Appendix A

Water Year 2025 Burnt Bridge Creek Microbial Source Tracking Report

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Introduction

Herrera Environmental Consultants (Herrera) conducted a microbial source tracking (MST) study under the 2024-2027 Burnt Bridge Creek Ambient Water Quality Monitoring Program for the City of Vancouver, Washington (the City) in accordance with the MST Quality Assurance Project Plan (QAPP) Addendum (Herrera 2024a). To better understand the types of fecal bacteria sources in the watershed, water samples were collected from the 11 established stream monitoring stations during six sampling events in water year (WY) 2025. The samples were analyzed for five deoxyribonucleic acid (DNA) markers of common fecal bacteria (*Bacteroidaes*) for source identification, including one human-associated marker, three animal-associated markers (bird, dog, and cow), and one marker representing all warm-blooded animals (humans, mammals, and birds) fecal sources. The primary goal of this MST study is to characterize human- and animal-source contributions across geographic and hydrologic gradients to support prioritization of best management practices (BMPs) to reduce *Escherichia coli* (*E. coli*) concentrations in Burnt Bridge Creek (BBC).

The sections that follow describe the MST study objectives, historical water quality monitoring efforts and findings, and relevant land use and stormwater management practices for each monitoring station.

Study Objective

The Burnt Bridge Creek Water Quality Monitoring Program and previous total maximum daily load (TMDL) and MST studies have identified fecal pollution exceeding state standards for *E. coli* and fecal coliform bacteria throughout the watershed. An MST study is needed to further identify and prioritize effective control measures for reducing fecal sources from septic systems and animals present in the watershed. Data collected for the 2025 MST study described herein is intended to improve understanding of fecal bacteria sources in the watershed using modern and approved MST methods under current BMPs implemented by the City. The study results will be used to identify how human and key animal sources vary across monitoring stations, storm and base flow events, and influence of land use activities based on monitoring subbasin characteristics.

The following study questions were adopted to guide the MST investigation and analysis.

- How do human and animal sources of fecal contamination vary geographically across monitoring stations along BBC?
- Which monitoring station(s) has the highest concentrations of human (HF183) fecal *Bacteroides*?
- Which event(s) (storm or base flow) has the highest concentrations of human (HF183) fecal *Bacteroides*? Does a particular marker have higher concentrations during storm events?

Background

Fecal Bacteria

E. coli is a type of bacterium that is commonly found in the intestines of warm-blooded animals, including humans. The bacteria serve as an indicator of fecal contamination and the presence of disease-causing pathogens that cause illness in individuals coming into contact with water through swimming or other activities. Washington State recreational use criteria for primary contact recreation must not exceed either of the following within a three-month averaging period:

- Geometric mean value of 100 colony forming units (CFU) or most probable number (MPN) per 100 milliliters (mL)
- No more than 10 percent of all samples (or, when fewer than ten samples are collected, the 90th percentile) exceeding 320 CFU or MPN per 100 mL

BBC and its tributaries Peterson Channel, Burton Channel and Cold Creek are listed as Category 5 impaired waters under Section 303(d) of the Clean Water Act due to state criteria exceedances for bacteria. The City is anticipating the completion of a TMDL Advance Restoration Plan (ARP) by Washington State Department of Ecology (Ecology) that will identify activities and strategies needed to bring the creek into compliance with state criteria. The ARP is a near-term plan that includes a schedule of actions that will be taken to achieve water quality standards and address the bacteria impairment, along with other listed parameters (i.e., pH, temperature, and dissolved oxygen).

Common sources of *E. coli* in streams include:

- Leaking or improperly maintained septic systems
- Failing wastewater pipes
- Fecal waste from domestic pets, especially dogs
- Livestock manure runoff
- Wildlife waste
- Direct human waste inputs

While *E. coli* is a general indicator of fecal contamination, MST studies can provide more information on specific sources. This information supports the City’s efforts to prioritize the most effective types of BMPs and target locations that will result in the greatest reduction in bacterial loading.

Historical Water Quality Data

The City has monitored bacteria throughout its long-term monitoring program spanning more than a decade, starting with fecal coliform and transitioning to *E. coli* in WY2017. Based on water quality analysis from WY2022 and 2023, *E. coli* concentrations during base flow events typically met water quality criteria on an annual basis but were found to be highest during the summer season, indicating potential sources of fecal bacteria from livestock, wildlife, or sewer leaks (Herrera 2024b). *E. coli* geometric mean concentrations were substantially greater and more variable during storm flow for all monitoring stations, likely due to bacteria mobilization from land surfaces by stormwater runoff.

The WY2024 Trend Analysis Report (Herrera 2025a) identified a statistically significant decreasing temporal trend in *E. coli* concentrations during base flow events for monitoring station BBC8.8 between 2018 to 2024. Long term trends in fecal coliform (2011 to WY2023) indicated increasing concentrations at upstream (BBC10.4, BBC8.8) and midstream (BBC7.0) stations, with decreasing concentrations at downstream stations (BBC5.9, BBC5.2, BBC1.6). These temporal patterns suggest localized water quality improvements in the lower basin, potentially reflecting targeted management actions (e.g., stormwater management and sanitary sewer connection), while elevated levels at upstream stations may indicate ongoing sources related to septic systems or land use. No temporal trends for *E. coli* nor fecal coliform during storm events were identified. In general, *E. coli* appears to be influenced by a variety of basin-wide factors including the influence of septic systems during base flow at stations BUR0.0, BBC2.6, and BBC1.6 and runoff from human and animal waste during storm flow events.

Table A-1 below summarizes the WY2022-2023 *E. coli* and fecal coliform results by monitoring station and hydrologic condition (base or storm flow) with respect to compliance with water quality criteria (WAC 173-201A). During storm events, all stations exceeded fecal coliform and *E. coli* criteria except for PET0.0. In base flow events, *E. coli* criteria were met at all stations except BUR0.0, whereas fecal coliform criteria were exceeded at several stations (Herrera 2024c).

Table A-1. Bacteria Data by Event Type and Monitoring Station for Water Years 2022 and 2023.

	Fecal Coliform Bacteria (CFU/100 mL)				*E. coli* Bacteria (CFU/100 mL)			
	Base Flow		Storm Flow		Base Flow		Storm Flow	
Station	Geomean	90th Percentile	Geomean	90th Percentile	Geomean	90th Percentile	Geomean	90th Percentile
BBC10.4	75	**231**	**255**	**1110**	50	139	**159**	**690**
BBC8.8	63	133	**213**	**710**	46	117	**142**	**400**
PET0.0	62	194	99	**299**	47	124	74	177
BBC8.4	80	**214**	**143**	**622**	60	136	88	**344**
BUR0.0	**124**	**624**	**373**	**996**	**125**	**612**	**270**	**668**
BBC7.0	84	**294**	**180**	**539**	56	223	**106**	**373**
BBC5.9	58	159	**171**	**449**	38	81	87	**365**
BBC5.2	68	**204**	**208**	**544**	44	110	**131**	**474**
BBC2.6	77	**220**	**229**	**810**	50	118	**139**	**346**
COL0.0	**105**	**404**	**514**	**2840**	69	320	**214**	**900**
BBC1.6	76	195	**259**	**910**	54	136	**139**	**367**

[a] **Bold values** exceed primary contact recreation criteria in freshwaters for fecal coliform (100 CFU/100 mL geometric mean [geomean] or 200 CFU/100 mL 90th percentile, which expired in 2020) or for *E. coli* (100 CFU/100 mL for geomean or 320 CFU/100 mL for 90th percentile) (WAC 173-201A).

For further information on pertinent *E. coli* and fecal coliform results, the MST QAPP addendum (Herrera 2024a) and WY2024 Trend Report (Herrera 2025a) provide an in-depth discussion. The main text of this report provides a general summary of WY2025 *E. coli*, temperature, and other relevant water quality parameters.

Source Tracking and Septic Indicators

Throughout the City's ambient monitoring program, water quality parameters have been targeted with the intention of characterizing potential septic sources of bacteria in BBC. These target septic indicators have included total and dissolved nutrients, fecal coliform, *E. coli*, and optical brighteners, among others.

Nutrients such as total nitrogen, nitrate+nitrite, total phosphorus, and orthophosphate have been targeted over the course of the monitoring program because they are important measures of stream health, affect dissolved oxygen and stream biota, and are critical to manage to protect downstream resources such as Vancouver Lake. The use of these nutrients on their own are usually not good indicators of septic system pollution due to other nutrient sources throughout the basin, including background nitrate+nitrite levels in groundwater from the Unconsolidated Sedimentary Aquifer (Herrera and PGG 2019), and processes such as soil sorption. These nutrients must be evaluated as an individual line of evidence in a broader evaluation to determine potential septic sources. Likewise, fecal coliform and *E. coli* have been used as the State of Washington's freshwater bacterial indicator parameters but are present in the environment from many different natural or anthropogenic sources and must be assessed in context with other indicators.

Regarding nutrients as a septic indicator, nitrate+nitrite concentrations in BBC are similar to nitrate concentrations measured in shallow groundwater wells from the uppermost component of the Unconsolidated Sedimentary Aquifer because it is the source of base flow in some segments of BBC (Herrera and PGG 2019). A significant decreasing temporal trend in nitrate+nitrite from 2011-WY2024 was detected at all mainstem stations for base flow (dry and combined seasons). The decrease in nitrate+nitrite concentrations over time may be related to a decrease in septic system contribution by the removal of 165 on-site septic systems within the watershed in the past five years with over 2,000 units remaining within the watershed.

Other target septic indicators and fecal source tracking parameters include optical brighteners, which are fluorescent whitening agents added to most commonly used laundry detergent. Measuring optical brighteners in waterways can be helpful in locating septic or wastewater influences but have some limits on use. Environmentally friendly detergents typically do not contain optical brighteners, and they are susceptible to adsorption onto soil and organic material. Natural organic matter can also positively interfere with optical brightener analyses. The WY2020–WY2021 Report concluded that optical brighteners are present in BBC during base flow and more so during storm flow and were observed at highest concentrations in the upstream reach and at lowest concentrations in the tributaries. Overall, the optical brightener monitoring conducted during WY2020–WY2021 was not particularly useful for detecting septic system inputs to BBC due to a lack of variance within the stream and interferences from natural organic matter.

Microbial Source Tracking

MST methods identify nonpoint sources of microbial contamination in water systems with fecal pollution. MST helps determine sources of contamination by analyzing specific markers on fecal bacteria DNA to quantify amounts of fecal host species from human and multiple animal sources. By quantifying host-specific genetic markers, MST provides further contextual source tracking information for sampling traditional fecal indicator bacteria (FIB) counts. MST studies co-sample environmental and hydrologic parameters—precipitation timing, runoff or flow, turbidity, temperature, and land use or watershed type—to provide context for interpretating marker and FIB concentrations.

Recent MST case studies provide useful context for interpretations of source-specific marker data and understanding fecal contamination patterns in differing environmental and hydrologic conditions. In Southern California stormwater discharges, for instance, rainfall magnitude and storm size were strongly associated with elevated FIB and human marker (HF183) loads across five storm events over two years (Steele 2018). In the agriculturally dominated Tillamook Bay, ruminant marker signals correlated with storm runoff, whereas *E. coli* counts did not, suggesting *E. coli* persistence in the water column, regrowth, and/or possible background avian sources (Shanks 2006). Similarly, in Washington D.C. urban headwater streams, Bayesian analysis of 33 MST and *E. coli* sampling events linked marker variability to precipitation and land use, showing dog, ruminant, and avian sources increased following precipitation, while human markers (HF183) showed greater spatial variability (Diedrich 2023; Shanks 2024). An extensive MST study of a rural watershed in Washington using both the host-specific qPCR method and the gene sequencing method both determined that wild birds and septic system waste were the primary fecal sources found in Vaughn Creek and causing closure of shellfish beds in Vaughn Bay (Herrera 2019, Xia et al. 2024).

While these studies demonstrate the analytical power of MST to illuminate fecal source dynamics across diverse hydrologic and land use settings, the studies also highlight the scale and methodological rigor required for robust statistical interpretation. The WY2025 MST study targets six sampling events without continuous hydrologic or modeling components. As a result, the findings presented provide indicative, event-based insights into dominant fecal source under storm and base flow conditions in one water year rather than comprehensive, statistically defensible conclusions.

Risk-based thresholds for MST human marker HF183 provide a quantitative framework for interpreting the potential public-health significance of human fecal contamination (Boehm and Soller 2020). MST marker HF183 is not a regulated parameter under Washington's Water Quality Standards (WAC 173-201A) standard. Instead, HF183 and other MST markers function as a source-identification tool that complement *E. coli* results by indicating which fecal sources are present and point to those driving exceedances of regulatory criteria.

The existing risk-based threshold for HF183, 525 copies per 100 mL, is based upon a framework that supports risk-relevant contamination (Boehm and Soller 2020). This threshold is derived from a quantitative microbial risk assessment supporting an MST study that links HF183 concentrations to defined public health risk benchmarks. This standard risk-based threshold corresponds to a median simulated illness risk of 32 illnesses per 1,000 recreational exposure, when the age of human sewage contamination is unknown and no gull fecal contamination is present, the risk-based threshold for HF183 is 525 copies/ 100mL (Boehm and Soller 2020). A specific study evaluating contaminated stormwater identified an inflection point of approximately 100 copies/ 100 mL of HF183 as the threshold at which a water body is considered unsafe for swimming (Lowry 2025). Because the median simulated illness risk for BBC is unknown, comparing results to these thresholds serve only as contextual reference and should be interpreted as an estimated application to the risk-based threshold.

By identifying which source (human, bird, dog) breaches this risk-based threshold, salient sources can be identified and remediated in a way that will yield the greatest impact to reduce human health risk. Risk-based thresholds are used qualitatively to support management decisions through confirming the presence or absence and relative abundance of a source. Although fecal material from both human and nonhuman sources can pose risks to public health, the risk associated with domestic and wildlife sources is generally considered lower than that from human sources. This distinction is driven in part by the host specificity of enteric viruses, the group of pathogens most commonly linked to human illness following exposure to bacteria impacted surface waters (Shanks 2006). Stormwater can convey a range of pathogenic organisms relevant to human health, including viral pathogens (e.g. norovirus, adenovirus), bacteria pathogens (e.g. *Campylobacter* spp., *Salmonella* spp., *Escherichia coli*), and protozoan pathogens (e.g. *Cryptosporidium* spp. and *Giardia* spp.). Human exposure to these microorganisms in stormwater influenced surface waters present elevated health risks, particularly during recreational contact in wet weather conditions (Boehm and Soller 2020; Cho 2016; Steele 2018; Tiwari 2022).

Previous MST Study

The Burnt Bridge Creek MST Study (Samadpour 1999) used phased, watershed-wide sampling under both base and storm flow conditions to identify likely sources of fecal contamination. Using DNA fingerprinting and ribosomal RNA typing of *E. coli* isolates, environmental samples were compared to a library of known human and animal fecal sources, including septic, sewer, and livestock samples collected within the watershed. Of the 528 isolates analyzed from key stream and storm drain sites, 64 percent matched a known source, while 36 percent did not match a unique source to any sample in the library. Among the matched isolates, birds represented the largest source group (28 percent), followed by humans (20 percent), dog (12 percent), cow (11 percent), and small mammals (7 percent). Longitudinal trends showed that human-associated isolates were most common in downstream reaches (BBC1.6 and COL0.0), while livestock-associated isolates were more prevalent upstream (BBC10.4 and 1.5-mile upstream station). Comparisons between septic and sewer samples indicated that most human-associated *E. coli* detected in surface waters were consistent with septic system sources rather than sanitary sewer inputs. For further summary information on the 1999 study, refer to the MST QAPP addendum (Herrera 2024a).

Results of this MST study relied on comparisons to an extensive library of known human and animal fecal sources developed by the University of Washington, which included unique DNA fingerprints from *E. coli* for many animal species and types of human sources in this geographic region. Conversely, the present MST study used DNA markers of a different type of bacteria (*Bacteriodales*) for only a select few sources. Therefore, comparisons of the present and historical MST study results are limited due to differences in the methods employed.

Site Description

The current Burnt Bridge Creek Water Quality Monitoring Program, as outlined in the QAPP (Herrera 2023), identifies eight stations along Burnt Bridge Creek (BBC) and three stations on tributaries. Septic system density and fecal bacteria (*E. coli* and fecal coliform) concentrations vary among monitoring stations, indicating influence by land use and stormwater management practices. Each monitoring station is briefly described in order of upstream (BBC10.4) to downstream (BBC1.6). Subbasin areas refer to the contributing area draining between the station and the nearest upstream station.

Site descriptions utilize the following figures and tables for details on land use, stormwater conveyance infrastructure, and septic density. Figure A-1 identifies zoning and parks within the eleven subbasins of BBC. Figure A-2 depicts impervious areas in red, stormwater conveyance infrastructure including outfalls and stream road crossings (e.g., culverts and cross-drains). Stream road crossings are mapped because the density of stormwater infrastructure and road-to-stream connectivity within each subbasin can influence the accumulation and mobilization of debris and pollutants during storm flow (Herrera 2025b). Figure A-3 depicts the density of septic systems (City of Vancouver 2024) within each subbasin on a gradient color scale.

Across monitoring stations, subbasins exhibit a mix of land uses, with the highest impervious areas concentrated in larger, more developed basins such as BBC10.4 and BUR0.0 located in the upstream portion of the watershed (see Figure A-2). Septic system density varies, ranging from low in smaller or more urbanized subbasins to moderate density in larger, predominantly residential areas. Overall, subbasins with higher impervious area and stormwater infrastructure tend to coincide with greater development intensity, while septic density is most pronounced in areas with dispersed residential parcels. The highest septic densities are also located in the more developed eastern basins BBC10.4 and BUR0.0, and specifically in residential areas at least a mile from the stream rather than in the commercial/industrial areas adjacent to the upper reaches of BBC.

Table A-2. Description of Monitoring Stations by Subbasin

Monitoring Station	Subbasin size (acres)	Impervious areas (acres)	Infrastructure[a]		Land use				Septic Density	
			Stormwater Outfalls (count per mile)	Stream Road Crossings (count per mile)	Commercial (%)	Industrial (%)	Residential (%)	Greenspace[b] (%)	Total Septic Systems (count)	Septic Density (count per acre)
BBC10.4	4437	1928	17.0	1.6	14%	23%	59%	4%	1236	0.28
BBC8.8	732	297	6.2	5.5	40%	0%	33%	28%	45	0.06
PET0.0	511	251	13.9	4.6	0%	39%	56%	4%	69	0.14
BBC8.4	135	39	7.3	0.0	0%	0%	74%	26%	30	0.23
BUR0.0	4120	1905	22.4	8.1	9%	5%	81%	5%	1176	0.29
BBC7.0	1702	816	8.1	2.2	22%	2%	59%	17%	186	0.11
BBC5.9	529	209	13.2	3.0	1%	17%	60%	22%	8	0.02
BBC5.2	813	444	19.7	2.0	21%	8%	69%	2%	52	0.07
BBC2.6	2435	1028	7.8	1.3	5%	1%	61%	34%	292	0.12
COL0.0	1649	729	2.3	2.3	8%	35%	54%	3%	235	0.14
BBC1.6	440	188	8.2	11.7	4%	34%	58%	5%	27	0.06
BBC0.0[c]	782	247	1.3	2.0	1%	0%	78%	21%	141	0.18

[a] Outfall count may be biased low due to incomplete mapping, particularly for privately owned outfalls. This may have the greatest impact on basins with large proportions of industrial zoned land.

[b] Green space includes all non-agricultural vegetated parcels that do not include commercial, industrial, residential developments and otherwise have limited impervious surfaces. Greenspaces within the BBC drainage typically include parks, managed riparian areas, and unmanaged forested areas.

[c] BBC0.0, the outlet of BBC to Vancouver Lake, is not a monitoring station identified in the QAPP (Herrera 2023) but is included to provide context for drainage along the last 1.6-mile reach of BBC.

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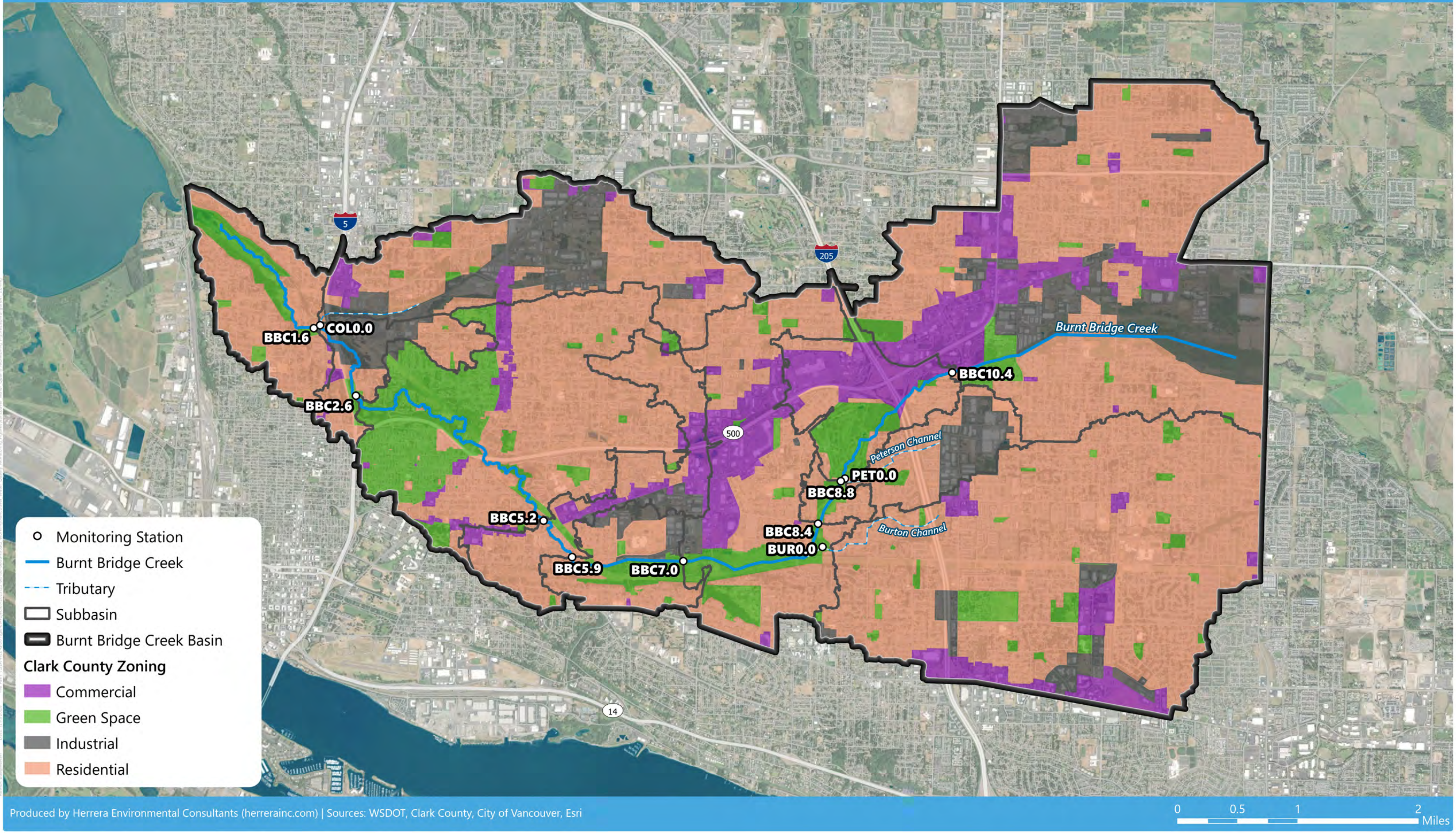
Figure A-1.
Zoning and Parks in Burnt Bridge Creek Drainage.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: WSDOT, Clark County, City of Vancouver, Esri

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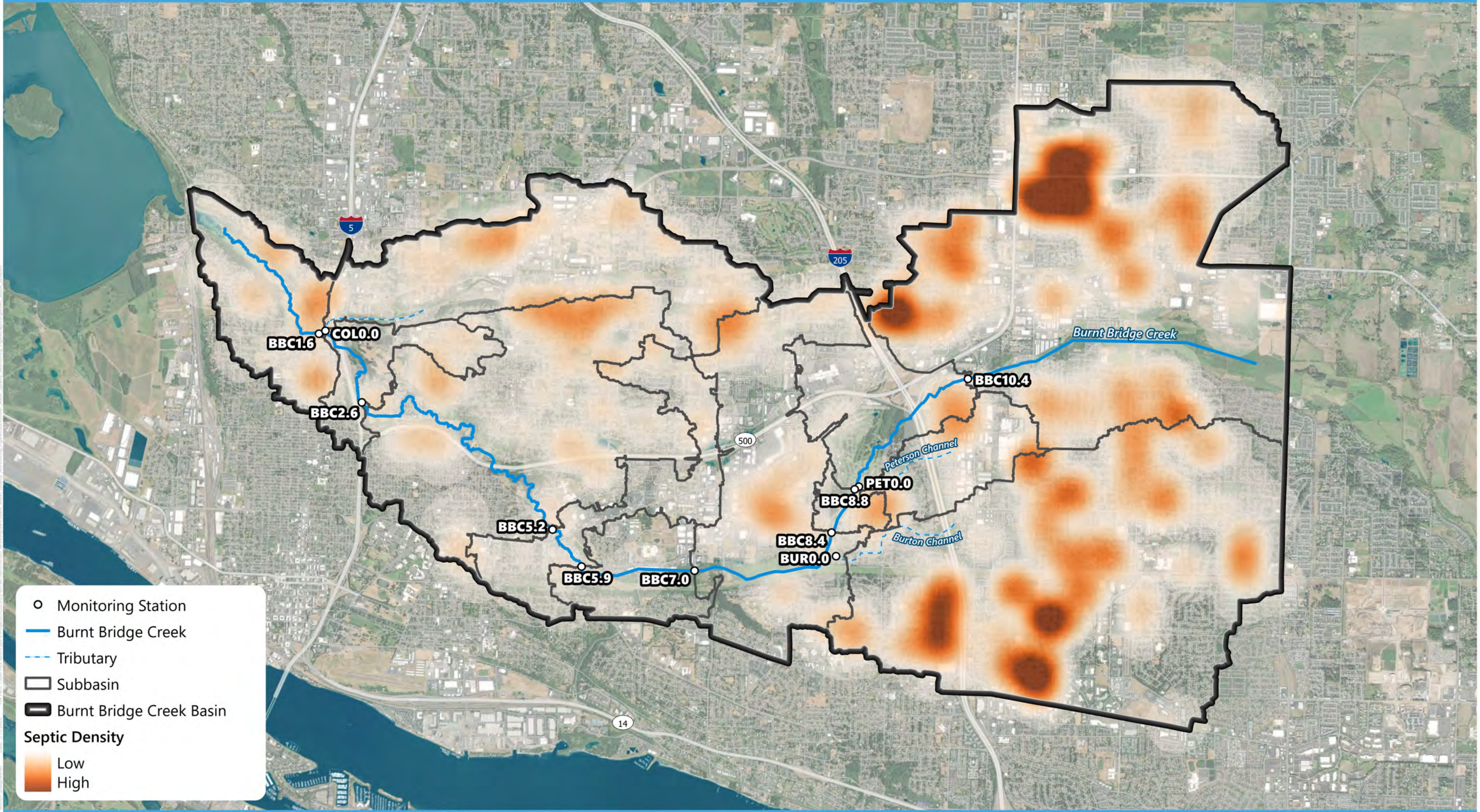
Figure A-2.
Septic Systems in Burnt Bridge Creek Drainage.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: WSDOT, Clark County, City of Vancouver, Esri

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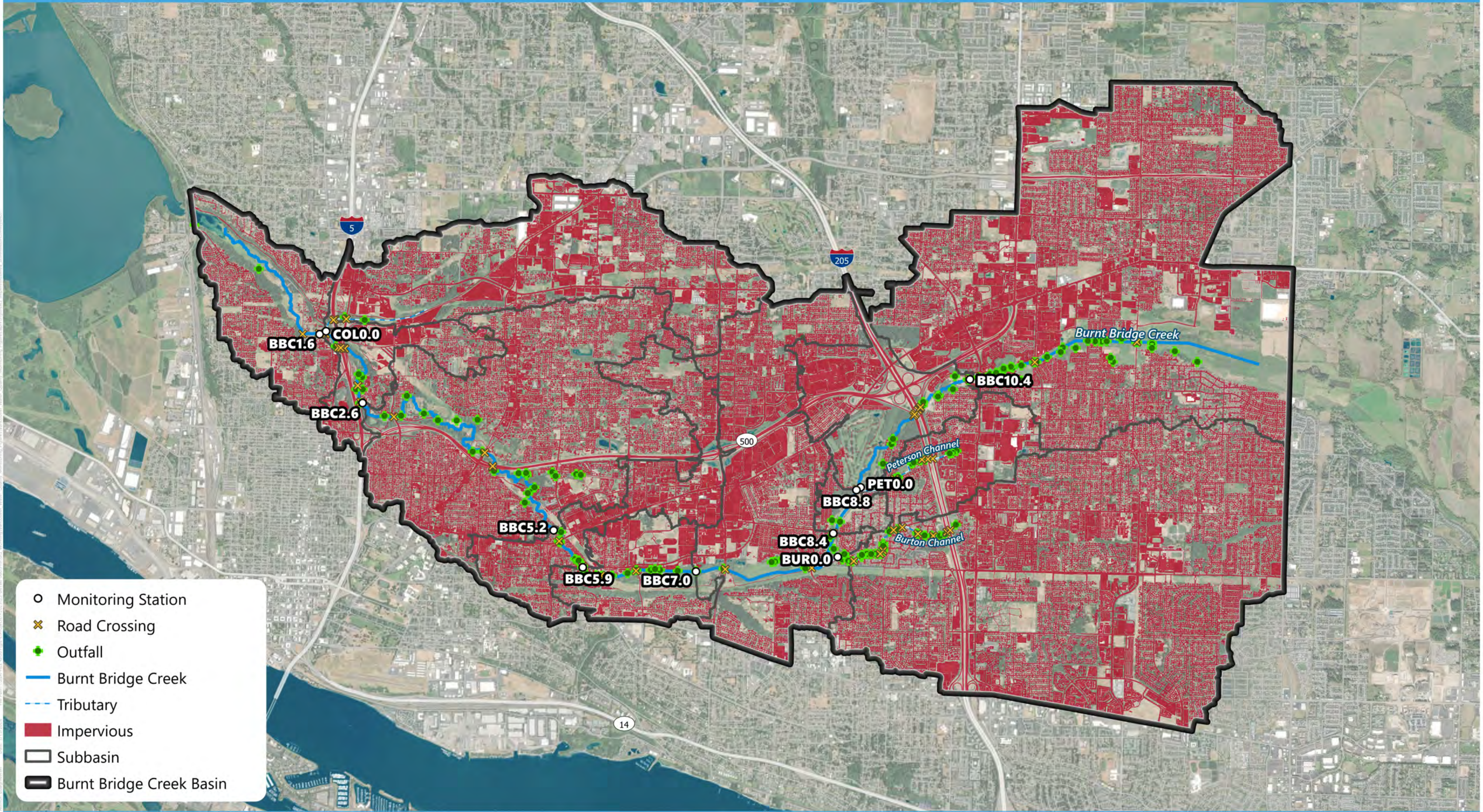
Figure A-3.
Impervious Area and Stormwater Conveyance to Burnt Bridge Creek.



Produced by Herrera Environmental Consultants (herrerainc.com) | Sources: WSDOT, Clark County, City of Vancouver, Esri

BBC10.4

The contributing area to the most upstream mainstem monitoring station, BBC10.4, is large (4,437 acres), with predominantly residential land use (61 percent), followed by industrial (23 percent) and mixed commercial (16 percent) land uses (see Table A-2). Septic system density is high in residential areas about 1 mile north of the creek. The contributing area includes extensive impervious cover with inputs from State Route 500 (SR 500) and receives stormwater from the highest number of outfalls among the subbasins, with relatively few stream road crossings. Stormwater is conveyed to infiltration facilities such as dry wells or other stormwater treatment facilities, and untreated stormwater also discharges directly to the creek. The monitoring station has 25 percent riparian canopy cover but little to no green space.

BBC8.8

Monitoring station BBC8.8, situated immediately above the confluence with Peterson Channel, features a similarly residential contributing area with moderate greenspace and a higher riparian cover of 52 percent. Most septic systems are located downstream, south of the creek, and septic density remains low relative to basin size. Impervious surfaces are moderately extensive, the contributing area includes SR 500 and Interstate 205, residential and commercial/industrial areas and a large golf course directly upstream of the monitoring station.

PET0.0

Monitoring station PET0.0 is located near the mouth of Peterson Channel draining a basin characterized primarily by residential land use but also includes a large industrial land use area in the upstream eastern portion of the basin. Impervious areas are proportionally high, indicating concentrated development. Clusters of septic systems are in the northwest and southeast portions of the subbasin. Upstream riparian canopy cover within 0.5 mile of PET0.0 is 46 percent. Stormwater is managed by dry wells and bioretention facilities, with some areas draining directly to the creek. Dry season base flow in Peterson Channel is primarily sustained through industrial non-contact cooling water discharge that displays unique water quality characteristics and may affect water quality at the downstream station BBC8.4.

BBC8.4

At station BBC8.4, the relatively small contributing area is residential with concentrated green space due to a large golf course upstream of the monitoring station. Upstream riparian canopy cover within 0.5 mile of BBC8.4 is 38 percent. Septic systems are clustered in the eastern portion of the subbasin. Impervious cover is low with minimal stormwater infrastructure.

BUR0.0

Monitoring station BUR0.0 is in Burton Channel, about 1,000 feet upstream of its confluence with BBC. The subbasin draining to BUR0.0 includes primarily residential as well as commercial/industrial land use. Upstream riparian canopy cover within 0.5 mile of BUR0.0 is 28 percent. Compared to other monitoring station subbasins, the area includes relatively high septic system density with clusters of septic systems distributed throughout residential areas of the subbasin. Infiltration facilities make up the majority of stormwater treatment and discharges to the stream. Flows at this station during base flow events are very low relative to the mainstem stations and other tributaries. Impervious surfaces are widespread, with numerous stream road crossings and the highest number of stormwater outfalls per river mile.

BBC7.0

The BBC7.0 contributing subbasin is primarily residential land use with inputs from SR 500 and commercial/industrial areas. Upstream riparian canopy cover within 0.5 mile of BBC7.0 is 53 percent. A duck pond is located immediately upstream of the sampling location. Septic density is moderate and clustered throughout the subbasin. Impervious surfaces cover a majority of the subbasin with a number of stormwater conveyance outfalls.

BBC5.9

At BBC5.9, the subbasin is primarily residential land use with inputs from commercial/industrial areas and moderate greenspace. Upstream riparian canopy cover within 0.5 mile of BBC5.9 is 34 percent. There are relatively few septic systems and low septic density. Stormwater is managed through infiltration facilities such as dry wells as well as conveyance that directly discharges to the creek.

BBC5.2

BBC5.2 includes primarily residential land use with inputs from commercial/industrial areas and limited greenspace. Upstream riparian canopy cover within 0.5 mile of the BBC5.2 is 40 percent. Septic density is moderate with systems clustered to the west of the creek and north of SR 500. Monitoring station BBC5.2 is in a residential neighborhood with open access to the creek through private property. Potential localized sources of pollution at this station may include pet waste and fertilizer nutrient runoff.

BBC2.6

BBC2.6, located in Leverich Park, has a contributing area with primarily residential land use and limited greenspace. and also includes inputs from a portion of SR 500 and commercial/industrial areas. Upstream riparian canopy cover within 0.5 mile of BBC2.6 is 46 percent. Septic density is moderate in the subbasin, particularly to the north of the creek and northeast corner of the subbasin. Impervious areas are substantial, with a moderate number of outfalls per river mile.

COL0.0

Cold Creek (COL0.0), is the third tributary of BBC, the subbasin draining to COL0.0 includes primarily residential as well as substantial commercial/industrial land use. Upstream riparian canopy cover within 0.5 mile of COL0.0 is 56 percent. The tributary is influenced by its groundwater source during base flow conditions, which results in differences from the main BBC channel and the tributary’s base and storm flow characteristics. The area includes a moderate septic density with septic systems distributed throughout most of the subbasin. Unlike the other stations, there are few mapped dry wells within the COL0.0 subbasin. Impervious areas are extensive, with comparatively sparse stormwater conveyance infrastructure, suggesting limited stormwater treatment relative to development intensity. Encampments have been noted by field staff around monitoring station COL0.0 along Cold Creek.

BBC1.6

Finally, the lowermost station BBC1.6 has a contributing area that includes primarily residential land use with inputs from a portion of Interstate 5 and notable industrial areas. Upstream riparian canopy cover within 0.5 mile of BBC1.6 is 56 percent. There are relatively few septic systems in the area and low septic density. Impervious surfaces are present but not dominant and stormwater infrastructure is limited, with moderate number of stormwater outfalls per river mile, and the highest number of stream road crossings per river mile. Water quality at this station is likely impacted by houseless encampments and influence from Cold Creek during storm flow conditions.

Methods

Study Design

This MST study is designed to identify dominant fecal sources contributing to bacterial contamination in BBC through targeted sampling events in WY2025, consistent with sampling criteria outlined in the Project QAPP and MST QAPP addendum (Herrera 2023; 2024a). Sample collection occurred at all 11 monitoring stations during three storm events in the winter wet season and three base flow events during summer months when, historically, fecal bacteria concentrations have been elevated compared to other periods of the year. Sampling was targeted to understand how fecal sources vary spatially throughout the watershed from stormwater input and during dry summer base flow.

While this study is designed to assess how fecal bacteria sources vary spatially and hydrologically in BBC, the ability to discern significant patterns is constrained by the limited number of sampling events and the absence of continuous flow data. The WY2025 MST program employs a simplified design focused on discrete grab sampling and host-specific marker quantification to characterize dominant fecal sources during representative storm and base flow periods from upstream to downstream monitoring stations. The study provides foundational data on fecal source presence and spatial variability.

Field and Laboratory Methods

Grab samples were collected using aseptic techniques and procedures outlined in the QAPP (Herrera 2023). As written in the QAPP Addenda (Herrera 2024a), samples were shipped overnight to the analytical laboratory, H2O Molecular, and analyzed using droplet digital polymerase chain reaction (ddPCR). This method enables detection of low concentrations of host-specific *Bacteroidales* genetic markers, which are robust indicators of fecal pollution from human and animal sources. The analysis targets five DNA markers representing human, bird, dog, cow, and All Source (i.e., all warm-blooded animals including humans, other mammals, and birds) (Table A-3). Detailed experimental design, sampling procedures, and analytical methods are further documented in the QAPP addenda (Herrera 2024a).

Table A-3. Targeted Fecal Source Markers for the Burnt Bridge Creek 2025 MST Study.

Species	Marker	Relevance	Notes
Human	HF183	Human sources include septic, sewer, and unsanitary practices. Human sources comprised 20% of matched sources in the previous MST study.	High sensitivity to humans. Human sources are associated with higher health risk and typically greater control effort than animal sources.
Avian	GFD	This marker is associated with the general influence of abundant bird populations in watershed, with all bird species comprising 28% of matched sources in the previous MST study.	Includes gulls, geese, chickens, and waterfowl.
Dog	DG37	Dogs were commonly observed during field events and dog sources comprised 12% of matched sources in previous MST study.	Recognized as dog-specific marker.
Cow	CowM3	This marker is associated with livestock and hobby farms in the watershed. Sources from cows comprised 11% of matched sources in previous MST study.	Distinguishes between cattle and other ruminants.
All Source	GenBac	This marker represents the concentration of all human and warm-blooded animal sources for comparison to individual host species.	Used to capture all fecal sources.

Data Quality Review

E. coli results from ALS Laboratory underwent data quality review along with other water quality data provided by the laboratory according to the QAPP (Herrera 2023). This included a review of sample holding times, precision of duplicate analyses, and accuracy of positive and negative control analyses in comparison to quality control objectives. Review of *E. coli* data quality is provided in Appendix B Data Quality Review and in the WY2025 Annual Summary Report.

