

COG Exhibit 604 – TCEQ Uncalibrated QUAL-TX Model Results

Table 1. TCEQ Uncalibrated QUAL-TX Results - Interim Phase – 1.0 MGD – Permit Limits: 5/1.6/5 and TP=1.0

Constituent	TCEQ QUAL-TX Uncalibrated		
	Rucker	Mid-cove	Lake
DO_avg mg/L	5.45	4.84	5.86
DO_diel mg/L	Not modeled		
Temp °C	30.5	30.5	30.5
Ecoli MPN/100L	Not modeled		
Ammonia mg/L	1.32	0.73	0.02
NO3 mg/L	0.19	1.18	0.12
TP ug/L	Not modeled		
Chl-a ug/L	Not modeled		

Table 2. TCEQ Uncalibrated QUAL-TX Results - Final Phase – 2.0 MGD – Permit Limits: 5/1/5 and TP=0.5mg/L

Constituent	TCEQ QUAL-TX Uncalibrated		
	Rucker	Mid-cove	Lake
DO_avg mg/L	5.58	4.81	5.82
DO_diel mg/L	Not modeled		
Temp °C	30.5	30.5	30.5
Ecoli MPN/100L	Not modeled		
Ammonia mg/L	0.88	0.30	0.02
NO3 mg/L	0.17	0.76	0.04
TP ug/L	Not modeled		
Chl-a ug/L	Not modeled		

COG Exhibit 605 - Maps of Receiving Waters, Model Layout, and Water Quality Stations

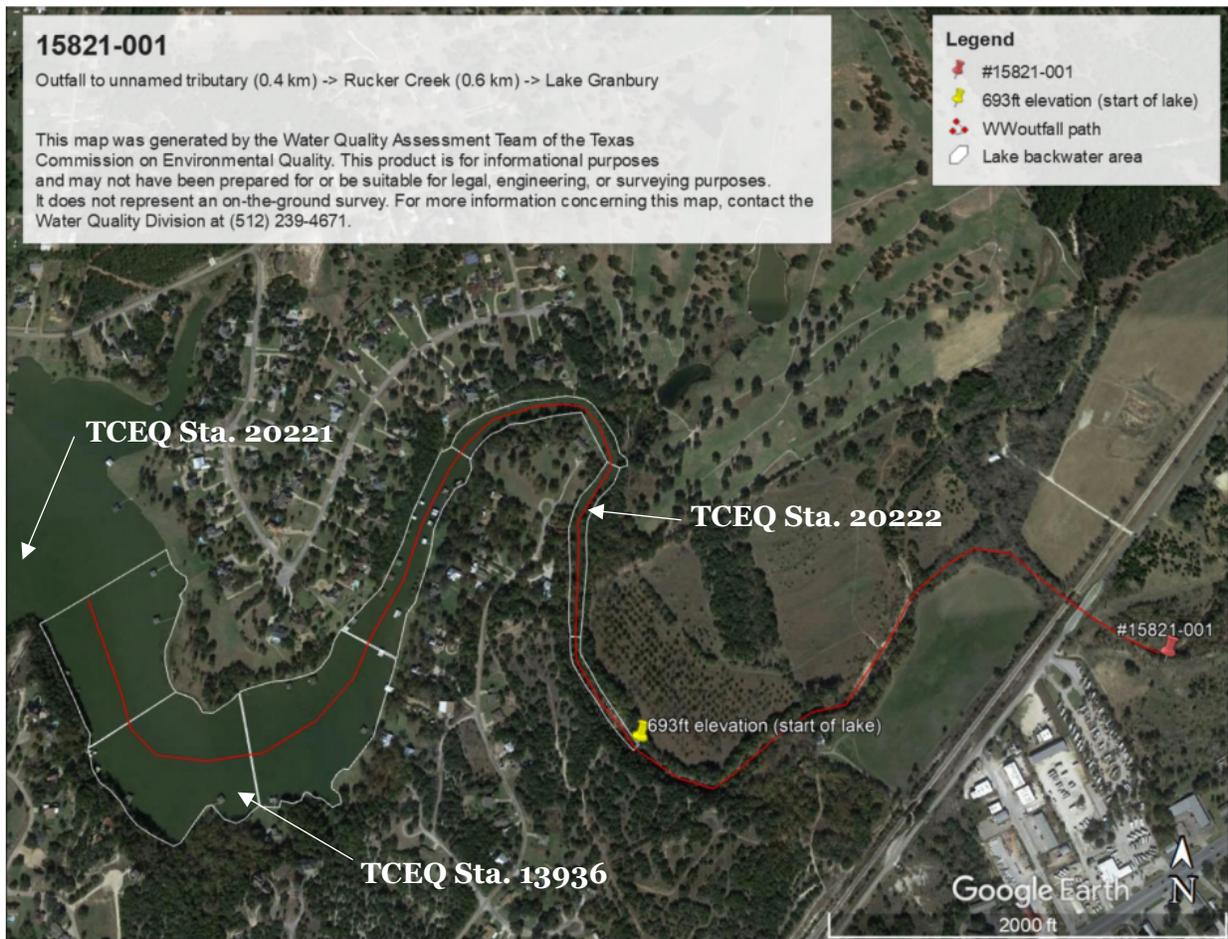


Figure 1. TCEQ QUAL-TX map showing model centerline (red) and water edge (white), with overlay of SWQM monitoring stations ("TCEQ Sta. #####").

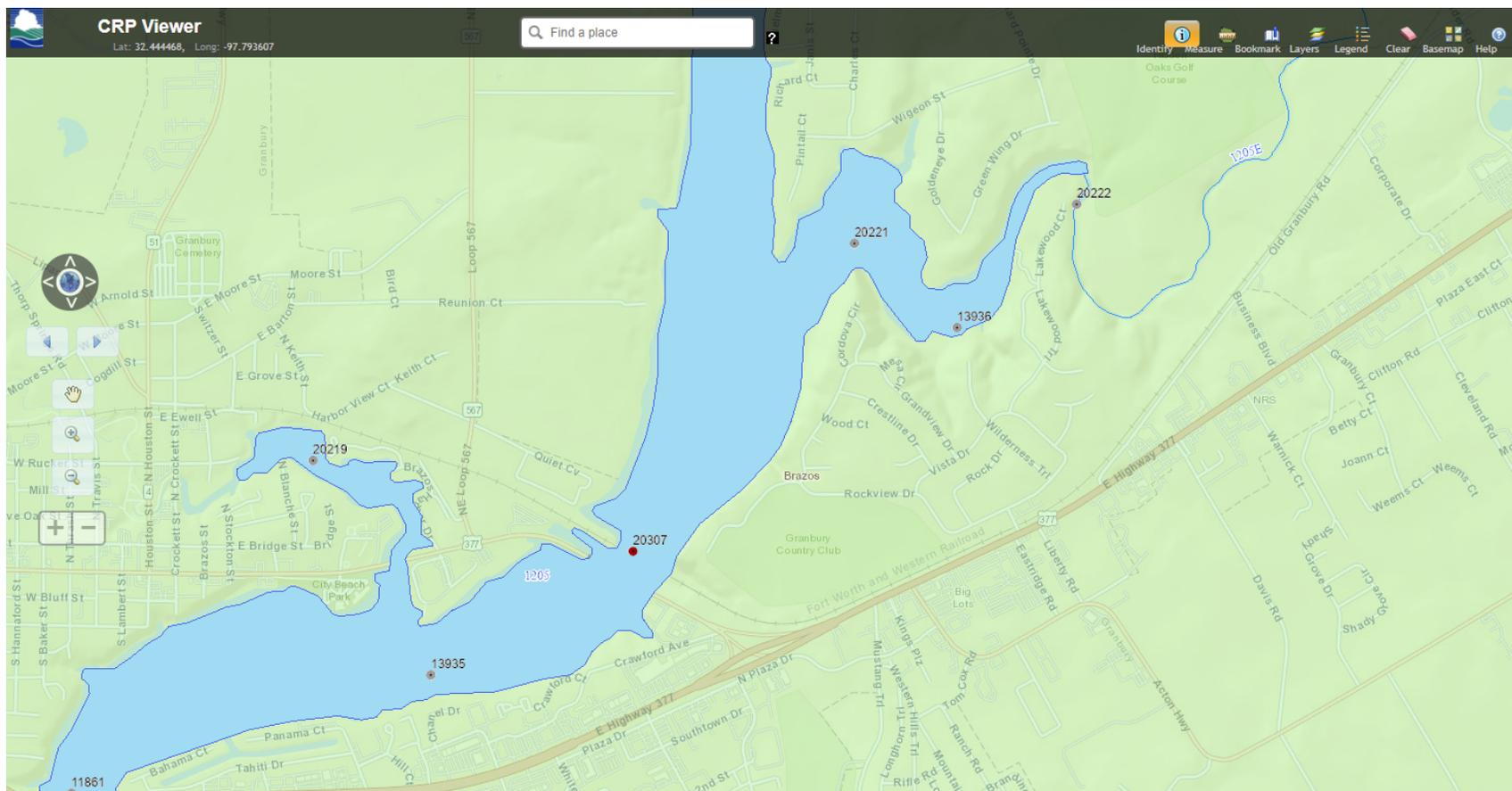


Figure 2. TCEQ SWQM monitoring stations.



Figure 3. QUAL-TX and QUAL2K model boundaries and Lake levels – Solid white line is 692 feet, the approximate shoreline near conservation pool elevation (CPE) also called normal pool, and the dotted blue line is approximate shoreline for a lower lake level at water elevation 686 ft (contour line source: TWDB hydrographic survey program).

COG Exhibit 606 - Model Geometry Inputs

Table 3. Model geometry inputs used for Applicant Updated QUALTX and QUAL2K for calibration and critical conditions, and for QUAL2K for low lake level condition

			Updated QUALTX and QUAL2K Calibration and critical conditions models		Low lake level (686 ft) model	
Reach	Distance Upstream (km)	Length of reach (km)	Typical Depth (m)	Typical Width (m)	Typical Depth (m)	Typical Width (m)
1 Rucker u/s	2.35	0.01	0.1	5.9	0.1	5.9
2 Unnamed	0.00	0.40	0.27	8.3	0.27	8.3
3 Rucker d/s	1.75	0.60	0.28	8.3	0.28	8.3
4 Lake BW1	1.55	0.20	0.75	16.3	0.30	8.3
5 Lake BW2	1.25	0.30	1.20	23.6	0.30	8.3
6 Lake BW3	1.00	0.25	2.22	30.0	0.30	9.7
7 Lake BW4	0.67	0.33	2.52	45.4	0.48	24.1
8 Lake Cove1	0.42	0.25	2.40	150.5	0.36	74.4
9 Lake Cove2	0.21	0.21	2.93	170.7	0.89	102.7
10 Lake Cove3	0.00	0.21	3.35	174.0	1.30	107.9

COG Exhibit 607 – Updated Uncalibrated QUAL-TX Model Results (from Applicant)

Table 4. Applicant Updated QUAL-TX Results - Interim Phase – 1.0 MGD – Permit Limits: 5/1.6/5 and TP=1.0

Constituent	Updated QUAL-TX Uncalibrated		
	Rucker	Mid-cove	Lake
DO_avg mg/L	5.05	4.82	5.90
DO_diel mg/L	Not modeled		
Temp °C	30.5	30.5	30.5
Ecoli MPN/100L	Not modeled		
Ammonia mg/L	1.32	0.12	0.02
NO3 mg/L	0.35	0.26	0.14
TP ug/L	Not modeled		
Chl-a ug/L	Not modeled		

The Updated QUAL-TX Uncalibrated model includes updated barometric pressure, depths, and widths, and also uses re-initialized SOD values for the no-load condition.

Table 5. Applicant Updated QUAL-TX Results - Final Phase – 2.0 MGD – Permit Limits: 5/1/5 and TP=0.5mg/L

Constituent	Updated QUAL-TX Uncalibrated		
	Rucker	Mid-cove	Lake
DO_avg mg/L	5.40	4.95	5.87
DO_diel mg/L	Not modeled		
Temp °C	30.5	30.5	30.5
Ecoli MPN/100L	Not modeled		
Ammonia mg/L	0.88	0.07	0.02
NO3 mg/L	0.17	0.82	0.15
TP ug/L	Not modeled		
Chl-a ug/L	Not modeled		

COG Exhibit 608 – Table comparing Lavon model inputs to QUAL-TX model inputs

**Lake Lavon model characteristics**

Depth=3.6m constant through model

Width=1067m constant

CBOD rate:  $K_1=0.2/\text{day}$

Amm rate: none

SOD rate: none

Reaer rate:  $K_2=0.042/\text{day}$

Diffusion:  $D_x = 86400\text{m}^2/\text{d}=1\text{m}^2/\text{s}$

DO inputs:  $\text{DO}_{\text{sat}} = 7.4\text{mg}/\text{L}$

Temperature:  $T=30^\circ\text{C}$

**Rucker/Granbury QUAL-TX characteristics**

QTX varies from 0.1 to 3.5m

QTX varies from 5.9 to 189.2m

$0.1/\text{day} = K_d$  minimum TCEQ and EPA rate

$0.3/\text{day} = K_n$  minimum TCEQ and EPA rate

$0.35\text{g}/\text{m}^2\text{-day} = \text{SOD}$  minimum TCEQ and EPA rate

$0.167/\text{day} = K_2$  minimum TCEQ and EPA per 0.6/D

$0.11\text{m}^2/\text{s} =$  minimum TCEQ in range 0.09-0.18 $\text{m}^2/\text{s}$

$6.0\text{mg}/\text{L} = 80\%\text{DO}_{\text{sat}}$

$30.5^\circ\text{C} =$  low flow critical conditions

COG Exhibit 609 – QUAL2K Model Boundary Conditions

Table 6. Model input boundary condition inputs for CALIBRATION scenario and CRITICAL CONDITIONS scenarios

Water Quality	Units	Upstream Boundary for Unnamed Tributary and Rucker Creek	Downstream Boundary	Upstream Boundary for Unnamed Tributary and Rucker Creek	Downstream Boundary
		CALIBRATION 9/15/21		CRITICAL CONDITIONS	
Flow rate Unnamed Tributary	cfs	0.00	-	0.03	-
Flow rate Rucker Creek	cfs	0.03	-	0.10	-
Lake Granbury Water Level Elevation	Feet	-	692.70 (CPE)	-	692.70 (CPE) 686.00*
Temperature	degree C	27.56	29.60	30.50	30.50
Conductivity	Umhos/cm	781.00	1030.00	781.00	2020.00
Inorganic Solids	mgD/L	5.60	10.00	5.60	20.00
Dissolved Oxygen	mg/L	6.53	5.90	6.00	6.53
CBODultimate	mgO2/L	7.11	2.30	2.99	2.30
Organic Nitrogen	ugN/L	780.00	685.00	150.00	830.00
NH4-Nitrogen	ugN/L	20.00	25.00	50.00	50.00
NO3-Nitrogen	ugN/L	20.00	20.00	100.00	80.00
Organic Phosphorus	ugP/L	6.20	10.00	21.48	15.00
Inorganic Phosphorus (SRP)	ugP/L	20.00	20.00	4.72	40.00
Phytoplankton	ugA/L	10.00	88.70	15.00	24.40
Pathogen	cfu/100 mL	70.00	2.00	70.00	5.00
Alkalinity	mgCaCO3/L	107.00	107.00	107.00	107.00
pH	s.u.	7.70	8.30	7.70	8.02

\* - A modified Critical Conditions scenario was evaluated where all boundary conditions remained the same except model geometry was changed to accommodate the lower lake level.

## COG Exhibit 610 - Expected quality of effluent discharge from proposed Granbury MBR WWTP

These are expected WWTP effluent discharge concentrations for typical day-to-day conditions. These originated from the designer of the proposed City of Granbury WWTP that is subject of this permit.

1. Conductivity – 1,560 umhos/cm current from existing plant (same level for East plant, BNR/MBR will not change conductivity)
2. TDS – 608 mg/L current from existing plant (same level for East plant, BNR/MBR will not change TDS)
3. Nitrogen (influent ammonia:TKN ratio is 0.73)
  - a. Effluent TKN – 0.1-0.2 mg/L (Abilene's MBR facility is 0.133 mg/L)
  - b. Effluent Nitrate – 12-14 mg/L (Abilene's MBR facility is 13.3 mg/L)
  - c. Effluent Ammonia – 0.0-0.2 mg/L (existing South conventional plant produces 0.2-0.3 mg/L, and Abilene's MBR facility is 0.105 mg/L)
4. Phosphorus (Orthophosphate:Total Phosphorus ratio is 0.8)
  - a. Effluent Orthophosphate – 0.1-0.2 mg/L (via current BNR design)
  - b. Effluent Polyphosphate – 0.1-0.2 mg/L (via current BNR design)
5. Phytoplankton – No data on projected phytoplankton
6. Alkalinity – 100-150 mg/L (due to anoxic selector restoring alkalinity to effluent)
7. pH – 7.4-7.8 (Abilene's MBR is 7.7)
8. temp – 24-26 C
9. E. Coli – 0-1 CFU (Abilene's MBR is <1.1)

COG Exhibit 611 - Calibrated QUAL2K Model Results for 3 observed condition scenarios

**Calibrated Q2K results**

Table 7. QUAL2K Results – Calibration September 2021 – Run A1 - No Load

Constituent	QUAL2K calibration conditions (0.03cfs and CPE) – travel time 5,000 days			Observation		
	Rucker	Mid-cove	Lake	Rucker	Mid-cove	Lake
DO_avg mg/L Daily average	6.5	6.25	6	6.5	6.5	6
DO_diel mg/L Minimum diel	5.75	5.5	5.5	n/a	5.1	n/a
Temp °C	22	25	29	24	27.7	29
Ecoli MPN/100L Pathogen (cfu/100mL)	70	0	2	n/a	12	0
Ammonia mg/L NH4	0.02	0.005	0.02	0.02	0.02	n/a
NO3 mg/L Nitrate	0.02	0.005	0.02	n/a	n/a	0.02
TP mg/L Total Phosphorus	0.014	0.025	0.031	0.025	0.037	0.031
Chl- <i>a</i> ug/L Phytoplankton	99 (+12%)	42 (-52%)	88	n/a	n/a	88
Btm Alg mg/m2 Bottom Algae	140 (occurring in 6% of segment length)	0	0	25% bottom coverage	10% bottom coverage	n/a

Percent change (%), where shown, is relative to baseline observation value where percent is calculated as:  $100\% * (\text{prediction} - \text{observation}) / \text{observation}$ . Positive percent change shown with a plus (+) symbol indicates prediction is higher than the baseline.  
n/a = not available

Table 8. QUAL2K Results – Calibration condition –Run A2 - Interim Phase – 1.0 MGD – Typical BNR/MBR effluent conc

Constituent	QUAL2K calibration conditions (0.03cfs and CPE) – travel time 100 days		
	Rucker	Mid-cove	Lake
DO_avg mg/L	6.5	6.5	5.9
DO_diel mg/L	5.5	6.5	5.5
Temp °C	27	25	29
Ecoli MPN/100L	70	0	0
Ammonia mg/L	0.14	0.02	0.001
NO3 mg/L	5.0	0.5	0.001
TP mg/L	0.18	0.14	0.03
Chl-a ug/L	0 (-100%)	37 (-58%)	88
Btm Alg mg/m2	160	75	0

Percent change (%), where shown, is relative to baseline observation value where percent is calculated as:  $100\% * (\text{prediction} - \text{observation}) / \text{observation}$ . Positive percent change shown with a plus (+) symbol indicates prediction is higher than the baseline.

Table 9. QUAL2K Results - Calibration condition –Run A3 - Final Phase – 2.0 MGD – Typical BNR/MBR effluent conc

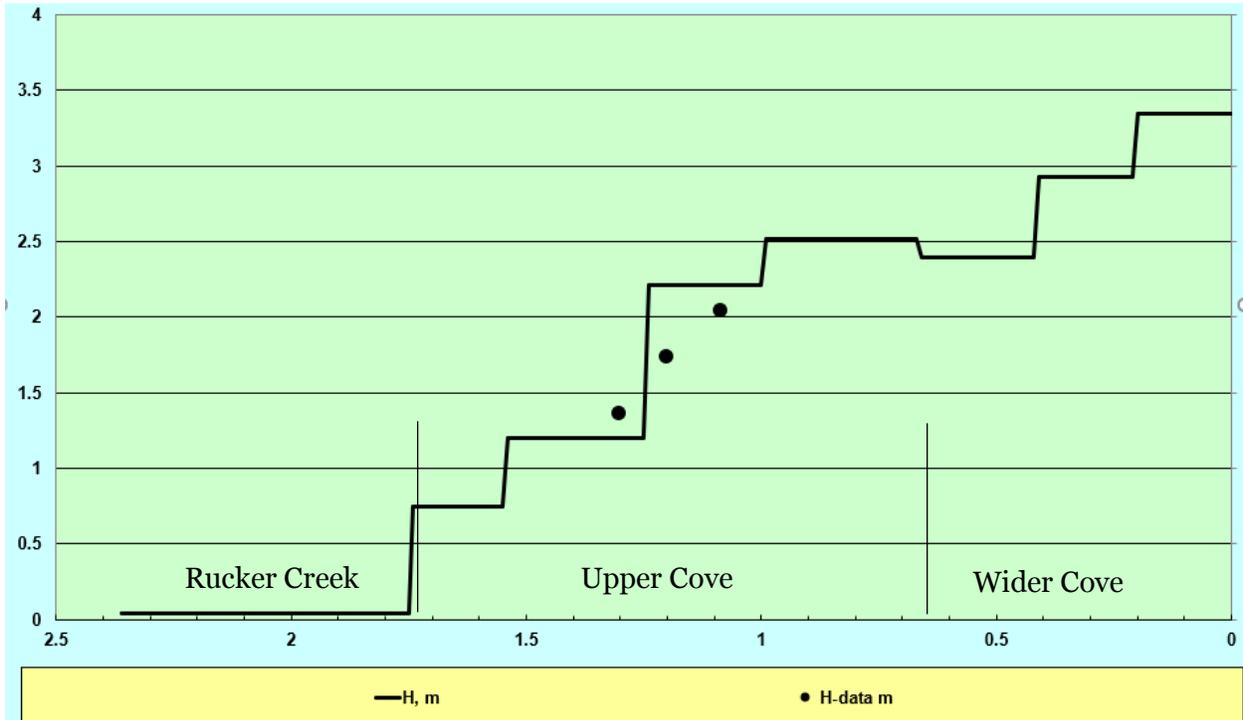
Constituent	QUAL2K calibration conditions (0.03cfs and CPE) – travel time 50 days		
	Rucker	Mid-cove	Lake
DO_avg mg/L	6.5	6.0	5.95
DO_diel mg/L	5.75	5.9	5.5
Temp °C	27	25	29
Ecoli MPN/100L	70 (47 <sup>1</sup> )	0 (17 <sup>2</sup> )	0
Ammonia mg/L	0.16	0.04	0.001
NO3 mg/L	7.8	1.0	0.001
TP mg/L	0.185	0.14	0.03
Chl-a ug/L	0 (-100%)	30 (-66%)	88
Btm Alg mg/m2	160	25	0

Percent change (%), where shown, is relative to baseline observation value where percent is calculated as:  $100\% * (\text{prediction} - \text{observation}) / \text{observation}$ . Positive percent change shown with a plus (+) symbol indicates prediction is higher than the baseline.

Note 1 – Maximum E.coli predicted in Rucker downstream of unnamed tributary

Note 2 – E.coli predicted near monitoring station 20222.

