



State of Oregon
DEQ Department of Environmental Quality

Integrated Report 2022, Assessments Methodology

Water Quality Assessments Program

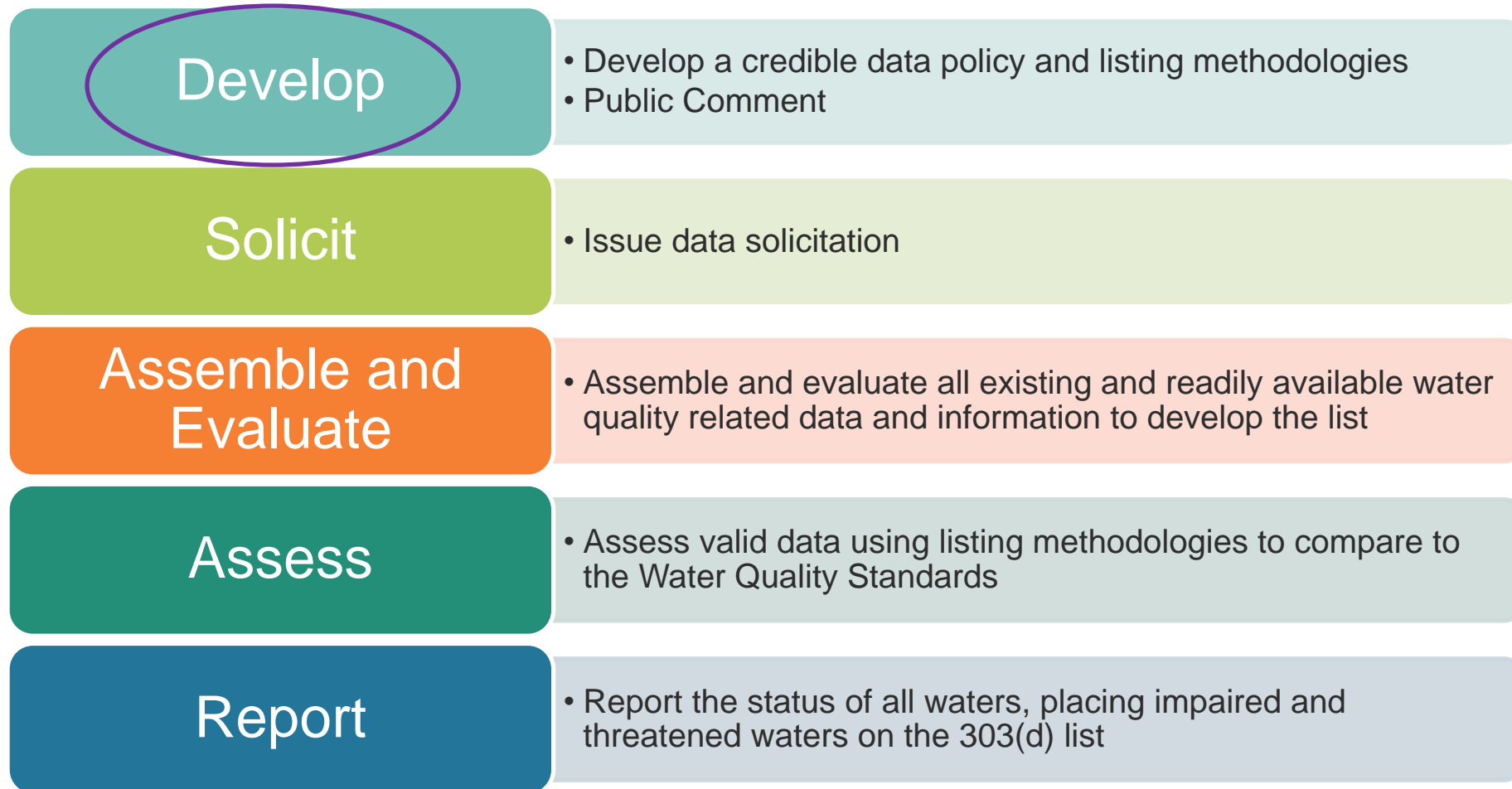
October 8, 2022
Webinar 2



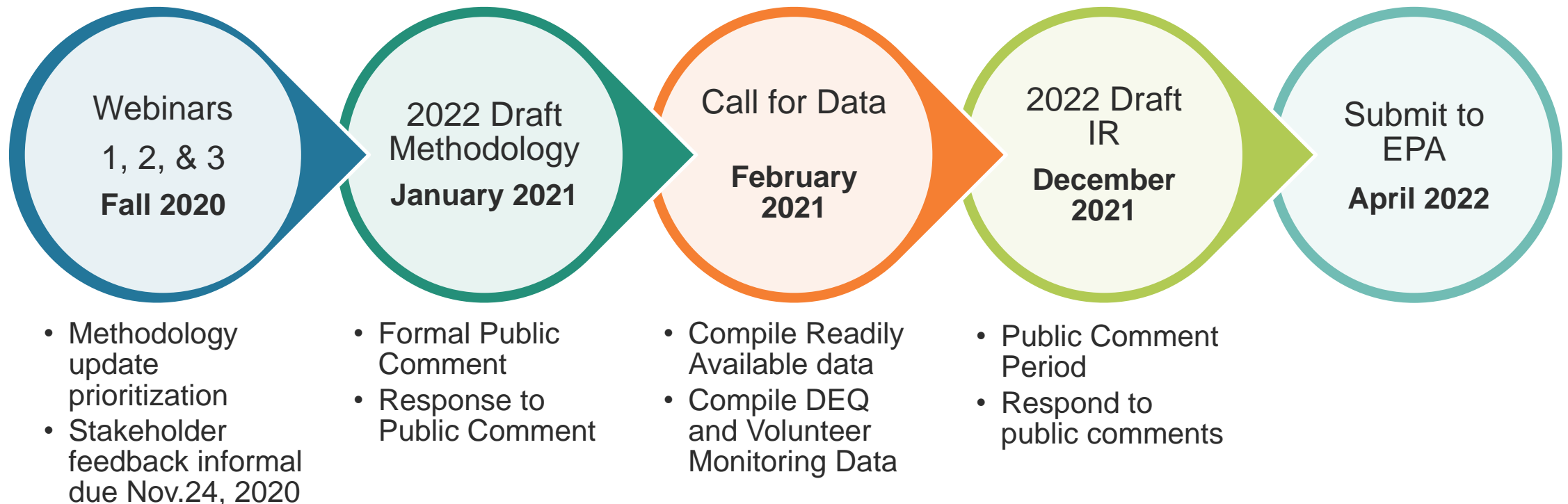
Agenda, Webinar 2

Time	Topic	Presenter
9:30 a.m.	Welcome and logistics	Michele Martin
9:40 a.m.	Background, Oregon's 2022 Water Quality Report and List of Water Quality Limited Waters (Integrated Report)	Becky Anthony
9:50 a.m.	Delisting for continuous dissolved oxygen and discussion <i>white paper</i> online	Travis Pritchard
11:10 a.m.	Break (10 min.)	
11:20 a.m.	Continuous pH methodology and discussion <i>white paper</i> online	Lesley Merrick
11:50 a.m.	Watershed assessment units; assessment by station Next steps	Becky Anthony
12:00 p.m.	Adjourn	

Integrated Report Process



Integrated Report 2022, Schedule



Dissolved oxygen delisting methodology update

- Dissolved oxygen in water is necessary for aquatic life
- 2 main drivers of low dissolved oxygen
 - Water Temperature
 - Warmer water → Lower DO levels
 - Microbial Activity



Dissolved oxygen standard

Table 15. Dissolved Oxygen & Intergravel Dissolved Oxygen Criteria (OAR-340-041-0016, TABLE 21)

D.O. Standard	Concentration and Period ¹ (All Units are mg/L)				Use/Level of Protection
	30-D	7-D	7- Mi	Min	
Salmonid Spawning		11.0 ^{2,3}		9.0 ³ IGDO: 8.0 ⁴	Principal use of salmonid spawning and incubation of embryos until emergence from the gravels. Low risk of impairment to cold-water aquatic life, other native fish and invertebrates.
Cold Water	8.0 ⁵		6.5	6.0	Principally cold-water aquatic life. Salmon, trout, cold-water invertebrates, and other native cold-water species exist throughout all or most of the year. Juvenile anadromous salmonids may rear throughout the year. No measurable risk level for these communities.
Cool Water	6.5		5.0	4.0	Mixed native cool-water aquatic life, such as sculpins, smelt, and lampreys. Waterbodies includes estuaries. Salmonids and other cold-water biota may be present during part or all of the year but do not form a dominant component of the community structure. No measurable risk to cool-water species, slight risk to cold-water species present.
Warm Water	5.5			4.0	Waterbodies whose aquatic life beneficial uses are characterized by introduced, or native, warm-water species.
Marine / No Risk	No Change from Background				The only DO criterion that provides no additional risks is “no change from background”. Waterbodies accorded this level of protection include marine waters and waters in Wilderness areas.

OAR-340-041-0002, TABLE 21 (Continued)

Note:

Shaded values present the absolute minimum criteria, unless the Department believes adequate data exists to apply the multiple criteria and associated periods.

¹ **30-D** = 30-day mean minimum as defined in OAR 340-41-006.

7-D = 7-day mean minimum as defined in OAR 340-41-006.

7-Mi = 7-day minimum mean as defined in OAR 340-41-006.

Min = Absolute minimums for surface samples when applying the averaging period, spatial median of IGDO.

² When Intergravel DO levels are 8.0 mg/L or greater, DO levels may be as low as 9.0 mg/L, without triggering a violation.

³ If conditions of barometric pressure, altitude and temperature preclude achievement of the footnoted criteria, then 95 percent saturation applies.

⁴ Intergravel DO criterion, spatial median minimum.

⁵ If conditions of barometric pressure, altitude, and temperature preclude achievement of 8.0 mg/L, then 90 percent saturation applies.