After receiving MST marker results from H2O Molecular, the data were reviewed for consistency with the following defined measurement quality objectives (MQOs). Samples were considered to meet MQOs when filter blanks contained fewer droplets than the limit set by calculating the limit of blank for each assay, indicating results below the detection limit (BDL). Positive control results were evaluated for percent recovery, and if percent recovery was positive, the MQO was met. Laboratory control samples (sketa22) were analyzed for matrix interference, as in, if results were within one log of the negative extraction control after dilution, this confirmed inhibition was not significant, and the MQO was met if the percent recovery was less than 10 percent. Field duplicates were also evaluated, and if the relative percent difference (RPD) exceeded 100 percent, the data were flagged as estimated (J). Additional details on data quality evaluation criteria are provided in the MST QAPP Addenda (Herrera 2024a).

Qualifiers provided by H2O Molecular were reviewed for consistency in reporting and interpretation. Herrera consulted with the laboratory manager at H2O Molecular to clarify the application of qualifiers, particularly those assigned to results below the limit of detection (LOD) to distinguish between trace detections and non-quantifiable results. Definitions of these qualifiers are further described in the Quality Assurance Review Results section.

Data Analysis

Analyses were selected to identify differences in MST Markers based on spatial and hydrologic characteristics. This section includes a subsection for each of the following procedures: qualified value handling, development of heatmaps, computation of summary statistics for MST Markers and *E. coli*, comparison between stations, comparison of *E. coli* results for MST events and all sampled events during WY2025, and a calculation and review of hydrologic metrics for MST sampling events.

These analyses were performed on all MST Marker data collected in WY2025 and other parameters collected in WY2025. Heatmaps were generated in Excel. R software packages were used to perform statistical analyses and create figures. A detailed analysis of data for other parameters collected in WY2025 is available in the WY2025 Summary Report.

Heatmaps

Heatmaps present individual MST Marker results organized by event and station. Different color classifications, or shading of the cells in the heatmap, are used to represent relative magnitude of the values. Color shading is grouped by parameter where green represents the lowest values, yellow represents the approximate 50th percentile of the results, and red represents the maximum values. Heatmaps were also developed for some summary statistics. Calculation of geomeans is discussed below.

Computation of Summary Statistics

Summary statistic geometric mean (geomean) were calculated for MST markers and *E. coli* samples collected during MST sampling events. The 90th percentile was calculated for *E. coli* samples collected during MST sampling events.

The geometric mean, rather than the arithmetic mean, is an appropriate measure of central tendency for values where results are multiplicative, such as colony growth over time. Separate results were calculated for each Station-Event Type pair.

Comparison Between Stations

Error bar figures in Appendix E Water Quality Figures were developed for *E. coli* and each MST marker to compare results across stations, from the most upstream station (BBC10.4) to the most downstream station (BBC1.6). These plots present the following information for each station: the minimum and maximum values as the lower and upper whiskers, respectively; the geomean is represented by a yellow circle; and the 90th percentile represented by a blue triangle. *E. coli* and MST markers are stacked in one figure for comparison and separate figures were developed for storm and base flow events.

Comparison of E. coli Results

A combined boxplot-error bar figure in Appendix E was developed to compare *E. coli* results collected during all WY2025 sampling events to the *E. coli* results collected during the MST sampling events. The error bars for each station and event type represent the minimum and maximum values as the lower and upper whiskers and the range of data as the vertical line between the lower and upper whiskers. The boxplots, including all *E. coli* results collected during WY2025, present the following information for each station and event type: the minimum and maximum values as the lower and upper whiskers, respectively; the median as the line in the box; and the 25th and 75th percentiles of the data as the lower and upper boundaries of the box, respectively.

Hydrologic Metrics

Continuous precipitation data from the Hayden Island Rain Gage (Portland BES 2025) was post-processed using a custom program that delineates the start and stop time of individual storm events based on user selectable storm criteria (e.g., antecedent dry period, minimum rainfall, interevent dry period, etc.). The program then computes the following suite of metrics for each storm event:

- Precipitation start and stop times
- Precipitation duration
- Precipitation depth
- Precipitation average intensity
- Precipitation maximum intensity
- Precipitation antecedent dry period

Table A-4 below summarizes storm metrics for all recorded storm events for the available record of the Hayden Island Rain Gage (WY 1995 through WY2025). The 25th percentile, median, and 75th percentile storm duration, peak intensity, total depth, and antecedent dry period were calculated for all storm events in the following date ranges:

- Full record (WY 1995 through WY2025)
- WY2025

Table A-5 provides hydrologic metrics for MST storm sampling events. Storm events and associated metrics for MST storm sampling events were identified based on sampling times. Storm metrics for MST storm sampling events were compared with the summary statistics for the full record and WY2025 to determine if MST events were representative of storm events in the BBC watershed. Further details on WY2025 sampling events are provided in Table 1 of the WY2025 Annual Summary Report. Storm sampling criteria are detailed in the QAPP (Herrera 2023).

Table A-4. Summary of Precipitation in WY2025 and Full Record (1995-2025)

Percentile	Storm duration (hour)	Depth (in)	Average Intensity	Max Intensity	Antecedent Dry Period
Full Record (1995-2025)					
25th percentile	0.25	0.02	0.004	0.04	10
median	4	0.08	0.02	0.08	19
75th percentile	10	0.27	0.04	0.16	44
WY2025					
25th percentile	0.63	0.02	0.009	0.04	10
median	4	0.10	0.02	0.08	17
75th percentile	10	0.32	0.04	0.20	46

Table A-5. Summary of Precipitation for MST Storm Events

Event	Storm duration (hour)	Depth (in)	Average Intensity	Max Intensity	Antecedent Dry Period
Event 2 (2/19/2025)	16	0.34	0.02	0.12	19
Event 3 (2/24/2025)	28	1.12	0.04	0.40	16
Event 4 (3/12/2025)	6	0.22	0.04	0.16	8

The MST storm events were generally longer in durations and in some cases, more intense than an average WY2025 storm. Compared to WY2025 overall, storm event depth of rainfall was generally near the median to above the 75th percentile. Antecedent dry periods were also generally shorter than the WY2025 median. Relative to the full record, Event 3 is within the upper end of storm depth and peak intensity, whereas Events 2 and 4 fall within the interquartile range of historical storm characteristics.

Results

Quality Assurance Review Results

See Appendix B Data Quality Review for detailed information on QAPP deviations and qualifiers for *E. coli* results. Deviations and qualifiers are summarized below.

- The *E. coli* value for one sample (BUR0.0-20250219) was qualified as estimated (J) due to field duplicate exceedance of the relative percent difference.
- Sampling was not conducted for dry base flow events (June-September) for monitoring station COL0.0 due to safety concerns.

The reporting limit for each MST marker is defined as more than one positive droplet (out of the approximately 20,000 to 40,000 droplets formed per reaction). Reactions with 1 or fewer positive droplets are below the reporting limit and marked by the lab as BDL (below detection limit). Reactions with 2 or more positive droplets are quantified. Because droplet formation is test specific, there are tests where the quantified value falls below the LOD (limit of detection). These tests represent trace detections since the LOD is recalculated on an annual basis. Therefore, when the quantified value falls below the LOD, the data is qualified as estimated (J). When BDLs are reported by the lab, we report the data as the respective LOD. We report the BDL data as the respective LOD because there are occurrences of results that are detected but are below the LOD (trace detections), and therefore not quantifiable, these results are qualified as estimated non-detections (UJ). For consistency in reporting, the data reported for results with UJ qualifiers are also the respective LODs. Table A-6 below describes the percentage of data qualified as non-detect (U) or estimated (J); no MST results were rejected.

Table A-6. Percentage of MST Data Qualified as Estimated (J) and Non-Detect (U) Values.

MST Marker	Water Year 2025[a] (%)			
	Base Flow		Storm Flow	
	U	J	U	J
All Source (GenBac)	0	0	0	0
Human (HF183)	50	23	0	3
Dog (DG37)	97	0	6	18
Bird (GFD)	10	10	0	0
Cow (CowM3)	90	7	100	0

[a] Percentages do not include duplicate samples. Estimated non-detect (UJ) qualifiers are counted as non-detects (U).

Fecal Bacteria Source Markers

Table A-7 below depicts geomeans of *E. coli* values and MST markers by event type and monitoring station, with shading by color scaling to illustrate relative magnitude across stations and event type, including italicization of values below analytical LODs. MST monitoring during WY2025 shows highly variable concentrations, with much higher concentrations of markers during winter storm events than dry season base flow. Across the dataset, fecal *Bacteroides* markers generally occurred at higher magnitudes and frequency during storm flow, while Human and Dog markers were typically low and often near or below their respective LODs during dry base flow events. Concentrations of the All Source marker is several orders of magnitude higher than any individual source markers, and the Bird marker was consistently among the highest concentrations among individual source markers.

Storm flow samples consistently yielded higher *E. coli* concentrations and were accompanied by elevated All Source marker concentrations ranging from 70,000 to more than 400,000 copies per 100 milliliters (copies/100 mL) across most sites. Human marker concentrations during storm flow were generally low in magnitude, typically between 40 and 200 copies/100 mL, except for monitoring station BUR0.0 exhibiting a moderately high geomean (1,533 copies/100 mL). The Bird marker was consistently present across stations and events, at highly variable concentrations ranging from 20 to over 9,000 copies/100 mL across storm and base flow events, indicating a persistent background source and dominant contribution to overall fecal loading along upstream and mid-stem reaches of BBC.

Base flow samples showed low marker concentrations across stations, with Human, Dog, and Bird makers generally near or below analytical LODs, while the All Source marker in base flow was about an order of magnitude lower than for storm flow. The Cow marker was largely not detected across storm and base flow.

Table A-7. Fecal Bacteria Heat Map of Geomeans by Event Type for the 2025 MST Study of Burnt Bridge Creek.

Station	**Winter Storm Flow**					**Summer Base Flow**				
	E. coli **(CFU/100 mL)**	**MST (copies/100mL)**				***E. coli*** **(CFU/100 mL)**	**MST (copies/100 mL)**			
		All Source (GenBac)	**Human (HF183)**	**Dog (DG37)**	**Bird (GFD)**		**All Source (GenBac)**	**Human (HF183)**	**Dog (DG37)**	**Bird (GFD)**
BBC10.4	132	331,086	84	78	2,240	194	178,935	*22*	*24*	138
BBC8.8	101	246,033	179	57	1,874	27	24,141	*26*	*24*	46
PET0.0	174	88,134	109	54	339	143	32,134	30	*24*	125
BBC8.4	91	234,528	197	42	1,746	138	43,467	36	*24*	64
BUR0.0	696	423,028	1,533	64	538	120	42,172	28	*24*	92
BBC7.0	260	178,245	103	38	1,117	251	54,489	*21*	*24*	263
BBC5.9	207	254,294	180	65	2,015	249	57,278	34	25	114
BBC5.2	176	175,400	124	58	1,526	300	23,940	*20*	*24*	41
BBC2.6	331	173,368	105	48	990	363	26,250	45	*24*	33
COL0.0[c]	1,049	71,738	191	27	1,045	NS	NS	NS	NS	NS
BBC1.6	352	222,896	105	47	812	273	23,302	38	*24*	*23*

[a] Color shading is grouped by parameter where green = lowest values, yellow = approximately 50th percentile, red = maximum values, grey = NS, grey and italicized = less than LOD (Human LOD = 27.5, Dog LOD = 24.4, Avian LOD = 24.8).

[b] Geomeans calculated for all MST sampling events.

[c] Sampling was not conducted at monitoring station COL0.0 for dry base flow events.

NS = Not sampled

Human Marker

Table A-8 presents *E. coli* and Human Marker (HF183) results for MST study storm flow and base events with comparison to water quality criteria. Primary contact recreation criteria in freshwaters for *E. coli* include 100 CFU/100 mL for the geomean and 320 CFU/100 mL for the 90th percentile (WAC 173 201A). A risk-based threshold of 525 copies/100 mL has been proposed as a concern for the human marker HF183 (Bolle and Soller 2020). Key observations pertaining to the MST monitoring events are described below:

- Stormwater runoff appears to be a major source of fecal bacteria in BUR0.0 and COL0.0 tributaries where the greatest *E. coli* geomeans and 90th-percentiles of all stations were measured and are likely contributing to increased storm flow concentrations at immediate downstream stations (BBC7.0 and BBC1.6 respectively). In contrast, the two tributaries did not appear to increase *E. coli* concentrations in the mainstem during dry weather as the stations immediately upstream (BBC8.4 and BBC2.6) of the tributaries have greater geomeans and 90th percentiles than the stations immediately downstream (BBC7.0 and BBC1.6).
- MST human marker results are largely consistent across monitoring stations during storm flow, except for a high geomean at BUR0.0. However, the human marker geomean decreased in BBC downstream of BUR0.0, suggesting that this tributary is not a significant source of human fecal loading, likely due to its relatively low flow. MST human marker results during base flow are largely below the LOD, except for monitoring station BBC2.6.

Table A-8. *E. coli* and Human Marker Results Comparison by Event Type for the 2025 MST Study of Burnt Bridge Creek.

Monitoring Station	***E. coli*** **Bacteria (CFU/100 mL)[a]**				**MST Human Marker[c] (HF183; copies/ 100 mL)**	
	Base Flow		**Storm Flow**		**Base Flow**	**Storm Flow**
	Geomean	**90th Percentile**	**Geomean**	**90th Percentile**	**Geomean**	**Geomean**
BBC10.4	**194**	270	**132**	201	*22*	84
BBC8.8	27	108	**101**	107	*26*	179
PET0.0	**143**	175	**174**	254	30	109
BBC8.4	**138**	**387**	91	115	36	197
BUR0.0	**120**	**301**	**696**	**1,715**	28	**1,533**
BBC7.0	**251**	**354**	**260**	**431**	21	103
BBC5.9	**249**	**374**	**207**	261	34	180
BBC5.2	**300**	**434**	**176**	241	*20*	124
BBC2.6	**363**	**961**	**331**	**552**	45	105
COL0.0[b]	NS	NS	**1,049**	**2,334**	NS	191
BBC1.6	**273**	**331**	**352**	**810**	38	105

a Bold values exceed primary contact recreation criteria in freshwaters for E. coli (100 CFU/100 mL for geomean or 320 CFU/100 mL for 90th percentile) (WAC 173 201A).

b Sampling was not conducted at monitoring station COL0.0 for base flow events.

c Bold values exceed the risk-based threshold of 525 copies/100 mL for HF183 (Bolle and Soller 2020). Italicized values are below the LOD (27.5 copies/ 100 mL).

MST = Microbial Source Tracking

NS = Not Sampled

Based on the risk-relevant framework, Table A-9 demonstrates exceedances of the 525 copies per 100 mL threshold (Boehm and Soller 2020), particularly at BUR0.0, and intermittently, BBC8.8 and BBC8.4, suggesting episodic inputs of fresh or recently mobilized human-associated contamination during high-flow conditions. In contrast, most dry base flow HF183 results remained at low concentrations or below detection limits, indicating a substantially reduced likelihood of human-associated contamination during dry weather.

Table A-9. Heat Map of Human MST Results By Threshold.

Monitoring Station	Human Marker (HF183; copies/100 mL)[ab]					
	Winter Storm Flow			Summer Base Flow		
	Event 2 (2/19/2025)	Event 3 (2/24/2025)	Event 4 (3/12/2025)	Event 1 (6/25/2025)	Event 2 (7/24/2025)	Event 3 (8/19/2025)
BBC10.4	55	71	152	*BDL*	*11*	36
BBC8.8	**682**	153	55	*23*	*BDL*	*BDL*
PET0.0	104	141	88	*22*	46	*BDL*
BBC8.4	**630**	165	73	*BDL*	62	*BDL*
BUR0.0	**1,501**	415	**5,784**	*BDL*	*BDL*	30
BBC7.0	296	*27*	140	*BDL*	*BDL*	*12*
BBC5.9	222	98	267	*BDL*	*BDL*	53
BBC5.2	197	53	182	*BDL*	*12*	*25*
BBC2.6	65	78	224	63	*23*	62
COL0.0[c]	92	**830**	92	NS	NS	NS
BBC1.6	88	87	152	73	*BDL*	*BDL*

a Bold values exceed the risk-based threshold for HF183 is 525 copies/ 100mL (Boehm and Soller 2020). A specific study evaluating contaminated stormwater identified an inflection point of approximately 100 copies/ 100 mL of HF183 as the threshold at which a water body is considered unsafe for swimming (Lowry 2025). Because the median simulated illness risk for BBC is unknown, comparing results to these thresholds serve only as contextual reference and should be interpreted as an estimated application to the risk-based threshold.

b Shading is determined across event type and defined as: green = lowest value, yellow = 100, red = 525, grey = NS, grey and italicized = <27.5 (below LOD).

c Sampling was not conducted at monitoring station COL0.0 for dry base flow events.

BDL = Below Detection Limit

MST = Microbial Source Tracking

NS = Not Sampled

Exceedances of the HF183 threshold provide supporting evidence regarding the probable origin of bacteria loads and the relative public-health implications of stormwater runoff versus background human fecal loading. Fecal contamination in BBC is likely a mixture of point sources of a variety of sources of fecal contamination with nonpoint sources from septic effluent into the stream, human fecal *Bacteroides* are present but not the driving force of fecal contamination. The lack of human marker threshold exceedances during base flow events may point to the impacts of background wildlife and non-human fecal loading during summer base flow periods.

All Source Marker

Table A-10 summarizes results for the All Source marker (GenBac), which is associated with warm blooded mammals and generally includes wildlife, domestic livestock, pets, and humans. The All Source marker targets general *Bacteroides*, a genus of bacteria within the order *Bacteroidales* that comprises anaerobic fecal bacteria abundant in the intestinal tracks of animals. Winter storm flow events exhibited the highest All Source marker concentrations, with the maximum observed value at BUR0.0. Elevated concentrations during winter storm flow events were also measured at upstream and mid-stem stations BBC10.4, BBC5.9, and BBC7.0. Summer base flow concentrations were lower than storm flow concentrations at all stations, with BBC10.4 and BBC5.9 exhibiting the highest All Source marker base flow values relative to other monitoring stations.

Table A-10. All Source Marker Results by Event and Monitoring Station.

Monitoring Station	All Source Marker (GenBac; copies/100 mL)[a]					
	Winter Storm Flow			Summer Base Flow		
	Event 2 (2/19/2025)	Event 3 (2/24/2025)	Event 4 (3/12/2025)	Event 1 (6/25/2025)	Event 2 (7/24/2025)	Event 3 (8/19/2025)
BBC10.4	628,420	309,250	186,751	88,447	222,850	290,663
BBC8.8	372,648	258,189	154,791	13,839	26,332	38,607
PET0.0	126,912	58,427	92,323	30,306	52,077	21,024
BBC8.4	410,913	151,080	207,793	22,675	50,402	71,862
BUR0.0	232,030	313,897	1,039,384	76,753	49,241	19,845
BBC7.0	479,244	73,078	161,700	35,776	53,228	84,955
BBC5.9	525,645	131,618	237,683	28,008	43,353	154,759
BBC5.2	438,952	60,851	202,025	13,857	15,454	64,076
BBC2.6	104,582	167,154	298,081	20,255	18,799	47,505
COL0.0[b]	22,689	137,623	118,238	NS	NS	NS
BBC1.6	154,797	125,308	570,904	19,179	29,711	22,205

[a] Shading is across events and defined as: green = lowest values, yellow = approximately 50th percentile, red = maximum values, grey = NS

[b] Sampling was not conducted at monitoring station COL0.0 for dry base flow events.

BDL = Below Detection Limit

MST = Microbial Source Tracking

NS = Not Sampled

Dog Marker

Table A-11 presents dog marker results by event and monitoring station with shading by color scaling the results. The Dog marker was consistently detected during storm events across most monitoring stations, with the highest concentrations occurring at the upstream stations BBC10.4, BBC8.4 and mid-stream stations BBC5.9 and BBC5.2. Dog markers were largely below detection during all base flow events.

Table A-11. Dog Marker Results by Event and Monitoring Station.

Monitoring Station	Dog Marker (DG37; copies/100 mL)[a]					
	Winter Storm Flow			Summer Base Flow		
	Event 2 (2/19/2025)	Event 3 (2/24/2025)	Event 4 (3/12/2025)	Event 1 (6/25/2025)	Event 2 (7/24/2025)	Event 3 (8/19/2025)
BBC10.4	116	83	49	*BDL*	*BDL*	*BDL*
BBC8.8	104	73	*BDL*	*BDL*	*BDL*	*BDL*
PET0.0	91	54	32	*BDL*	*BDL*	*BDL*
BBC8.4	120	*24*	27	*BDL*	*BDL*	*BDL*
BUR0.0	31	72	113	*BDL*	*BDL*	*BDL*
BBC7.0	71	40	*19*	*BDL*	*BDL*	*BDL*
BBC5.9	150	144	*12*	*BDL*	*BDL*	26
BBC5.2	159	33	38	*BDL*	*BDL*	*BDL*
BBC2.6	*24*	39	118	*BDL*	*BDL*	*BDL*
COL0.0[b]	*BDL*	44	*18*	NS	NS	NS
BBC1.6	44	75	32	*BDL*	*BDL*	*BDL*

[a] Shading is across events and defined as: green = lowest values, yellow = approximately 50th percentile, red =maximum values, grey = NS, grey and italicized = <24.4 (below LOD)

[b] Sampling was not conducted at monitoring station COL0.0 for dry base flow events.

BDL = Below Detection Limit

MST = Microbial Source Tracking

NS = Not Sampled

Bird Marker

The Bird marker was consistently detected with greatest concentrations at upstream station BBC10.4 and mid-stream monitoring stations. Storm flow samples frequently reached several hundred to several thousand copies per 100 mL. Base flow concentrations were much lower, generally declining to tens of copies per 100 mL and occasionally falling below the LOD. Although the magnitude varied by station and event, the Bird marker was broadly detected under both storm and base flow. The color shading in Table A-12 highlights these patterns.

Table A-12. Bird Marker Results by Event and Monitoring Station.

Monitoring Station	Bird Marker (GFD; copies/100 mL)[a]					
	Winter Storm Flow			Summer Base Flow		
	Event 2 (2/19/2025)	Event 3 (2/24/2025)	Event 4 (3/12/2025)	Event 1 (6/25/2025)	Event 2 (7/24/2025)	Event 3 (8/19/2025)
BBC10.4	9,160	1,795	683	148	91	197
BBC8.8	6,499	1,422	712	34	52	55
PET0.0	656	242	246	168	171	68
BBC8.4	6,506	1,021	801	80	68	48
BUR0.0	2,014	86	904	28	128	219
BBC7.0	6,972	393	509	260	270	258
BBC5.9	7,663	1,085	984	35	194	218
BBC5.2	6,104	768	758	*18*	53	69
BBC2.6	1,484	607	1,079	*17*	*BDL*	81
COL0.0[b]	940	974	1,247	NS	NS	NS
BBC1.6	1,665	380	847	*BDL*	*BDL*	*19*

[a] Shading is across events and defined as: green = lowest values, yellow = approximately 50th percentile, red =maximum values, grey = NS, grey and italicized = <24.8 (below LOD)

[b] Sampling was not conducted at monitoring station COL0.0 for dry base flow events.

BDL = Below Detection Limit

MST = Microbial Source Tracking

NS = Not Sampled

Cow Marker

The Cow marker was largely undetected across all stations and events, indicating minimal influence from bovine sources in the BBC watershed. Only two isolated detections occurred during base flow: a moderate concentration at BBC10.4 (28 copies/100mL) and a trace detection, below the LOD, at BUR0.0 and BBC10.4 (Table A-13). All storm sample results were below respective detection limits. This suggests an absence of sustained or storm-responsive inputs from cattle, consistent with the predominantly urban and residential land use in the subbasins.

Table A-13. Cow Marker Results by Event and Monitoring Station.

Monitoring Station	Cow Marker (CowM3; copies/100 mL)[a]					
	Winter Storm Flow			Summer Base Flow		
	Event 2 (2/19/2025)	Event 3 (2/24/2025)	Event 4 (3/12/2025)	Event 1 (6/25/2025)	Event 2 (7/24/2025)	Event 3 (8/19/2025)
BBC10.4	*BDL*	*BDL*	*BDL*	28	*12*	*BDL*
BBC8.8	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*
PET0.0	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*
BBC8.4	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*
BUR0.0	*BDL*	*BDL*	*BDL*	*11*	*BDL*	*BDL*
BBC7.0	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*
BBC5.9	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*
BBC5.2	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*
BBC2.6	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*
COL0.0[b]	*BDL*	*BDL*	*BDL*	NS	NS	NS
BBC1.6	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*

[a] Shading is across events and defined as: green = lowest values, yellow = approximately 50th percentile, red =maximum values, grey = NS, grey and italicized = <16.5 (below LOD)

[b] Sampling was not conducted at monitoring station COL0.0 for dry base flow events.

BDL = Below Detection Limit

MST = Microbial Source Tracking

NS = Not Sampled

Discussion

Concentration of MST markers quantified by ddPCR are generally below thresholds associated with elevated risk of contamination (525 copies/100 mL, Boehm and Soller 2020). Nevertheless, the detection of human fecal *Bacteroides* in BBC remains noteworthy, as these markers should ideally be absent from ambient surface waters. Spatial patterns in human and animal source contributions reflect the following distribution and transport dynamics within BBC:

- Upstream reaches of BBC (BBC10.4) receive mixed mammalian inputs with comparatively lower human contributions.
- Mid-stem (BBC8.4, BBC7.0, BBC5.9) and tributary (BUR0.0) segments show elevated human fecal inputs likely attributable to stormwater driven runoff; septic system effluent from under functioning drain fields; and potential direct inputs from human activity on streambanks or recreation from nearby parks.
- Downstream stations exhibit (BBC2.6, BBC1.6) largely trace human fecal inputs, with variability likely influenced by storm intensity, flow conditions, and fecal bacteria loading from certain tributaries (COL0.0).

Storm event samples consistently produced higher MST marker concentrations, reinforcing the interpretation that stormwater is the principal transport pathway for human fecal *Bacteroides* and other source inputs. Elevated *E. coli* during dry base flow events suggest that fecal bacteria are primarily derived from wildlife or other non-human background fecal sources with trace contributions from human related point and nonpoint sources. Because this MST dataset represents discrete sampling events, the results capture only one interval within a highly dynamic microbial loading regime that shifts with hydrology, seasonality, and surrounding land use.

Sources and Pathways

Bacteroides markers are widely used in MST because of their high host-specificity and relatively high abundance in sewage (Paruch 2022). *Bacteroides* transport in surface waters is strongly influenced by hydrology (overland runoff), particle attachment (sediment, suspended solids), and resuspension from bed sediments during higher-energy flow events (Cho 2016; Kim 2015; Zimmer-Faust 2017). Patterns observed in the BBC MST results illuminate subbasin-specific land use impacts and the importance of hydrological flow in fecal loading pathways. These factors collectively frame the discussion of MST pathways and sources in BBC, and inform how fecal contamination is transported, diluted, or masked along the stream. Fecal *Bacteroides* source tracking finds that fecal loading concentrations are contingent upon pathways that differ from upstream to downstream.

Concentrations of MST markers sampled at BBC remain below thresholds associated with elevated human-health risk; however, the recurring presence of human Bacteroides across multiple stations indicates chronic, low-level inputs sustained by watershed conditions rather than isolated failure points. Spatial patterns in MST detections are consistent with an urban stream characterized by a series of diverse contributing subbasins that vary in size, land use, septic density, and impervious coverage. Stormwater conveyance and runoff from primarily residential land use appear to be key factors influencing the sources of fecal bacteria observed in BBC. Many upstream and midstream stations also show high Bird marker detections, suggesting substantial inputs from birds in residential and park areas. The strong Bird and All Source marker signatures help contextualize the relatively low Human marker concentrations, suggesting direct inputs from wildlife or nonhuman fecal bacteria to BBC and delayed transport of human-associated fecal bacteria via stormwater; as a result, the risk of illness is generally reduced because many disease-causing viruses are specific to humans.

In the upstream headwaters (BBC10.4), the large, predominantly residential drainage area contains widespread stormwater infrastructure and substantial impervious acreage that together mobilize mixed mammalian and avian fecal material during storms. Despite high septic system density, human-associated markers remain relatively low, which suggests either limited septic influence or strong dilution effects in the large drainage area. The abundance of Bird and All Source markers in this upstream reach likely reflect residential landscaping, riparian habitat, and park-adjacent land use, and their magnitude in comparison to the Human marker suggests that septic system inputs may not contribute much to the observed concentrations of *E. coli*.

Across mid-stream subbasins (BBC8.4, BBC7.0, BBC5.9) and the large tributary BUR0.0, watershed characteristics create conditions that increase human fecal loading attributed to increased septic densities, impervious surfaces and stormwater outfalls. BUR0.0, in particular, is among the largest subbasins in the watershed, with extensive residential land use, high septic density, and nearly 1,900 acres of impervious surface, providing multiple pathways for septic influences and rapid stormwater mobilization. Mid-stream subbasins also exhibit abundant avian signals that reflect their closer proximity to parks and larger areas of greenspace, conditions that produce avian fecal bacteria inputs more frequently and directly than human fecal bacteria.

Relative to other stations, Human markers were elevated at BUR0.0 during storm events, suggesting that septic drain fields, residential runoff, and direct inputs from recreation or encampments meaningfully contribute to contamination during storms. Historically, total phosphorus concentrations at BUR0.0 have been elevated during stormflow (Herrera 2024c), a pattern less evident in WY2025 (see Main Text). Storm-related increases in total phosphorus may suggest episodic mobilization of septic effluent because elevated total phosphorus can indicate failing septic systems (Robertson 2021). Nitrogen does not show a discernible storm response, likely due to masking by existing groundwater contamination. Septic effluent mobilization during storm events at station BUR0.0 is therefore proposed, based on the high density of septic systems, unique conditions discussed in the Main Text, and historical association between storm events and increased total phosphorus concentrations.

Downstream subbasins (BBC2.6 and BBC1.6) show more variable and typically lower concentrations of the Human marker, reflecting cumulative inputs from upstream, hydrologic mixing, and attenuation processes such as dilution, sedimentation, and microbial die-off. The density of mid-stream impervious surfaces and stream road crossings contribute to episodic pulses of runoff-derived contamination, but the large downstream drainage areas provide greater dilution capacity. The Bird marker also decreased slightly in lower reaches, consistent with reduced local sourcing and more diffuse upstream contributions.

Across the watershed, the pronounced increase in MST marker concentrations during storm events underlines stormwater as the dominant vector for fecal mobilization. Impervious surfaces, outfalls, and densely distributed septic systems all contribute to storm-driven generation and transport of fecal material, while avian activity contributes substantially to the non-human background. Ultimately, MST results represent a time-limited snapshot of a broader, hydrologically dynamic system in which human, avian, and mammalian sources interact with land use and stormwater infrastructure to shape fecal contamination patterns throughout BBC.

Limitations of Interpretation

The MST dataset is subject to key limitations:

- **Limited temporal coverage**: Three storm and three base flow events were sampled within a single water year and no winter base flow sampling occurred. No summer base flow MST sampling occurred at monitoring station COL0.0, limiting characterization of seasonal variability and hydrologic dynamics.
- **Grab sampling constraints**: Discrete grab samples may miss short-duration pulses, lagged transport pathways, and peak-flow conditions, reducing the ability to distinguish between chronic and event-driven sources.
- **Analytical challenges in stormwater**: Elevated TSS, turbidity, and organic matter can inhibit molecular assays (Steele 2018). Although ddPCR improves tolerance to inhibition, low marker concentrations may reflect both hydrologic conditions and analytical constraints.
- **Lack of concurrent flow data**: The absence of flow measurements limit assessment of the relative influence of stormwater as it relates to tributaries and bacteria loading.

All warm-blooded sources of *Bacteroides* (GenBac) represent aggregate contributions from nonspecific mammalian sources in the watershed (e.g., pets, deer, beavers, raccoons, rats, nutria). The consistently higher magnitude of general mammal marker concentrations relative to human-associated markers indicates that human fecal inputs constitute a relatively small fraction of the overall mammalian load at most sites. High non-human mammalian fecal loading may correspond with a lower risk of illness from direct contact with the urban stream. However, because marker concentrations are relative to the analyzed extract volume (100 µL), comparisons across markers are inherently relative and may shift with changes in eluted sample volume.

Despite these limitations, the dataset provides a reasonable basis for preliminary source attribution in an urban watershed. When interpreted alongside ambient water quality data and land use information, the MST results help delineate likely contributions from human, dog, avian, and cow sources across the monitored stations and identify priority areas for further investigation.

Conclusions and Recommendations

Spatial patterns in MST results indicate fecal contamination in BBC is dominated by animal sources, with localized and episodic human contributions that vary by reach. Upstream segments (BBC10.4) show mixed mammalian inputs with relatively low human contributions. Mid-stem (BBC8.4, BBC7.0, BBC5.9) and tributary (BUR0.0) segments exhibit elevated human markers consistent with stormwater driven transport and influence from residential runoff. Downstream stations (BBC2.6, BBC1.6) generally reflect trace human fecal contributions, with variability linked to storm conditions and loadings to tributary Cold Creek. Higher concentrations of Human markers during storm events underscore stormwater as the primary transport pathway, whereas elevated *E. coli* during summer base flow conditions suggest dominance of wildlife and other background non-human sources.

A comprehensive management approach to reducing fecal contamination in the City's urban stream should integrate structural stormwater improvements, non-structural watershed management strategies, and social-service interventions. Increasing riparian cover through targeted restoration and invasive-species management can stabilize banks, reduce overland flow velocities, and promote natural filtration of bacteria-laden runoff. Complementary upgrades to stormwater treatment infrastructure, such as expanding green infrastructure and addressing untreated outfalls, would further reduce bacterial loading during storm events. Furthermore, establishing continuous flow and turbidity monitoring at key subbasins is essential for improving hydrologic understanding, quantifying storm-driven pollutant transport, and supporting event-based response strategies.

Human-sourced contamination can be further mitigated by strengthening coordination with human services providers to reduce encampment-related waste, improve trash management, and expand access to sanitation resources in areas adjacent to the stream. Pet-related contributions can be managed through expanded public education, increased availability of pet-waste disposal stations, and targeted enforcement in high-use park corridors.

The City's existing Sewer Connection Incentive Program (SCIP) provides a strong framework for implementing long-term interventions. SCIP could be expanded to prioritize subbasins with high HF183 detections, integrate bacterial reduction goals into project scoring criteria, and fund pilot projects such as enhanced treatment vaults, biofiltration retrofits, and riparian reconnection projects. Combining these management actions would enhance the resilience of the watershed and reduce human and pet-derived bacterial contamination over time.

Additional Monitoring

The 2025 MST study provided sufficient insights on sources within the stream and established a baseline for future comparison. Further evaluation may be conducted in the future to determine whether any particular area or source warrants more focused source tracking or targeted MST monitoring. Periodic repeat MST monitoring should be considered to assess trends over time and to evaluate the effectiveness of management actions, such as water quality improvement projects, sewer system connections, and public education/ outreach related to pet waste. For additional MST studies on BBC, the development of hydrologic models, and application of quantitative microbial risk assessment models may provide additional insights. However, these models require a higher level of effort and expertise that is outside the current scope of the City's monitoring efforts.

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Table D-1. WY2025 Base Flow Summary Statistics Table.

Station	Criteria[1]	n	Minimum	25th Percentile	Median	Mean	Geomean	75th Percentile	90th Percentile	Maximum	Percent Detected
Conductivity (µS/cm)											
BBC10.4	-	7	160	168	170	177	176	187	192	197	100%
BBC8.8	-	7	158	168	178	175	175	181	187	194	100%
PET0.0	-	7	219	220	232	235	235	248	254	260	100%
BBC8.4	-	7	172	189	197	205	204	225	230	237	100%
BUR0.0	-	7	202	212	214	215	215	220	226	227	100%
BBC7.0	-	7	163	192	202	206	205	227	232	240	100%
BBC5.9	-	7	148	190	200	202	200	227	228	230	100%
BBC5.2	-	7	150	191	200	200	198	215	226	236	100%
BBC2.6	-	7	148	193	202	204	202	228	234	241	100%
COL0.0	-	2	181	191	200	200	199	210	215	219	100%
BBC1.6	-	6	189	200	205	213	212	226	239	247	100%
Dissolved Oxygen (mg/L)											
BBC10.4	10	7	3.9	4.1	4.8	5.3	5.2	6.5	7.1	7.4	100%
BBC8.8	10	7	8.1	8.4	8.9	9.6	9.5	10.4	11.4	12.5	100%
PET0.0	10	7	8.6	8.7	8.8	9.1	9.0	9.5	9.6	9.7	100%
BBC8.4	10	7	8.4	8.5	8.9	9.5	9.4	10.5	10.9	11.2	100%
BUR0.0	10	7	8.0	8.3	8.6	9.4	9.3	10.5	11.2	12.0	100%
BBC7.0	10	7	7.7	8.9	9.0	9.3	9.3	10.1	10.5	10.7	100%
BBC5.9	10	7	6.6	7.1	7.3	8.0	7.9	8.7	9.7	10.4	100%
BBC5.2	10	7	8.8	9.0	9.3	9.6	9.5	10.1	10.6	10.6	100%
BBC2.6	10	7	8.9	9.2	9.3	10.0	9.9	10.9	11.4	11.7	100%
COL0.0	10	2	11.2	11.4	11.5	11.5	11.5	11.6	11.7	11.8	100%
BBC1.6	10	6	9.0	9.2	9.4	9.9	9.8	10.3	11.2	11.8	100%
Dissolved Oxygen Saturation (%)											
BBC10.4	-	7	40.7	42.8	49.7	50.8	50.0	57.6	62.7	64.3	100%
BBC8.8	-	7	87.1	88.1	90.3	93.4	92.9	90.7	102	119	100%
PET0.0	-	7	88.6	90.4	90.6	91.0	91.0	92.1	92.8	92.9	100%
BBC8.4	-	7	87.7	89.6	90.5	92.7	92.6	92.6	99.0	107	100%
BUR0.0	-	7	78.1	83.7	87.2	90.6	90.0	95.1	102	111	100%
BBC7.0	-	7	79.5	84.6	91.1	93.6	93.0	101	108	113	100%
BBC5.9	-	7	70.9	71.9	77.8	78.1	77.6	78.3	86.2	97.4	100%
BBC5.2	-	7	85.3	91.4	96.2	94.3	94.2	97.7	98.9	101	100%
BBC2.6	-	7	96.0	96.3	96.6	97.4	97.4	98.1	99.9	101	100%
COL0.0	-	2	98.9	99.4	99.9	99.9	99.9	100	101	101	100%
BBC1.6	-	6	96.4	96.8	97.0	98.1	98.1	99.4	101	102	100%
E. coli (MPN/100 mL)											
BBC10.4	100-320	7	7.4	32.4	135	229	90.9	239	543	921	100%
BBC8.8	100-320	7	8.5	12.8	23.1	38.2	24.8	39.5	78	131	100%
PET0.0	100-320	7	3.1	29.0	102	97.4	52.0	170	178	179	100%
BBC8.4	100-320	7	15.8	35.0	61.3	116	66.3	102	251	461	100%
BUR0.0	100-320	7	26.2	58.5	90.8	119	88.1	129	217	345	100%
BBC7.0	100-320	7	30.9	84.4	140	197	142	337	365	365	100%
BBC5.9	100-320	7	25.9	56.0	166	186	123	295	383	411	100%
BBC5.2	100-320	7	21.8	88.2	179	210	146	317	380	461	100%
BBC2.6	100-320	7	33.1	62.7	131	449	189	723	1236	1410	100%
COL0.0	100-320	2	26.2	43.6	61.1	61.1	50.1	78.5	88.9	95.9	100%
BBC1.6	100-320	7	18.3	78.3	214	261	152	311	533	816	100%
MST - All Sources (GenBac; copies/100 mL)											
BBC10.4	-	3	88447	155648	222850	200653	178935	256756	277100	290663	100%
BBC8.8	-	3	13839	20085	26332	26259	24141	32469	36152	38607	100%
PET0.0	-	3	21024	25665	30306	34469	32134	41191	47723	52077	100%
BBC8.4	-	3	22675	36538	50402	48313	43467	61132	67570	71862	100%
BUR0.0	-	3	19845	34543	49241	48613	42172	62997	71250	76753	100%
BBC7.0	-	3	35776	44502	53228	57987	54489	69092	78610	84956	100%
BBC5.9	-	3	28008	35681	43353	75373	57278	99056	132478	154759	100%
BBC5.2	-	3	13857	14655	15454	31129	23940	39765	54351	64076	100%
BBC2.6	-	3	18799	19527	20255	28853	26250	33880	42055	47505	100%
BBC1.6	-	3	19179	20692	22205	23698	23302	25958	28209	29711	100%
MST - Bird (GFD; copies/100 mL)											
BBC10.4	-	3	91.1	119	148	145	138	172	187	197	100%
BBC8.8	-	3	34.3	43.2	52.0	47.2	46.2	53.7	54.6	55.3	100%
PET0.0	-	3	68.3	118	168	135	125	169	170	171	100%
BBC8.4	-	3	47.9	58.0	68.1	65.4	64.0	74.2	77.8	80.2	100%
BUR0.0	-	3	28.3	77.9	128	125	92.5	173	201	219	100%
BBC7.0	-	3	258	259	260	263	263	265	268	270	100%
BBC5.9	-	3	34.7	114	194	149	114	206	213	218	100%
BBC5.2	-	3	18.4	35.6	52.7	46.7	40.6	60.9	65.8	69.1	100%
BBC2.6	-	3	17.3	21.1	24.8	41.0	32.6	52.9	69.7	80.9	67%
BBC1.6	-	3	18.7	21.8	24.8	22.8	22.6	24.8	24.8	24.8	33%
MST - Cow (CowM3; copies/100 mL)											
BBC10.4	-	3	12.4	14.5	16.5	19.1	18.0	22.5	26.0	28.4	67%
BBC8.8	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
PET0.0	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC8.4	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BUR0.0	-	3	11.3	13.9	16.5	14.8	14.5	16.5	16.5	16.5	33%
BBC7.0	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC5.9	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC5.2	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC2.6	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC1.6	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
MST - Dog (DG37; copies/100 mL)											
BBC10.4	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
BBC8.8	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
PET0.0	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
BBC8.4	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
BUR0.0	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
BBC7.0	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
BBC5.9	-	3	24.4	24.4	24.4	25.1	25.0	25.4	26.0	26.4	33%
BBC5.2	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
BBC2.6	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%
BBC1.6	-	3	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	0%

Table D-1. WY2025 Base Flow Summary Statistics Table.

