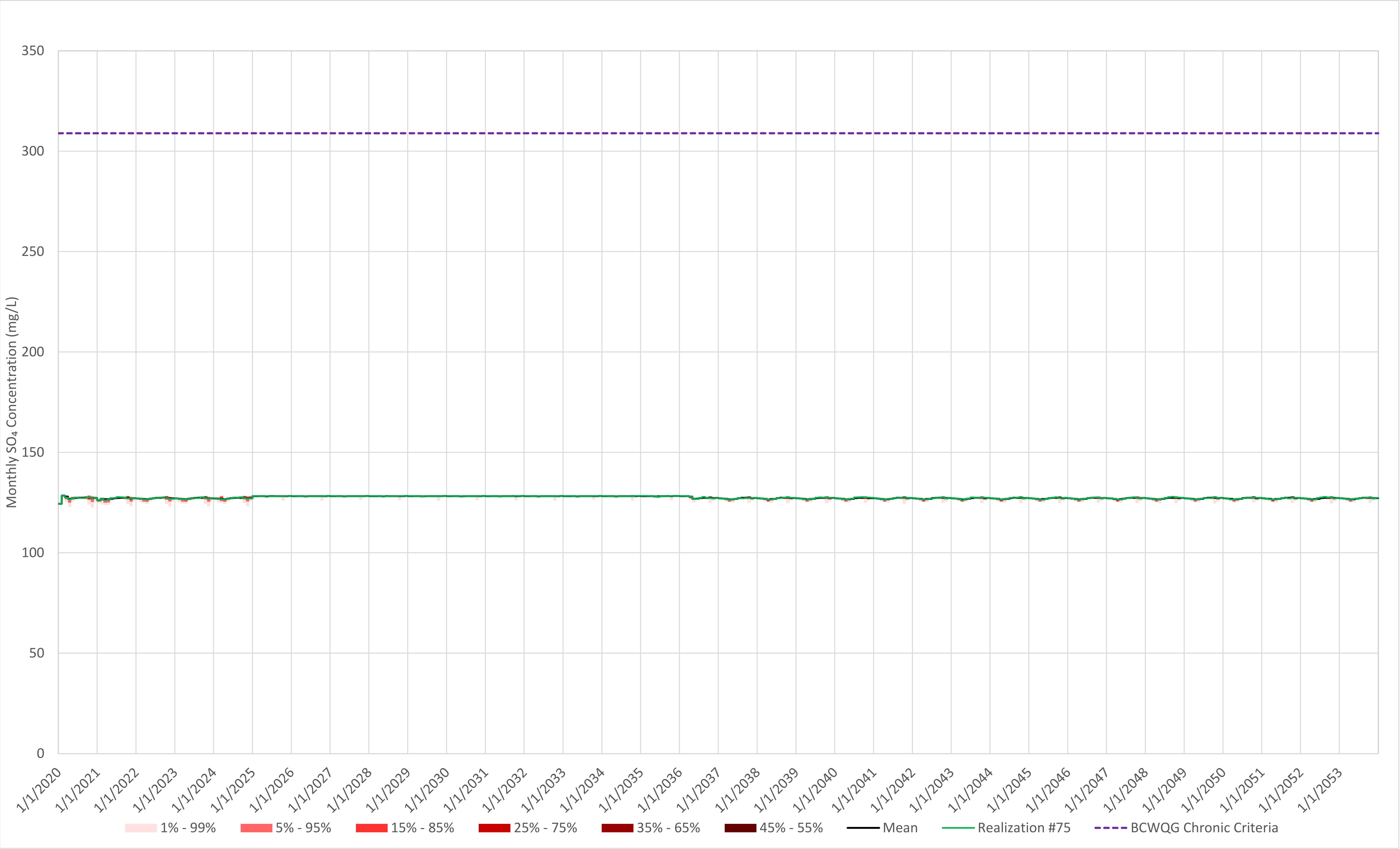
Upper Case (P_{95}) Scenarios

Reporting Location: GC_1

Scenario: Average Case (P_{95}) Layering Succeeds

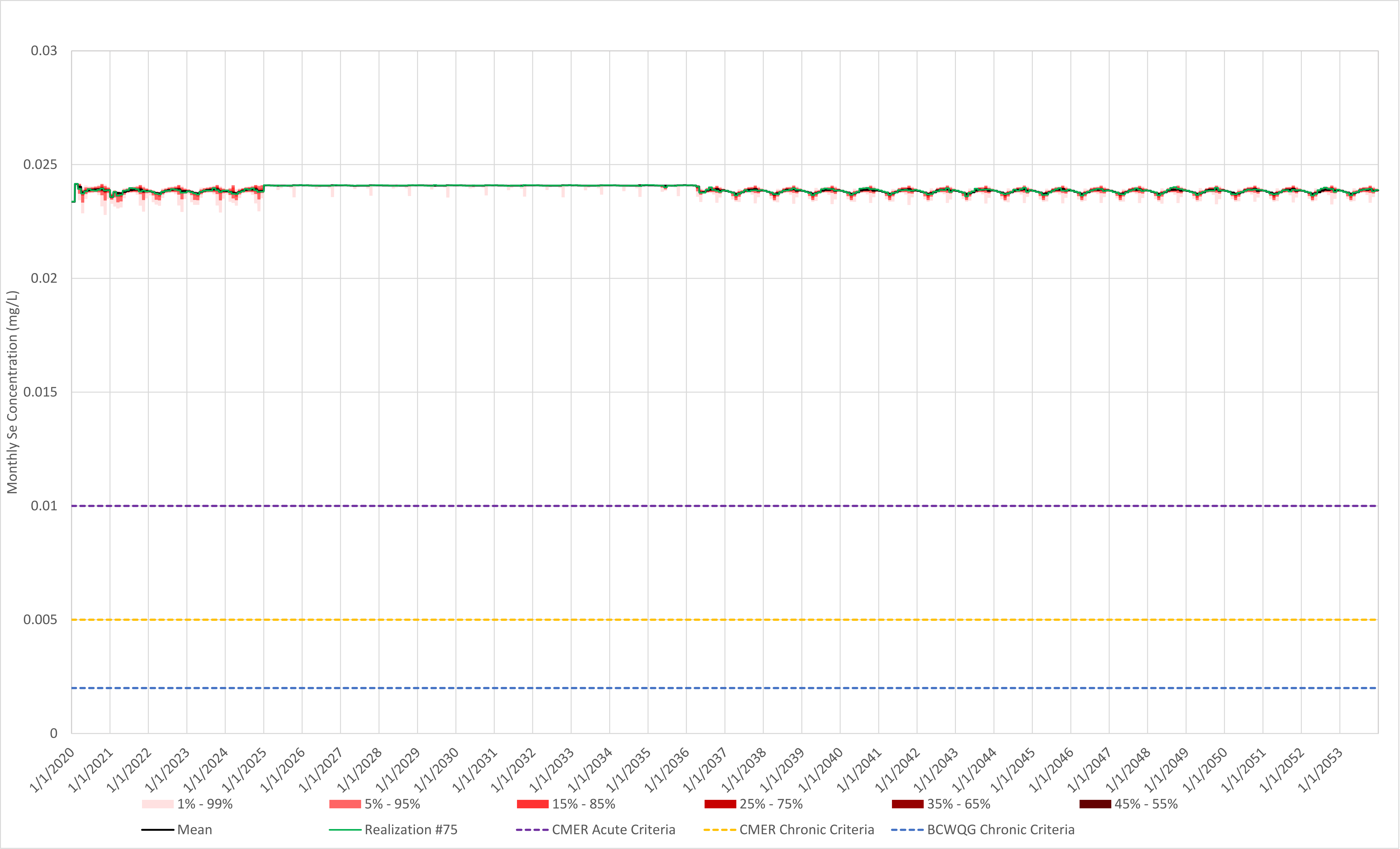

0.03
0.025
0.02
0.015
0.01
0.005
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