Dissolved oxygen standard

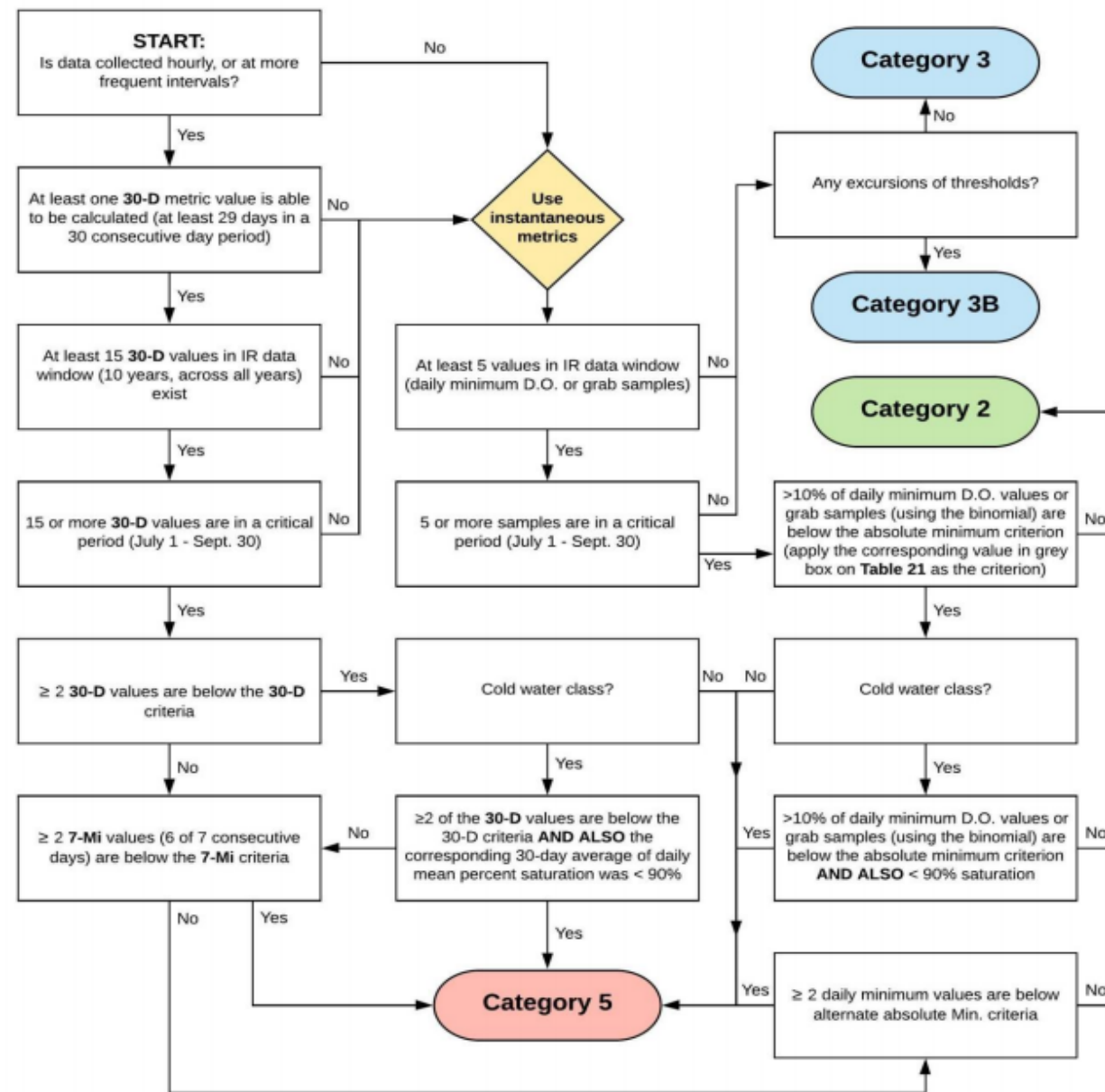


Figure 5. The decision tree for assessment of the dissolved oxygen year-round criteria

Dissolved oxygen motivation for update

Current Delisting methodology not appropriate for DO standard

Most other parameters utilize the binomial process to delist

Conventional delistings require 15 sample minimum
10% of samples are excursions with a 90% confidence

Example: if 41-47 samples, delist if excursions ≤ 6

Sample Size	Delist if excursions \leq
15	1
16-18	2
19-25	3
26-32	4
33-40	5
41-47	6
48-55	7
56-63	8
64-71	9
72-79	10
80-88	11
89-96	12
97-104	13
105-113	14
114-121	15
122-130	16
131-138	17
139-147	18
148-156	19
157-164	20
165-173	21
174-182	22
183-191	23
192-199	24
≥ 200	See generalized delisting method for formula to calculate the number of excursions

Dissolved oxygen delisting

Motivation

- DEQ developed new statistical based delisting methodology for 2018/2020 Integrated Report
 - Based on similar binomial process as listing policy
 - 90% confidence level of actual exceedance proportion is $< 10\%$
- The uniqueness of the Dissolved Oxygen (DO) standard and resulting assessment methodology makes the statistical binomial test inappropriate for delisting.

Dissolved oxygen delisting - proposal

Full critical period (or spawning option)

- Dataset must include minimum 3 years of data that have 80% of the critical period (July 1st – September 30th) in each year represented *and*
- Continuous metrics analysis results in a category 2 designation of attaining criteria

OR

Short term probe deployments

- Dataset includes minimum 3 years of data that contains at least 5 full days of continuous dissolved oxygen per critical period month per year *and*
- The daily minimum values assess to a attaining condition

Dissolved oxygen delisting - proposal

In addition, for the 2022 and 2024 Integrated Report cycles only:

- Grab sample method
 - Dataset includes 3 years of data that contain at least 2 results for each critical period month
 - There are no excursions of any applicable criteria
- Allows monitoring partners to adjust to continuous sampling methodologies

Discussion Points

- What type of data should be used?
- When should the data be collected?
- How much data do we need?