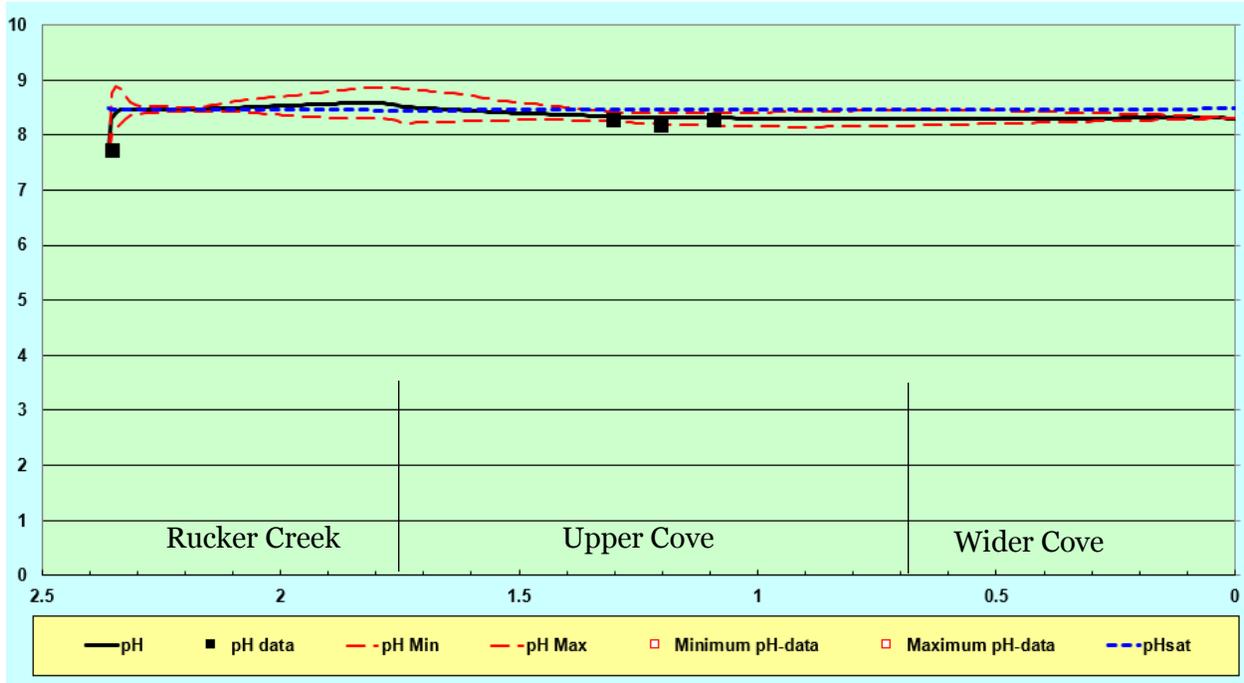
COG Exhibit 612 - Run A1 – Calibration to observed conditions  
**CALIBRATED QUAL2K – September 15, 2021 – No Load Q<sub>o</sub>**



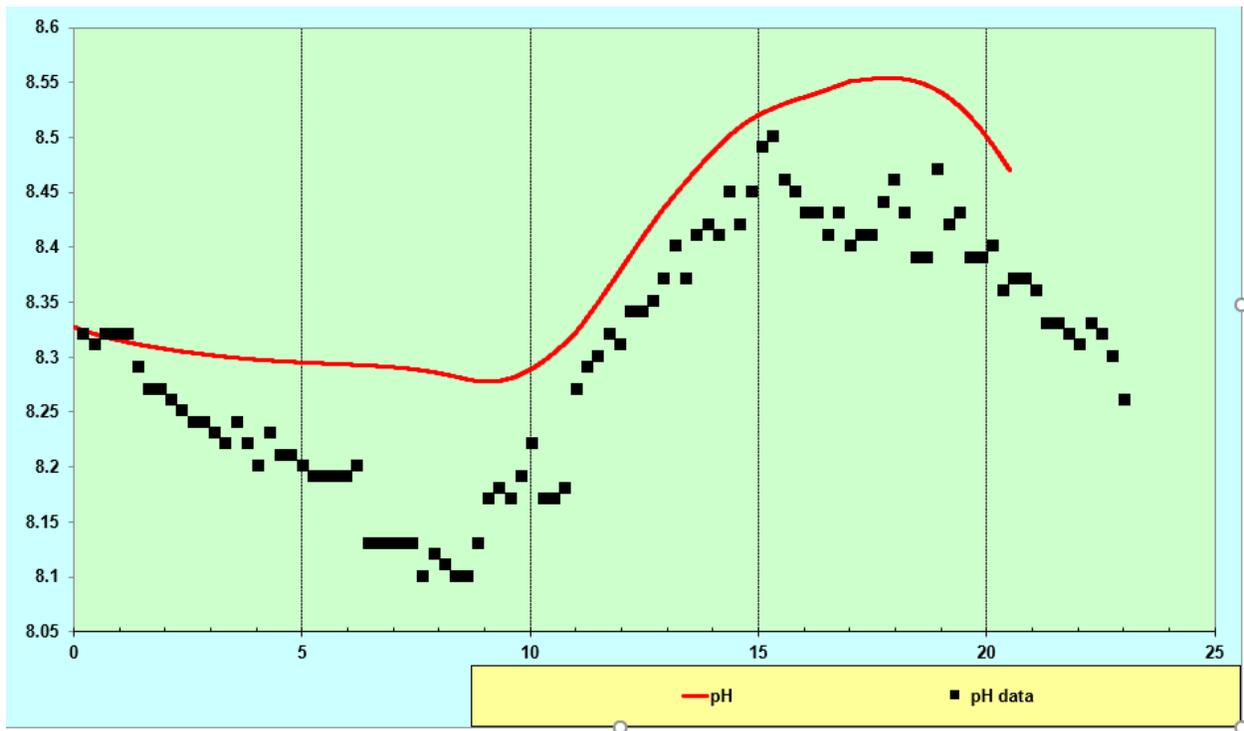
X axis: Distance upstream from cove downstream boundary (kilometers, km)



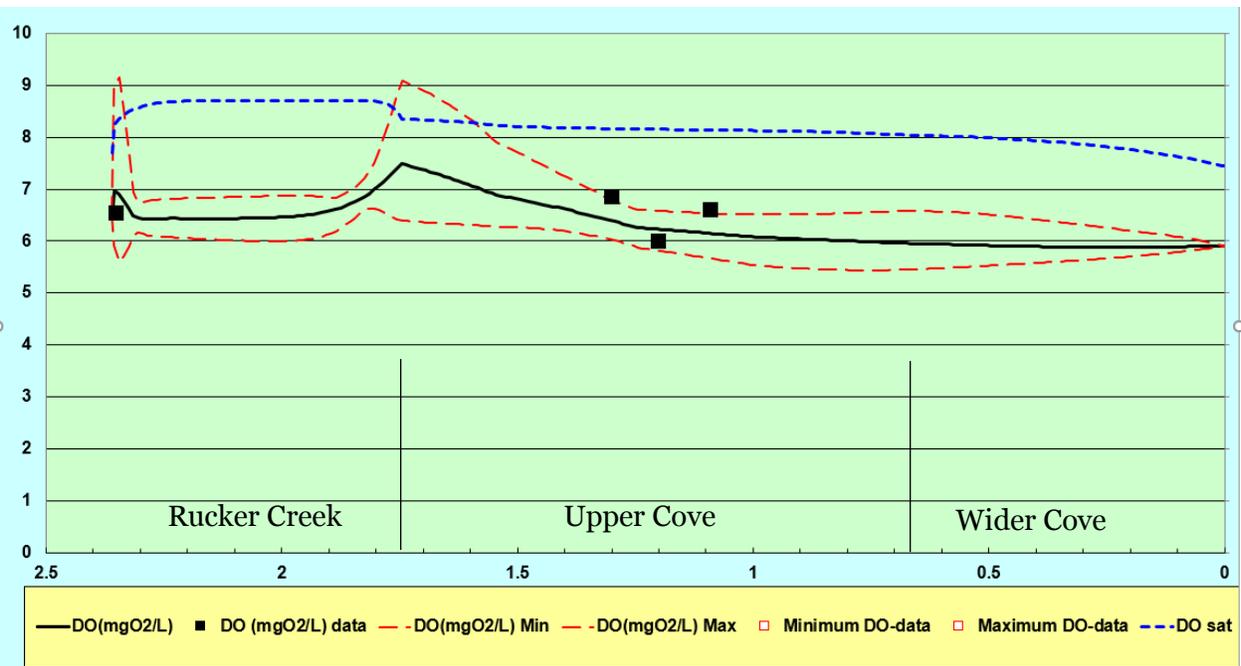
X axis: Distance upstream from cove downstream boundary (km)



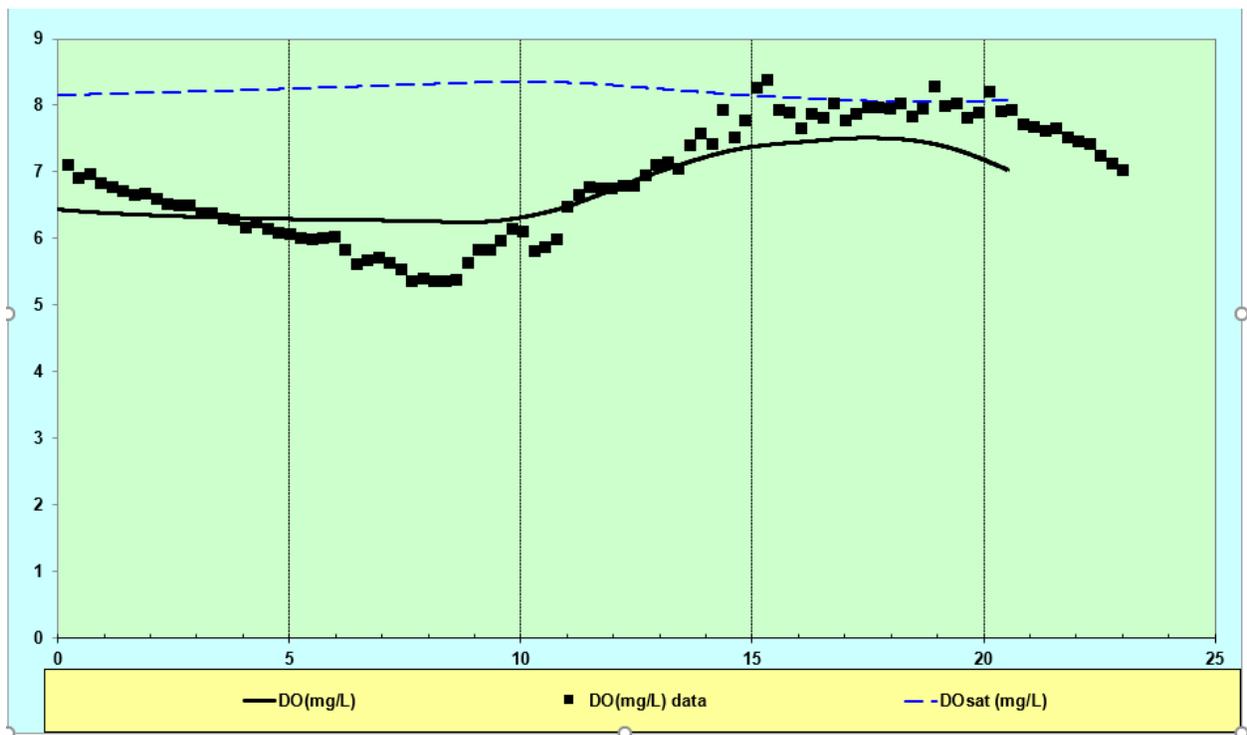
X axis: Distance upstream from cove downstream boundary (km)



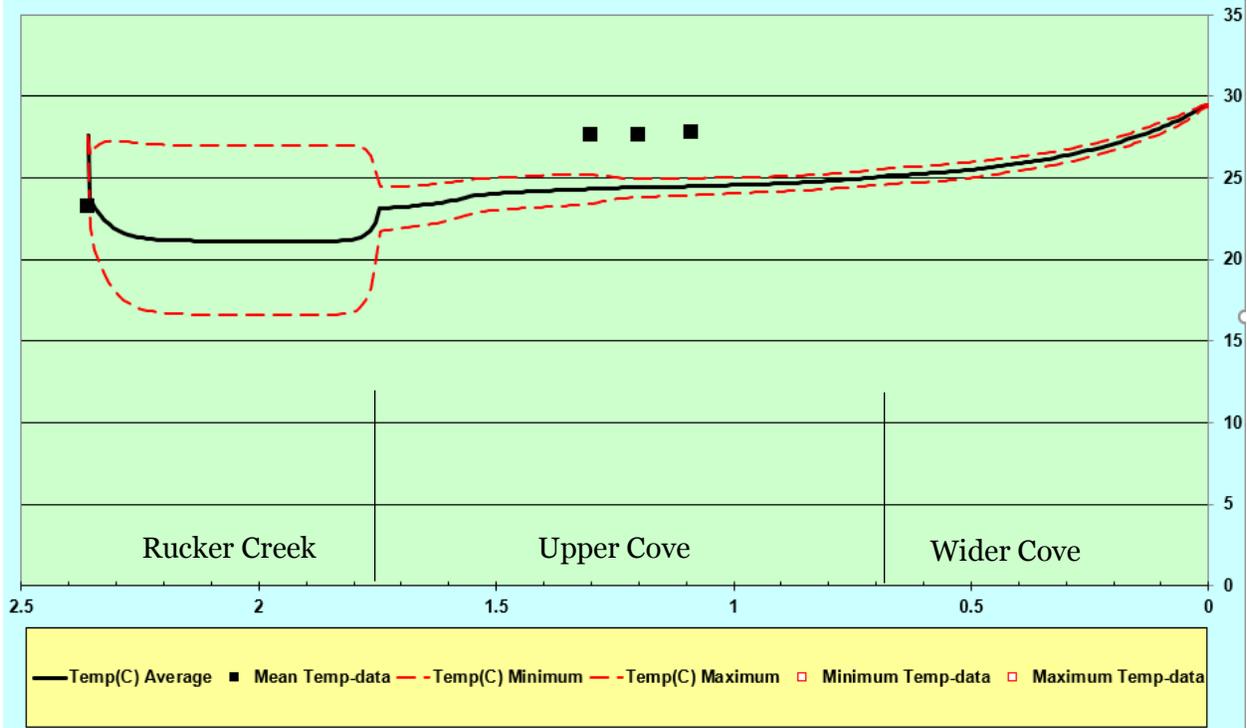
X axis: Time (hours)



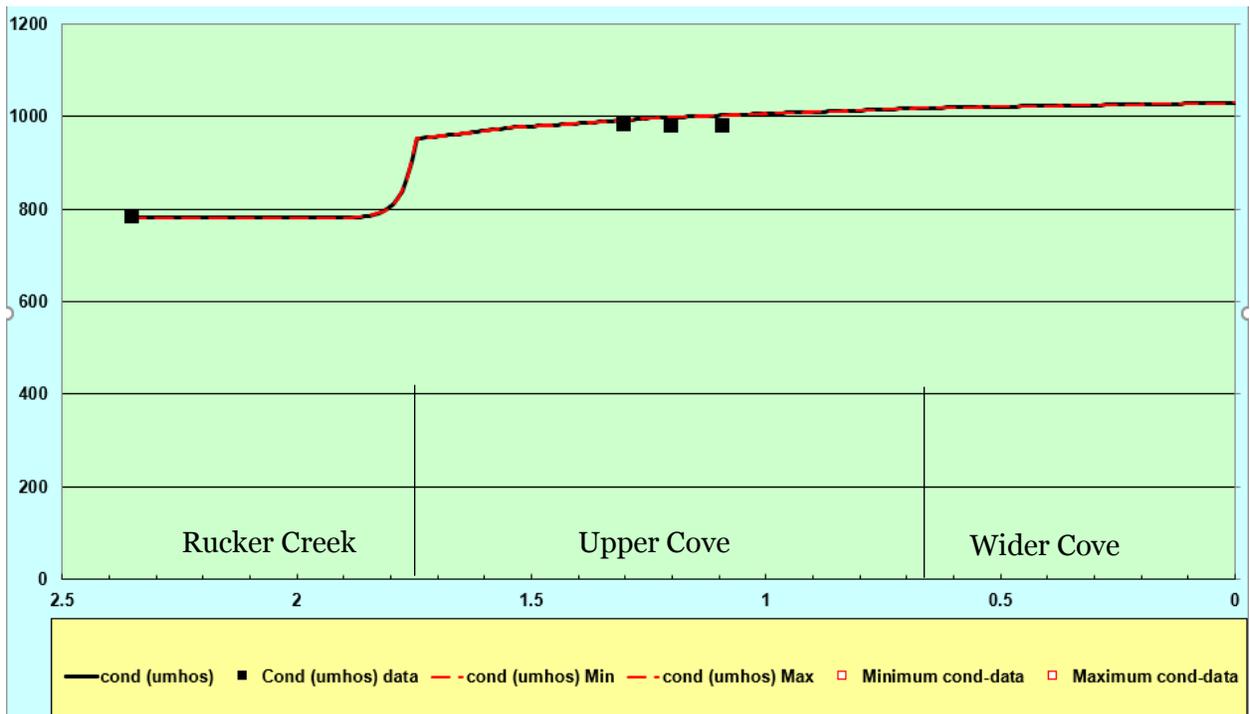
X axis: Distance upstream from cove downstream boundary (km)



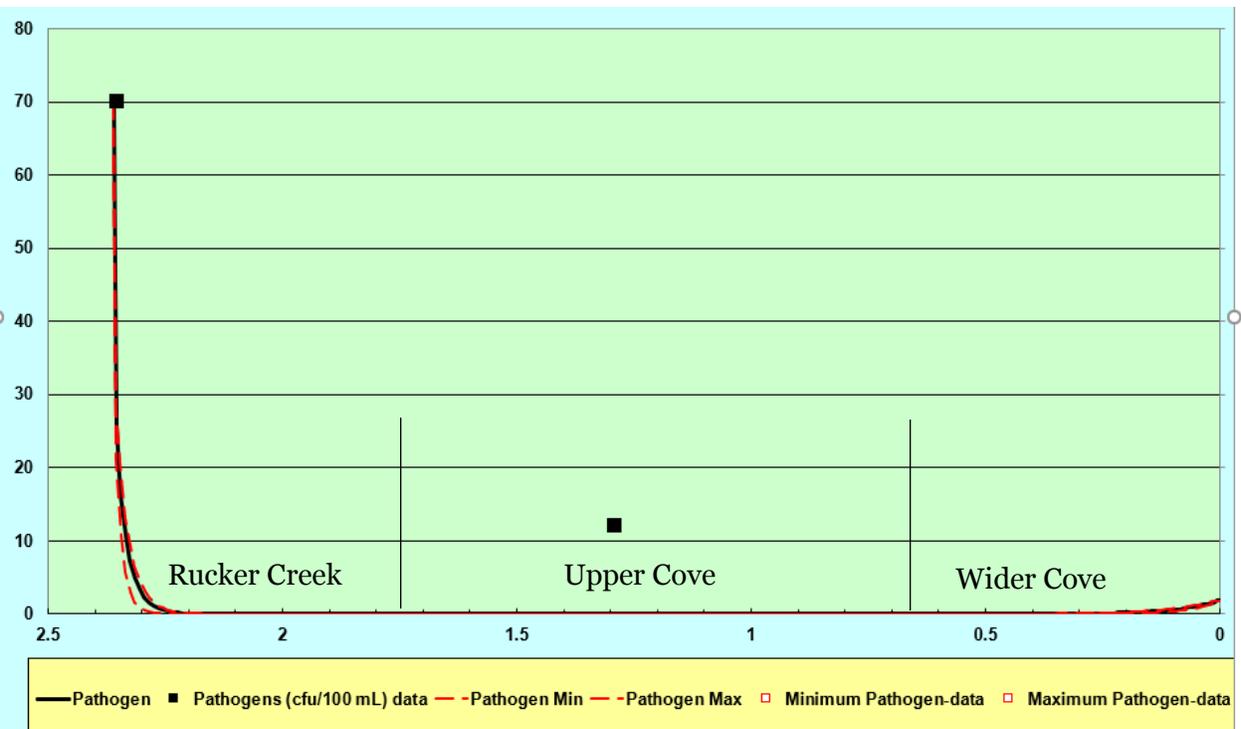
X axis: Time (hours)



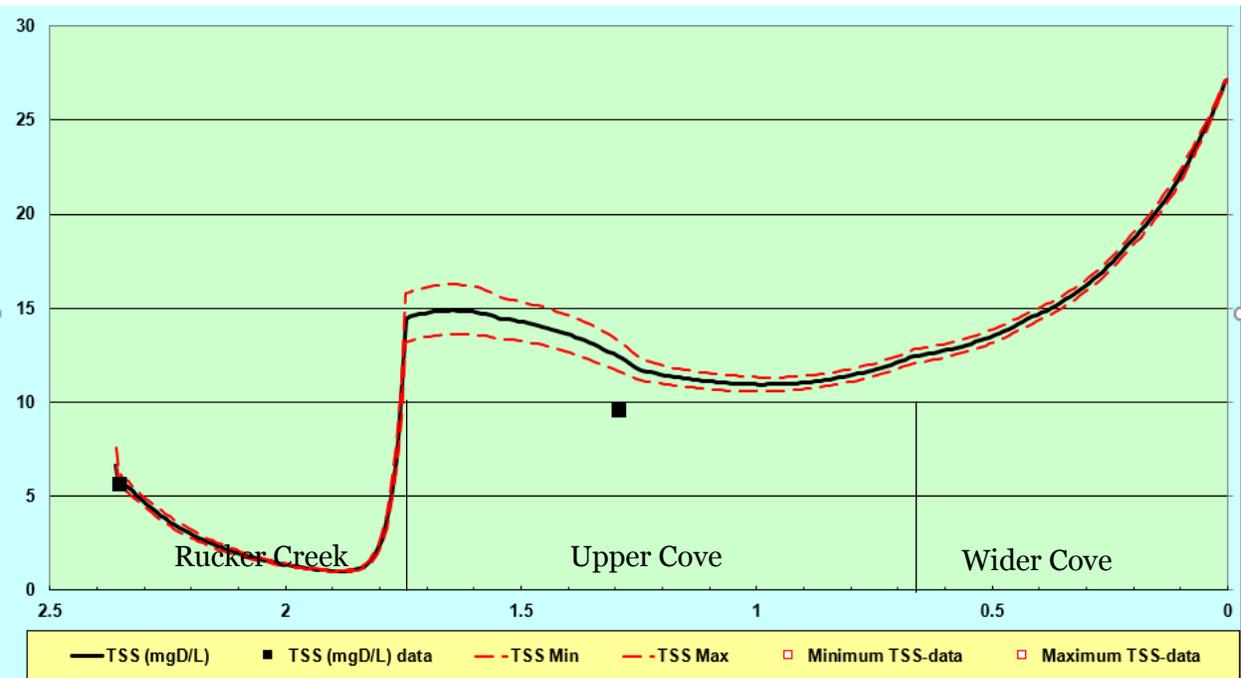
X axis: Distance upstream from cove downstream boundary (km)



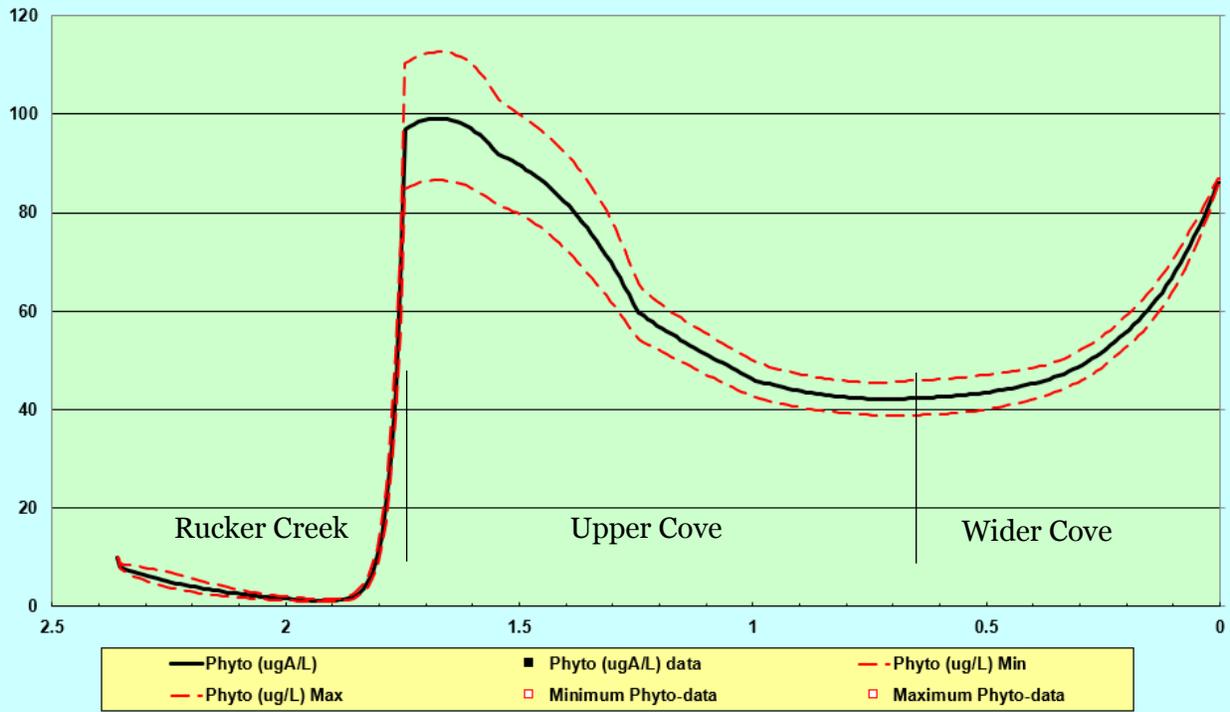
X axis: Distance upstream from cove downstream boundary (km)



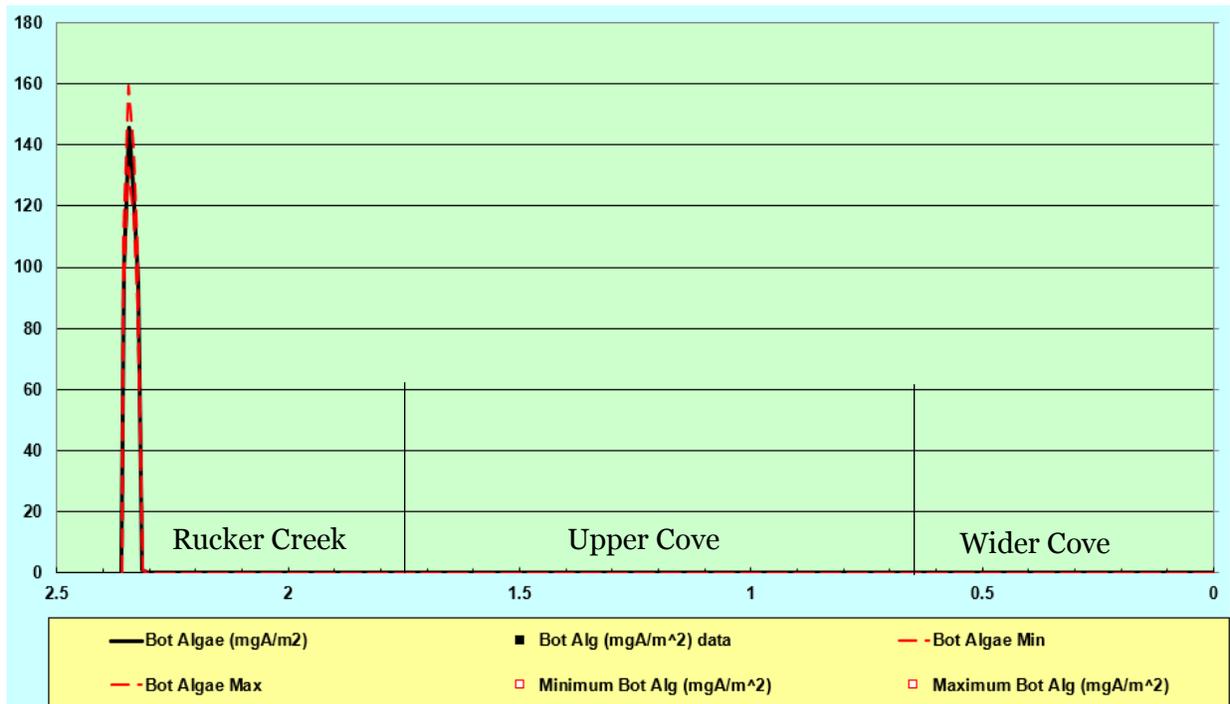
X axis: Distance upstream from cove downstream boundary (km)