Station	Criteria[1]	n	Minimum	25th Percentile	Median	Mean	Geomean	75th Percentile	90th Percentile	Maximum	Percent Detected
MST - Human (HF183; copies/100 mL)											
BBC10.4	-	3	11.4	19.5	27.5	24.9	22.4	31.7	34.1	35.8	67%
BBC8.8	-	3	22.9	25.2	27.5	26.0	25.9	27.5	27.5	27.5	33%
PET0.0	-	3	22.3	24.9	27.5	31.9	30.4	36.7	42.2	45.9	67%
BBC8.4	-	3	27.5	27.5	27.5	39.1	36.1	45.0	55.4	62.4	33%
BUR0.0	-	3	27.5	27.5	27.5	28.5	28.4	29.0	29.8	30.4	33%
BBC7.0	-	3	12.3	19.9	27.5	22.4	21.0	27.5	27.5	27.5	33%
BBC5.9	-	3	27.5	27.5	27.5	35.9	34.2	40.1	47.7	52.7	33%
BBC5.2	-	3	11.7	18.4	25.1	21.4	20.1	26.3	27.0	27.5	67%
BBC2.6	-	3	23.4	42.8	62.2	49.6	45.2	62.8	63.1	63.3	100%
BBC1.6	-	3	27.5	27.5	27.5	42.8	38.1	50.4	64.1	73.3	33%
Nitrate + Nitrite as Nitrogen (mg/L)											
BBC10.4	0.15	7	0.67	1.0	1.3	1.4	1.3	1.6	2.1	2.7	100%
BBC8.8	0.15	7	0.41	0.77	1.4	1.2	1.1	1.7	2.0	2.0	100%
PET0.0	0.15	7	1.5	1.5	1.6	1.7	1.6	1.7	1.9	2.0	100%
BBC8.4	0.15	7	1.1	1.2	1.5	1.4	1.4	1.6	1.8	1.9	100%
BUR0.0	0.15	7	1.6	1.7	1.8	2.1	2.1	2.6	3.0	3.1	100%
BBC7.0	0.15	7	0.95	1.1	1.2	1.3	1.2	1.4	1.5	1.7	100%
BBC5.9	0.15	7	0.87	1.0	1.1	1.2	1.1	1.4	1.4	1.6	100%
BBC5.2	0.15	7	1.0	1.1	1.1	1.2	1.2	1.4	1.5	1.6	100%
BBC2.6	0.15	7	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.6	100%
COL0.0	0.15	2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	100%
BBC1.6	0.15	7	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	100%
Nitrogen, Total as Nitrogen (mg/L)											
BBC10.4	0.38	7	1.1	1.7	2.2	2.2	2.1	2.4	3.0	3.9	100%
BBC8.8	0.38	7	0.85	1.6	2.0	1.8	1.7	2.1	2.4	2.6	100%
PET0.0	0.38	7	1.9	2.0	2.2	2.2	2.2	2.3	2.4	2.5	100%
BBC8.4	0.38	7	1.7	1.9	2.1	2.1	2.1	2.2	2.3	2.5	100%
BUR0.0	0.38	7	1.9	2.4	2.8	2.8	2.7	3.2	3.6	3.7	100%
BBC7.0	0.38	7	1.6	1.8	2.0	2.0	1.9	2.1	2.2	2.2	100%
BBC5.9	0.38	7	1.5	1.7	2.0	1.9	1.9	2.0	2.1	2.3	100%
BBC5.2	0.38	7	1.6	1.8	2.0	1.9	1.9	2.0	2.1	2.1	100%
BBC2.6	0.38	7	1.7	1.8	2.0	2.0	2.0	2.1	2.3	2.5	100%
COL0.0	0.38	2	1.8	1.8	1.9	1.9	1.9	1.9	2.0	2.0	100%
BBC1.6	0.38	7	1.7	1.7	1.9	1.9	1.9	2.1	2.2	2.2	100%
Nitrogen, Total Kjeldahl (mg/L)											
BBC10.4	-	7	0.46	0.62	0.82	0.79	0.75	0.89	1.0	1.2	100%
BBC8.8	-	7	0.24	0.50	0.58	0.59	0.55	0.65	0.82	1.0	100%
PET0.0	-	7	0.40	0.40	0.54	0.53	0.51	0.61	0.66	0.72	100%
BBC8.4	-	7	0.46	0.55	0.60	0.63	0.62	0.69	0.82	0.90	100%
BUR0.0	-	7	0.28	0.54	0.58	0.66	0.61	0.74	0.95	1.2	100%
BBC7.0	-	7	0.52	0.59	0.66	0.70	0.69	0.76	0.87	1.0	100%
BBC5.9	-	7	0.44	0.66	0.72	0.73	0.71	0.84	0.94	1.0	100%
BBC5.2	-	7	0.44	0.54	0.66	0.67	0.65	0.80	0.89	0.94	100%
BBC2.6	-	7	0.42	0.66	0.76	0.74	0.72	0.88	0.91	0.92	100%
COL0.0	-	2	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	100%
BBC1.6	-	7	0.46	0.54	0.64	0.65	0.63	0.75	0.84	0.86	100%
Orthophosphate as Phosphorus, Dissolved (mg/L)											
BBC10.4	-	7	0.06	0.06	0.07	0.08	0.08	0.09	0.11	0.12	100%
BBC8.8	-	7	0.05	0.06	0.07	0.08	0.07	0.10	0.10	0.10	100%
PET0.0	-	7	0.09	0.10	0.11	0.11	0.11	0.13	0.14	0.15	100%
BBC8.4	-	7	0.07	0.09	0.10	0.10	0.10	0.11	0.12	0.13	100%
BUR0.0	-	7	0.04	0.04	0.07	0.07	0.06	0.10	0.10	0.10	100%
BBC7.0	-	7	0.07	0.11	0.11	0.11	0.11	0.13	0.14	0.14	100%
BBC5.9	-	7	0.07	0.12	0.12	0.12	0.11	0.13	0.13	0.13	100%
BBC5.2	-	7	0.07	0.11	0.12	0.11	0.11	0.13	0.13	0.14	100%
BBC2.6	-	7	0.08	0.11	0.11	0.12	0.12	0.13	0.14	0.16	100%
COL0.0	-	2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	100%
BBC1.6	-	7	0.08	0.10	0.11	0.12	0.11	0.14	0.14	0.15	100%
pH											
BBC10.4	6.5-8.5	7	6.3	6.4	6.5	6.4	6.4	6.5	6.6	6.7	100%
BBC8.8	6.5-8.5	7	6.8	7.1	7.3	7.2	7.2	7.3	7.4	7.5	100%
PET0.0	6.5-8.5	7	7.0	7.1	7.2	7.2	7.2	7.4	7.4	7.4	100%
BBC8.4	6.5-8.5	7	7.0	7.3	7.4	7.4	7.4	7.5	7.6	7.6	100%
BUR0.0	6.5-8.5	7	6.9	7.0	7.1	7.1	7.1	7.2	7.2	7.2	100%
BBC7.0	6.5-8.5	7	7.0	7.2	7.5	7.4	7.4	7.6	7.7	7.8	100%
BBC5.9	6.5-8.5	7	6.9	7.1	7.3	7.2	7.2	7.4	7.5	7.5	100%
BBC5.2	6.5-8.5	7	7.0	7.3	7.6	7.5	7.5	7.8	7.8	7.9	100%
BBC2.6	6.5-8.5	7	7.4	7.7	7.8	7.7	7.7	7.9	7.9	7.9	100%
COL0.0	6.5-8.5	2	7.7	7.7	7.8	7.8	7.8	7.8	7.8	7.8	100%
BBC1.6	6.5-8.5	6	7.7	7.8	7.9	7.8	7.8	7.9	7.9	7.9	100%
Phosphorus, Total (mg/L)											
BBC10.4	0.04	7	0.07	0.09	0.09	0.12	0.12	0.17	0.19	0.20	100%
BBC8.8	0.04	7	0.06	0.09	0.12	0.11	0.11	0.13	0.14	0.15	100%
PET0.0	0.04	7	0.09	0.11	0.13	0.13	0.13	0.15	0.17	0.17	100%
BBC8.4	0.04	7	0.08	0.12	0.13	0.13	0.12	0.14	0.14	0.15	100%
BUR0.0	0.04	7	0.05	0.07	0.09	0.09	0.09	0.11	0.12	0.12	100%
BBC7.0	0.04	7	0.12	0.14	0.15	0.14	0.14	0.16	0.16	0.16	100%
BBC5.9	0.04	7	0.05	0.13	0.14	0.14	0.13	0.17	0.19	0.21	100%
BBC5.2	0.04	7	0.11	0.13	0.14	0.15	0.15	0.17	0.18	0.19	100%
BBC2.6	0.04	7	0.08	0.14	0.15	0.14	0.14	0.17	0.17	0.17	100%
COL0.0	0.04	2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	100%
BBC1.6	0.04	7	0.10	0.13	0.15	0.15	0.14	0.17	0.17	0.17	100%
Solids, Total Suspended (mg/L)											
BBC10.4	-	7	1.9	2.2	2.3	2.4	2.4	2.7	3.1	3.1	100%
BBC8.8	-	7	1.9	3.2	3.5	6.9	4.9	6.7	13.7	23.4	100%
PET0.0	-	7	1.3	1.9	2.4	2.9	2.6	3.9	4.8	5.0	100%
BBC8.4	-	7	2.8	3.2	3.8	3.7	3.7	4.0	4.5	5.2	100%
BUR0.0	-	7	1.0	1.0	1.7	2.0	1.7	2.2	3.3	4.7	71%
BBC7.0	-	7	2.3	3.9	8.2	7.2	6.1	10.2	11.4	11.6	100%
BBC5.9	-	7	2.0	3.1	3.1	3.4	3.3	3.5	4.4	5.8	100%
BBC5.2	-	7	2.2	3.4	4.3	5.6	4.5	4.7	9.6	16.9	100%
BBC2.6	-	7	3.3	3.5	4.6	5.4	5.0	6.6	9.1	10.1	100%
COL0.0	-	2	2.2	2.5	2.8	2.8	2.7	3.1	3.3	3.4	100%
BBC1.6	-	7	3.1	3.7	5.3	6.3	5.6	8.6	9.7	10.8	100%

Table D-1. WY2025 Base Flow Summary Statistics Table.

Station	Criteria[1]	n	Minimum	25th Percentile	Median	Mean	Geomean	75th Percentile	90th Percentile	Maximum	Percent Detected
Temperature (degrees C)											
BBC10.4	17.5	7	7.7	10.7	16.3	13.9	13.3	17.3	17.6	17.7	100%
BBC8.8	17.5	7	8.1	11.3	16.4	14.5	13.9	17.7	18.4	19.1	100%
PET0.0	17.5	7	12.8	13.6	16.1	15.7	15.5	17.8	17.9	18.0	100%
BBC8.4	17.5	7	9.4	11.9	16.2	14.7	14.3	17.7	17.8	18.0	100%
BUR0.0	17.5	7	10.5	11.7	14.3	13.7	13.5	15.9	16.0	16.1	100%
BBC7.0	17.5	7	8.7	11.9	17.0	15.6	14.8	18.8	20.9	22.1	100%
BBC5.9	17.5	7	8.3	11.0	16.7	14.7	14.0	18.2	18.7	19.5	100%
BBC5.2	17.5	7	8.4	11.2	16.9	14.9	14.2	18.3	19.5	20.3	100%
BBC2.6	17.5	7	8.1	11.3	16.8	14.6	14.0	17.8	18.7	19.5	100%
COL0.0	17.5	2	8.6	8.9	9.2	9.2	9.1	9.4	9.6	9.7	100%
BBC1.6	17.5	6	8.1	14.3	16.8	15.4	14.8	17.7	18.5	19.1	100%
Turbidity (NTU)											
BBC10.4	-	7	1.1	1.4	1.5	3.3	2.5	5.1	6.8	7.3	100%
BBC8.8	-	7	1.5	2.3	3.4	4.4	3.7	6.5	7.4	8.4	100%
PET0.0	-	7	0.90	1.1	1.3	1.2	1.2	1.4	1.4	1.4	100%
BBC8.4	-	7	1.4	1.6	2.2	2.9	2.5	4.0	5.4	5.8	100%
BUR0.0	-	7	0.74	0.94	1.1	1.4	1.3	1.9	2.4	2.4	100%
BBC7.0	-	7	2.5	3.4	3.9	3.9	3.8	4.6	4.8	4.9	100%
BBC5.9	-	7	1.8	1.9	2.0	2.9	2.7	3.9	4.7	4.8	100%
BBC5.2	-	7	1.6	1.8	2.1	3.5	2.7	3.5	6.9	10.0	100%
BBC2.6	-	7	1.9	2.2	2.7	3.6	3.2	4.7	6.3	6.8	100%
COL0.0	-	2	2.6	2.9	3.1	3.1	3.1	3.3	3.5	3.6	100%
BBC1.6	-	7	2.0	2.2	3.4	3.9	3.4	4.9	6.8	7.8	100%

C = Celsius; mg/L = milligram/L; mL = milliliter; MST = Microbial Source Tracking; NTU = nephelometric turbidity units; MPN = Most probable number

[1] Criteria outlined in Main Text Table 4

Table D-2. WY2025 Storm Flow Summary Statistics Table.

Station	Criteria[1]	n	Minimum	25th Percentile	Median	Mean	Geomean	75th Percentile	90th Percentile	Maximum	Percent Detected
Conductivity (µS/cm)											
BBC10.4	-	5	108	122	149	139	137	150	160	166	100%
BBC8.8	-	5	109	125	147	140	139	157	159	161	100%
PET0.0	-	5	139	154	175	173	171	193	199	202	100%
BBC8.4	-	5	117	129	161	148	147	164	168	170	100%
BUR0.0	-	5	51.5	57.8	76.8	87.7	80.0	86.7	134	166	100%
BBC7.0	-	5	96.8	133	140	134	132	145	152	157	100%
BBC5.9	-	5	91.1	131	153	140	137	154	165	172	100%
BBC5.2	-	5	86.5	129	151	137	134	154	161	166	100%
BBC2.6	-	5	72.1	137	140	133	128	152	158	163	100%
COL0.0	-	4	50.9	86.2	100	88.6	85.2	102	103	104	100%
BBC1.6	-	5	72.7	128	142	129	124	150	151	152	100%
Copper, Dissolved (µg/L)											
BBC10.4	-	5	0.92	1.1	1.2	1.2	1.2	1.3	1.3	1.3	100%
BBC8.8	-	5	0.88	1.0	1.3	1.4	1.3	1.4	2.0	2.5	100%
PET0.0	-	5	1.2	1.3	1.6	1.5	1.5	1.6	1.7	1.7	100%
BBC8.4	-	5	1.2	1.3	1.4	1.4	1.4	1.5	1.7	1.8	100%
BUR0.0	-	5	1	1.4	1.7	1.8	1.7	2.0	2.5	2.8	100%
BBC7.0	-	5	1.3	1.4	1.4	1.5	1.5	1.5	1.8	2.0	100%
BBC5.9	-	5	1.3	1.3	1.4	1.5	1.5	1.5	1.9	2.1	100%
BBC5.2	-	5	1.2	1.4	1.5	1.5	1.5	1.5	1.7	1.9	100%
BBC2.6	-	5	1.4	1.5	1.5	1.5	1.5	1.5	1.6	1.6	100%
COL0.0	-	4	2.7	2.8	3.0	3.0	2.9	3.1	3.1	3.2	100%
BBC1.6	-	5	1.4	1.6	1.7	1.7	1.7	1.8	1.8	1.8	100%
Copper, Total (µg/L)											
BBC10.4	-	5	1.6	1.9	1.9	2.3	2.2	2.4	3.1	3.6	100%
BBC8.8	-	5	1.3	1.4	1.5	1.8	1.7	2.3	2.3	2.4	100%
PET0.0	-	5	3.4	4.1	6.0	6.8	5.9	6.2	11.2	14.5	100%
BBC8.4	-	5	2.0	2.9	3.4	3.6	3.4	3.6	5.2	6.4	100%
BUR0.0	-	5	1.5	2.8	4.4	6.7	4.4	4.8	13.9	19.9	100%
BBC7.0	-	5	2.3	2.3	2.9	4.2	3.7	5.4	7.1	8.3	100%
BBC5.9	-	5	2.1	2.6	2.7	2.8	2.7	2.8	3.3	3.7	100%
BBC5.2	-	5	2.1	2.5	2.7	2.8	2.8	3.2	3.5	3.8	100%
BBC2.6	-	5	2.2	2.4	3.1	5.2	4.2	8.2	9.2	9.9	100%
COL0.0	-	4	5.0	7.5	8.9	9.5	8.8	10.9	13.5	15.3	100%
BBC1.6	-	5	2.4	3.0	4.0	5.2	4.6	7.8	8.4	8.9	100%
Dissolved Oxygen (mg/L)											
BBC10.4	10	5	5.4	6.6	7.0	7.0	6.9	7.8	7.9	8.0	100%
BBC8.8	10	5	8.9	9.2	9.7	9.7	9.7	10.3	10.4	10.5	100%
PET0.0	10	5	8.1	9.0	9.2	9.2	9.1	9.6	9.8	10.0	100%
BBC8.4	10	5	8.7	9.6	9.9	9.7	9.7	10.0	10.2	10.4	100%
BUR0.0	10	5	9.3	10.4	10.6	10.4	10.4	10.8	11.0	11.2	100%
BBC7.0	10	5	8.5	9.0	9.4	9.5	9.5	10.4	10.4	10.4	100%
BBC5.9	10	5	7.8	8.2	9.0	8.9	8.9	9.5	10.0	10.3	100%
BBC5.2	10	5	9.5	9.6	9.9	10.1	10.1	10.2	10.8	11.2	100%
BBC2.6	10	5	10.1	10.6	10.7	10.8	10.8	10.9	11.4	11.7	100%
COL0.0	10	4	10.9	11.2	11.5	11.5	11.5	11.8	12.0	12.1	100%
BBC1.6	10	5	10.3	10.7	10.9	10.9	10.9	11.0	11.5	11.8	100%
Dissolved Oxygen Saturation (%)											
BBC10.4	-	5	49.0	59.9	60.3	61.0	60.6	67.5	67.9	68.2	100%
BBC8.8	-	5	80.1	80.3	85.7	85.5	85.4	89.4	91.0	92.0	100%
PET0.0	-	5	78.2	83.7	87.5	85.0	85.0	87.6	88.0	88.2	100%
BBC8.4	-	5	80.6	83.7	87.7	86.6	86.5	89.5	90.7	91.5	100%
BUR0.0	-	5	85.4	91.0	93.0	91.3	91.2	93.0	93.5	93.9	100%
BBC7.0	-	5	78.3	78.7	87.0	84.6	84.5	87.8	90.0	91.4	100%
BBC5.9	-	5	71.0	71.7	82.7	79.2	78.9	83.8	85.5	86.7	100%
BBC5.2	-	5	84.0	87.2	90.3	89.4	89.3	91.5	92.9	93.8	100%
BBC2.6	-	5	92.4	94.3	94.8	95.5	95.5	97.6	98.0	98.3	100%
COL0.0	-	4	98.7	98.8	99.8	99.8	99.8	100.8	101.0	101.1	100%
BBC1.6	-	5	94.6	95.7	96.1	96.9	96.9	98.8	99.2	99.4	100%
E. coli (MPN/100 mL)											
BBC10.4	100-320	5	60.2	111	185	181	154	205	289	345	100%
BBC8.8	100-320	5	78.9	86.0	90.8	93.7	93.1	105	107	108	100%
PET0.0	100-320	5	40.4	88.2	140	152	124	228	248	261	100%
BBC8.4	100-320	5	73.3	83.3	95.9	96.3	94.7	106	116	123	100%
BUR0.0	100-320	5	225	276	613	817	594	980	1586	1990	100%
BBC7.0	100-320	5	179	192	201	299	271	436	467	488	100%
BBC5.9	100-320	5	153	161	201	224	214	276	307	328	100%
BBC5.2	100-320	5	126	145	166	205	191	260	300	326	100%
BBC2.6	100-320	5	172	192	308	326	293	345	506	613	100%
COL0.0	100-320	4	240	1553	2205	1768	1293	2420	2420	2420	100%
BBC1.6	100-320	5	130	201	365	519	386	921	956	980	100%
Hardness, Total as CaCO3 (mg/L)											
BBC10.4	-	5	46.4	48.0	60.2	57.1	56.5	64.4	65.6	66.4	100%
BBC8.8	-	5	42.8	44.0	60.8	55.1	54.2	62.0	64.2	65.7	100%
PET0.0	-	5	52.0	58.8	66.9	66.5	65.6	71.2	78.6	83.6	100%
BBC8.4	-	5	45.6	46.4	68.4	60.0	58.9	69.7	69.9	70.0	100%
BUR0.0	-	5	20.4	27.6	29.6	36.1	32.6	30.7	55.7	72.4	100%
BBC7.0	-	5	35.2	48.0	56.4	53.2	52.0	60.6	63.6	65.6	100%
BBC5.9	-	5	32.4	48.0	58.0	54.7	52.8	66.0	67.7	68.9	100%
BBC5.2	-	5	38.4	46.4	57.6	56.7	55.1	63.2	72.1	78.1	100%
BBC2.6	-	5	34.0	50.4	62.8	56.8	55.0	65.2	69.1	71.7	100%
COL0.0	-	4	30.0	35.4	40.2	38.6	38.1	43.4	43.6	43.8	100%
BBC1.6	-	5	35.6	47.6	61.2	55.4	53.9	61.6	67.2	70.9	100%
MST - All Sources (GenBac; copies/100 mL)											
BBC10.4	-	3	186751	248001	309250	374807	331086	468835	564586	628420	100%
BBC8.8	-	3	154791	206490	258189	261876	246033	315418	349756	372648	100%
PET0.0	-	3	58427	75375	92323	92554	88134	109617	119994	126912	100%
BBC8.4	-	3	151080	179436	207793	256595	234528	309353	370289	410913	100%
BUR0.0	-	3	232030	272964	313897	528437	423028	676640	894286	1039384	100%
BBC7.0	-	3	73078	117389	161700	238007	178245	320472	415735	479244	100%
BBC5.9	-	3	131618	184651	237683	298316	254294	381664	468053	525645	100%
BBC5.2	-	3	60851	131438	202025	233943	175400	320489	391567	438952	100%
BBC2.6	-	3	104582	135868	167154	189939	173368	232617	271895	298081	100%
COL0.0	-	3	22689	70463	118238	92850	71738	127930	133746	137623	100%
BBC1.6	-	3	125308	140053	154797	283670	222896	362851	487683	570904	100%
MST - Bird (GFD; copies/100 mL)											
BBC10.4	-	3	683	1239	1795	3879	2240	5477	7687	9160	100%
BBC8.8	-	3	712	1067	1422	2878	1874	3960	5483	6499	100%
PET0.0	-	3	242	244	246	382	339	451	574	656	100%
BBC8.4	-	3	801	911	1021	2776	1746	3764	5409	6506	100%
BUR0.0	-	3	85.6	495	904	1001	538	1459	1792	2014	100%
BBC7.0	-	3	393	451	509	2624	1117	3740	5679	6972	100%
BBC5.9	-	3	984	1034	1085	3244	2015	4374	6347	7663	100%
BBC5.2	-	3	758	763	768	2543	1526	3436	5037	6104	100%
BBC2.6	-	3	607	843	1079	1057	990	1282	1403	1484	100%
COL0.0	-	3	940	957	974	1053	1045	1110	1192	1247	100%
BBC1.6	-	3	380	613	847	964	812	1256	1501	1665	100%

Table D-2. WY2025 Storm Flow Summary Statistics Table.

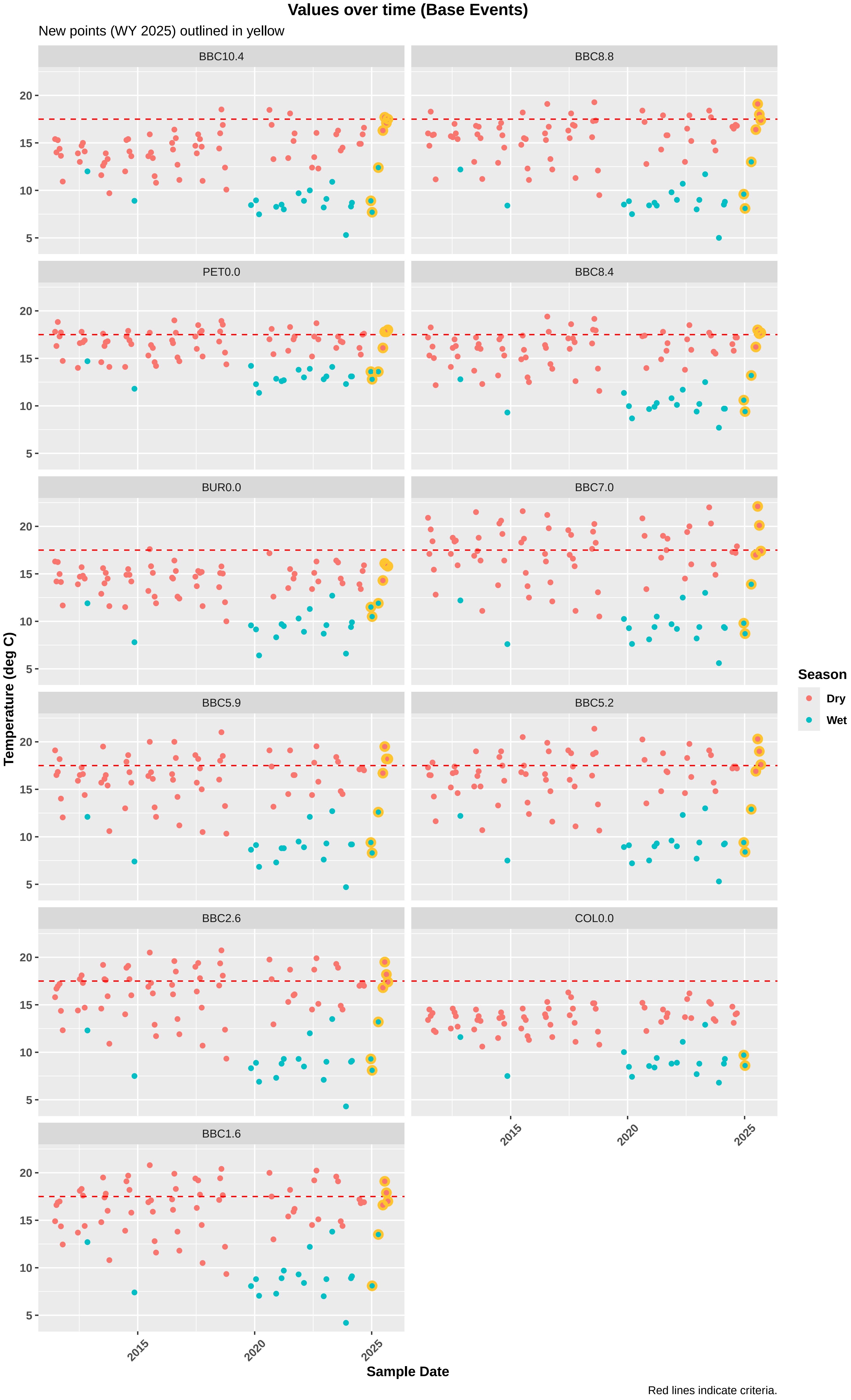
Station	Criteria[1]	n	Minimum	25th Percentile	Median	Mean	Geomean	75th Percentile	90th Percentile	Maximum	Percent Detected
MST - Cow (CowM3; copies/100 mL)											
BBC10.4	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC8.8	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
PET0.0	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC8.4	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BUR0.0	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC7.0	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC5.9	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC5.2	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC2.6	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
COL0.0	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
BBC1.6	-	3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	0%
MST - Dog (DG37; copies/100 mL)											
BBC10.4	-	3	48.7	66.0	83.3	82.7	77.8	100	110	116	100%
BBC8.8	-	3	24.4	48.7	72.9	67.0	56.9	88.4	97.6	104	67%
PET0.0	-	3	31.5	42.7	53.9	58.8	53.6	72.4	83.5	90.9	100%
BBC8.4	-	3	23.5	25.1	26.6	56.6	42.1	73.1	101	120	100%
BUR0.0	-	3	31.4	51.9	72.4	72.2	63.5	92.6	105	113	100%
BBC7.0	-	3	19.1	29.5	39.9	43.2	37.8	55.3	64.5	70.7	100%
BBC5.9	-	3	12.4	78.4	144	102	64.5	147	149	150	100%
BBC5.2	-	3	33.4	35.5	37.5	76.7	58.4	98.3	135	159	100%
BBC2.6	-	3	23.8	31.5	39.1	60.4	47.9	78.7	102	118	100%
COL0.0	-	3	18.4	21.4	24.4	28.8	27.0	34.0	39.8	43.6	67%
BBC1.6	-	3	31.6	37.9	44.2	50.1	47.1	59.4	68.5	74.6	100%
MST - Human (HF183; copies/100 mL)											
BBC10.4	-	3	55.0	62.8	70.5	92.6	83.9	111	136	152	100%
BBC8.8	-	3	55.2	104	153	297	179	417	576	682	100%
PET0.0	-	3	88.2	96.1	104	111	109	123	134	141	100%
BBC8.4	-	3	73.3	119	165	289	197	397	537	630	100%
BUR0.0	-	3	415	958	1501	2567	1533	3643	4928	5784	100%
BBC7.0	-	3	26.6	83.2	140	154	103	218	265	296	100%
BBC5.9	-	3	98.4	160	222	196	180	245	258	267	100%
BBC5.2	-	3	53.4	117	182	144	124	189	194	197	100%
BBC2.6	-	3	65.4	71.8	78.2	123	105	151	195	224	100%
COL0.0	-	3	91.9	92.0	92.0	338	191	461	682	830	100%
BBC1.6	-	3	87.1	87.8	88.4	109	105	120	139	152	100%
Nitrate + Nitrite as Nitrogen (mg/L)											
BBC10.4	0.15	5	0.85	0.89	1.1	1.1	1.1	1.4	1.4	1.5	100%
BBC8.8	0.15	5	0.91	0.93	1.0	1.1	1.1	1.3	1.5	1.6	100%
PET0.0	0.15	5	1.0	1.2	1.3	1.3	1.3	1.4	1.5	1.6	100%
BBC8.4	0.15	5	1.0	1.0	1.0	1.2	1.1	1.4	1.4	1.5	100%
BUR0.0	0.15	5	0.41	0.53	0.61	0.88	0.72	0.69	1.6	2.2	100%
BBC7.0	0.15	5	0.65	0.70	0.93	0.89	0.87	1.1	1.1	1.1	100%
BBC5.9	0.15	5	0.64	0.70	0.93	0.93	0.90	1.0	1.2	1.4	100%
BBC5.2	0.15	5	0.60	0.75	0.92	0.93	0.90	1.1	1.2	1.3	100%
BBC2.6	0.15	5	0.41	0.88	1.0	0.90	0.85	1.1	1.1	1.2	100%
COL0.0	0.15	4	0.18	0.38	0.48	0.43	0.39	0.53	0.56	0.58	100%
BBC1.6	0.15	5	0.38	0.79	0.87	0.85	0.79	1.0	1.1	1.2	100%
Nitrogen, Total as Nitrogen (mg/L)											
BBC10.4	0.38	5	1.7	1.9	1.9	2.0	2.0	1.9	2.3	2.6	100%
BBC8.8	0.38	5	1.6	1.8	2.0	2.0	2.0	2.1	2.3	2.5	100%
PET0.0	0.38	5	1.5	1.9	2.1	1.9	1.9	2.1	2.1	2.2	100%
BBC8.4	0.38	5	1.8	2.0	2.0	2.0	2.0	2.1	2.2	2.2	100%
BUR0.0	0.38	5	1.3	1.3	1.4	1.7	1.7	1.9	2.3	2.6	100%
BBC7.0	0.38	5	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.9	100%
BBC5.9	0.38	5	1.4	1.5	1.7	1.7	1.6	1.7	2.0	2.2	100%
BBC5.2	0.38	5	1.4	1.5	1.6	1.7	1.7	1.6	2.1	2.3	100%
BBC2.6	0.38	5	1.5	1.7	1.7	1.9	1.8	1.7	2.3	2.7	100%
COL0.0	0.38	4	0.92	1.0	1.1	1.1	1.1	1.2	1.3	1.4	100%
BBC1.6	0.38	5	1.5	1.5	1.6	1.7	1.7	1.7	2.1	2.3	100%
Nitrogen, Total Kjeldahl (mg/L)											
BBC10.4	-	5	0.56	0.76	0.82	0.87	0.84	1.1	1.1	1.1	100%
BBC8.8	-	5	0.70	0.76	0.80	0.85	0.84	0.90	1.0	1.1	100%
PET0.0	-	5	0.44	0.50	0.64	0.64	0.62	0.74	0.84	0.90	100%
BBC8.4	-	5	0.64	0.78	0.80	0.86	0.85	1.0	1.0	1.1	100%
BUR0.0	-	5	0.44	0.62	0.82	0.83	0.77	0.82	1.2	1.5	100%
BBC7.0	-	5	0.54	0.68	0.82	0.78	0.76	0.92	0.93	0.94	100%
BBC5.9	-	5	0.62	0.66	0.74	0.74	0.73	0.82	0.83	0.84	100%
BBC5.2	-	5	0.56	0.66	0.74	0.75	0.74	0.78	0.92	1.0	100%
BBC2.6	-	5	0.62	0.78	0.78	1.0	0.92	1.1	1.4	1.5	100%
COL0.0	-	4	0.58	0.63	0.69	0.69	0.68	0.75	0.77	0.78	100%
BBC1.6	-	5	0.62	0.66	0.72	0.85	0.82	1.1	1.1	1.1	100%
Orthophosphate as Phosphorus, Dissolved (mg/L)											
BBC10.4	-	5	0.07	0.07	0.08	0.09	0.09	0.12	0.12	0.12	100%
BBC8.8	-	5	0.06	0.07	0.08	0.08	0.08	0.10	0.10	0.10	100%
PET0.0	-	5	0.06	0.06	0.08	0.08	0.08	0.09	0.09	0.09	100%
BBC8.4	-	5	0.06	0.08	0.09	0.08	0.08	0.10	0.10	0.10	100%
BUR0.0	-	5	0.02	0.03	0.04	0.04	0.04	0.05	0.06	0.07	100%
BBC7.0	-	5	0.06	0.06	0.09	0.09	0.08	0.10	0.11	0.12	100%
BBC5.9	-	5	0.07	0.07	0.10	0.09	0.09	0.10	0.10	0.10	100%
BBC5.2	-	5	0.06	0.07	0.10	0.08	0.08	0.10	0.10	0.10	100%
BBC2.6	-	5	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10	100%
COL0.0	-	4	0.02	0.03	0.03	0.04	0.04	0.04	0.06	0.07	100%
BBC1.6	-	5	0.06	0.06	0.07	0.07	0.07	0.08	0.09	0.09	100%
pH											
BBC10.4	6.5-8.5	5	6.3	6.3	6.4	6.3	6.3	6.4	6.4	6.5	100%
BBC8.8	6.5-8.5	5	6.5	6.5	6.9	6.8	6.8	7.0	7.0	7.1	100%
PET0.0	6.5-8.5	5	6.6	6.6	6.8	6.8	6.8	6.9	7.0	7.1	100%
BBC8.4	6.5-8.5	5	6.6	6.7	6.7	6.8	6.8	7.0	7.1	7.2	100%
BUR0.0	6.5-8.5	5	6.3	6.4	6.7	6.6	6.6	6.9	6.9	7.0	100%
BBC7.0	6.5-8.5	5	6.7	6.9	7.0	7.0	7.0	7.1	7.1	7.2	100%
BBC5.9	6.5-8.5	5	6.7	6.9	7.0	6.9	6.9	7.0	7.0	7.1	100%
BBC5.2	6.5-8.5	5	6.8	7.0	7.2	7.1	7.1	7.2	7.2	7.2	100%
BBC2.6	6.5-8.5	5	6.9	7.4	7.5	7.4	7.4	7.5	7.6	7.6	100%
COL0.0	6.5-8.5	4	7.1	7.3	7.5	7.4	7.4	7.5	7.5	7.6	100%
BBC1.6	6.5-8.5	5	7.0	7.4	7.5	7.4	7.4	7.6	7.6	7.7	100%
Phosphorus, Total (mg/L)											
BBC10.4	0.04	5	0.10	0.15	0.20	0.18	0.17	0.21	0.22	0.22	100%
BBC8.8	0.04	5	0.10	0.13	0.13	0.14	0.13	0.15	0.17	0.18	100%
PET0.0	0.04	5	0.09	0.09	0.09	0.10	0.10	0.10	0.12	0.14	100%
BBC8.4	0.04	5	0.10	0.12	0.13	0.13	0.13	0.14	0.15	0.16	100%
BUR0.0	0.04	5	0.03	0.03	0.06	0.11	0.07	0.07	0.26	0.39	100%
BBC7.0	0.04	5	0.11	0.11	0.12	0.13	0.13	0.13	0.17	0.19	100%
BBC5.9	0.04	5	0.11	0.13	0.13	0.13	0.13	0.14	0.15	0.15	100%
BBC5.2	0.04	5	0.10	0.12	0.13	0.13	0.13	0.14	0.15	0.16	100%
BBC2.6	0.04	5	0.10	0.14	0.16	0.19	0.18	0.28	0.28	0.29	100%
COL0.0	0.04	4	0.10	0.12	0.13	0.12	0.12	0.14	0.14	0.14	100%
BBC1.6	0.04	5	0.10	0.16	0.25	0.21	0.19	0.26	0.27	0.27	100%

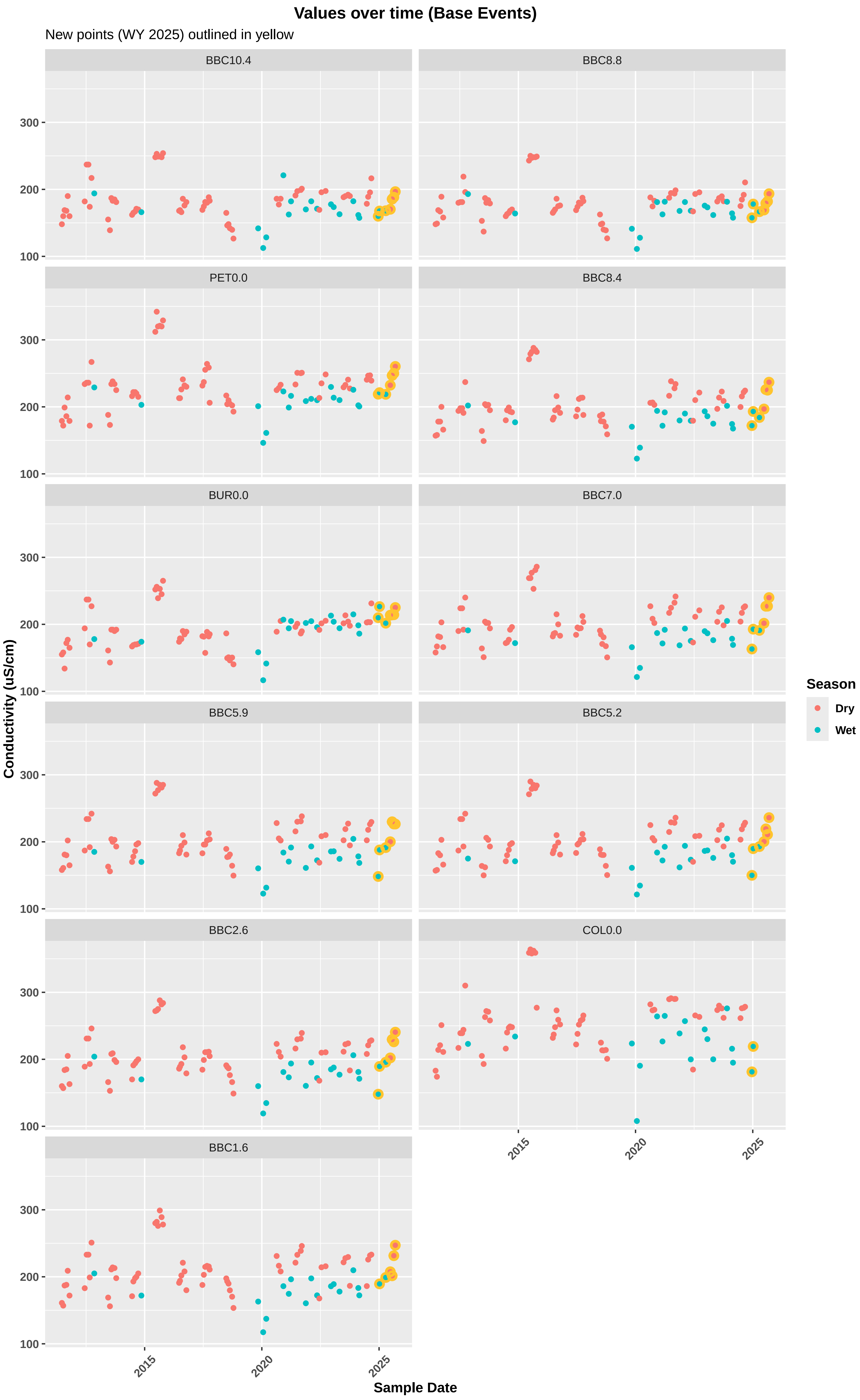
Table D-2. WY2025 Storm Flow Summary Statistics Table.