Dissolved oxygen delisting

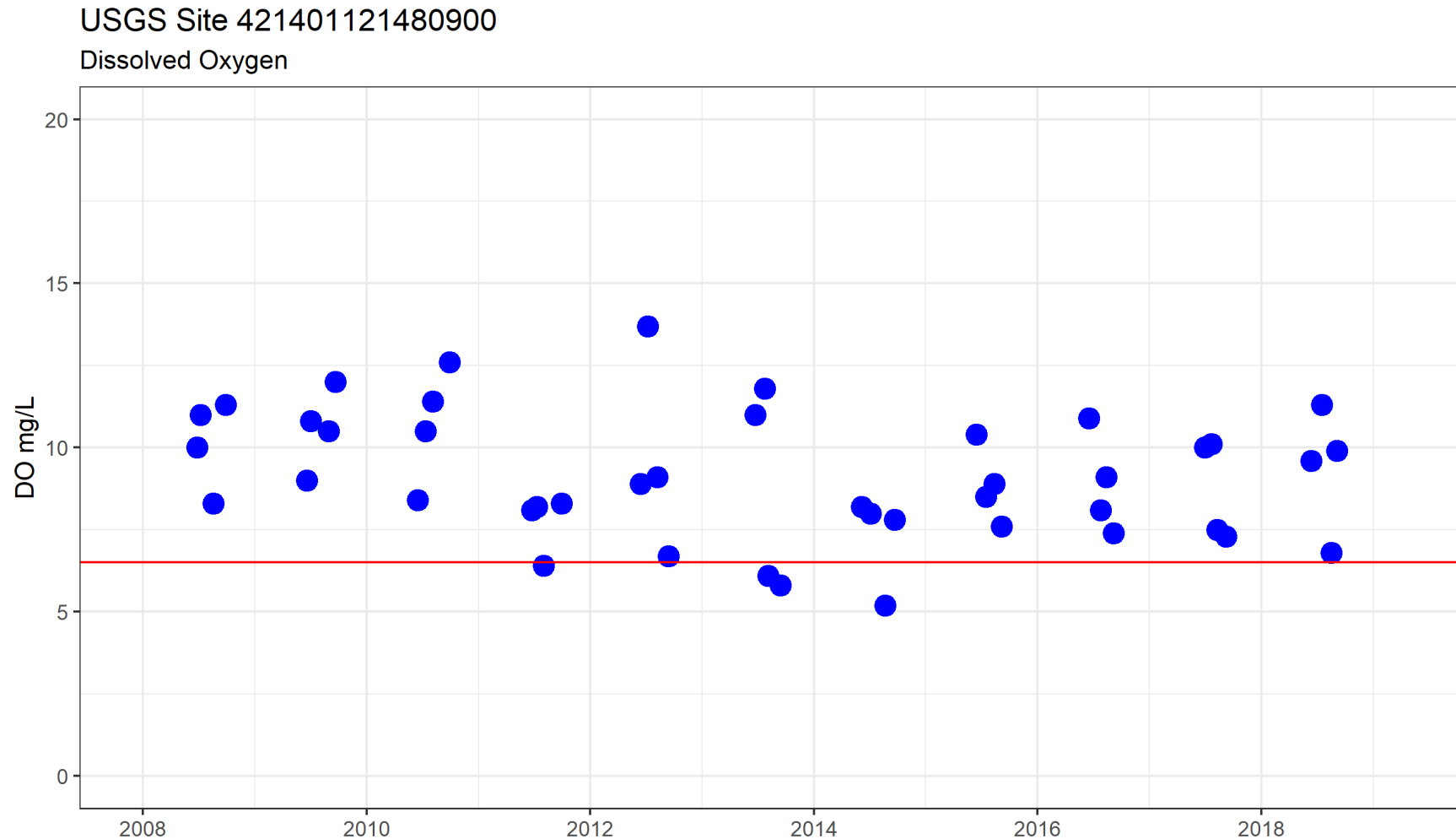
What type of data should be collected

- Grab samples are inadequate to characterize attainment

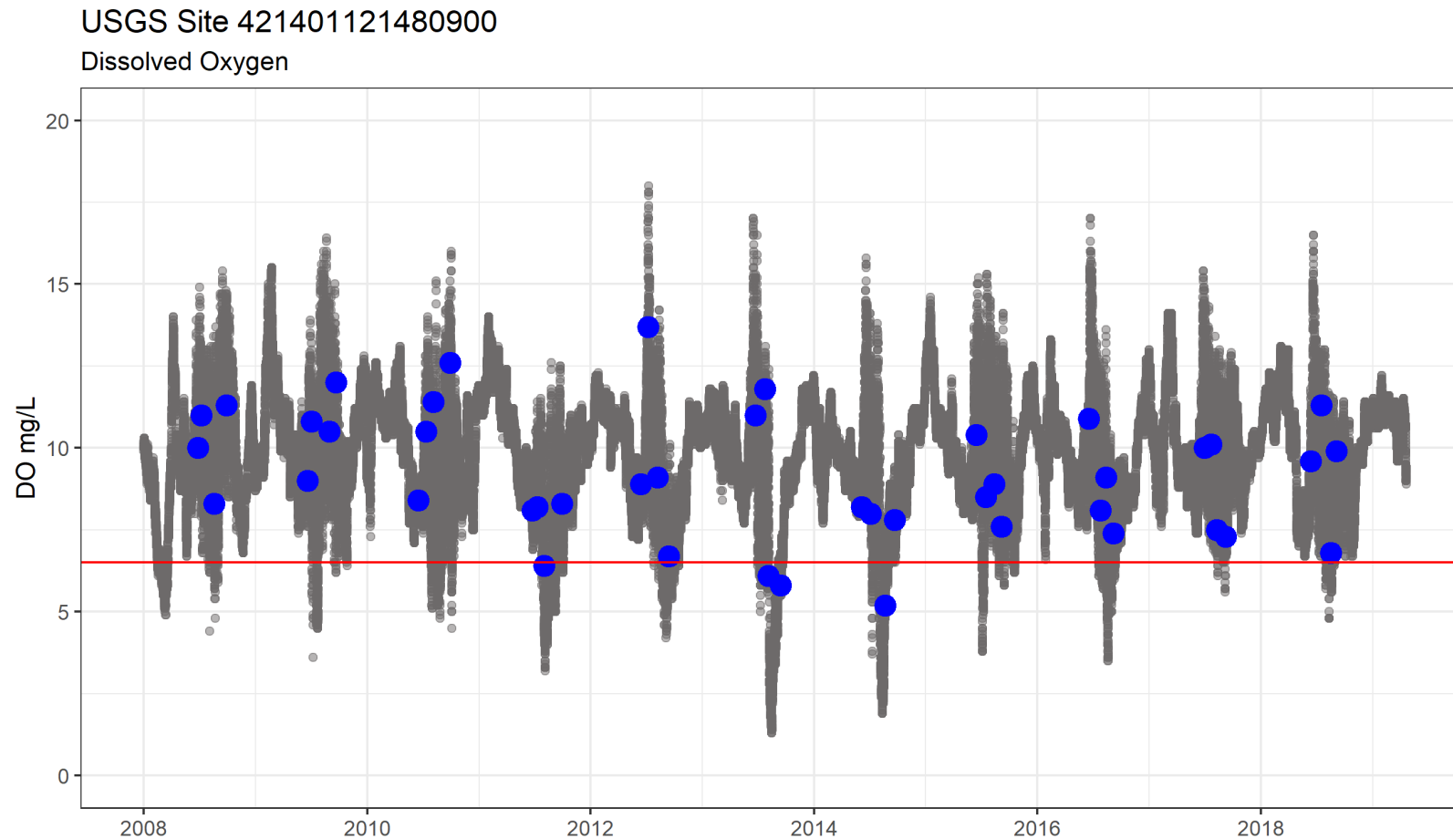
Simulated Sampling Program	Average Accuracy of 5000 Simulations
08:00 - 17:00 critical period monthly grab sampling	60%
08:00 - 12:00 critical period monthly grab sampling	62%
03:00 - 17:00 critical period monthly grab sampling	56%
08:00 - 17:00 critical period weekly grab sampling	67%



Dissolved oxygen delisting grab vs. continuous



Dissolved oxygen Delisting Grab vs Continuous



Dissolved oxygen delisting

- Short term continuous probe deployments perform better

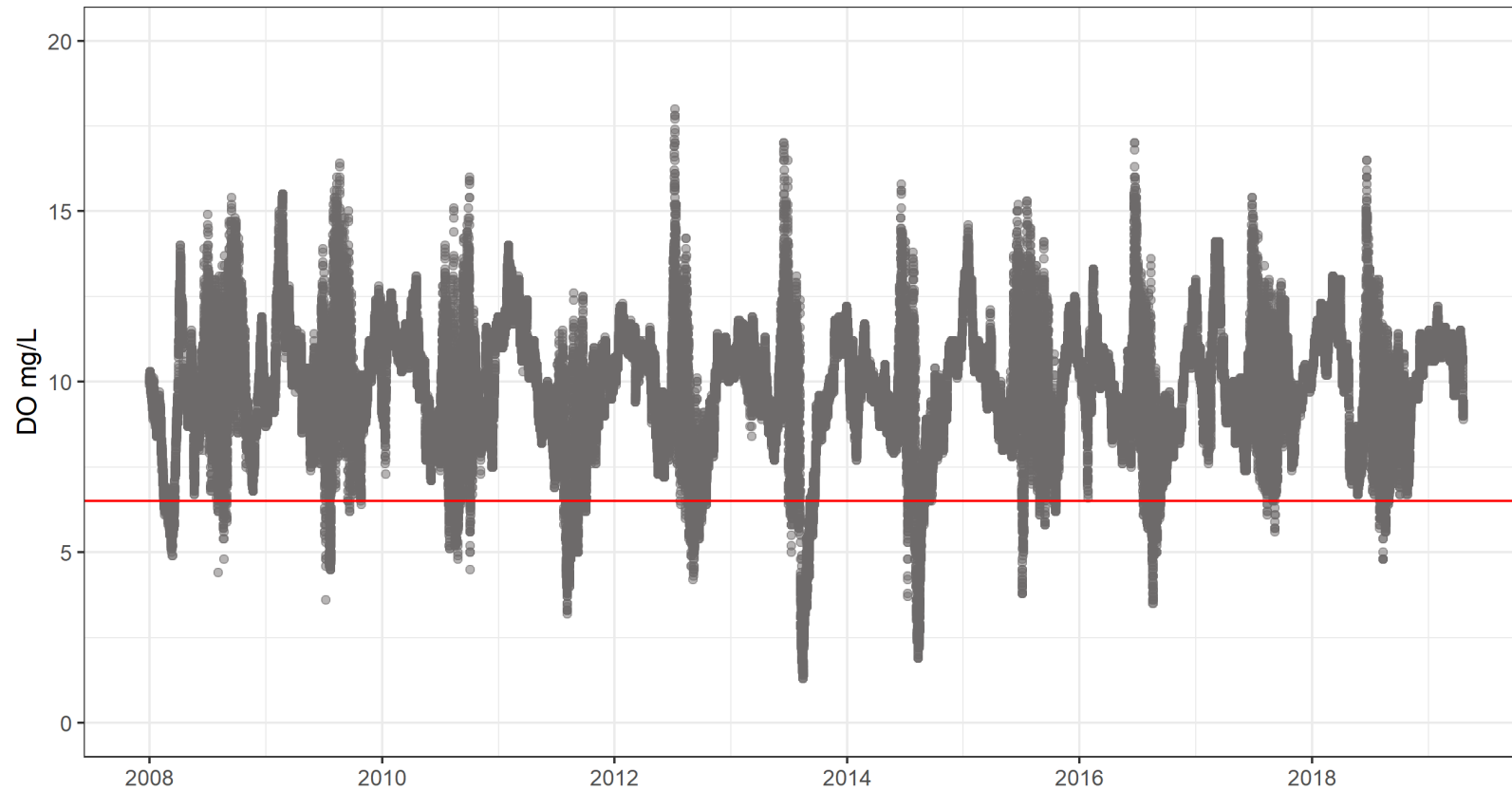
Simulated Sampling Program	Average Accuracy of 5000 Simulations
2 full day continuous probe deployment per critical period month	84%
3 full day continuous probe deployment per critical period month	86%
4 full day continuous probe deployment per critical period month	87%
5 full day continuous probe deployment per critical period month	89%



