SGW-64218-VA
Revision 0

200-ZP-1 Optimization Study - Groundwater Monitoring Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

SGW-64218-VA
Revision 0

200-ZP-1 Optimization Study - Groundwater Monitoring Plan

Date Published
November 2019

To be Presented at
Department of Energy, Richland Office

Environmental Protection Agency (EPA) and Washington State Department of Ecology
Richland, WA

10/24/2019 and 11/06/2019

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
CH2MHILL
Plateau Remediation Company
P.O. Box 1600
Richland, Washington 99352

Copyright License
By acceptance of this article, the publisher and/or recipient acknowledges the U.S. Government's right to retain a non exclusive, royalty-free license in and to any copyright covering this paper.

APPROVED
By Julia Raymer at 9:34 am, Nov 05, 2019

Release Approval | Date

Approved for Public Release;
Further Dissemination Unlimited

LEGAL DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced from the best available copy.

Printed in the United States of America

200-ZP-1 Optimization Study – Groundwater Monitoring Plan

Presented by: Mark E. Byrnes, CH2M HILL Plateau Remediation Company (CHPRC)

Presented to: Department of Energy, Richland Washington and Environmental Protection Agency on October 24, 2019 and Washington State Department of Ecology on November 6, 2019

Overview

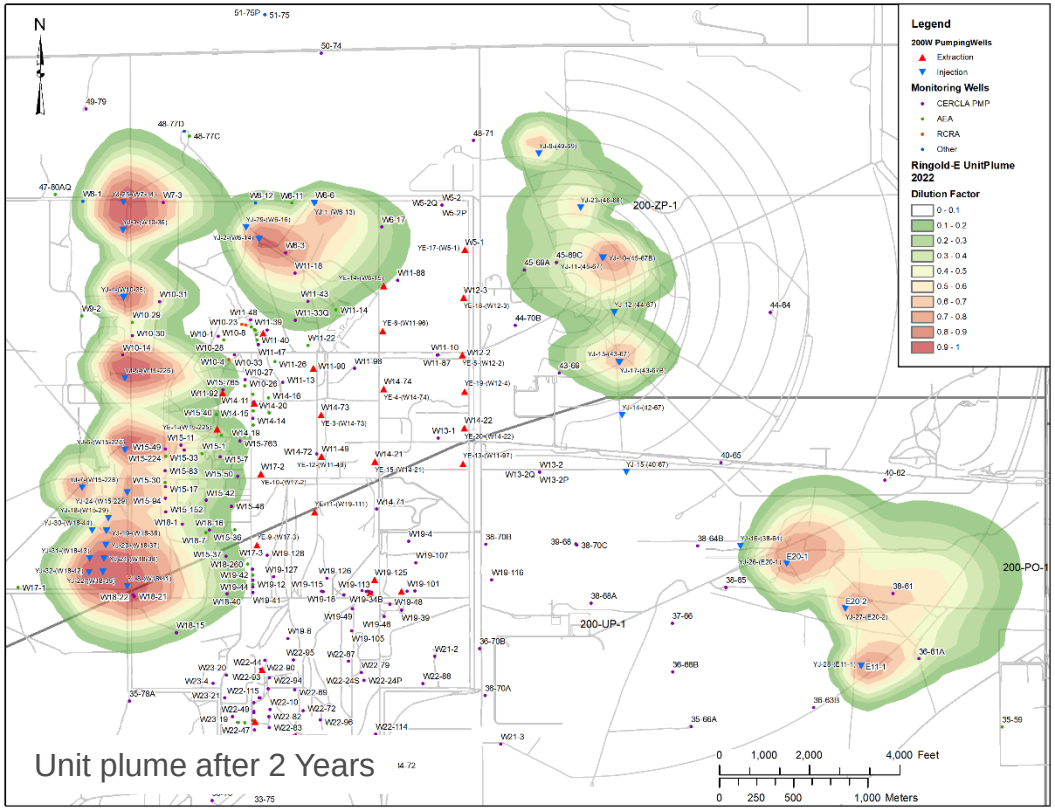
- The Optimization Study Plan (OSP) includes
  - Developing a Data Quality Objectives (DQO) Sampling and Analysis Plan (SAP) in Fiscal Year (FY) 2020 for monitoring during the study
  - Identifying near-term monitoring that needs to be initiated in FY20 prior to the OSP SAP being issued (to be implemented by Tri-Party Agreement (Hanford Federal Facility Agreement and Consent Order) (TPA) Change Notice (CN)
- Near-term monitoring focuses on aquifer locations near the injection wells where changes may occur starting in FY2020
- Near-term monitoring includes following constituents: Nitrate, Carbon Tetrachloride, Sulfate.
- Principal Study Questions (PSQs) were identified to guide the near-term monitoring plan
- Near-term plan identifies well locations and monitoring for constituents needed to meet the near-term PSQs and expected PSQs for the OSP SAP

Well and Monitoring Frequency Selection Process

- Identified candidate monitoring wells with expected breakthrough of injection water in 3-year period
  - Considered all applicable wells , Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), Atomic Energy Act of 1954 (AEA), no current program)
- Evaluated suitability of each well for meeting near-term PSQs
  - Effective porosity (monitoring of nitrate as a tracer)
  - Nitrate dilution (comparison of nitrate at well to injected nitrate concentration)
  - Elution rate of carbon tetrachloride (rate of CCl_4 decline compared to water velocity)
- Assessment Approach
  - Breakthrough curve (fast, slow, magnitude)
  - Screen interval (depth, saturation)
  - CCl_4 concentration (>10 ug/L present)
  - Redundancy and other well issues

Well and Monitoring Frequency Example Breakthrough - Maps

- Based on Central Plateau Groundwater Model (CPGWM)
- Accounts for 3D flow and transport, mixing and dilution
- Value of 1.0 released at each injection well
- In maps - color scale represents proportion of water at that location and time derived from injection
- In graphs - rising line represents arrival of water derived from injection

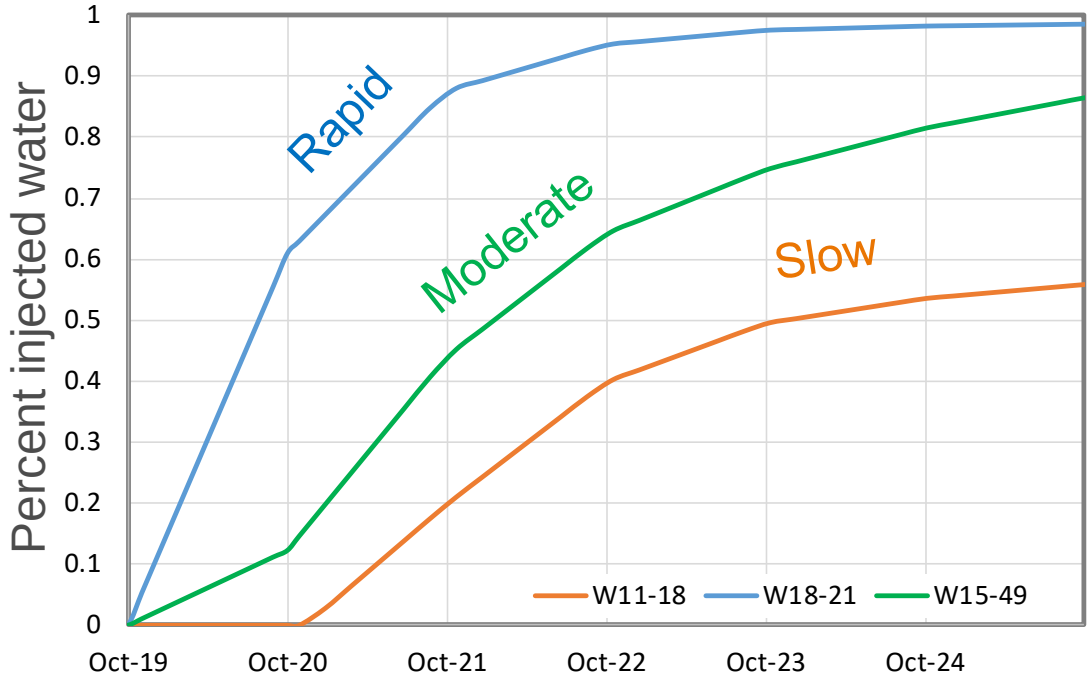


Unit plume after 2 Years

CH2MHILL
Plateau Remediation Company
a Jacobs company

Well and Monitoring Frequency Example Breakthrough - Curves

- Change in effluent assumed to occur October 2019 (Actual change began October 8th 2019)
- Graph provides examples of rapid, moderate, and slow (*but still likely detectable*) arrival

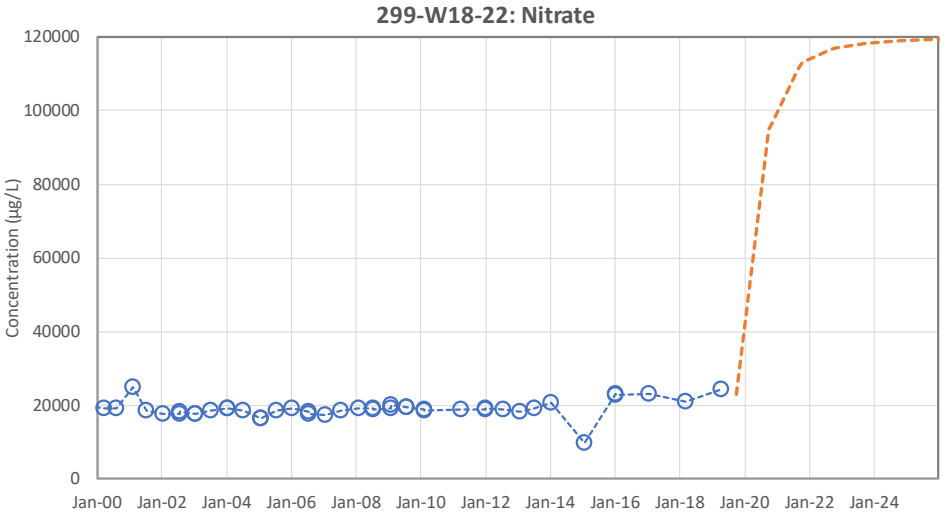


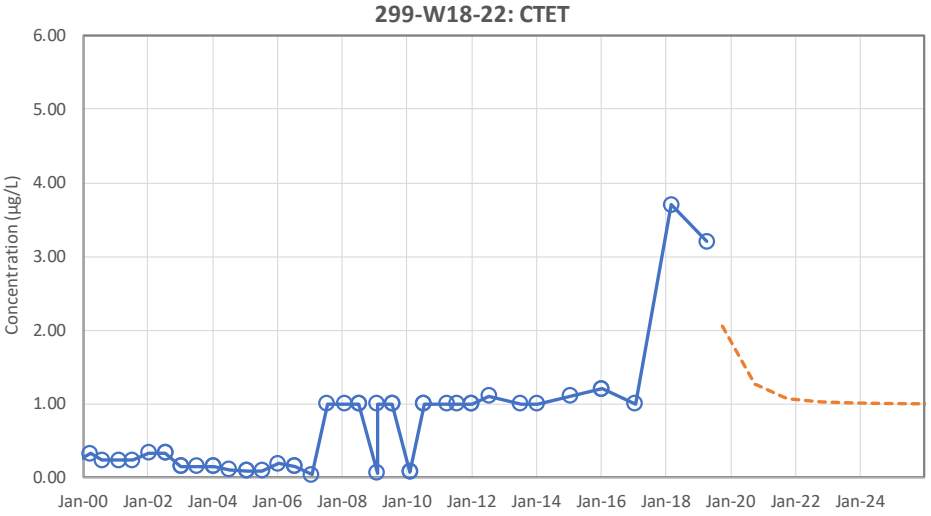
CH2MHILL
Plateau Remediation Company
a Jacobs company