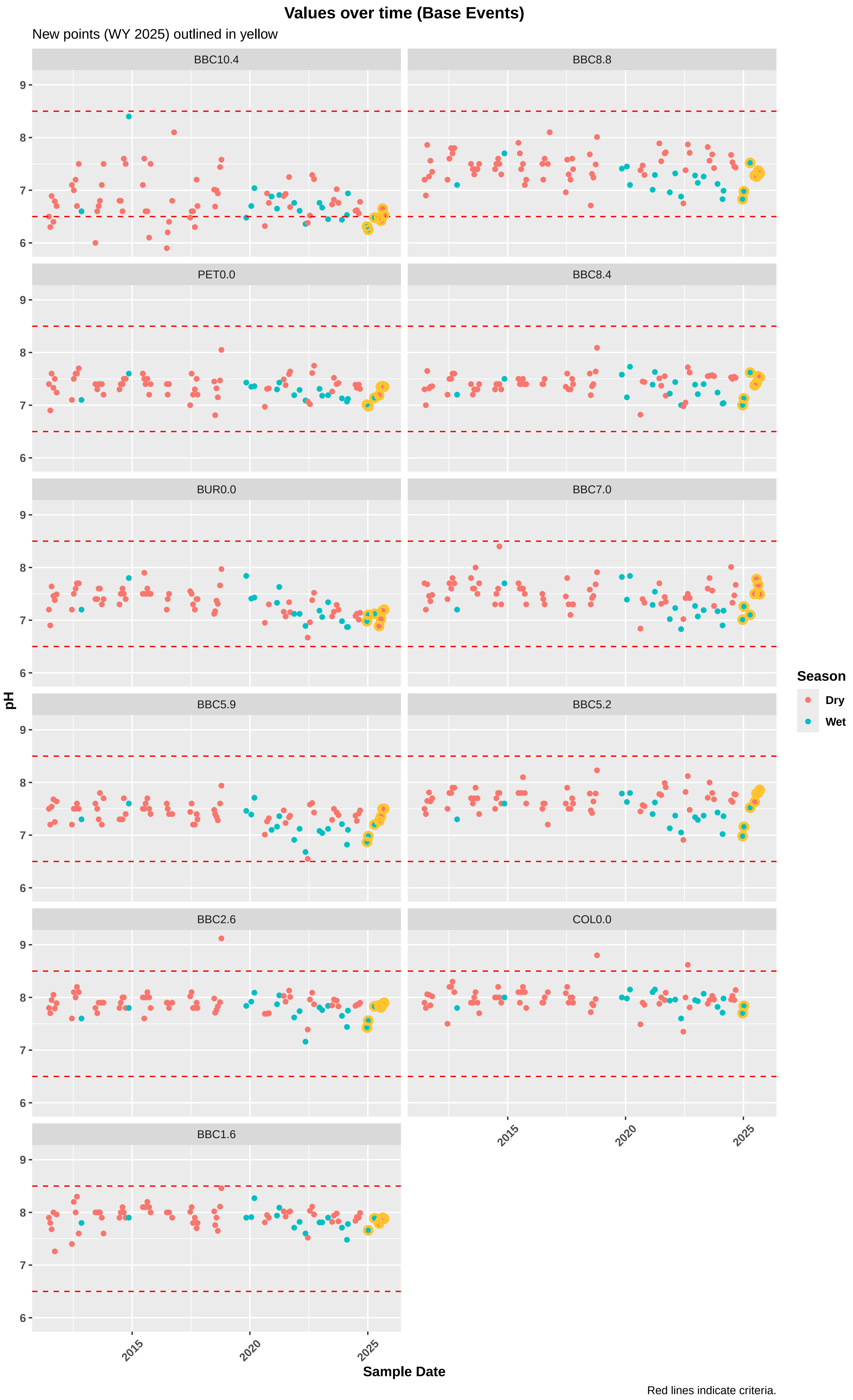
Station	Criteria[1]	n	Minimum	25th Percentile	Median	Mean	Geomean	75th Percentile	90th Percentile	Maximum	Percent Detected
Solids, Total Suspended (mg/L)											
BBC10.4	-	5	3.0	4.8	8.6	8.4	7.2	11.2	13.1	14.4	100%
BBC8.8	-	5	3.2	4.3	5.2	7.5	6.4	12.3	12.5	12.6	100%
PET0.0	-	5	1.0	2.8	6.9	7.9	4.9	7.0	15.8	21.6	80%
BBC8.4	-	5	3.1	4.2	13.1	11.5	8.8	13.2	19.7	24.0	100%
BUR0.0	-	5	1.1	2.3	16.9	33.9	10.5	24.2	84.7	125	100%
BBC7.0	-	5	4.2	4.7	5.7	17.5	10.1	16.5	40.3	56.2	100%
BBC5.9	-	5	3.6	4.4	8.9	10.2	8.1	10.8	18.3	23.3	100%
BBC5.2	-	5	3.5	4.4	8.6	12.1	9.1	18.8	22.8	25.4	100%
BBC2.6	-	5	6.3	11.1	21.4	51.6	28.2	106	110	113	100%
COL0.0	-	4	7.5	20.0	28.3	42.3	28.0	50.6	83.2	105	100%
BBC1.6	-	5	7.6	12.0	26.0	49.1	29.8	90.8	102	109	100%
Temperature (degrees C)											
BBC10.4	17.5	5	7.5	8.9	9.5	9.7	9.6	10.9	11.3	11.5	100%
BBC8.8	17.5	5	7.5	9.1	9.5	9.7	9.6	10.8	11.3	11.6	100%
PET0.0	17.5	5	9.7	11.3	12.0	12.0	11.9	13.3	13.7	13.9	100%
BBC8.4	17.5	5	8.0	9.6	10.4	10.4	10.3	11.9	12.0	12.0	100%
BUR0.0	17.5	5	7.3	8.9	8.9	9.5	9.4	11.0	11.4	11.6	100%
BBC7.0	17.5	5	8.0	9.1	9.8	10.1	10.0	11.7	11.8	11.8	100%
BBC5.9	17.5	5	7.8	9.2	9.9	10.0	9.9	11.4	11.6	11.8	100%
BBC5.2	17.5	5	7.8	9.3	9.9	10.1	10.0	11.6	11.7	11.8	100%
BBC2.6	17.5	5	7.9	9.1	9.9	10.0	9.9	11.4	11.6	11.8	100%
COL0.0	17.5	4	7.4	8.5	9.1	9.2	9.1	9.8	10.6	11.1	100%
BBC1.6	17.5	5	7.9	9.3	9.8	10.0	9.9	11.3	11.6	11.8	100%
Turbidity (NTU)											
BBC10.4	-	5	5.9	7.1	9.4	10.0	9.4	12.4	14.0	15.0	100%
BBC8.8	-	5	3.0	4.5	4.9	7.0	6.1	10.6	11.4	11.9	100%
PET0.0	-	5	1.1	1.5	6.7	5.4	3.9	6.9	9.3	10.9	100%
BBC8.4	-	5	2.6	4.0	10.1	7.5	6.5	10.2	10.5	10.7	100%
BUR0.0	-	5	2.1	4.8	18.6	25.5	12.6	20.6	57.1	81.5	100%
BBC7.0	-	5	3.6	4.6	7.5	9.6	7.8	11.8	16.9	20.3	100%
BBC5.9	-	5	3.2	3.6	8.4	7.4	6.4	8.6	11.2	13.0	100%
BBC5.2	-	5	3.8	4.5	9.0	8.7	7.6	11.4	13.3	14.6	100%
BBC2.6	-	5	5.0	6.0	12.7	20.5	14.2	33.1	40.7	45.7	100%
COL0.0	-	4	8.7	22.4	32.6	34.2	27.4	44.4	55.4	62.8	100%
BBC1.6	-	5	5.9	5.9	16.2	21.9	15.6	38.7	41.0	42.6	100%
Zinc, Dissolved (µg/L)											
BBC10.4	-	5	7.7	9.6	21.2	41.8	23.3	31.7	96.1	139	100%
BBC8.8	-	5	9.2	10.5	11.7	14.4	13.4	14.3	21.6	26.4	100%
PET0.0	-	5	9.5	12.0	12.0	12.7	12.5	12.9	15.4	17.0	100%
BBC8.4	-	5	9.9	11.1	12.5	13.9	13.2	12.8	18.9	23.0	100%
BUR0.0	-	5	20.8	23.9	25.2	50.6	35.2	27.9	104	155	100%
BBC7.0	-	5	17.0	18.7	20.3	21.1	20.8	21.8	25.4	27.8	100%
BBC5.9	-	5	14.1	14.8	15.6	16.8	16.6	17.5	20.1	21.8	100%
BBC5.2	-	5	12.4	15.3	15.6	16.0	15.9	16.9	18.8	20.0	100%
BBC2.6	-	5	9.3	9.9	10.4	10.9	10.9	12.2	12.6	12.9	100%
COL0.0	-	4	20.1	22.6	24.8	25.4	25.1	27.7	30.3	32.0	100%
BBC1.6	-	5	10.1	10.9	11.8	11.7	11.7	12.5	13.0	13.3	100%
Zinc, Total (µg/L)											
BBC10.4	-	5	9.8	13.4	24.7	46.7	27.9	34.6	104	151	100%
BBC8.8	-	5	12.3	14.7	16.6	18.9	18.0	20.2	26.6	30.8	100%
PET0.0	-	5	9.7	14.2	17.6	17.4	16.6	22.6	22.7	22.8	100%
BBC8.4	-	5	12.4	13.6	18.8	20.4	18.8	19.8	30.4	37.5	100%
BUR0.0	-	5	21.4	43.5	46.7	82.7	62.9	136	154	166	100%
BBC7.0	-	5	20.8	22.6	24.5	37.4	33.2	52.6	61.1	66.7	100%
BBC5.9	-	5	16.9	18.3	20.8	23.6	22.5	23.0	32.6	39.0	100%
BBC5.2	-	5	16.3	19.1	23.1	24.5	23.4	24.8	33.4	39.1	100%
BBC2.6	-	5	13.7	18.2	25.0	38.6	30.9	58.6	69.9	77.4	100%
COL0.0	-	4	35.2	54.4	63.7	63.5	60.1	72.8	84.0	91.4	100%
BBC1.6	-	5	15.7	21.1	30.1	37.8	32.5	52.3	62.8	69.8	100%

C = Celsius; mg/L = milligram/L; mL = milliliter; MST = Microbial Source Tracking; NTU = nephelometric turbidity units; MPN = Most probable number

1 Criteria outlined in Main Text Table 4


Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
20
15
10
5
2015
2020
2025
Temperature (deg C)
Sample Date
Season
● Dry
● Wet
Red lines indicate criteria.

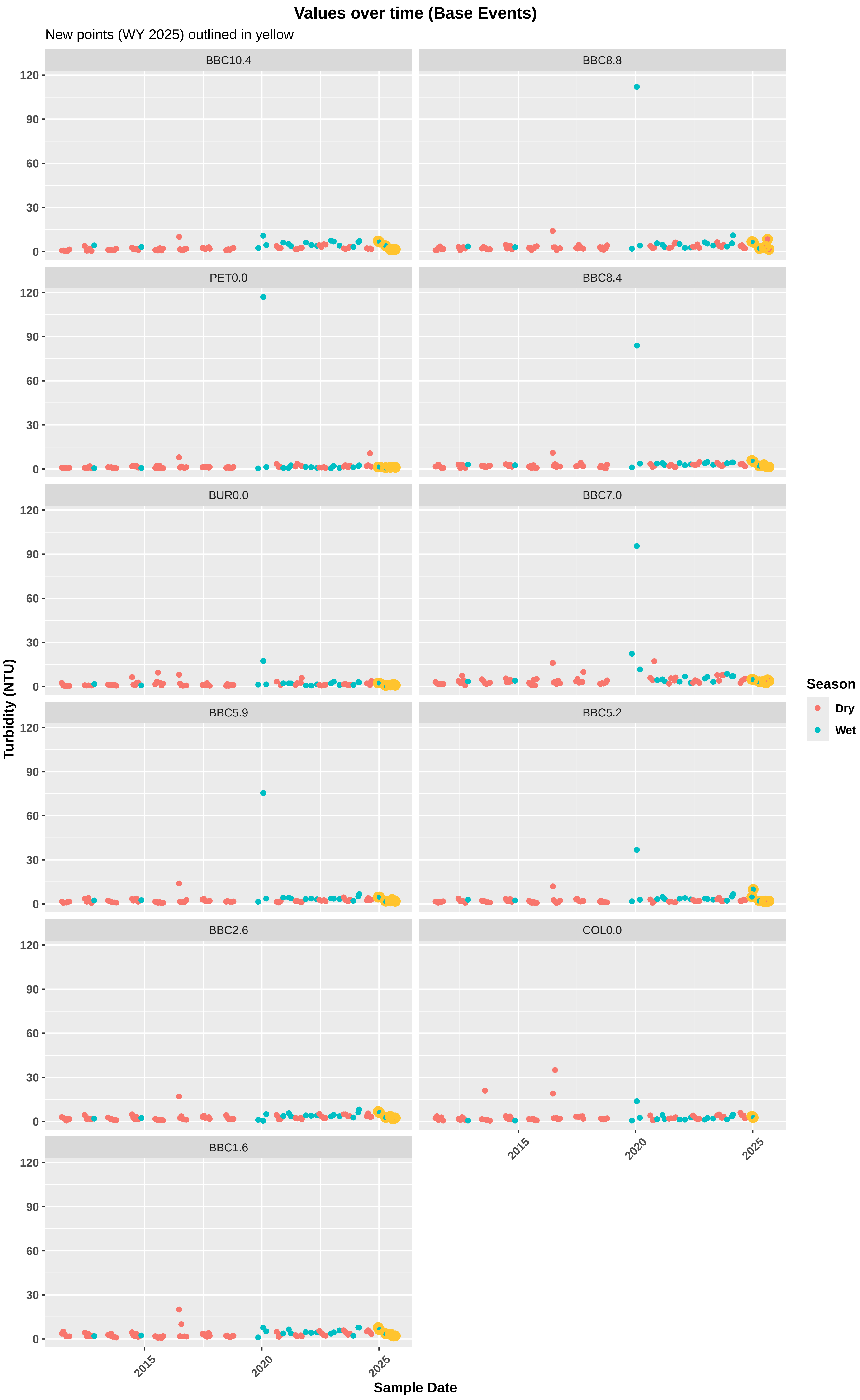

Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Conductivity (uS/cm)
100
200
300
2015
2020
2025
Sample Date
Season
Dry
Wet


Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
pH
9
8
7
6
2015
2020
2025
Sample Date
Season
Dry
Wet
Red lines indicate criteria.

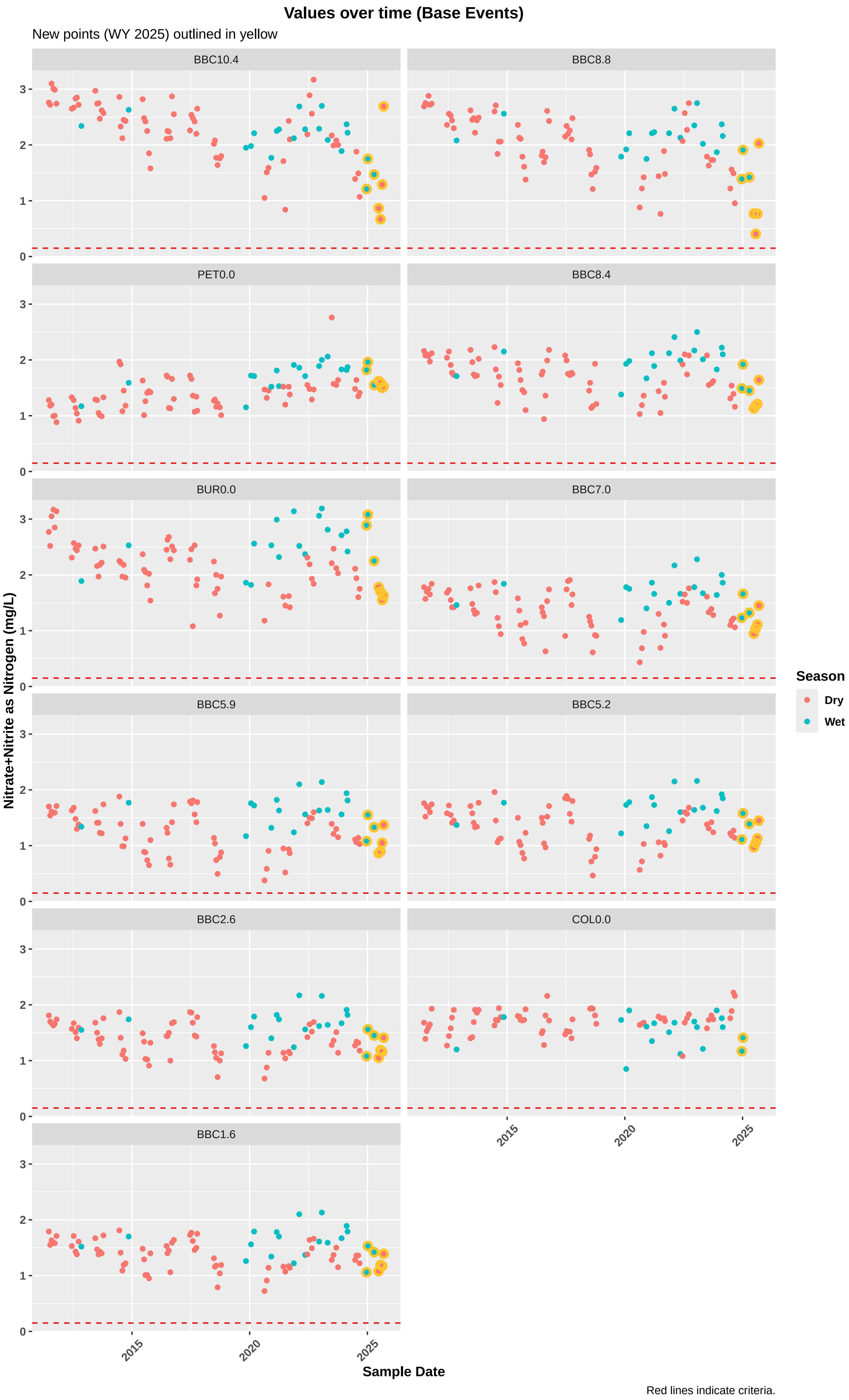
Values over time (Base Events)

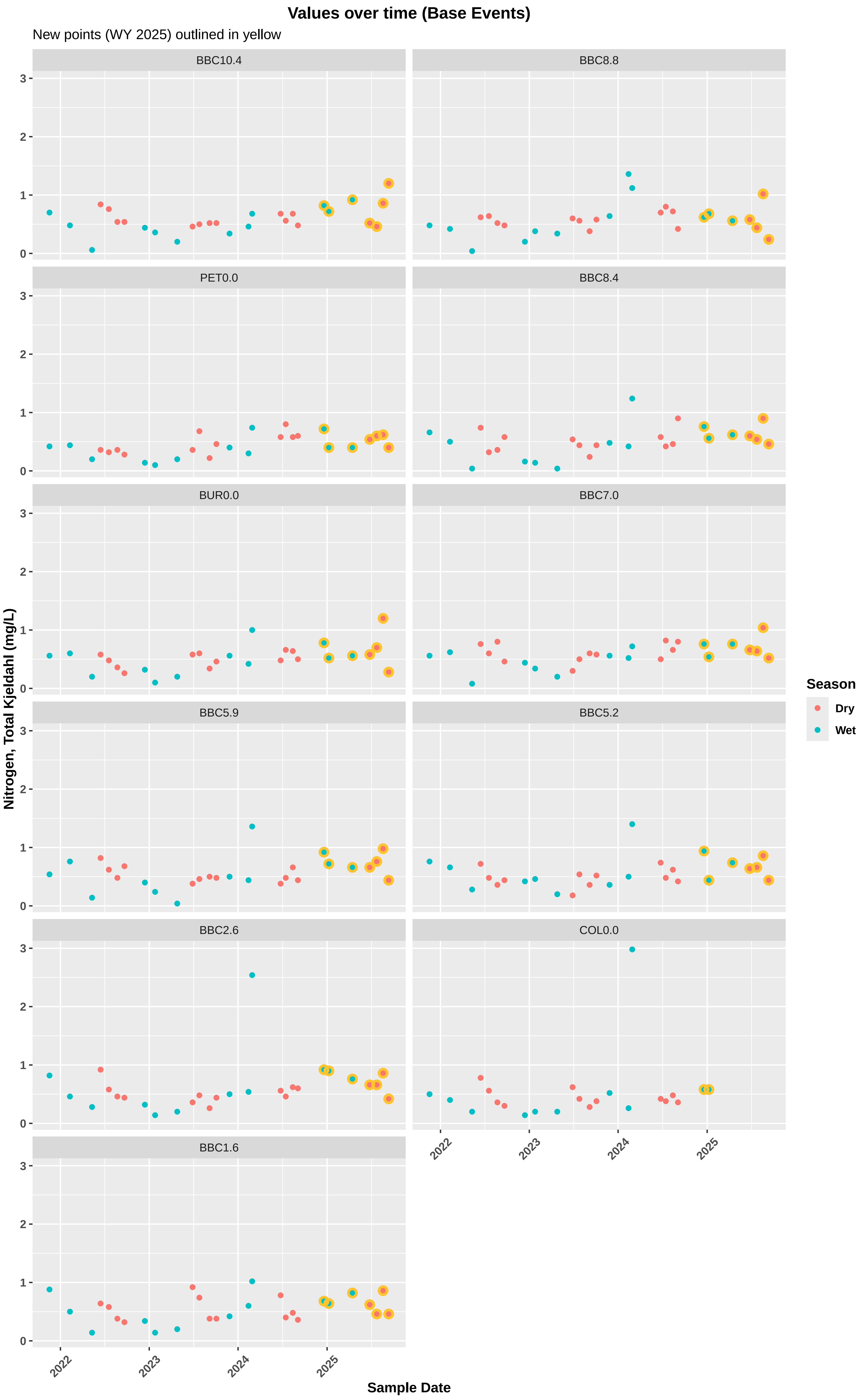
New points (WY 2025) outlined in yellow

Red lines indicate criteria.


Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
120
90
60
30
0
2015
2020
2025
Turbidity (NTU)
Sample Date
Season
● Dry
● Wet

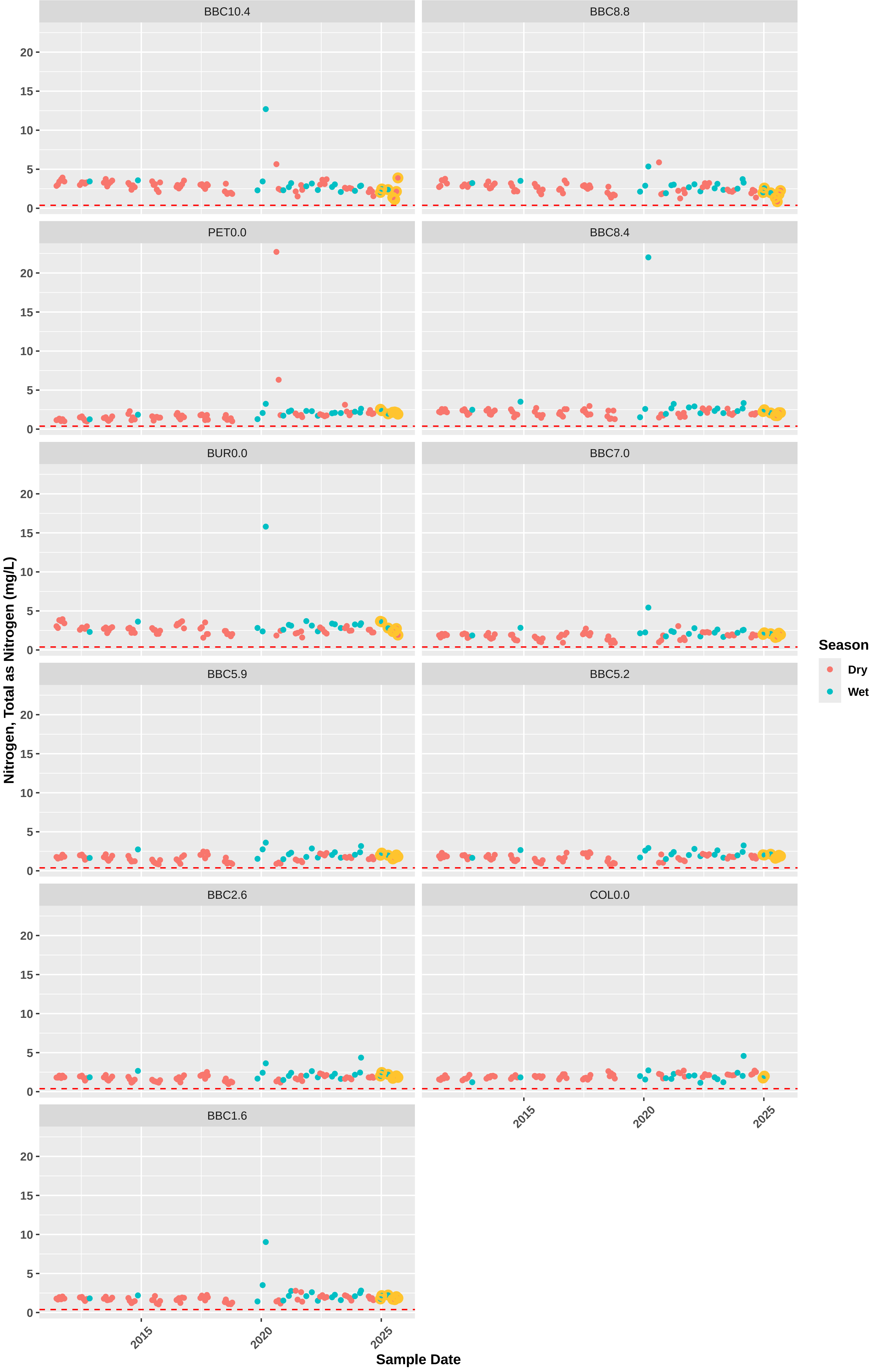

Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
60
40
20
0
Solids, Total Suspended (mg/L)
2015
2020
2025
Sample Date
Season
● Dry
● Wet


Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
0
1
2
3
2015
2020
2025
Nitrate+Nitrite as Nitrogen (mg/L)
Sample Date
Season
Dry
Wet
Red lines indicate criteria.

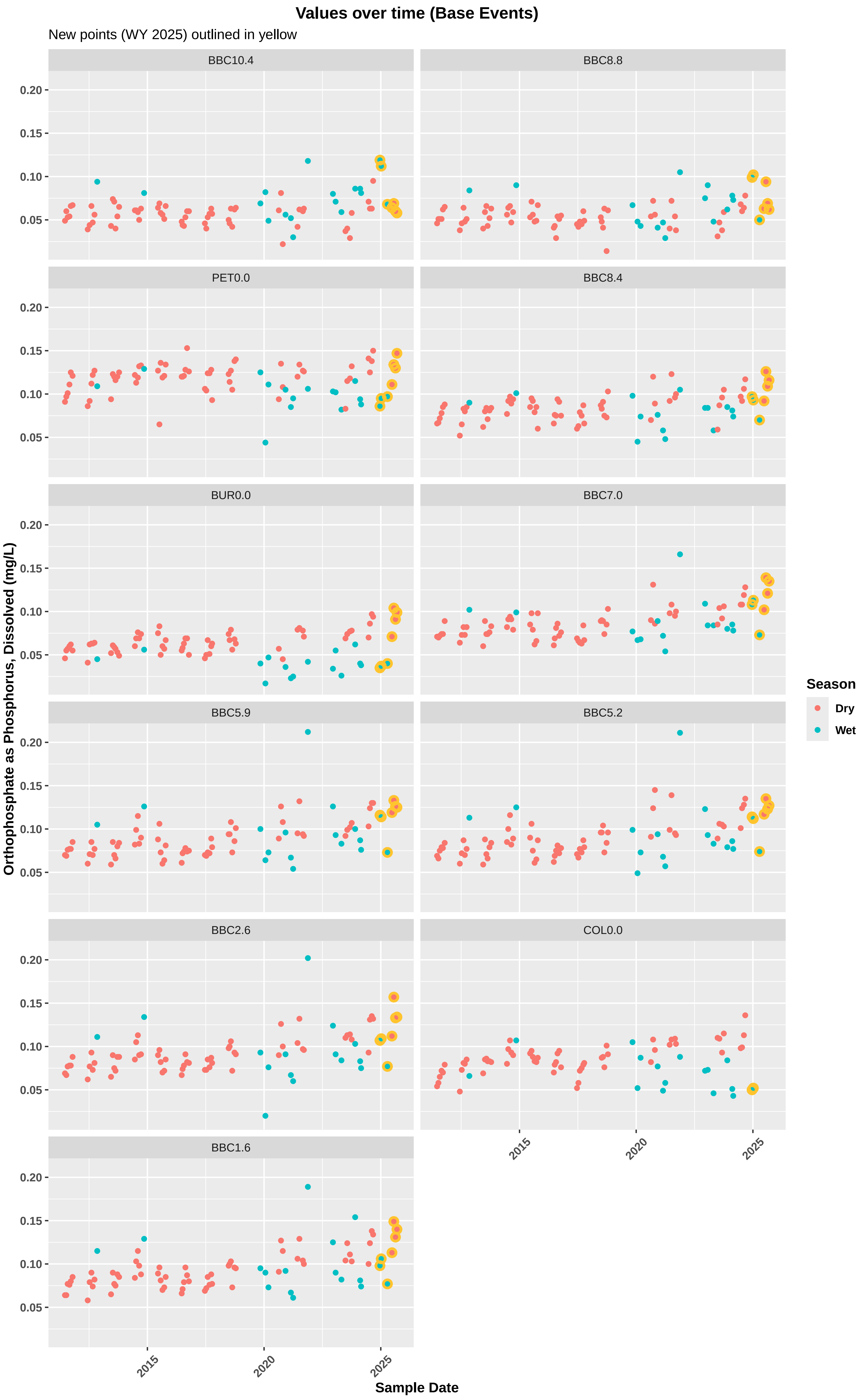

Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
0
1
2
3
2022
2023
2024
2025
Nitrogen, Total Kjeldahl (mg/L)
Sample Date
Season
Dry
Wet

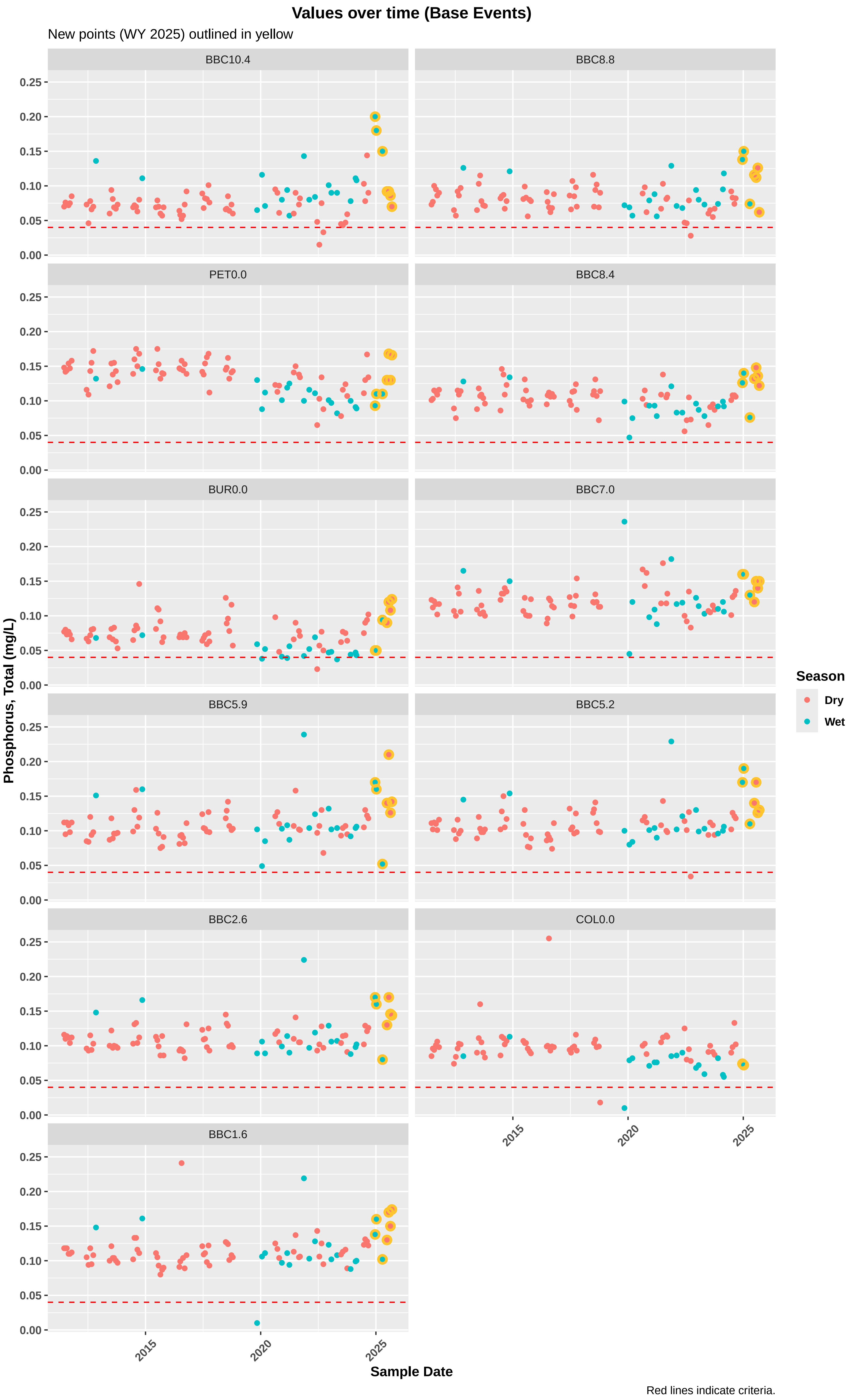
Values over time (Base Events)

New points (WY 2025) outlined in yellow



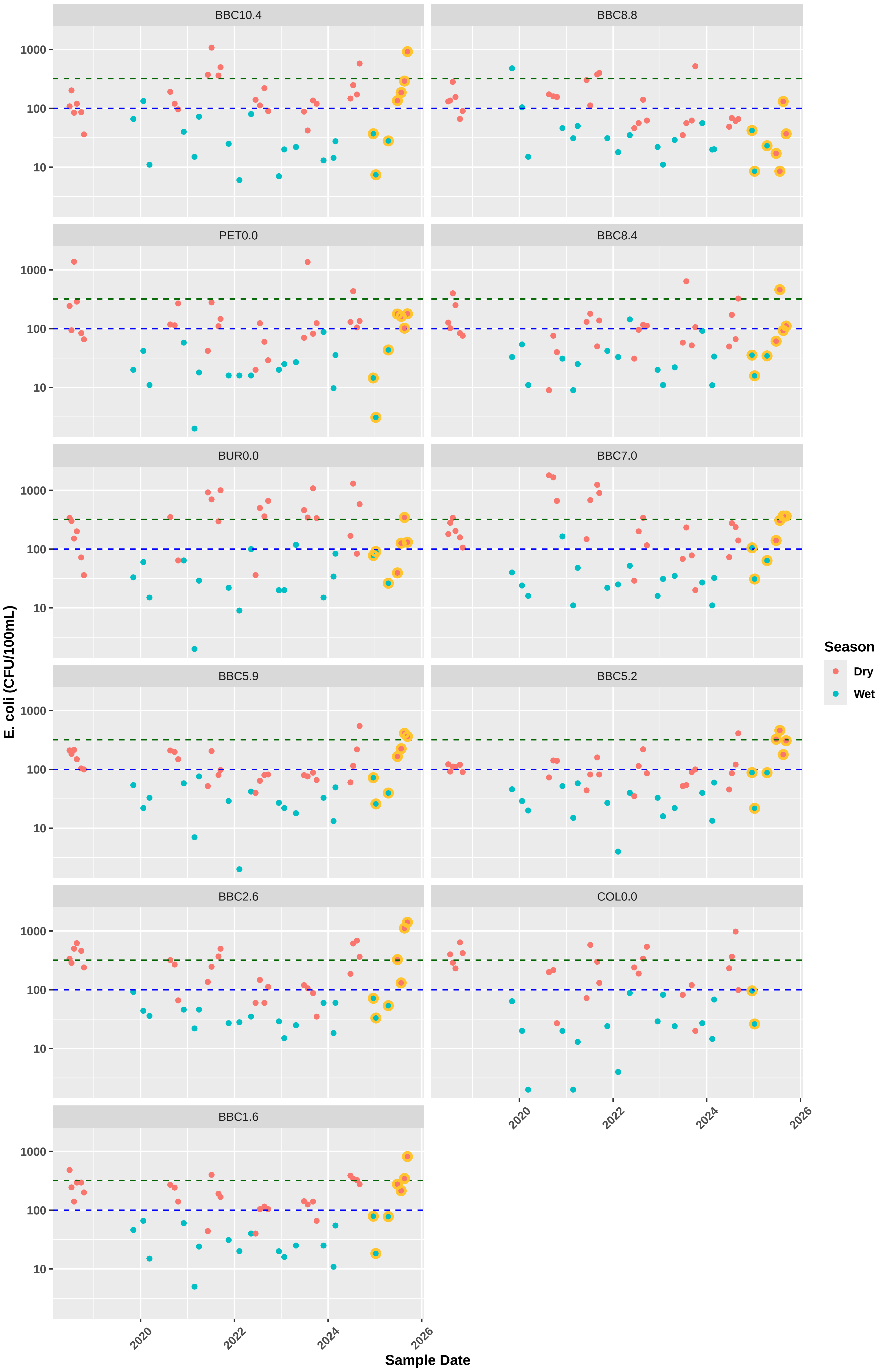
Red lines indicate criteria.


Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
0.20
0.15
0.10
0.05
Orthophosphate as Phosphorus, Dissolved (mg/L)
2015
2020
2025
Sample Date
Season
Dry
Wet


Values over time (Base Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
0.00
0.05
0.10
0.15
0.20
0.25
2015
2020
2025
Phosphorus, Total (mg/L)
Sample Date
Season
Dry
Wet
Red lines indicate criteria.

Values over time (Base Events)

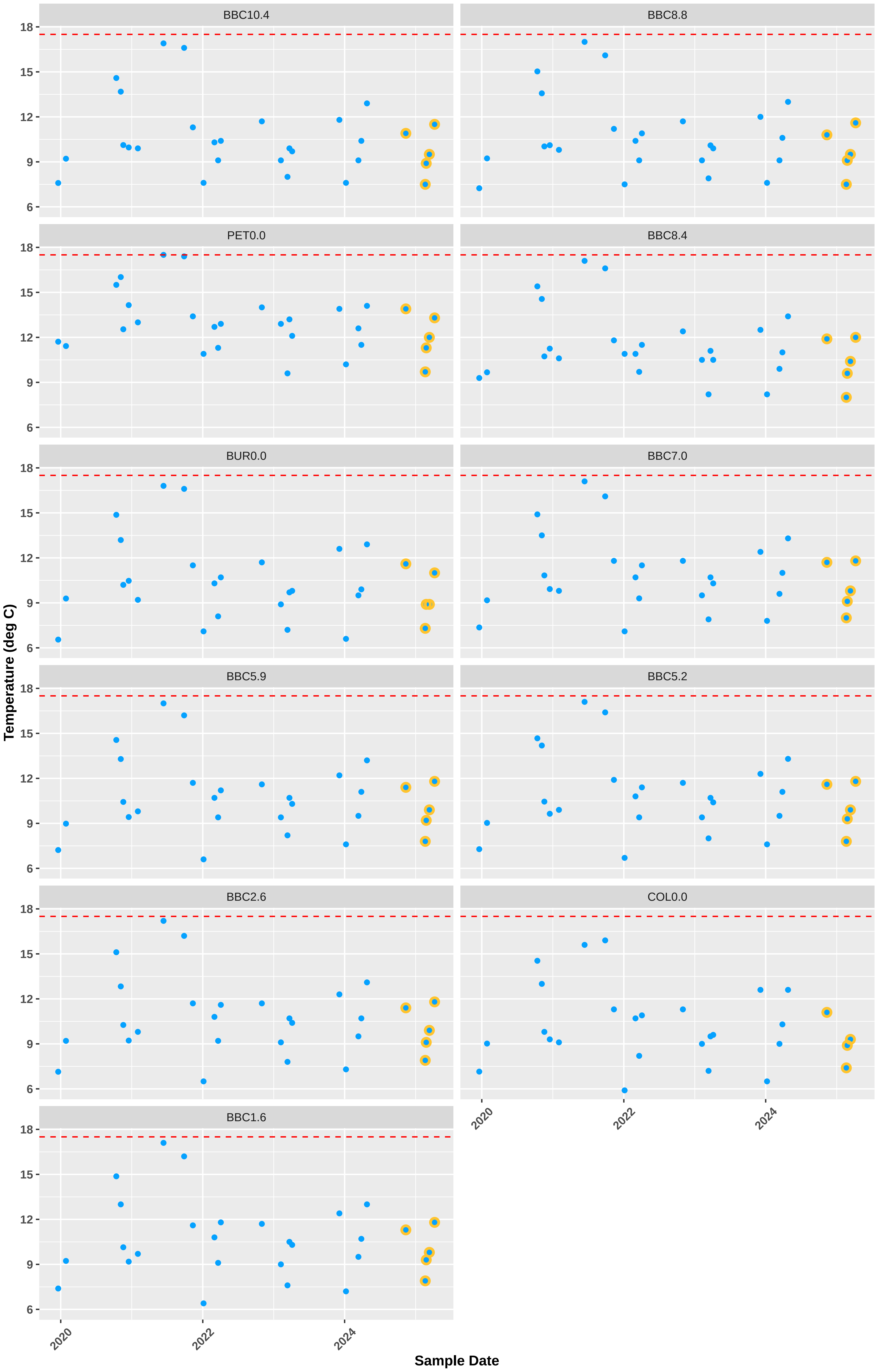
New points (WY 2025) outlined in yellow



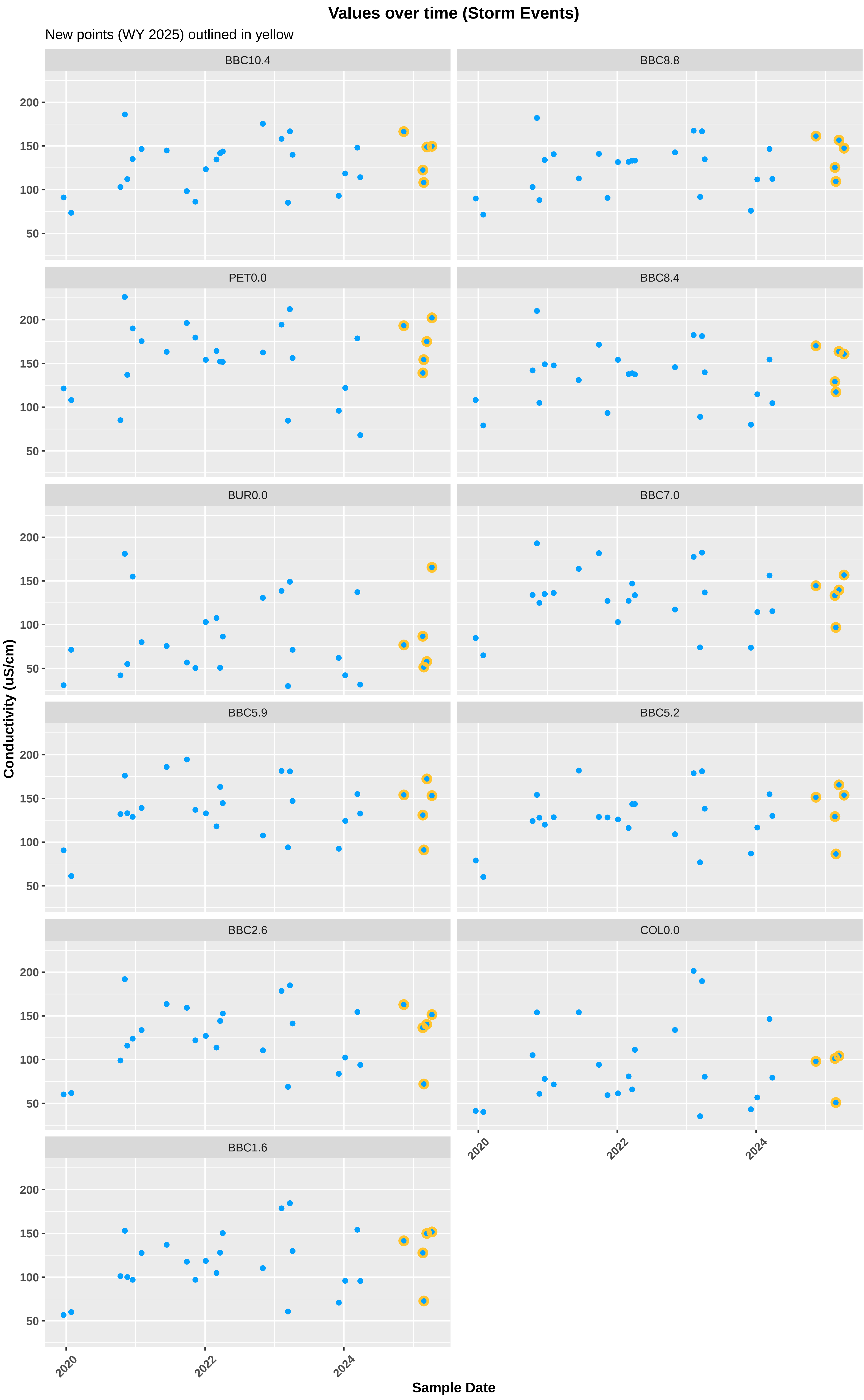
Blue lines indicate criteria for geometric mean.
Dark green lines indicate criteria for 90th percentile.

Values over time (Storm Events)

New points (WY 2025) outlined in yellow

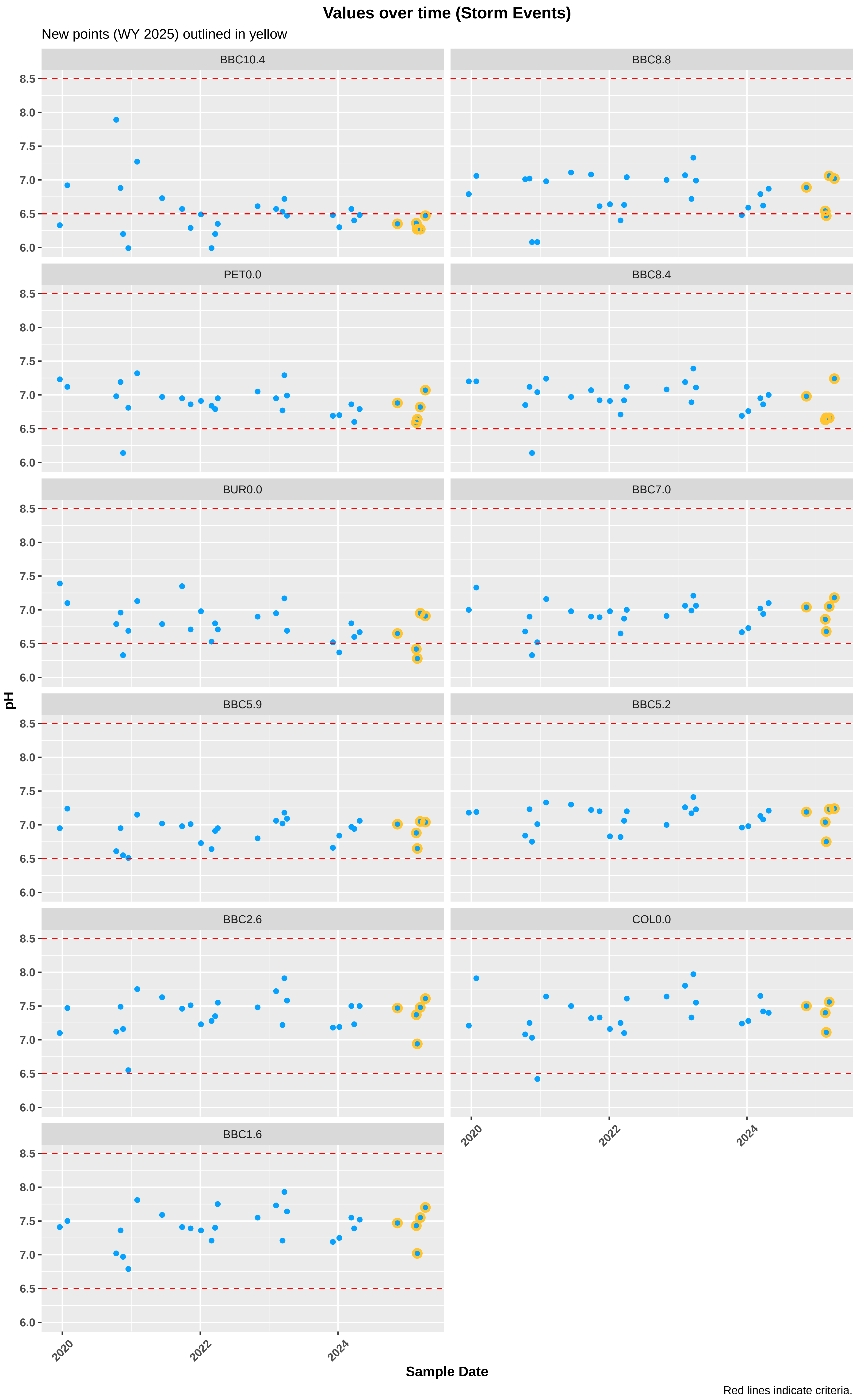


Red lines indicate criteria.



Values over time (Storm Events)

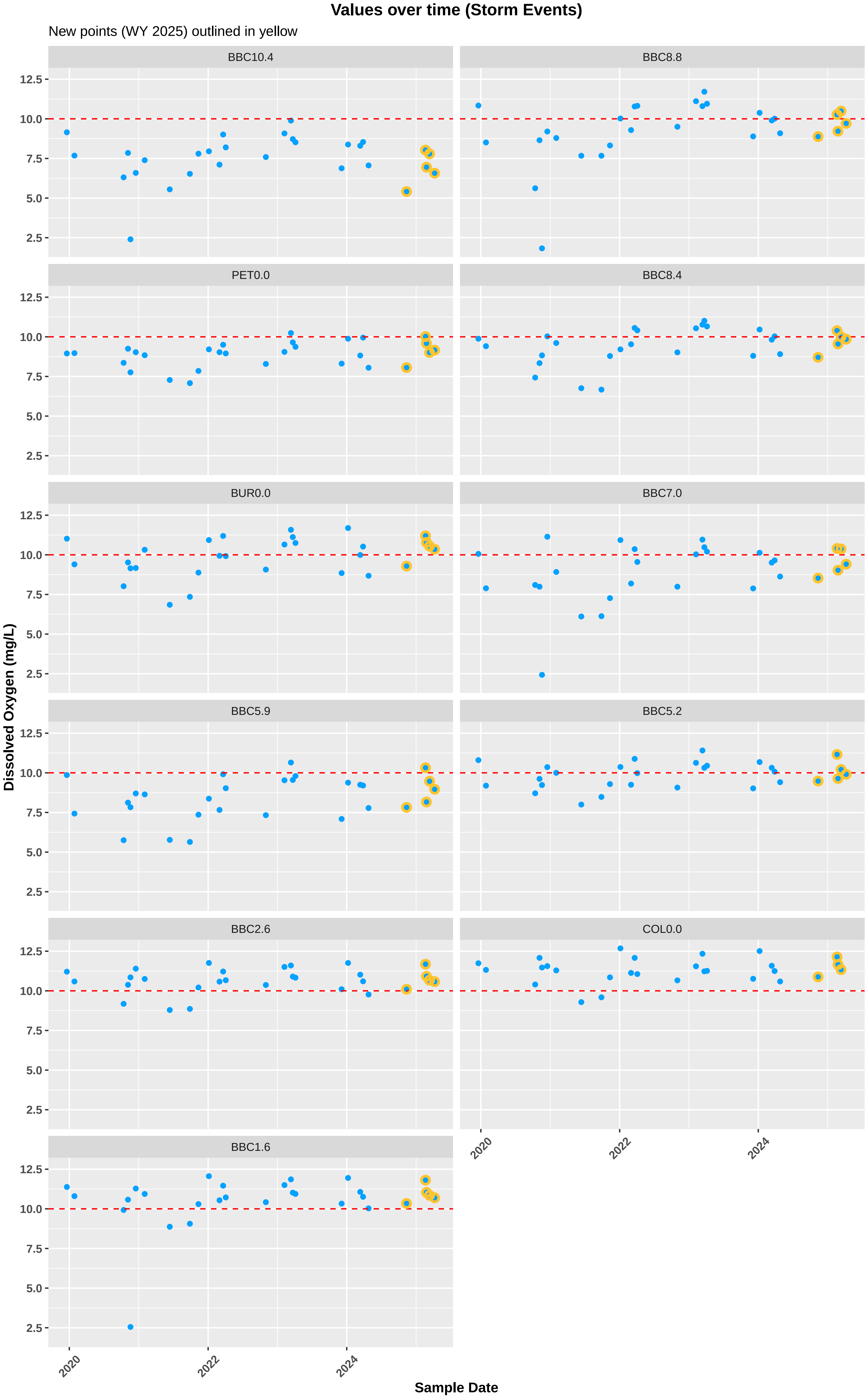
New points (WY 2025) outlined in yellow



Values over time (Storm Events)

New points (WY 2025) outlined in yellow

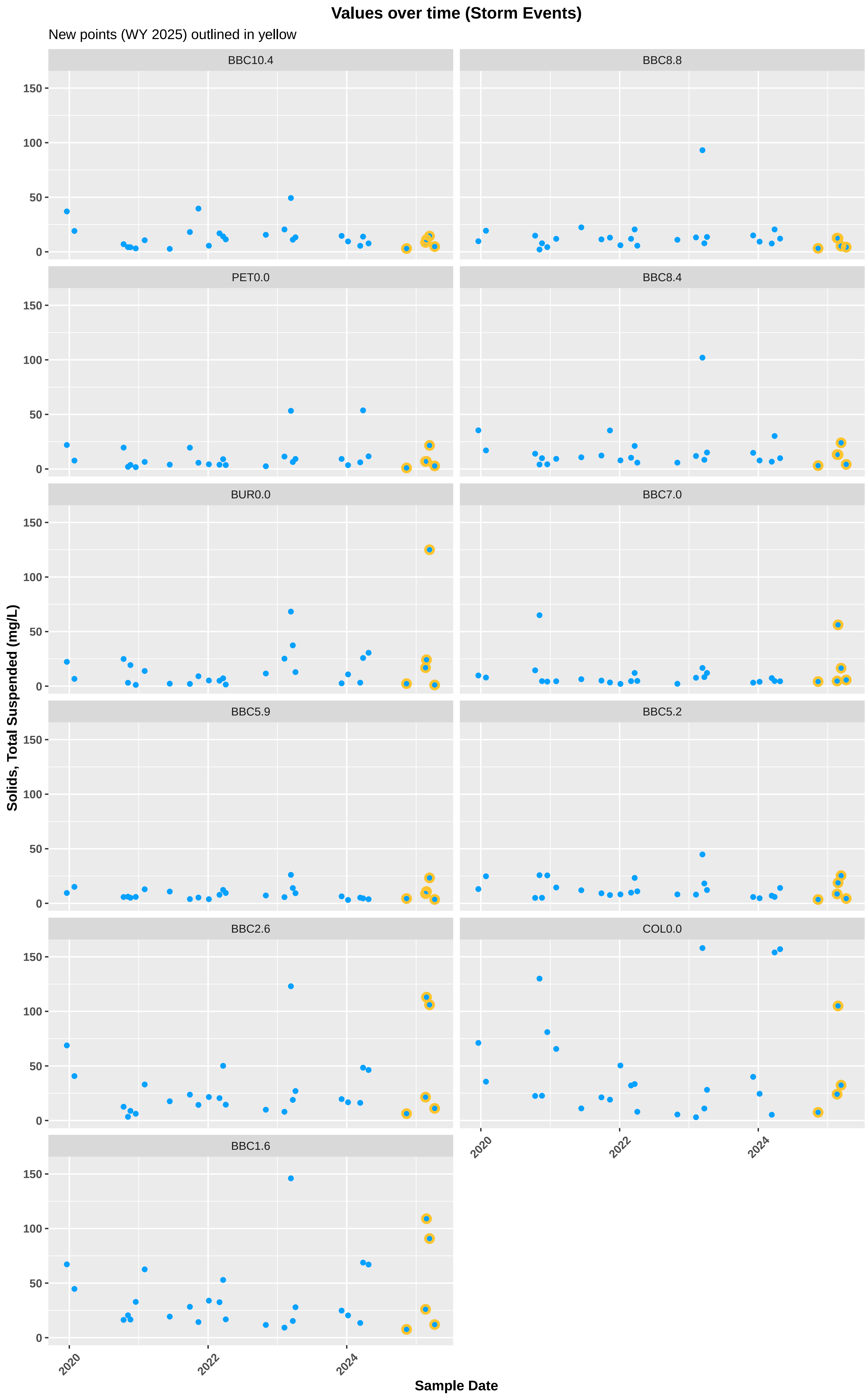
Red lines indicate criteria.



Red lines indicate criteria.

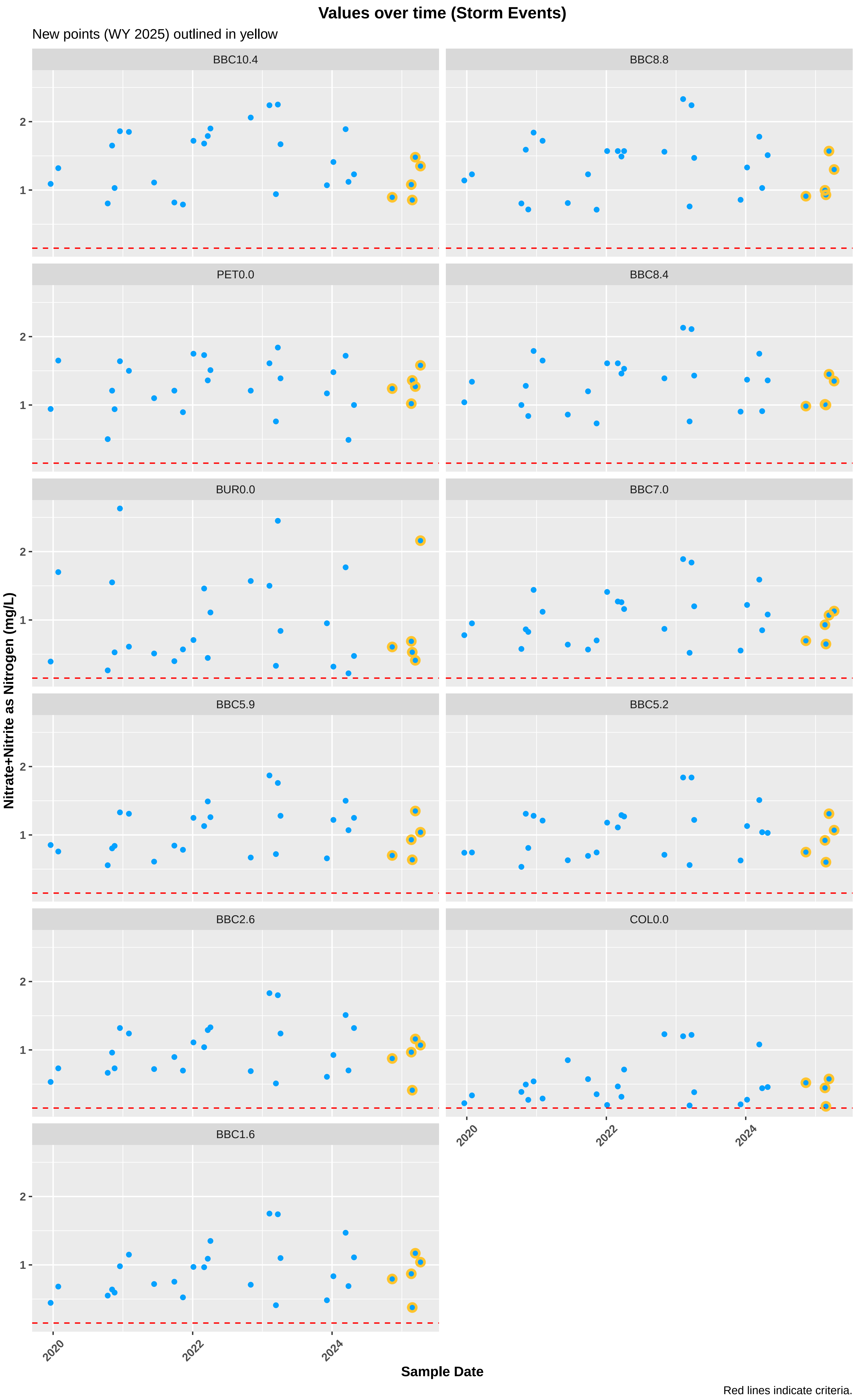
Values over time (Storm Events)

New points (WY 2025) outlined in yellow

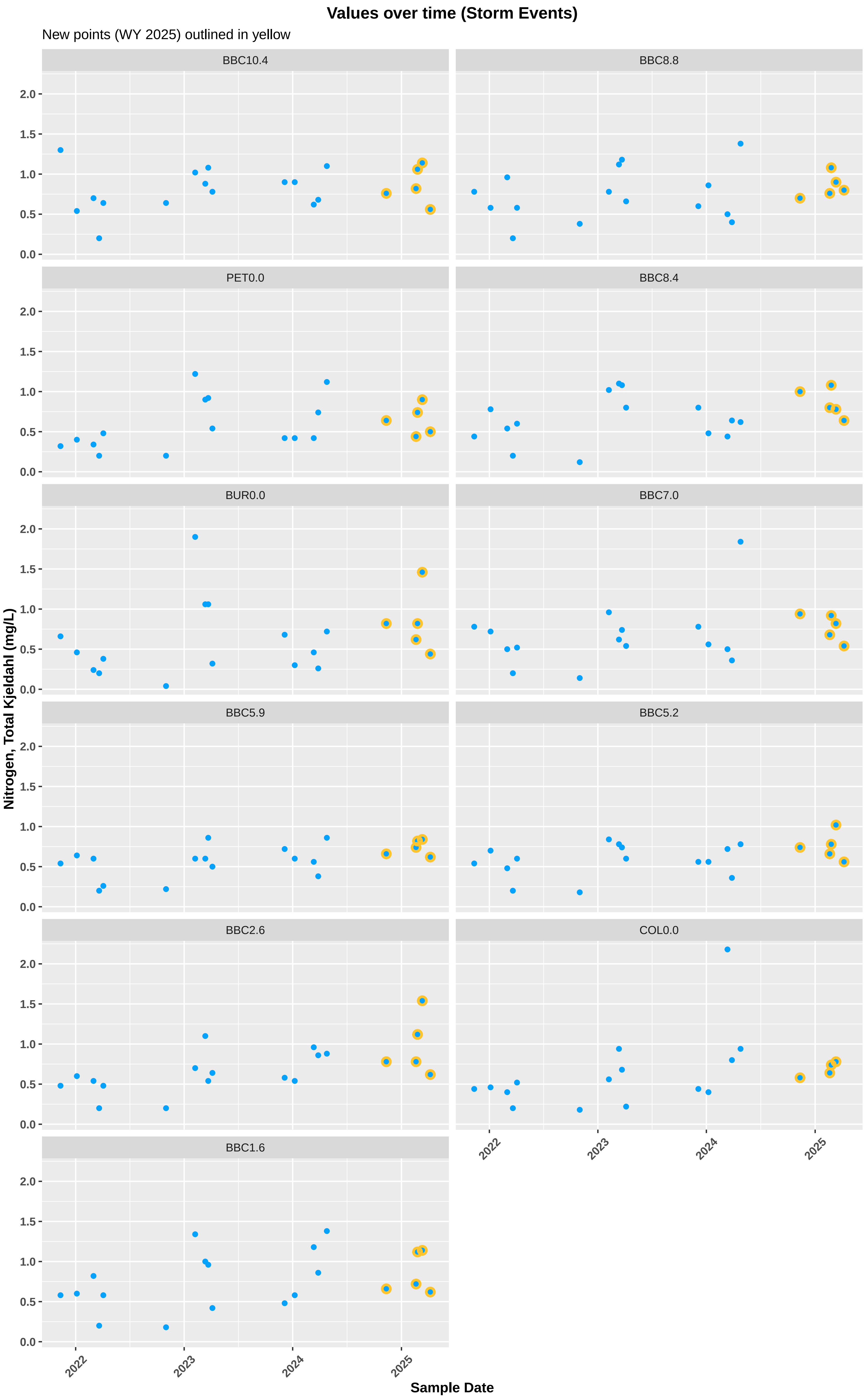


Values over time (Storm Events)

New points (WY 2025) outlined in yellow

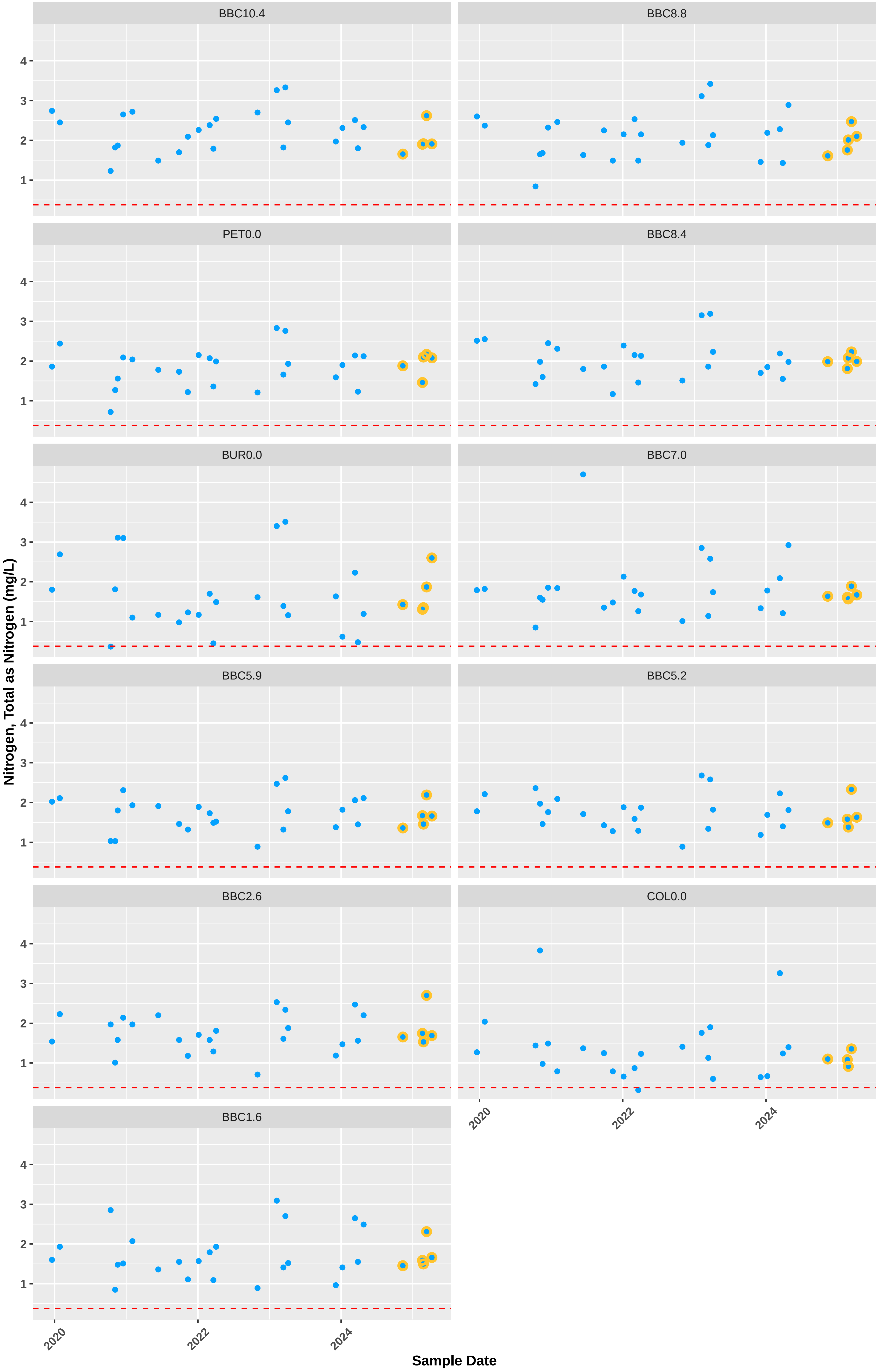


Values over time (Storm Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
2
1
Nitrate+Nitrite as Nitrogen (mg/L)
2020
2022
2024
Sample Date
Red lines indicate criteria.

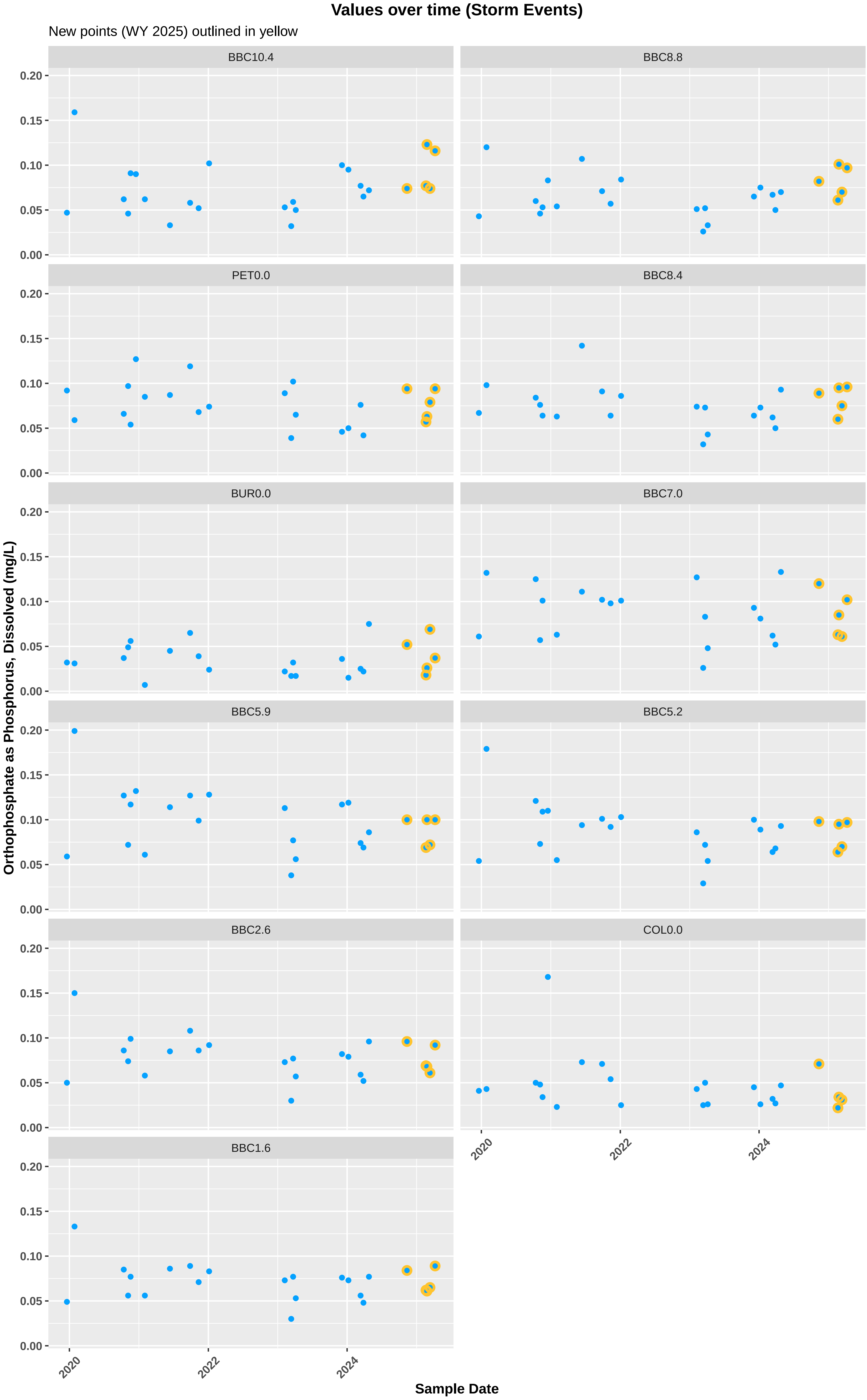

Values over time (Storm Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Nitrogen, Total Kjeldahl (mg/L)
0.0
0.5
1.0
1.5
2.0
2022
2023
2024
2025
Sample Date

Values over time (Storm Events)

New points (WY 2025) outlined in yellow



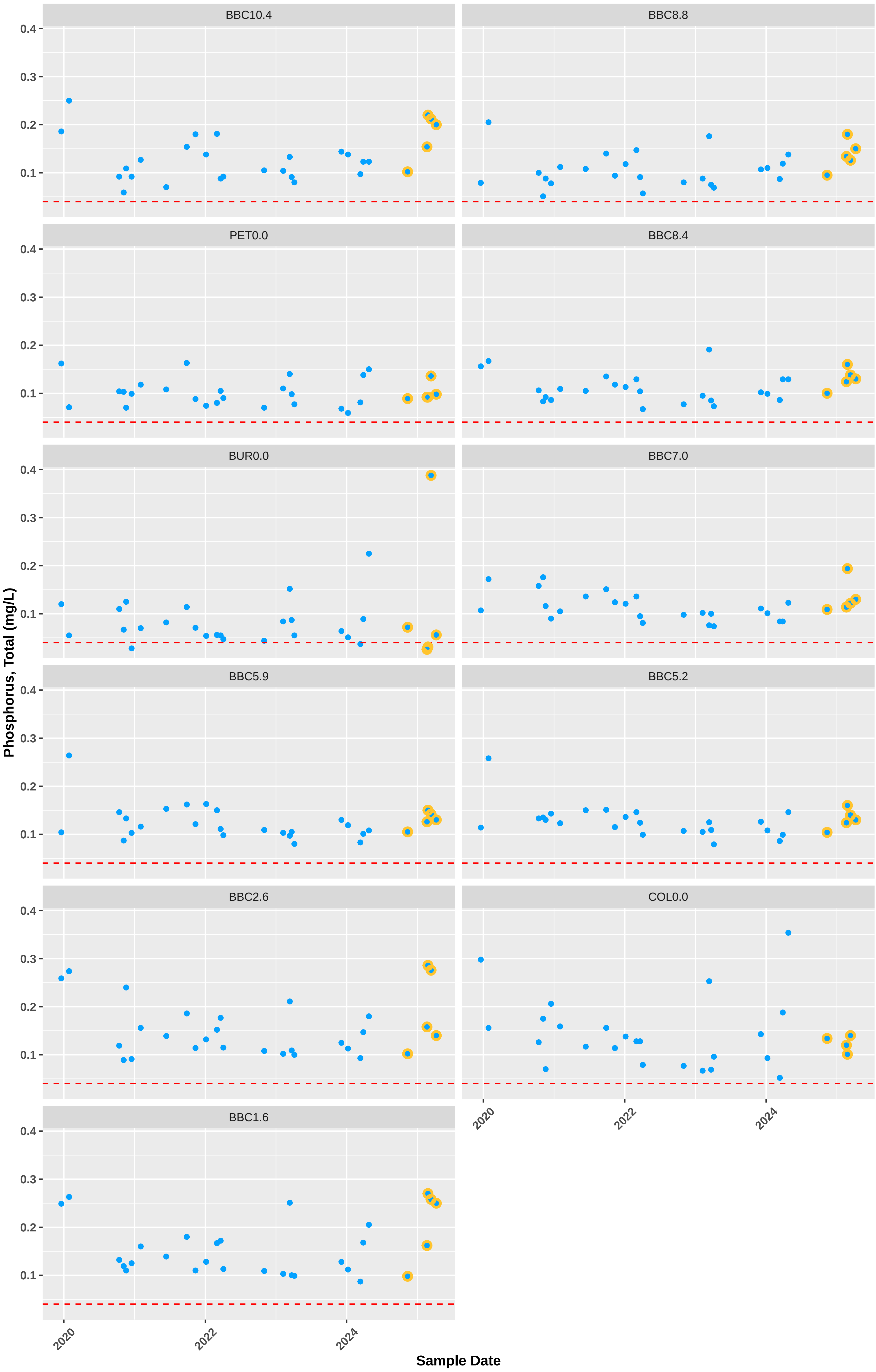
Red lines indicate criteria.