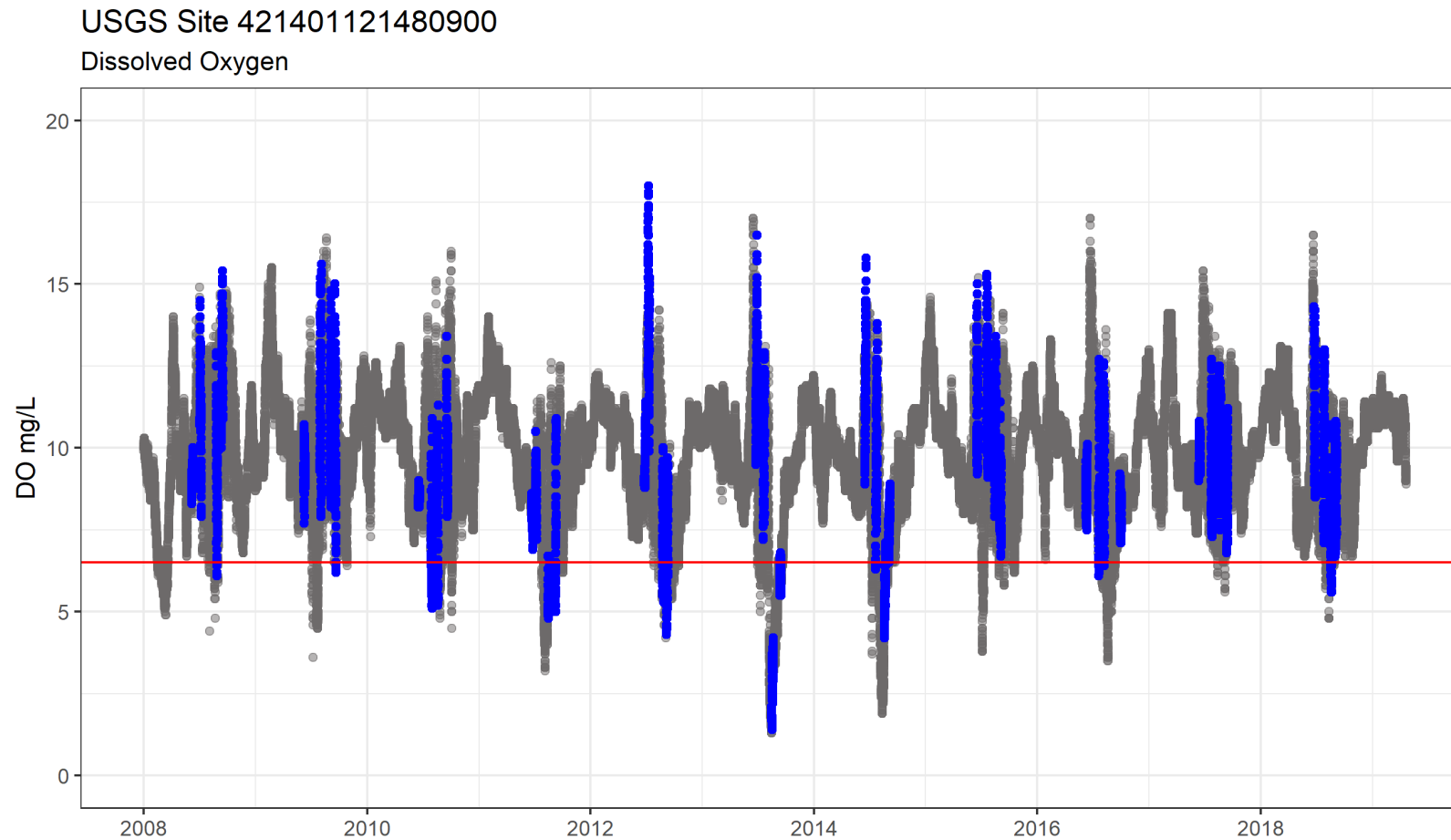
Continuous vs. Grab

USGS Site 421401121480900

Dissolved Oxygen



Continuous vs. Grab



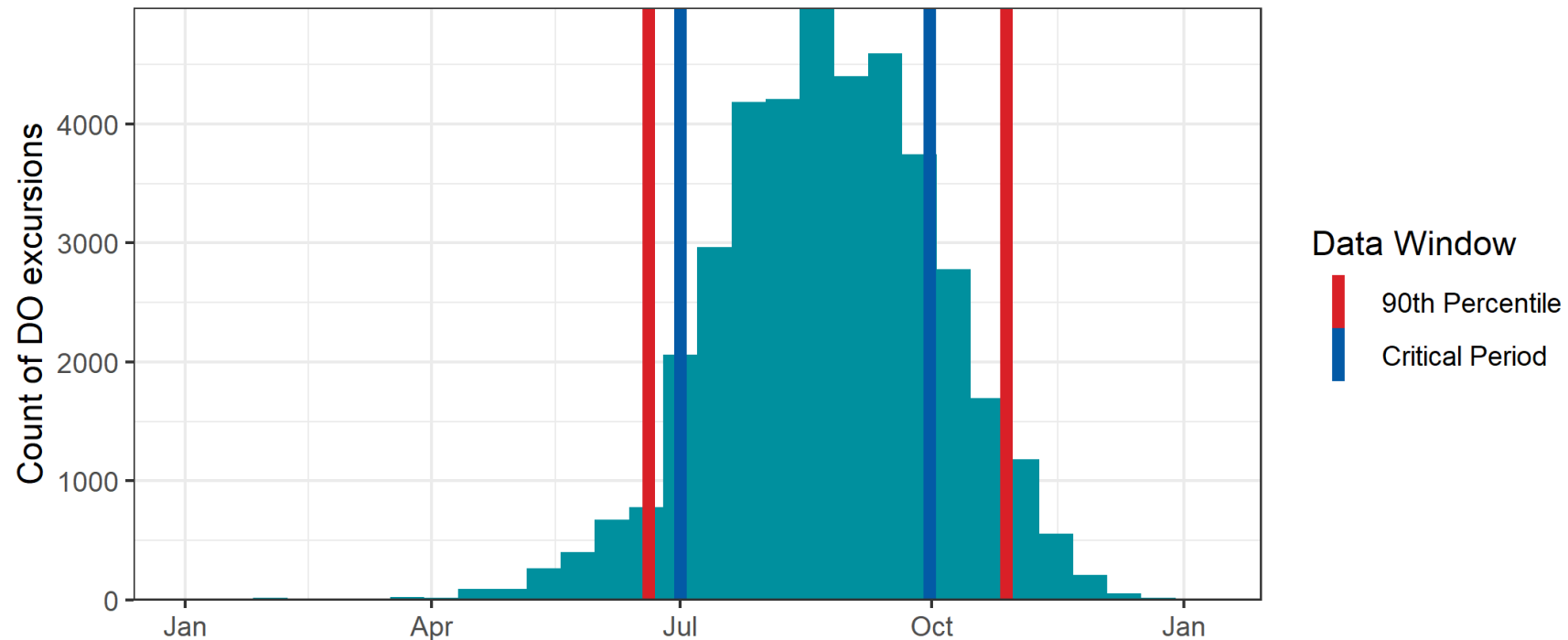
Discussion

- Given the low level of confidence of grab samples to accurately identify non-impaired conditions, should the temporary grab method be included?
 - What is the appropriate balance between protectiveness of Oregon's waterways and ability to use the data we currently have?
- What should the minimum number of critical period grab samples be to include in a delisting procedure?

Time of year

Dissolved Oxygen Criteria Excursions by Day of Year

Date of year-round criteria excursion for all Monitoring Locations in 2018/2020 data window

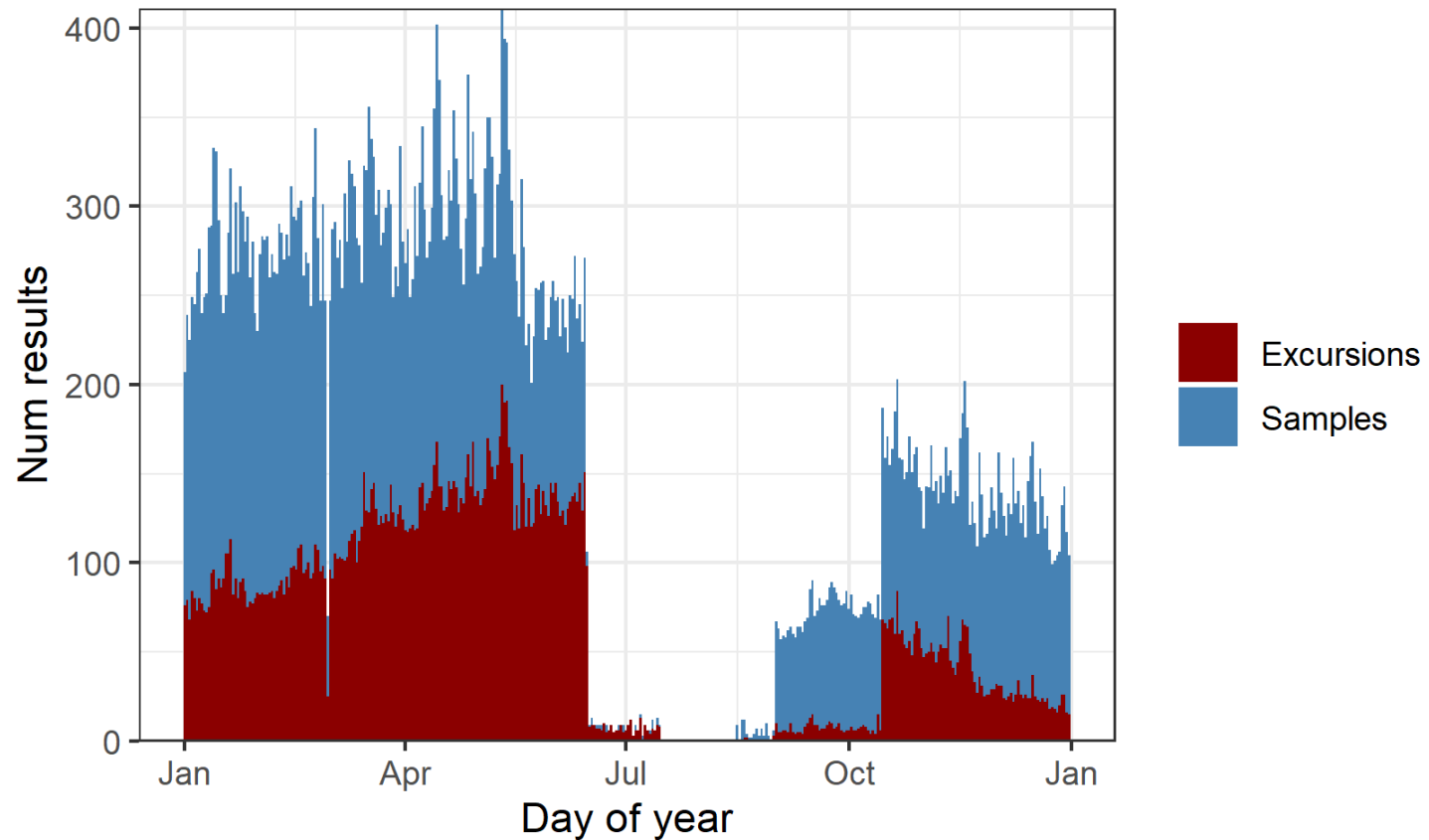


90th percentile bars represents the time period that contains 90% of all year round DO excursions.
Critical Period bars represent the DO critical period of June 1st through September 30th.

Time of year

DO Spawning Excursions

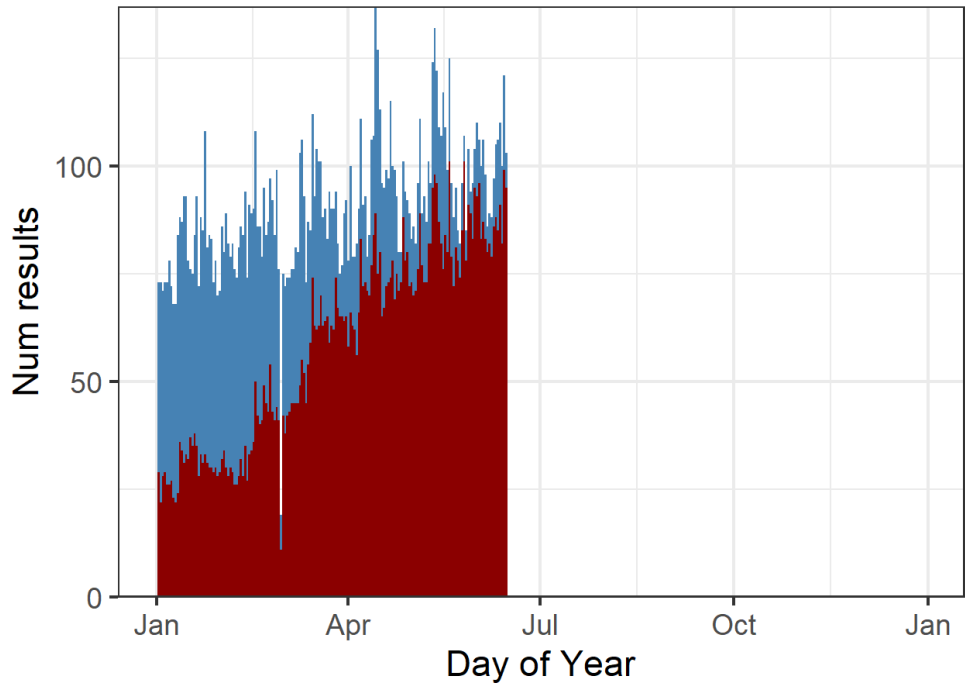
Total number spawning results and excursions