Example Projected Breakthrough Well 299-W18-22

- "Unit value" injected at all injection wells simulated by the CPGWM, gives unit breakthrough (UBW) at each Monitoring Well (MW) over time
- Effluent NO3 (EV_{NO3})assumed to be 120,000 µg/L [as NO3]
- Effluent Carbon Tetrachloride (CTET) assumed to be 1.0 µg/L
- Historical measured sample results tabulated, average of last 5 samples calculated ($\bar{A}$)
- Predicted concentration at time *t* calculated as:

$$UBW_t \times EV_{NO3} + (1-UBW_t) \times \bar{A}$$





Well and Monitoring Frequency Results - Table

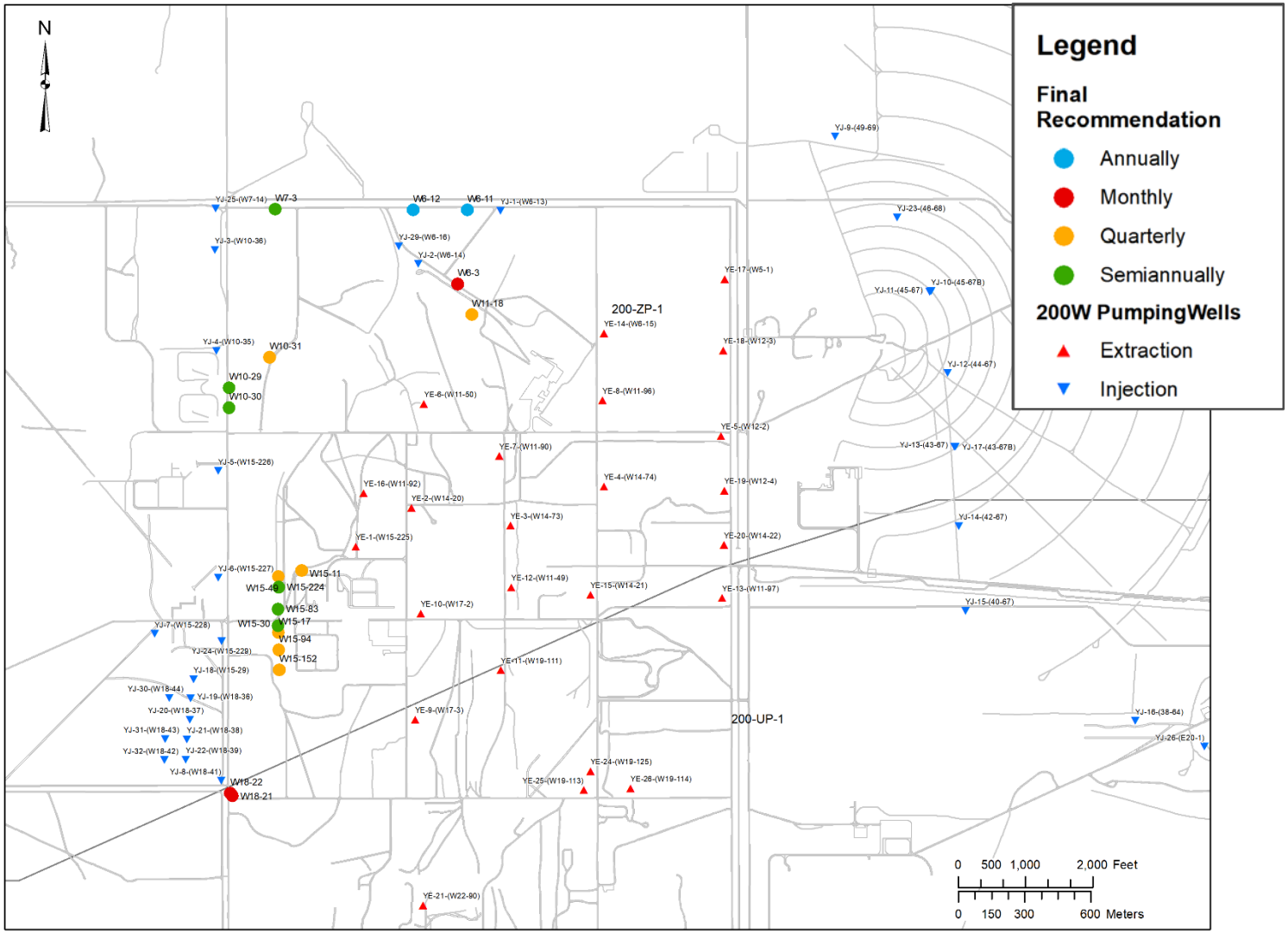
Well Name	Recommendation	Comment - PSQ 1 (porosity), 2 (nitrate), 3 (CT): G (good) M (marginal)	Current Sampling Program	Current Frequnc	Increased Frequency?	Additional Trips (annually)
299-W18-22	Monthly	1,2 G (Ring A)	200-ZP-1 GW-OU Monitoring	A	Y	11
299-W18-21	Monthly	1,2 G (Ring E)	LLWMA-4	SA	Y	10
299-W6-11	Annually	2 M (Ring E, upgradient)	SALDS (600-211)	A	N	None
299-W10-29	Semiannually	1,2,3 G (Ring E, cross gradient)	200-ZP GW-IA Monitoring	SA	N	None
299-W6-12	Annually	2 M (Ring E, upgradient)	SALDS (600-211)	A	N	None
299-W6-3	Monthly	1,2 G (Ring E)	200-ZP-1 GW-OU Monitoring	A	Y	11
299-W10-31	Quarterly	1,2,3 G (Ring E)	200-ZP GW-IA Monitoring	SA	Y	2
299-W15-17	Quarterly	1,2 G (Ring E deep)	200-ZP GW-IA Monitoring	SA	Y	2
299-W15-94	Quarterly	1,2,3 G (Ring E)	200-ZP GW-IA Monitoring	SA	Y	2
299-W10-30	Semiannually	1,2 M (Ring E, cross gradient)	200-ZP GW-IA Monitoring	SA	N	None
299-W15-30	Semiannually	1,2,3 G (Ring E)	200-ZP GW-IA Monitoring	SA	N	None
299-W7-3	Semiannually	2 M (Ring E, upgradient)	SALDS (600-211)	SA	N	None
299-W15-49	Quarterly	1,2,3 G (Ring E)	200-ZP-1 GW-OU Monitoring	A	Y	3
299-W15-224	Semiannually	1,2 G (Ring E)	200-ZP GW-IA Monitoring	SA	N	None
299-W15-152	Quarterly	1,2, G (Ring E)	200-ZP GW-IA Monitoring	SA	Y	2
299-W15-83	Semiannually	1,2,3 M (Ring E, cross gradient)	200-ZP GW-IA Monitoring	SA	N	None
299-W11-18	Quarterly	1,2,3 G (Ring E)	200-ZP-1 GW-OU Monitoring	A	Y	3
299-W15-11	Quarterly	1,2,3 G (Ring E, long screen)	200-ZP-1 GW-OU Monitoring	A	Y	3
	Annually = 2	**18 wells, maximum (redundancy evaluation in process); 49 additional well trips annually:**			Same Frequency = 8	
	Semiannually = 6	8 wells = No additional well trips			More Frequent = 10	
	Quarterly = 7	4 wells = 2 additonal trips				
	Monthly = 3	3 wells = 3 additional trips				
		1 well = 10 additional trips (possibly fewer)				
		2 wells = 11 additional trips (possibly fewer)				

Pairing of Injection Wells and Monitoring Wells

Group	Injection well	Monitoring well	Comment
1	YJ-25	W7-3	Downgradient
2	YJ-1	W6-11/W6-12	Upgradient evaluation
3	YJ-2	**W6-3**/W11-18	Sequence downgradient, CT elution
4	YJ-4	W10-31/W10-29	Down- and cross-gradient, CT elution
5	YJ-5	W10-30	Cross-gradient, CT elution
6	YJ-6	W15-49/W15-224	Paired downgradient, CT elution
7		W15-11	Sequence from W15-49, CT elution
8		W15-83	Cross-gradient, CT elution
9	YJ-24	W15-17/W15-30/W15-94	Paired downgradient at different depths, CT elution
10	YJ-18	W15-152	Downgradient
11	YJ-8	**W18-21/W18-22**	Downgradient Ring E/Ring A

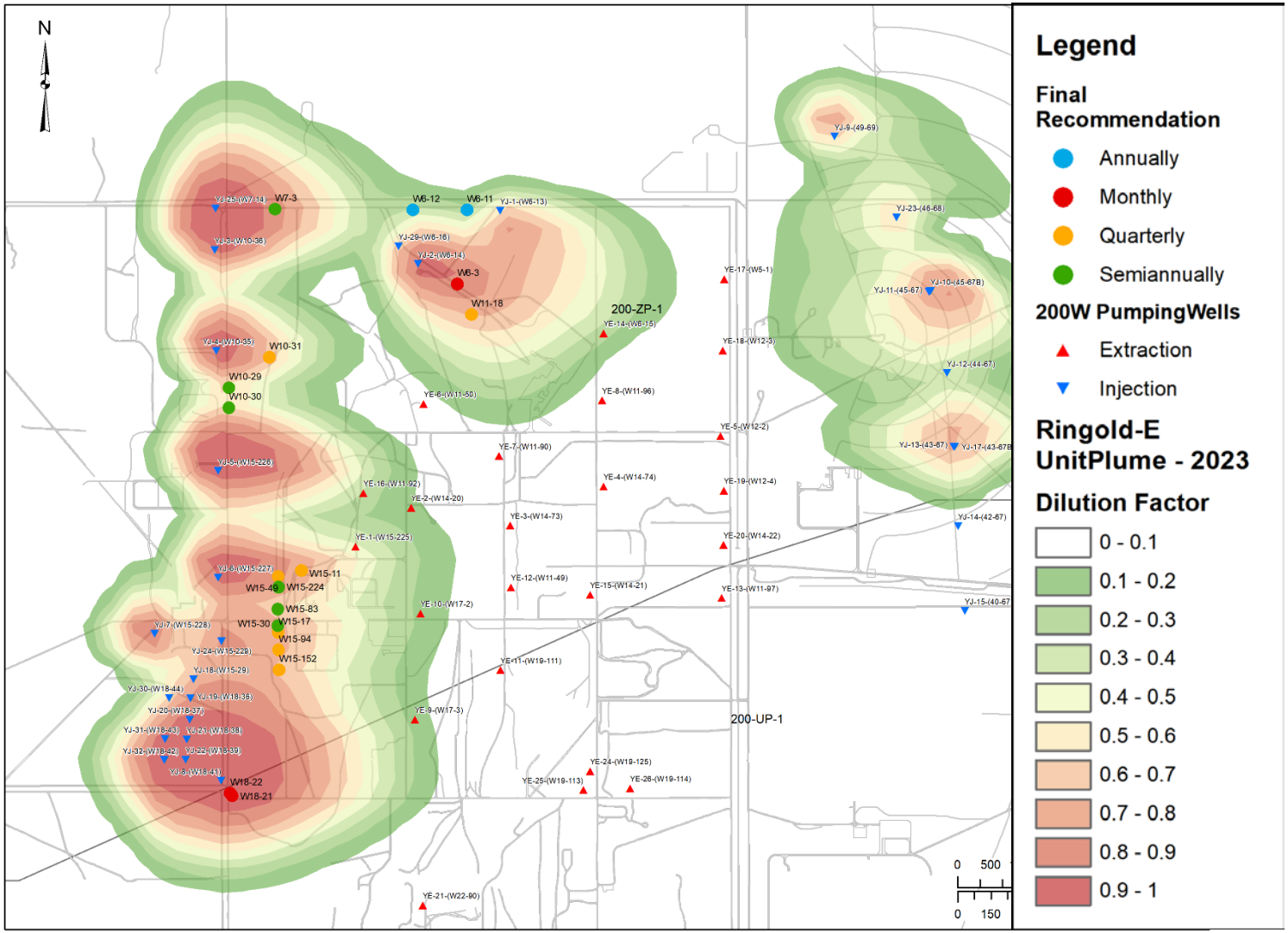
Bold indicates monthly sampling for rapid breakthrough