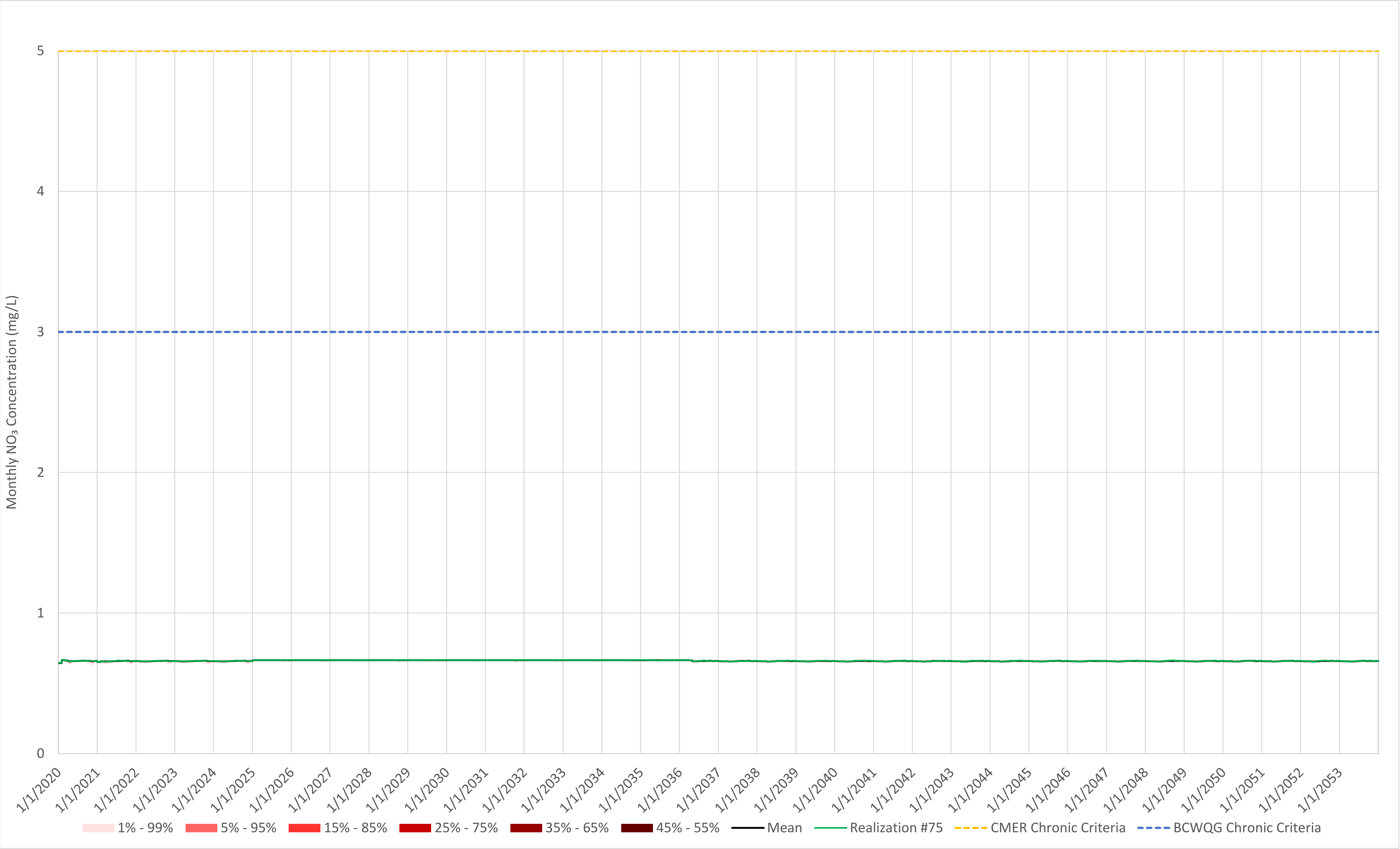

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

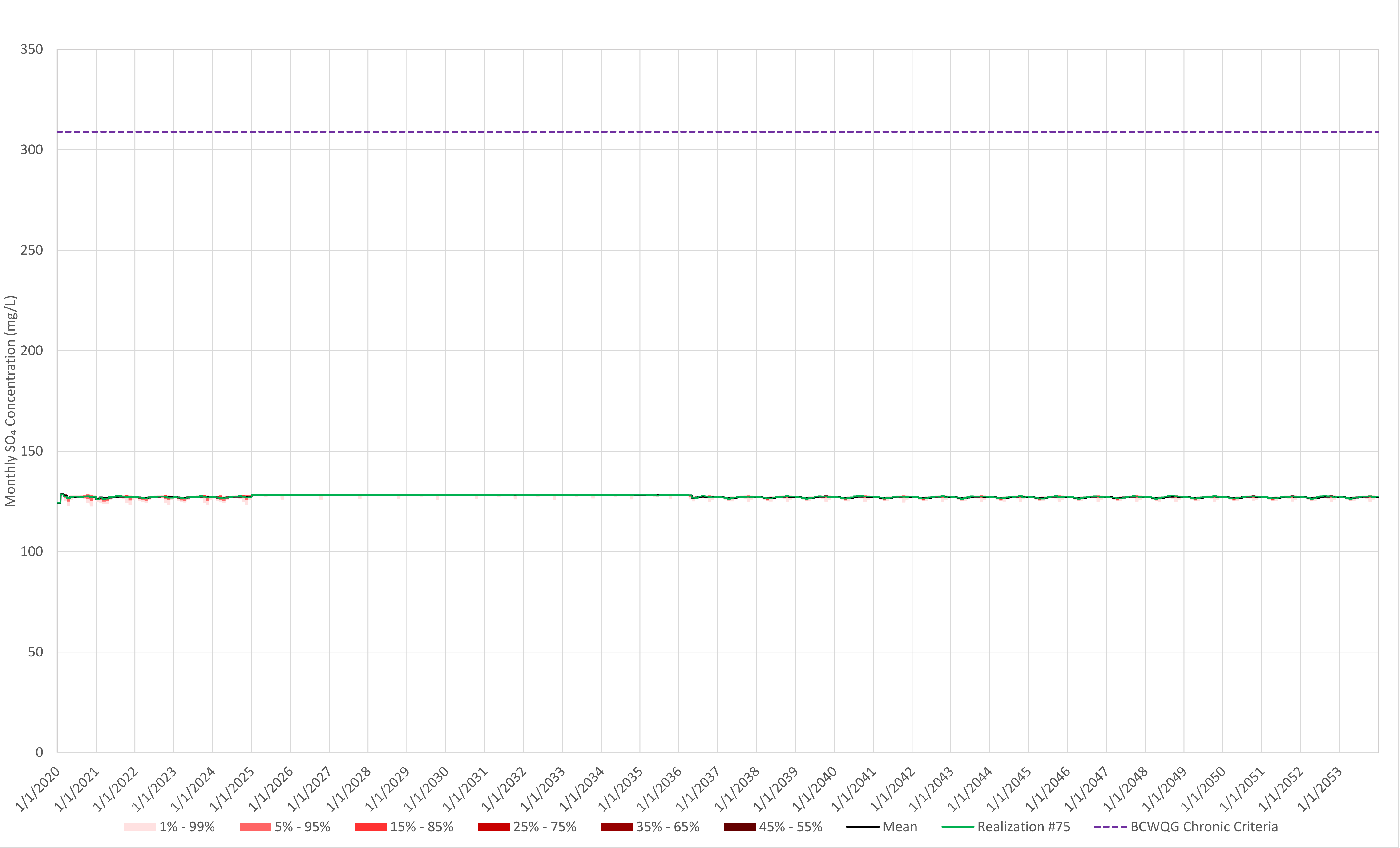

Monthly SO₄ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: GC_1

Scenario: Average Case (P_{95}) Layering Fails

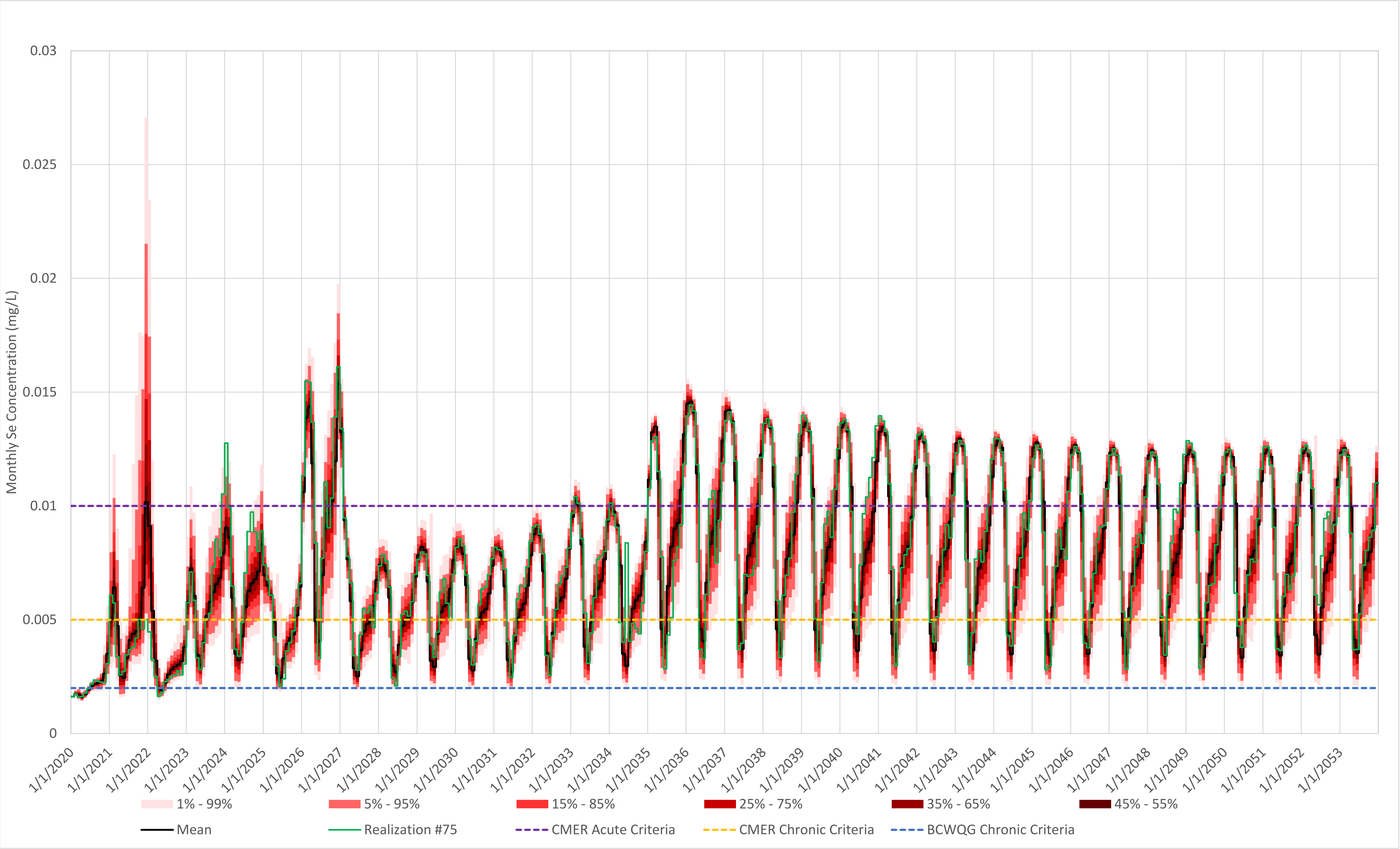

Monthly Se Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

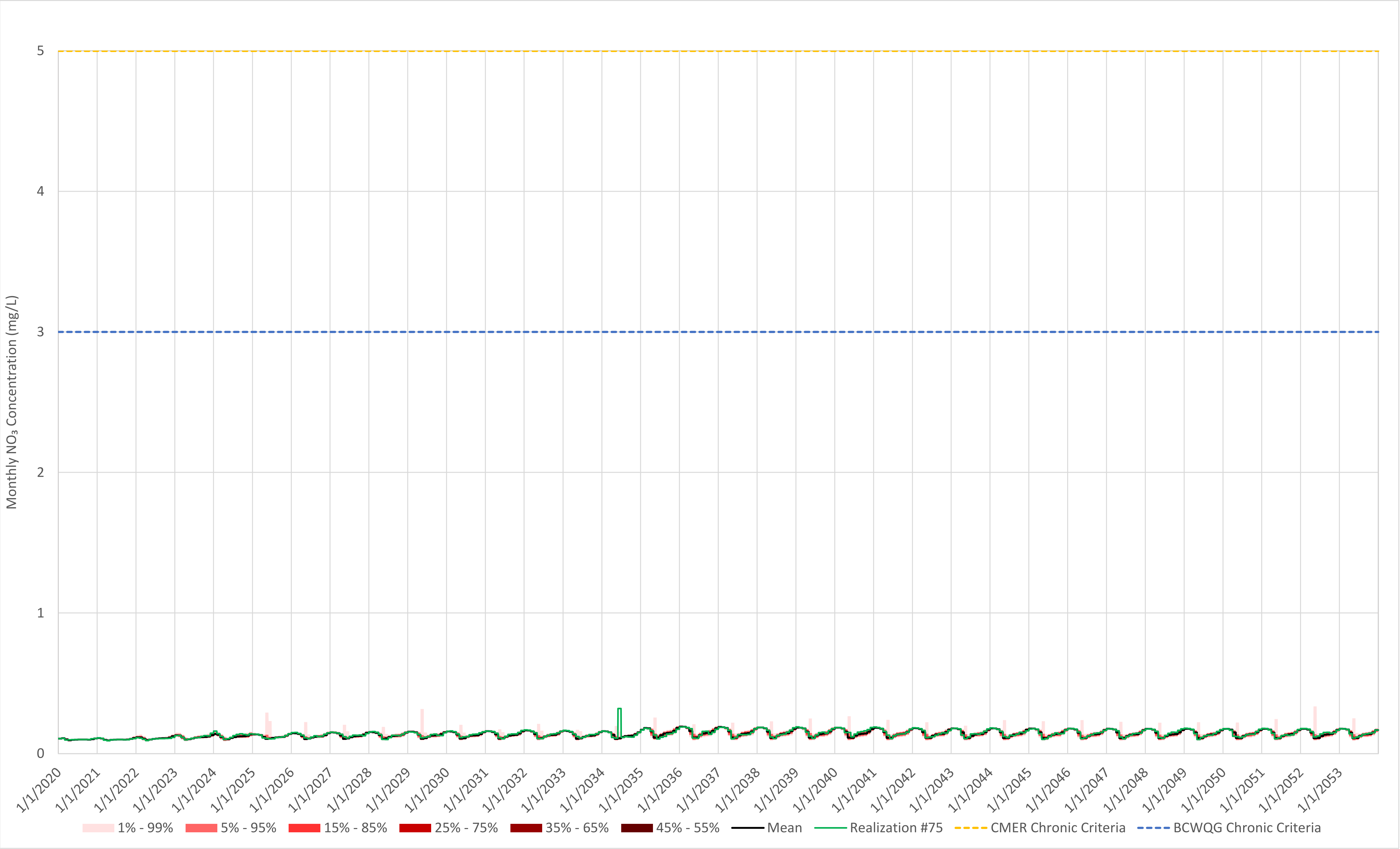

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

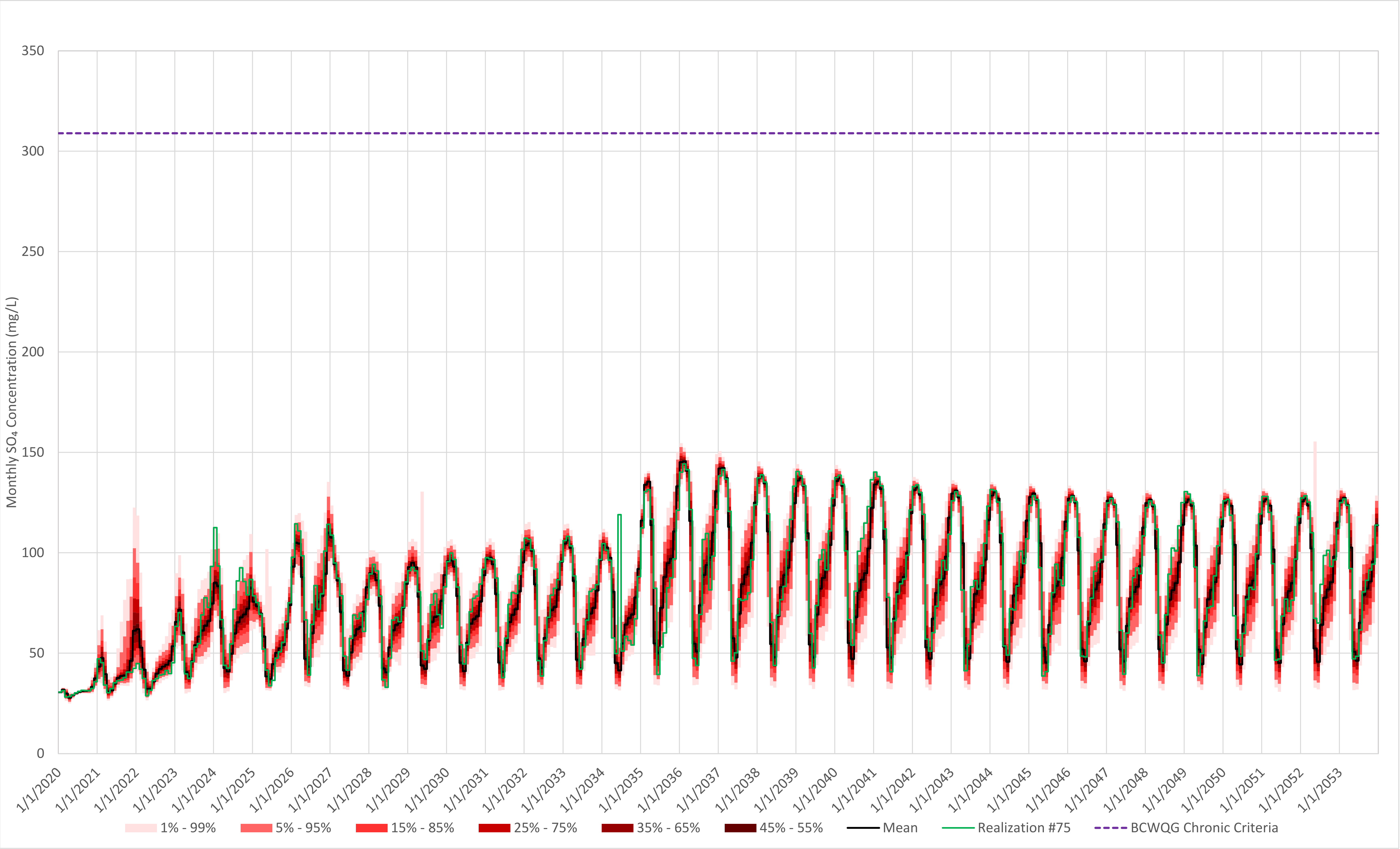

Monthly SO$_4$ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: WRD Sediment Pond

Scenario: Average Case (P_{95}) Layering Succeeds

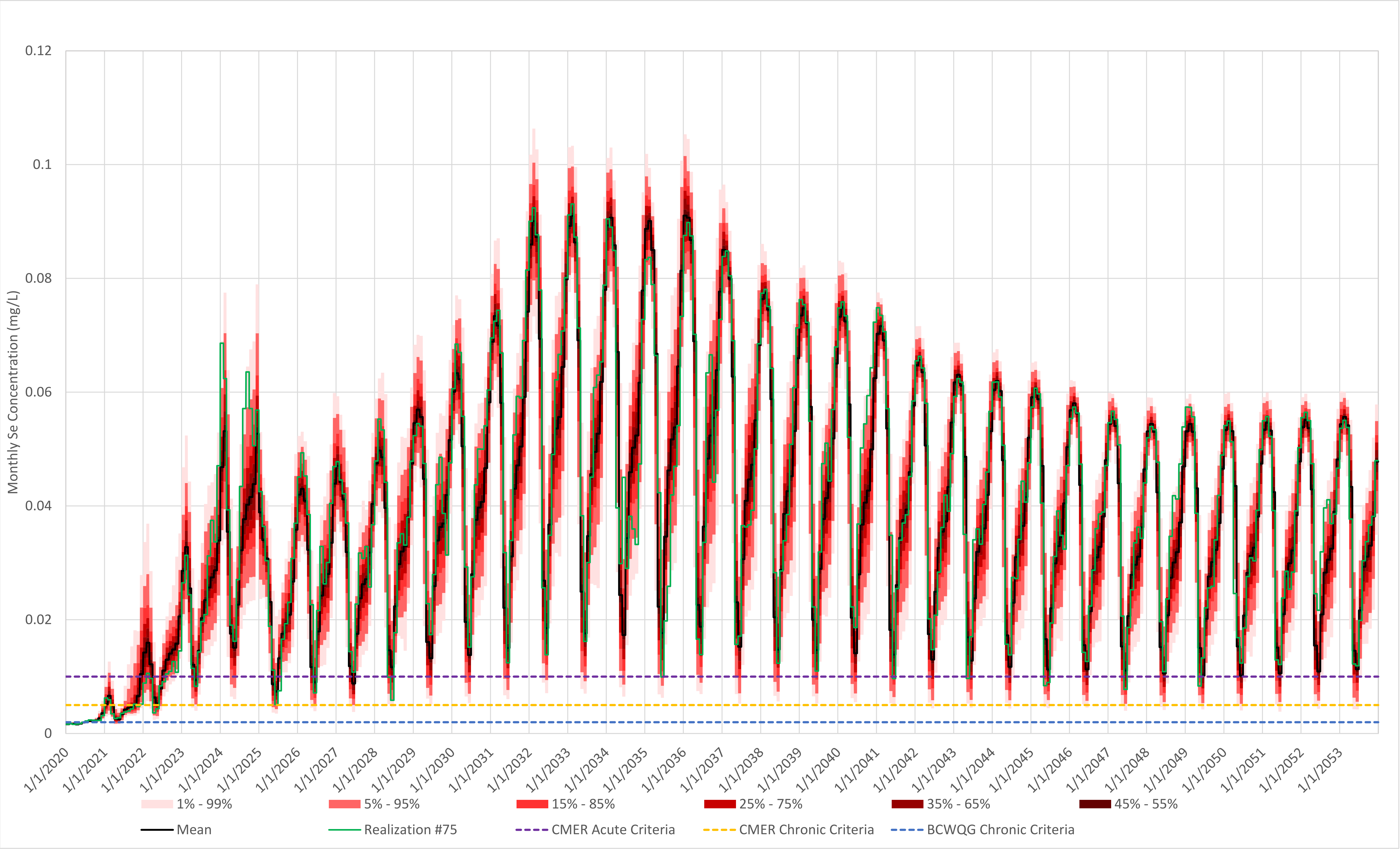

0.03
0.025
0.02
0.015
0.01
0.005
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