Time of year

DO Spawning Excursions

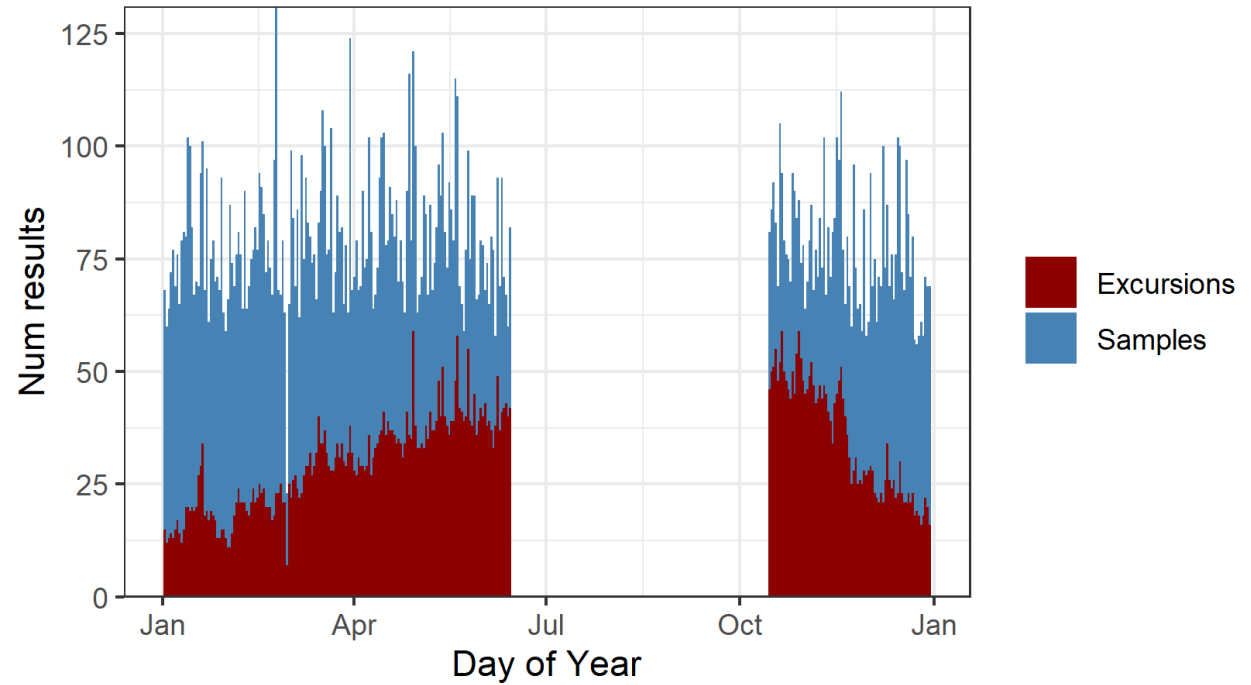
Num spawning results and excursions- DO code = 25



January 1 - June 15

DO Spawning Excursions

Num spawning results and excursions- DO code = 20

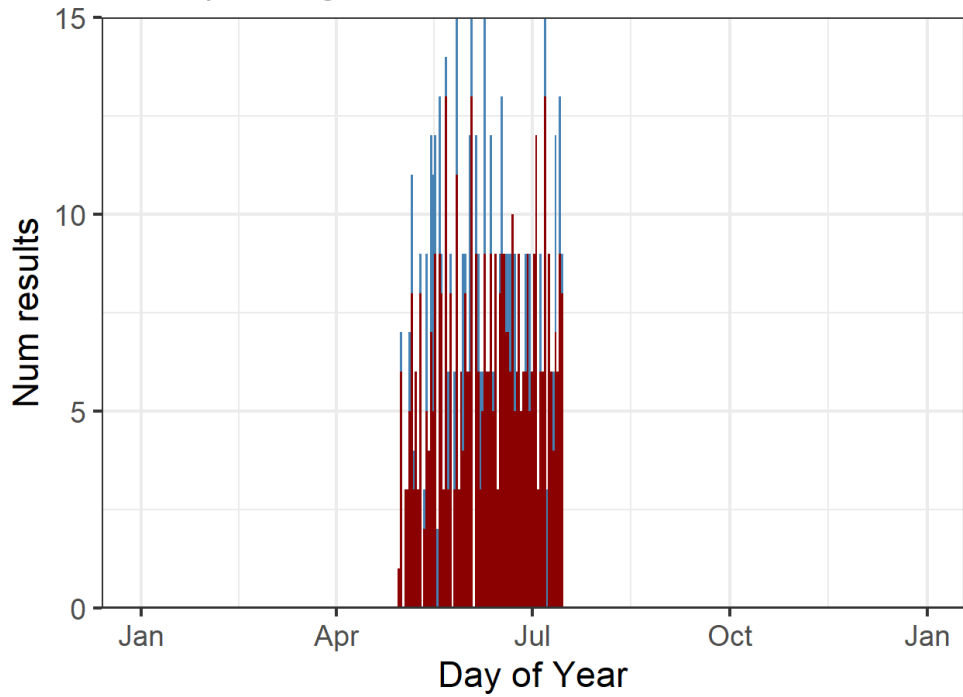


October 15 - June 15

Time of year

DO Spawning Excursions

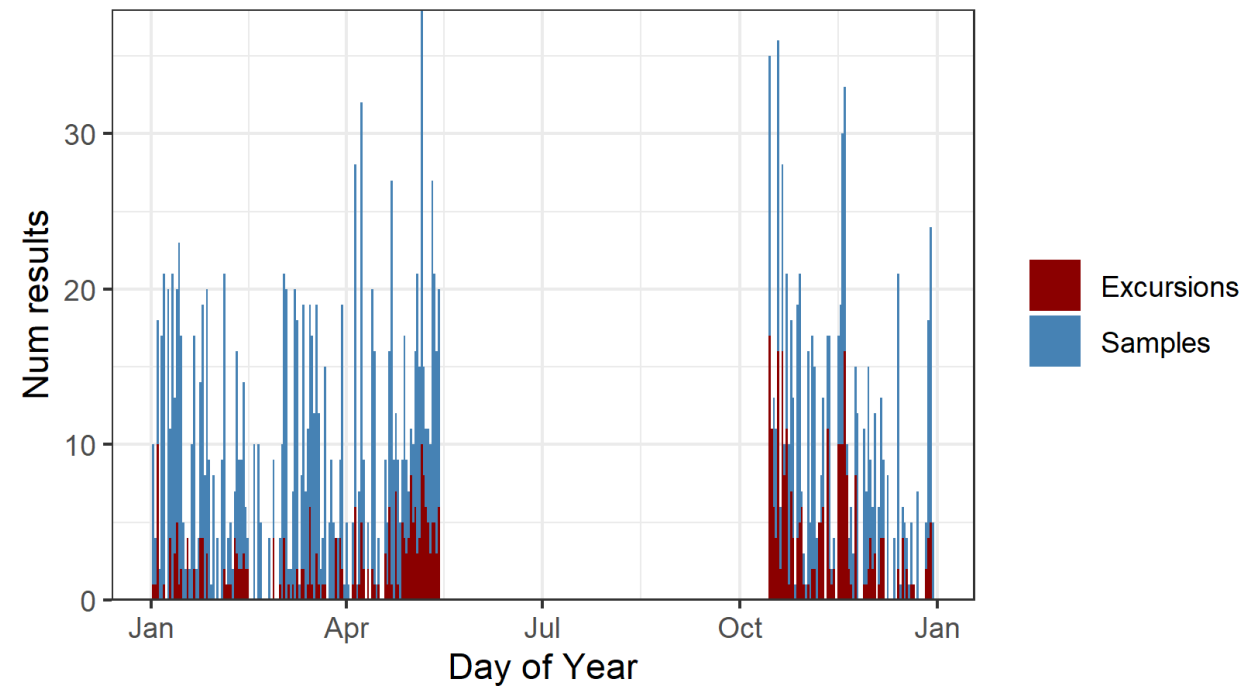
Num spawning results and excursions- DO code = 35



April 1 – July 15

DO Spawning Excursions

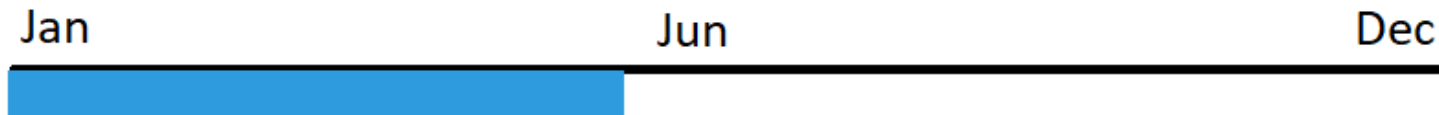
Num spawning results and excursions- DO code = 19



October 15 - May 15

Discussion

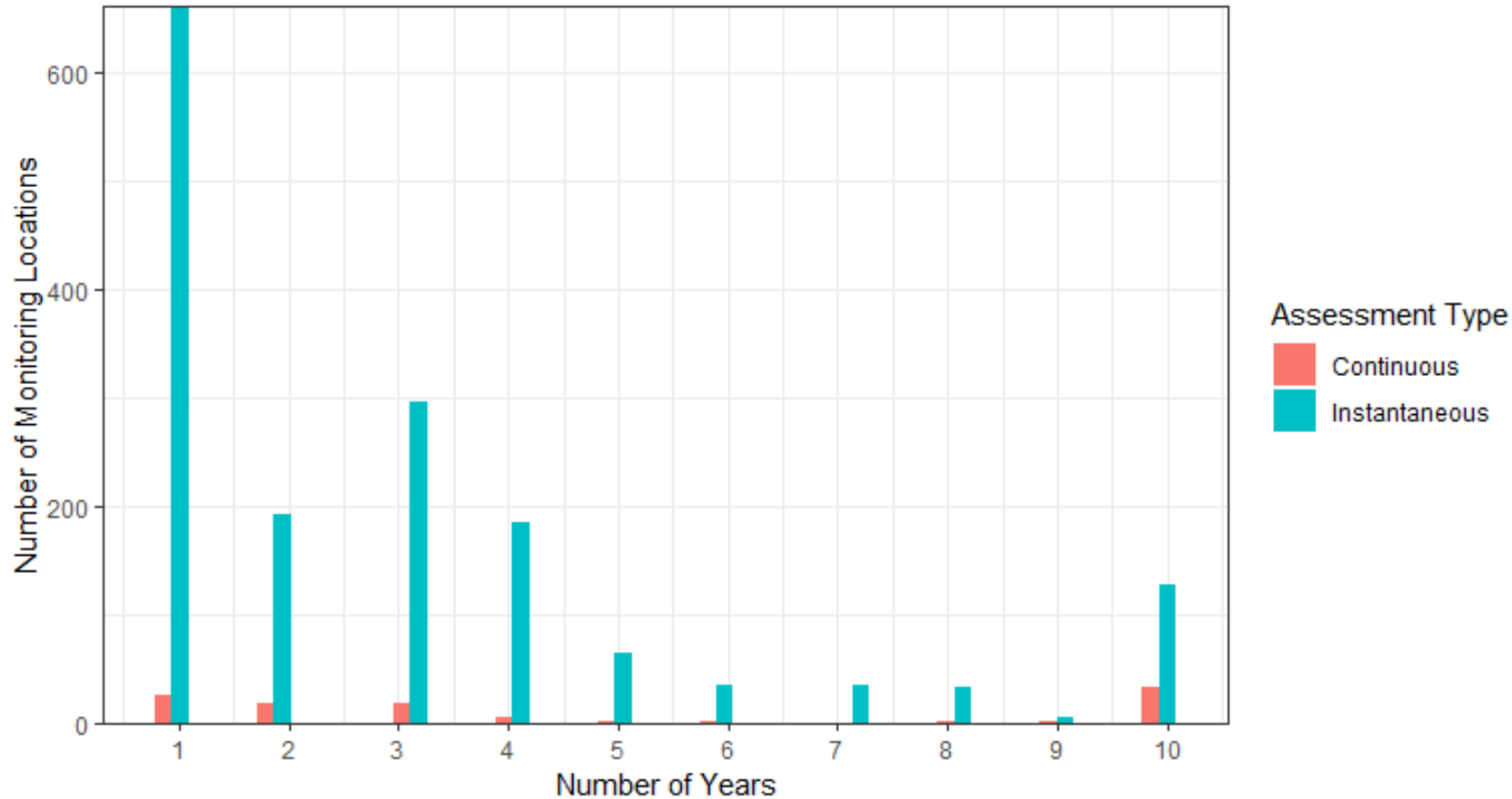
- Sample Question:
 - What is the critical period for assessing spawning listings?
 - The entire spawning period? Shoulders? A percentage?