Well and Monitoring Frequency Results - Map



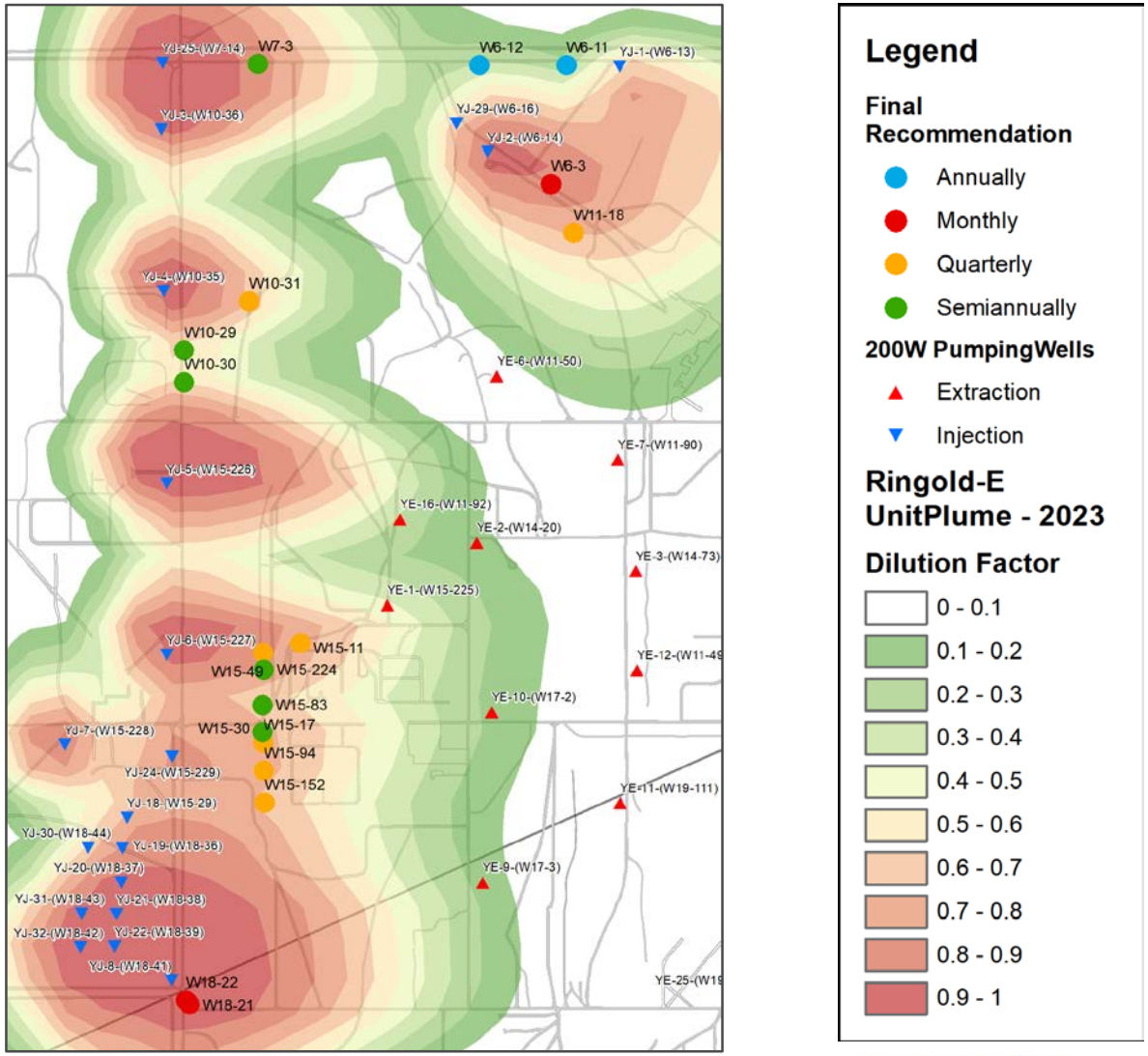
CH2MHILL
Plateau Remediation Company
a Jacobs company

Well and Monitoring Frequency Results – Map with Unit Concentrations

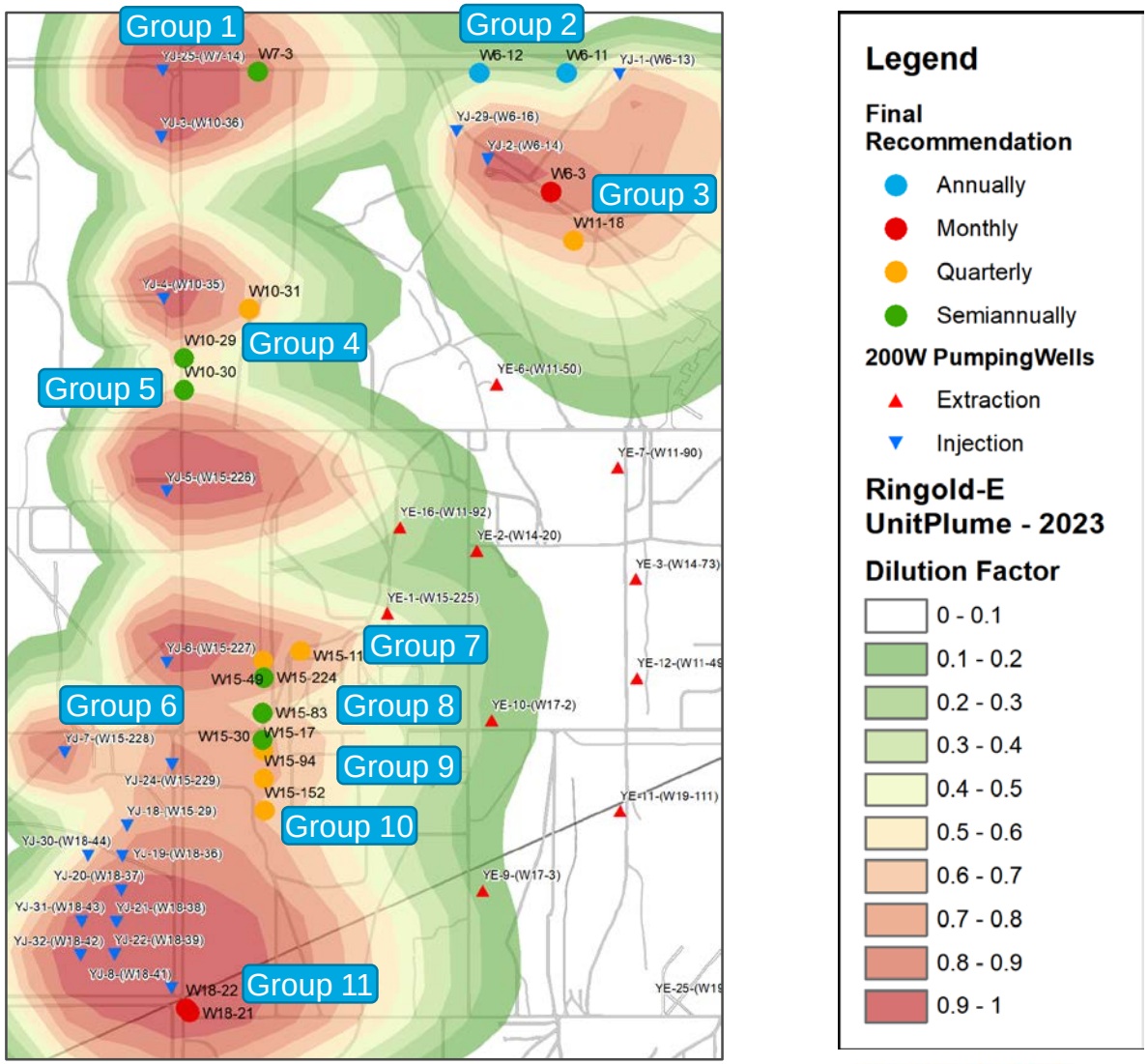


CH2MHILL
Plateau Remediation Company
a Jacobs company

Well and Monitoring Frequency Results – Map with Unit Concentrations (Zoom)



Well and Monitoring Frequency Results – Map with Unit Concentrations (Zoom)

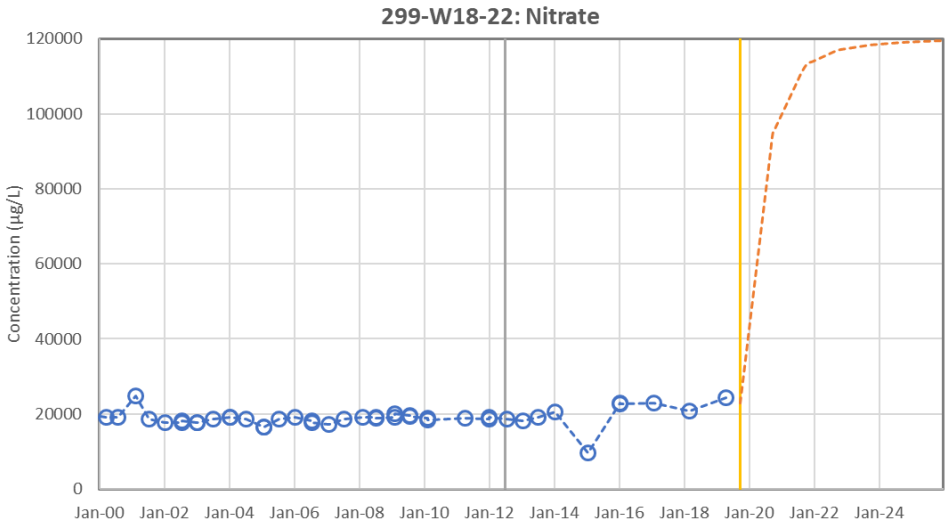


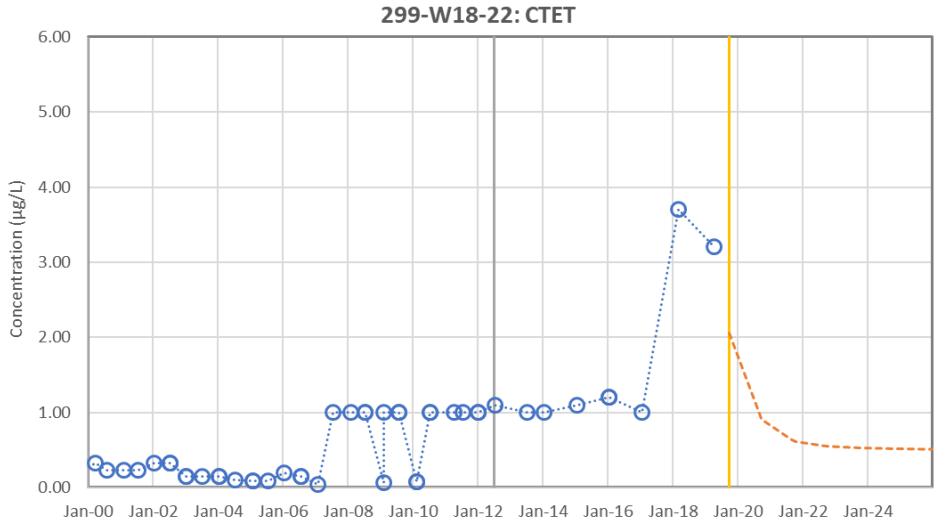
CH2MHILL
Plateau Remediation Company
a Jacobs company