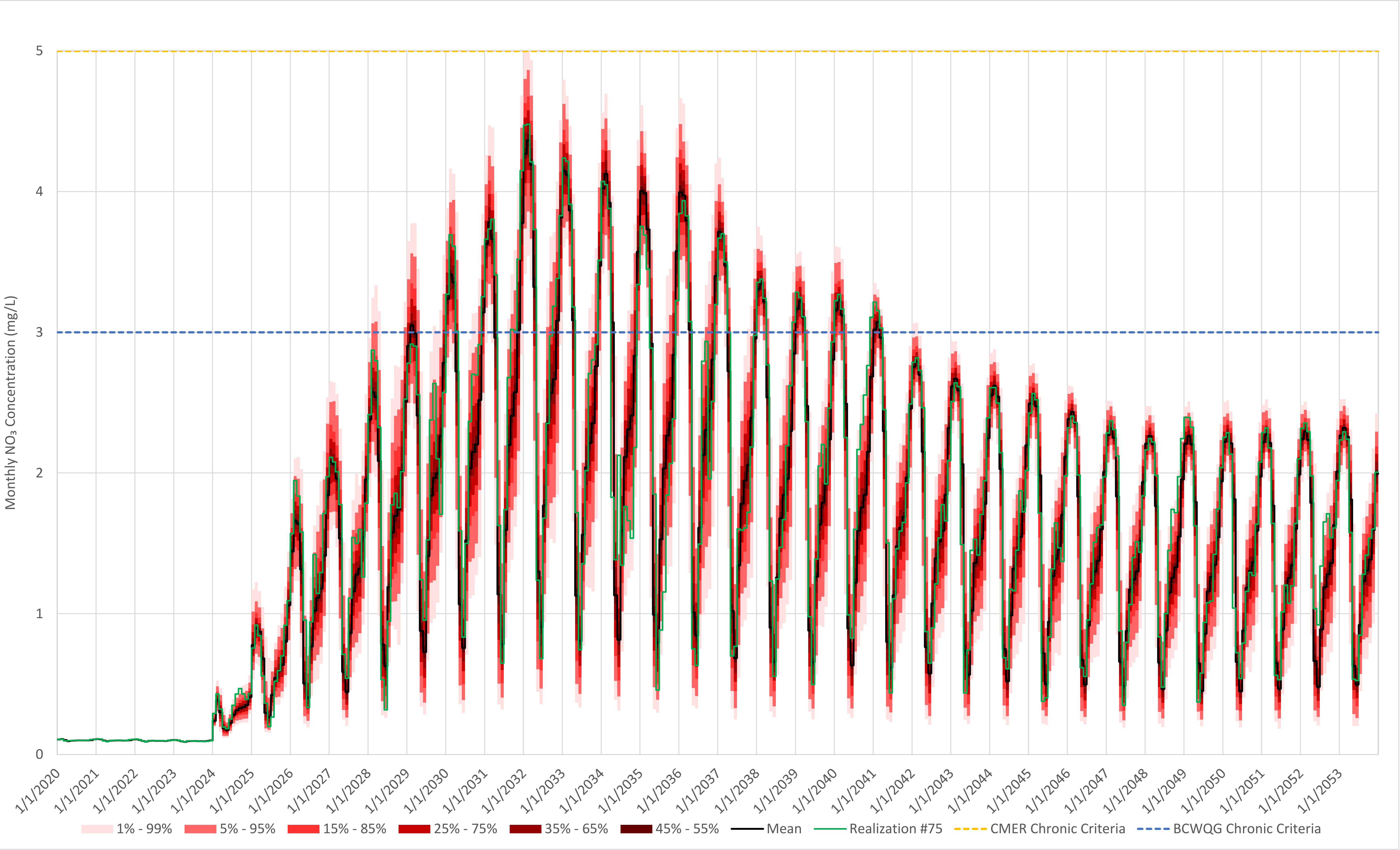

5
4
3
2
1
0
Monthly NO$_3$ Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

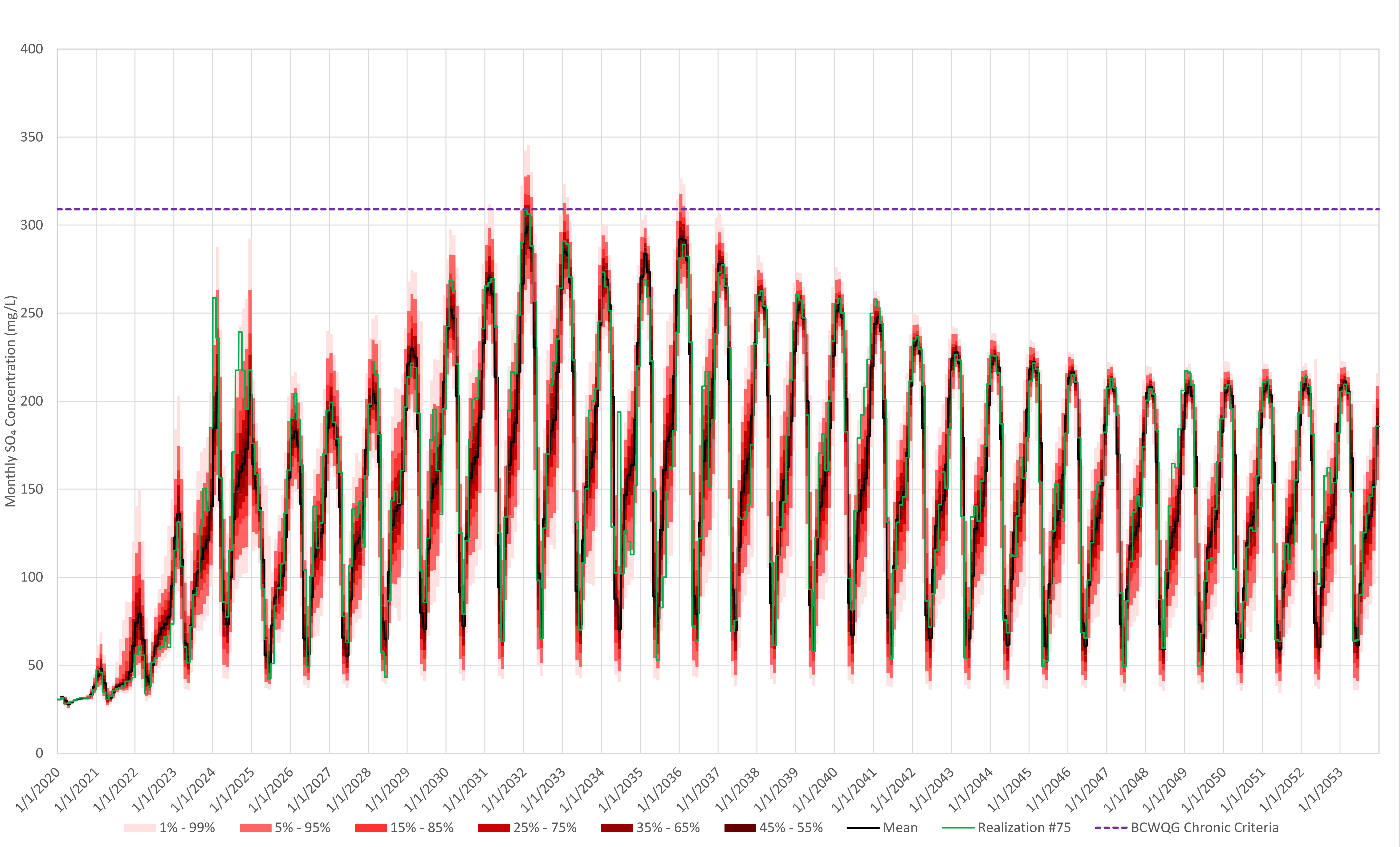

Monthly SO$_4$ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: WRD Sediment Pond

Scenario: Average Case (P_{95}) Layering Fails


0.12
0.1
0.08
0.06
0.04
0.02
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