Data Quantity

Dissolved Oxygen Data Quantity

Number of years of year-round data available from 2008-2018



Number of years	Average Accuracy over 5,000 simulations
1	76 %
2	85 %
3	87 %
4	88 %
5	90 %

Simulation results of 5 day continuous deployments during critical period

Discussion

- Feedback:
 - What should the minimum number of years be for critical period sampling?
 - This DEQ proposal has 3 years; future Integrated Reports will likely have 4-5 year data windows.
 - Is 3 years enough? Too much?
 - Should the number of years be a percentage of data window?
 - Should the number of years be tied to climate variability and climate triggers?

Break

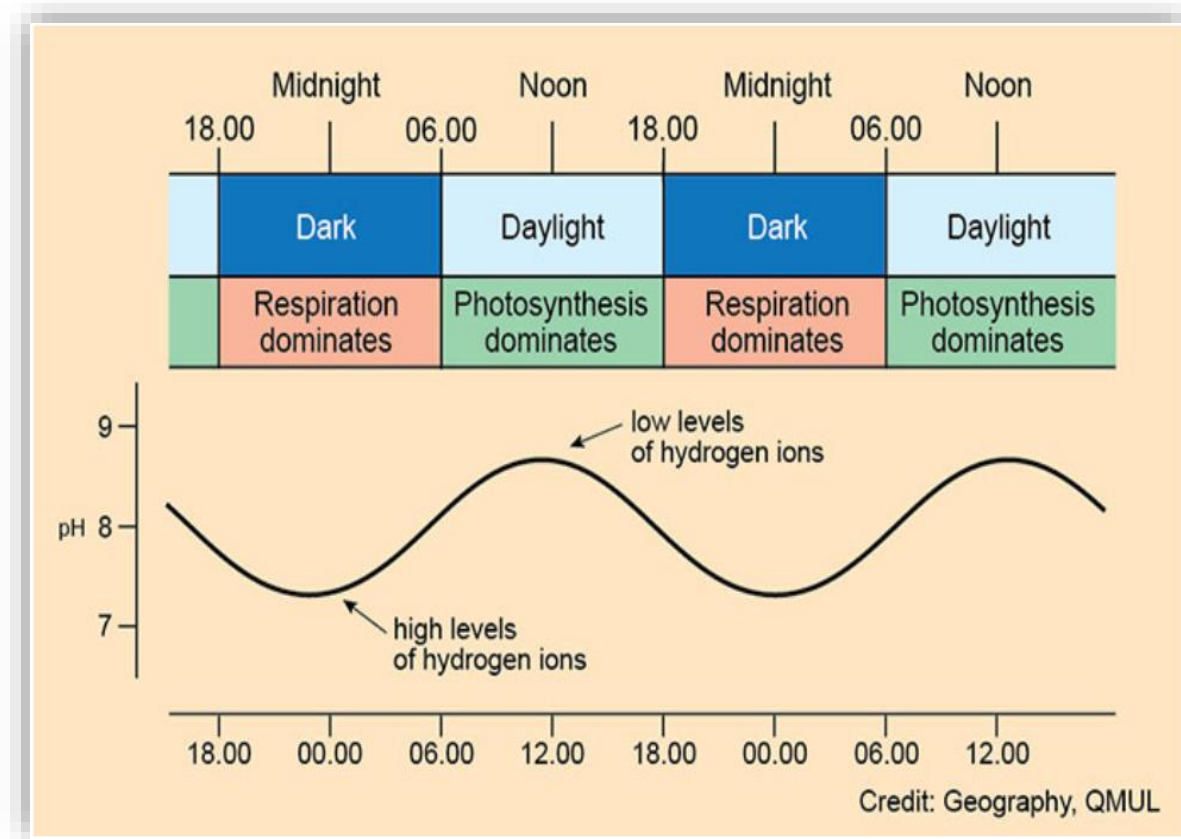


Continuous pH listing and delisting update



Background pH in natural waters

- Measure of the concentration of H^+ or OH^- ions in solution
- Acidic or Alkaline
- Normal diurnal fluctuation
- pH range can vary based across ecosystems
 - Can be affected by human activity
- Collecting continuous or time series data are now part of routine monitoring programs

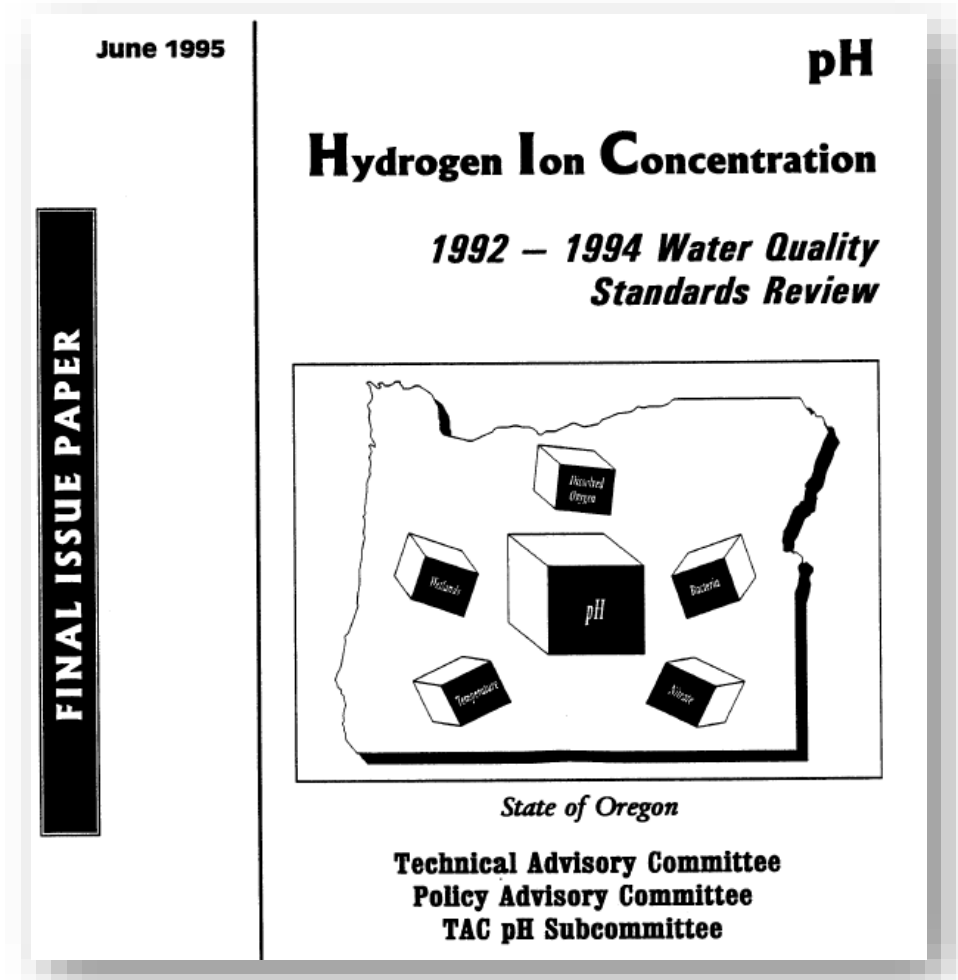


[Daily fluctuations in pH as a result of photosynthesis.](https://www.qmul.ac.uk/chesswatch/water-quality-sensors/ph/)

<https://www.qmul.ac.uk/chesswatch/water-quality-sensors/ph/>

pH water quality standard

- Protection of the most sensitive beneficial use
 - Salmonids and resident fish
- Adopted by the EQC in 1996
- Does not include any metrics for time series data
- Recognizes that rapid changes in pH can have adverse effects on fish



pH and the Integrated Report

- Currently based on grab data
- Updated to use the binomial test in 2018/2020
 - >10% exceedance rate
- Method for utilizing continuous data must include
 - Frequency
 - Duration

Critical Values for Listing Conventional Pollutants²⁰

Null Hypothesis: Actual exceedance proportion is $\leq 10\%$
Alternate hypothesis: Actual exceedance proportion is $> 10\%$
Minimum confidence level is 90%
A minimum sample size of five is required.