Well and Monitoring Frequency Next Steps

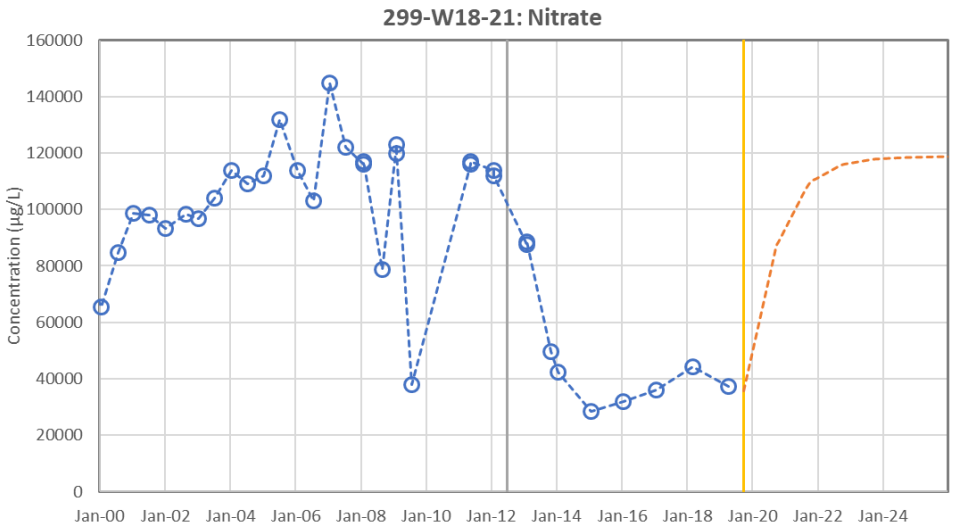
- Prepare TPA change notice for Performance Monitoring Plan (PMP) (DOE/RL-2009-115)
- TPA change notice is adequate for additional sampling through FY2020
- Preparation underway for DQO/SAP long term monitoring (for duration of optimization study)
  - Additional PSQs will be considered for long term monitoring

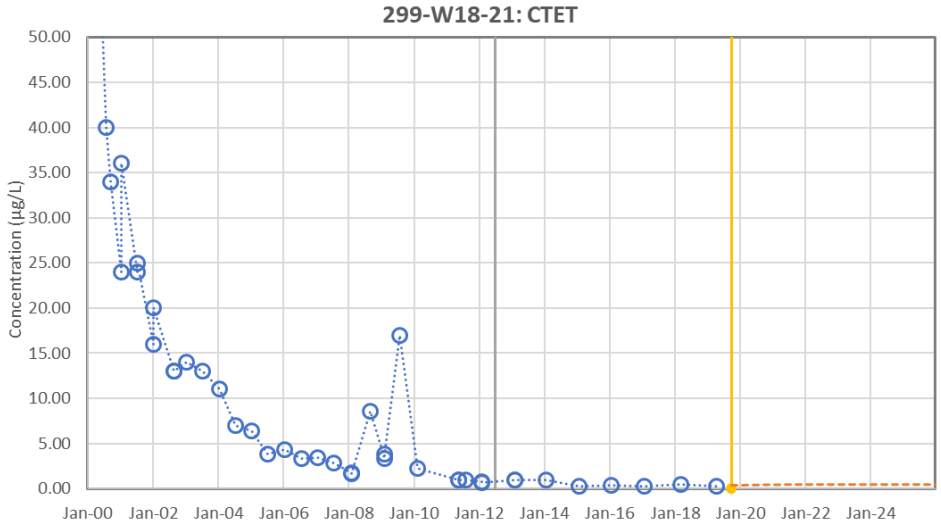
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W18-22



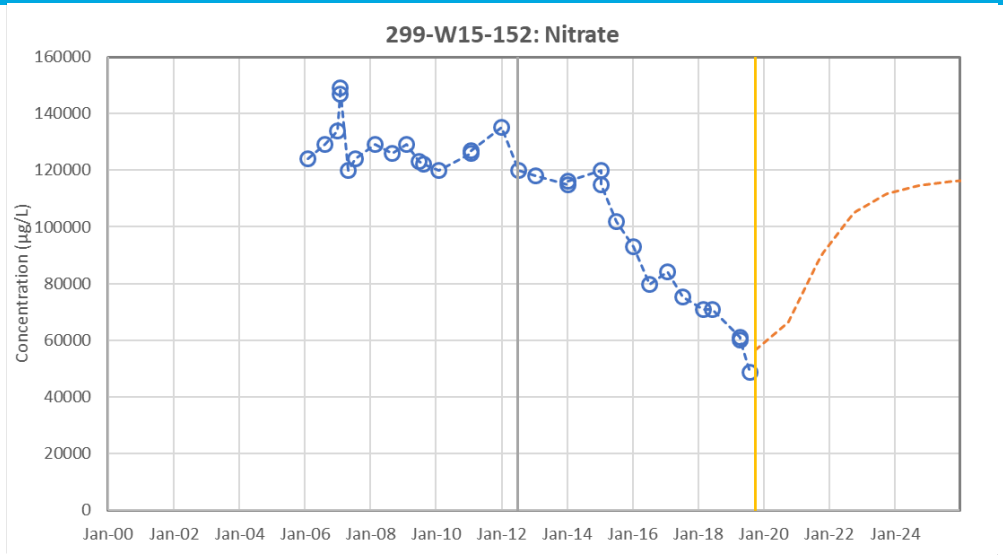


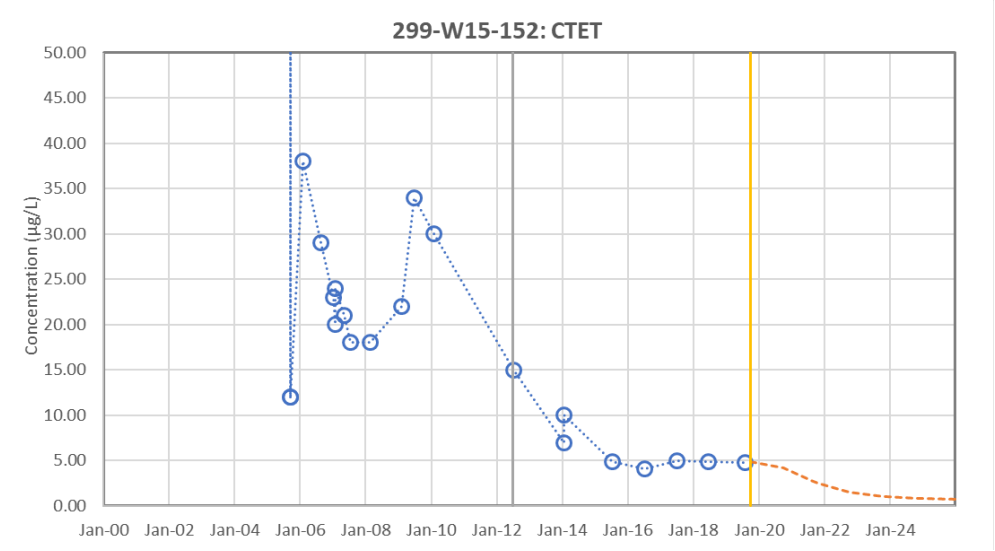
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W18-21



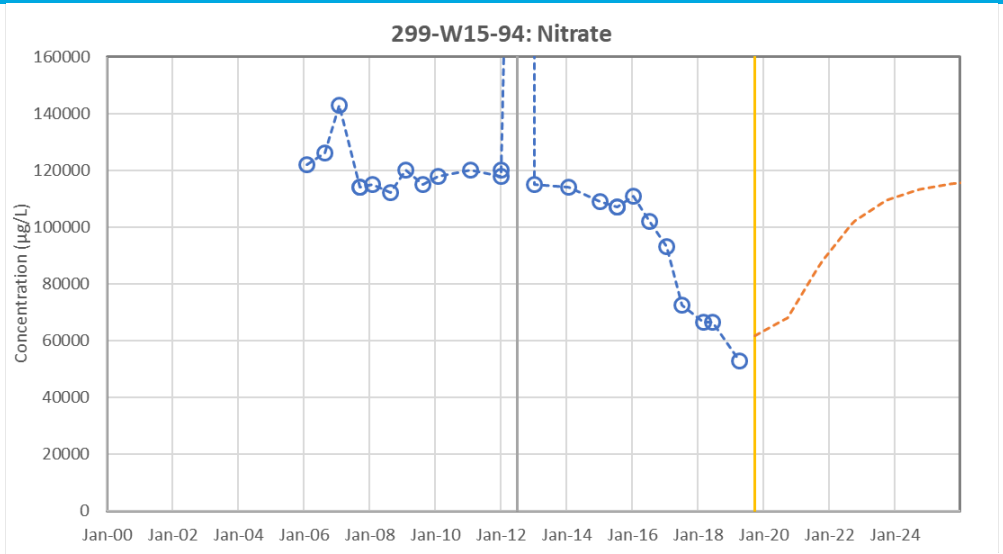


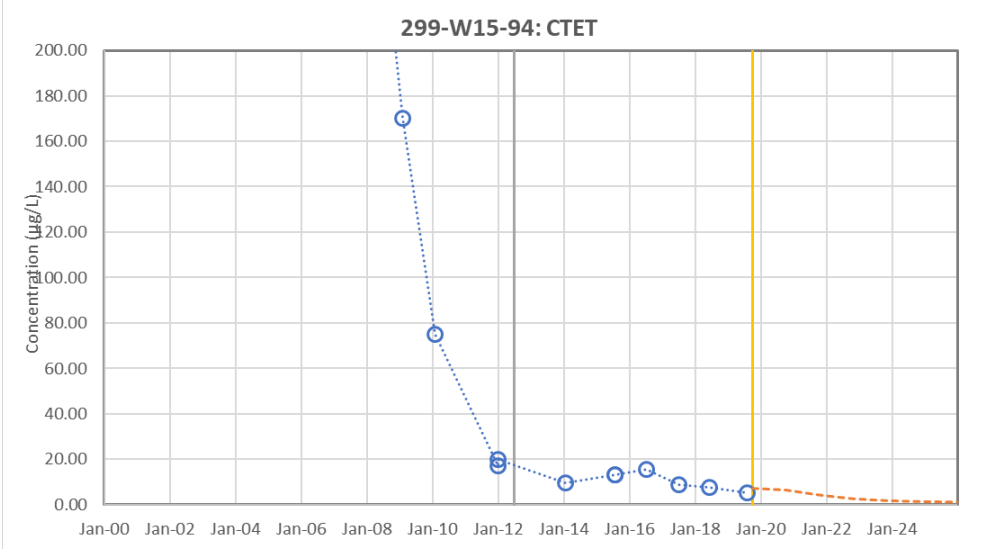
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-152