Values over time (Storm Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
0.00
0.05
0.10
0.15
0.20
Orthophosphate as Phosphorus, Dissolved (mg/L)
2020
2022
2024
Sample Date

Values over time (Storm Events)

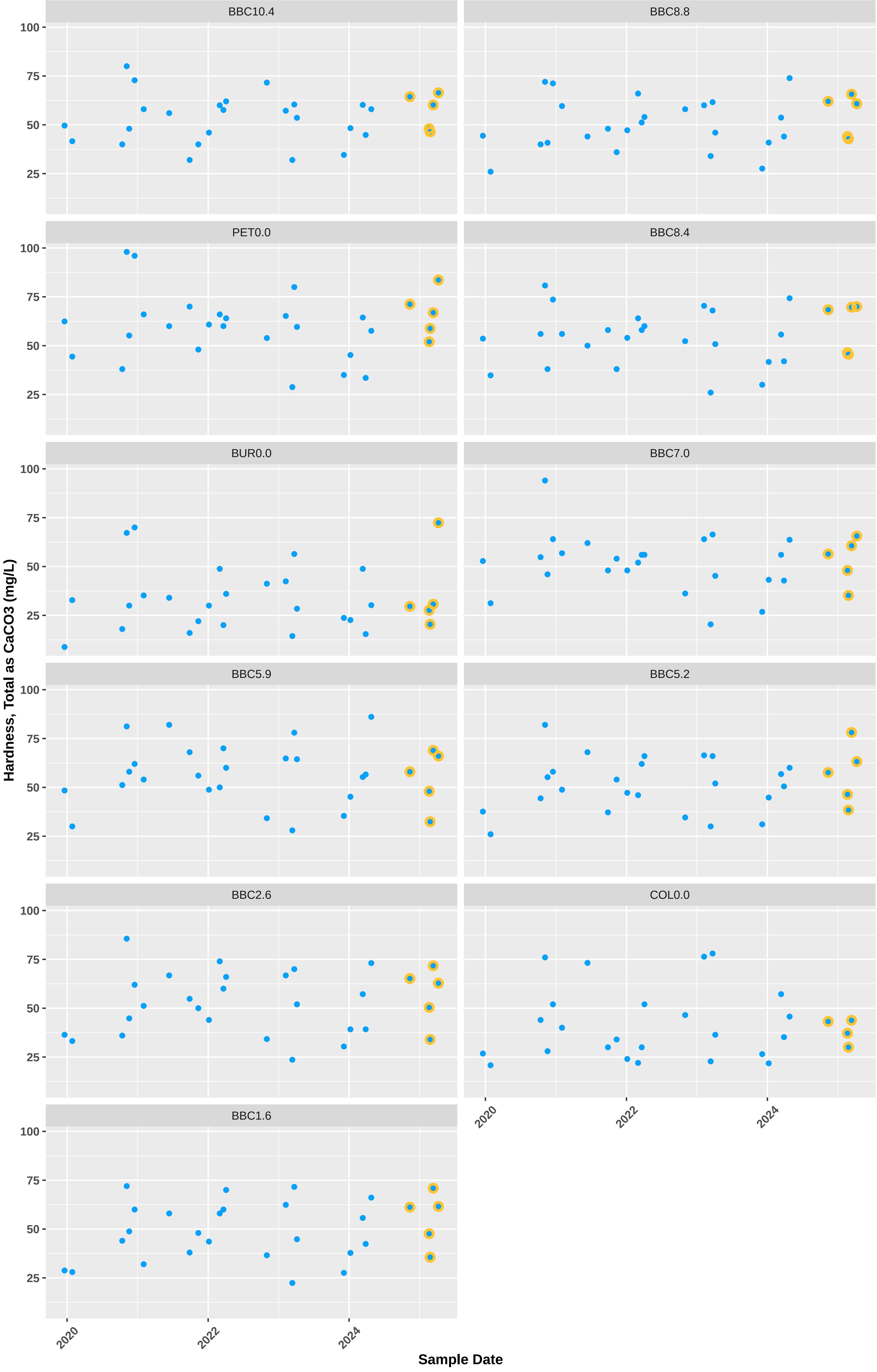
New points (WY 2025) outlined in yellow



Red lines indicate criteria.

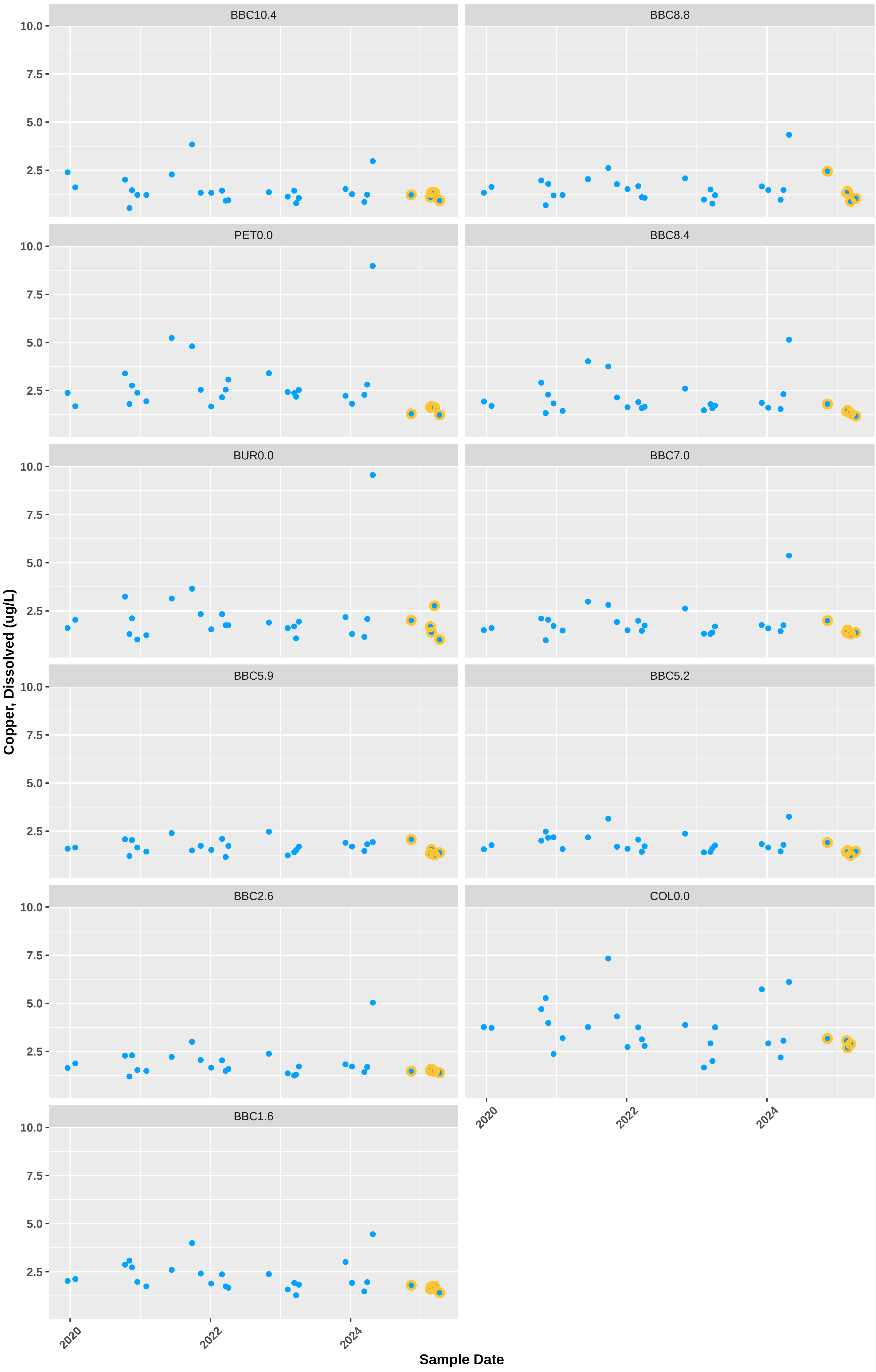
Values over time (Storm Events)

New points (WY 2025) outlined in yellow



Values over time (Storm Events)

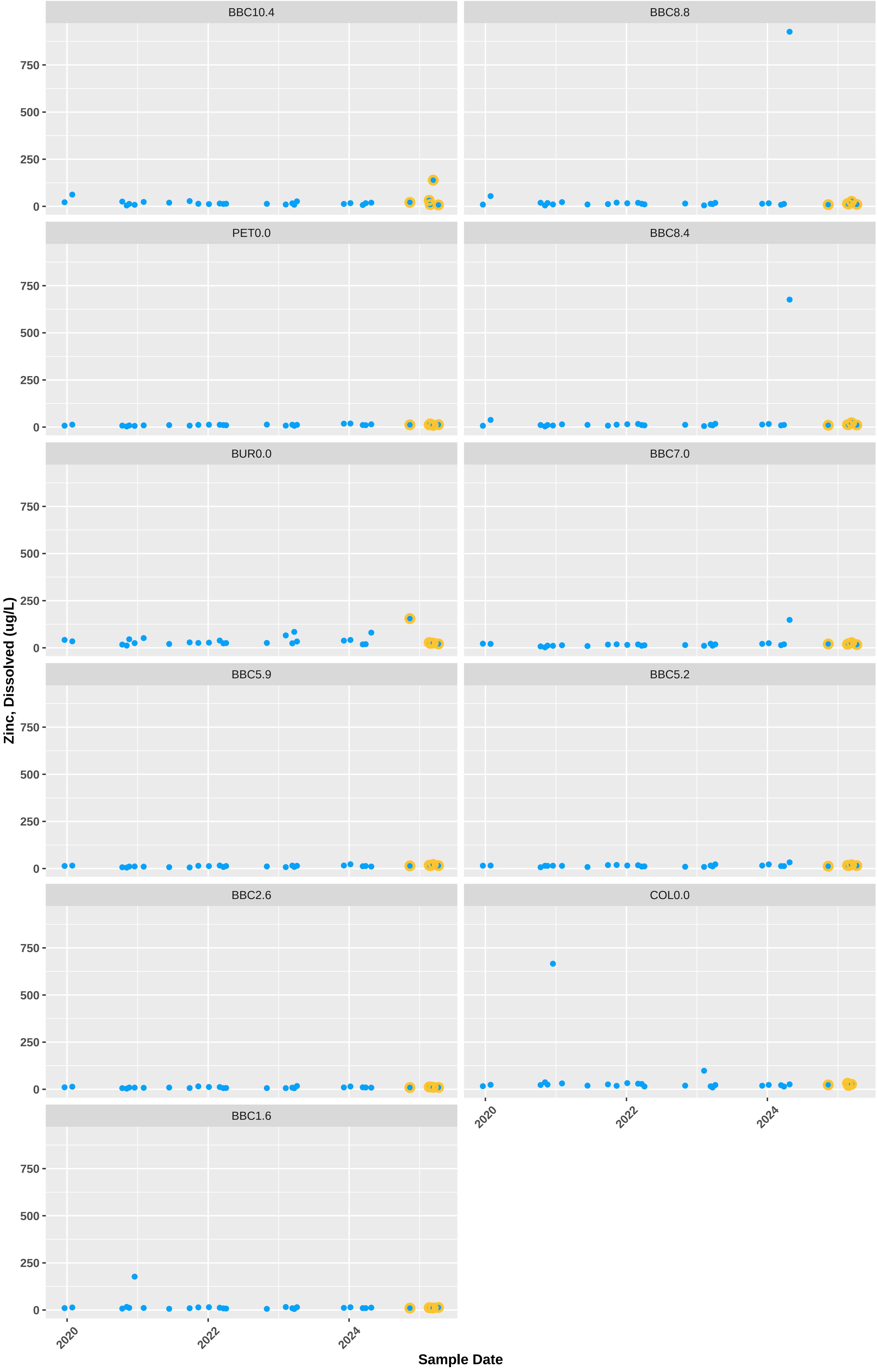
New points (WY 2025) outlined in yellow



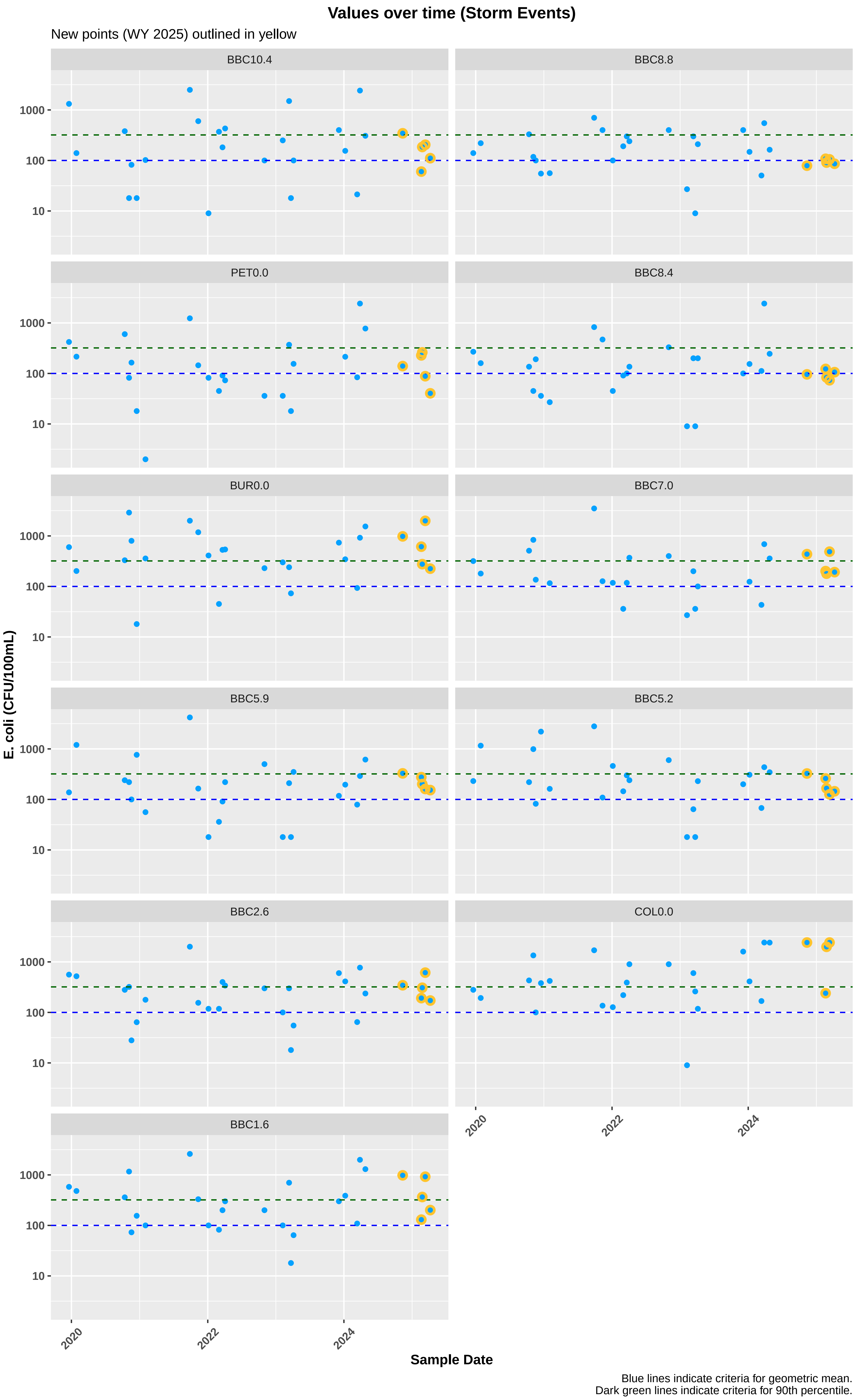

Values over time (Storm Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
0
10
20
30
40
Copper, Total (ug/L)
2020
2022
2024
Sample Date

Values over time (Storm Events)

New points (WY 2025) outlined in yellow

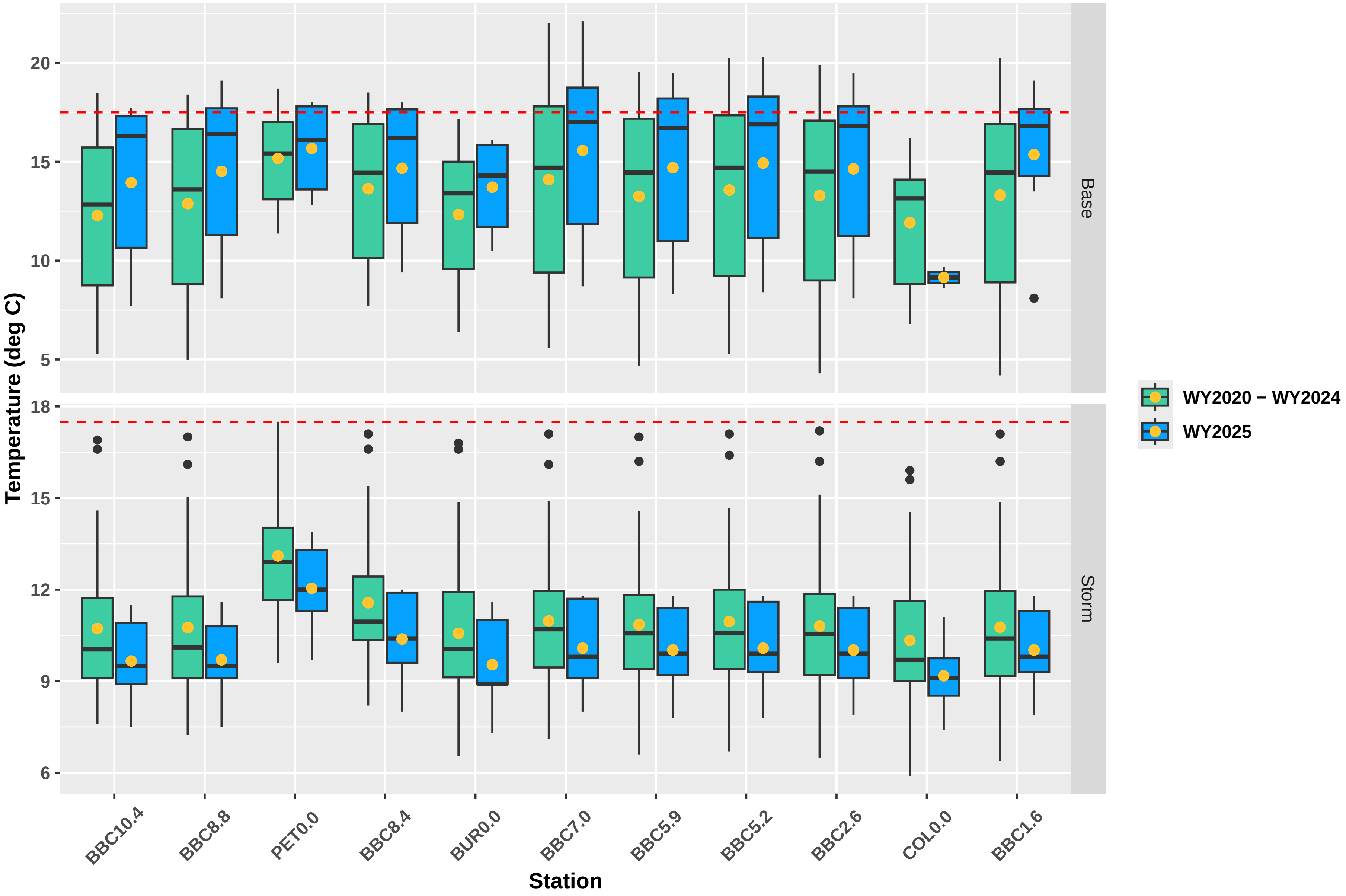



Values over time (Storm Events)
New points (WY 2025) outlined in yellow
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
750
500
250
0
Zinc, Total (ug/L)
2020
2022
2024
Sample Date

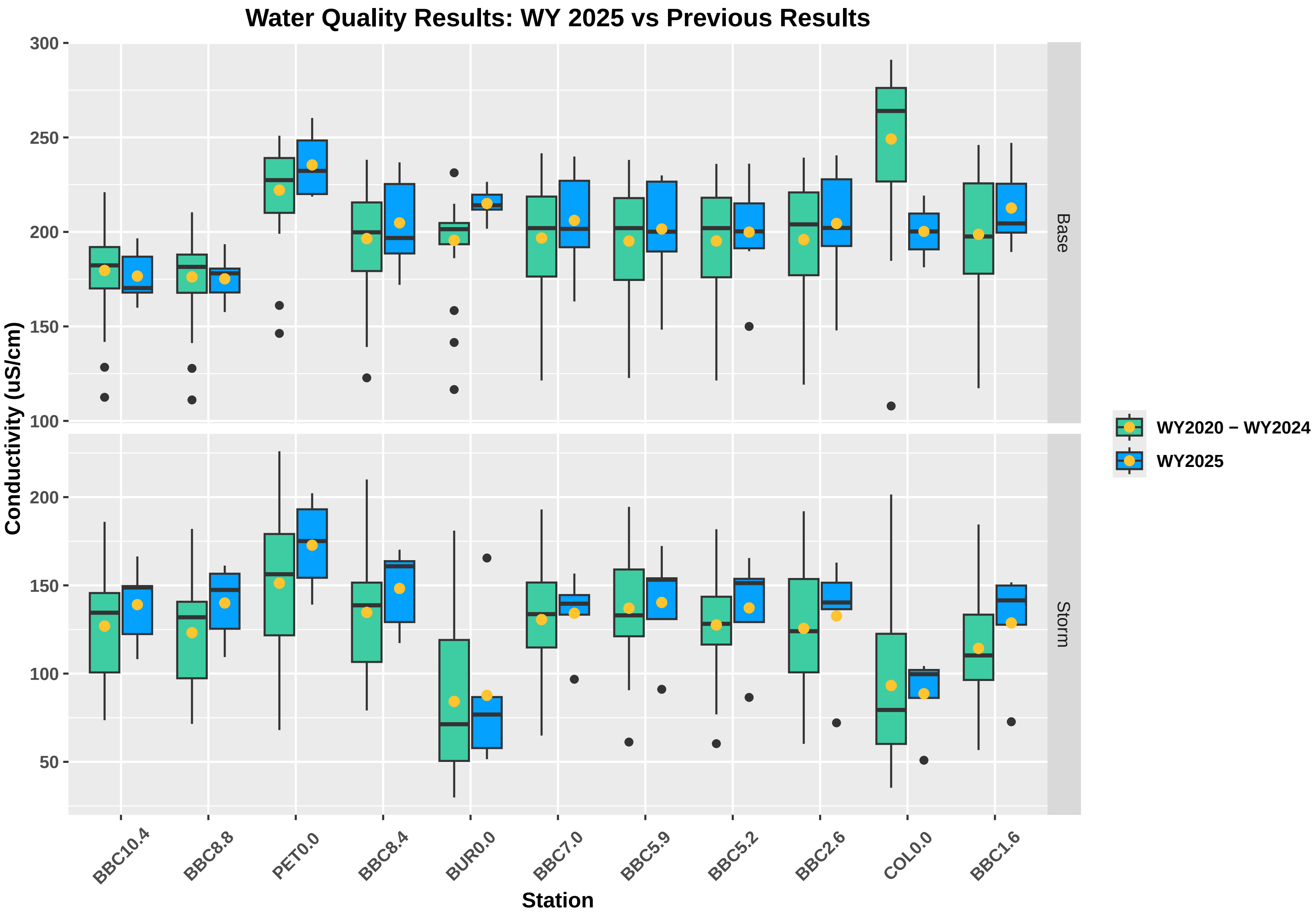


Blue lines indicate criteria for geometric mean.
Dark green lines indicate criteria for 90th percentile.

Water Quality Results: WY 2025 vs Previous Results

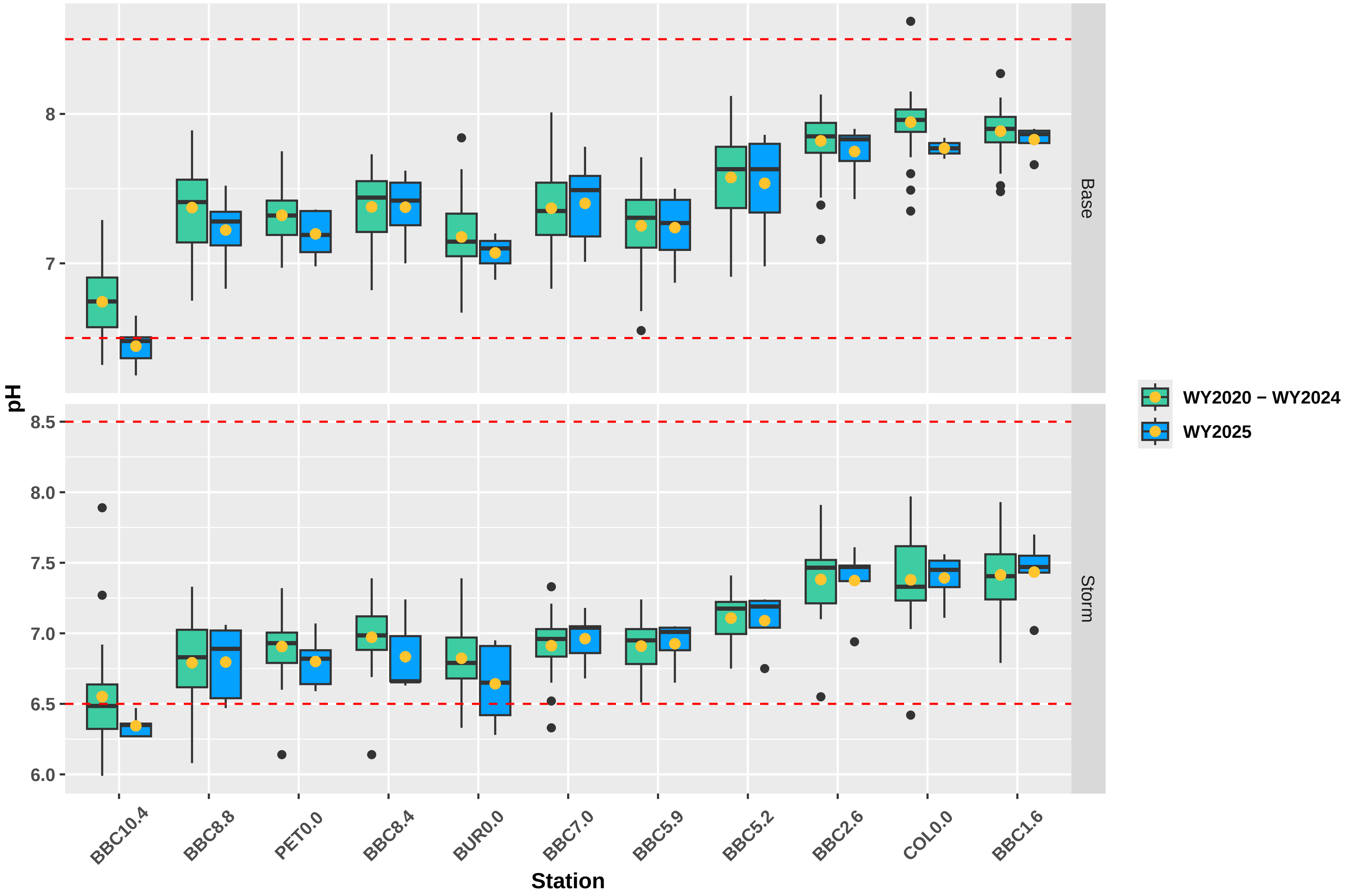


Red lines indicate criteria.
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

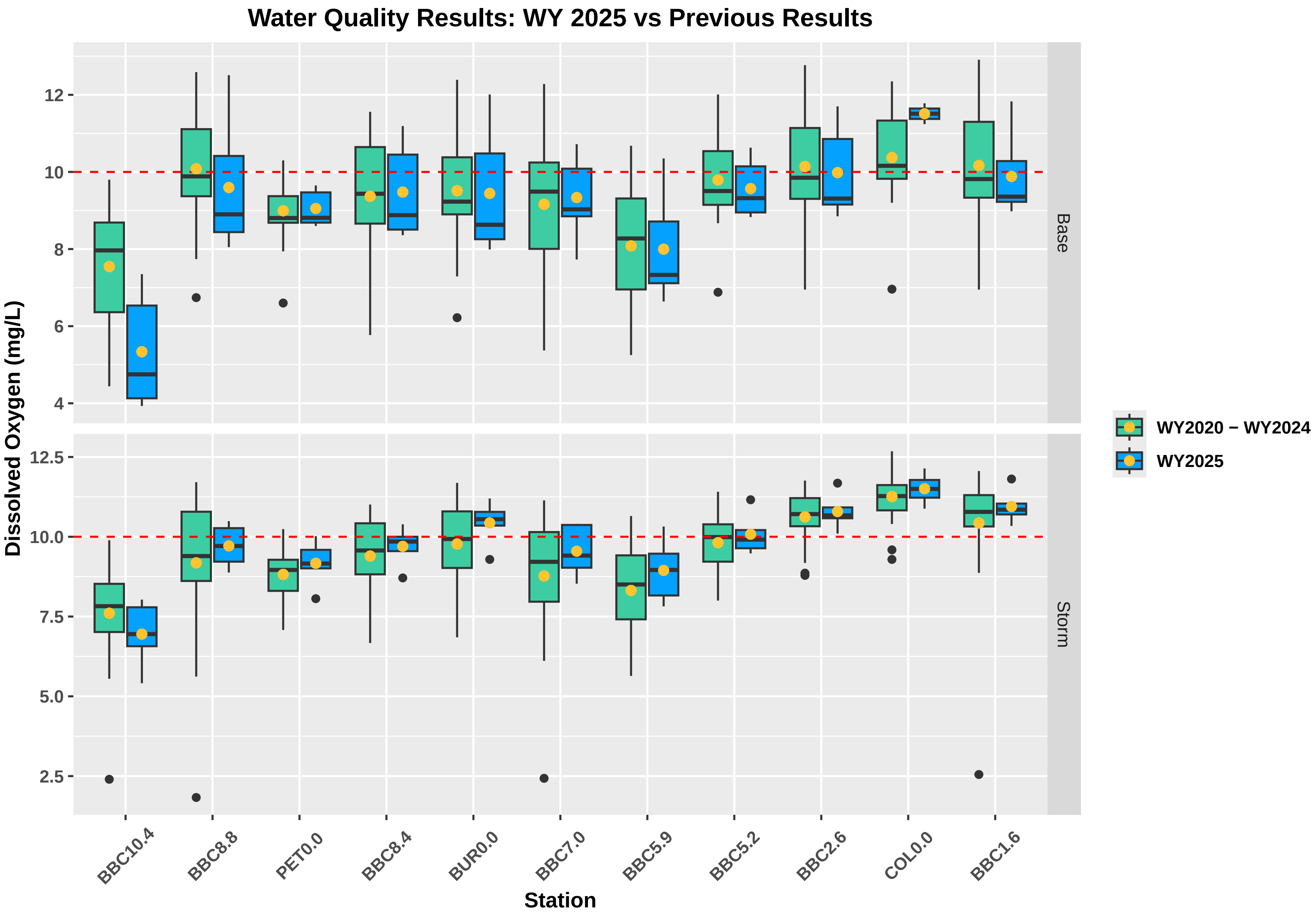


Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

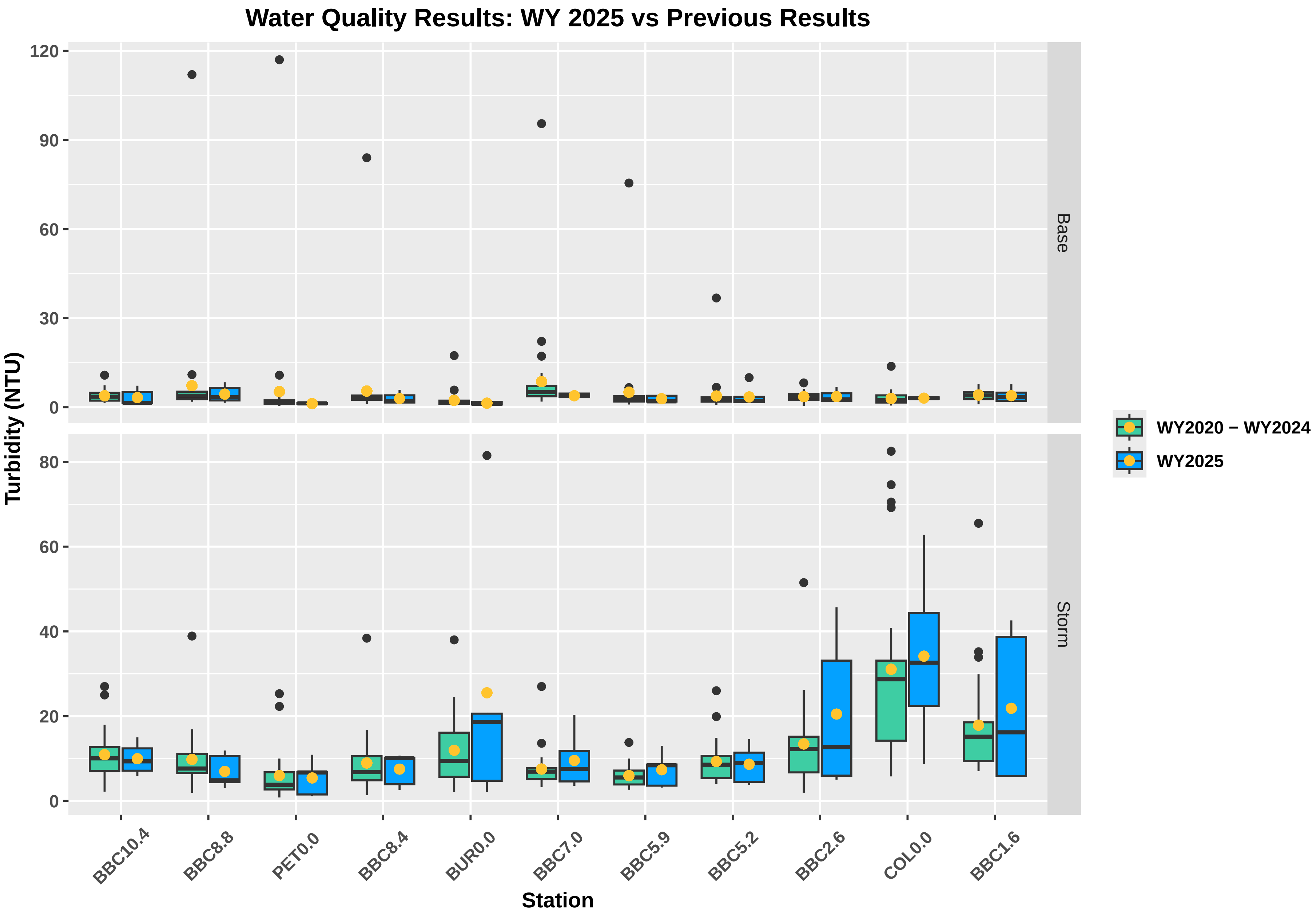
Water Quality Results: WY 2025 vs Previous Results



Red lines indicate criteria.
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

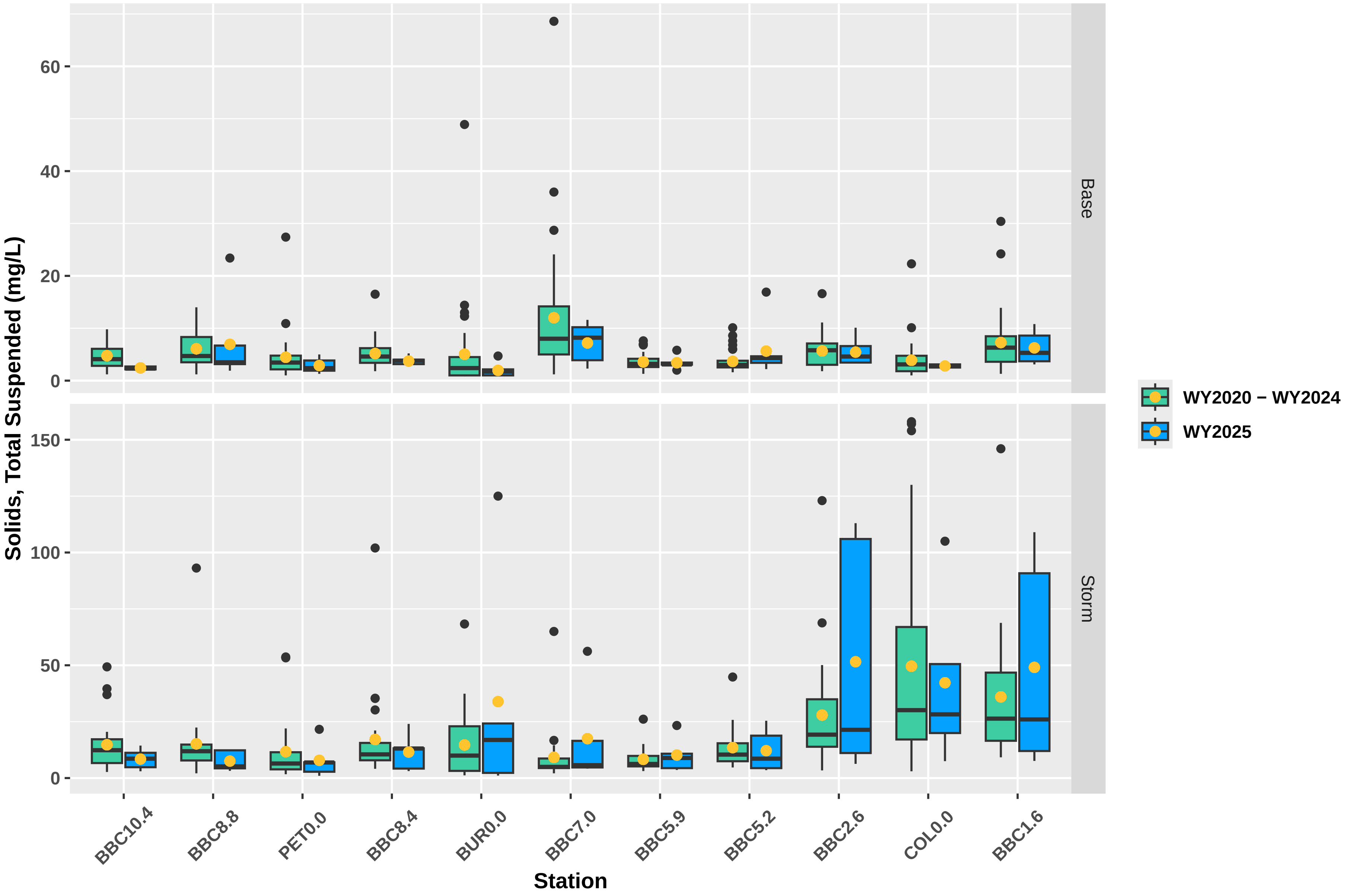


Red lines indicate criteria.
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