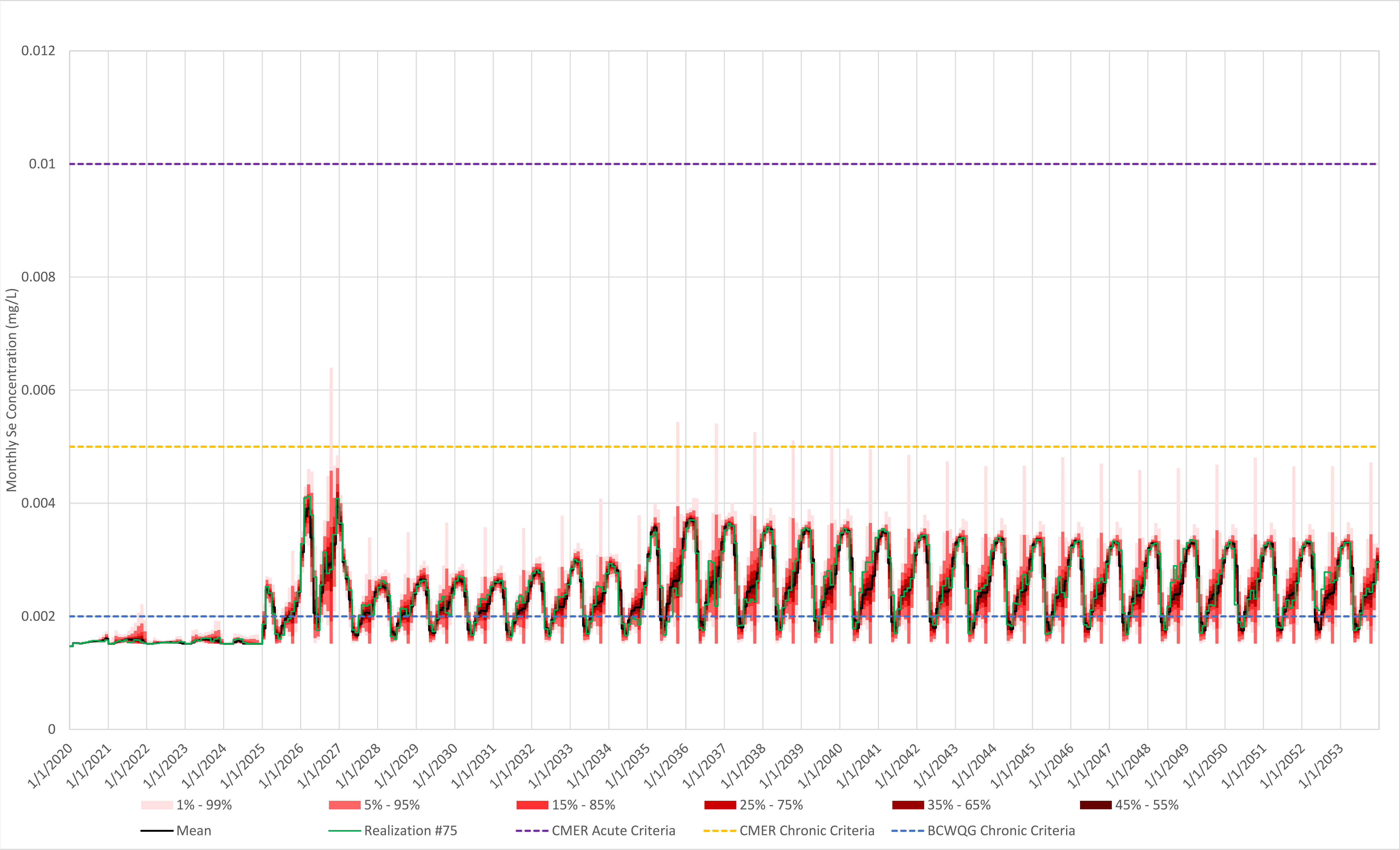

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

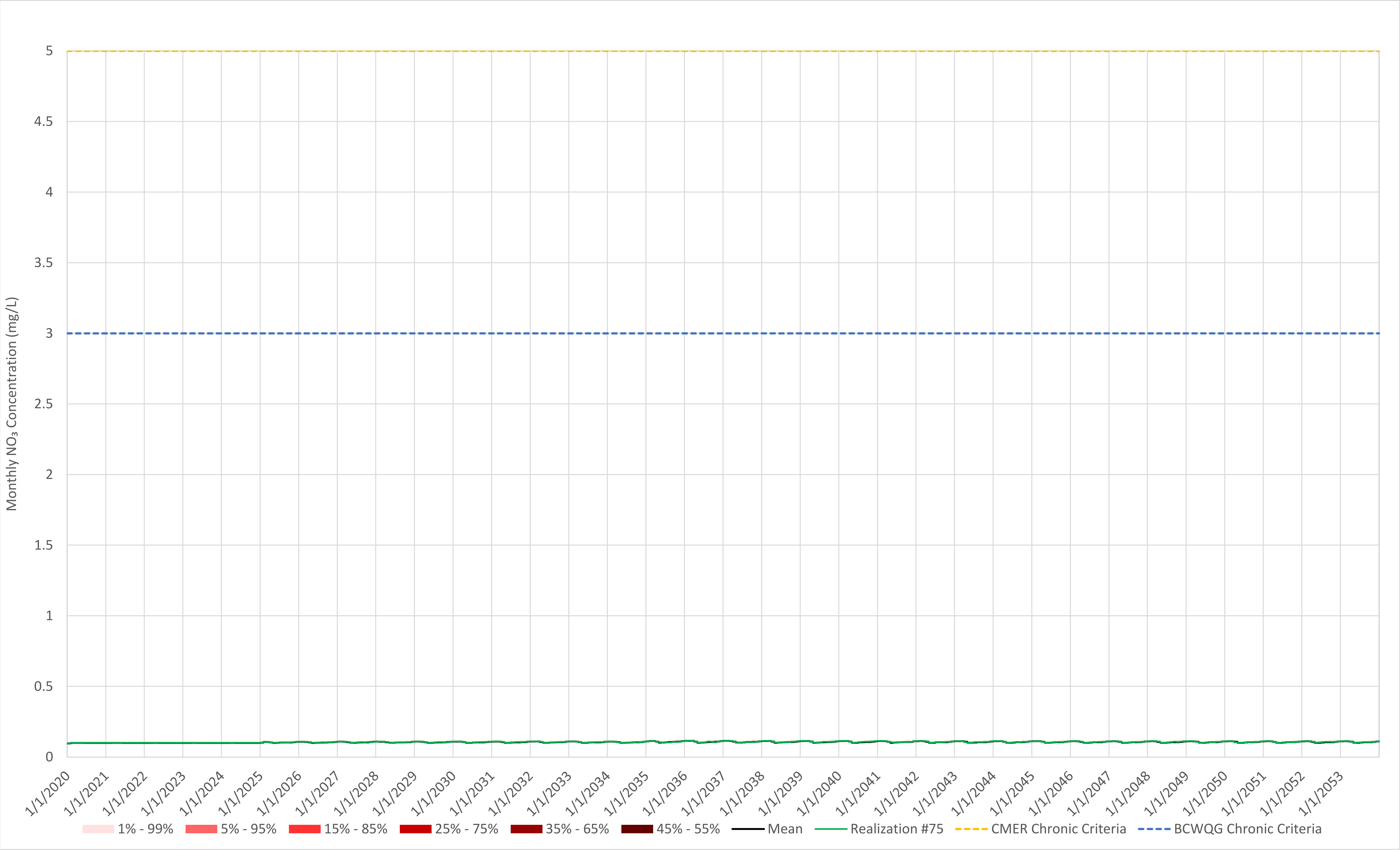


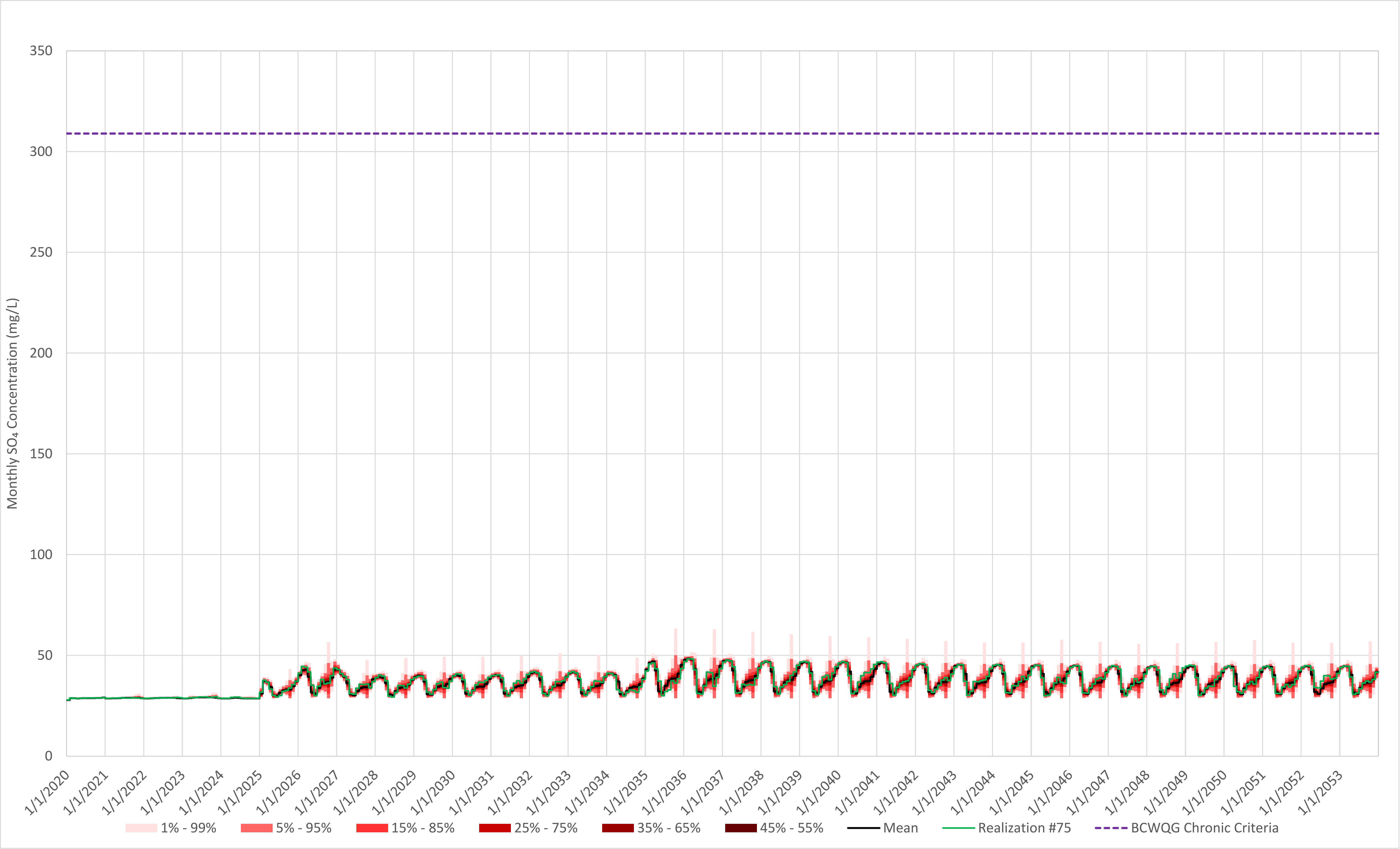
Monthly SO$_4$ Concentration (mg/L)
0
50
100
150
200
250
300
350
400
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: AC_3

Scenario: Average Case (P_{95}) Layering Succeeds


Monthly Se Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

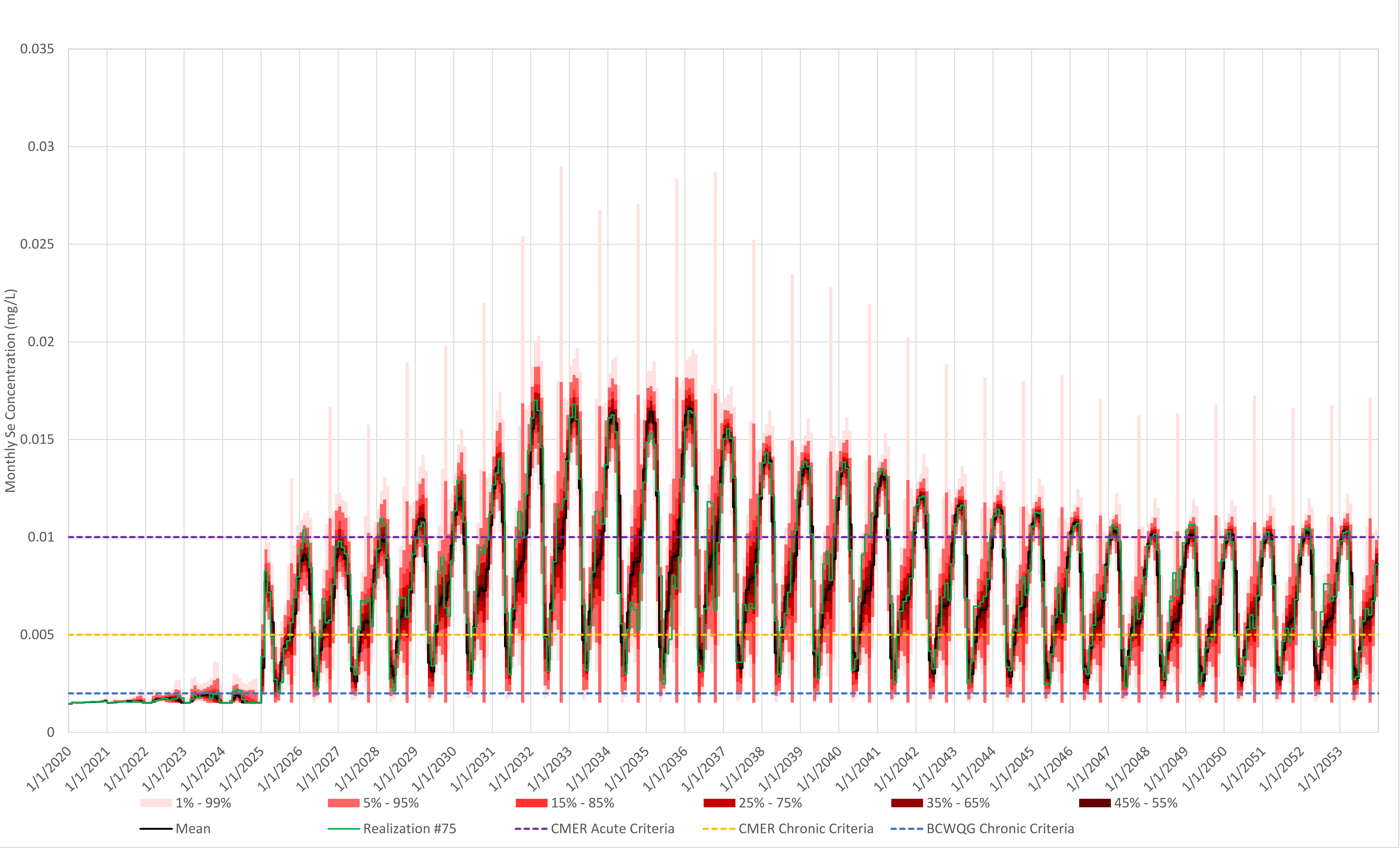

Monthly NO$_3$ Concentration (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

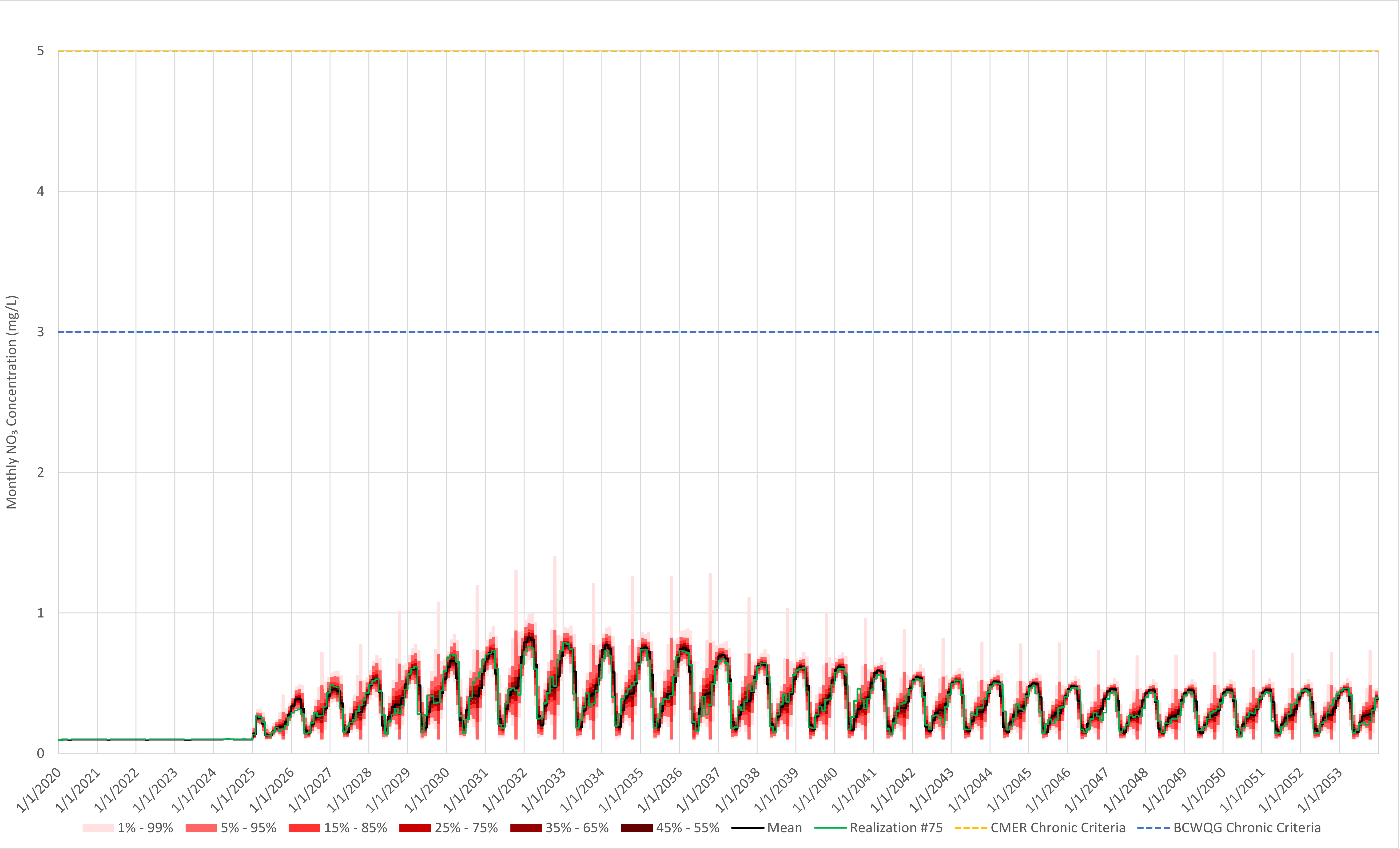


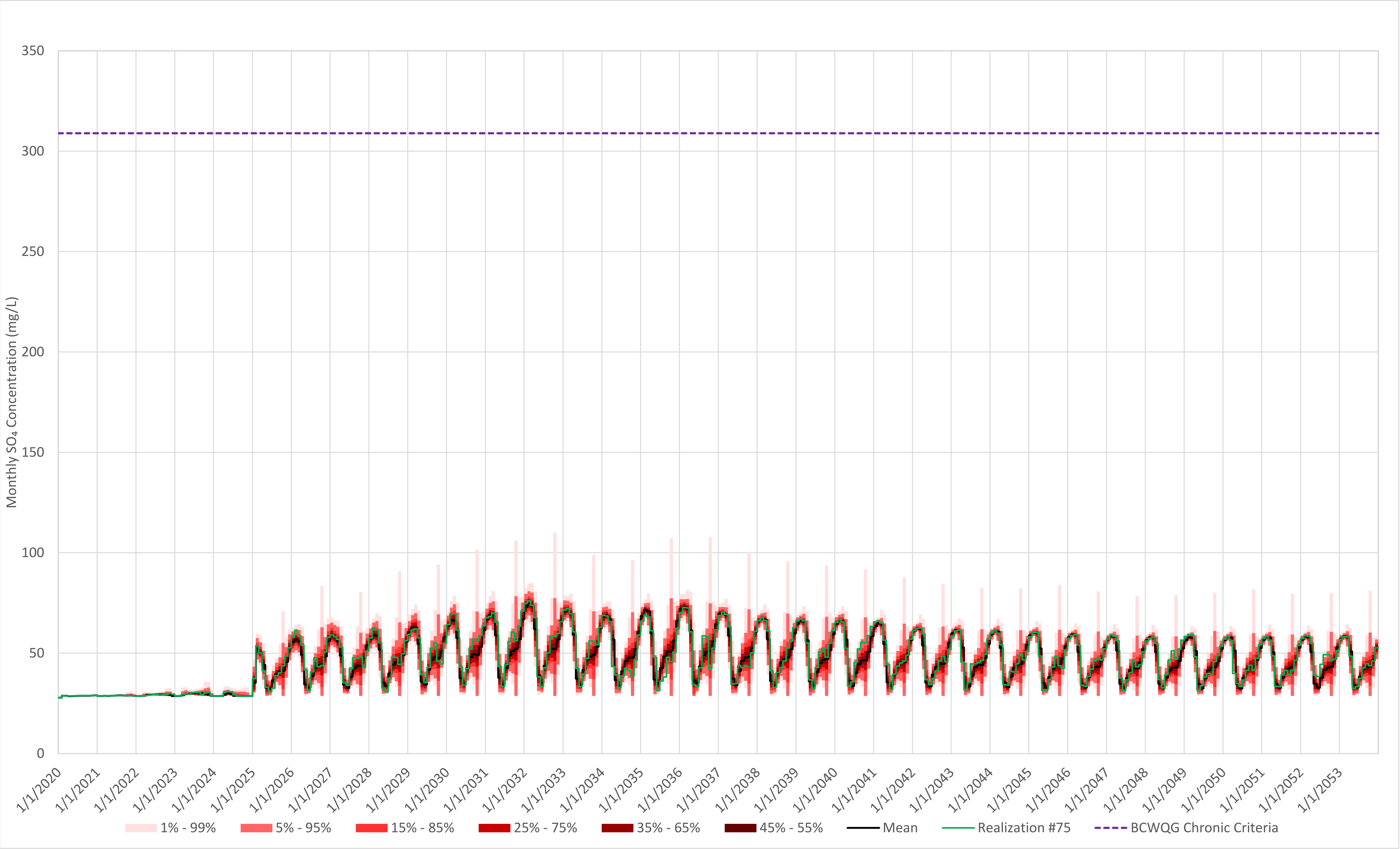
350
300
250
200
150
100
50
0
Monthly SO₄ Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: AC_3