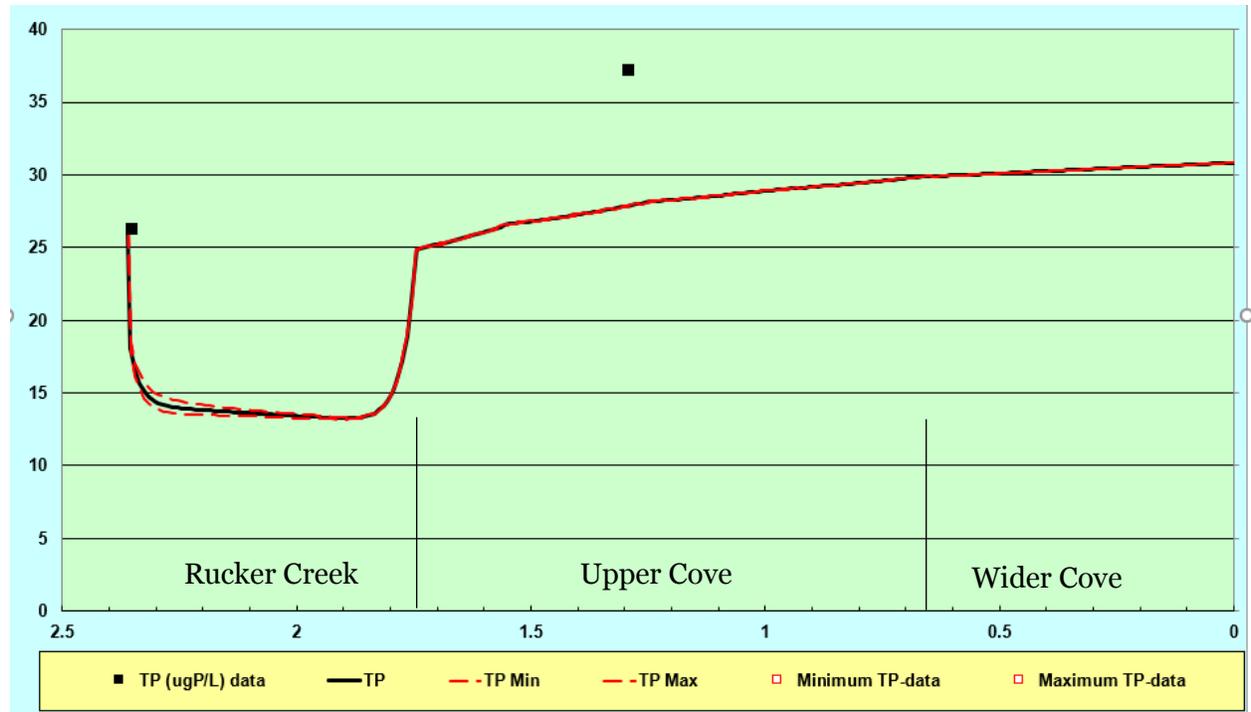
X axis: Distance upstream from cove downstream boundary (km)



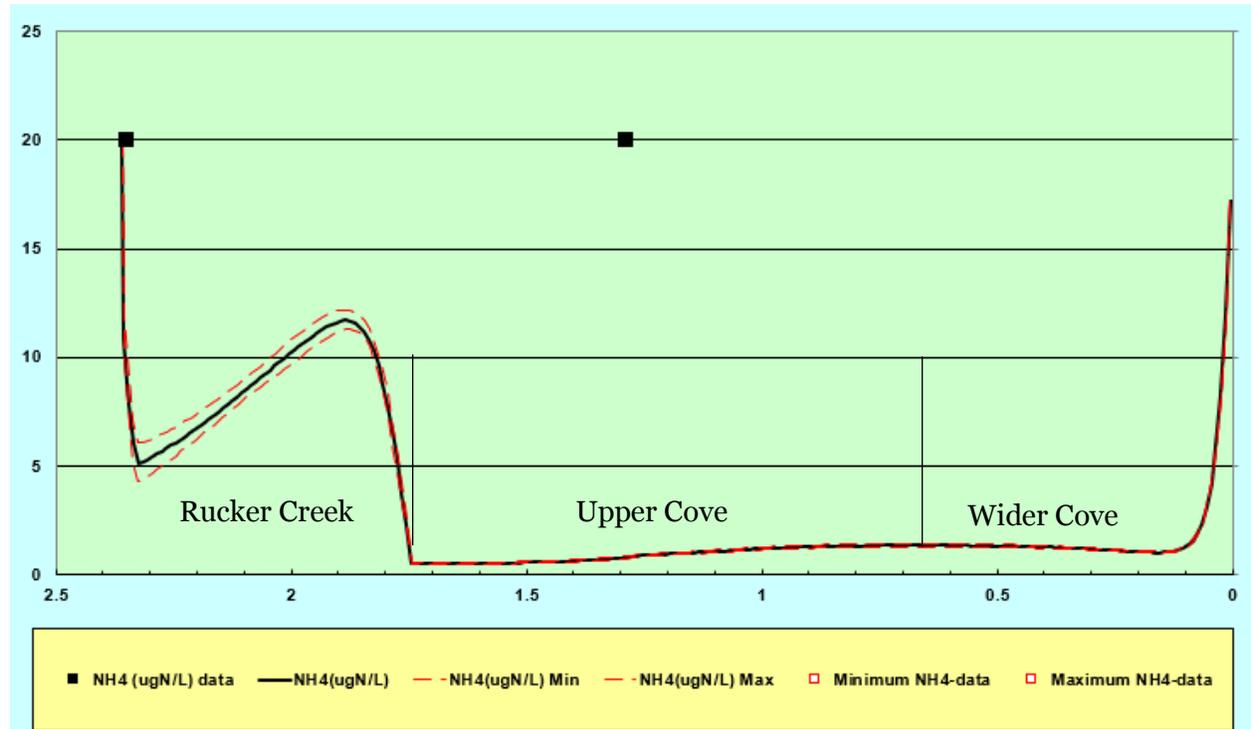
X axis: Distance upstream from cove downstream boundary (km)



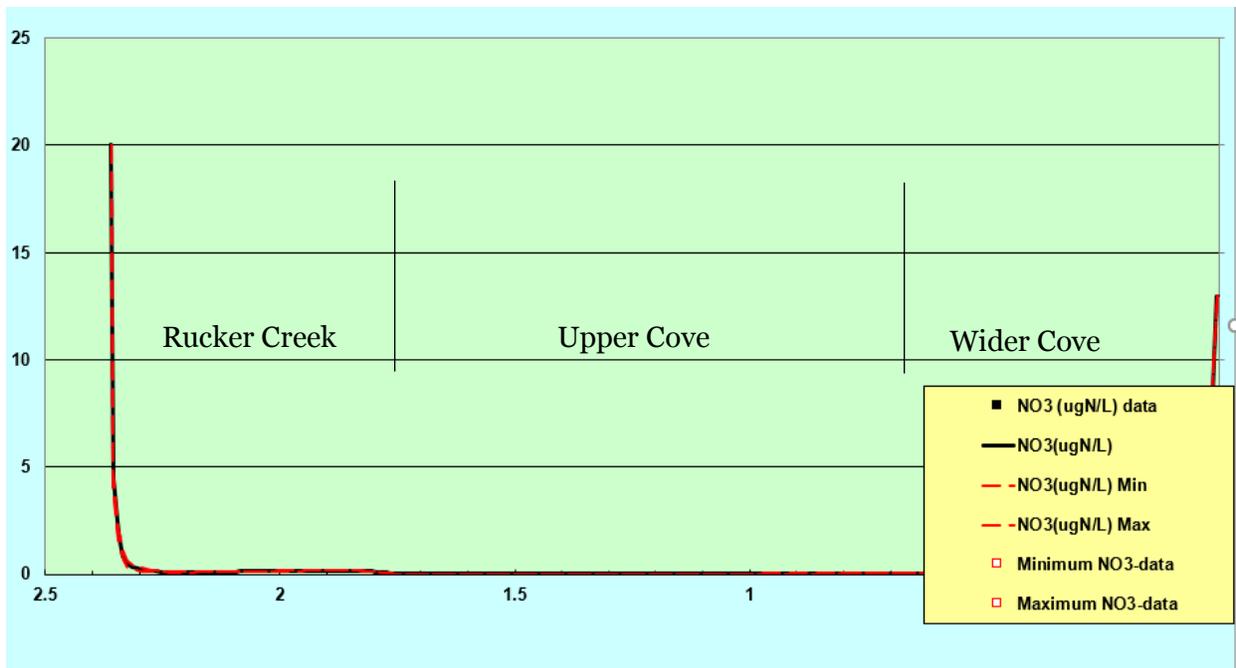
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)



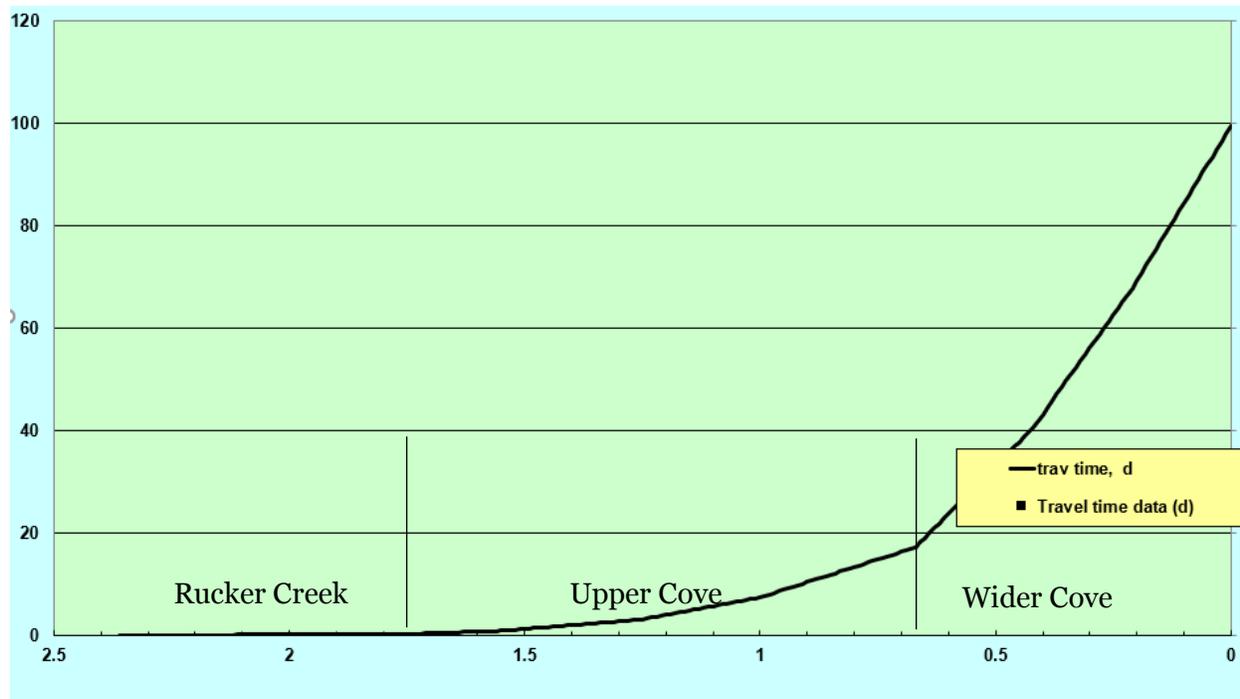
X axis: Distance upstream from cove downstream boundary (km)



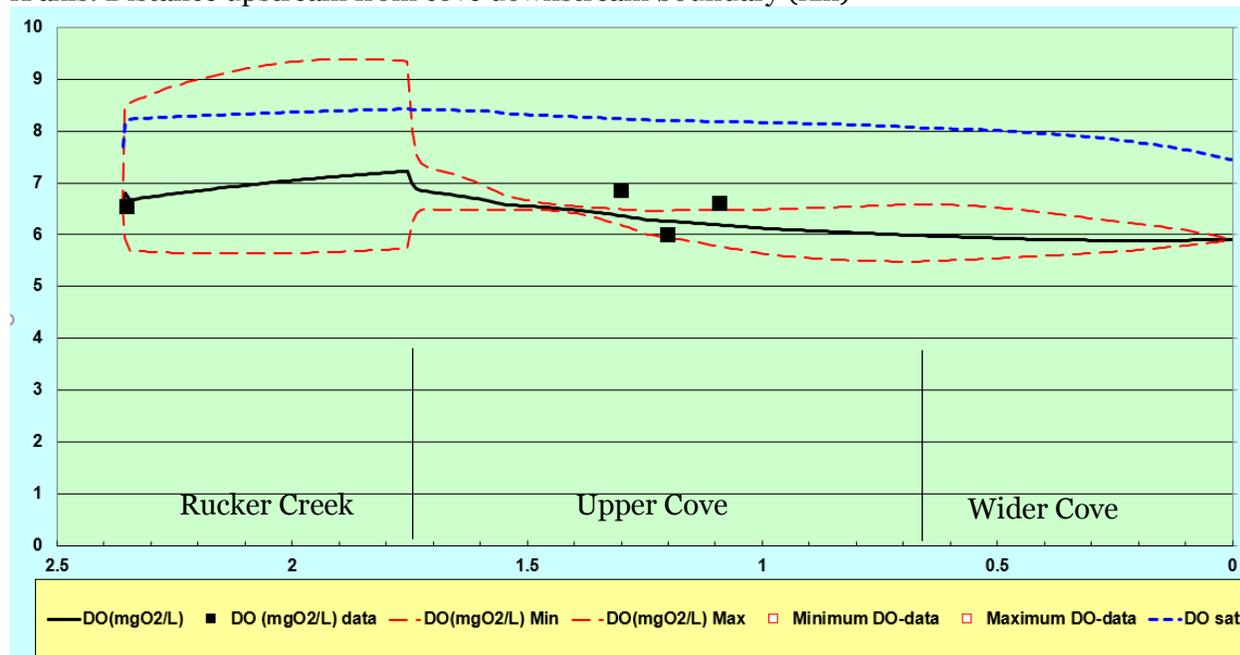
X axis: Distance upstream from cove downstream boundary (km)

COG Exhibit 613 - Run A2 – Current conditions with 1.0 MGD discharge at typical concentrations

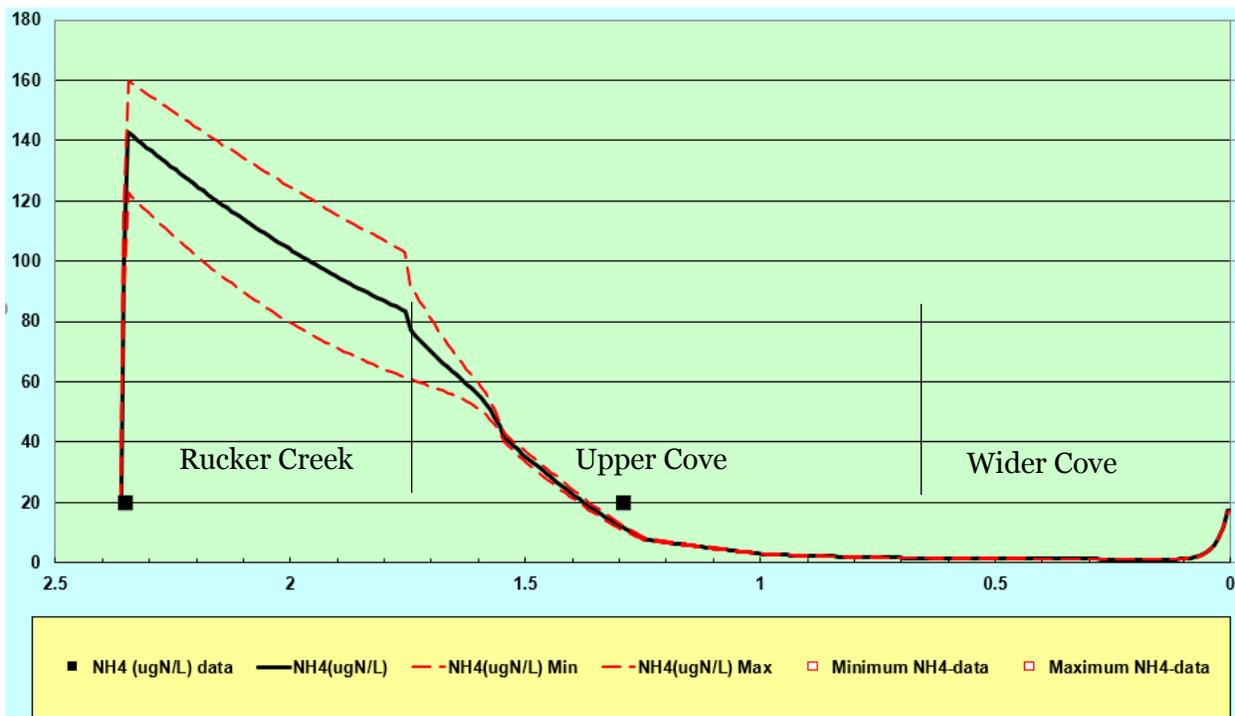
**CALIBRATED QUAL2K – INTERIM 1.0 MGD – Typical effluent Q\_1b**



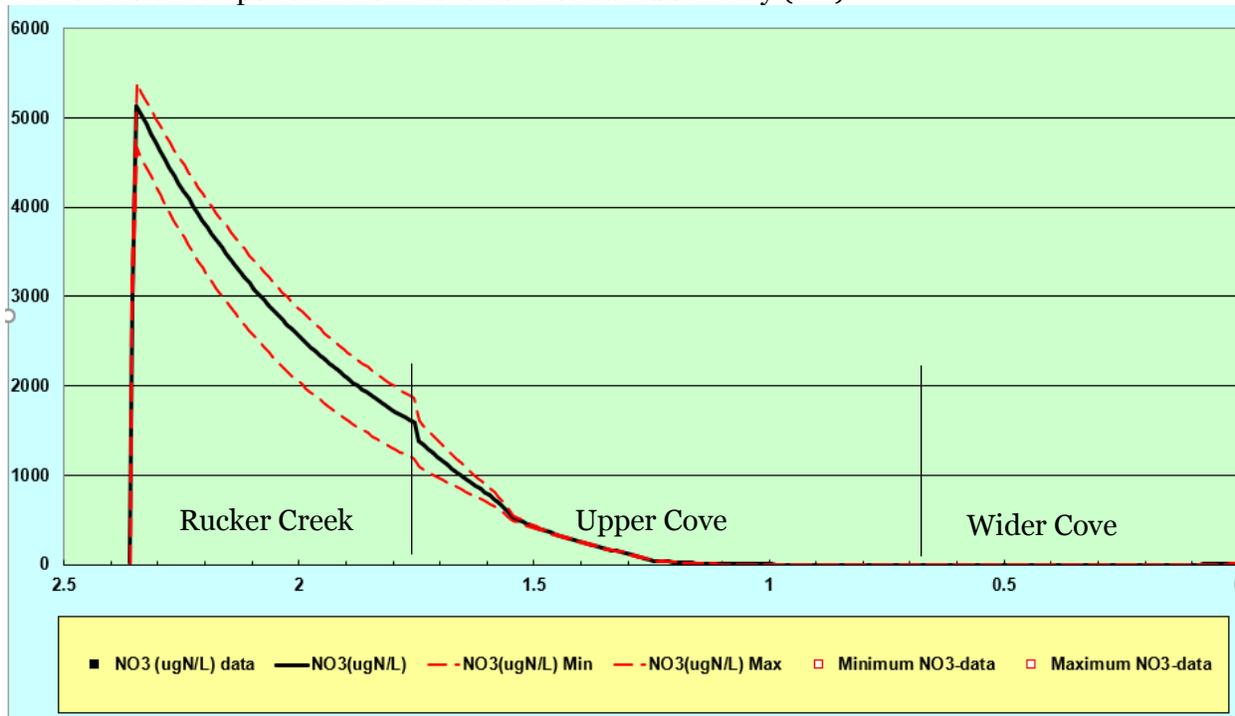
X axis: Distance upstream from cove downstream boundary (km)



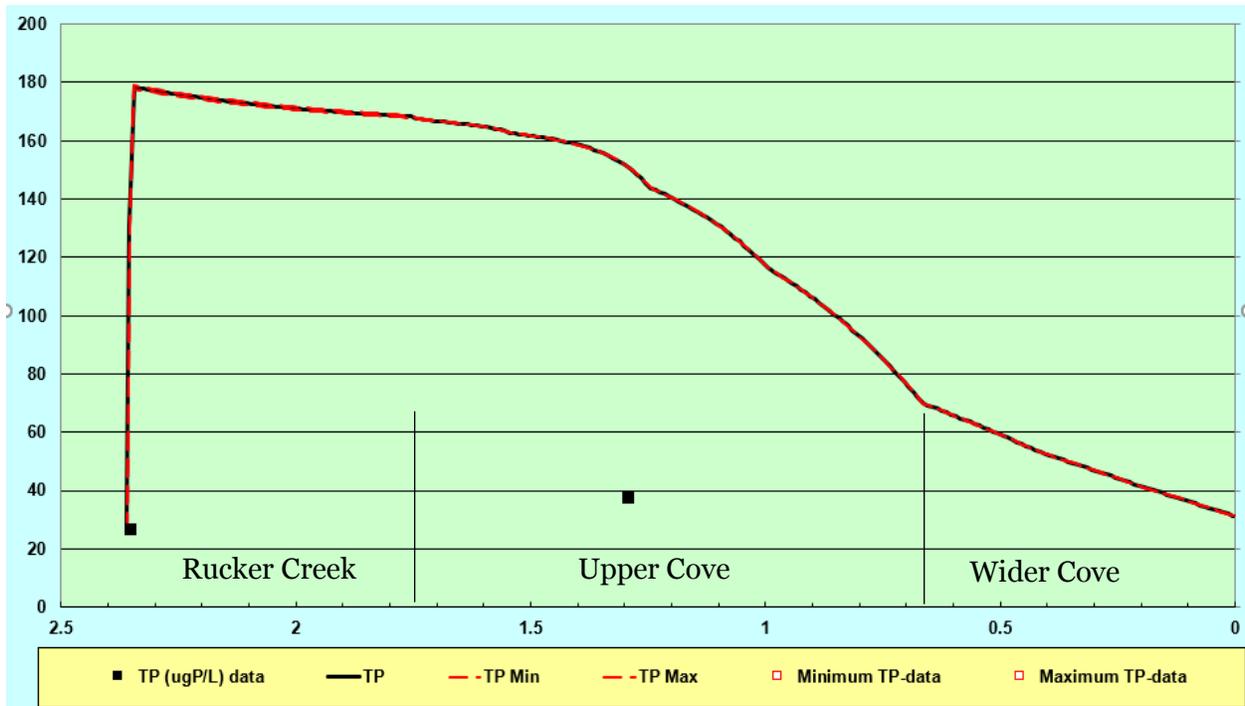
X axis: Distance upstream from cove downstream boundary (km)



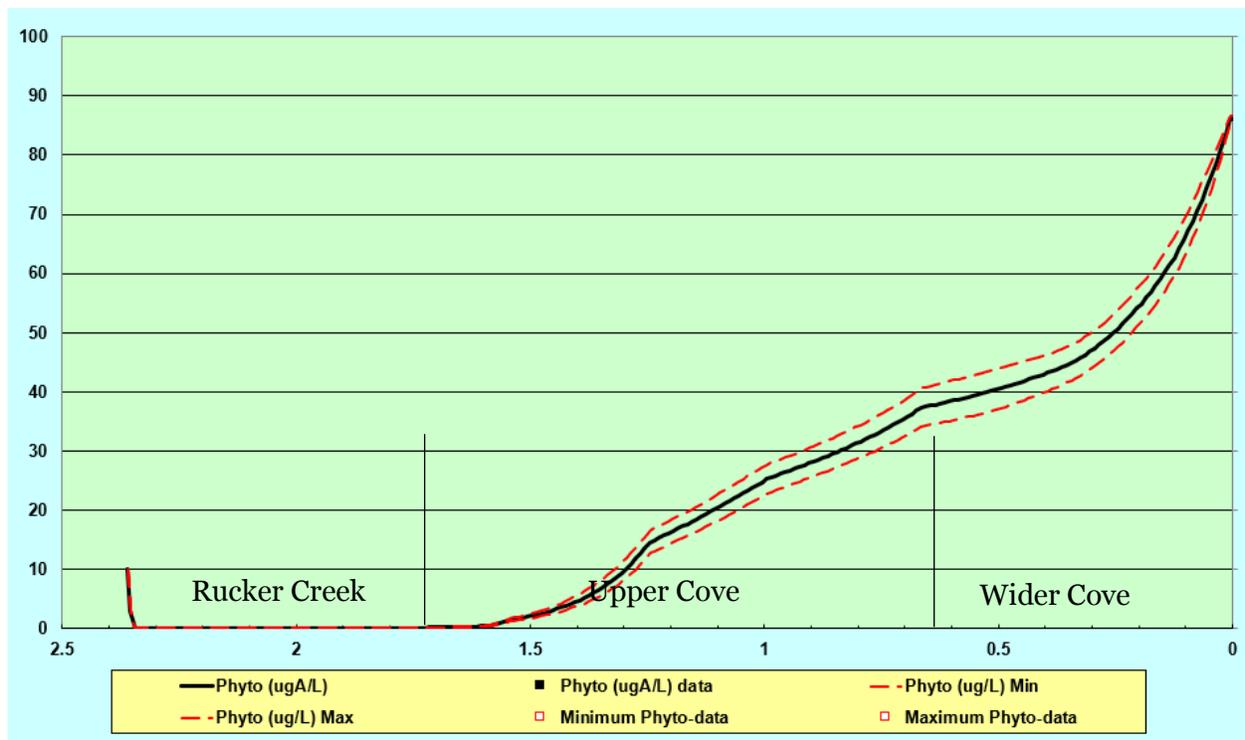
X axis: Distance upstream from cove downstream boundary (km)



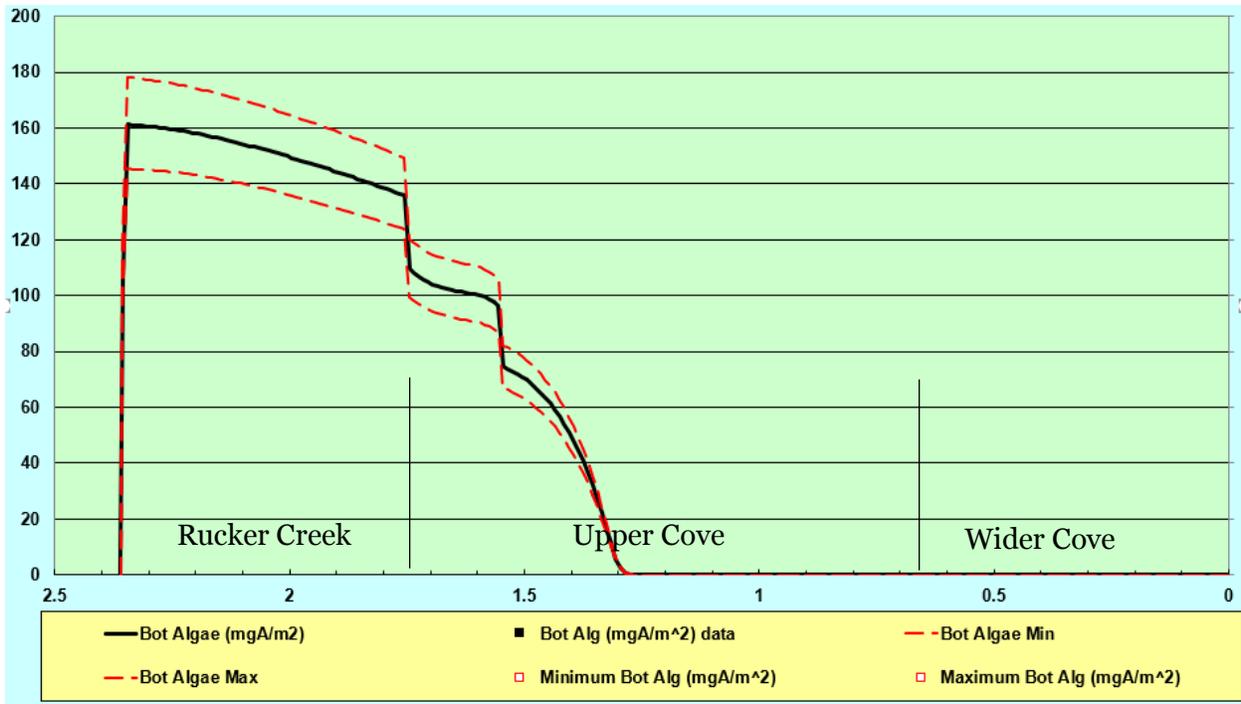
X axis: Distance upstream from cove downstream boundary (km)