Table 6. Minimum number of sample excursions required to list as impaired for conventional pollutants

Sample Size	List if excursions \geq :
5 - 11	2*
12-18	4
19-25	5
26-32	6
33-40	7
41-47	8
48-55	9
56-63	10
64-71	11
72-79	12
80-88	13
89-96	14
97-104	15
105-113	16
114-121	17
122-130	18
131-138	19

²⁰ Excluding continuous dissolved oxygen and temperature

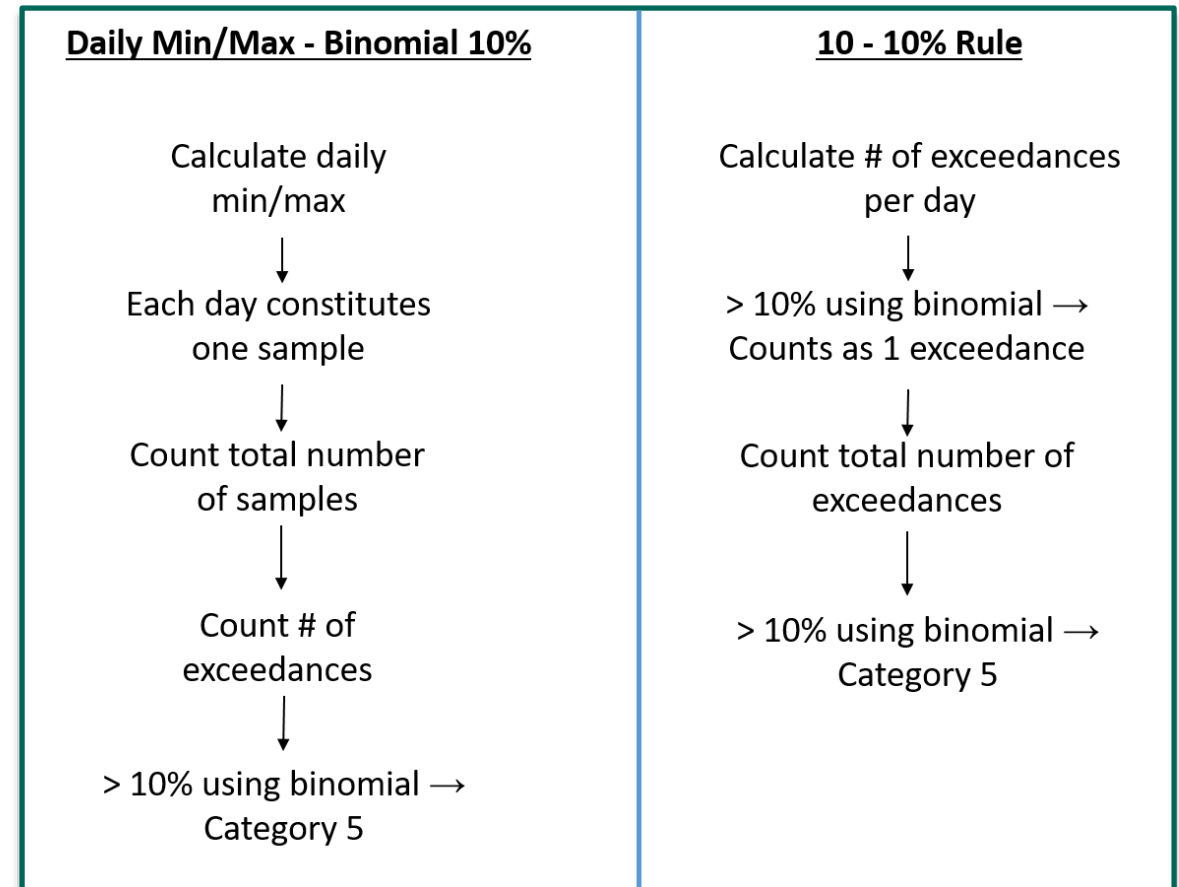
<https://www.oregon.gov/deq/wq/Documents/irMethodologyF1820.pdf>

Methods used in other states

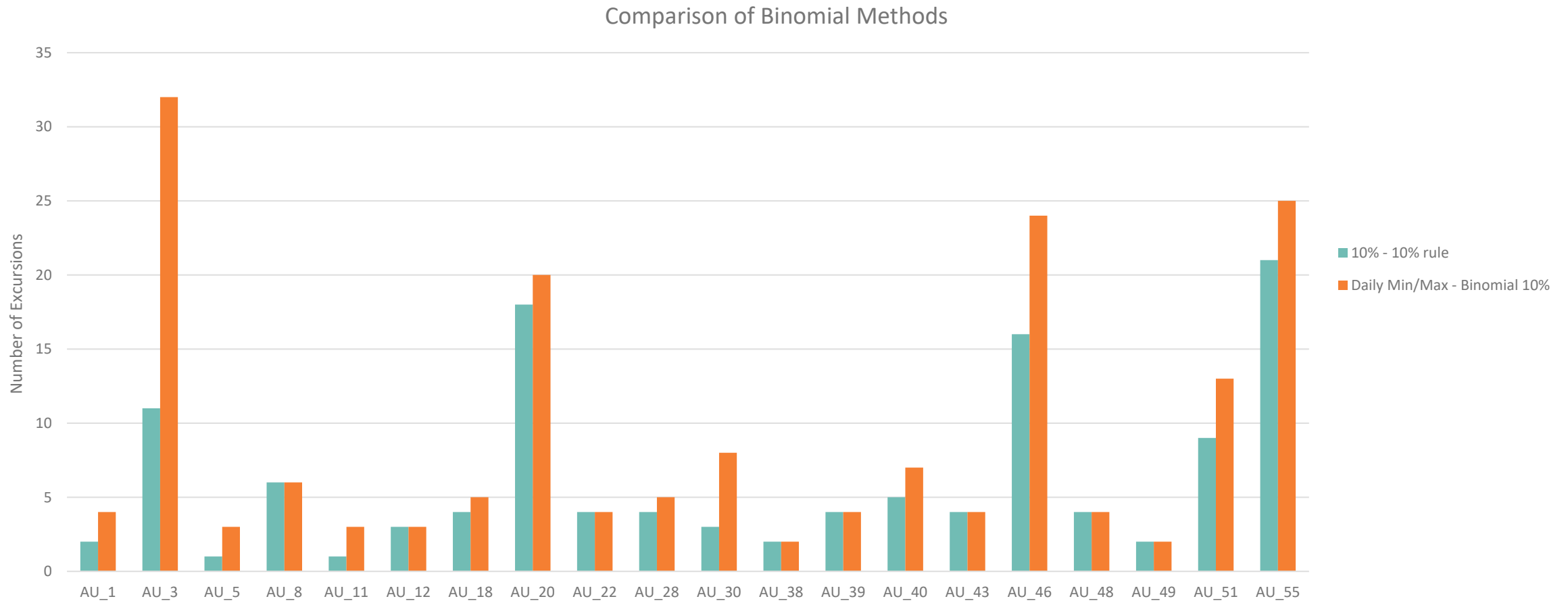
- Evaluation of chronic exceedances in a given time period
- Calculate daily statistic and use the binomial test at $>10\%$ exceedance rate
- 10% -10% Rule – Use the binomial test twice
 1. Daily
 2. Entire dataset
- Hypergeometric test – discrete probability distribution per year

Exploring the options

- We did not evaluate
 - Chronic
 - Hypergeometric
- Explored the binomial methods
 - Consistent with current method