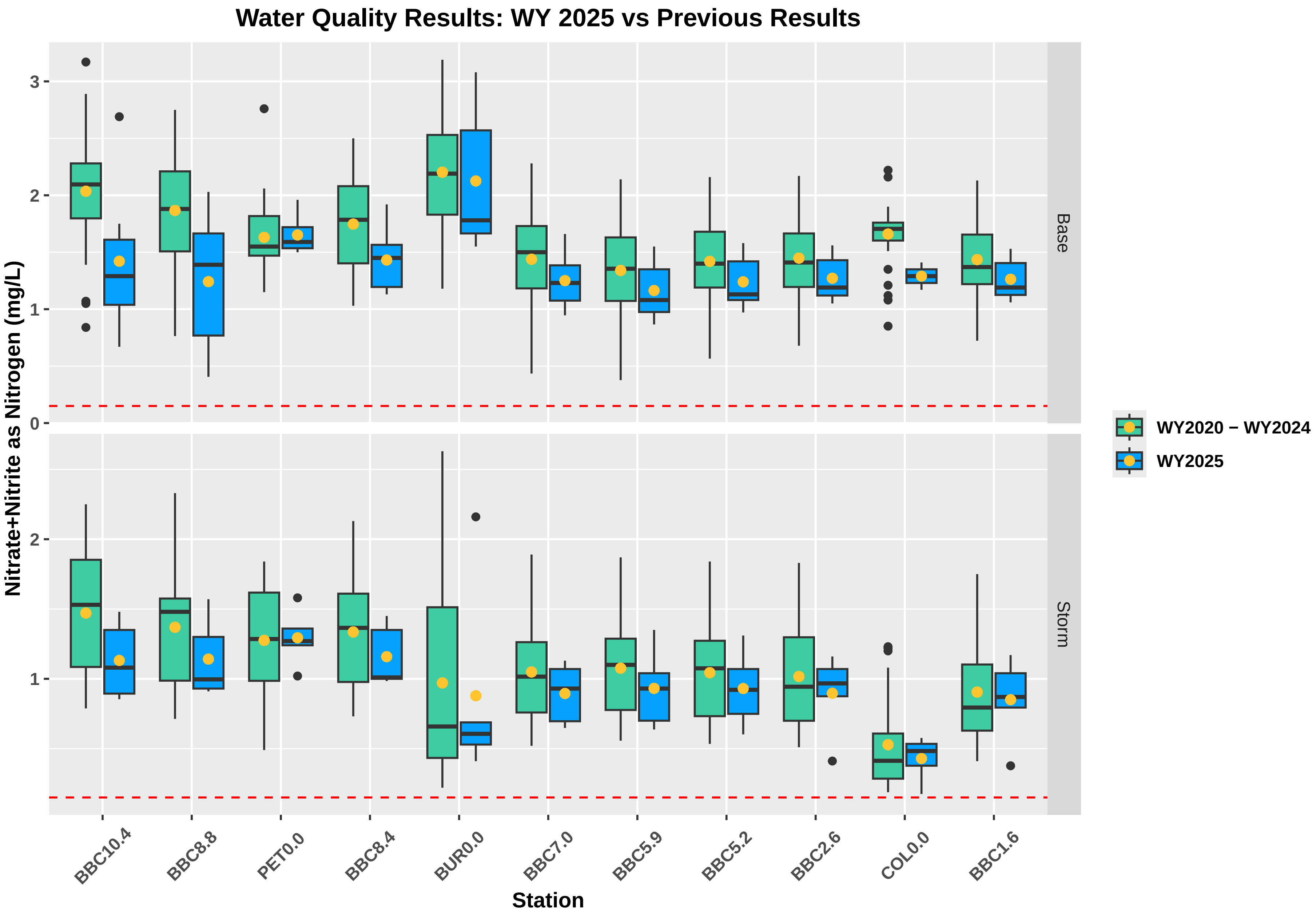


Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

Water Quality Results: WY 2025 vs Previous Results

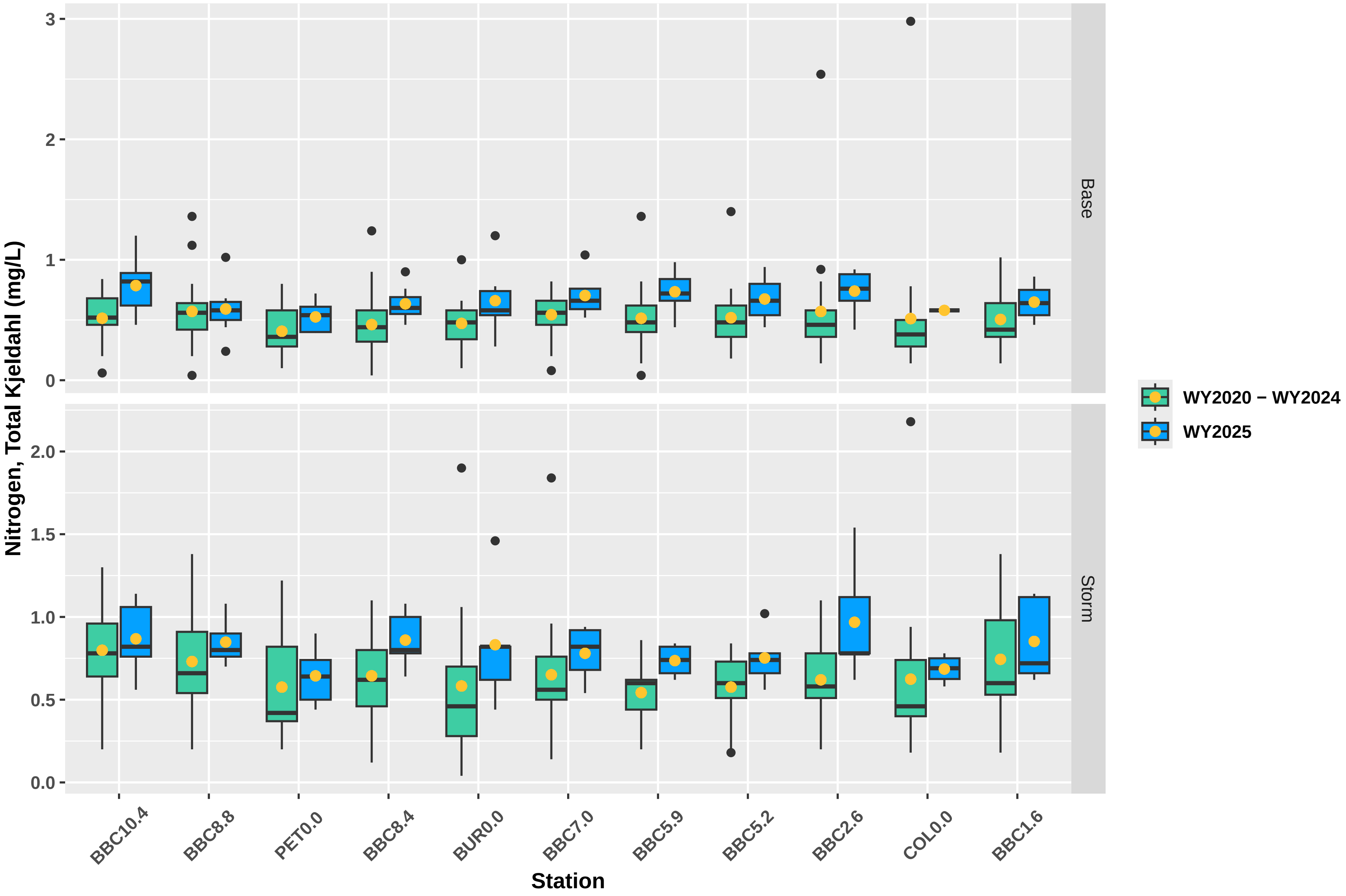


Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

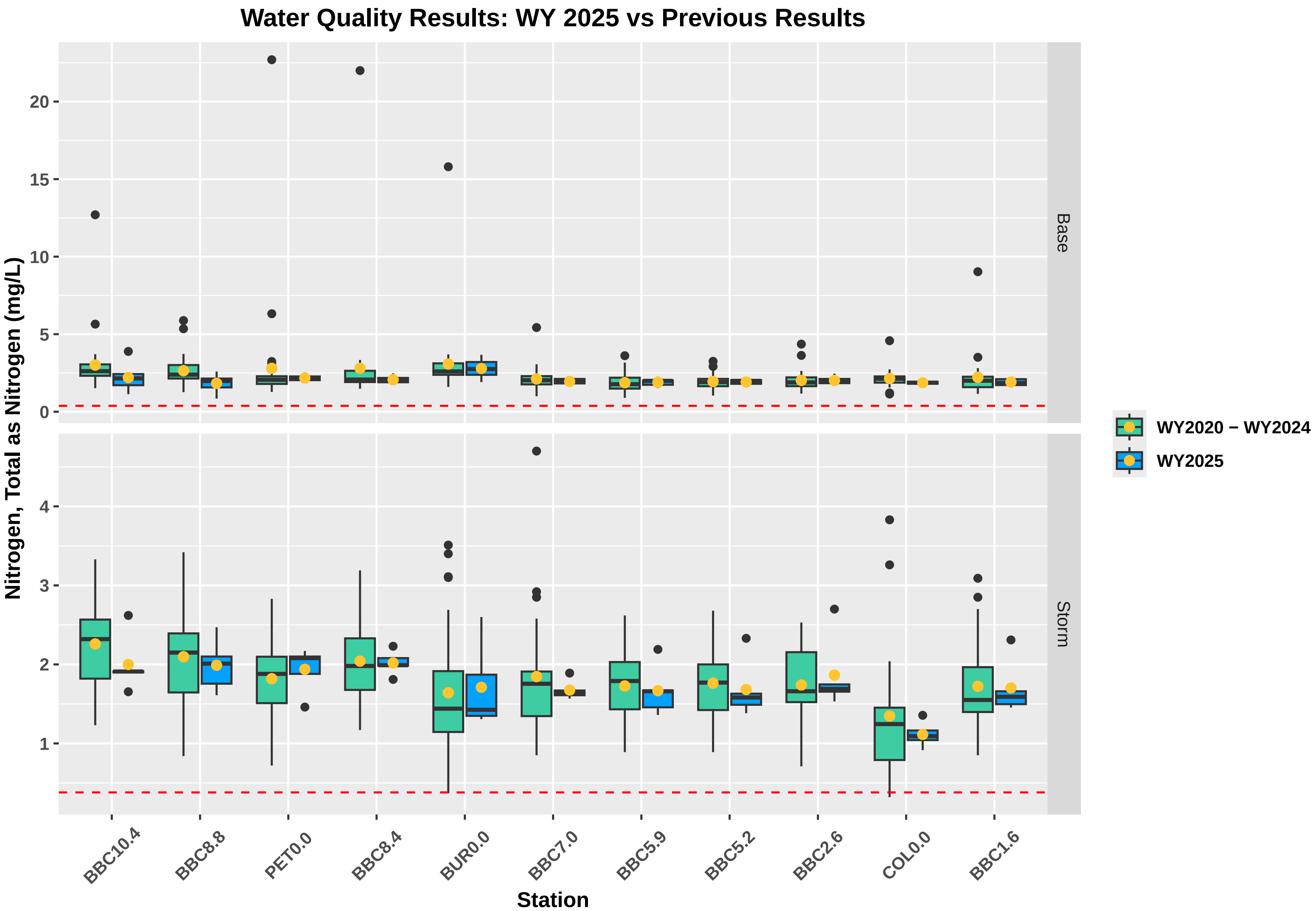


Red lines indicate criteria.
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

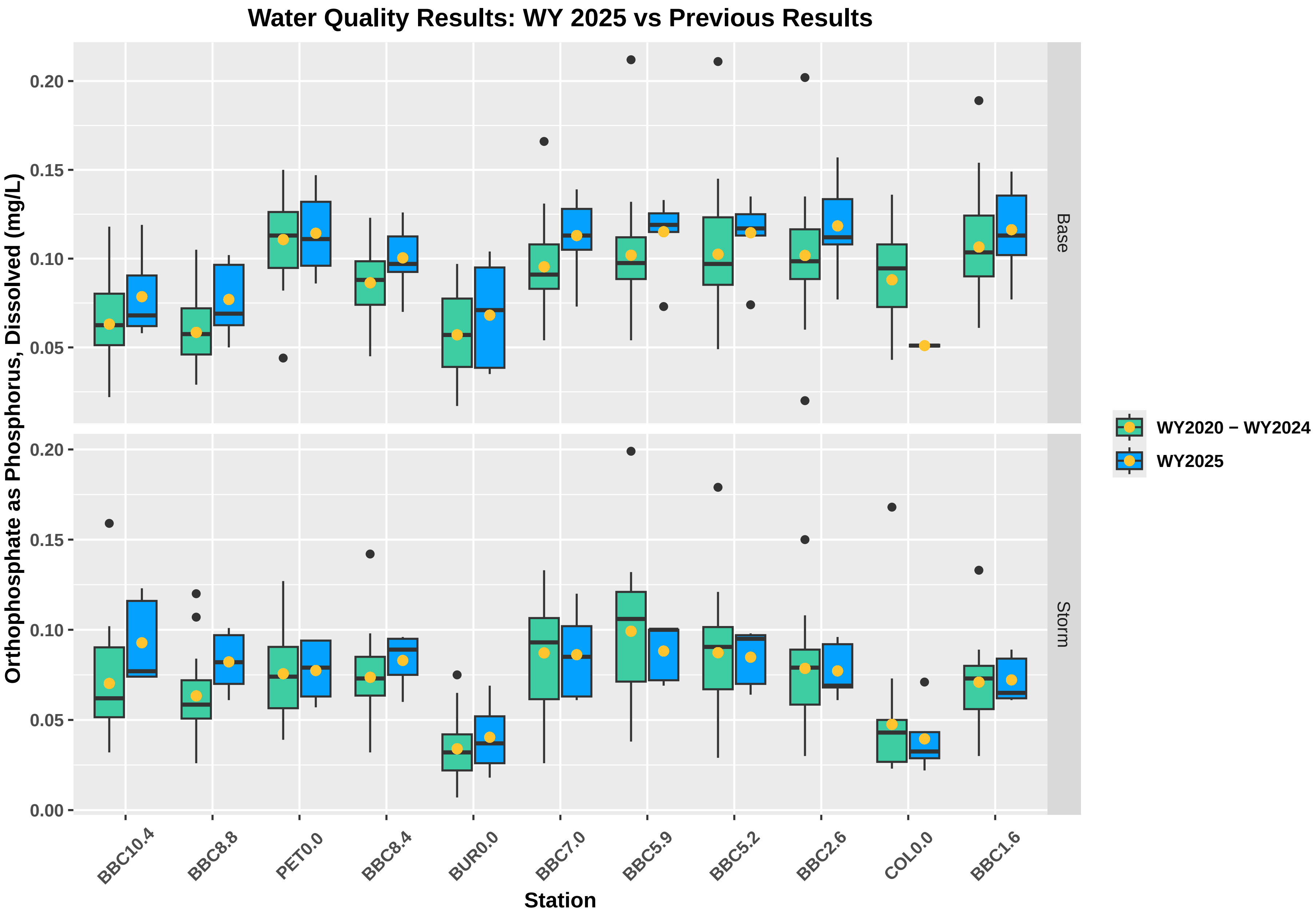
Water Quality Results: WY 2025 vs Previous Results



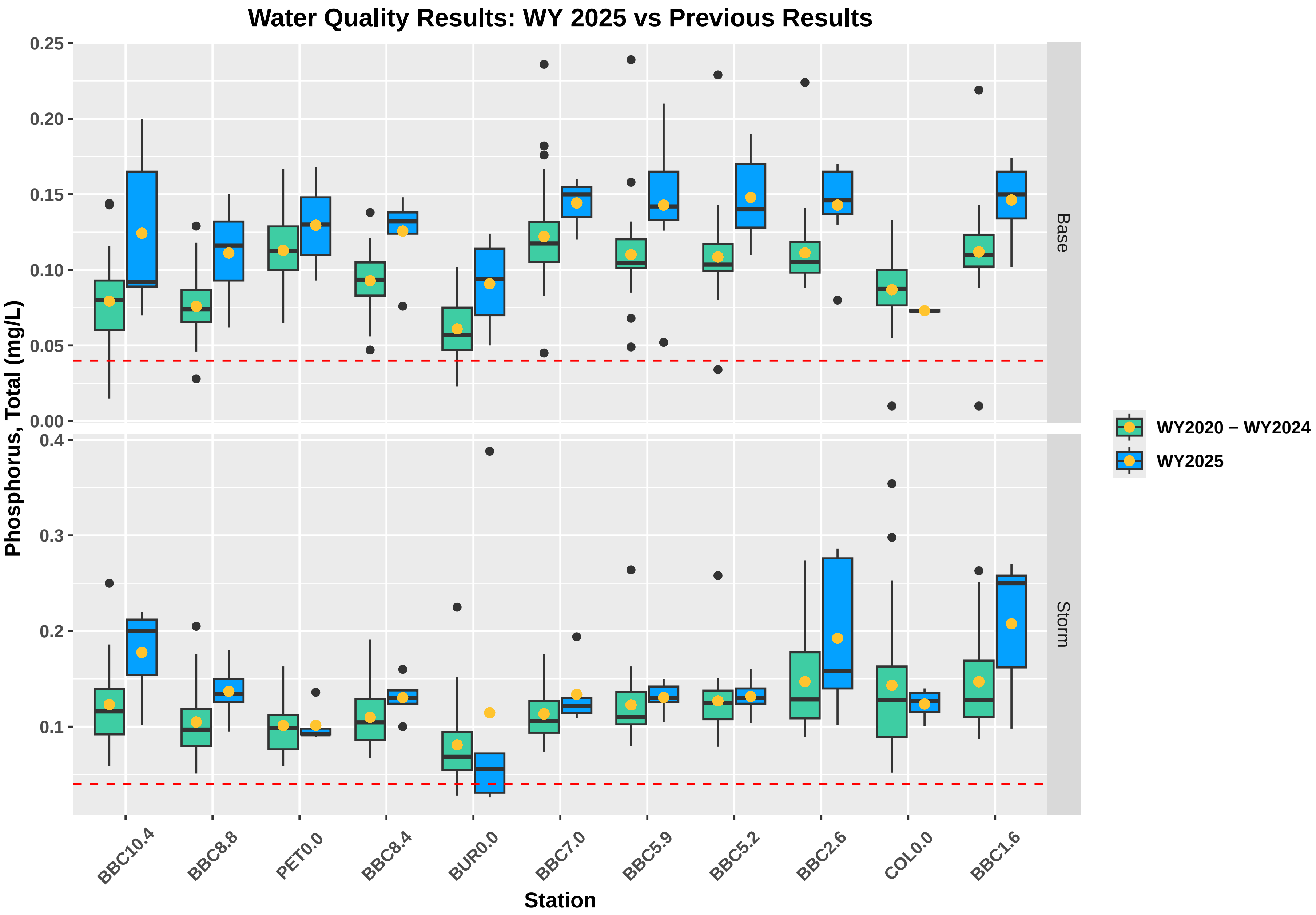
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.



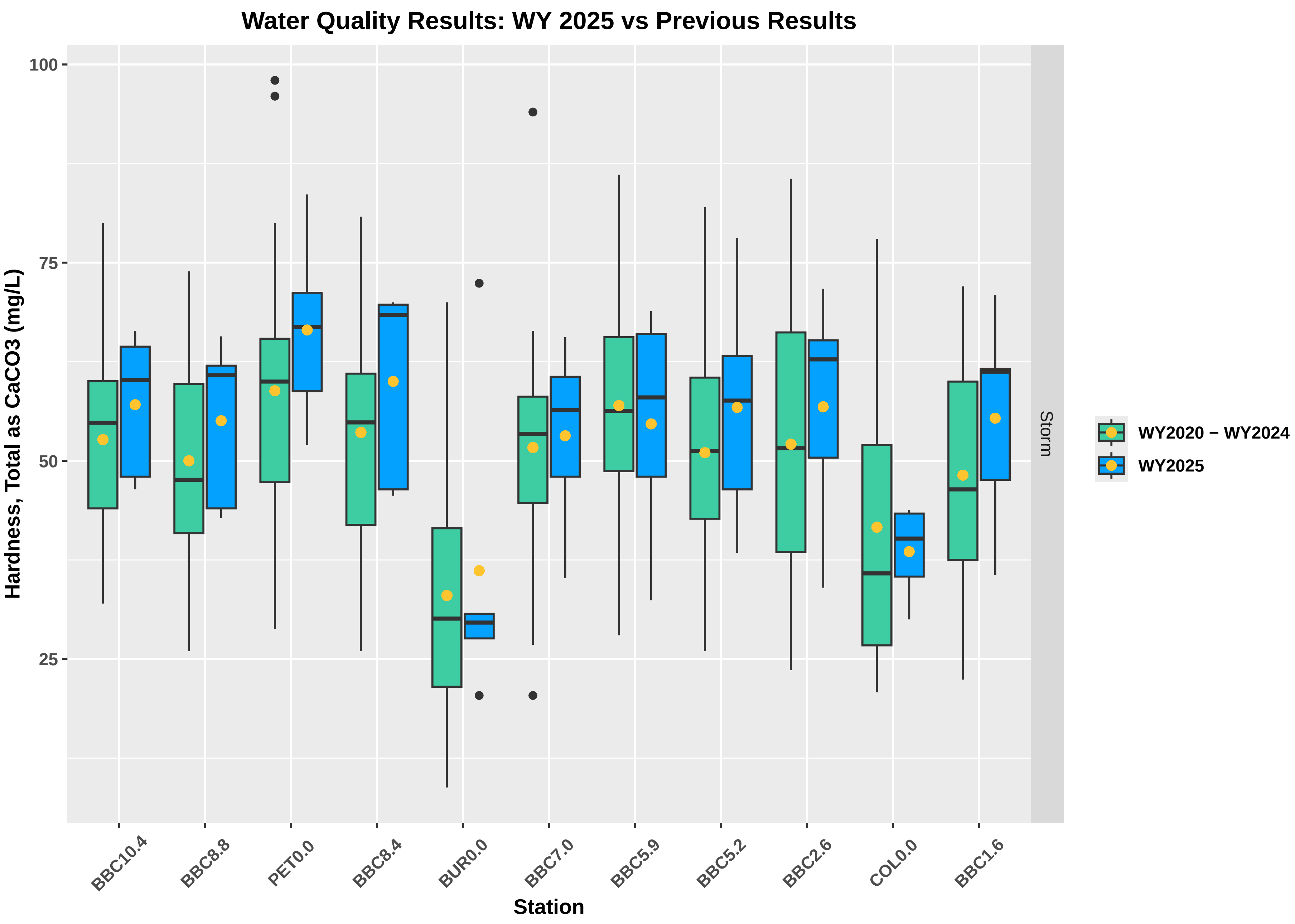
Red lines indicate criteria.
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.



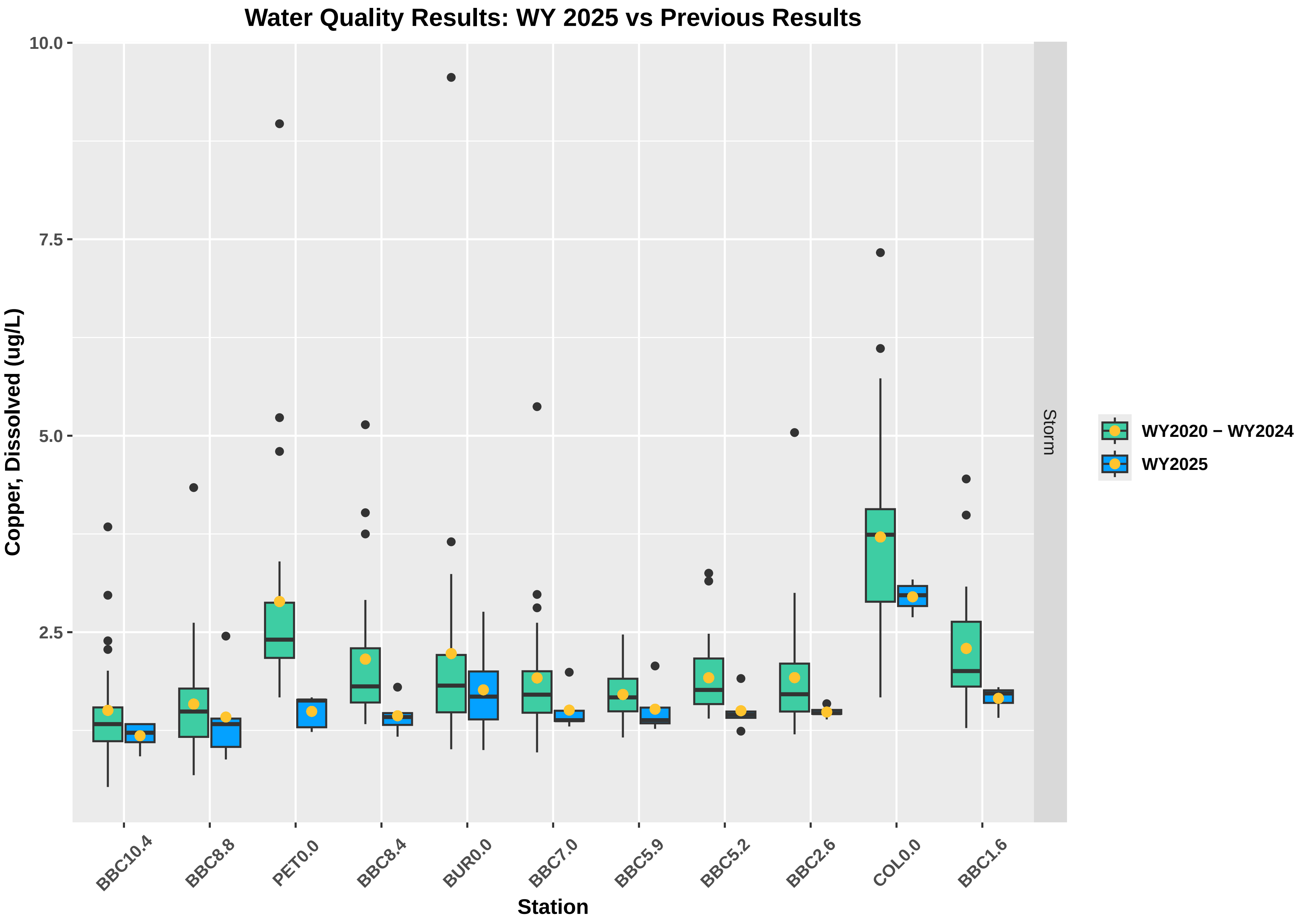
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.



Red lines indicate criteria.
Arithmetic mean shown in yellow.
WY2025 Base results for COL0.0 include only two points.

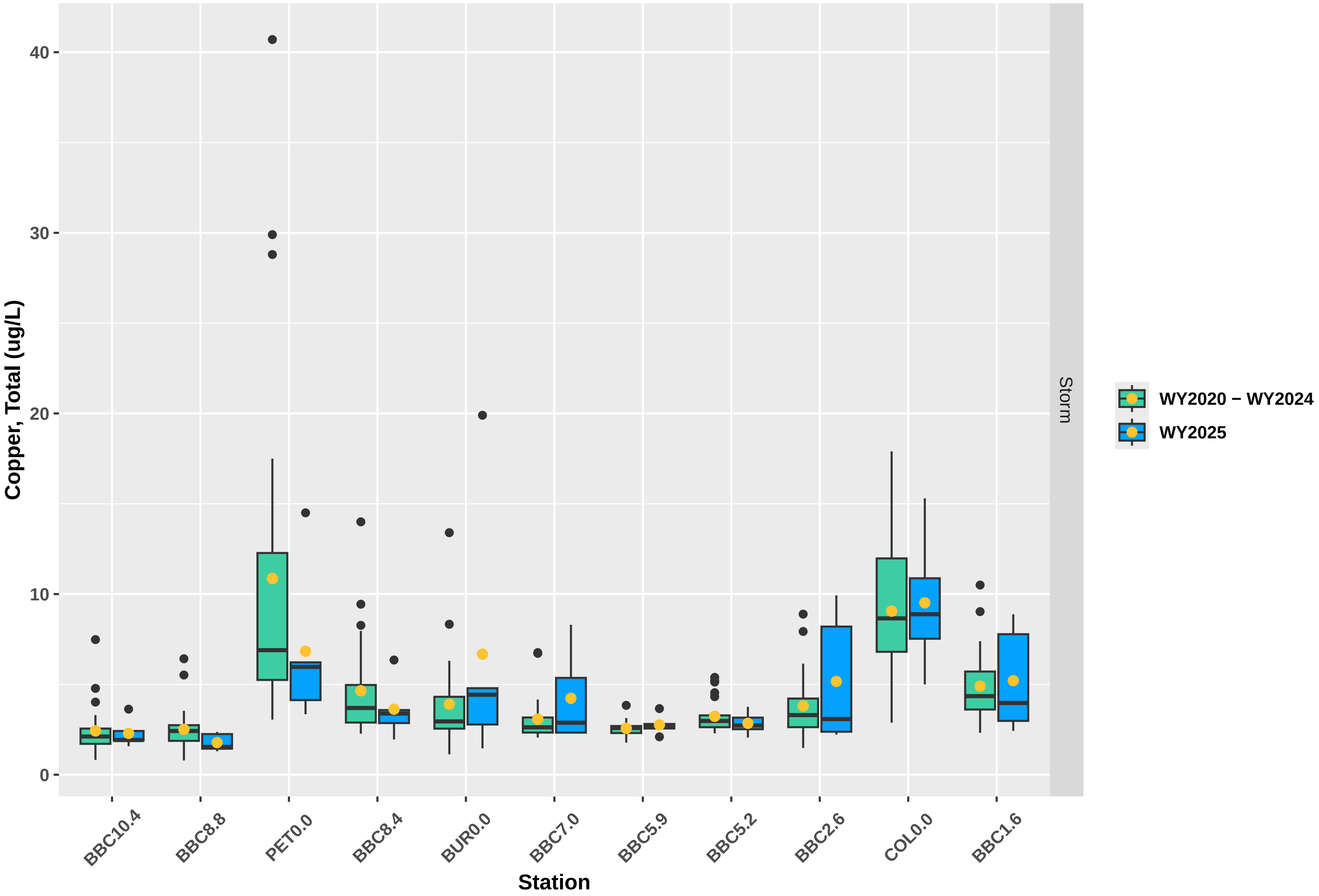


Arithmetic mean shown in yellow.



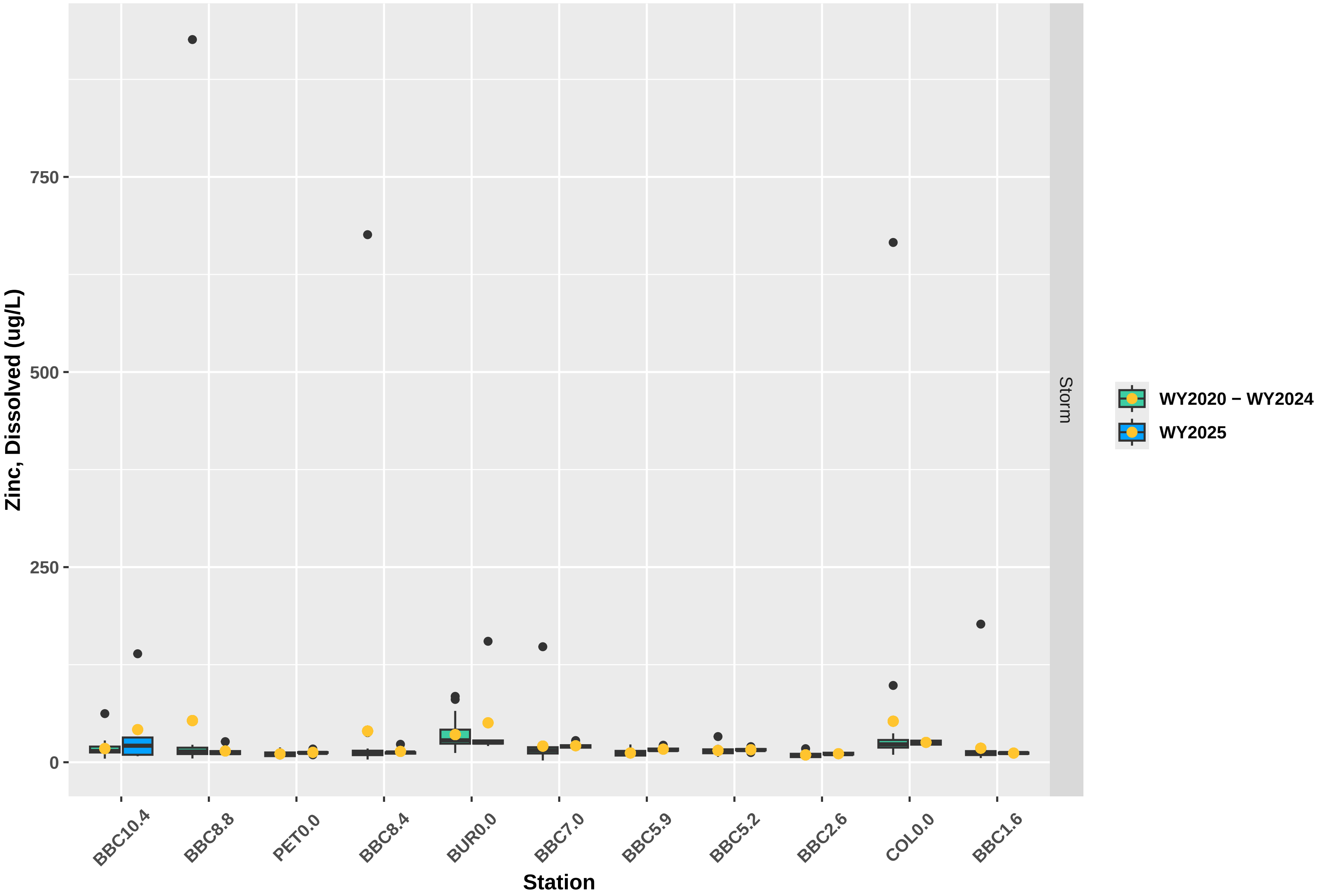
Arithmetic mean shown in yellow.

Water Quality Results: WY 2025 vs Previous Results



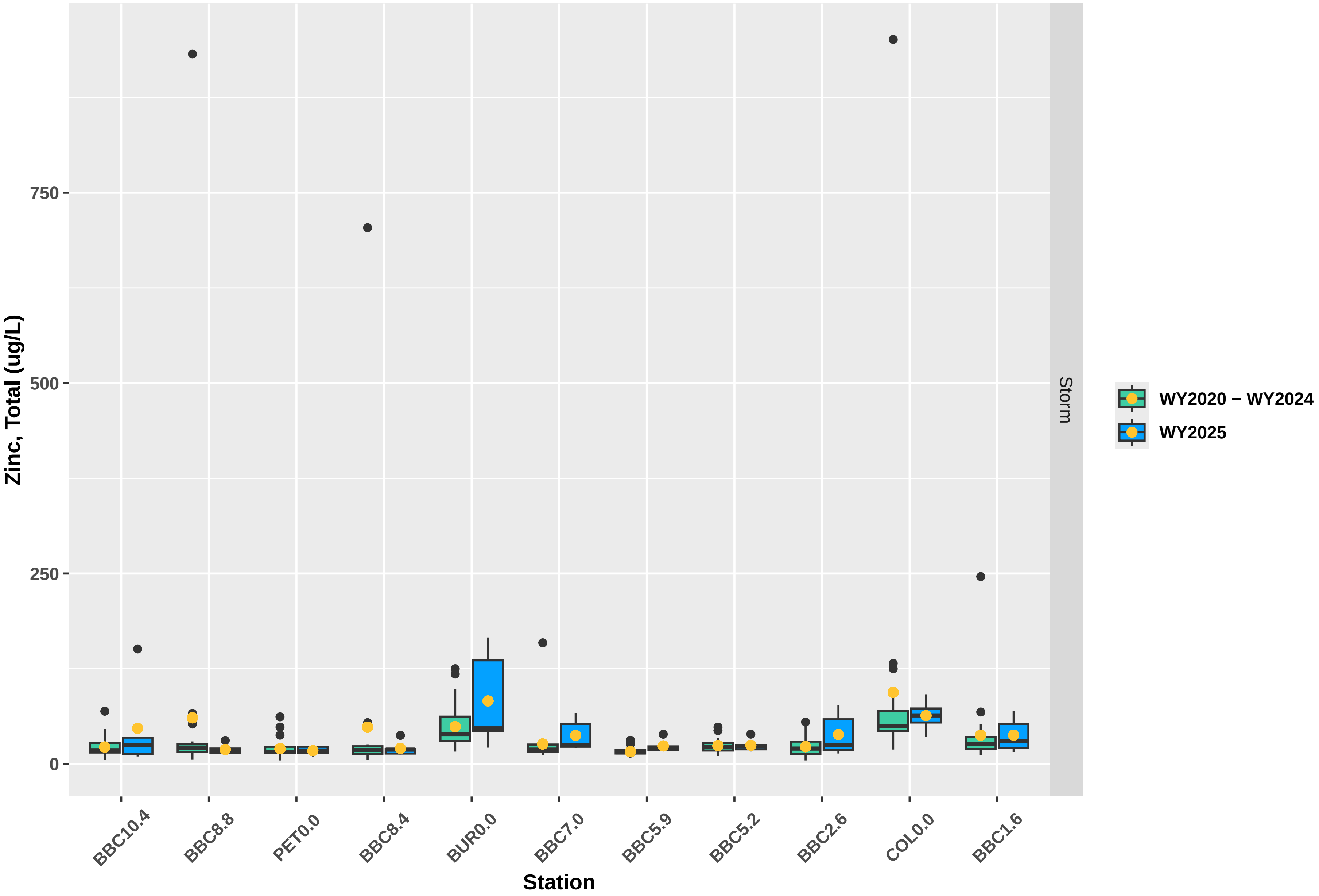
Arithmetic mean shown in yellow.

Water Quality Results: WY 2025 vs Previous Results

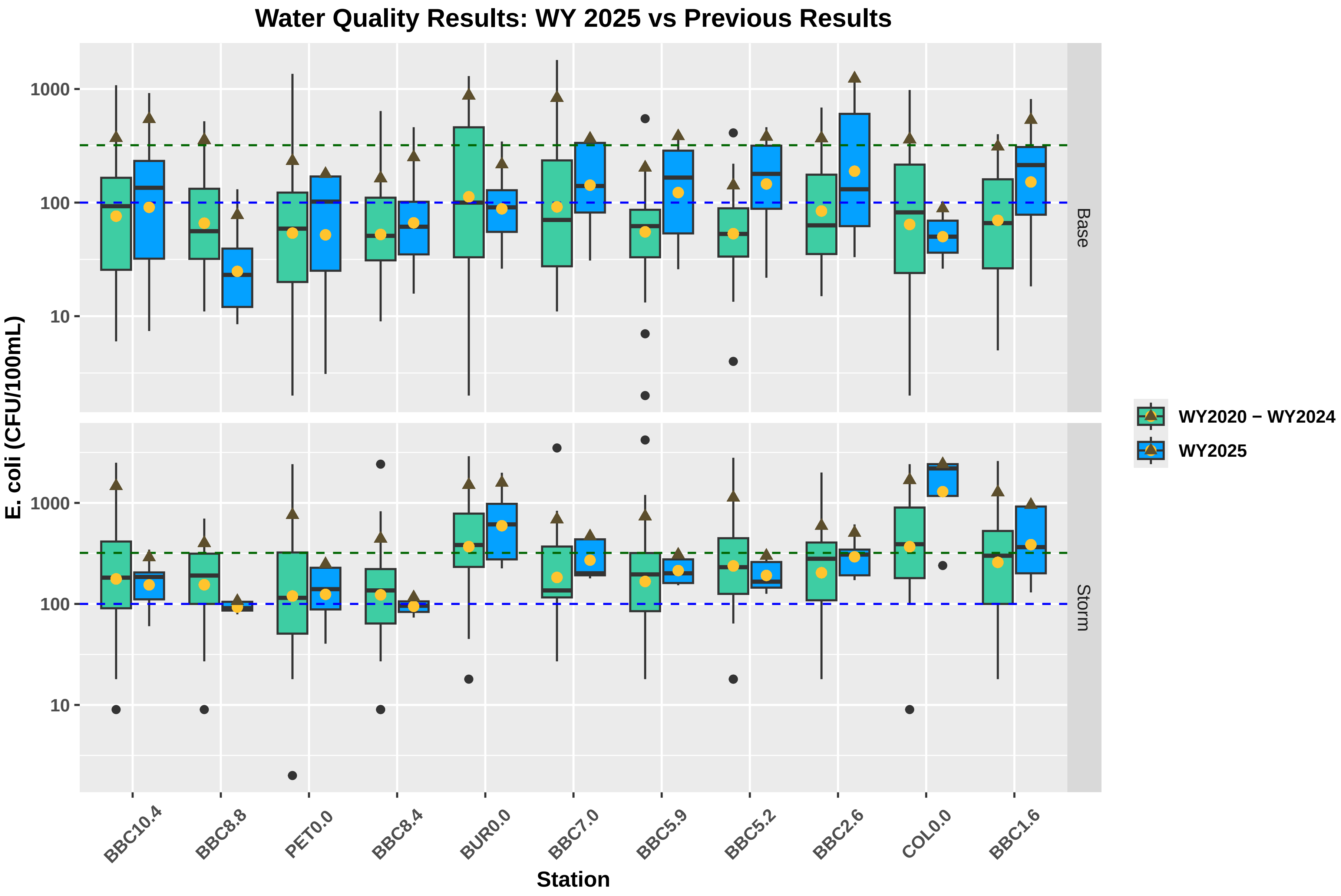


Arithmetic mean shown in yellow.