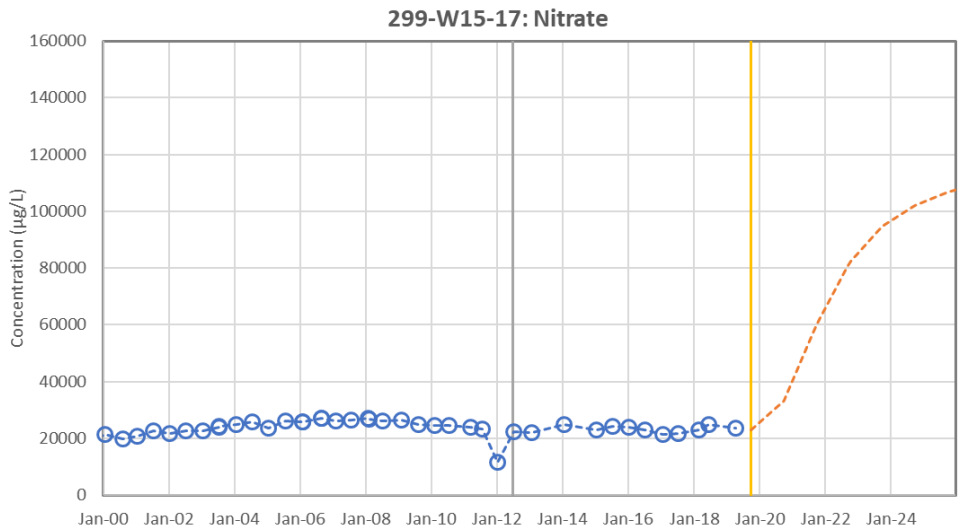


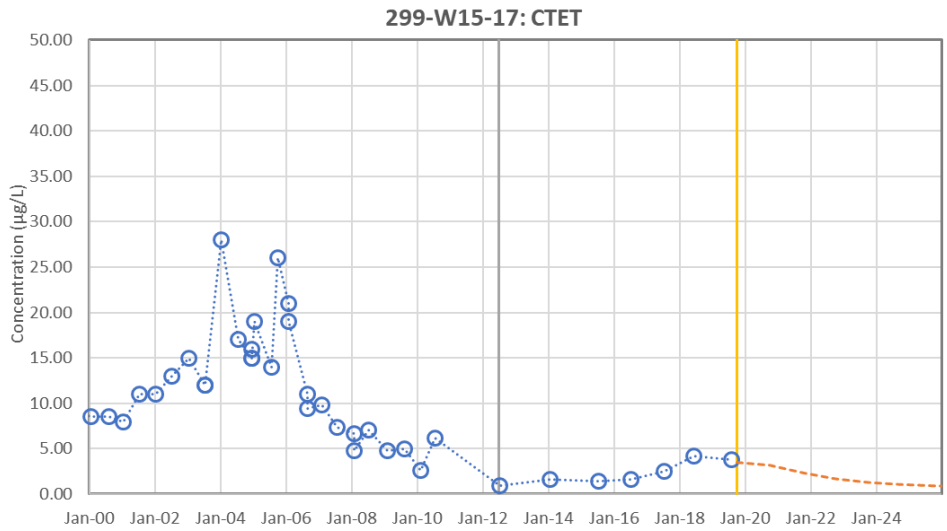
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-94



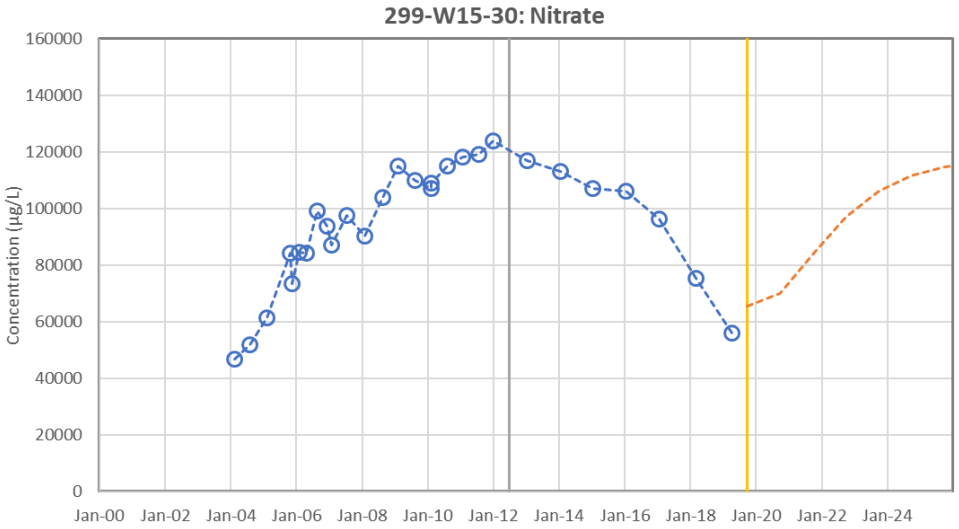


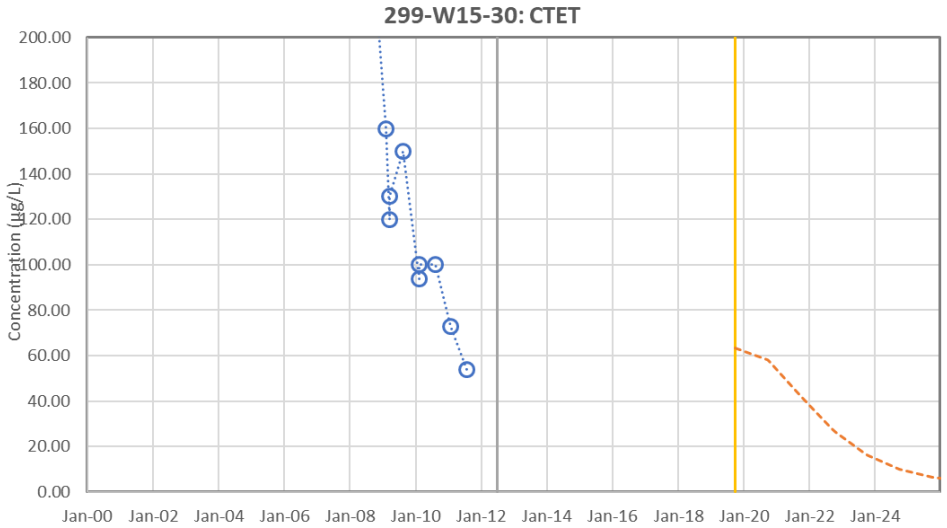
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-17



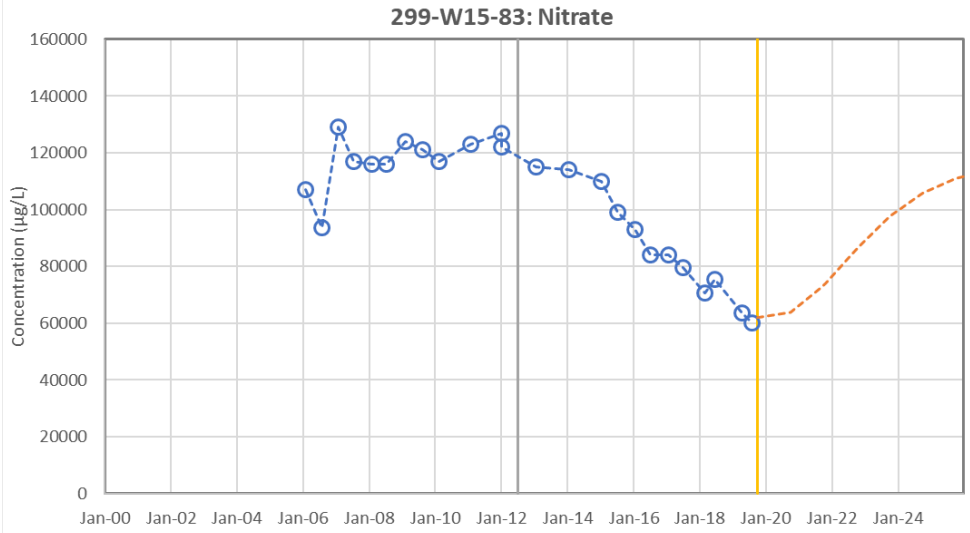


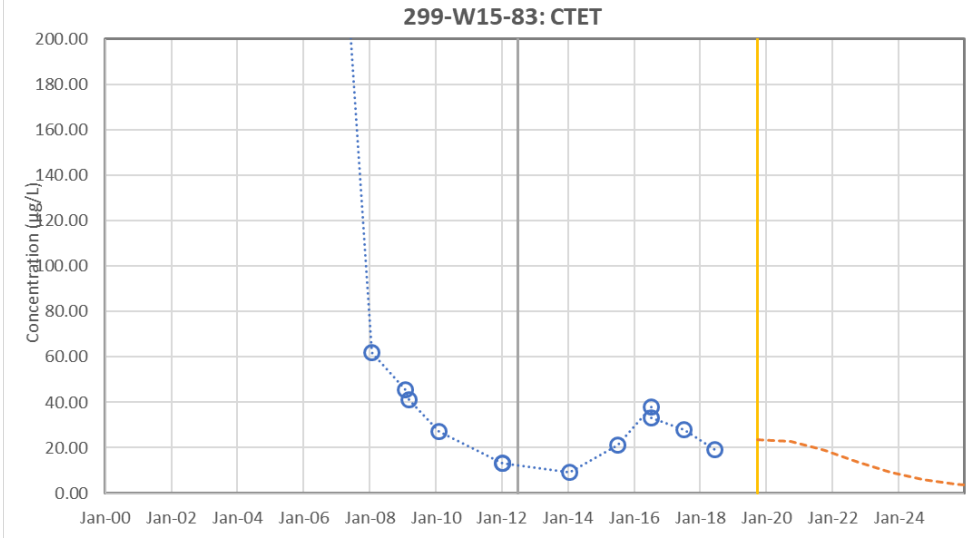
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-30



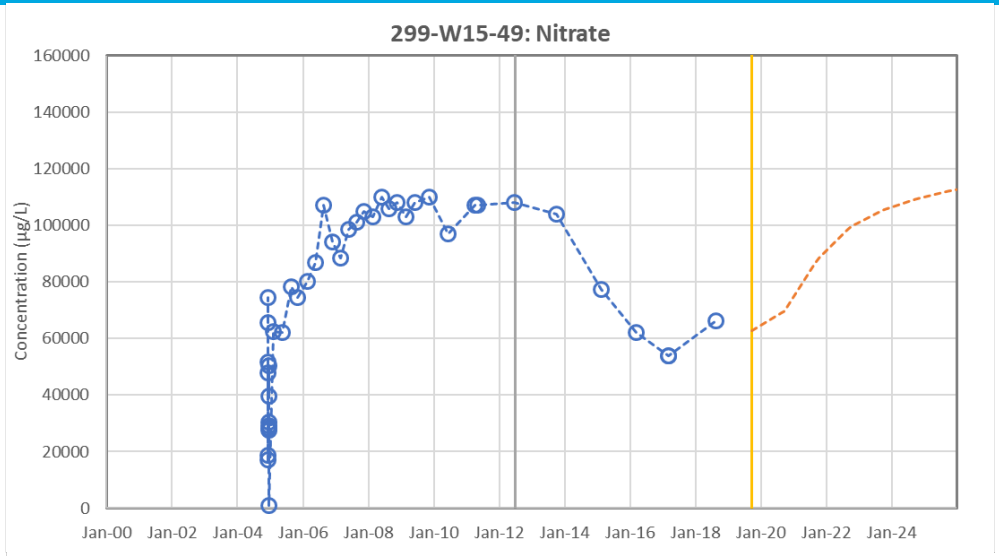


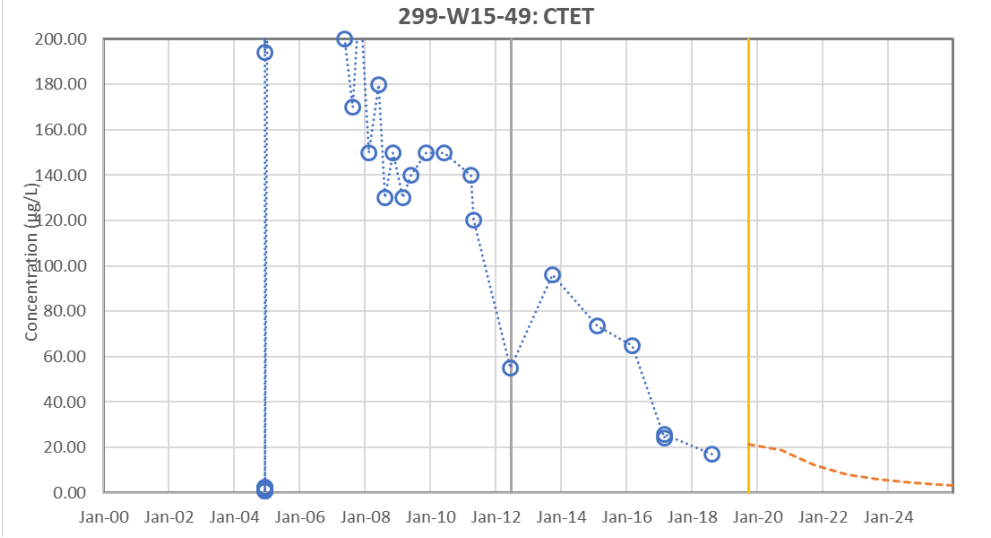
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-83