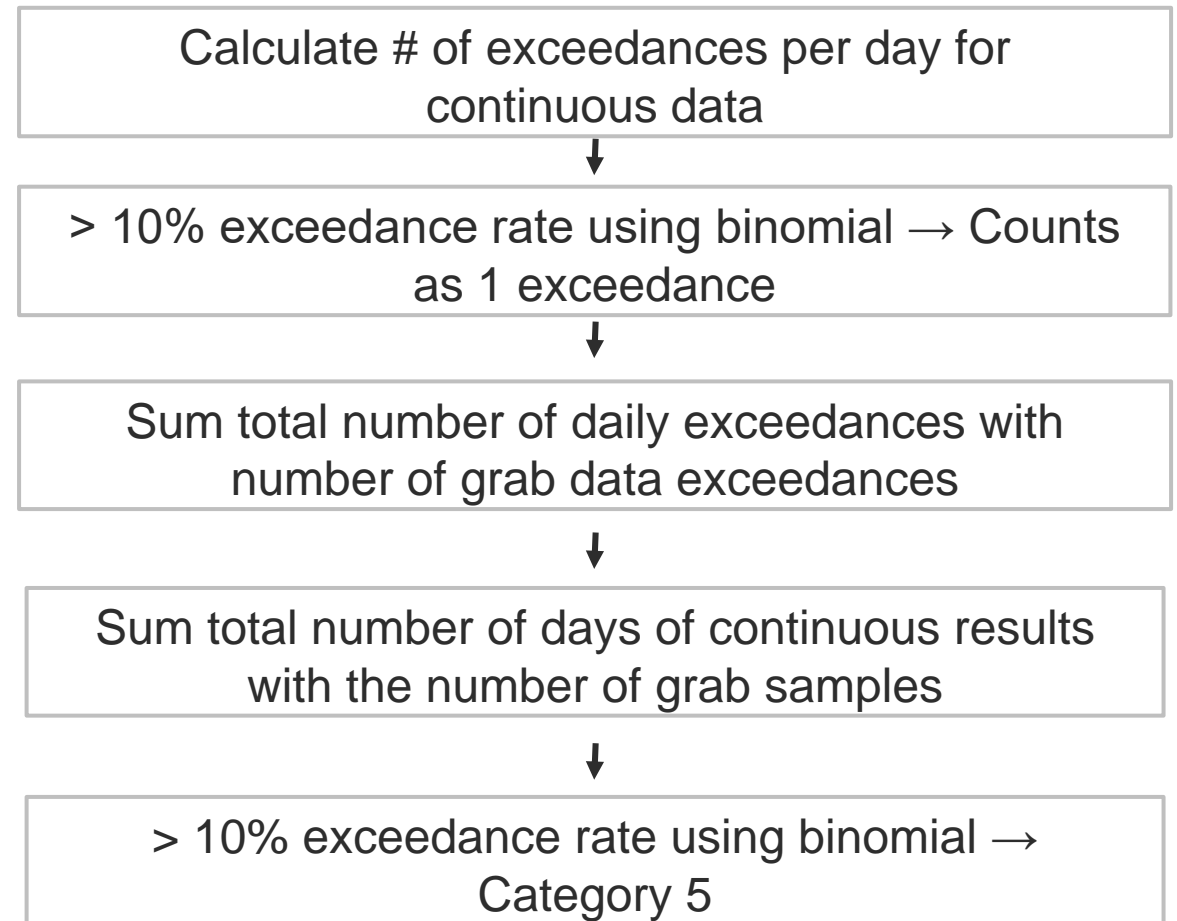


Comparing Binomial Methods



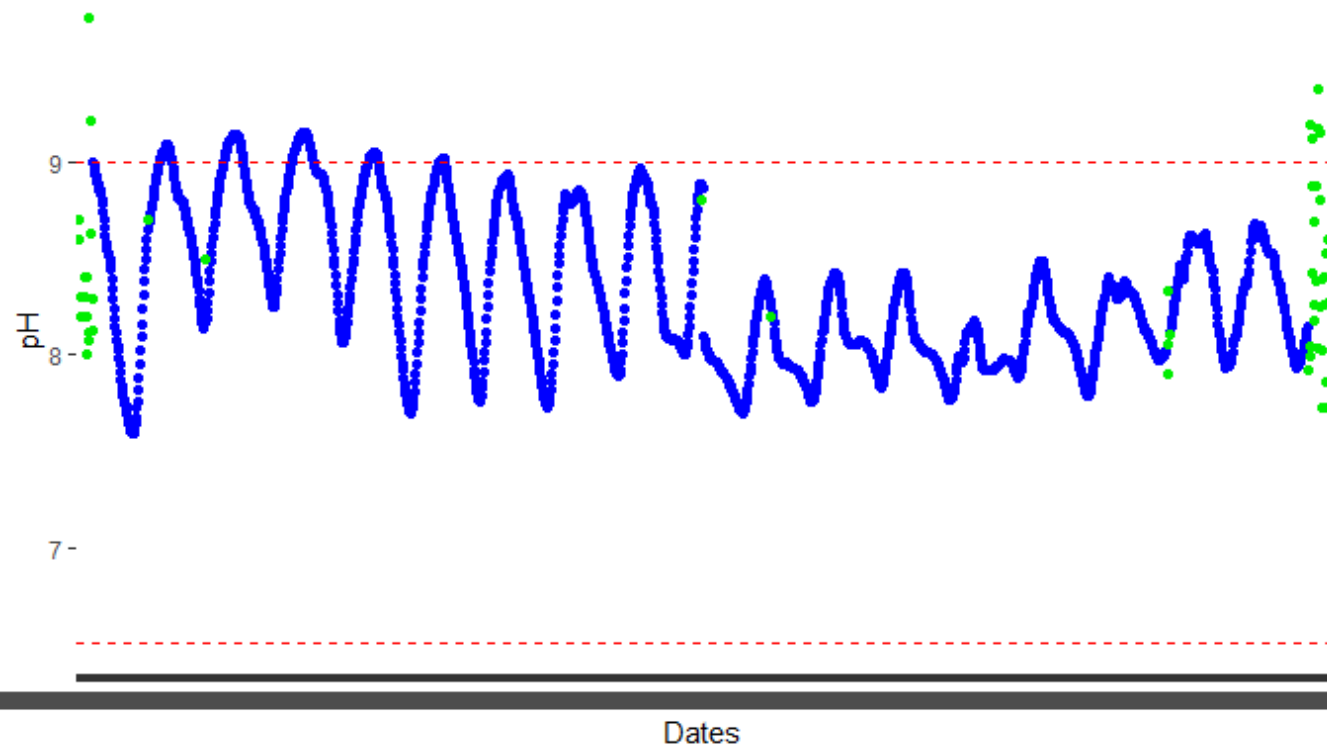
Proposed Method

- Utilize the 10 - 10% method
 - Combines grab and continuous data sources
 - Incorporates the entire diurnal cycle
 - Minimizes the effect of serial correlation



Example

OR_SR_1705020304_05_102818



Method	Number days/ Number samples	Exceedances	List if Exceedances \geq	IR Category
10% - 10%	21	4	5	Cat 2
Daily Stats	21	5	5	Cat 5
Grab Only	56	6	10	Cat 2
Combined	77	10	12*	Cat 2

Delisting

- Utilize existing method
 - Reject the null hypothesis of the binomial test
- Valid for pH because criteria does not specify summary statistics

Critical Values for Delisting Conventional Pollutants

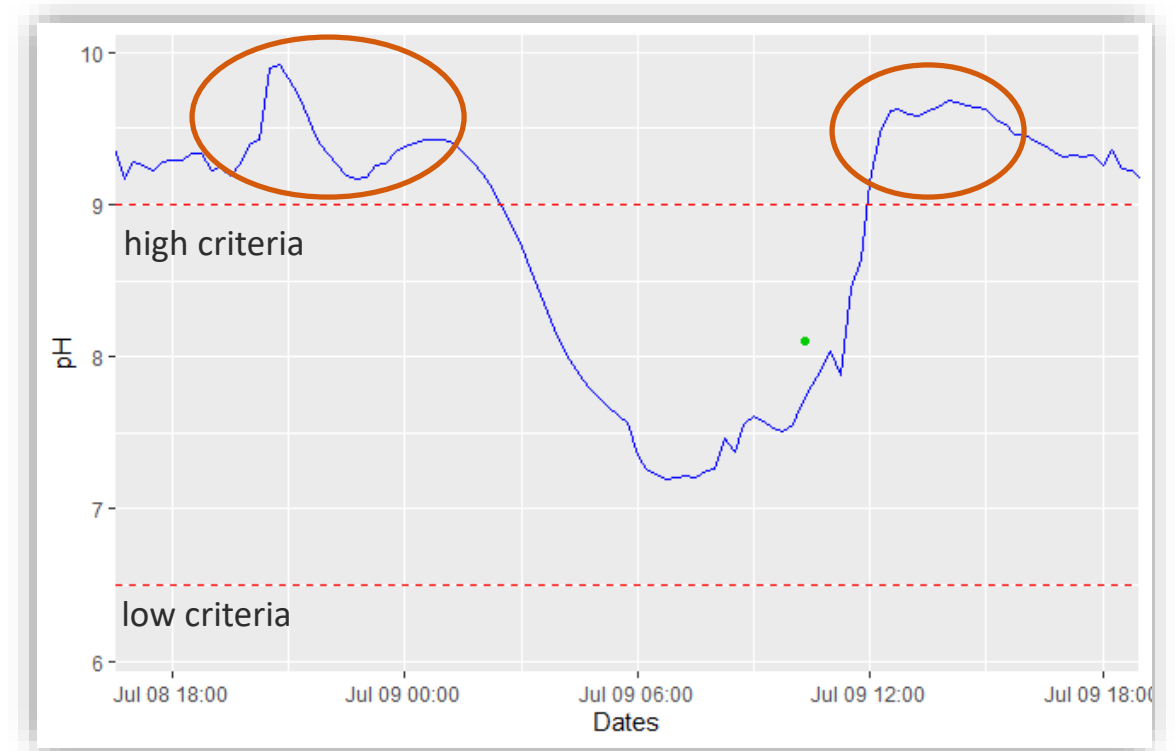
Null Hypothesis: Actual exceedance proportion is $>10\%$
Alternate hypothesis: Actual exceedance proportion is $\leq 10\%$
Minimum confidence level is 90%
A minimum sample size of 15 is required.

Table 10. Maximum number of sample excursions to delist as impaired for conventional pollutants

Sample Size	Delist if excursions \leq :
15	1
16-18	2
19-25	3
26-32	4
33-40	5
41-47	6
48-55	7
56-63	8
64-71	9
72-79	10
80-88	11
89-96	12
97-104	13
105-113	14
114-121	15
122-130	16
131-138	17
139-147	18

Acute toxicity considerations

- Screen data for rapid changes in pH that may not be captured in the 10%-10% method
 - +/- 0.5 pH units outside of the upper numeric criteria range
 - Less than 24 hours
- Protective of most sensitive beneficial use

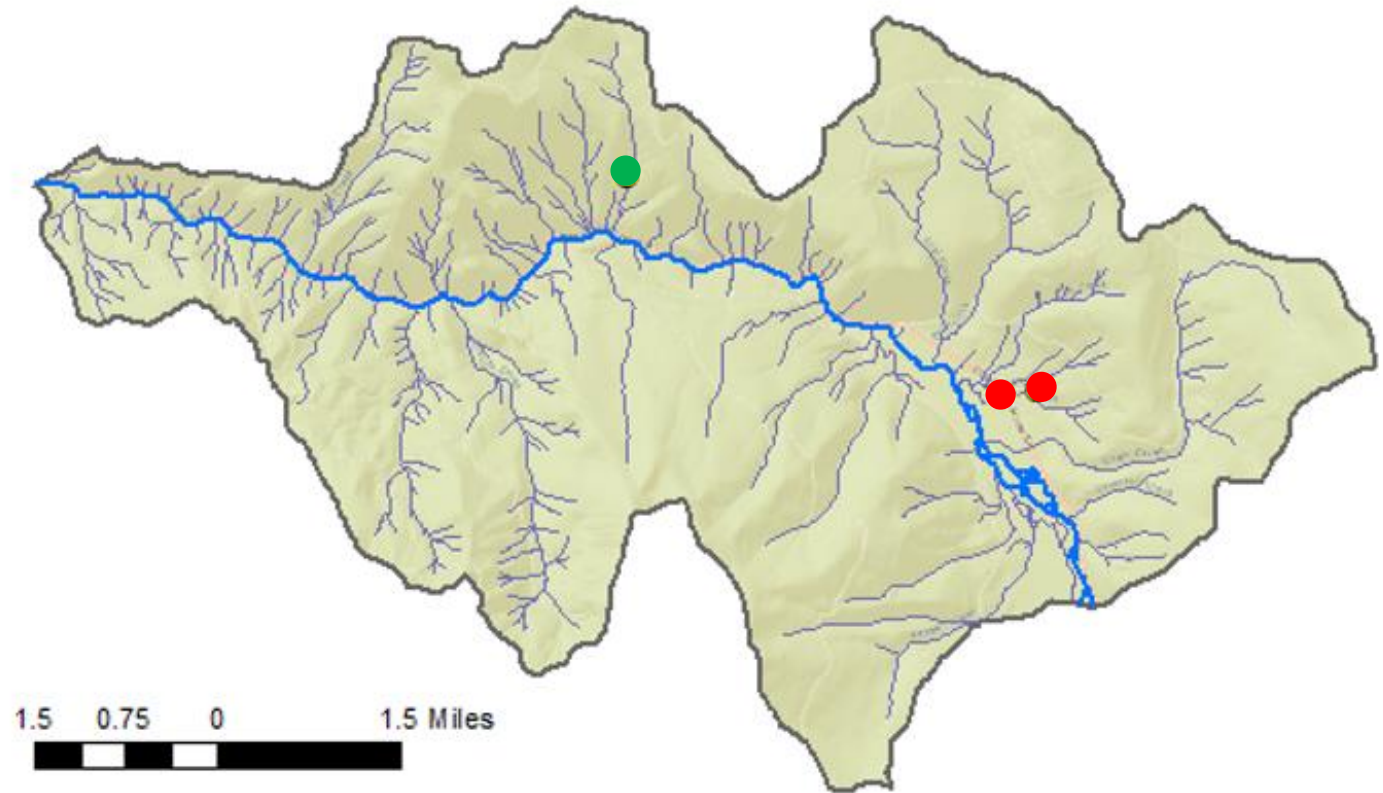


Discussion

- Do you support the proposed 10-10 method?
- Are there other methods we should consider?
- Should acute or rapid changes be considered for listing?

Additional short-term priority

- Assess watershed assessment units at each monitoring station
- Map will illustrate attainment/impairment at each monitoring station
- Conclusion - roll up to Assessment Unit



Next steps

- Accepting informal comments on short-term updates
Updated to: November 24, 2020.
Email integratedreport@deq.state.or.us
- Finalize draft methodology Winter 2020
- Formal public comment period January 2021

Questions?

- Contact: anthony.becky@deq.state.or.us
- Email: integratedreport@deq.state.or.us
- Sign up for GovDelivery list: **WQ Assessment Reporting and 303(d)** to stay up to date. Go to DEQ's webpage: <https://www.oregon.gov/deq/wq/Pages/Integrated-Report-Improvements.aspx>