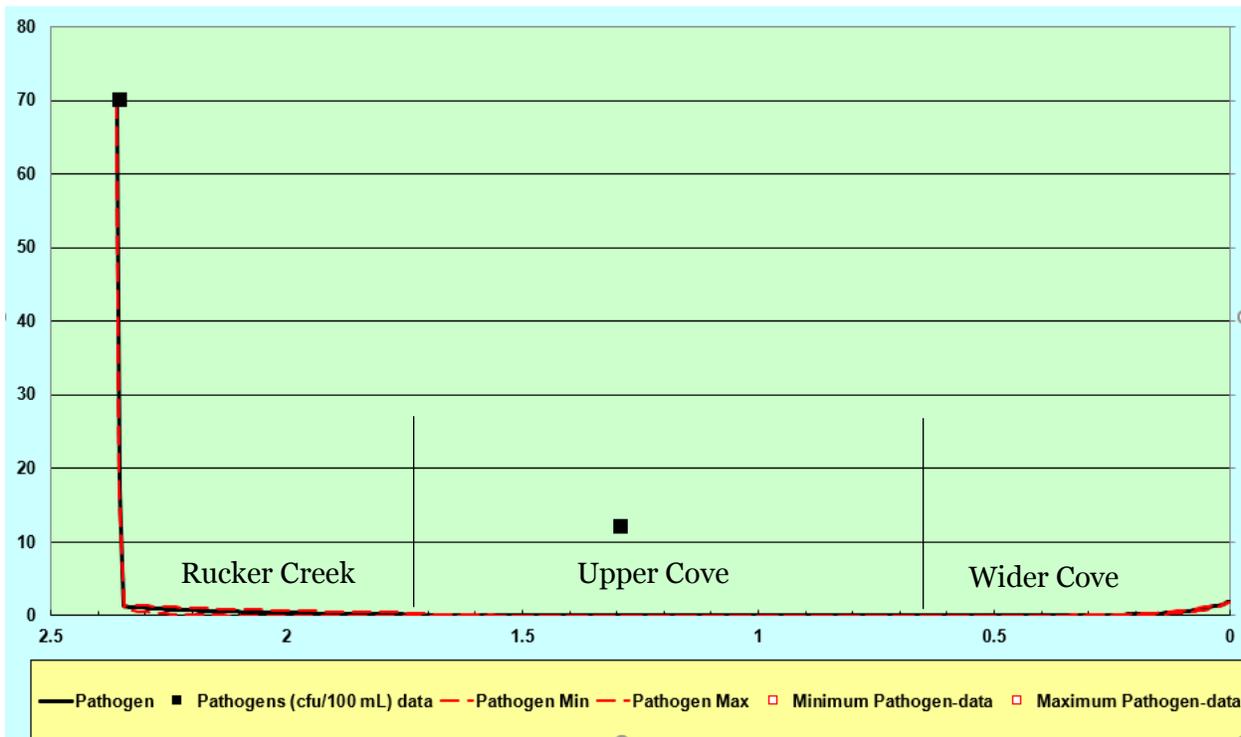
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)



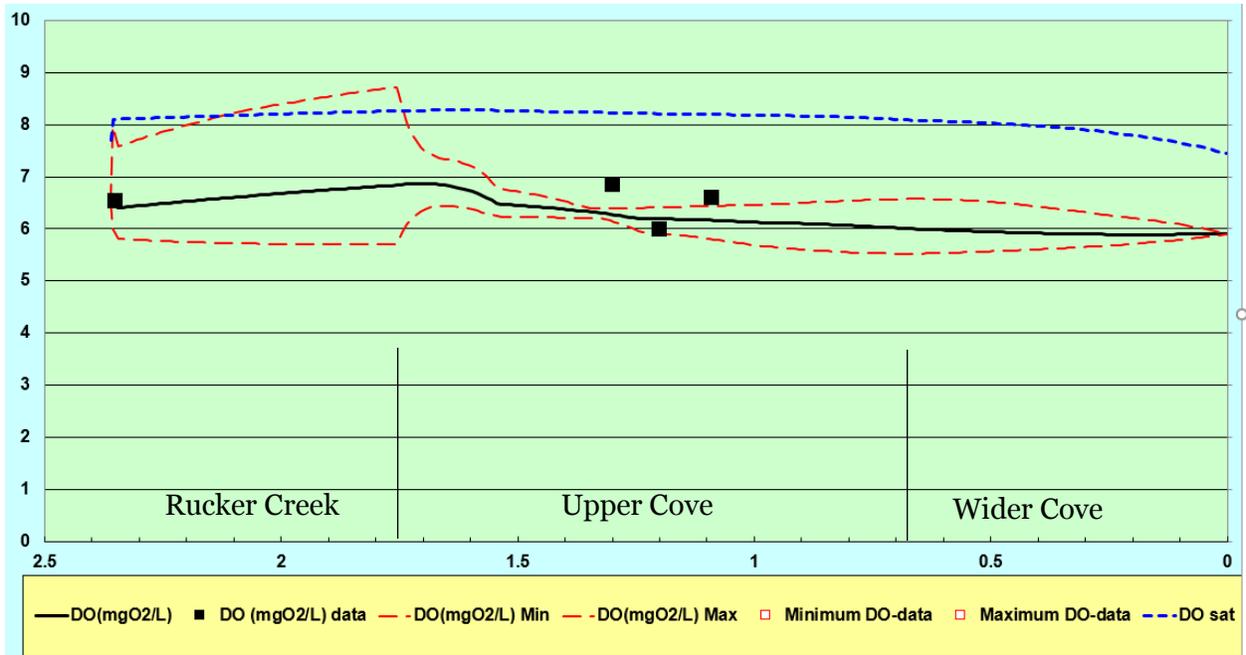
X axis: Distance upstream from cove downstream boundary (km)



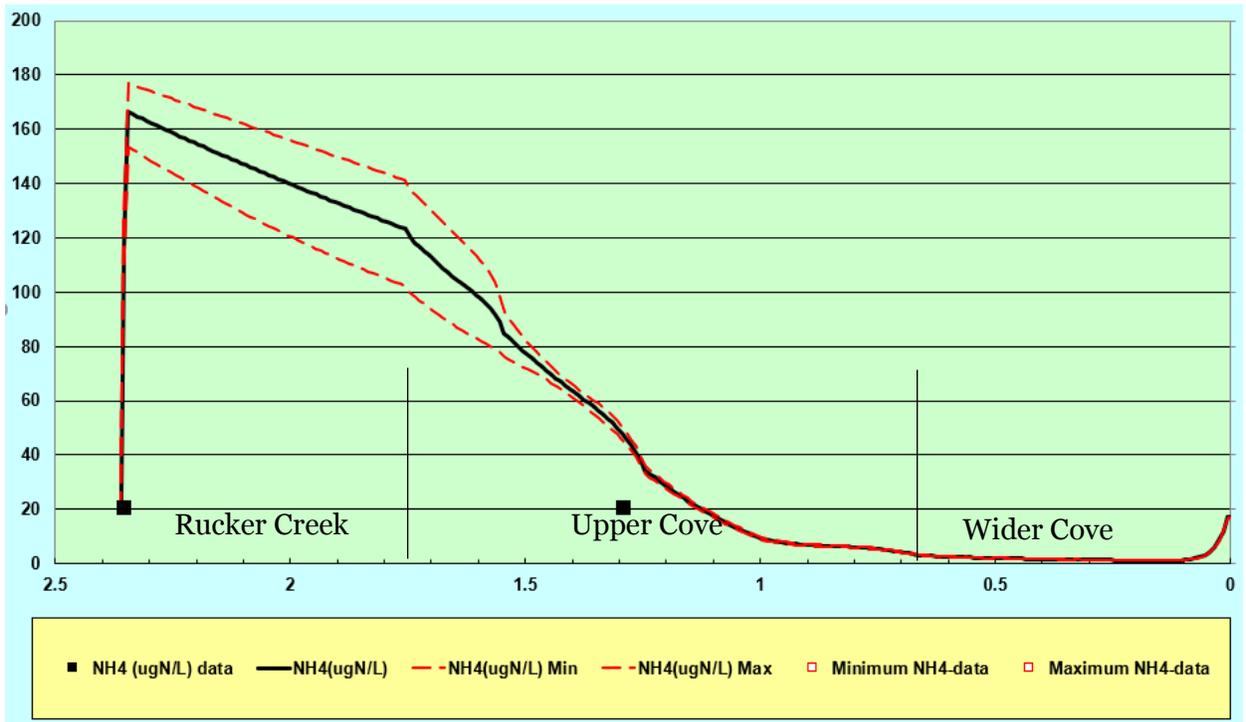
X axis: Distance upstream from cove downstream boundary (km)

COG Exhibit 614 - Run A3 - Current conditions with 2.0 MGD discharge at typical concentrations

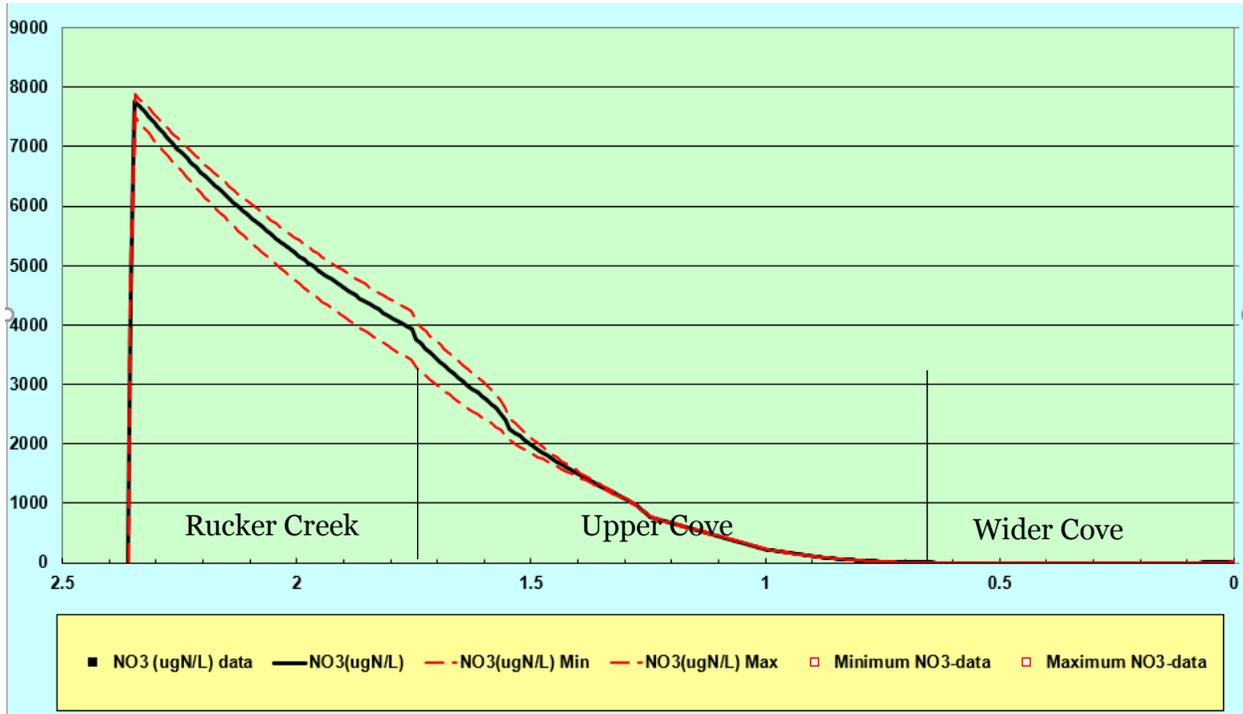
**CALIBRATED QUAL2K – FINAL 2.0 MGD – Typical effluent Q\_2b**



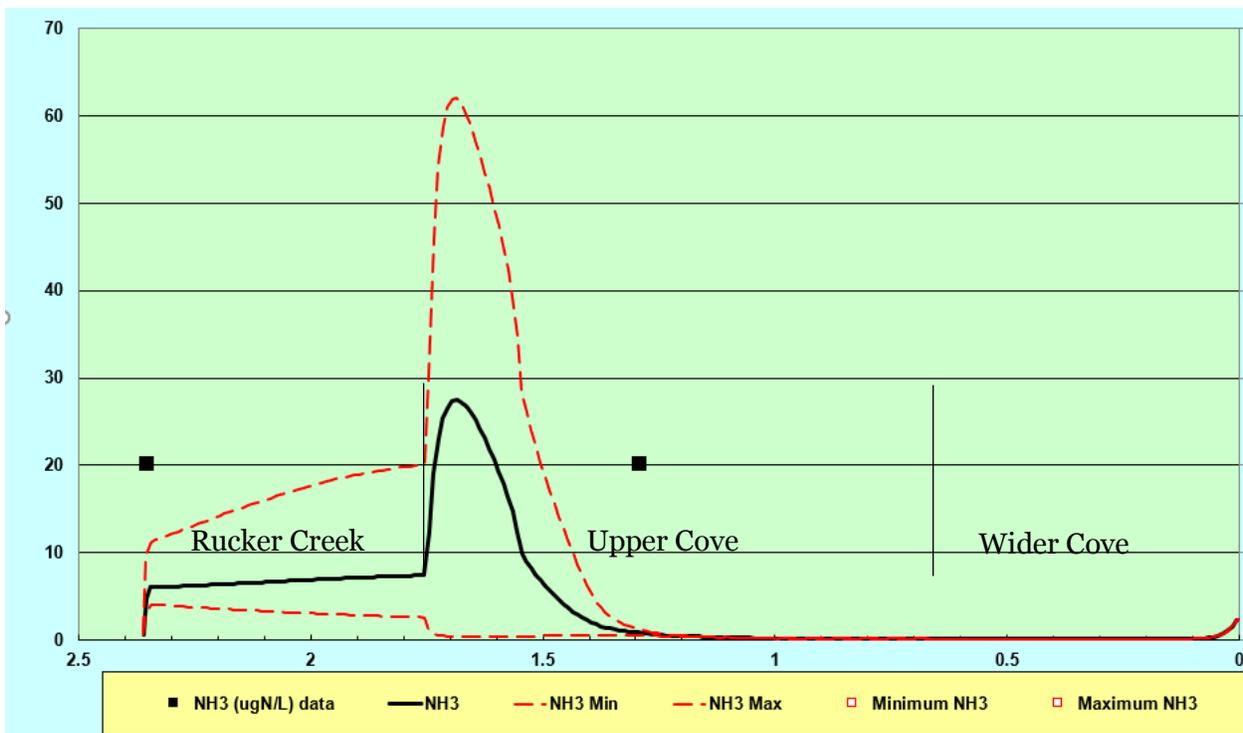
X axis: Distance upstream from cove downstream boundary (km)



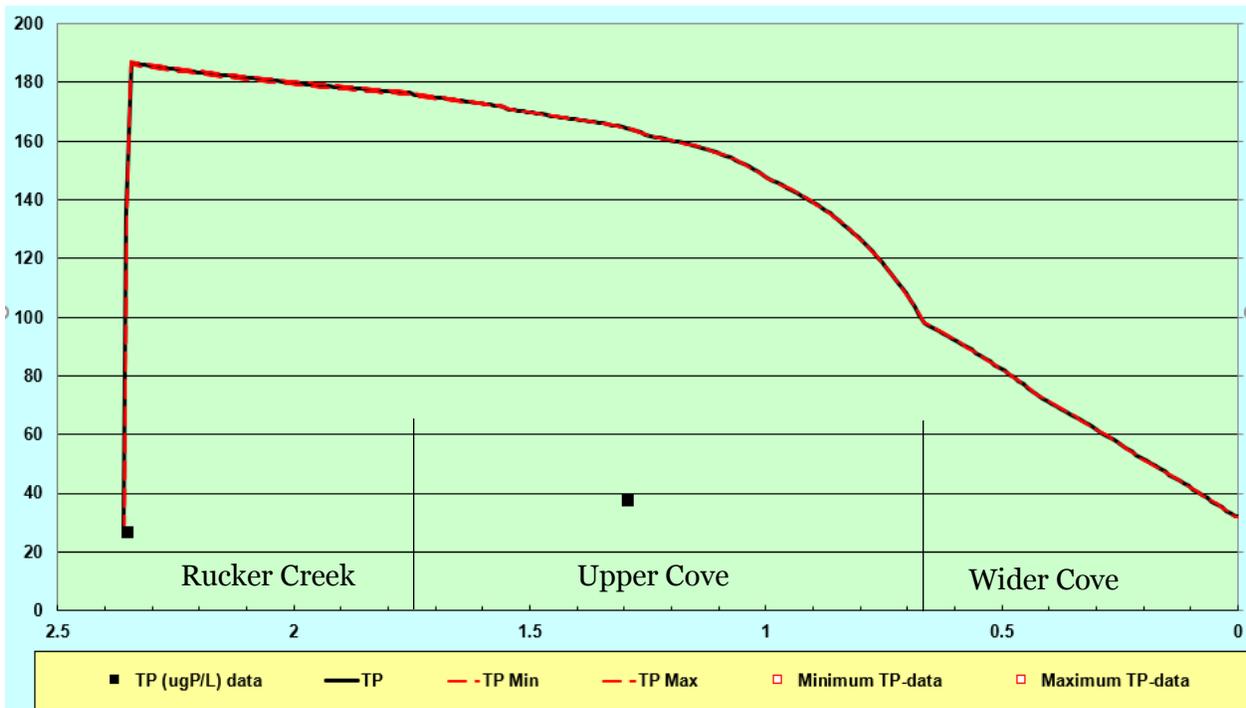
X axis: Distance upstream from cove downstream boundary (km)



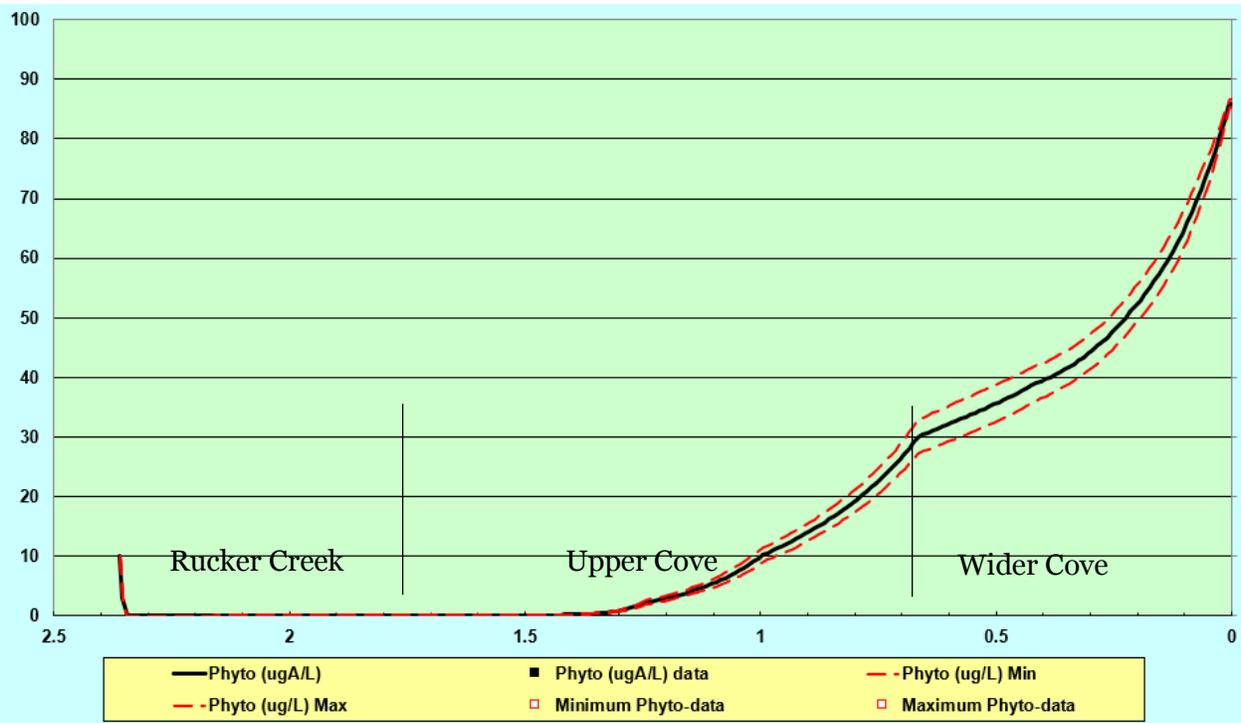
X axis: Distance upstream from cove downstream boundary (km)



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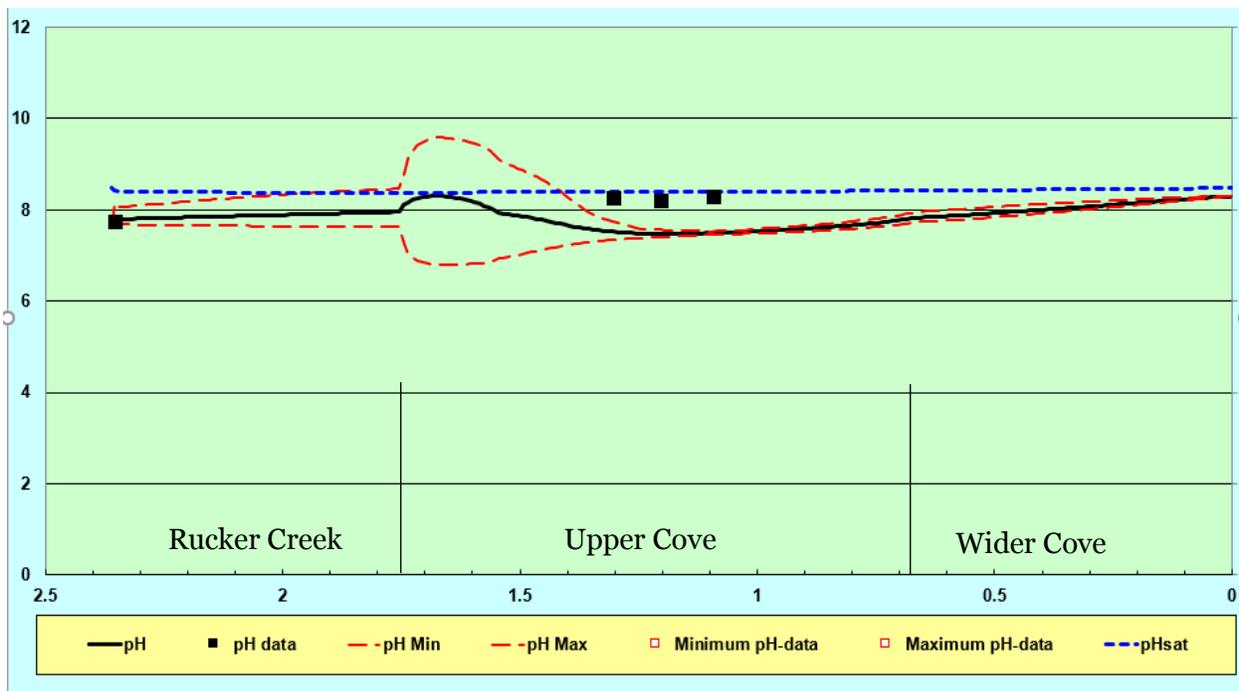
X axis: Distance upstream from cove downstream boundary (km)



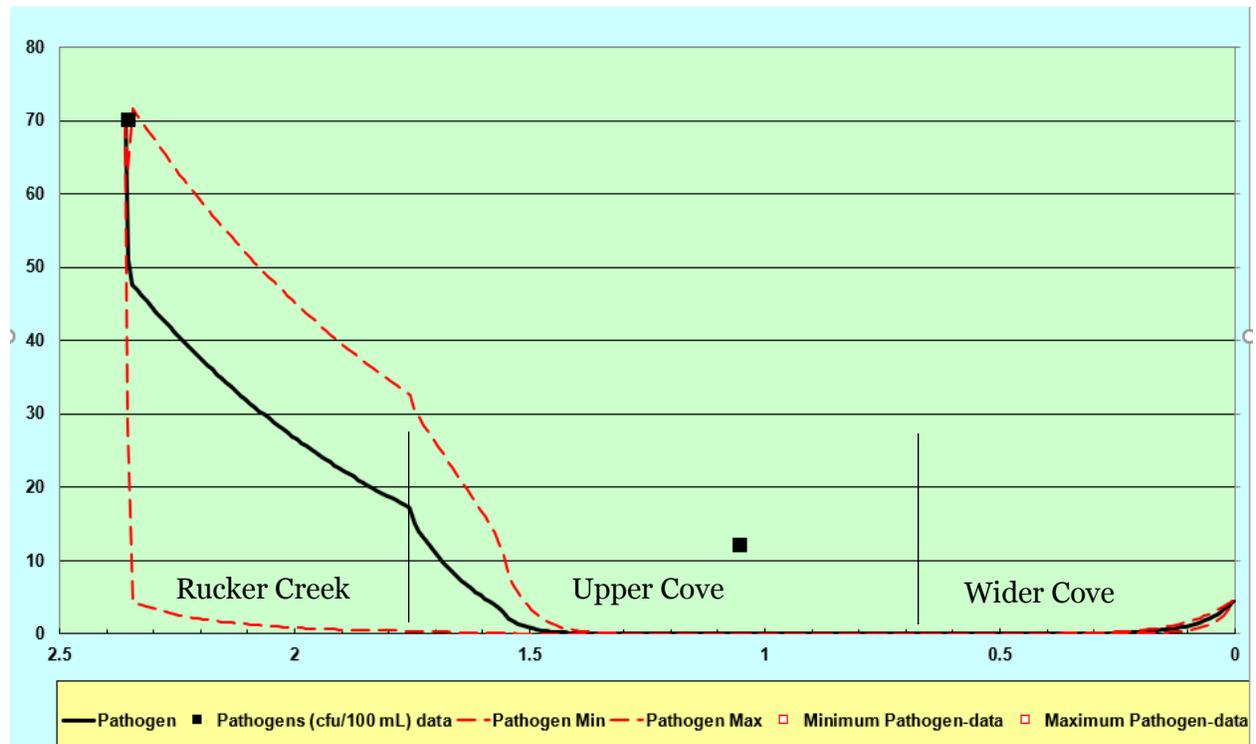
X axis: Distance upstream from cove downstream boundary (km)



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X axis: Distance upstream from cove downstream boundary (km)



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COG Exhibit 615 - Calibrated QUAL2K Model Results for 6 critical condition scenarios

Table 10. QUAL2K Results – Run B1 and C1 - Critical conditions - No Load

Constituent	QUAL2K critical conditions - Run B1 (7Q2 and CPE) – travel time 5,000 days			QUAL2K low lake level - Run C1 (7Q2 and 686ft) – travel time 180 days		
	Rucker	Mid-cove	Lake	Rucker	Mid-cove	Lake
DO_avg mg/L	5.5	7.0	6.5	5.25	4.75	7
DO_diel mg/L	5.5	5.5	6.25	5.25	2.0	5
Temp °C	29	30.5	30.5	29	30.5	30.5
Ecoli MPN/100L	70	0	0	70	0	0
Ammonia mg/L	0.05	0	0	0.05	0	0
NO3 mg/L	0.1	0	0	0.1	0	0
TP mg/L	0.027	0.05	0.055	0.027	0.04	0.055
Chl-a ug/L	15 (-51%)	100 (+226%)	25 (-18%)	5 (-84%)	430 (+1302%)	50 (+63%)
Btm Alg mg/m2	0.04	0	0.14	0	0	0

Percent change (%) in chlorophyll-*a* is relative to baseline 30.6 ug/L average value reported at mid-lake TCEQ stations 11861 and 20307. Since there is no chlorophyll-*a* criterion in Appendix F of the Texas Surface Water Quality Standards, the average value was chosen since it is between the 50 and 80 percentile values (27.3 and 43.5 ug/L, respectively) often used to characterize ambient water quality conditions. Percent change is calculated as: 100% \* (prediction – 30.6) / 30.6. Positive percent change shown with a plus (+) symbol indicates prediction is higher than the baseline.