Water Quality Results: WY 2025 vs Previous Results

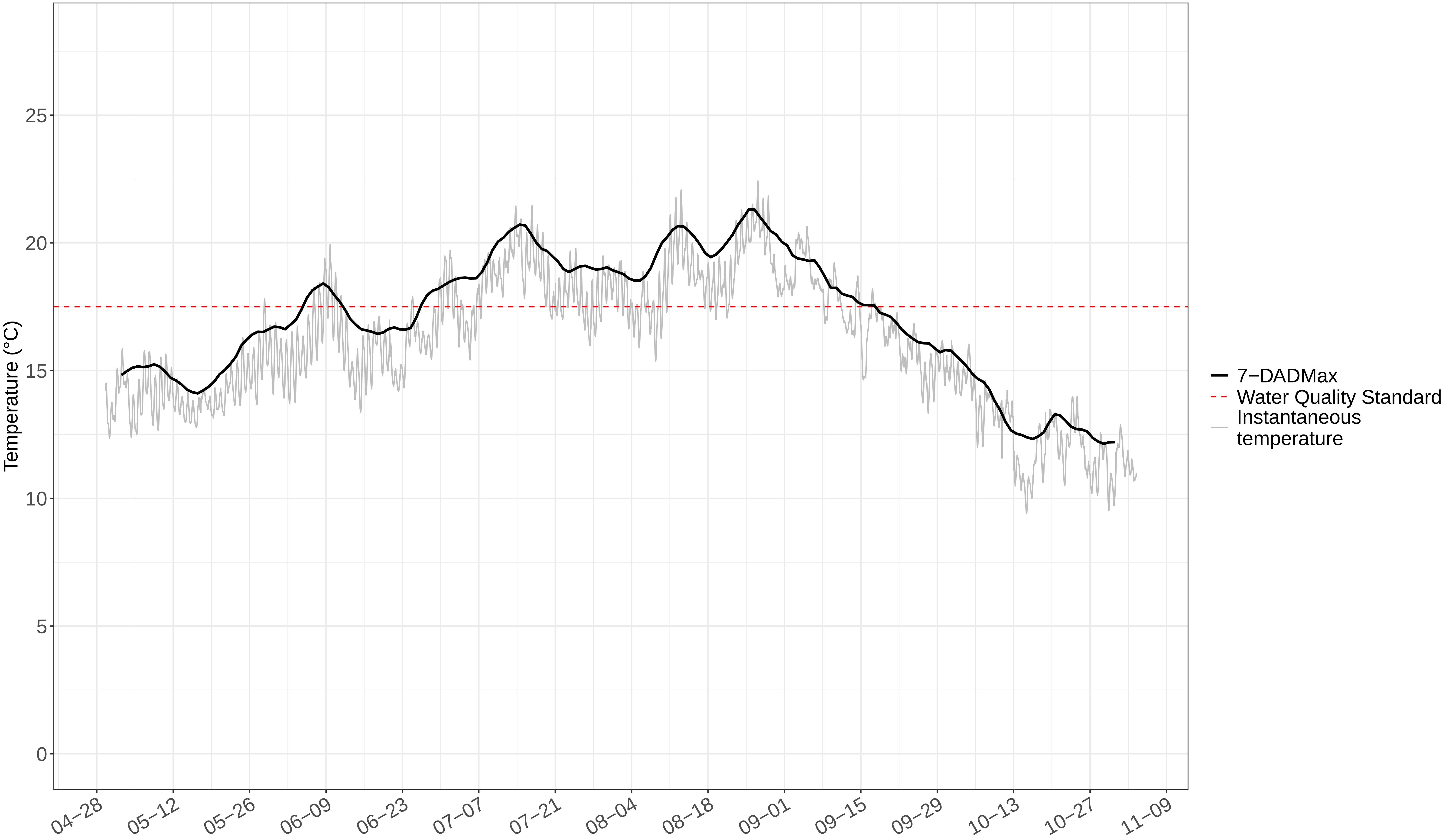


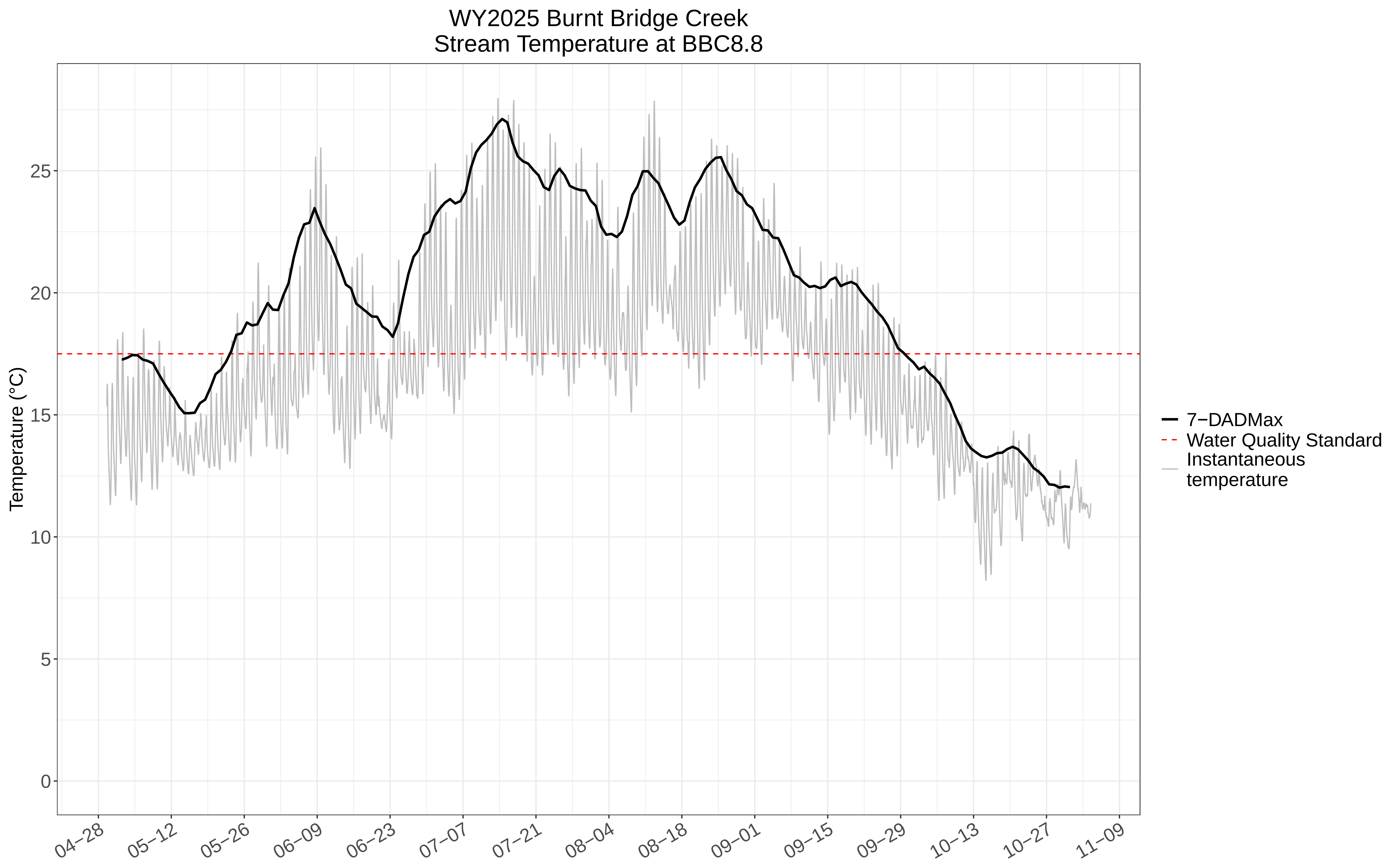
Arithmetic mean shown in yellow.



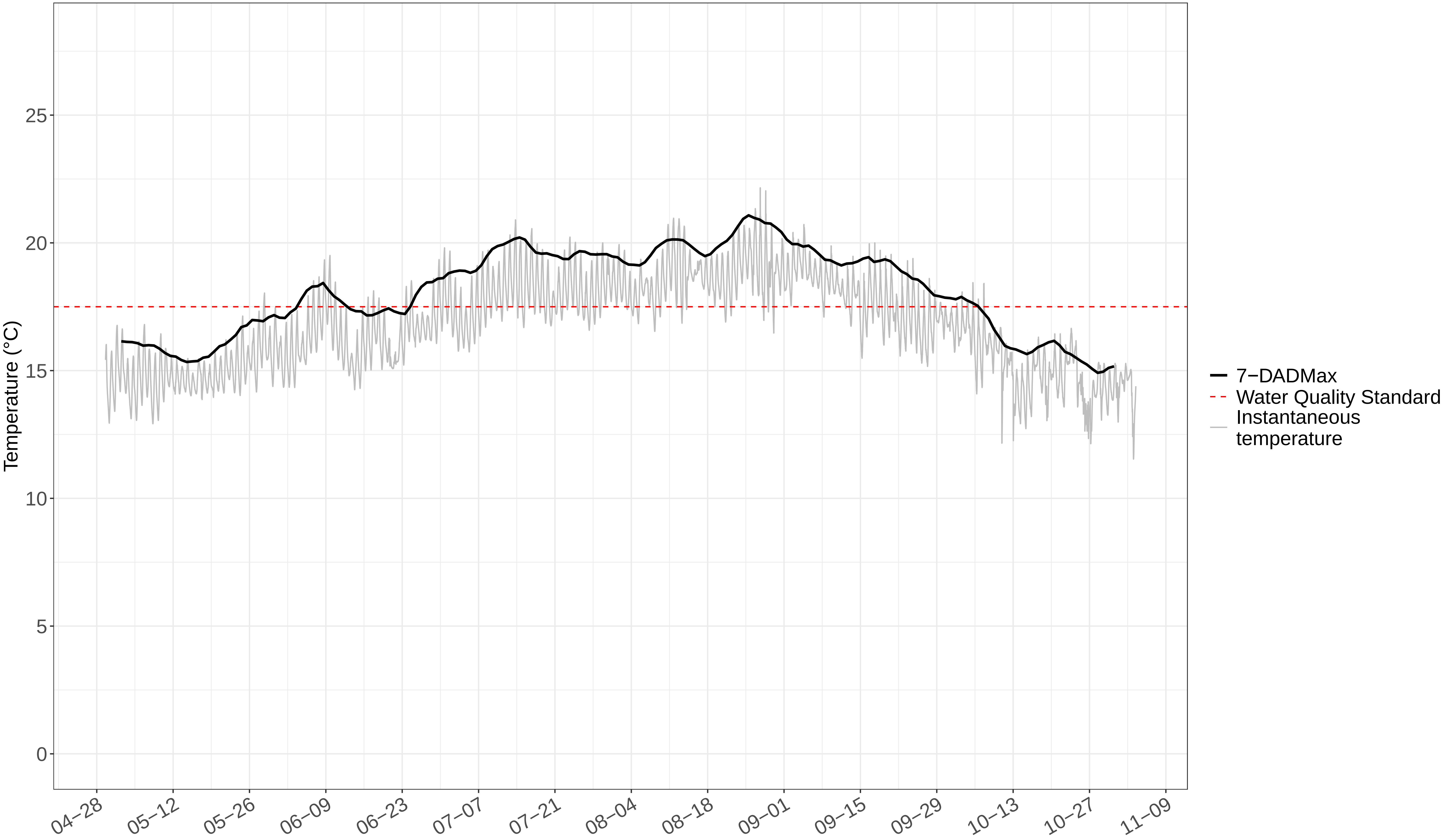
Blue lines indicate criteria for geometric mean.
Dark green lines indicate criteria for 90th percentile.
Geometric mean shown in yellow.
90th percentile shown as a brown triangle.
WY2025 Base results for COL0.0 include only two points.

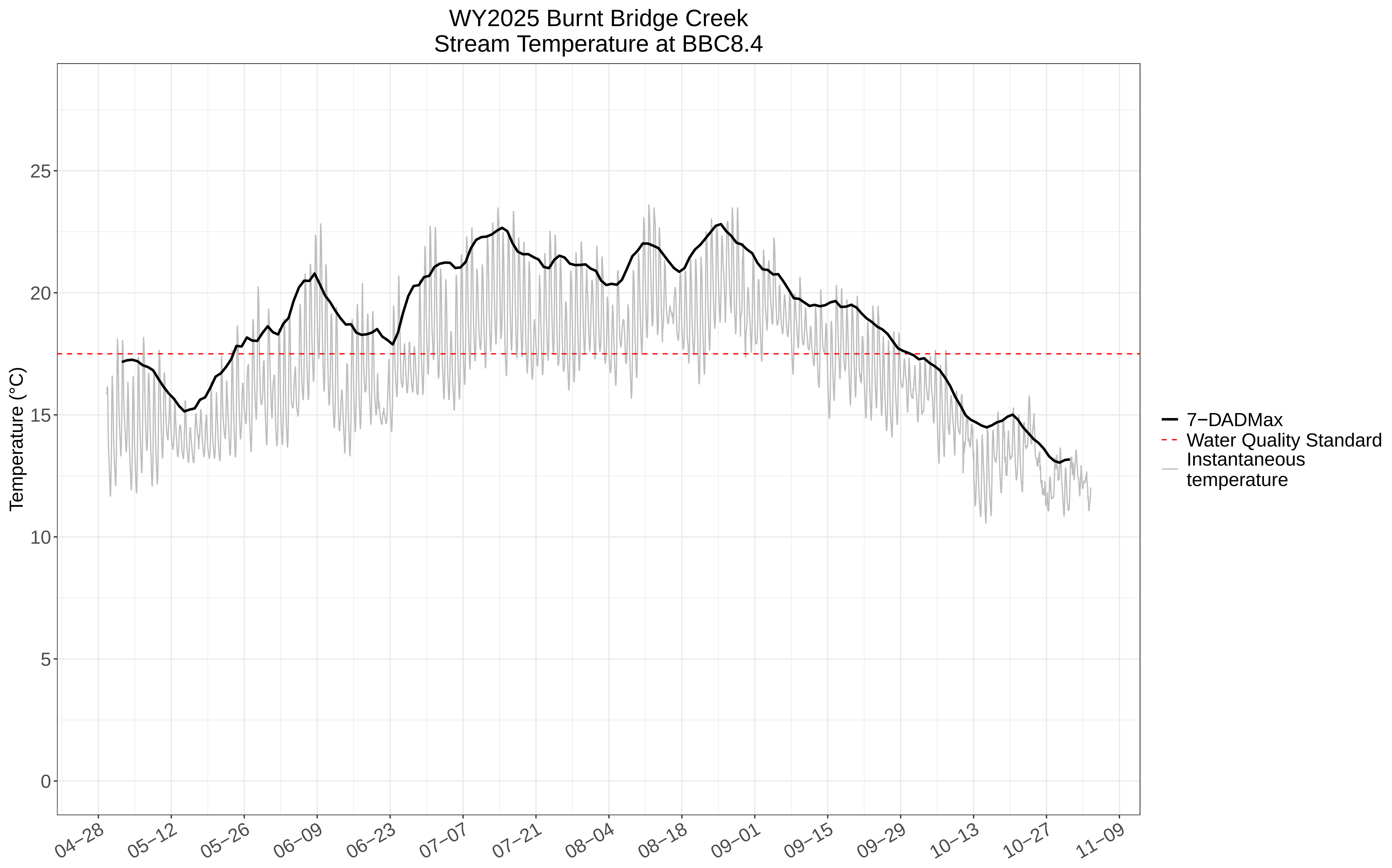
WY2025 Burnt Bridge Creek
Stream Temperature at BBC10.4

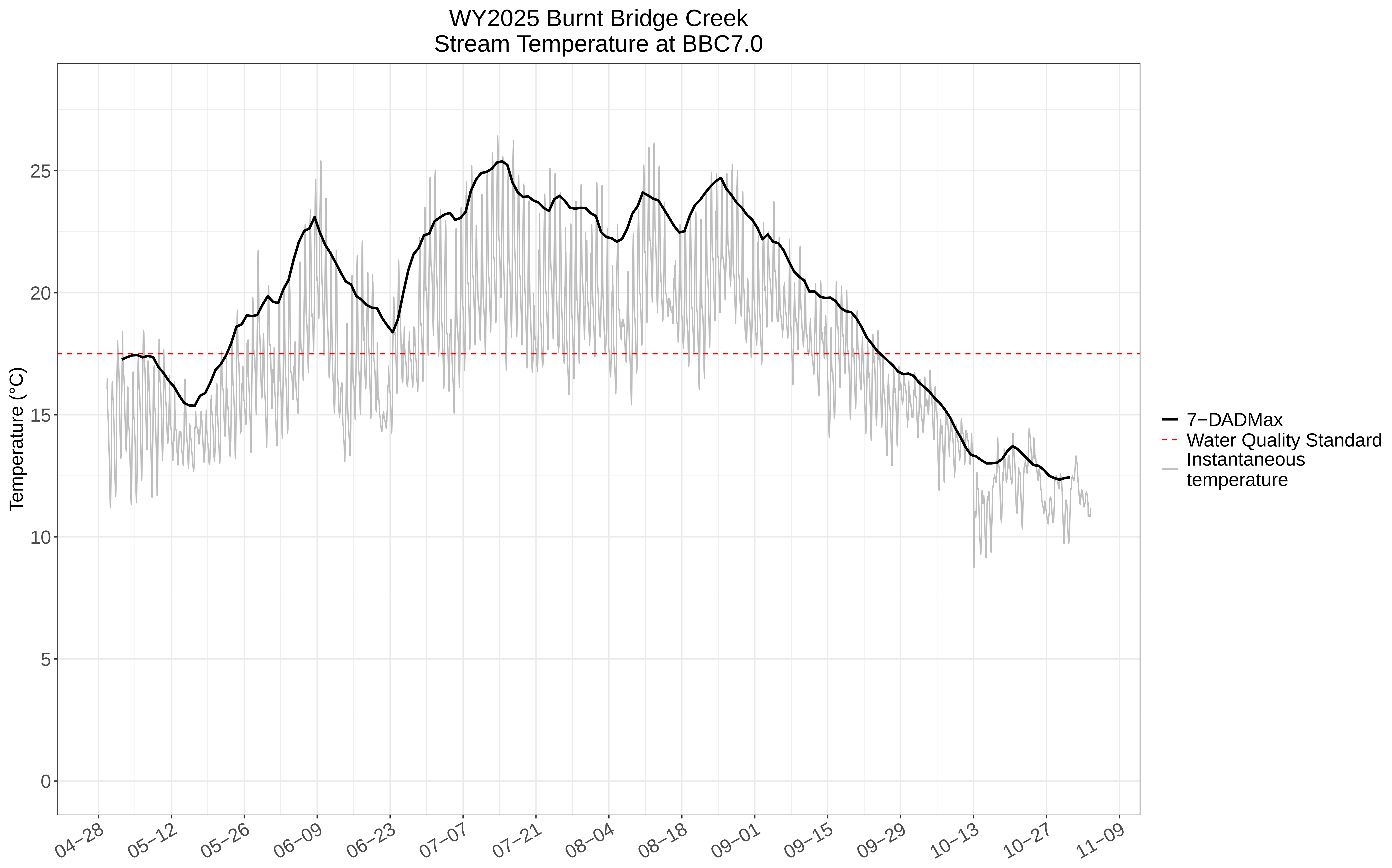


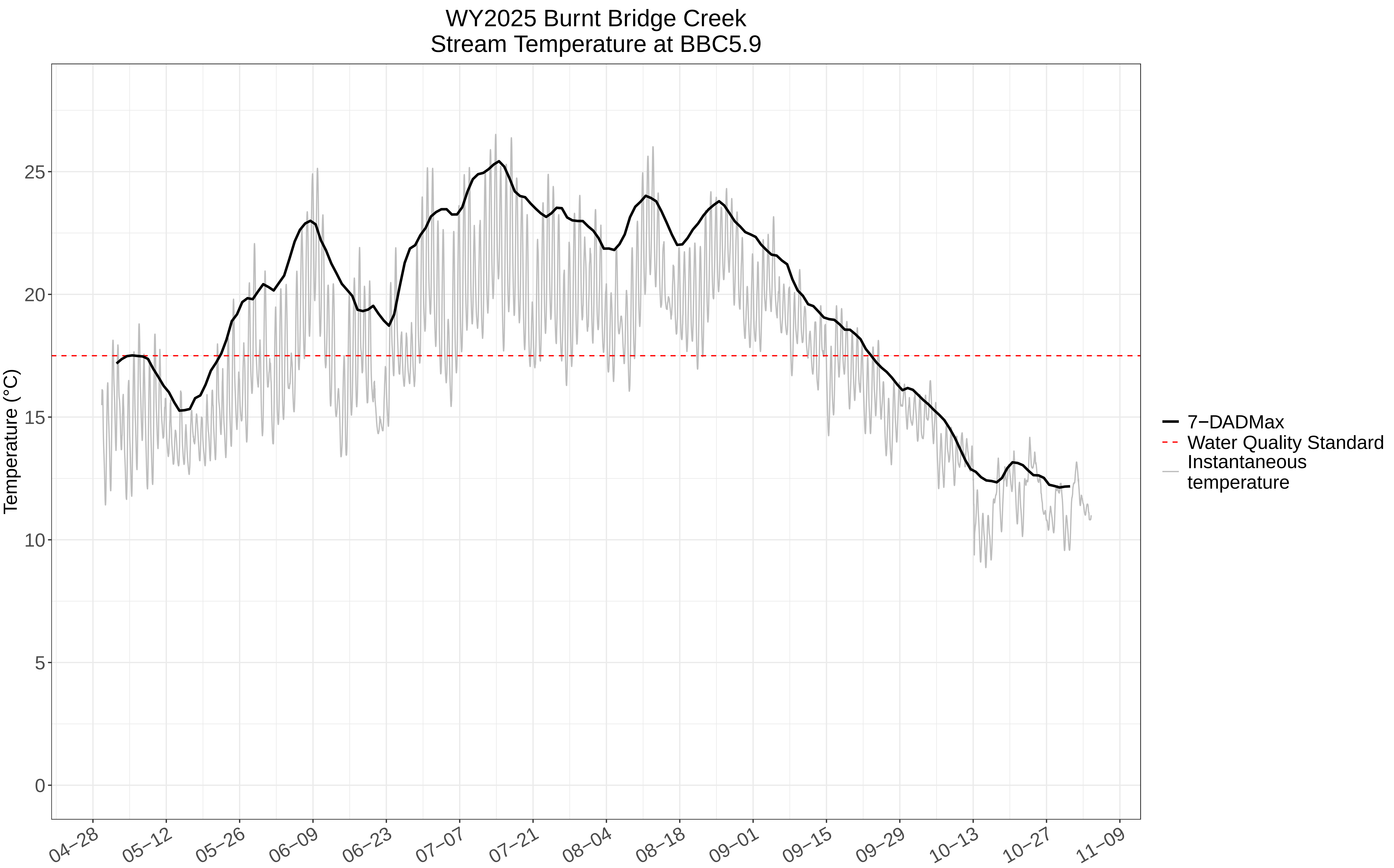

WY2025 Burnt Bridge Creek
Stream Temperature at BBC8.8
Temperature (°C)
0
5
10
15
20
25
04−28
05−12
05−26
06−09
06−23
07−07
07−21
08−04
08−18
09−01
09−15
09−29
10−13
10−27
11−09
7−DADMax
Water Quality Standard
Instantaneous temperature

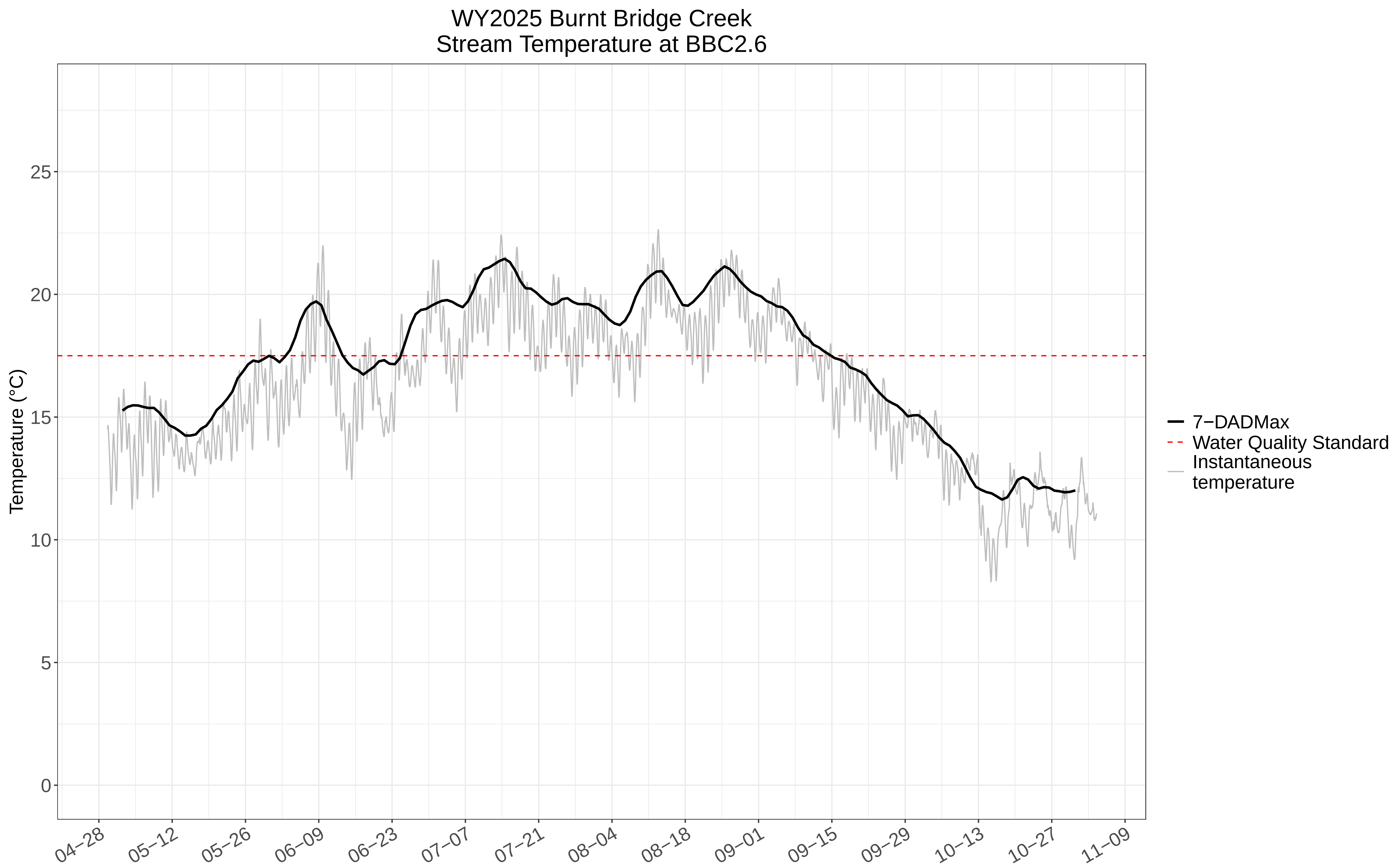
WY2025 Burnt Bridge Creek
Stream Temperature at PET0.0

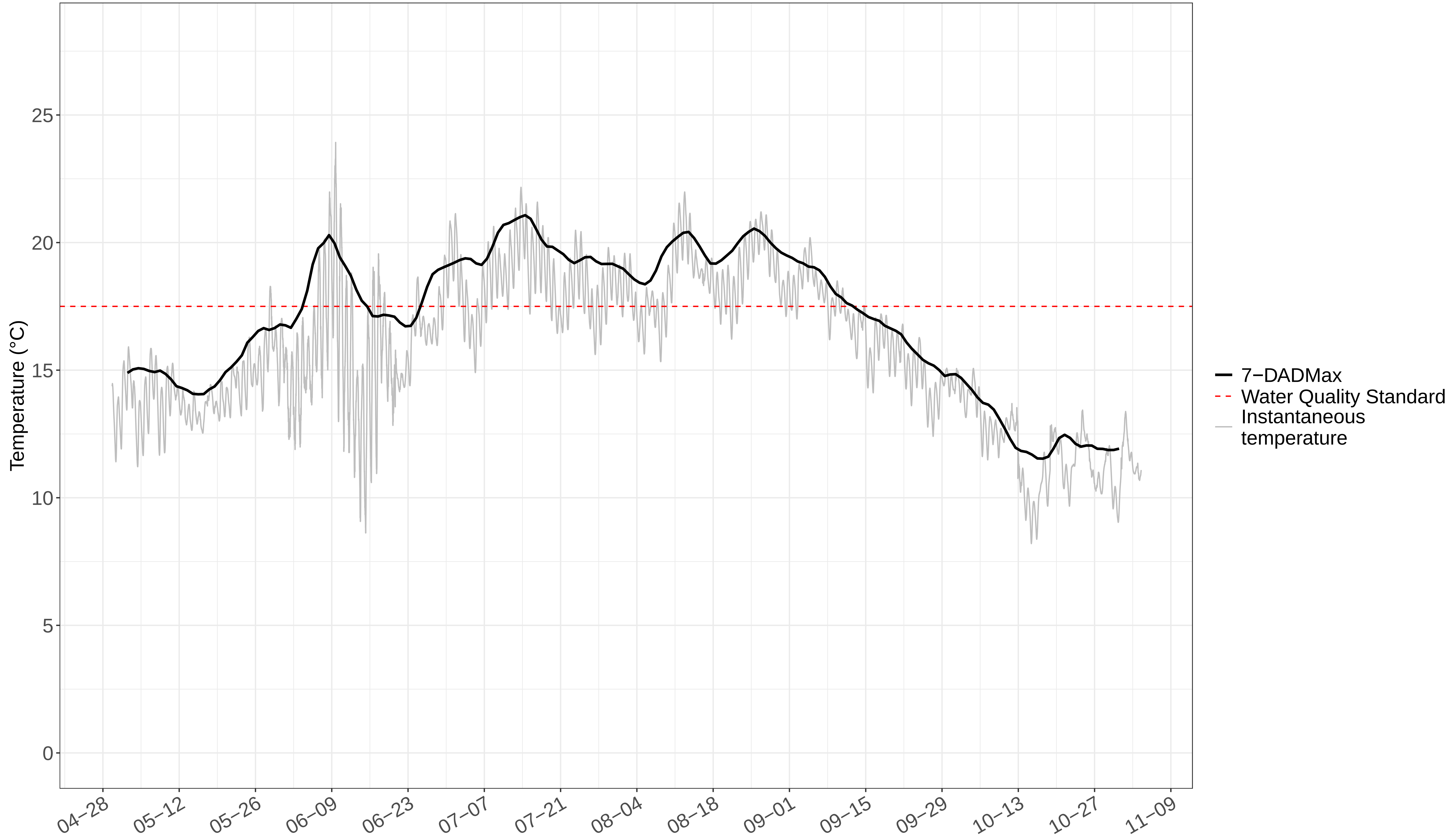



WY2025 Burnt Bridge Creek
Stream Temperature at BBC8.4
Temperature (°C)
0
5
10
15
20
25
04−28
05−12
05−26
06−09
06−23
07−07
07−21
08−04
08−18
09−01
09−15
09−29
10−13
10−27
11−09
7−DADMax
Water Quality Standard
Instantaneous temperature


WY2025 Burnt Bridge Creek
Stream Temperature at BBC7.0
Temperature (°C)
0
5
10
15
20
25
04−28
05−12
05−26
06−09
06−23
07−07
07−21
08−04
08−18
09−01
09−15
09−29
10−13
10−27
11−09
7−DADMax
Water Quality Standard
Instantaneous temperature


WY2025 Burnt Bridge Creek
Stream Temperature at BBC5.9
Temperature (°C)
0
5
10
15
20
25
04−28
05−12
05−26
06−09
06−23
07−07
07−21
08−04
08−18
09−01
09−15
09−29
10−13
10−27
11−09
7−DADMax
Water Quality Standard
Instantaneous temperature

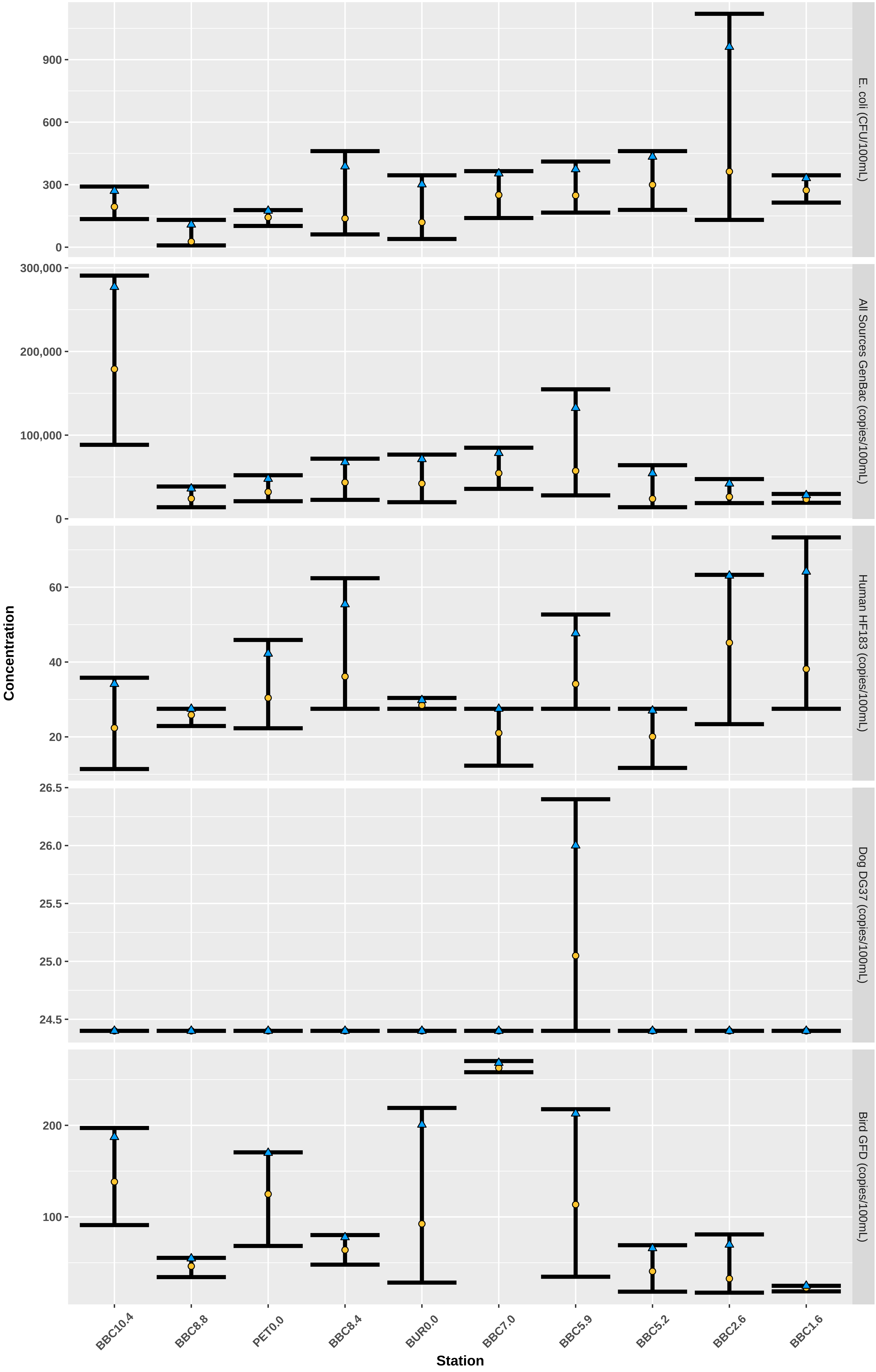

WY2025 Burnt Bridge Creek
Stream Temperature at BBC2.6
Temperature (°C)
25
20
15
10
5
0
04−28
05−12
05−26
06−09
06−23
07−07
07−21
08−04
08−18
09−01
09−15
09−29
10−13
10−27
11−09
7−DADMax
Water Quality Standard
Instantaneous temperature



WY2025 Burnt Bridge Creek
Stream Temperature at BBC1.6

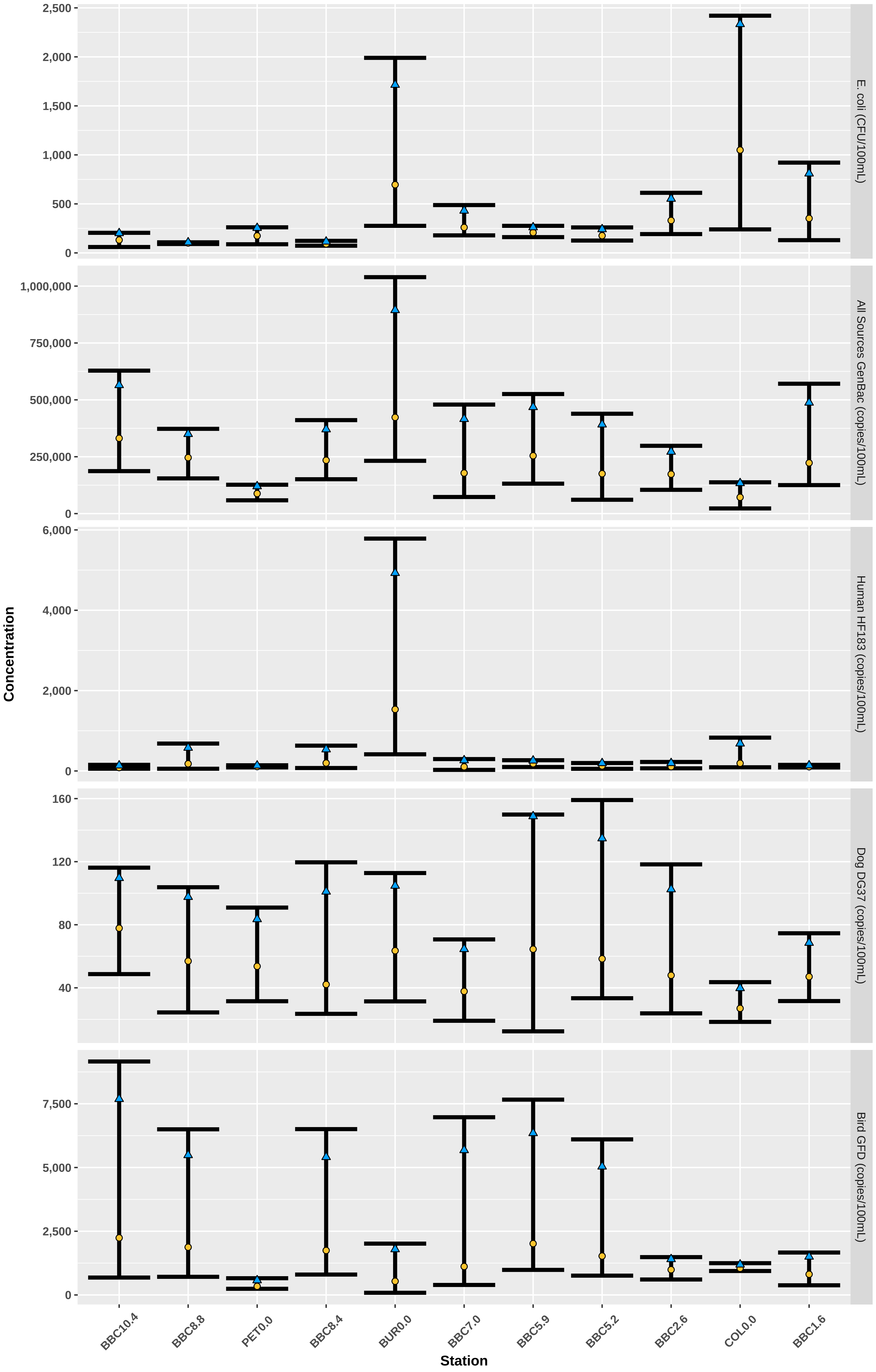
E. Coli versus MST Results for 2025 Base Flow Sampling Events

Geometric mean shown in yellow.
90th percentile shown as a blue triangle.



E. Coli versus MST Results for 2025 Storm Sampling Events

Geometric mean shown in yellow.
90th percentile shown as a blue triangle.



Comparison of all WY 2025 events to MST sampling events

Gold errorbars and points indicate range of E. coli values for MST sampling events
Boxplots indicate distribution of E. coli values collected for all events in WY 2025