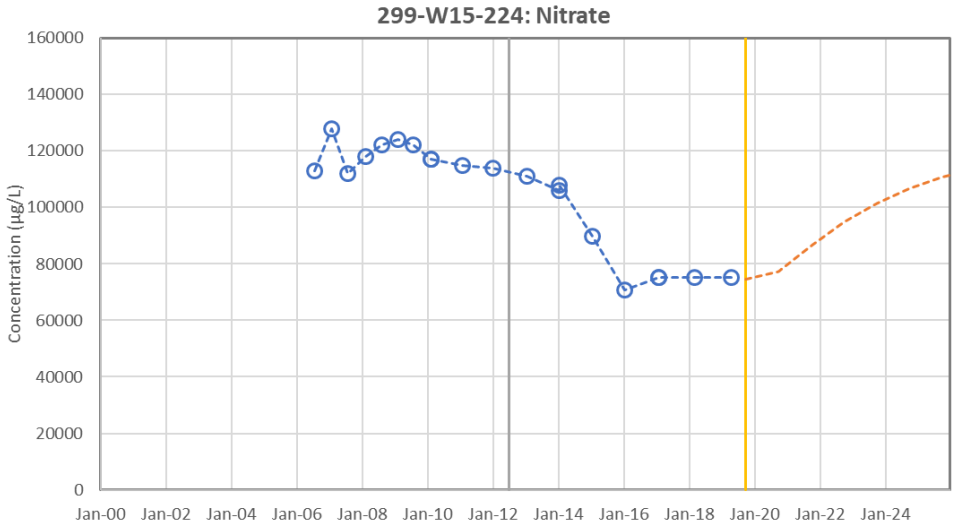


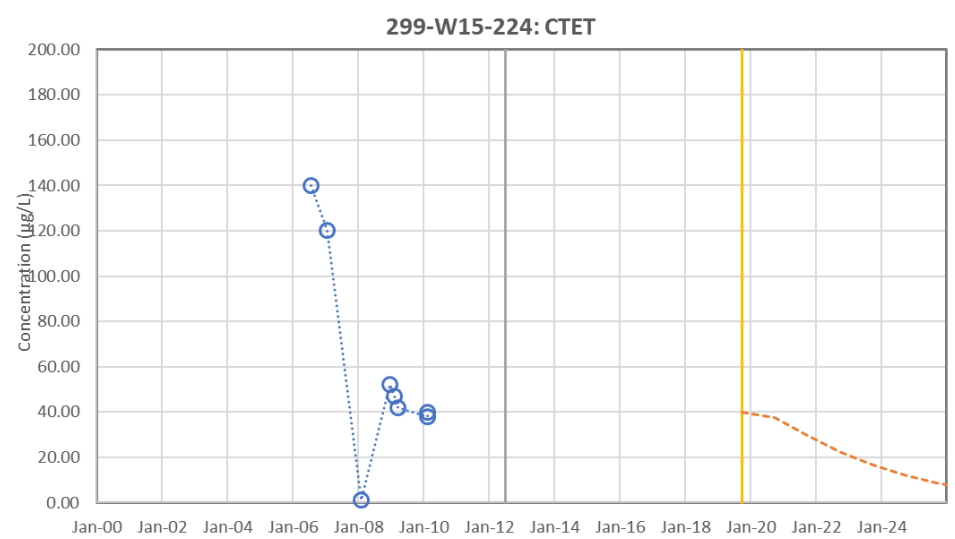
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-49



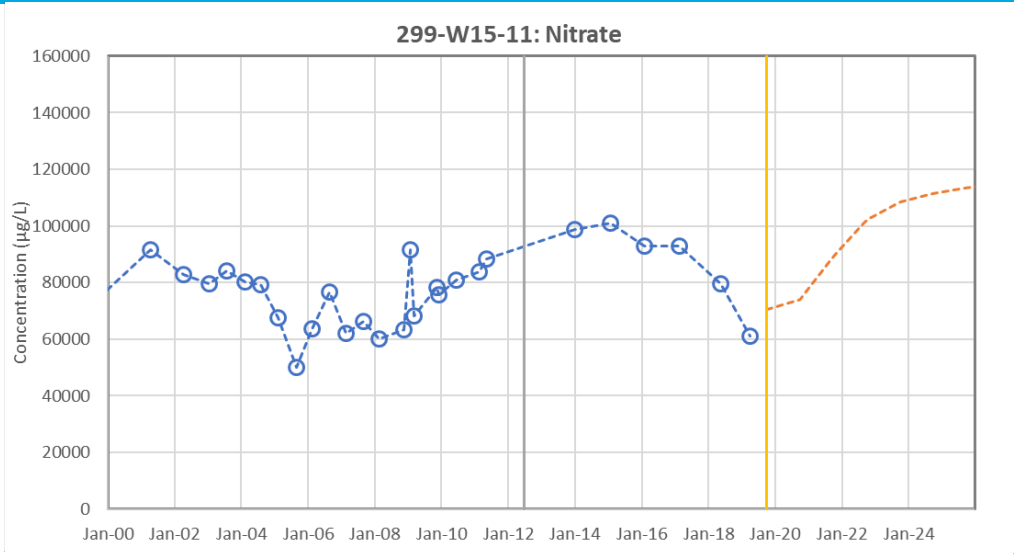


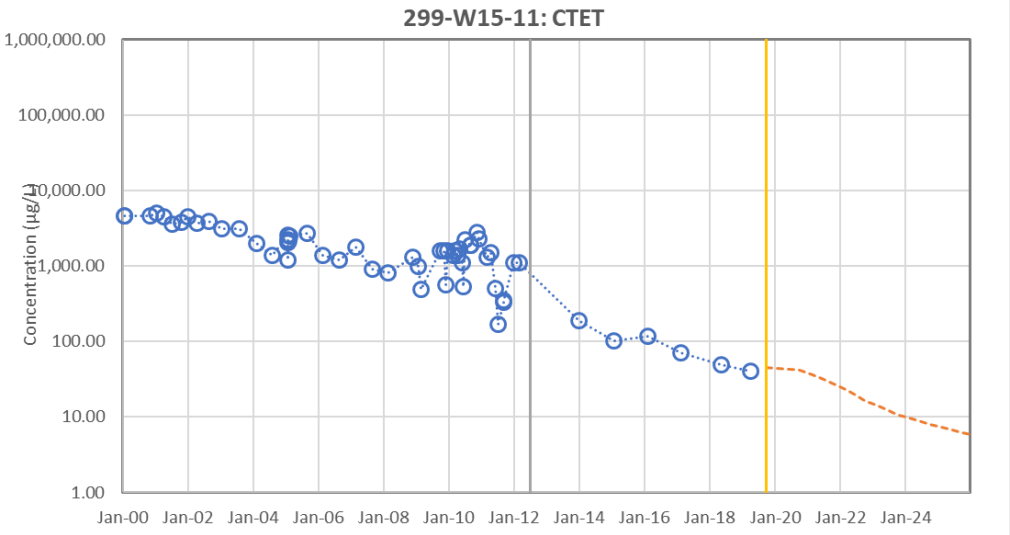
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-224



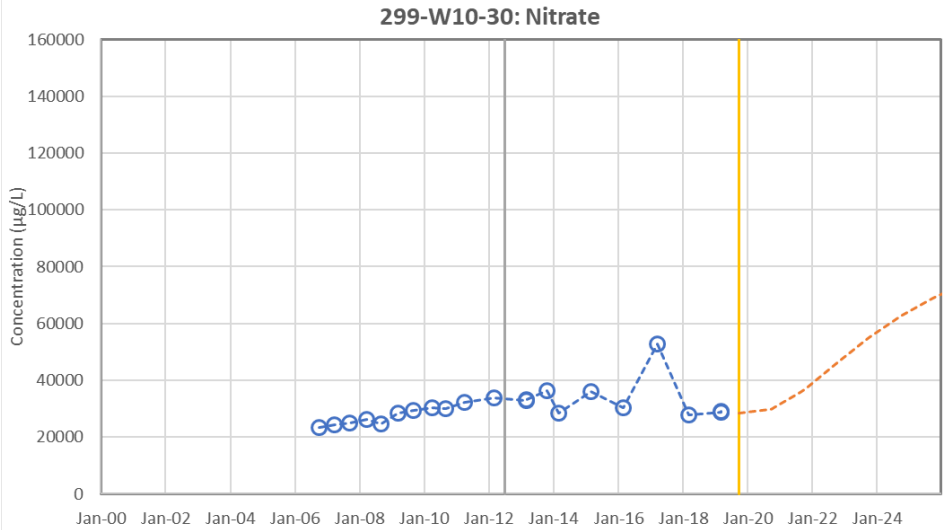


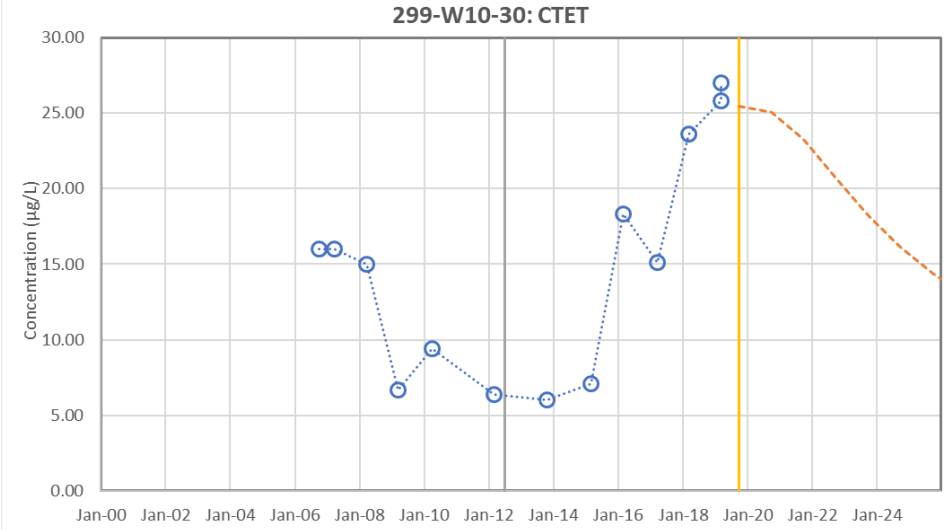
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W15-11