Table 11. QUAL2K Results – Runs B2 and C2 - Interim Phase – 1.0 MGD – Permit Limits: 5/1.6/5 and TP=1.0

Constituent	QUAL2K critical conditions – Run B2 (7Q2 and CPE) – travel time 94 days			QUAL2K low lake level – Run C2 (7Q2 and 686ft) – travel time 11 days		
	Rucker	Mid-cove	Lake	Rucker	Mid-cove	Lake
DO_avg mg/L	5.9	6.5	6.5	5.9	5.9	7
DO_diel mg/L	4.2	5.95	6.25	4.2	3.8	5.5
Temp °C	29	30.5	30.5	30.5	30.5	30.5
Ecoli MPN/100L	70 (26 <sup>1</sup> )	5 (0 <sup>2</sup> )	0	70	5	0
Ammonia mg/L	1.27	0.4	0	1.27	0.62	0
NO3 mg/L	3.3	0.4	0	3.3	0.4	0
TP mg/L	0.85	0.7	0.05	0.85	0.75	0.055
Chl-a ug/L	2 (-93%)	32 (+4%)	25 (-18%)	2 (-93%)	4 (-87%)	60 (+96%)
Btm Alg mg/m2	120	0	0	120	180	0

Percent change (%) in chlorophyll-a is relative to baseline 30.66 ug/L average value reported at mid-lake TCEQ stations 11861 and 20307. Since there is no chlorophyll-a criterion in Appendix F of the Texas Surface Water Quality Standards, the average value was chosen since it is between the 50 and 80 percentile values (27.3 and 43.5 ug/L, respectively) often used to characterize ambient water quality conditions. Percent change is calculated as: 100% \* (prediction – 30.6) / 30.6. Positive percent change shown with a plus (+) symbol indicates prediction is higher than the baseline.

Note 1 – Maximum E.coli predicted in Rucker downstream of unnamed tributary

Note 2 – E.coli predicted near monitoring station 20222.

Table 12. QUAL2K Results – Runs B3 and C3 - Final Phase – 2.0 MGD – Permit Limits: 5/1/5 and TP=0.5mg/L

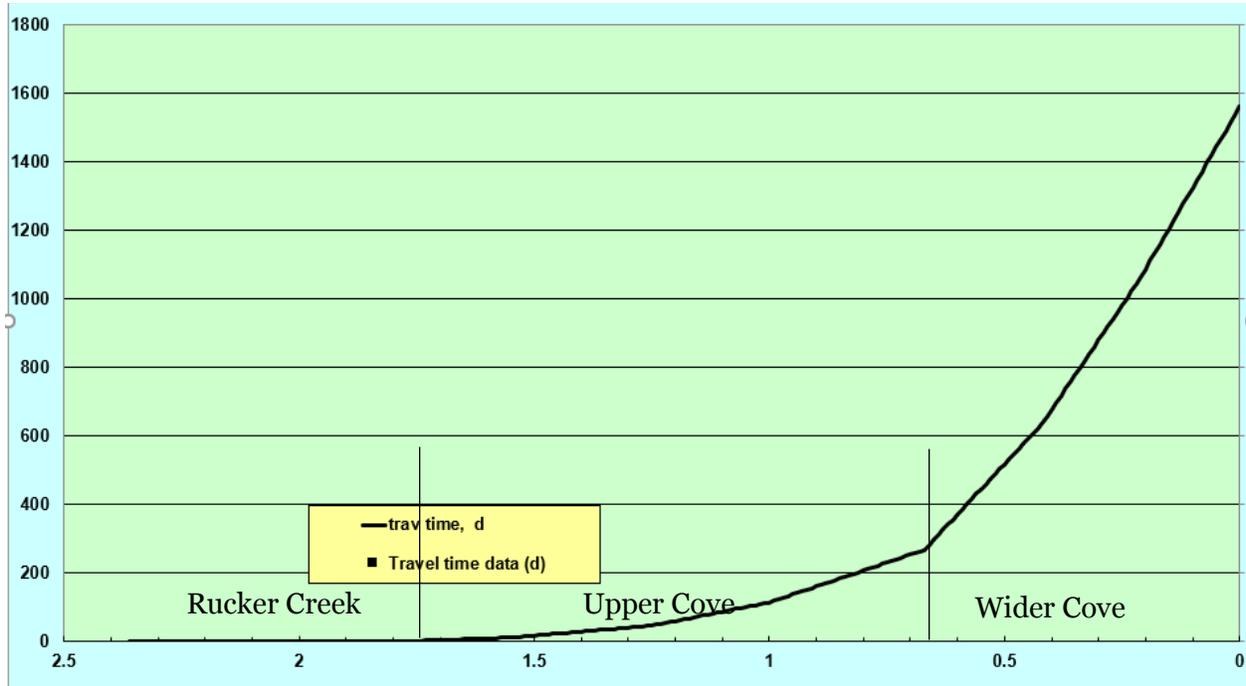
Constituent	QUAL2K critical conditions – Run B3 (7Q2 and CPE) – travel time 48 days			QUAL2K low lake level – Run C3 (7Q2 and 686ft) – travel time 5.8 days		
	Rucker	Mid-cove	Lake	Rucker	Mid-cove	Lake
DO_avg mg/L	6.0	5.5	6.5	6.0	6.0	3.7
DO_diel mg/L	4.85	5.9	6.0	4.75	4	2.9
Temp °C	29	30.5	30.5	30.5	30.5	30.5
Ecoli MPN/100L	70 (45 <sup>1</sup> )	17 (0 <sup>2</sup> )	0	70	10	0
Ammonia mg/L	0.87	0.3	0	0.87	0.55	0
NO3 mg/L	6.1	1.0	0	6.1	1.0	0
TP mg/L	0.455	0.35	0.06	0.46	0.4	0.055
Chl-a ug/L	0 (-100%)	27 (-12%)	25 (-18%)	1 (-97%)	2 (-93%)	27 (-12%)
Btm Alg mg/m2	110	35	0	105	180	100

Percent change (%) in chlorophyll-a is relative to baseline 30.66 ug/L average value reported at mid-lake TCEQ stations 11861 and 20307. Since there is no chlorophyll-a criterion in Appendix F of the Texas Surface Water Quality Standards, the average value was chosen since it is between the 50 and 80 percentile values (27.3 and 43.5 ug/L, respectively) often used to characterize ambient water quality conditions. Percent change is calculated as: 100% \* (prediction – 30.6) / 30.6. Positive percent change shown with a plus (+) symbol indicates prediction is higher than the baseline.

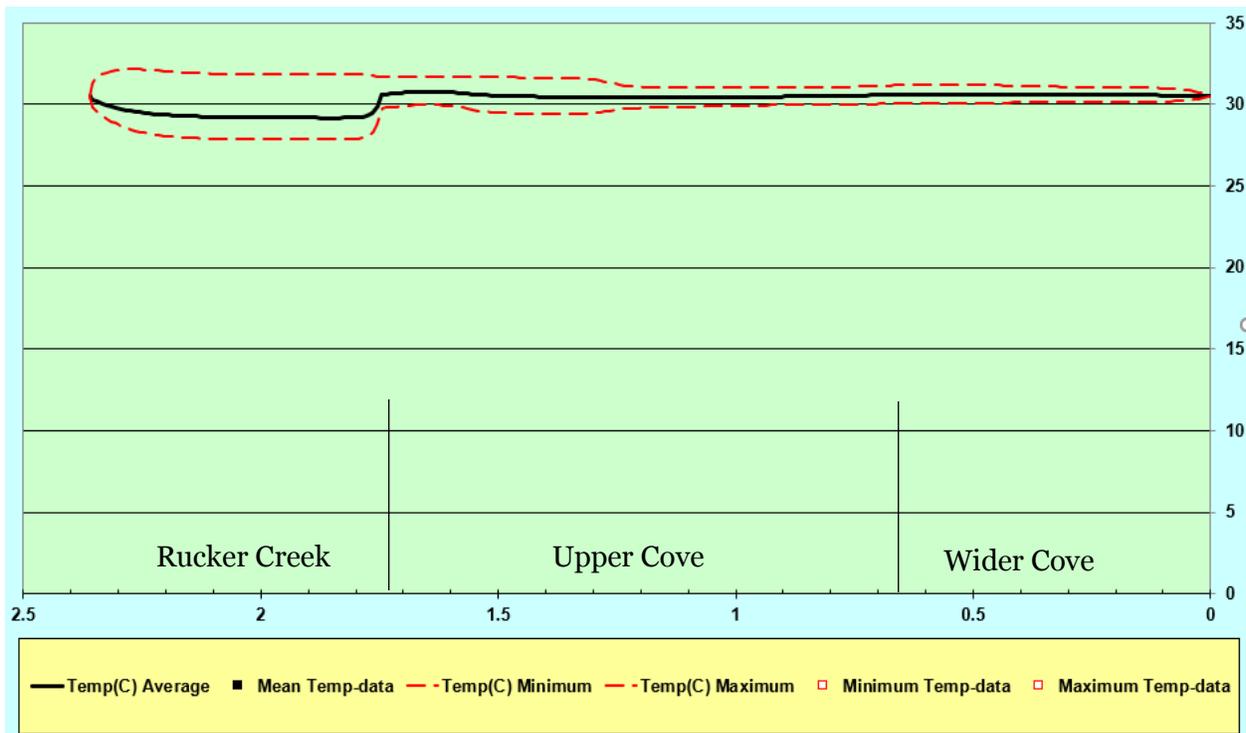
Note 1 – Maximum E.coli predicted in Rucker downstream of unnamed tributary

Note 2 – E.coli predicted near monitoring station 20222.

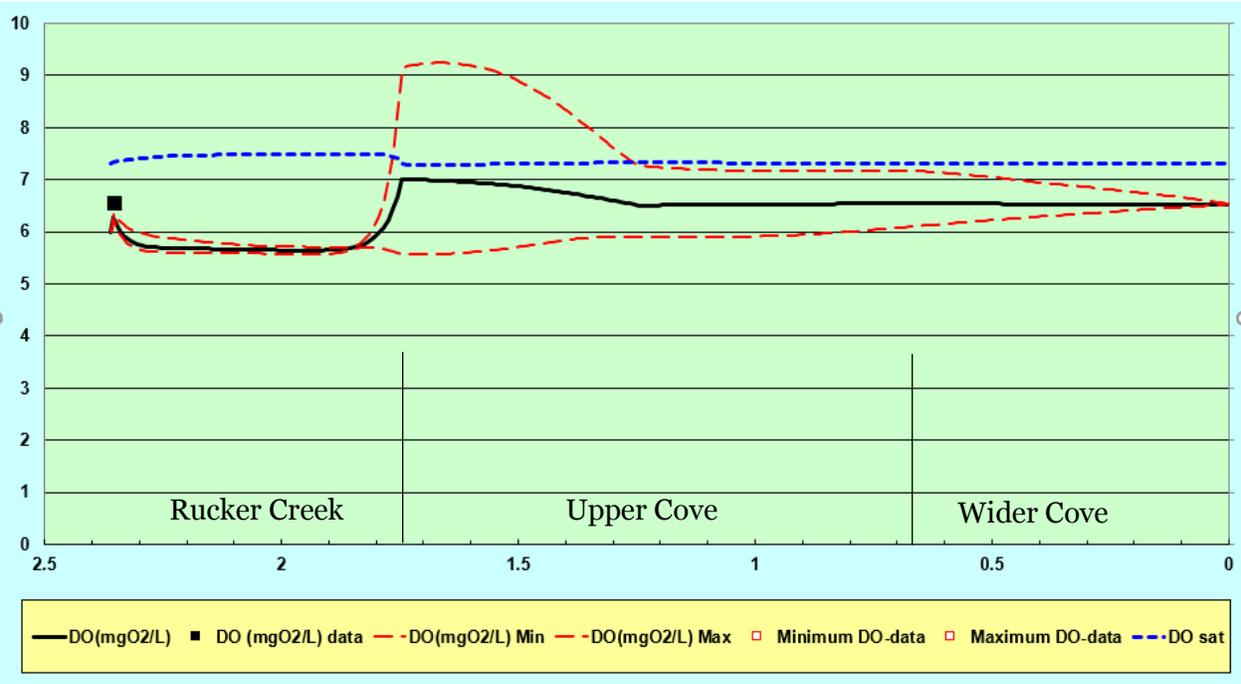
COG Exhibit 616 - Run B1 – Critical conditions with no discharge  
**CALIBRATED QUAL2K – Critical Condition No Load F\_o**



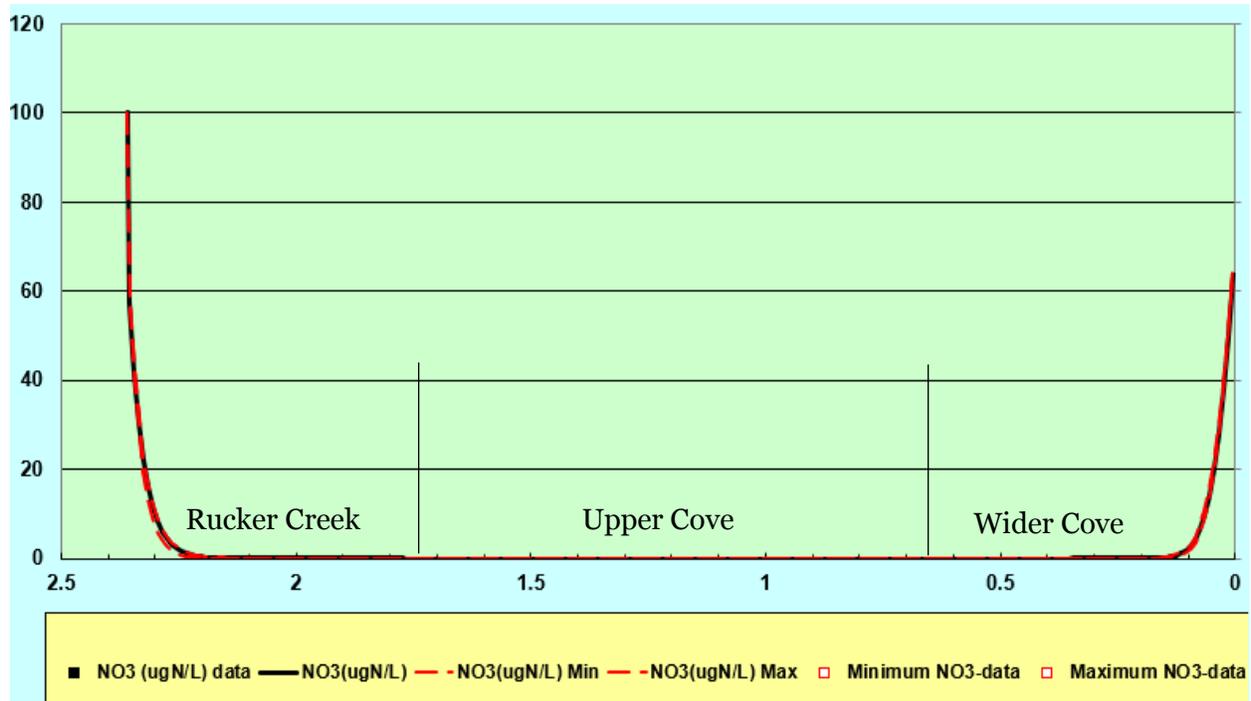
X axis: Distance upstream from cove downstream boundary (km)



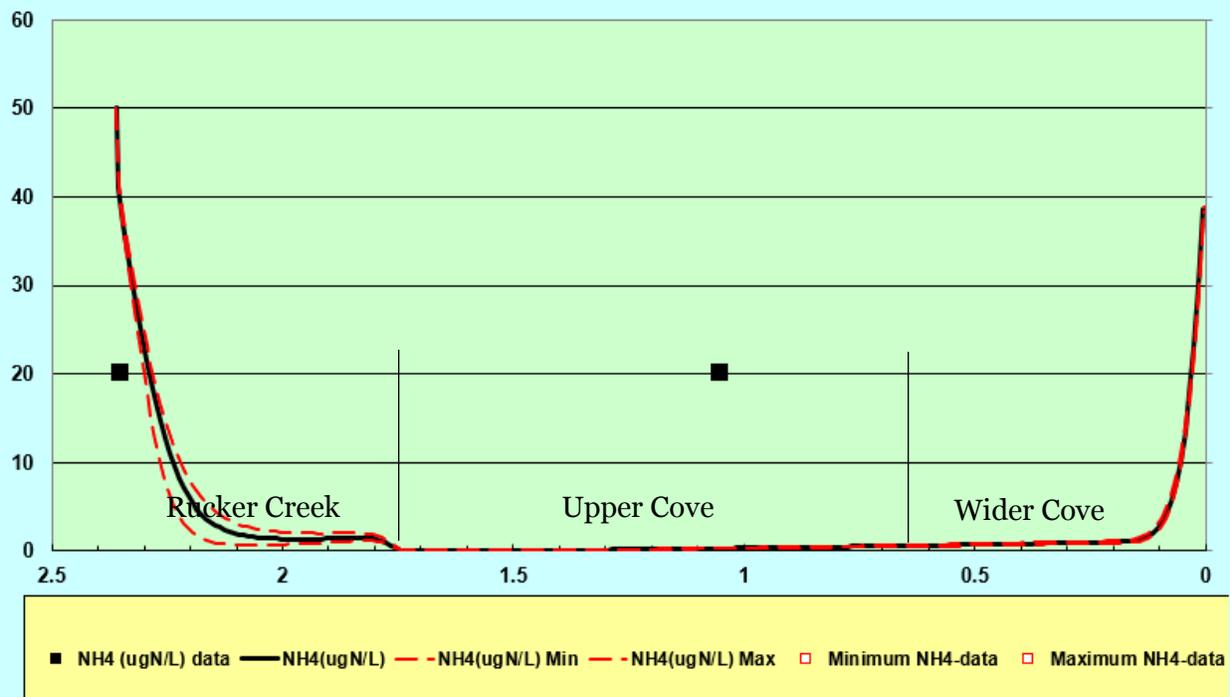
X axis: Distance upstream from cove downstream boundary (km)



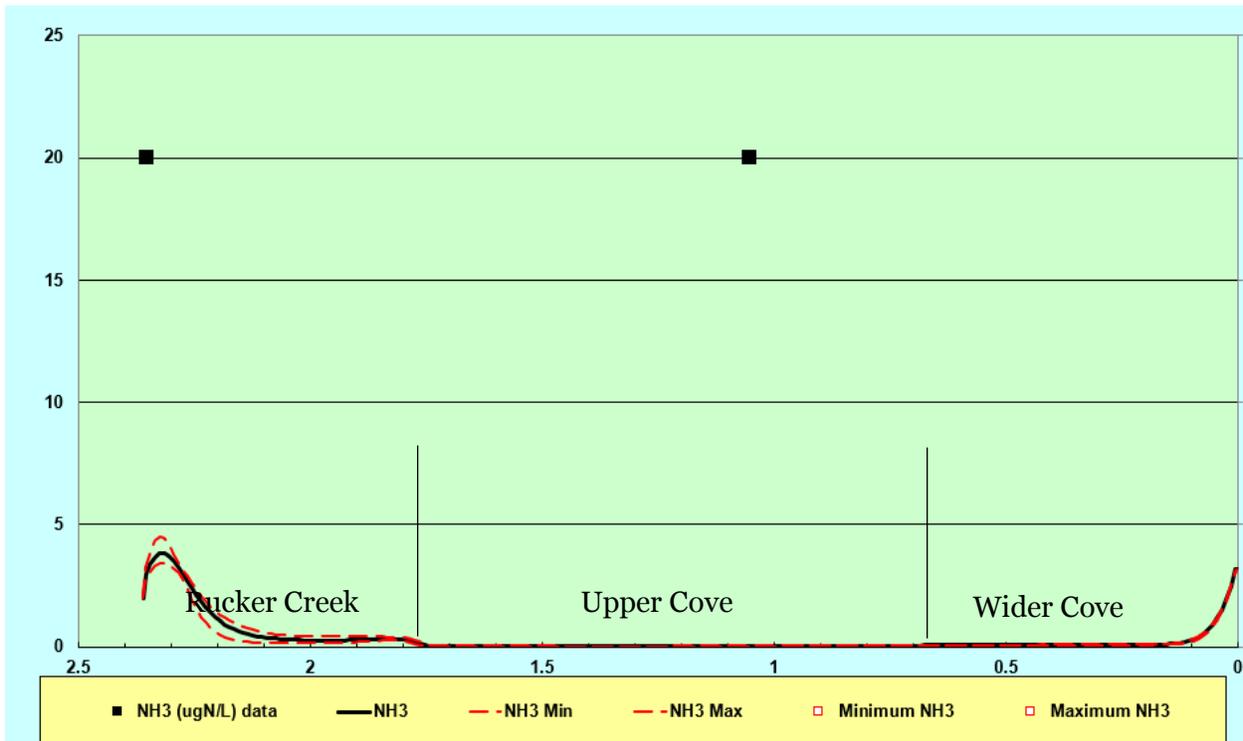
X axis: Distance upstream from cove downstream boundary (km)



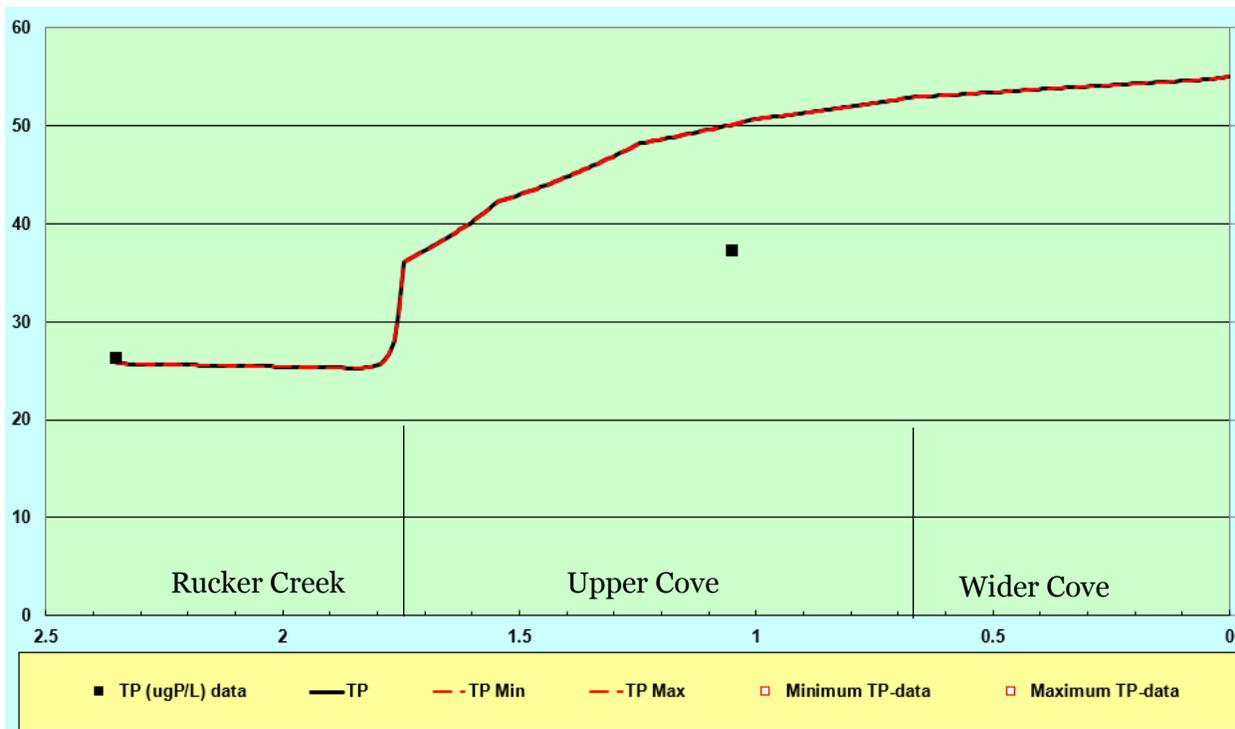
X axis: Distance upstream from cove downstream boundary (km)