Scenario: Average Case (P_{95}) Layering Fails

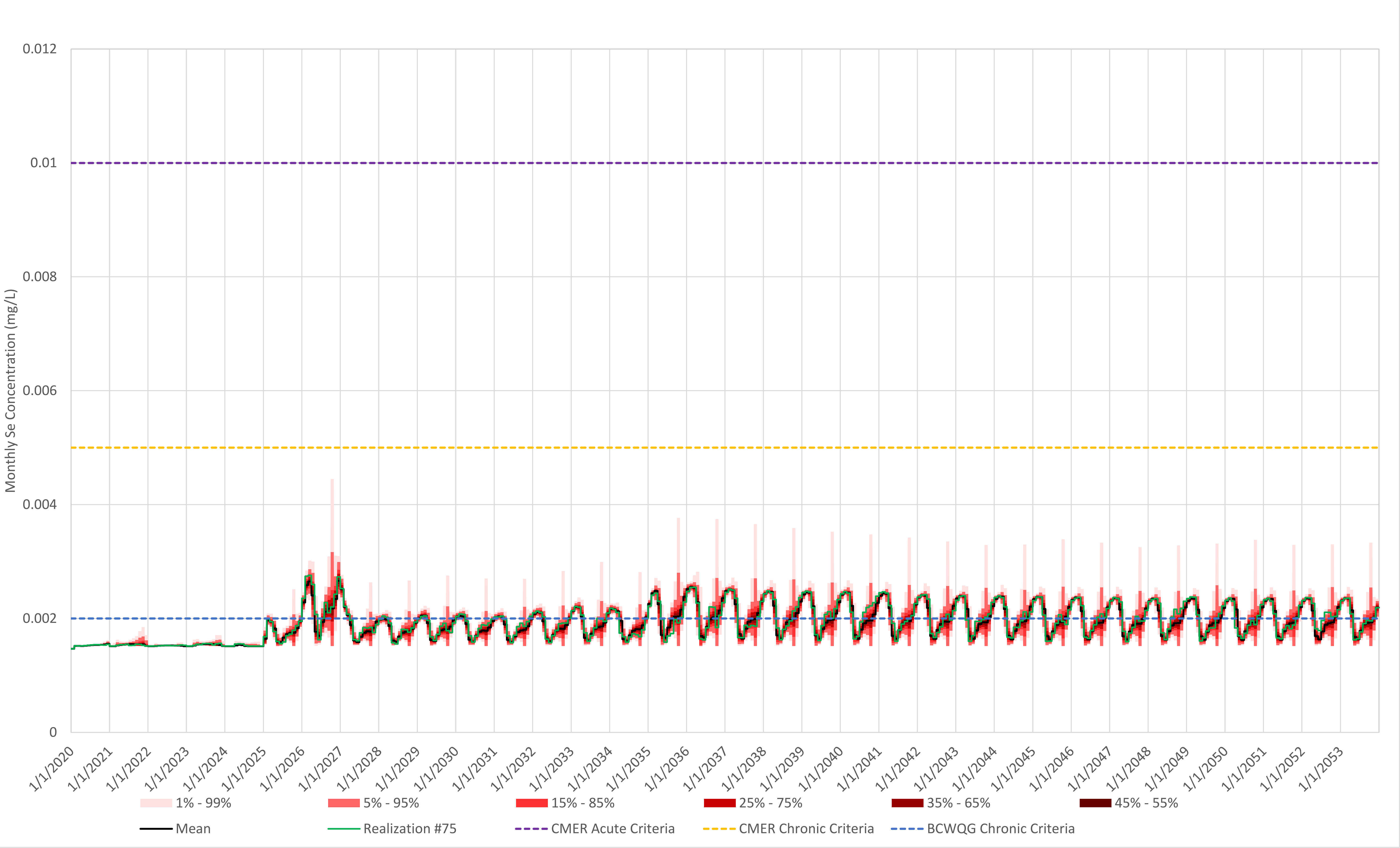

Monthly Se Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

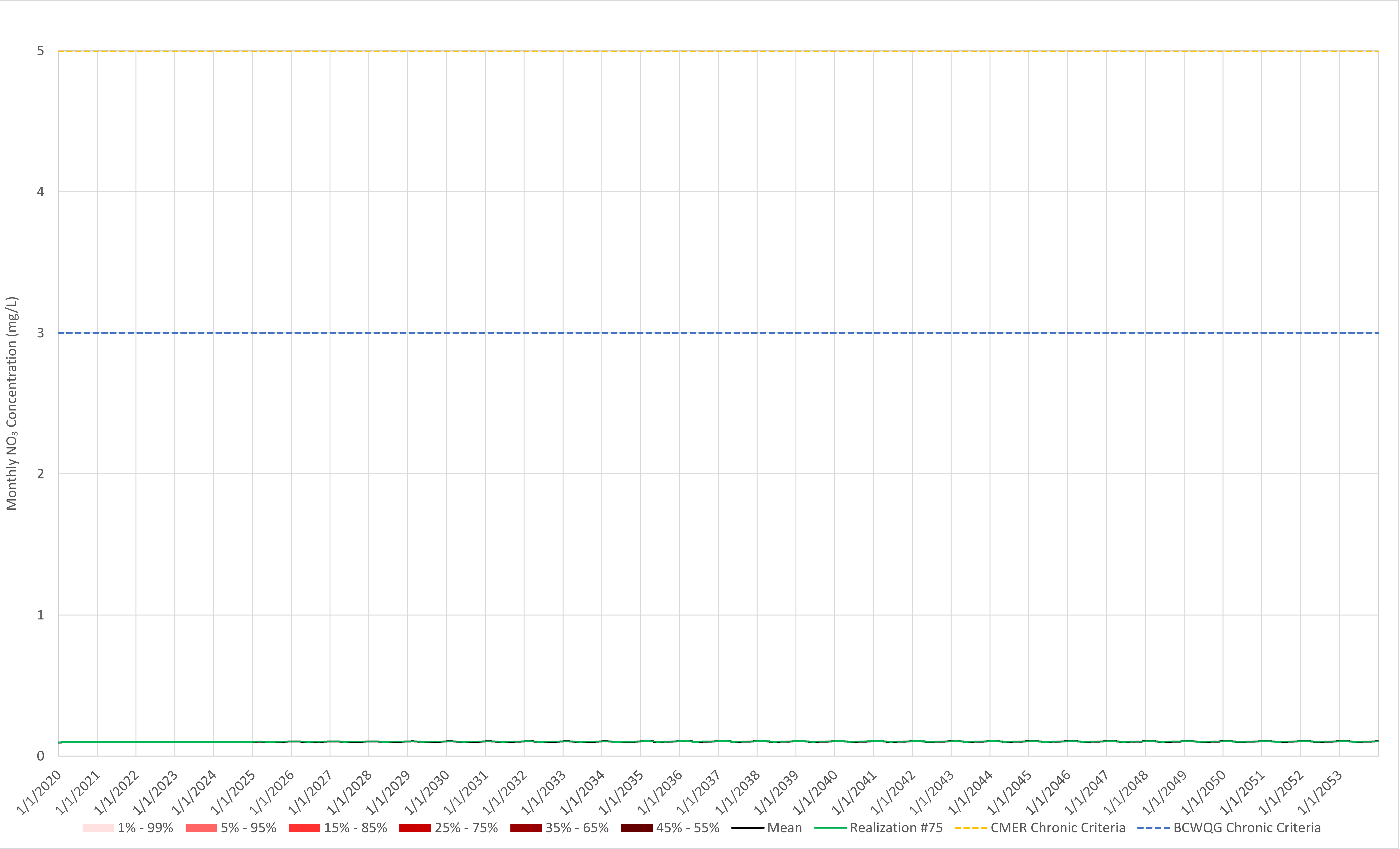

Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly SO$_4$ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