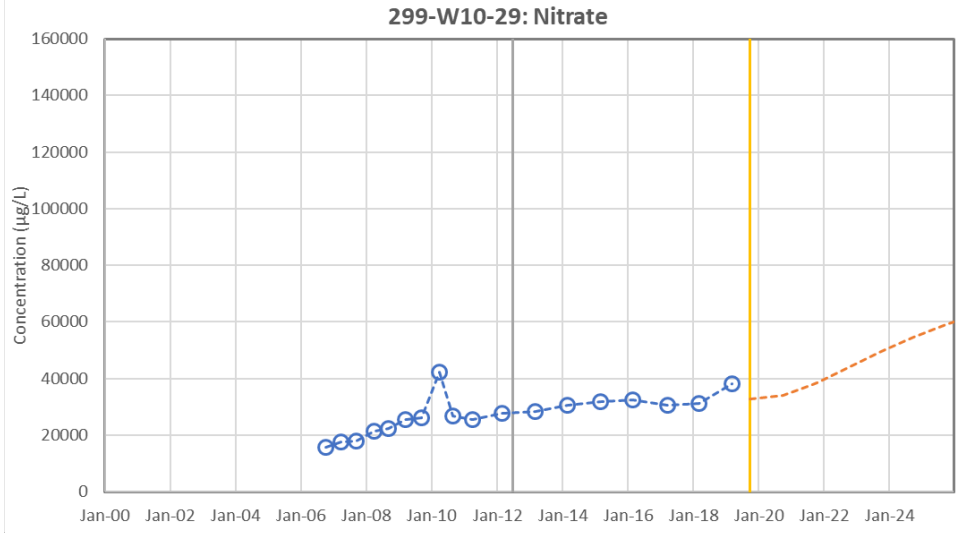


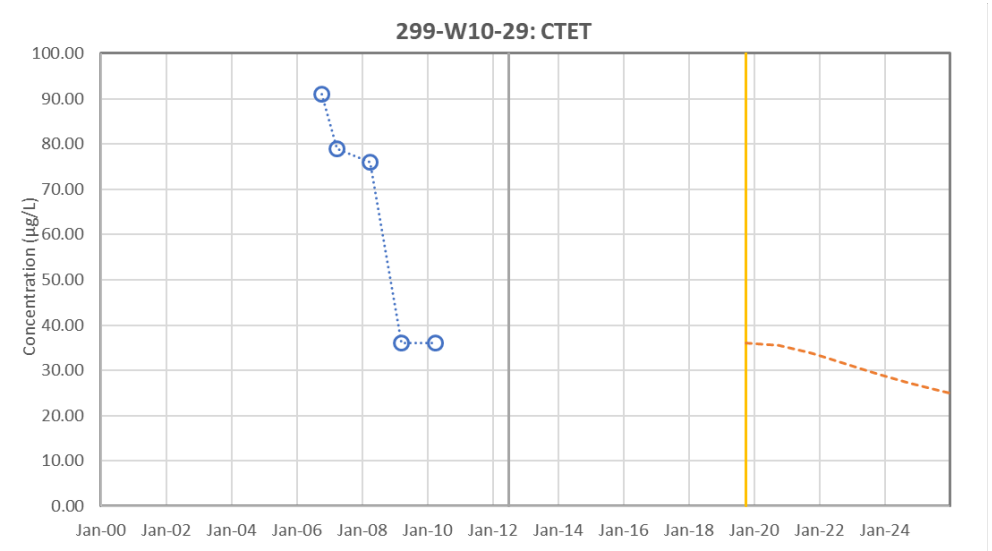
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W10-30



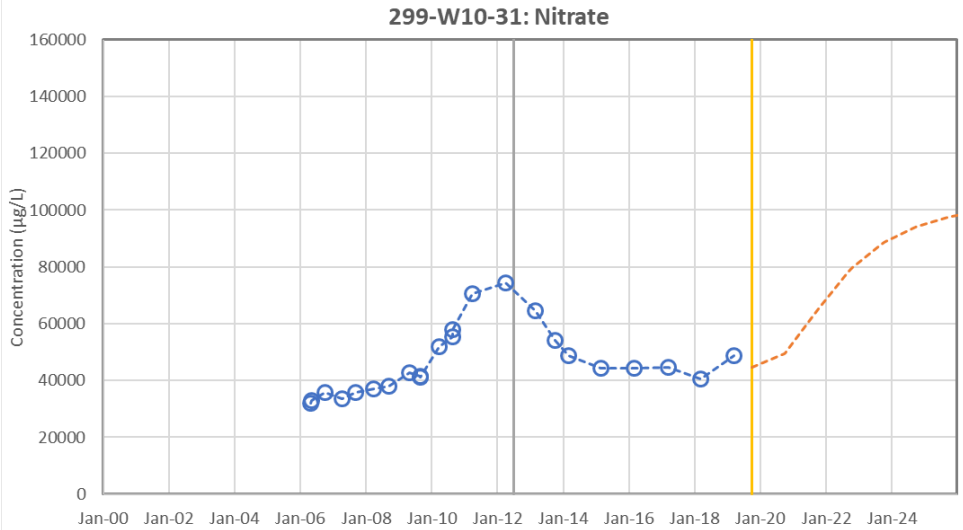


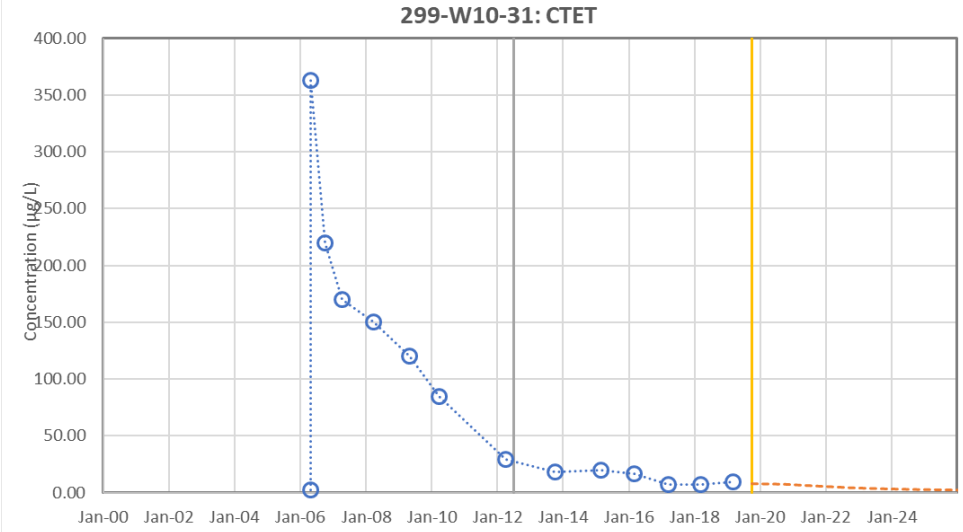
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W10-29



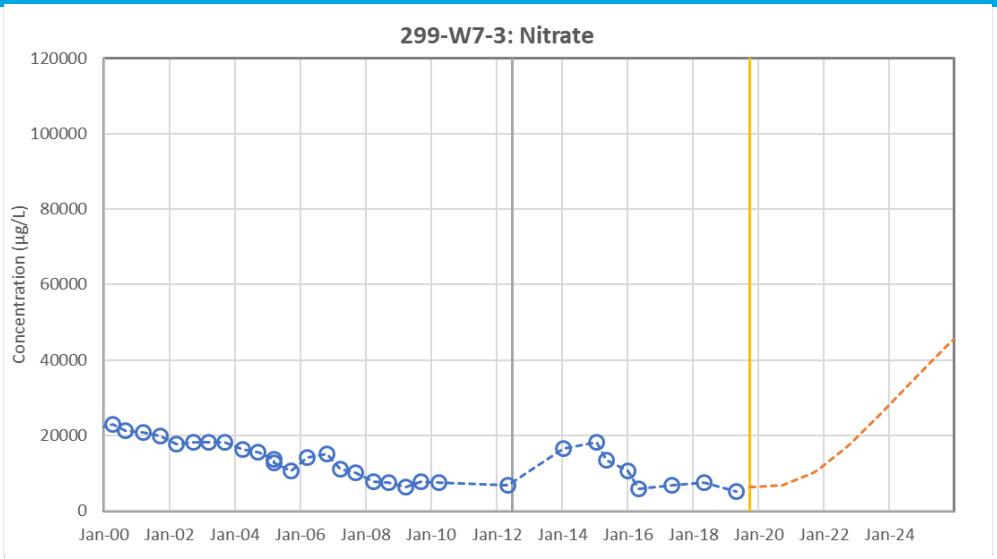


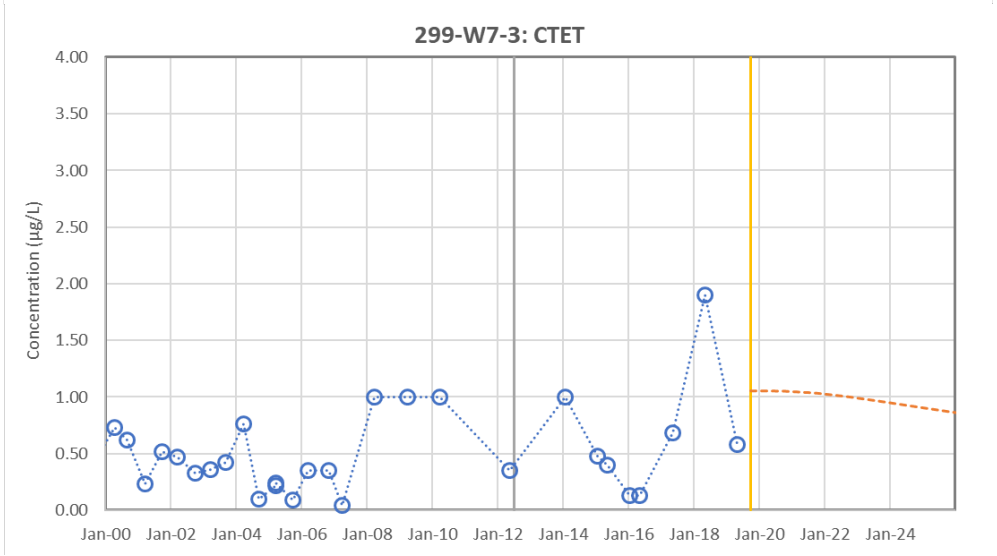
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W10-31



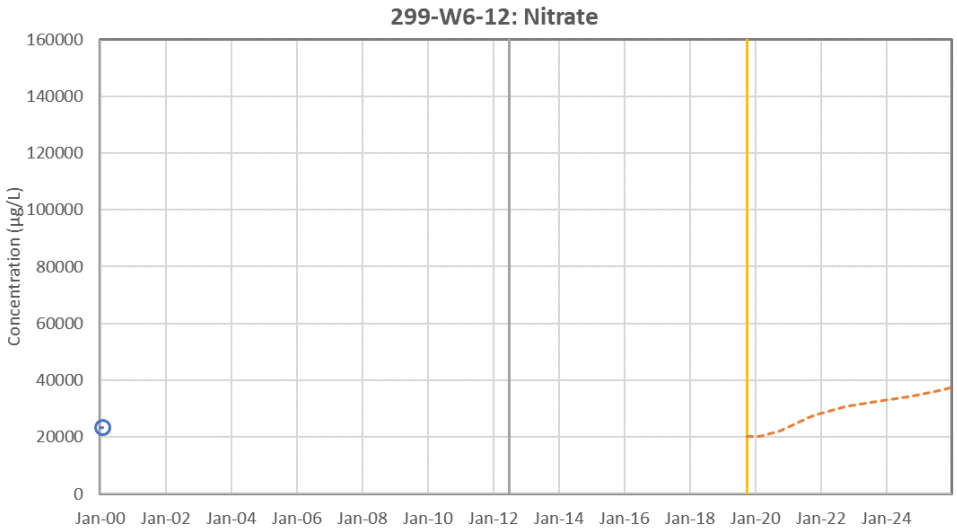


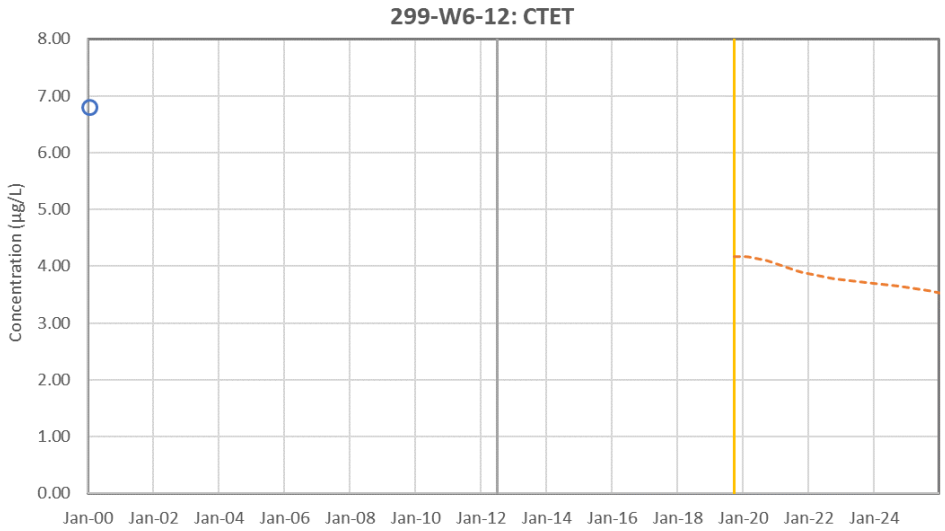
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W7-3