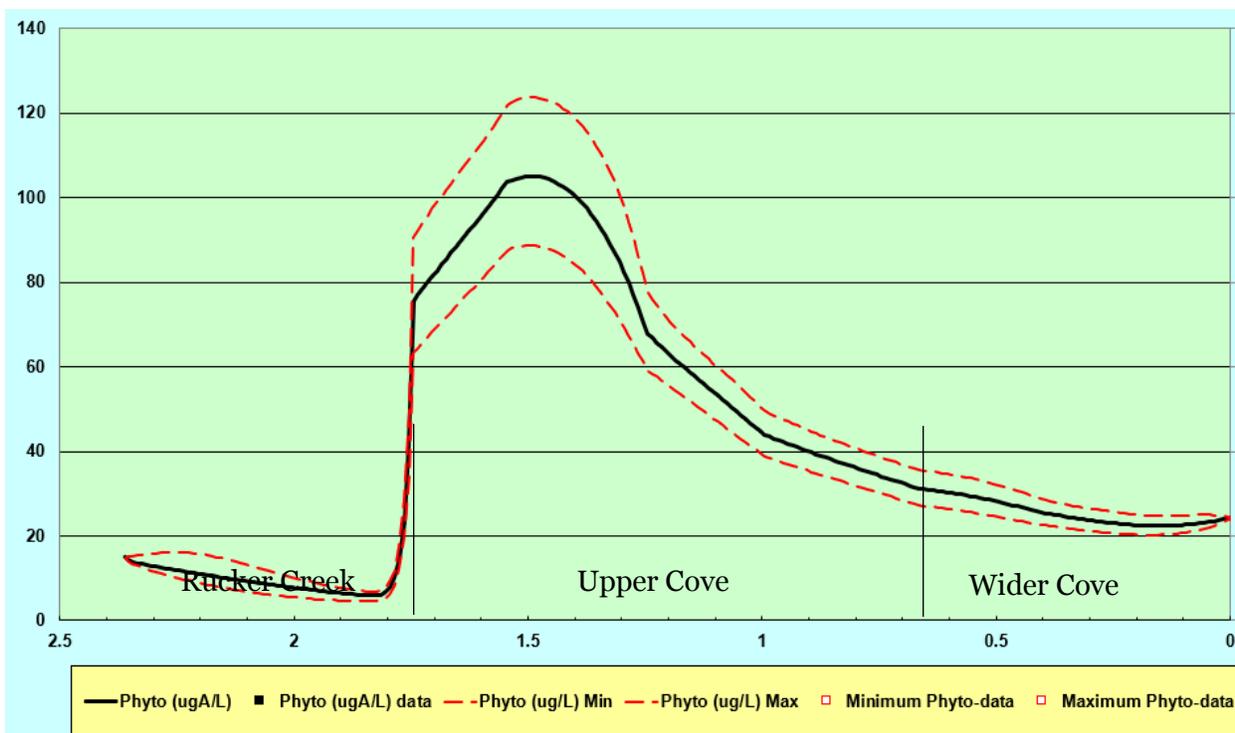
X axis: Distance upstream from cove downstream boundary (km)



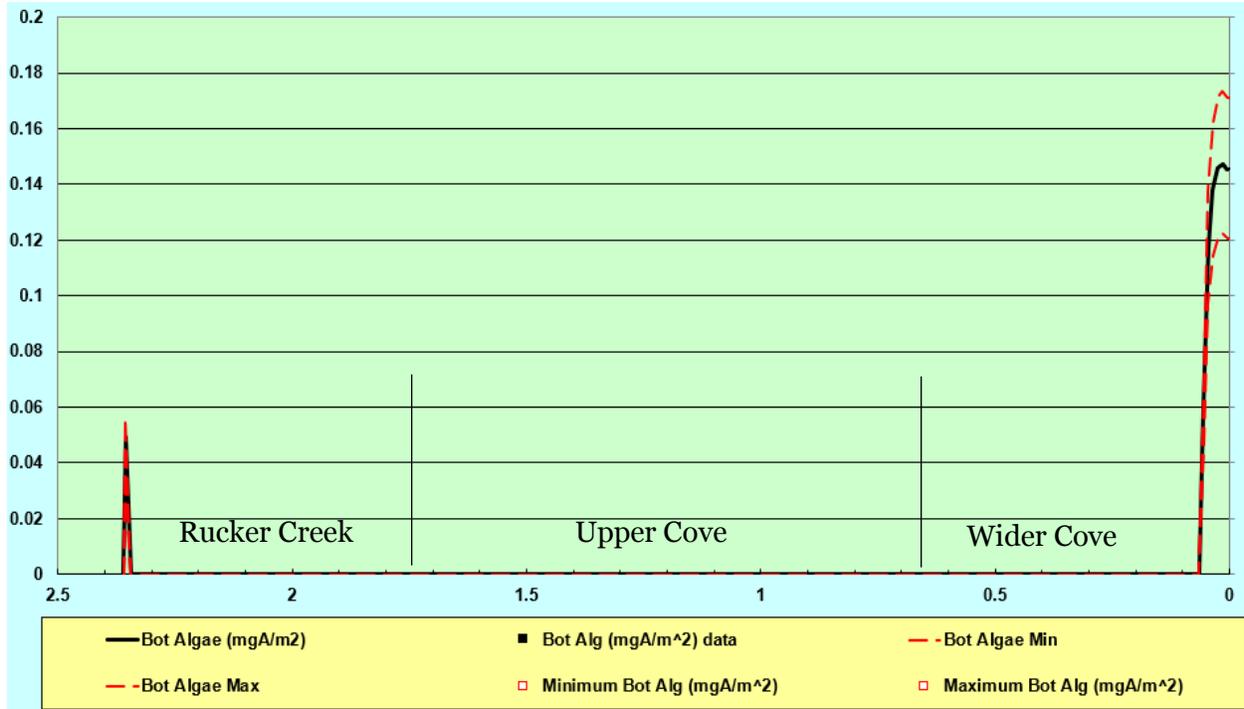
X axis: Distance upstream from cove downstream boundary (km)



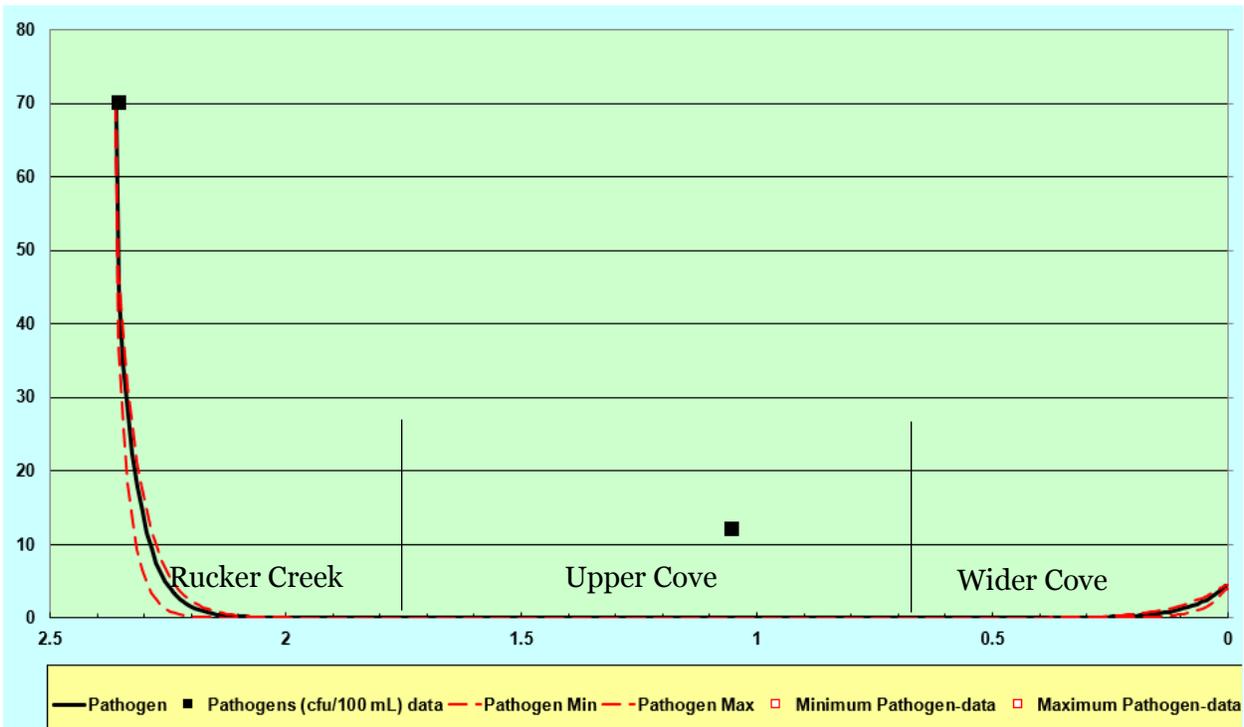
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)

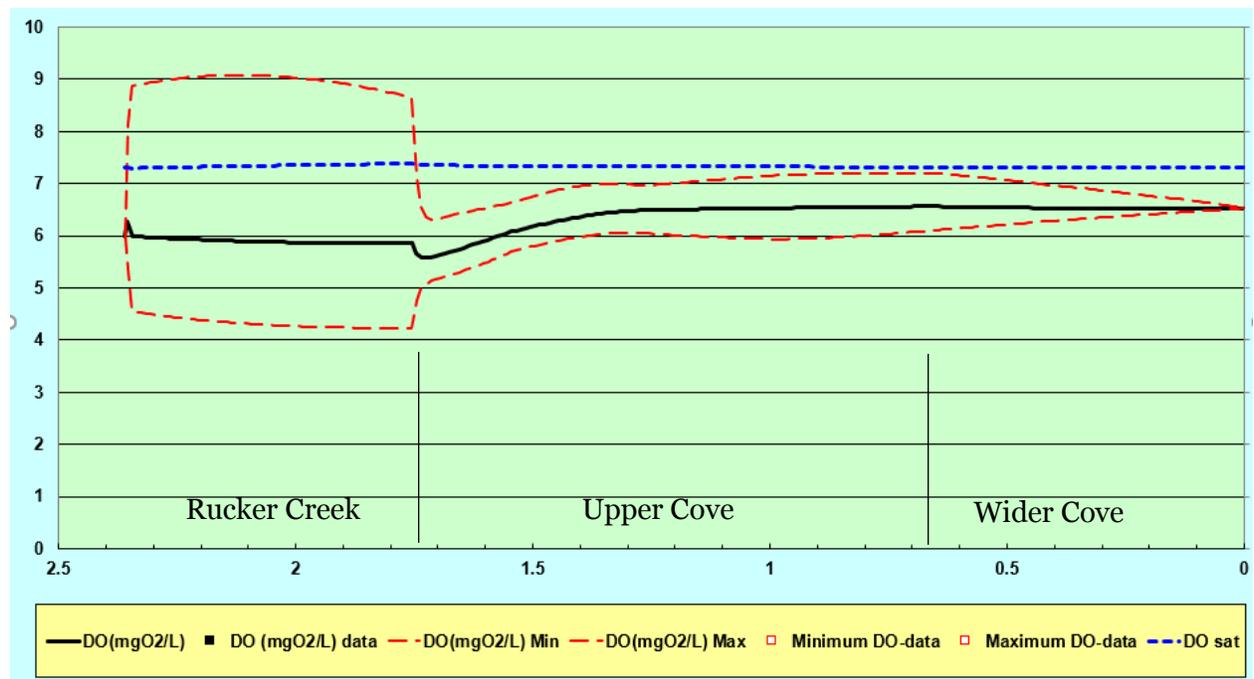


X axis: Distance upstream from cove downstream boundary (km)

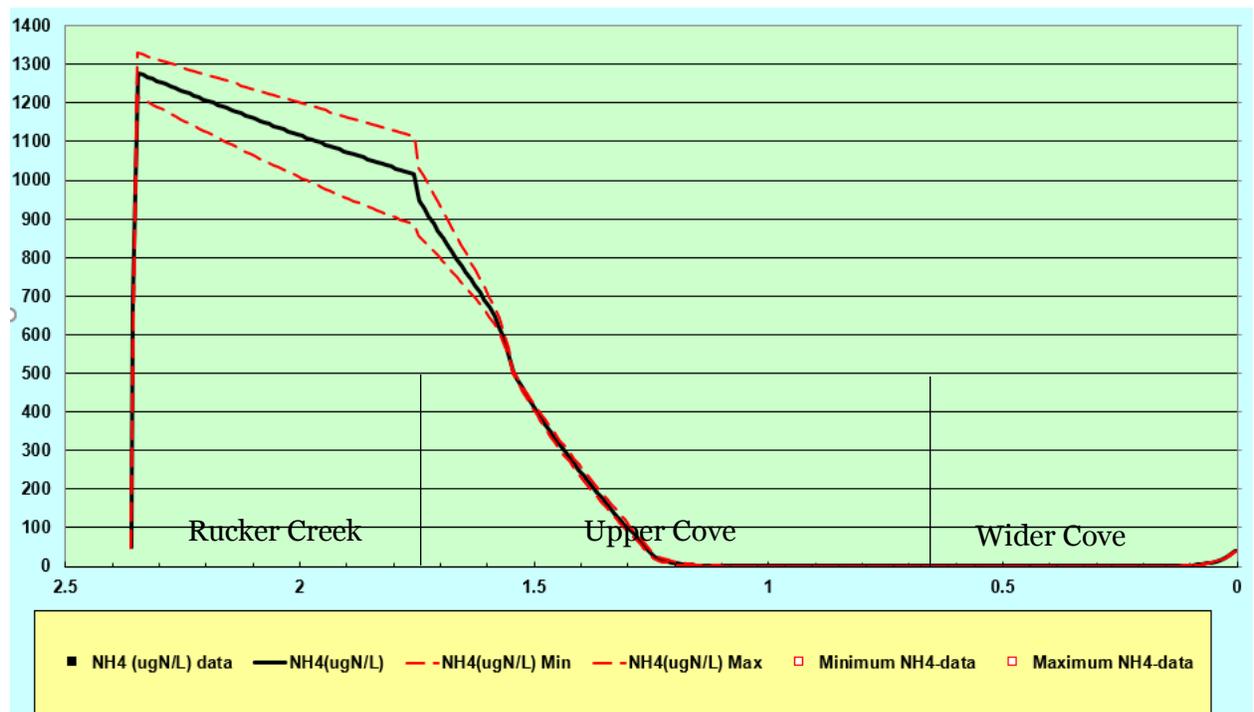


X axis: Distance upstream from cove downstream boundary (km)

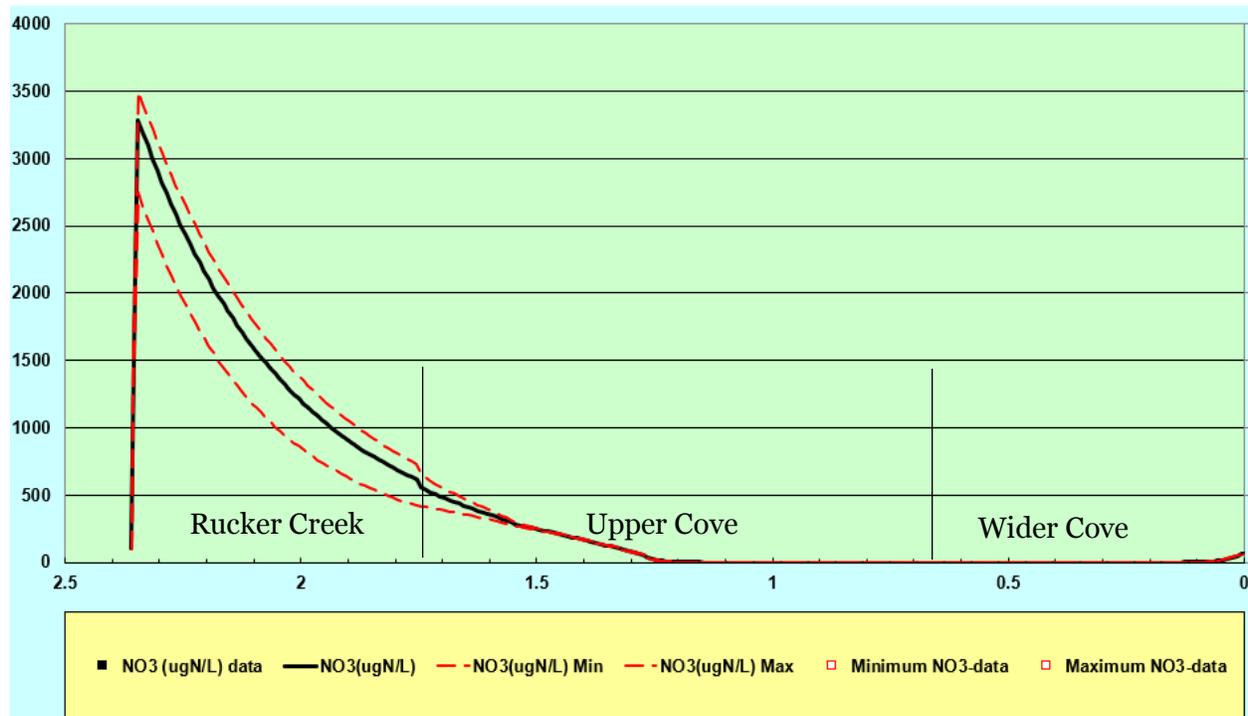
COG Exhibit 617 - Run B2 – Critical conditions with 1.0 MGD discharge at full permit limits  
**CALIBRATED QUAL2K – FINAL 1.0 MGD – Critical Condition Full Permit F\_1b**



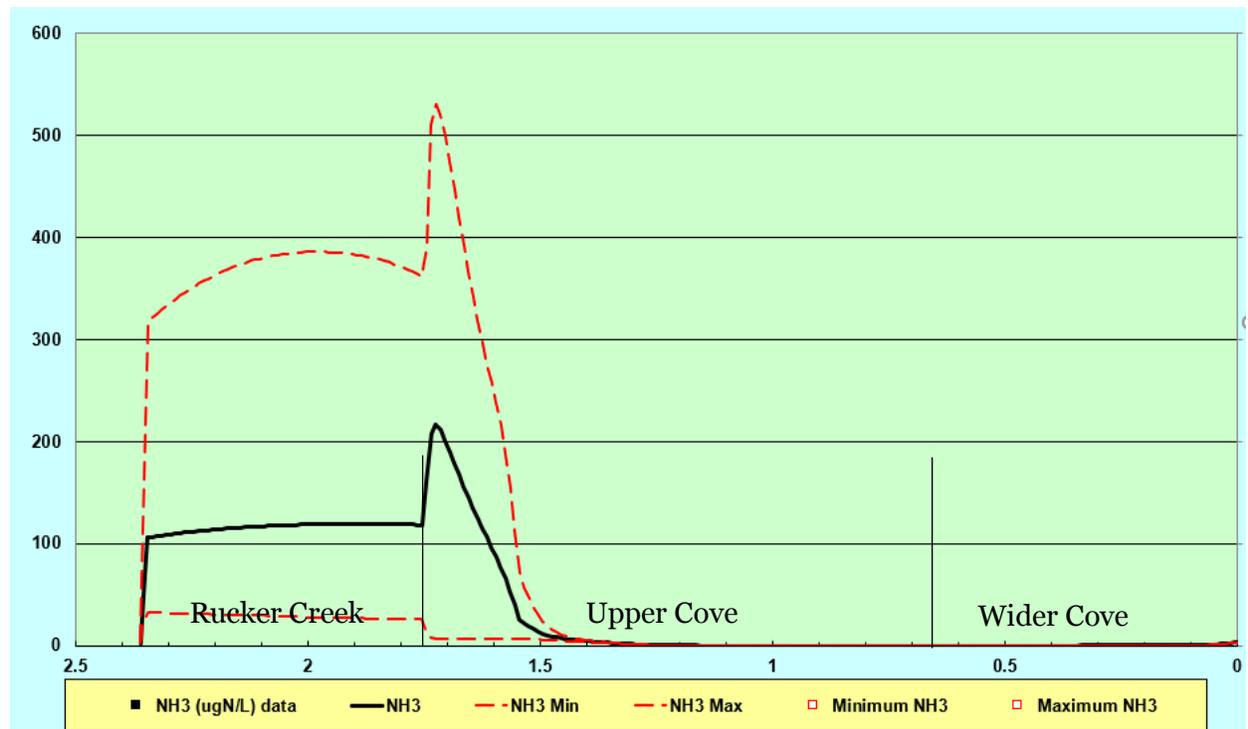
X axis: Distance upstream from cove downstream boundary (km)



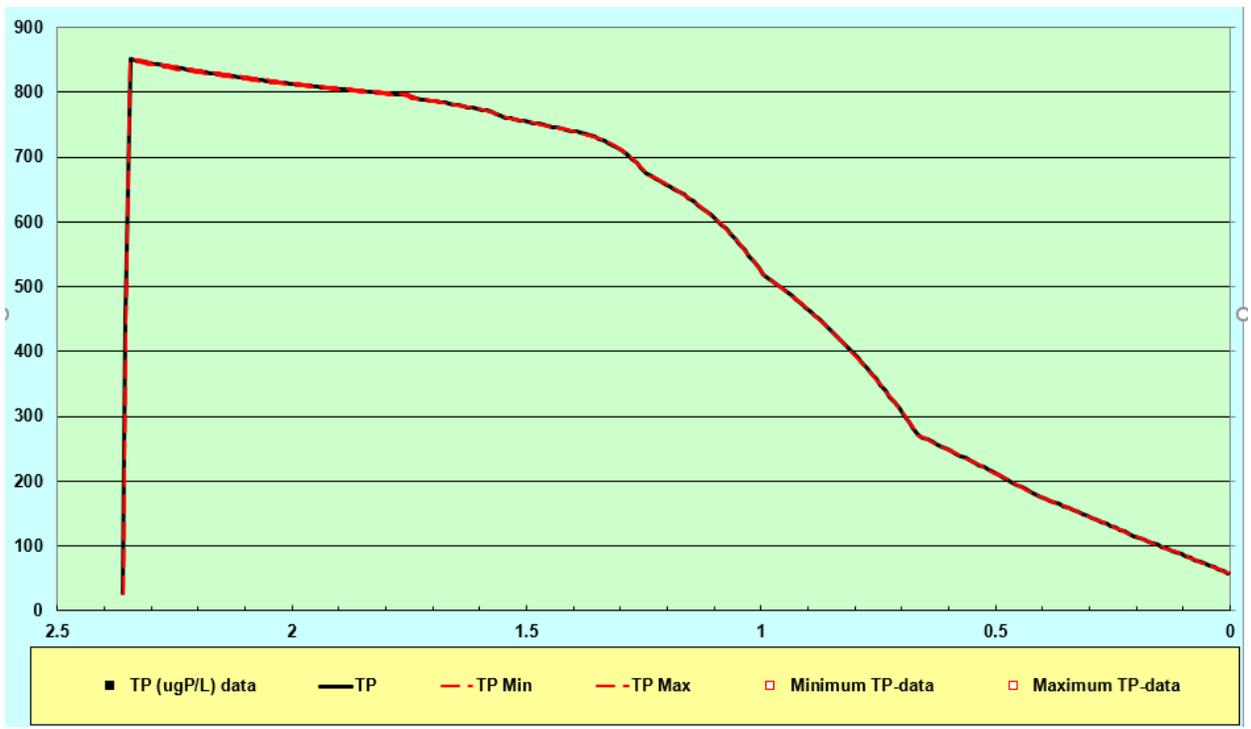
X axis: Distance upstream from cove downstream boundary (km)



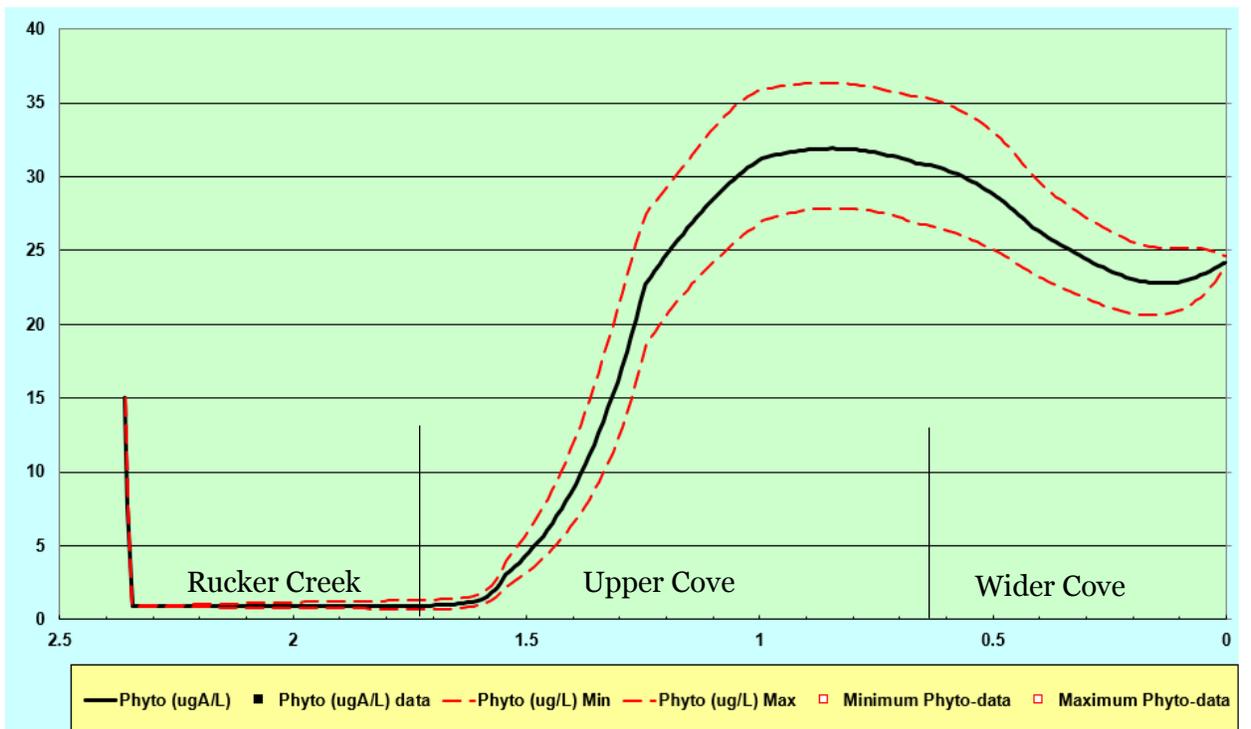
X axis: Distance upstream from cove downstream boundary (km)