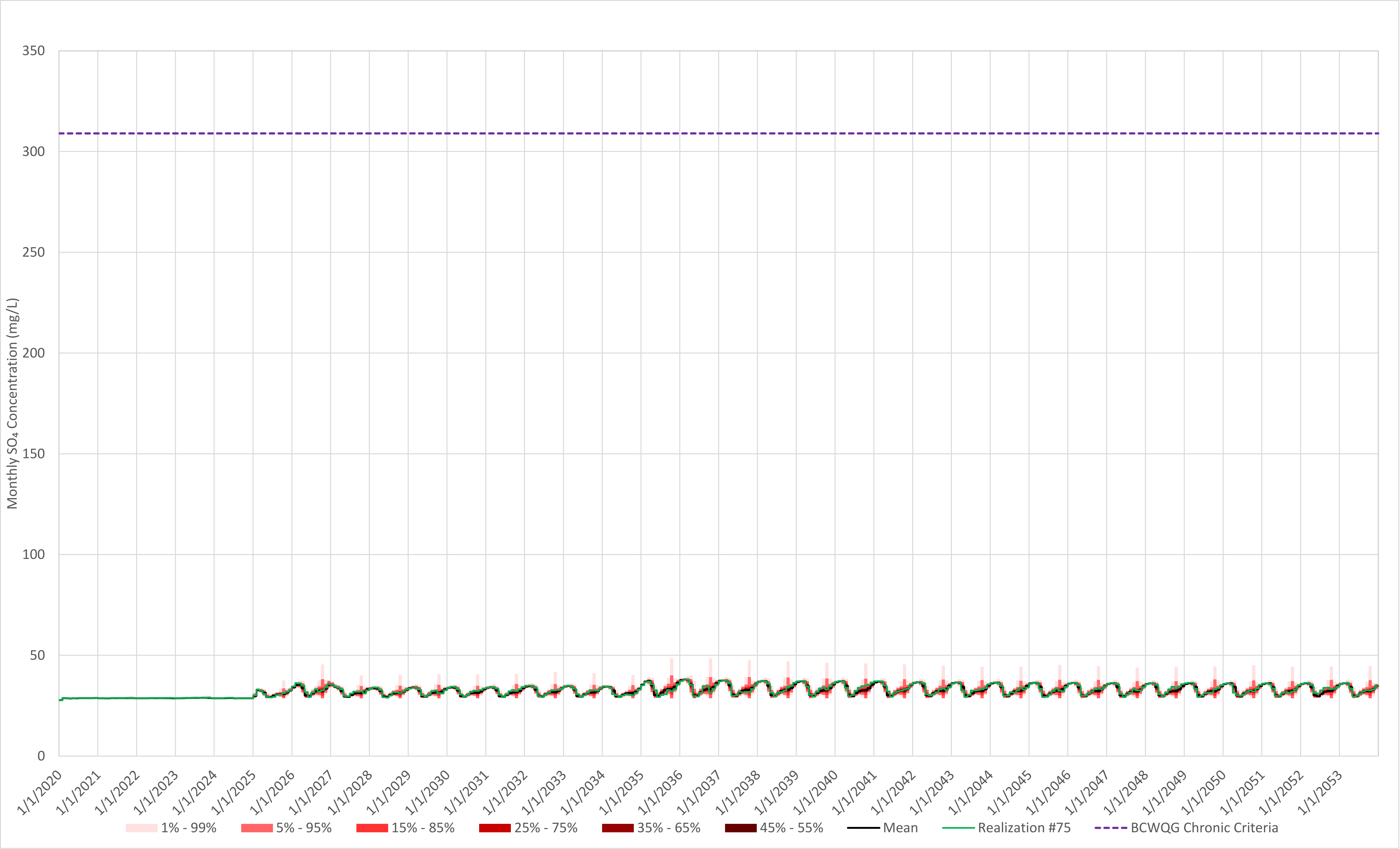
Reporting Location: AC_1

Scenario: Average Case (P_{95}) Layering Succeeds


Monthly Se Concentration (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

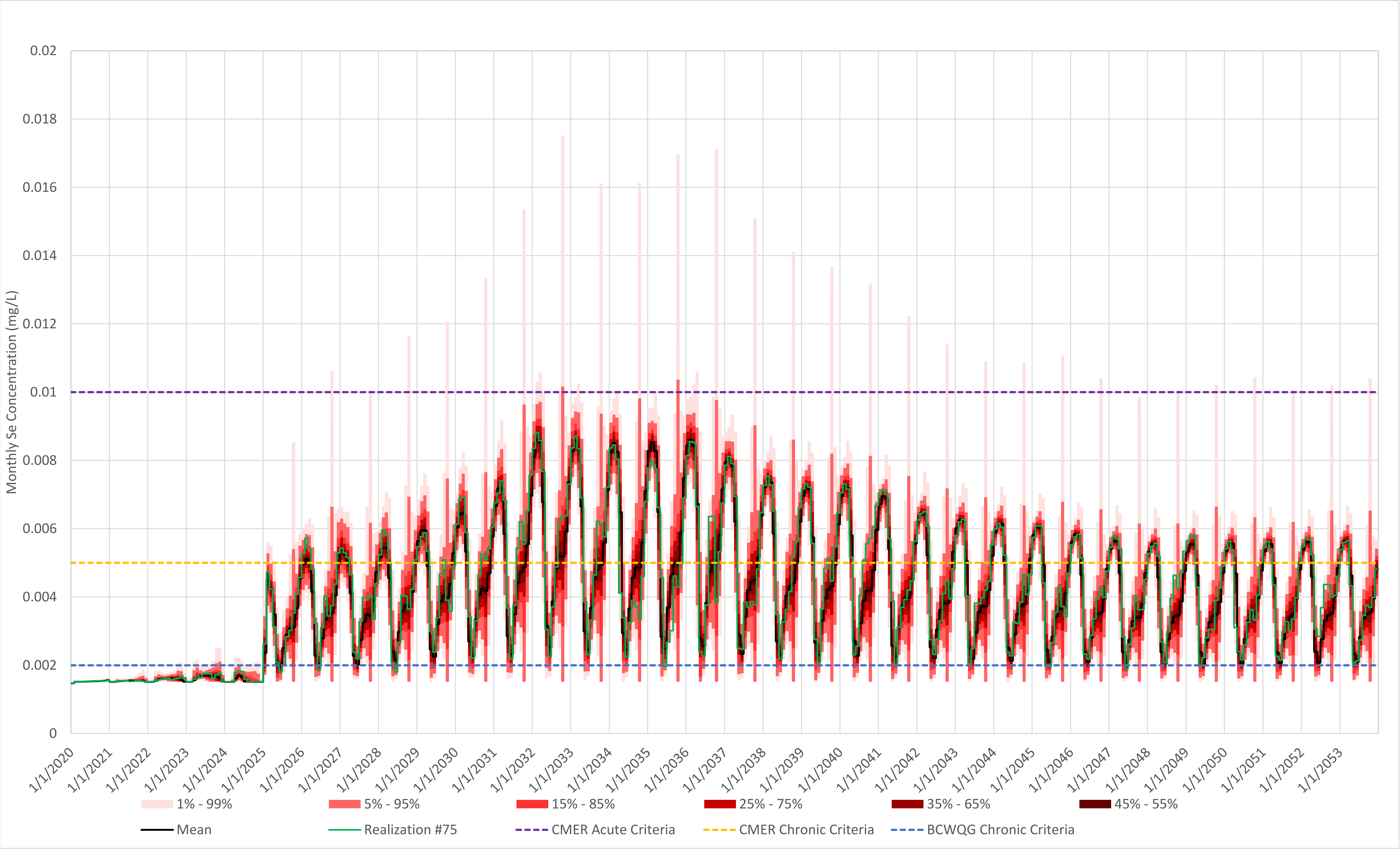


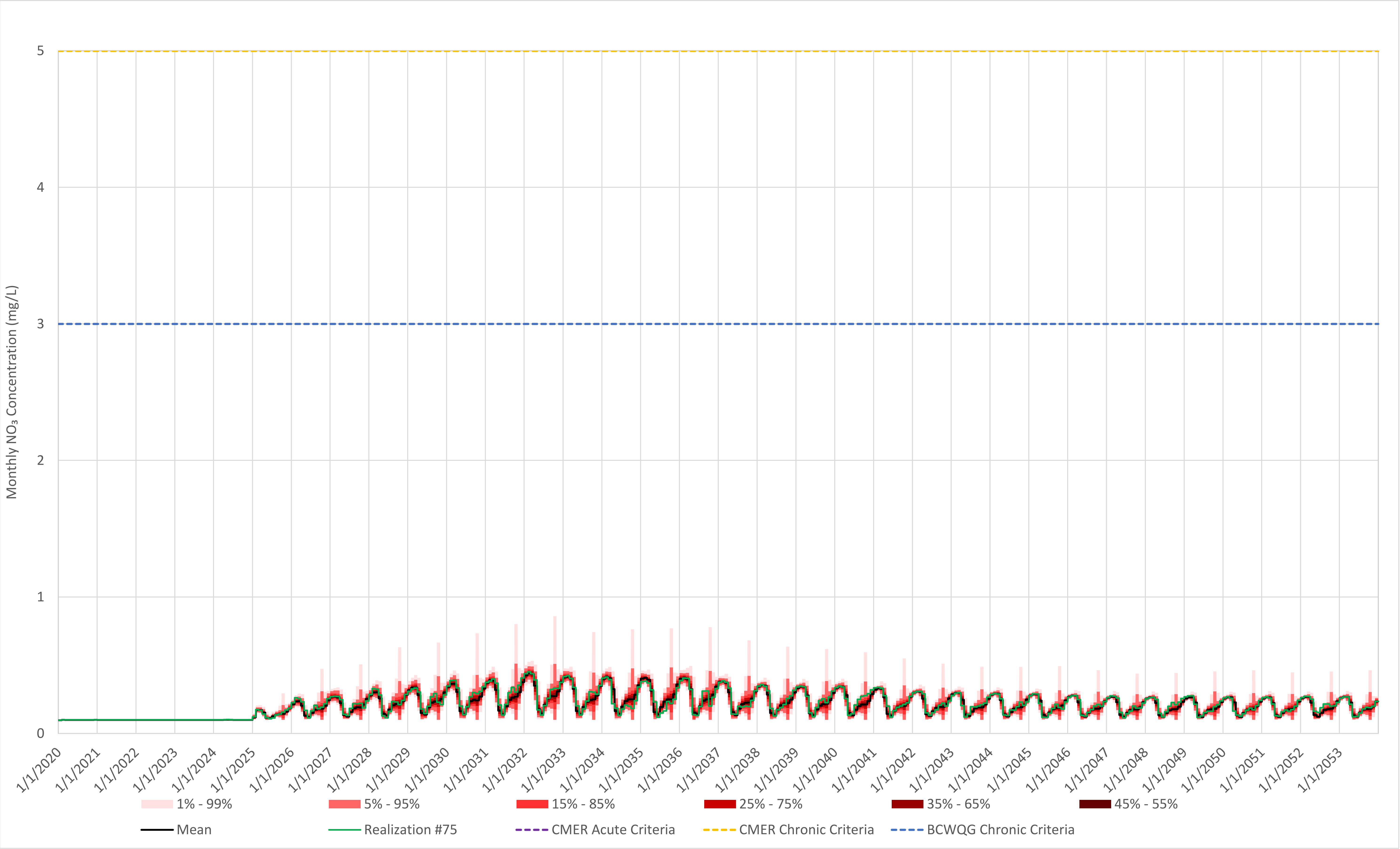
5
4
3
2
1
0
Monthly NO_3 Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria

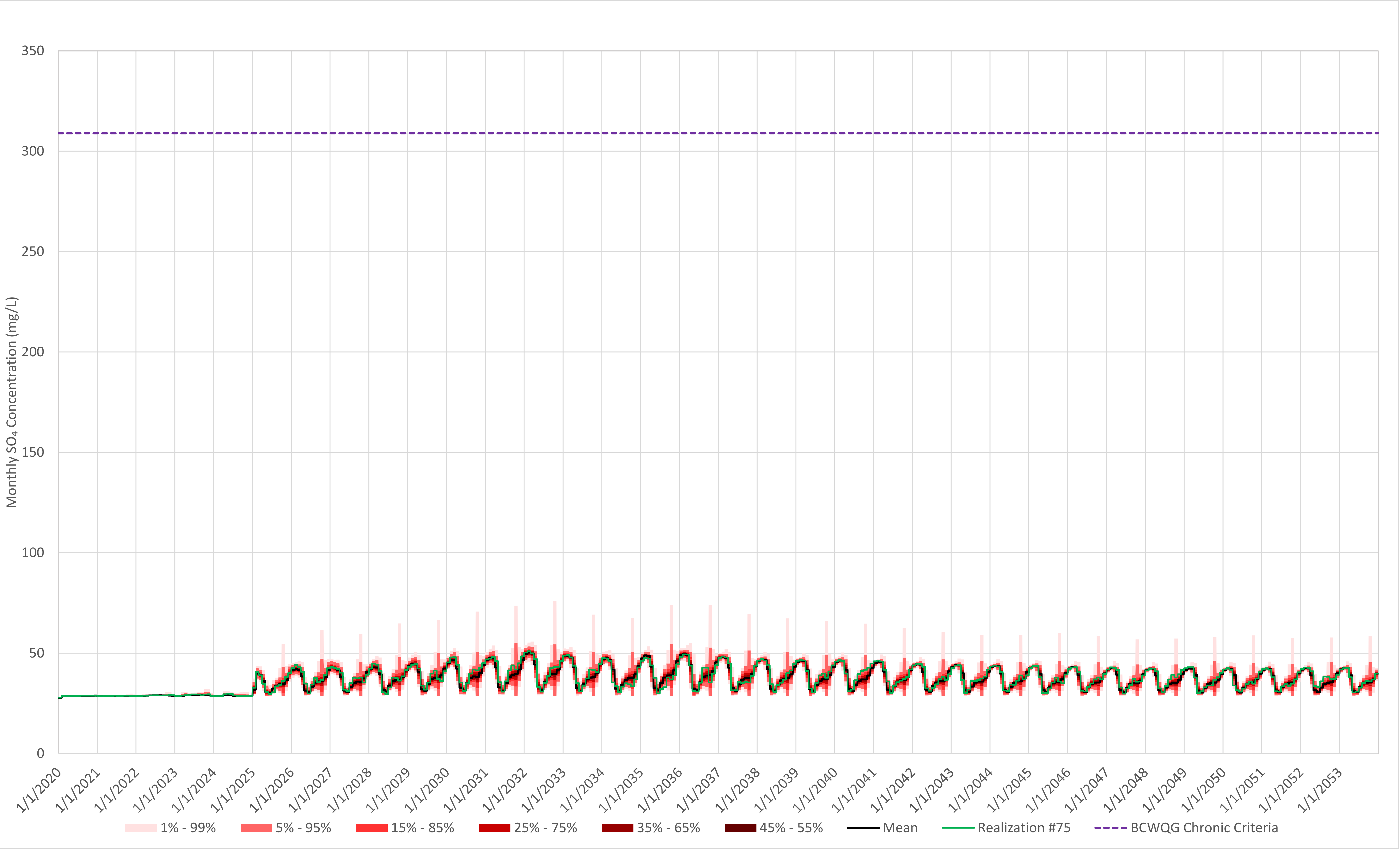

Monthly SO$_4$ Concentration (mg/L)
350
300
250
200
150
100
50
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: AC_1