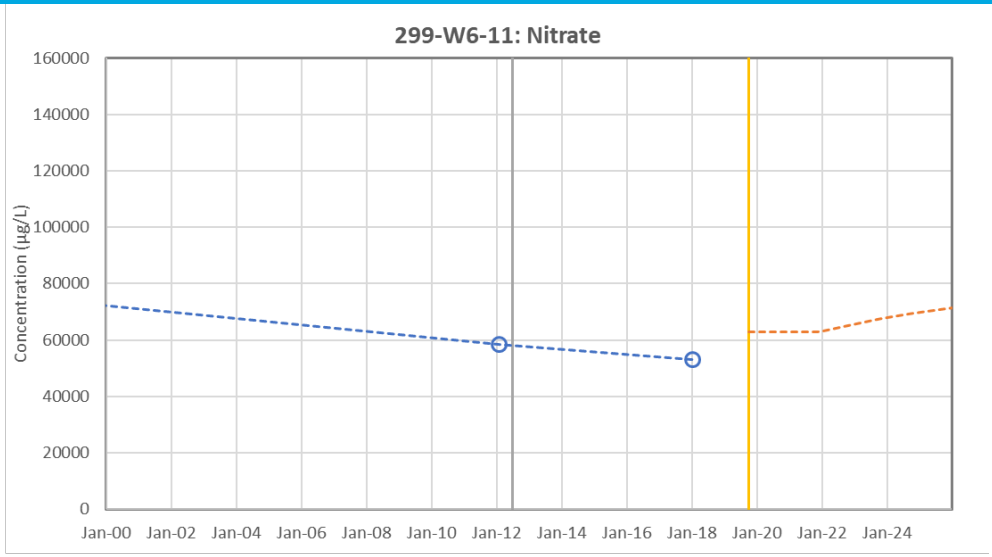


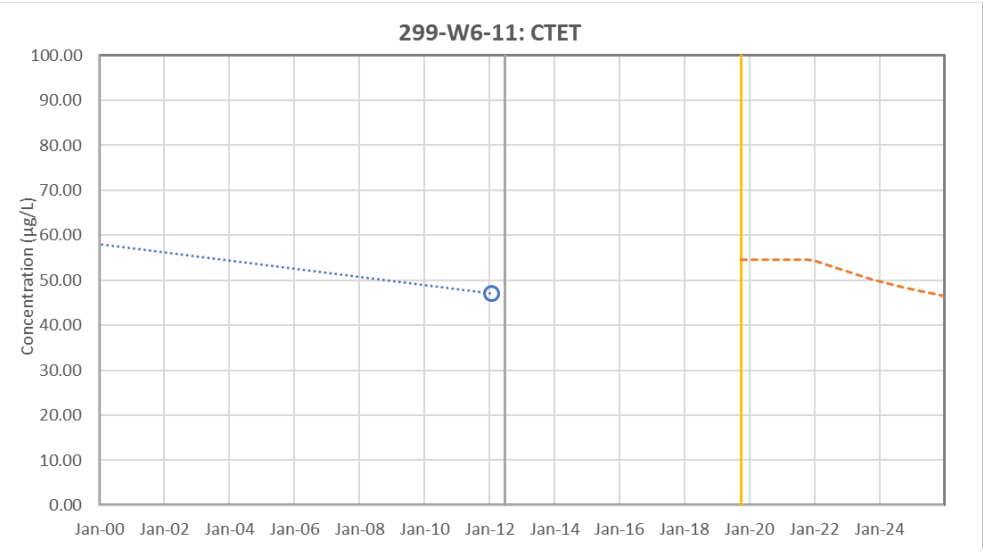
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W6-12



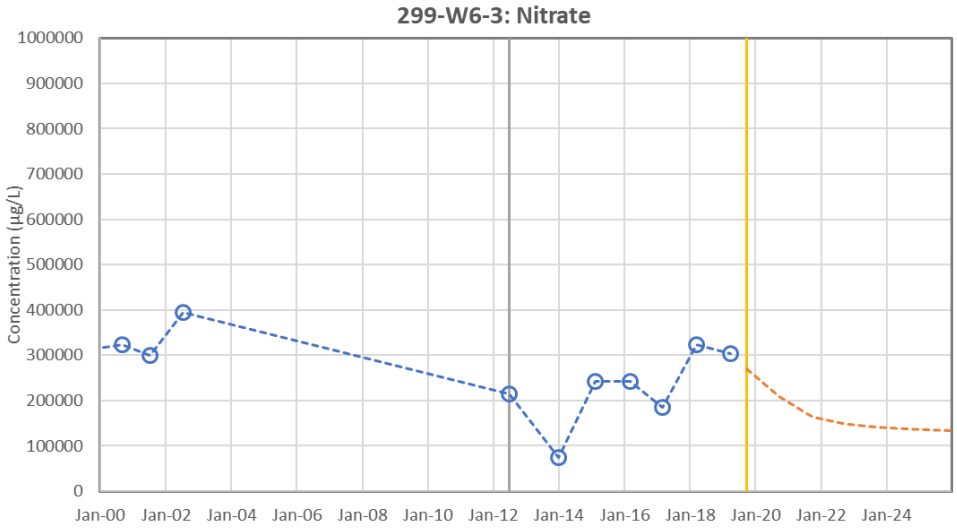


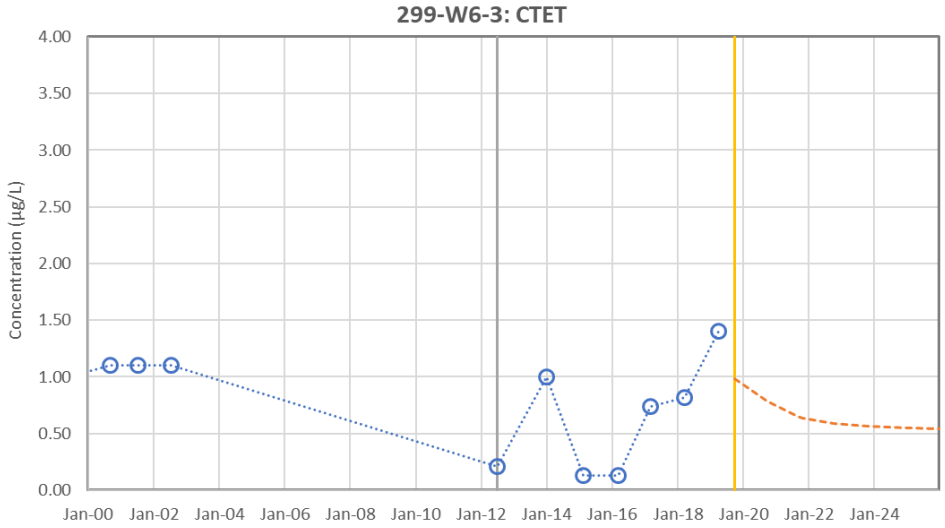
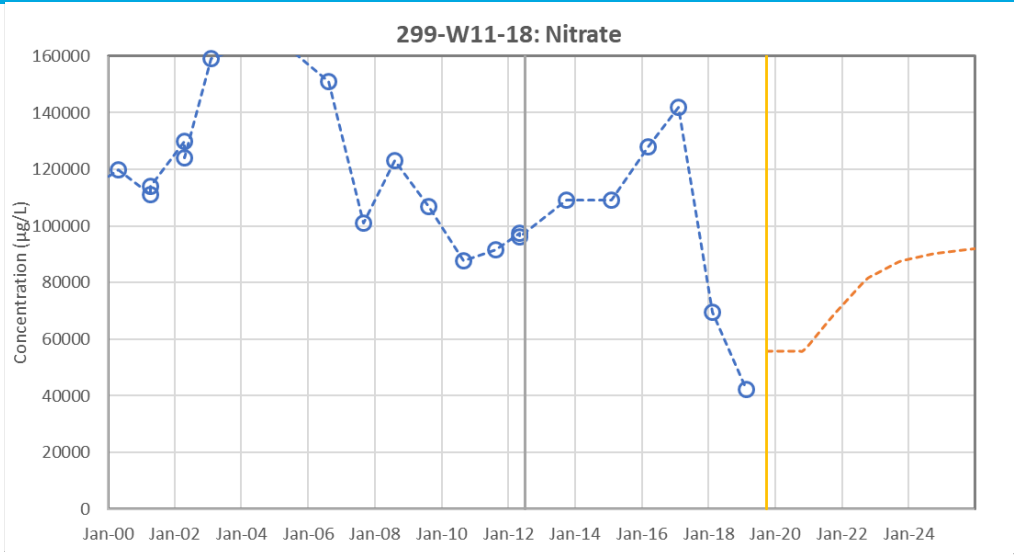
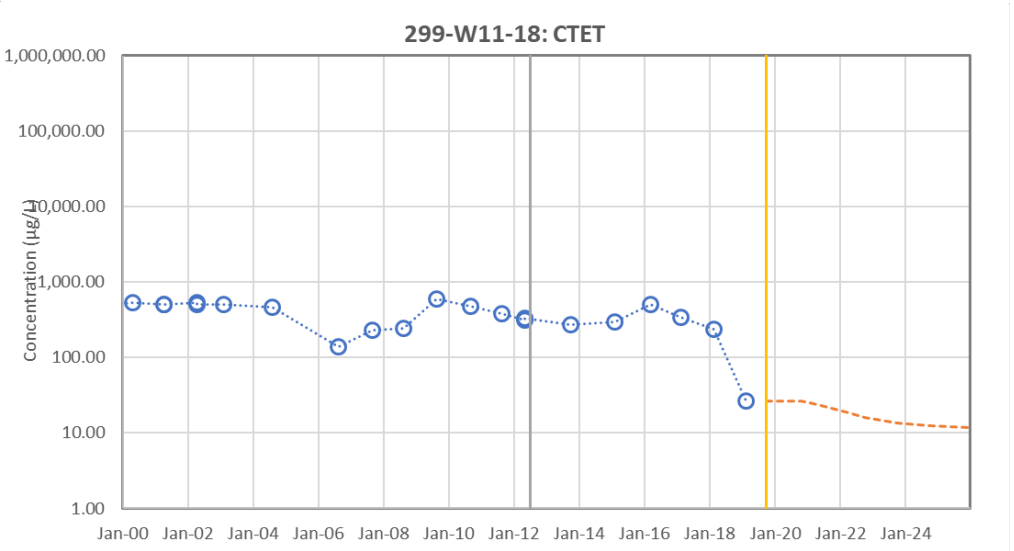
Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W6-11





Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W6-3





Projected Breakthrough Curves for Nitrate and Elution Curves for CTET: W11-18