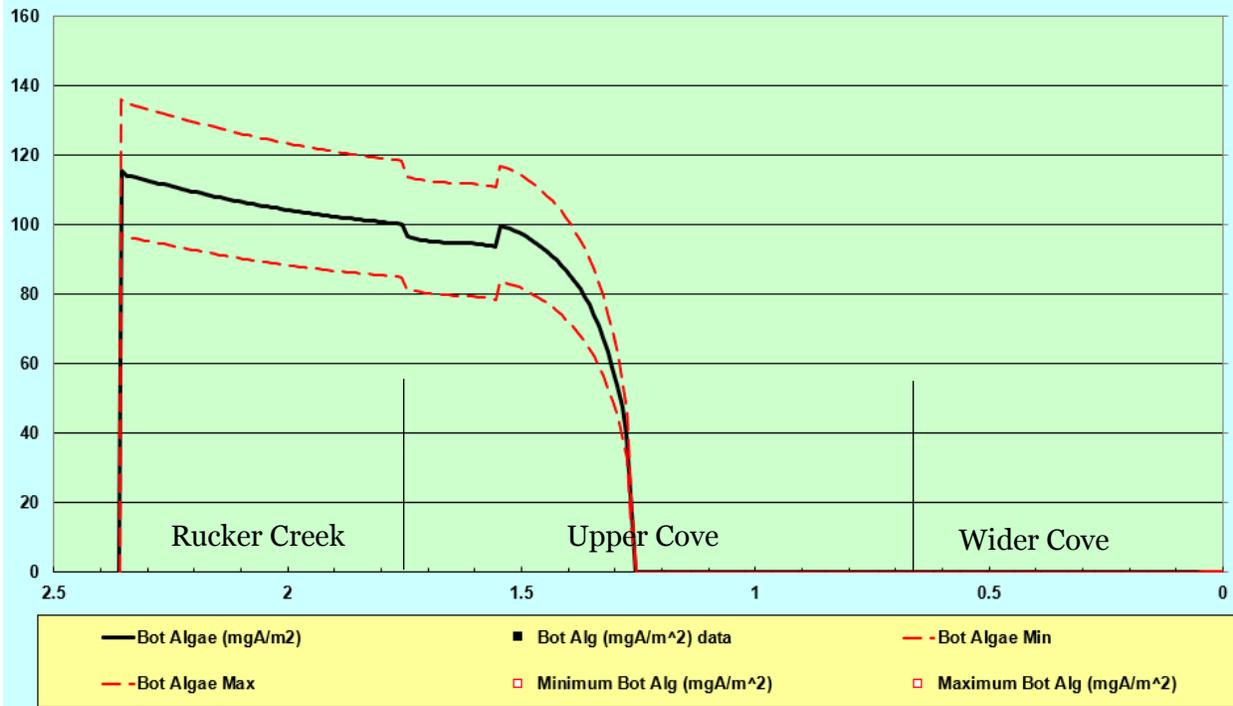
X axis: Distance upstream from cove downstream boundary (km)



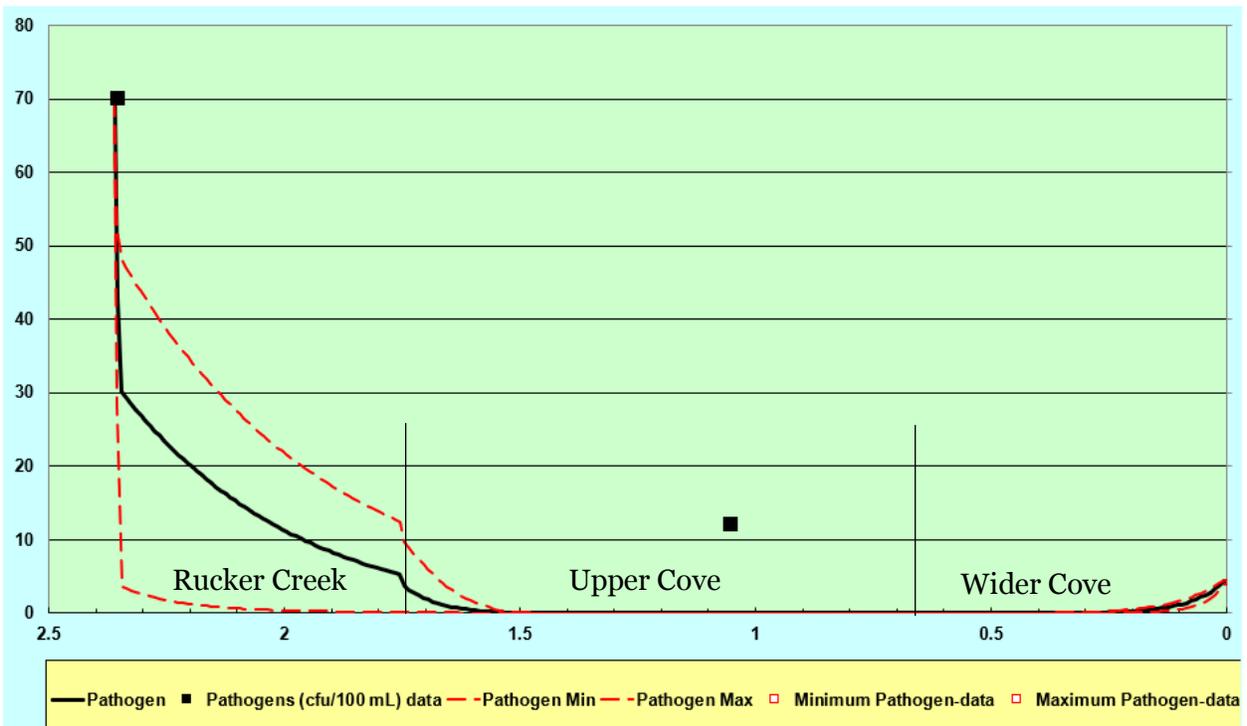
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)

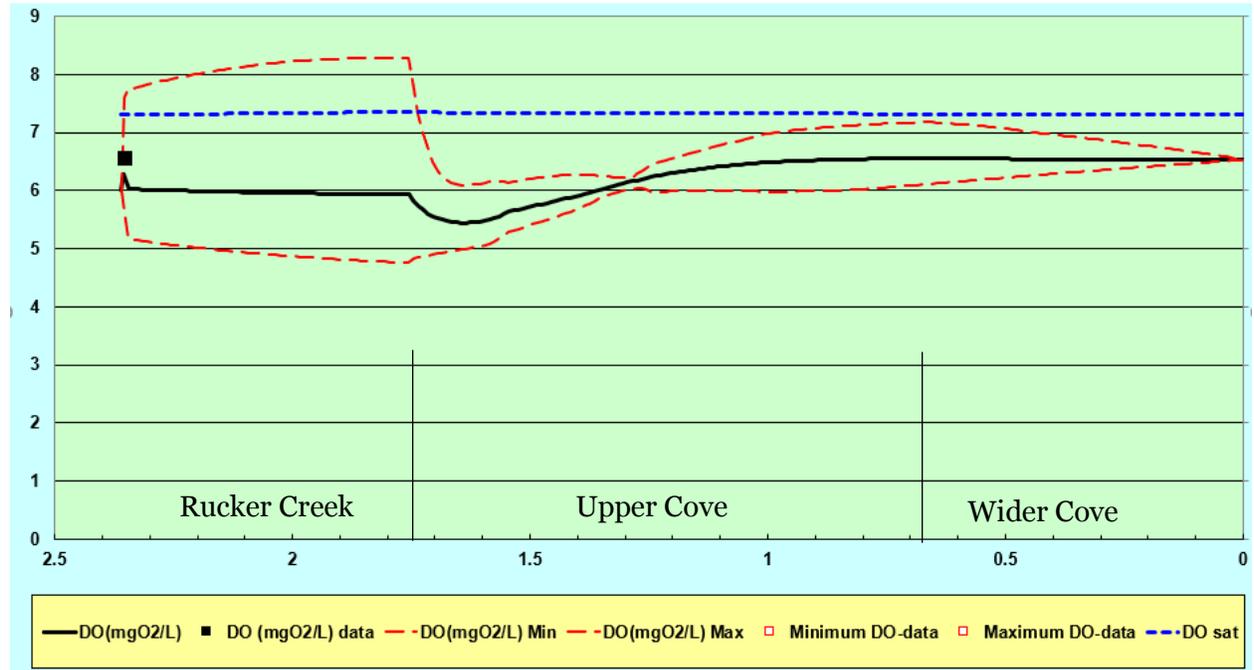


X axis: Distance upstream from cove downstream boundary (km)

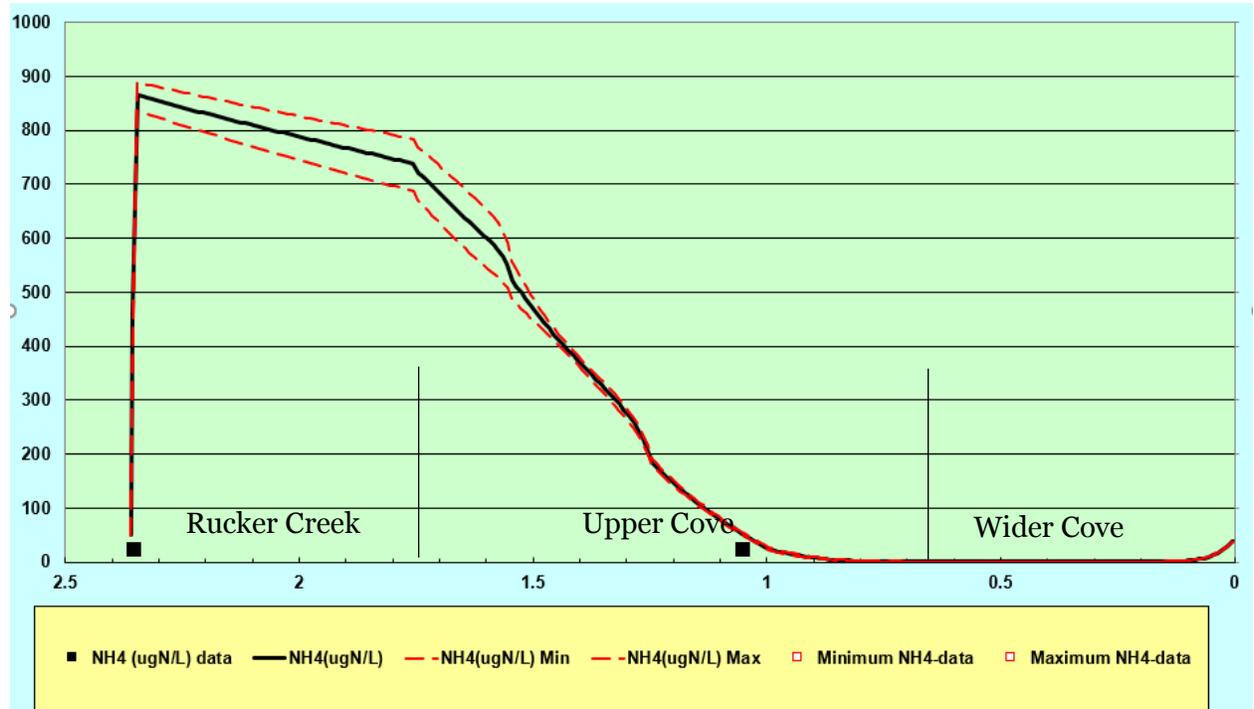


X axis: Distance upstream from cove downstream boundary (km)

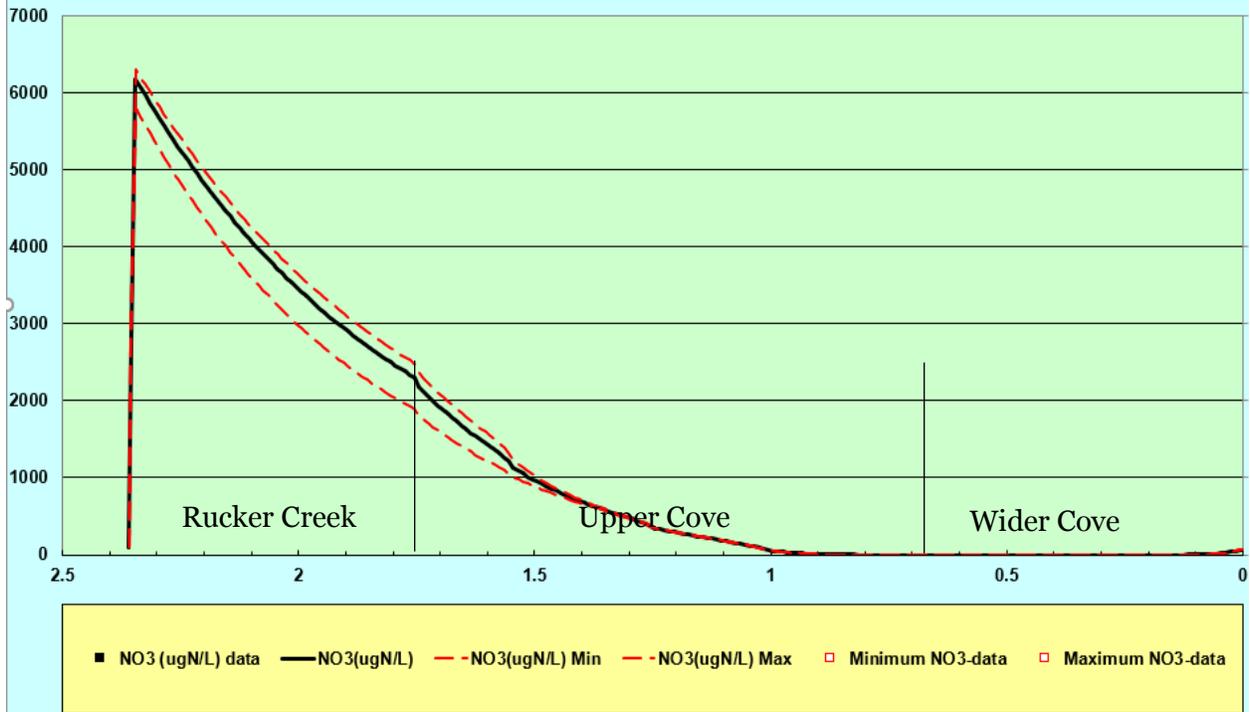
COG Exhibit 618 - Run B3 - Critical conditions with 2.0 MGD discharge at full permit limits  
**CALIBRATED QUAL2K – FINAL 2.0 MGD – Critical Condition Full Permit F\_2b**



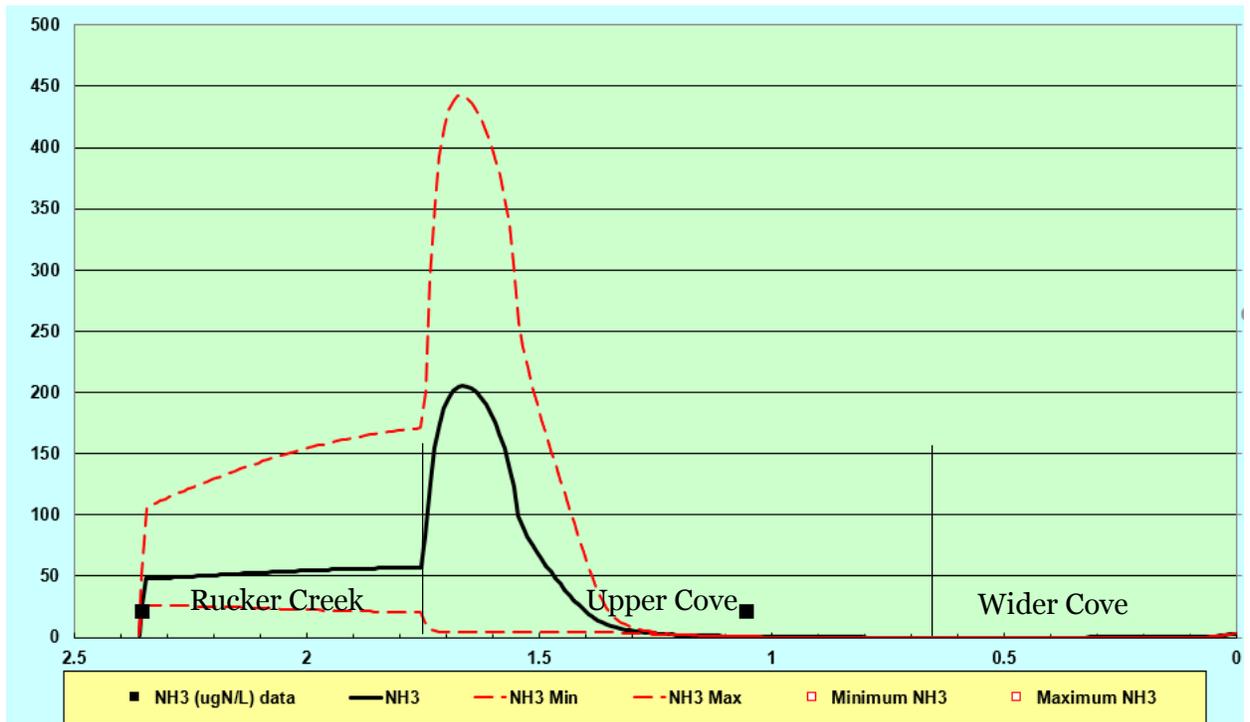
X axis: Distance upstream from cove downstream boundary (km)



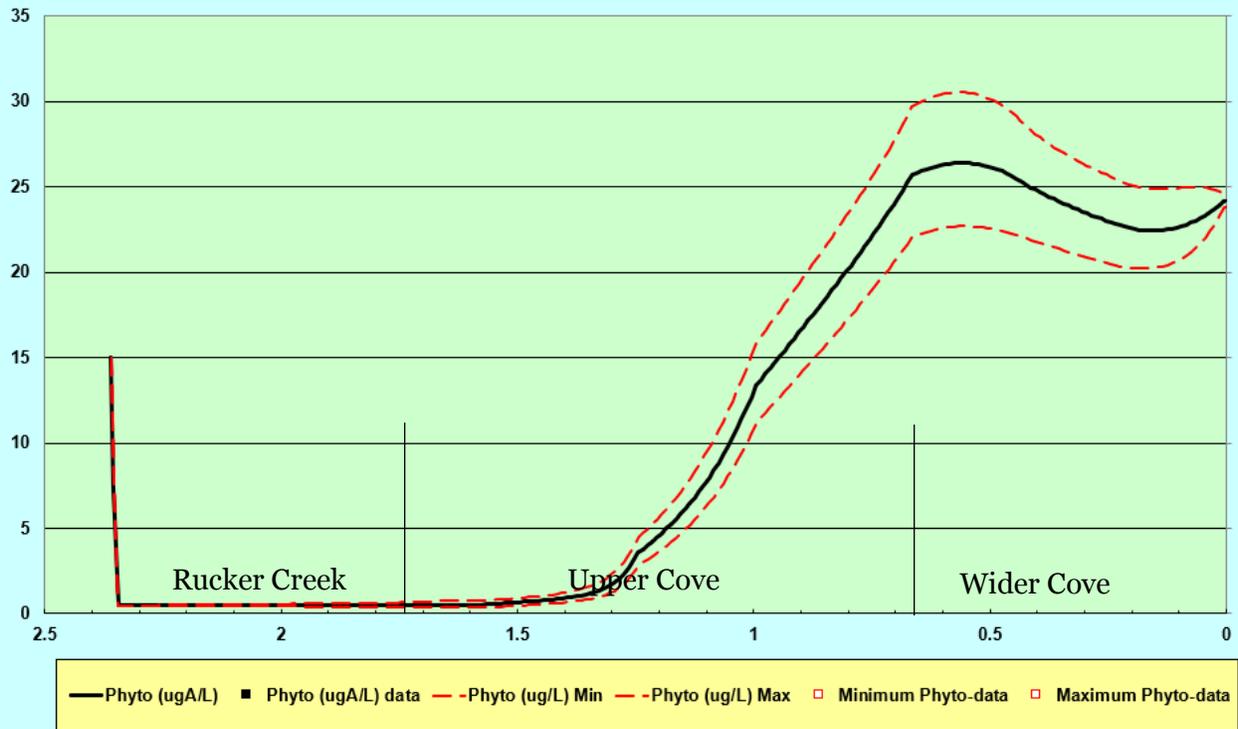
X axis: Distance upstream from cove downstream boundary (km)



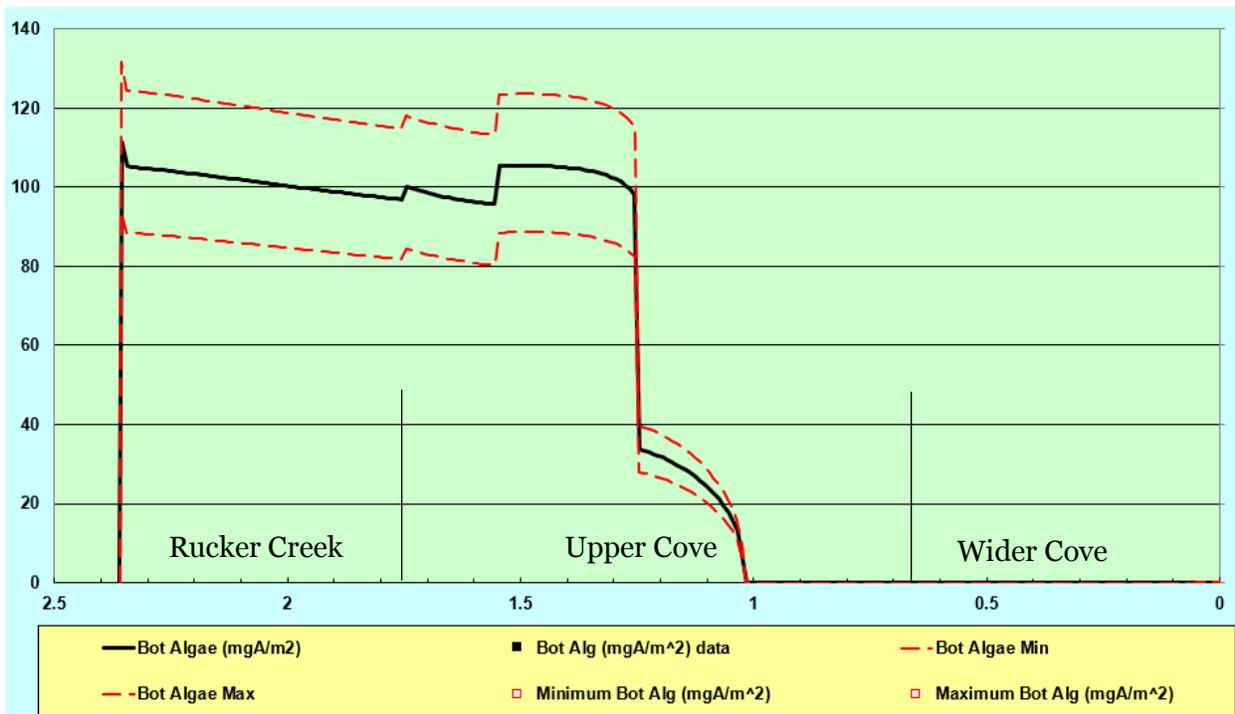
X axis: Distance upstream from cove downstream boundary (km)



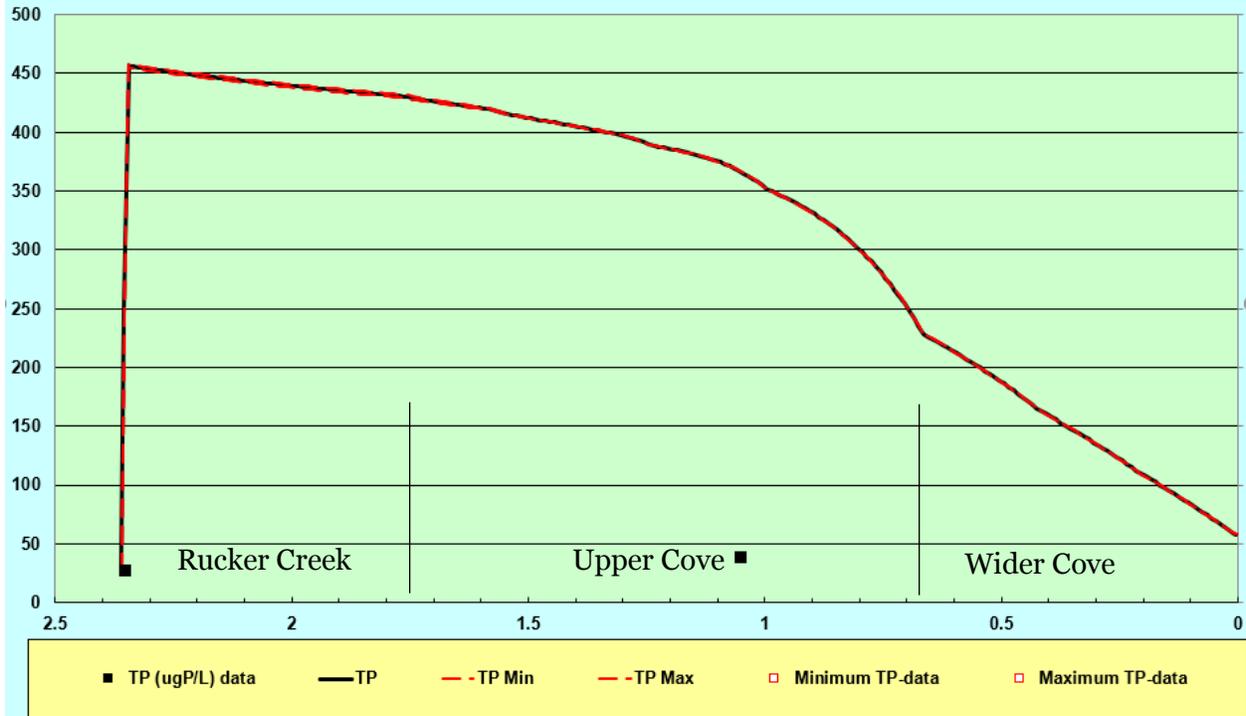
X axis: Distance upstream from cove downstream boundary (km)



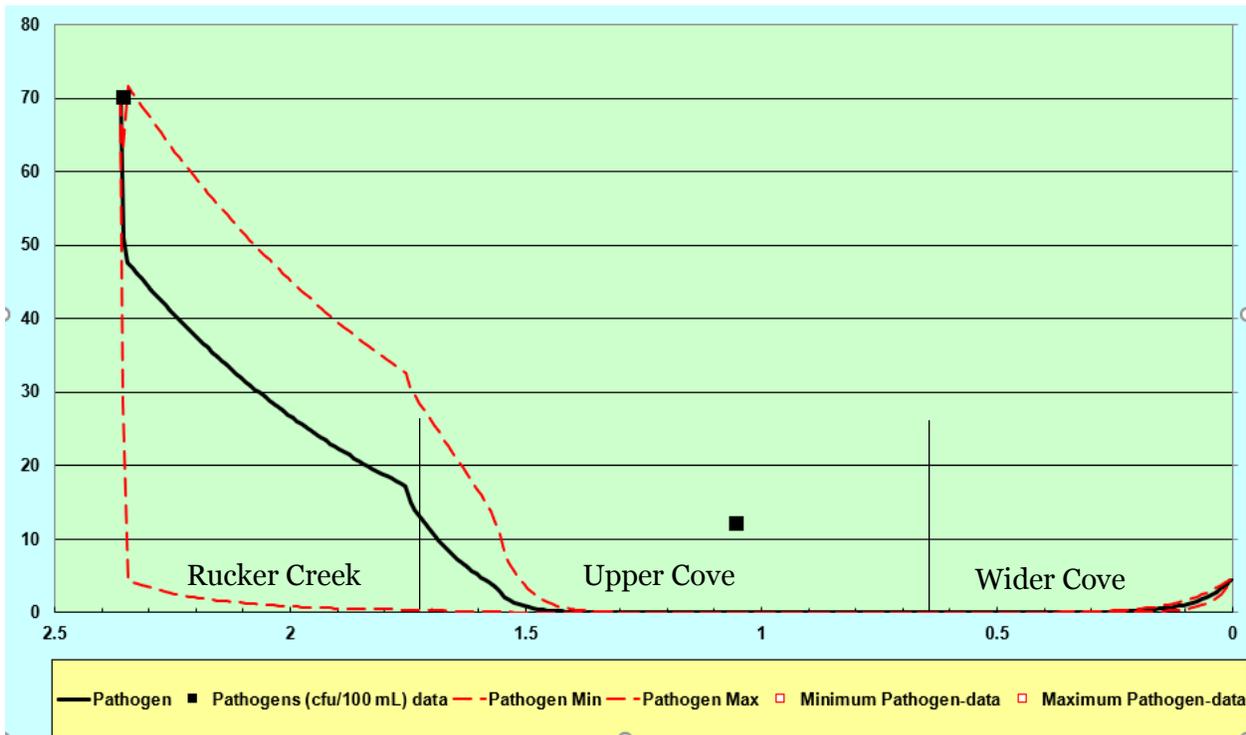
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)