Scenario: Average Case (P_{95}) Layering Fails

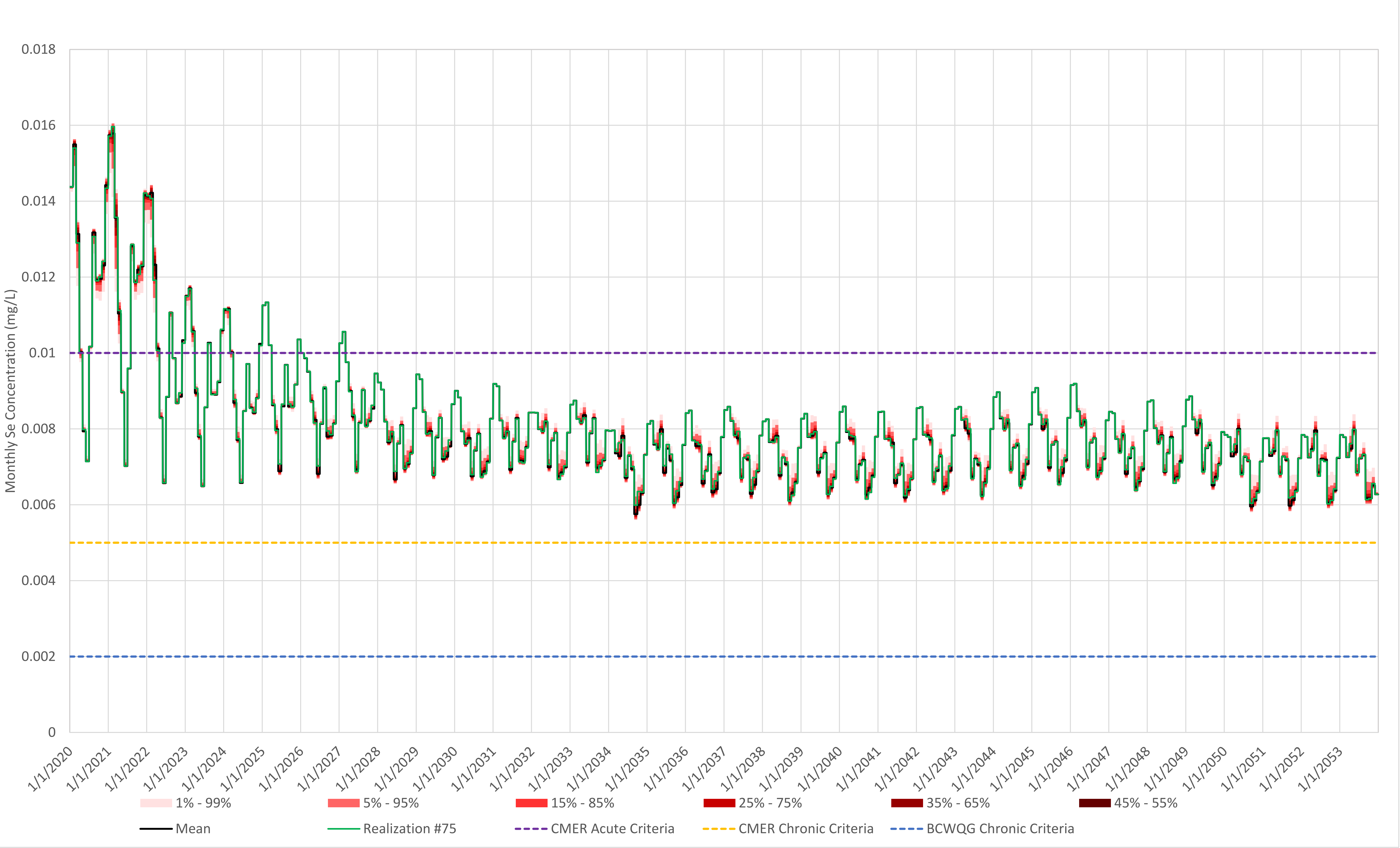

Monthly Se Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

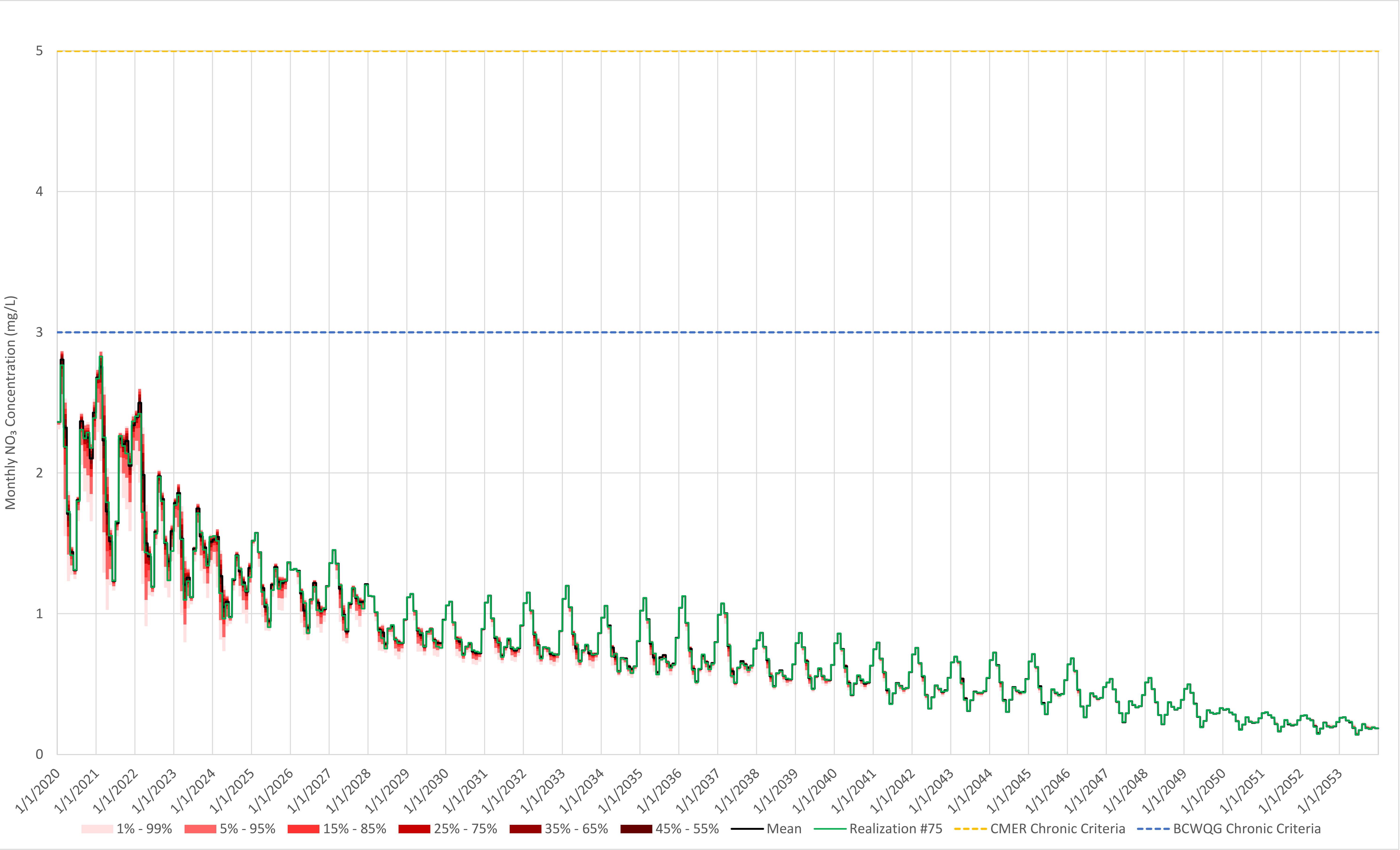

Monthly NO$_3$ Concentration (mg/L)
5
4
3
2
1
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

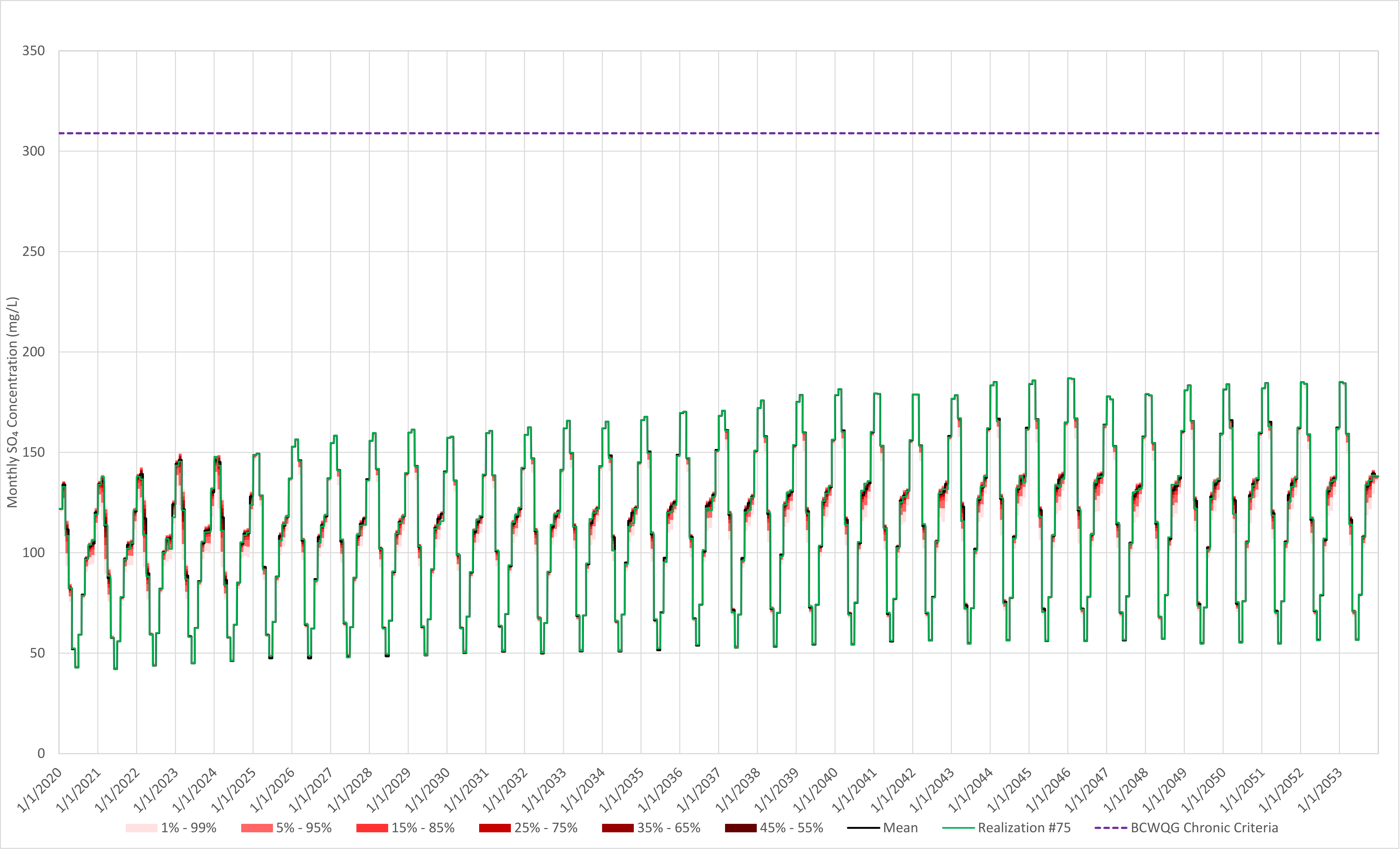

Monthly SO_4 Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Reporting Location: EV_ER1

Scenario: Average Case (P_{95}) Layering Succeeds

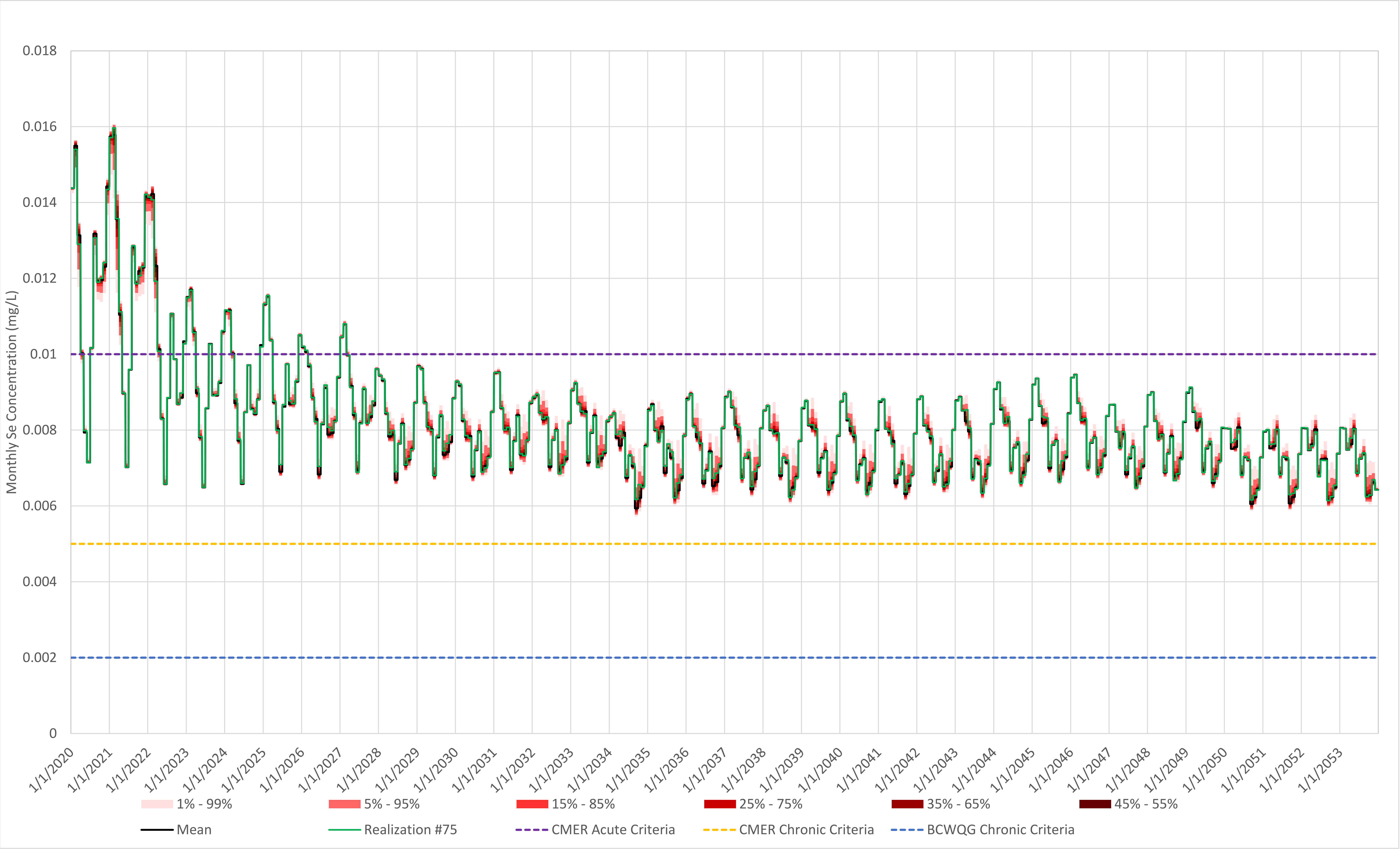

0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Monthly Se Concentration (mg/L)
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria

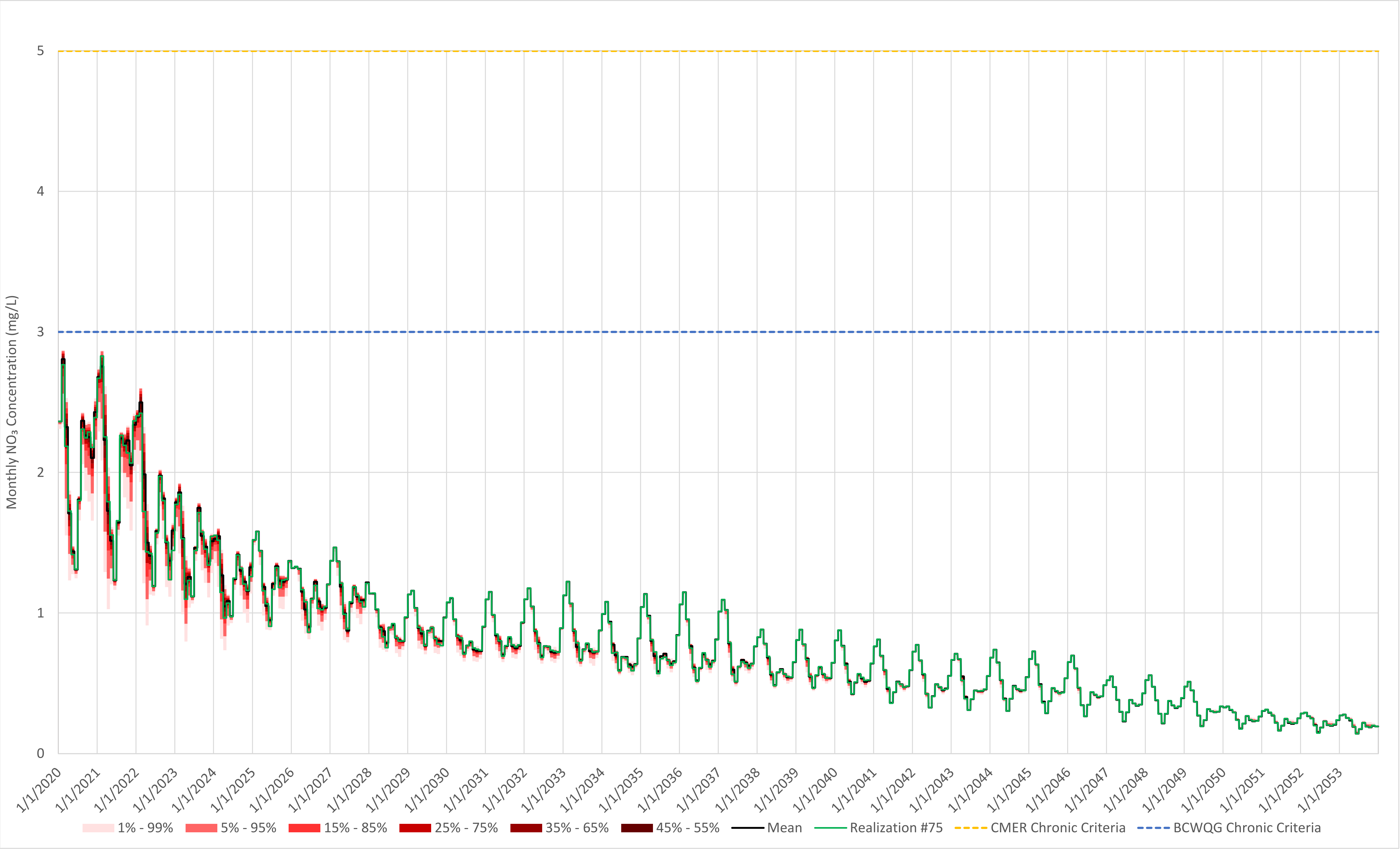

Monthly NO₃ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly SO$_4$ Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

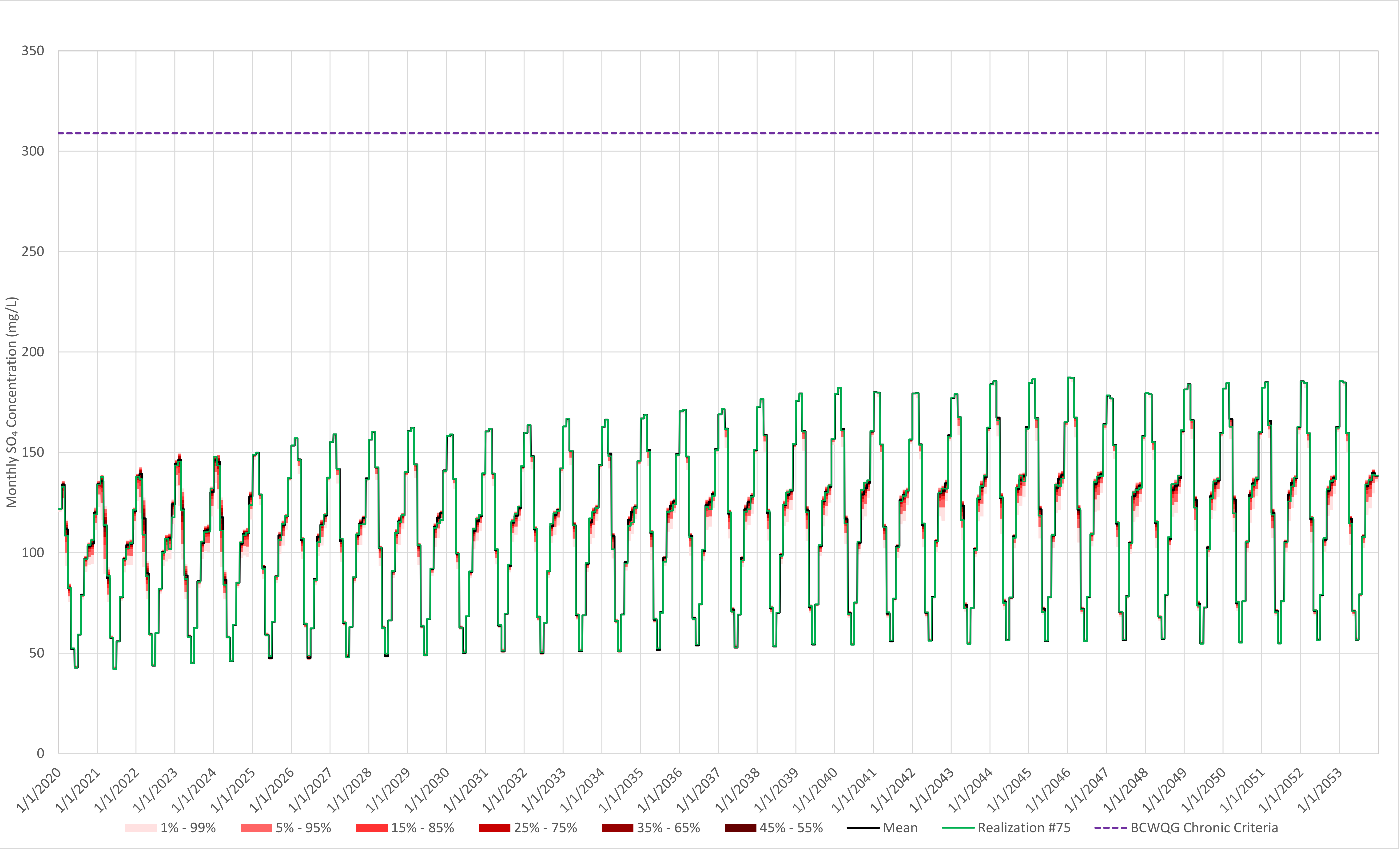
Reporting Location: EV_ER1

Scenario: Average Case (P_{95}) Layering Fails


Monthly Se Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Acute Criteria
CMER Chronic Criteria
BCWQG Chronic Criteria



Monthly NO$_3$ Concentration (mg/L)
0
1
2
3
4
5
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
CMER Chronic Criteria
BCWQG Chronic Criteria


Monthly SO₄ Concentration (mg/L)
0
50
100
150
200
250
300
350
1/1/2020
1/1/2021
1/1/2022
1/1/2023
1/1/2024
1/1/2025
1/1/2026
1/1/2027
1/1/2028
1/1/2029
1/1/2030
1/1/2031
1/1/2032
1/1/2033
1/1/2034
1/1/2035
1/1/2036
1/1/2037
1/1/2038
1/1/2039
1/1/2040
1/1/2041
1/1/2042
1/1/2043
1/1/2044
1/1/2045
1/1/2046
1/1/2047
1/1/2048
1/1/2049
1/1/2050
1/1/2051
1/1/2052
1/1/2053
1% - 99%
5% - 95%
15% - 85%
25% - 75%
35% - 65%
45% - 55%
Mean
Realization #75
BCWQG Chronic Criteria

Appendix D 2018-07-30 ENV RWQM_NWP Data Share Agreement

DATA USE AGREEMENT

THIS DATA USE AGREEMENT (the "**Agreement**") is made as of the 30th day of July, 2018 (the "**Effective Date**")

BETWEEN:

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF BRITISH COLUMBIA, AS REPRESENTED BY THE MINISTER OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY, ("ENV")

- AND –

NWP Coal Canada Limited, a corporation having an incorporation number of BC0836434
and incorporated under the laws of [British Columbia] ("**Recipient**")

(ENV and the Recipient are collectively referred to herein as the "**Parties**", and are each individually referred to as a "**Party**")

RECITALS:

A. Teck has, through its Regional Water Quality Model, compiled certain data (the "**Data**") consisting of projected concentrations of selenium, sulphate, nitrate and projected flow with respect to the Order Stations identified in Ministerial Order 113 approved April 15, 2013 (the "**Order**") located within the designated area described in Schedule A of the Order. That Data is more particularly described in Appendix "A" of this Agreement;

B. Teck has authorized ENV to distribute the Data to third parties on a non-exclusive basis on terms set out in an Agreement entered into between Teck and ENV, dated for reference as July 2018; and

C. ENV wishes to distribute the Data to the Recipient, and the Recipient wishes to have access to the Data.

NOW THEREFORE, in consideration of the premises and the mutual obligations hereinafter described, and other good and valuable consideration, the receipt of which is hereby acknowledged by both Parties, and intending to be legally bound, the Parties agree as follows:

1. Definitions and Interpretation

1.1 The definitions stated in the recitals are incorporated into this Agreement.

1.2 In this Agreement,

(a) "**Affiliate**" means a business entity which directly or indirectly controls, is controlled by, or is under common control with Teck. A business entity controls another business entity if it possesses the direct or indirect power to lawfully direct the management and policies of the other entity through ownership of voting securities, contract, voting trust or otherwise;

(b) "**Purpose**" means the purpose set out in section 2;

(c) "**Representatives**" means the directors, officers, employees, consultants and contractors of a person; and

(d) **"Teck"** means Teck Coal Limited, a corporation existing under the federal laws of Canada.

1.3 Appendix "A" is attached to, and forms part of, this Agreement.

2. Purpose

The purpose of this Agreement is provide the Data to the Recipient, being a person engaged in mining or other resource operations, to assist the Recipient in meeting its regulatory requirements under the laws of British Columbia. Specifically, ENV anticipates that the Data will be used by the Recipient for the purposes of evaluating water quality in the area subject to the Elk Valley Water Quality Plan, taking into consideration the Recipient's and other mining and resource operations' contributions of selenium, sulphate and nitrate in the Elk Valley.

3. Use Restrictions

3.1 Subject to the terms of this Agreement, ENV hereby grants to the Recipient a non-exclusive, irrevocable, royalty-free, world-wide licence during the Term to use and reproduce (including in a different format) the Data for the Purpose.

3.2 No right or license, either express or implied, is granted hereunder to any other proprietary or confidential information, or intellectual property rights of Teck or ENV. For the avoidance of doubt, the Recipient is not granted a right or licence to use any trademarks, trade names, brands or other marks of Teck or its Affiliates, or ENV, whether or not the same may be reflected on any Data disclosed to the Recipient.

3.3 Notwithstanding the license granted to the Recipient in section 3.1, all right, title and interest in and to the Data remains vested in Teck.

4. Disclosure and Compliance

4.1 Subject to section 4.2, Data received by the Recipient under this Agreement shall not be disclosed to any entity or individual other than the Recipient's Representatives who require access to the Data in connection with the Purpose.

4.2 Notwithstanding section 4.1, the Recipient may disclose the Data if such disclosure is required for the purposes of a court proceeding or to fulfill an obligation imposed under statute.

4.3 The Recipient will make each of its Representatives who receives the Data aware of the terms of this Agreement and the restrictions with respect to use of the Data.

4.4 The Recipient agrees to notify ENV in writing immediately upon the Recipient's discovery of a use or disclosure of the Data that is not for the Purpose or which is in breach of this Agreement.

5. Publication and Publicity

5.1 The Recipient shall obtain prior approval from ENV and Teck, respectively, before issuing any press release, or public statement using ENV's name, Teck's name, or the name of any of Teck's Affiliates, related to the Data under this Agreement. The foregoing prohibition shall not apply if disclosure of such name is legally required by applicable public disclosure requirements however in such a case the Recipient must provide a copy to ENV and Teck, as applicable, for its information and comment using its best efforts to ensure it is provided at least five (5) business days prior to release. Such review and comment shall not be considered certification by ENV or Teck of the accuracy of the information in such a release, or a confirmation by ENV or Teck that the content of such release complies with the rules, policies, by-laws and disclosure standards of the applicable regulatory authorities or stock exchanges. The Parties acknowledge and agree that the provisions of this clause shall not operate so as to prevent a Party from complying with its timely disclosure obligations under applicable law and regulations.

6. No Warranty and Release

6.1 ENV makes no representation or warranty as to the accuracy or completeness of the Data. The Recipient agrees that ENV, Teck, and the Affiliates of Teck, and their respective Representatives shall not have any liability for any errors or omissions, or for any damages resulting from the use, interpretation or analysis of the Data by the Recipient or its Representatives. ENV disclaims any liability and responsibility for any representation or warranty with respect to the Data that may be made or alleged to have been made or contained in any document or statement made or communicated to the Recipient, including but not limited to, any opinion or information provided to the Recipient by ENV or its Representatives.

6.2 The Recipient releases ENV from any loss, damage or liability which the Recipient may suffer through its use of the Data for the Purpose, and shall and does hereby exonerate, defend, indemnify and hold harmless ENV from and against any claim, demand, liability, loss, damage, death or injury whatsoever, including legal fees, arising out of or in connection with the use of or reliance upon the Data by the Recipient.

7. Remedies

ENV shall be entitled to seek injunctive relief to prevent breaches of this Agreement and to the specific enforcement of the terms of this Agreement, in addition to any other remedy to which ENV would be entitled under applicable law.

8. Notices

Any notice, demand, request, consent, approval or other communication which is required or permitted by this Agreement to be given or made by a Party (a "**Communication**") must be in writing and either personally delivered, sent by prepaid registered mail, or sent by email. Any Communication must be sent to the intended recipient at its address as follows:

To NWP Coal Canada at:

Attention: Art Palm
email: art.palm@jamesonresources.com.au

To ENV at:
Regional Director
Mining Operations
400-640 Borland Street
Williams Lake, BC
V2G 4T1

Attention: Douglas Hill
email: Doug.Hill@gov.bc.ca

or at any other address as any Party may from time to time advise the other by Communication given in accordance with this Section 8. Any Communication delivered to the Party to whom it is addressed will be deemed to have been given and received on the day it is so delivered at that Party's address, provided that if that day is not a business day then the Communication will be deemed to have been given and received on the next business day. Any Communication transmitted by email will be deemed to have been given and received on the day on which it was transmitted, but if the Communication is transmitted on a day which is not a business day or after 3:00 p.m. (local time of the recipient), the Communication will be deemed to have been received on the next business day. Any Communication given by registered mail will be deemed to have been received on the fifth business day after which it is so mailed. If a strike or lockout of postal employees is then in effect or generally known to be impending, every Communication must be effected by personal delivery or by email.

9. Agreement Binding

This Agreement is binding upon the Parties and their respective successors and permitted assigns and, unless otherwise expressly provided for in this Agreement, no other person shall have any rights hereunder.

10. Assignment

Neither Party may assign any of its rights under this Agreement without the prior written consent of the other Party in its absolute discretion. No assignment of this Agreement or of the rights and/or obligations under this Agreement shall release or relieve the assigning Party of any obligations under this Agreement whether arising before or after such assignment.

11. **Entire Agreement**

This Agreement constitutes the entire agreement between the Parties pertaining to its subject matter, and supersedes all prior agreements, understandings, negotiations and discussions, whether oral or written, of the Parties, and there are no representations, warranties or other agreements between the Parties in connection with the subject matter of this Agreement.

12. **Amendment; Waiver**

No amendment of this Agreement shall be valid and binding on the Parties hereto unless made in writing and signed by an authorized representative of each Party. No supplement, modification, waiver, discharge or termination of this Agreement is binding unless it is executed in writing by the Party to be bound. No waiver of, failure to exercise, or delay in exercising, any provision of this Agreement constitutes a waiver of any other provision (whether or not similar) nor does any waiver constitute a continuing waiver unless otherwise expressly provided.

13. **Governing Law**

This Agreement is governed by, and is to be construed and interpreted in accordance with, the laws of the Province of British Columbia and the laws of Canada applicable in British Columbia.

14. **Severability**

Each provision of this Agreement is distinct and severable. If any provision of this Agreement, in whole or in part, is or becomes illegal, invalid or unenforceable in British Columbia the illegality, invalidity or unenforceability of that provision will not affect the legality, validity or enforceability of the remaining provisions, or the legality, validity or enforceability of that provision in British Columbia.

15. **Counterparts Permitted**

This Agreement may be executed and delivered by the Parties in one or more counterparts, each of which when so executed and delivered will be an original, and those counterparts will together constitute one and the same instrument. Delivery of this Agreement by facsimile transmission, e-mail or functionally equivalent electronic transmission constitutes valid and effective delivery.

16. **Term**

16.1 Subject to section 16.2 of this Agreement, the term of this Agreement starts on the date of execution and ends on July 2023 (the "**Term**").

16.2 Sections 3.2, 3.3, 4.1, 5.1, 6.1 and 7, and any other sections of this Agreement which, by their terms or nature, are intended to survive the termination of this Agreement, will continue in force indefinitely subject to any applicable limitation period prescribed by law, even after this Agreement ends.

17. **Miscellaneous**

Words importing the singular number only shall include the plural and *vice versa*, and words importing the use of any gender shall include all genders.

18. **Independent Legal Advice**

Each of the Parties acknowledges that it has read and understands the terms and conditions of this Agreement and acknowledges and agrees that it has had the opportunity to seek, and was not prevented or discouraged by any other Party to this Agreement from seeking, any independent legal advice which it considered necessary before the execution and delivery of this Agreement and that, if it did not avail itself of that opportunity before signing this Agreement, it did so voluntarily without any undue pressure, and agrees that its failure to obtain independent legal advice will not be used by it as a defense to the enforcement of its obligations under this Agreement.

IN WITNESS WHEREOF, the Parties have executed this Agreement as of the Effective Date.

MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY	**The RECIPIENT**
Per:	Per: <Original signed by>
<Original signed by>	
Name: Douglas Hill	Name: Art Palm
Title: Regional Director, Mining Operations, Environmental Protection Division	Title: CEO
Per:	Per:
Name:	Name:
Title:	Title:

APPENDIX A

DATA