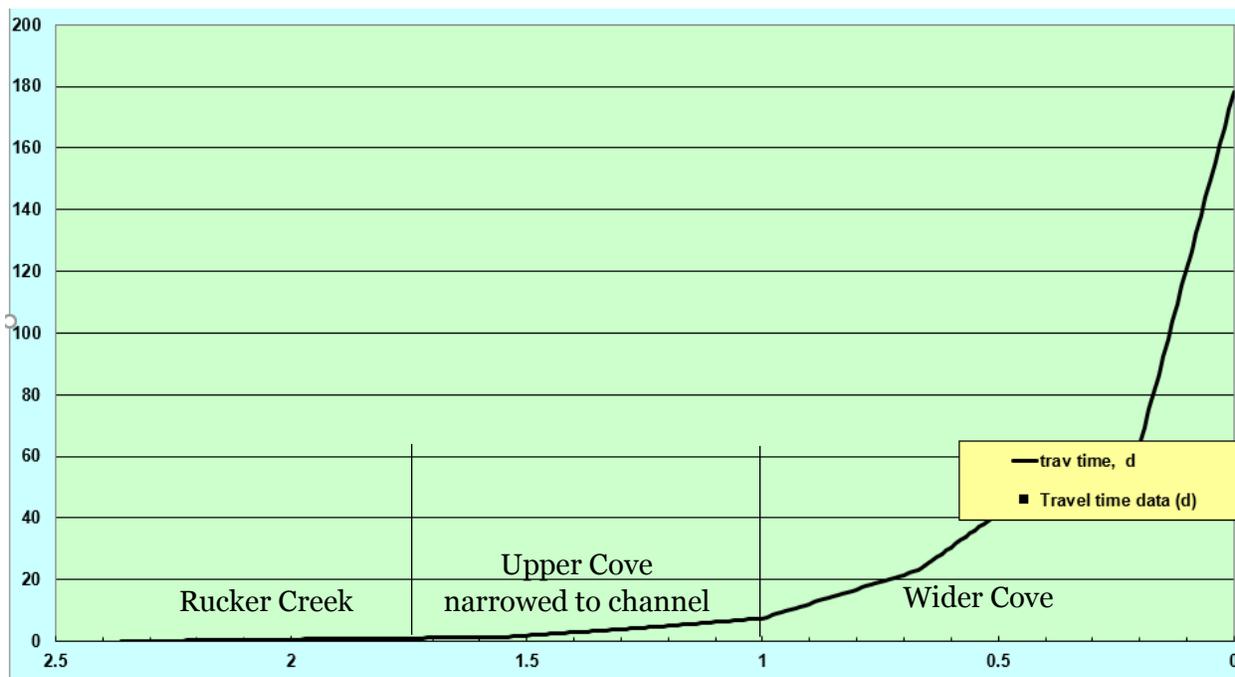


X axis: Distance upstream from cove downstream boundary (km)

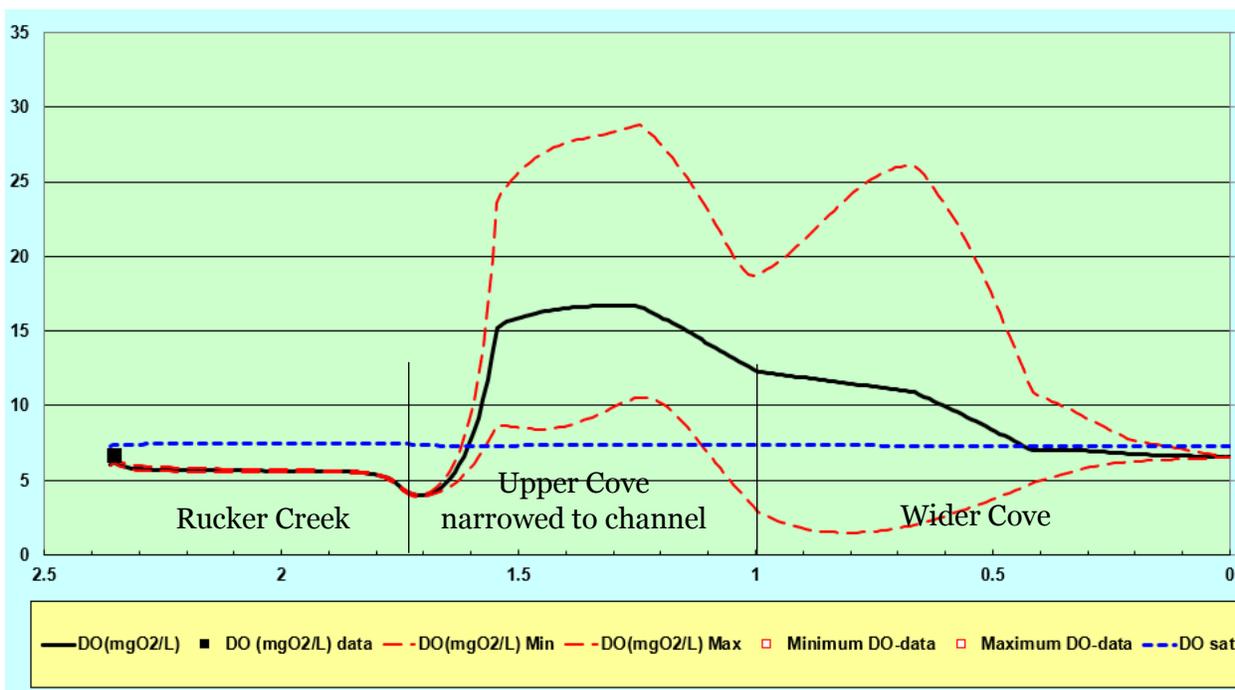


X axis: Distance upstream from cove downstream boundary (km)

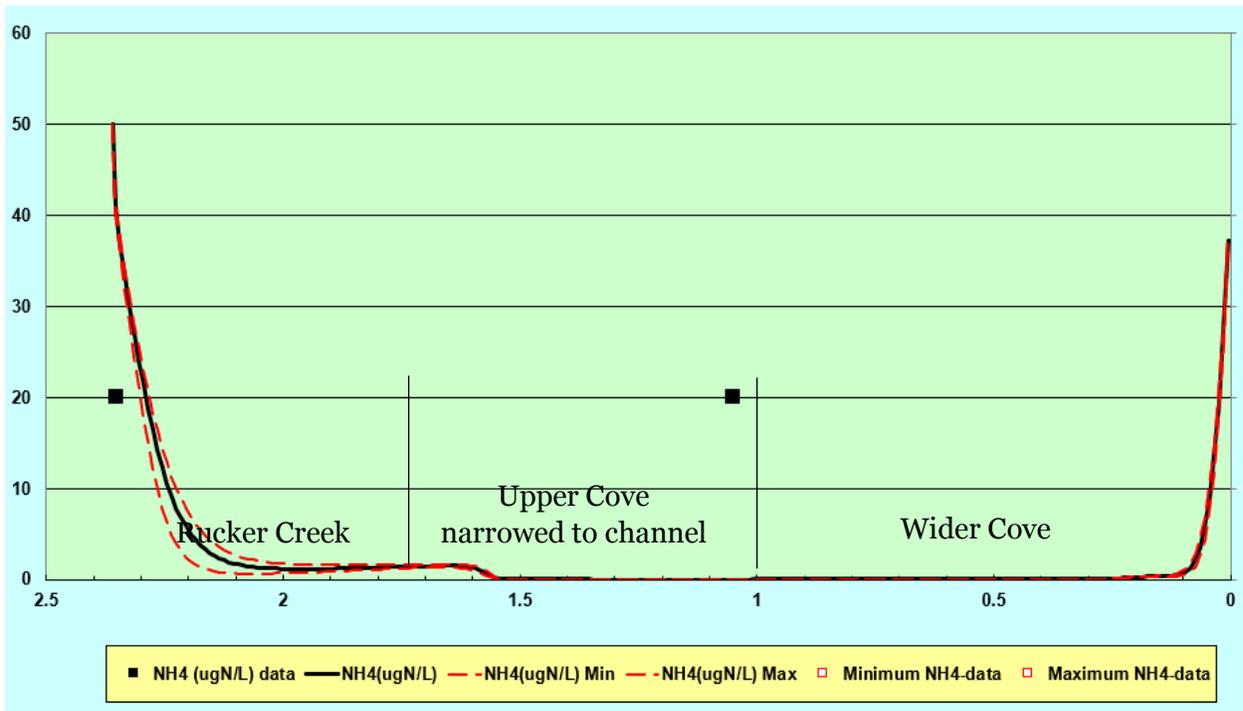
**CALIBRATED QUALI2K – CRITICAL CONDITIONS AND LOW LAKE LEVEL 686 – No Load**



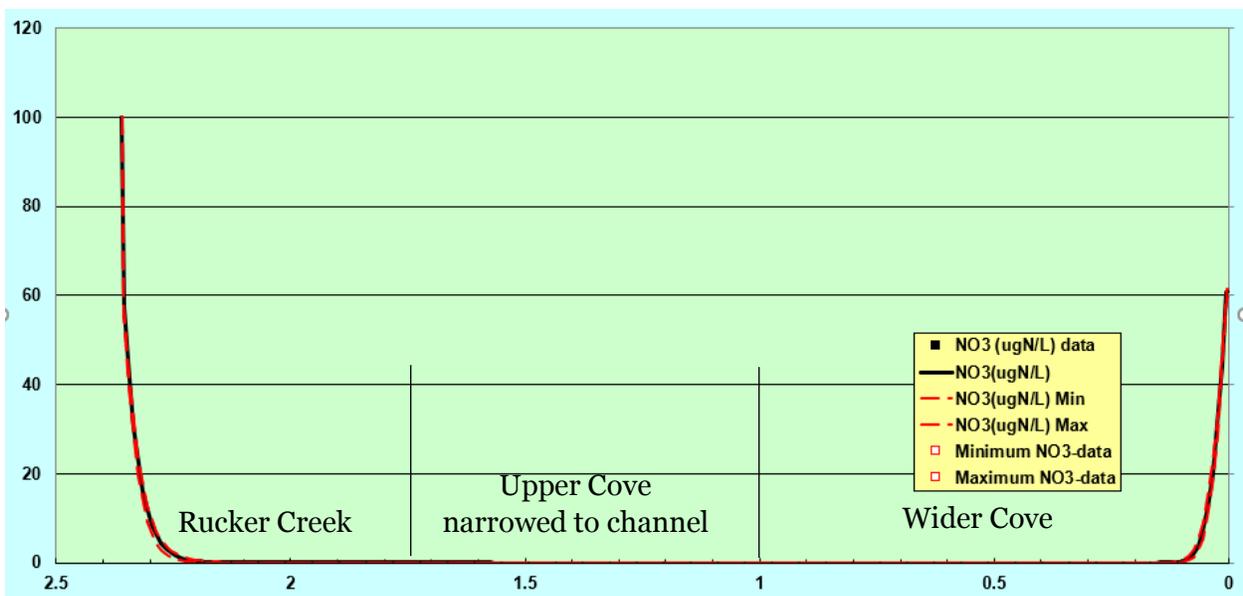
X axis: Distance upstream from cove downstream boundary (km)



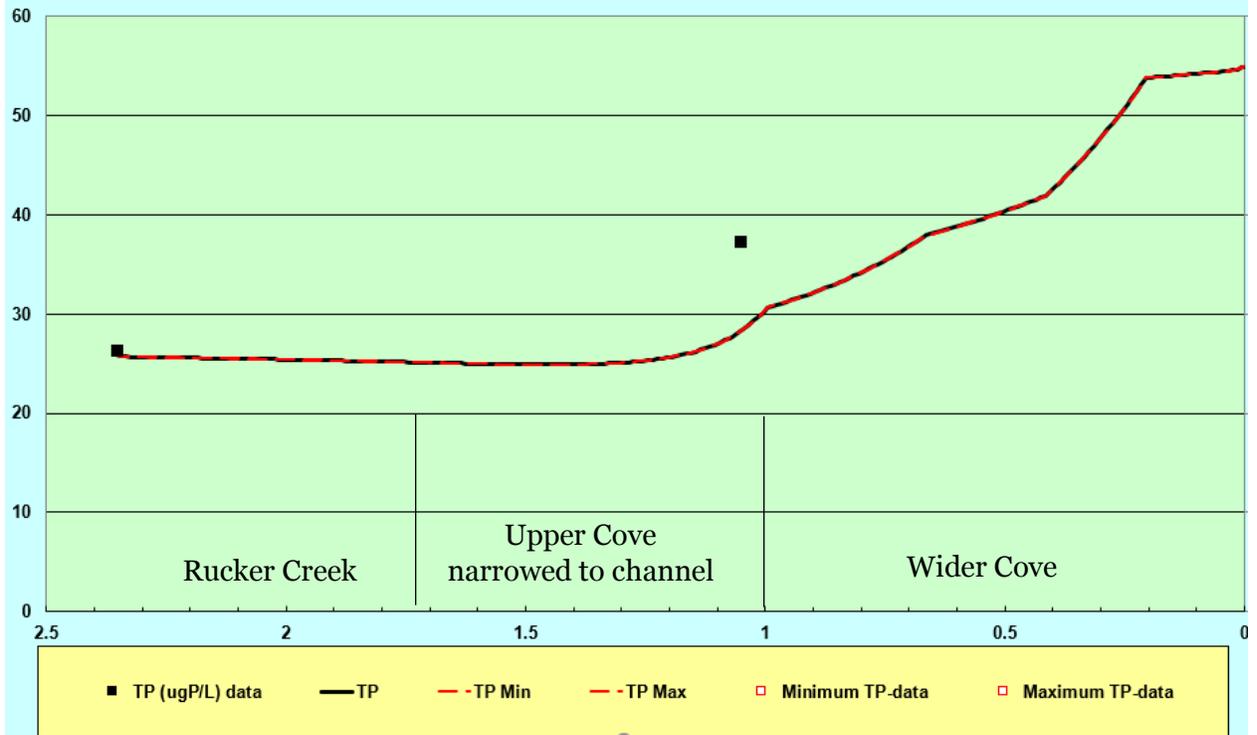
X axis: Distance upstream from cove downstream boundary (km)



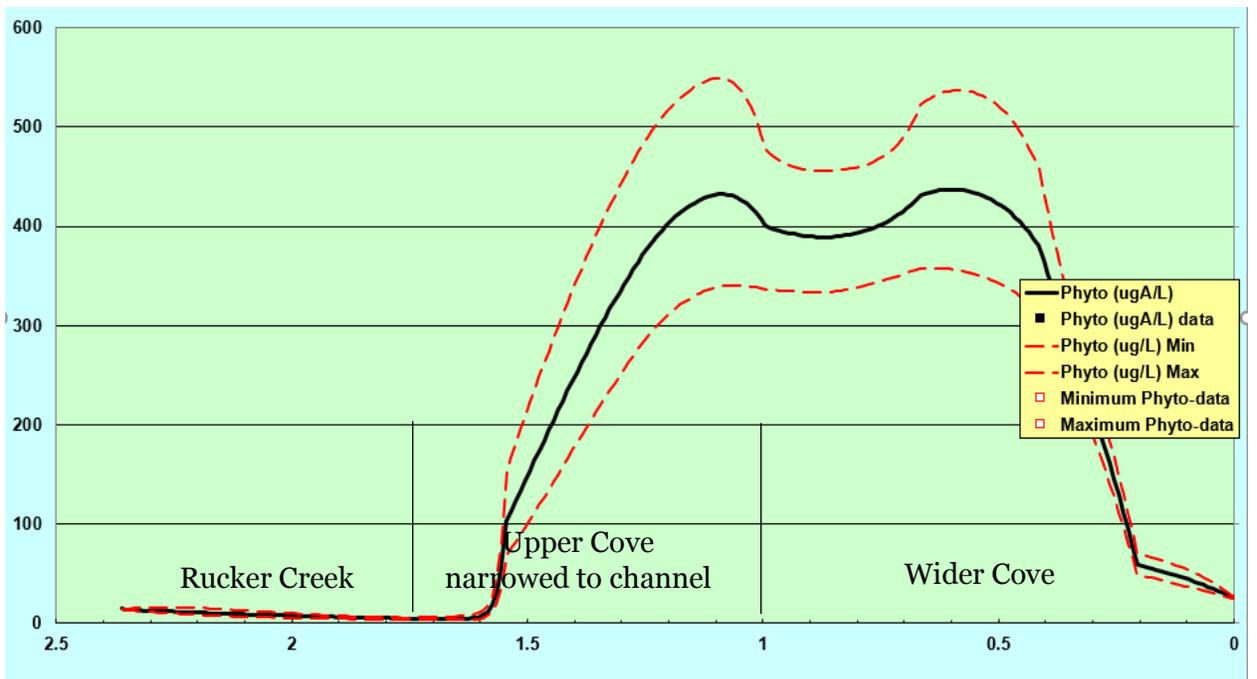
X axis: Distance upstream from cove downstream boundary (km)



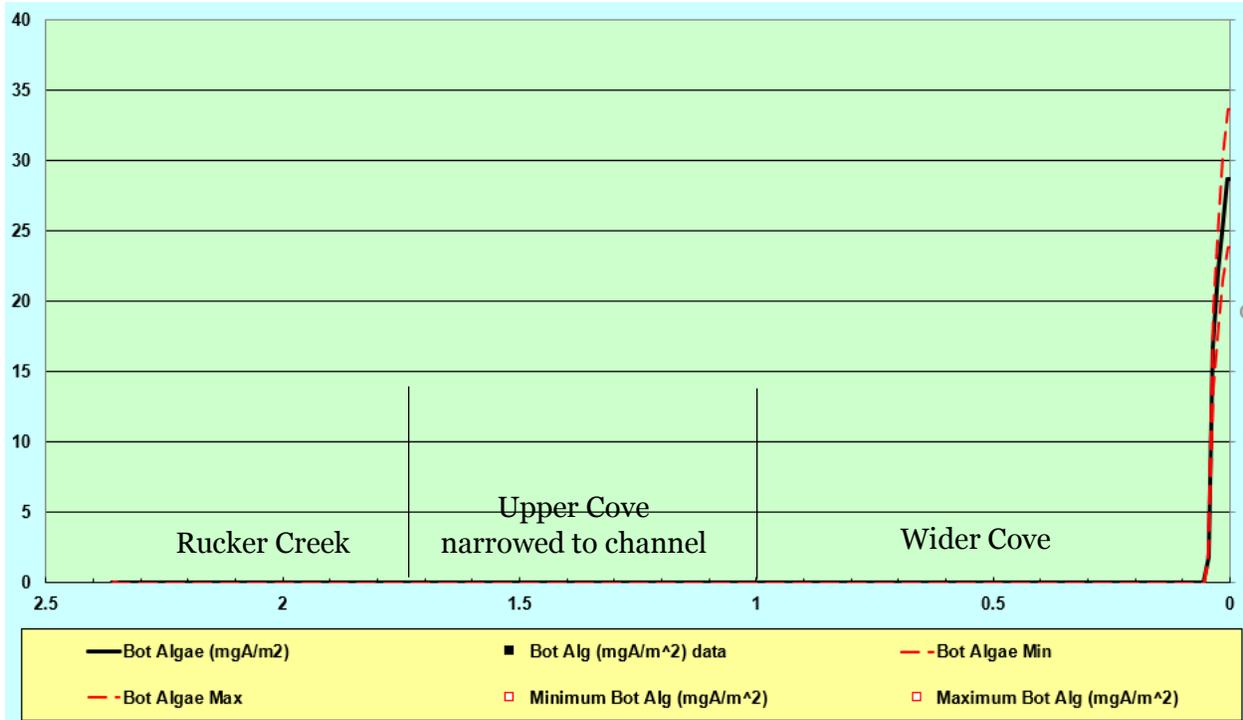
X axis: Distance upstream from cove downstream boundary (km)



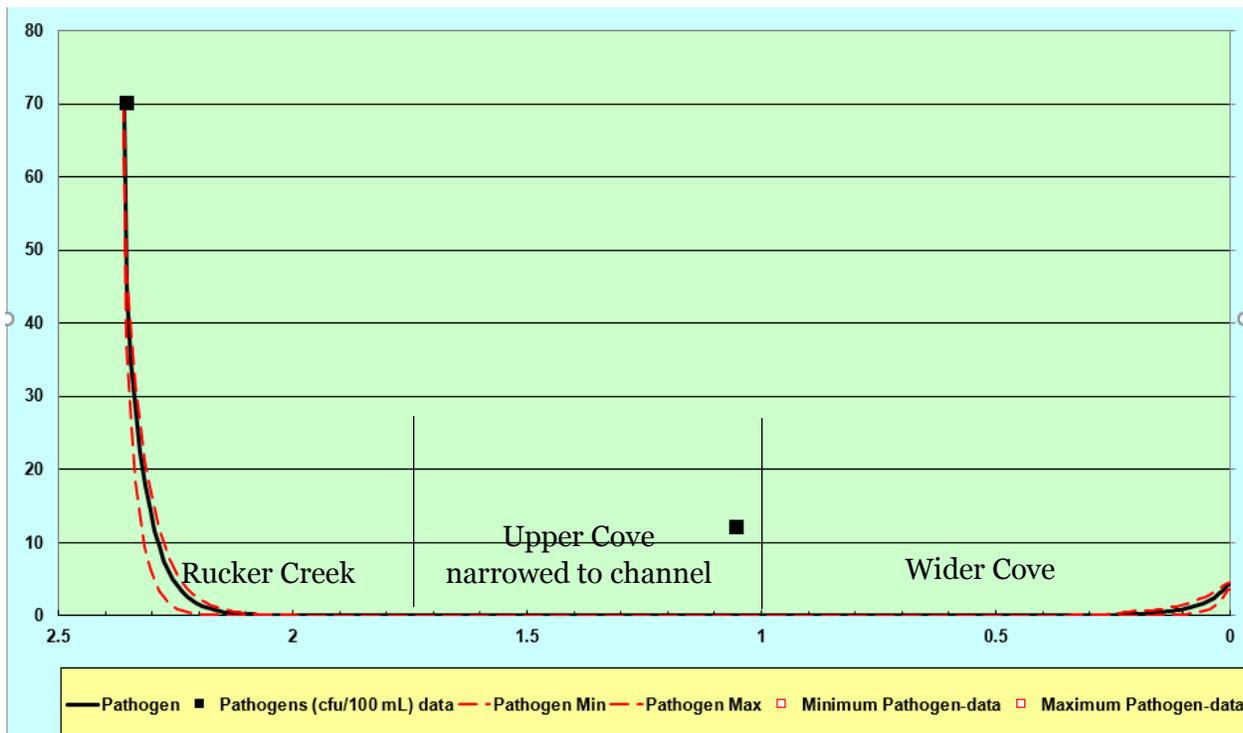
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)



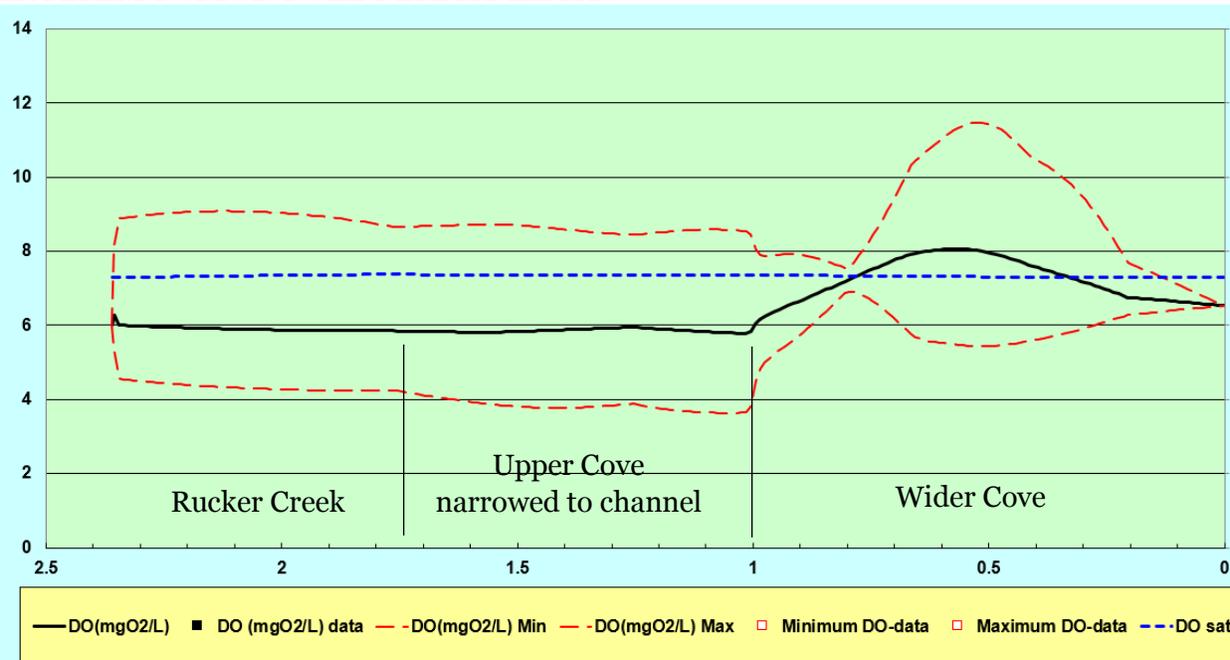
X axis: Distance upstream from cove downstream boundary (km)



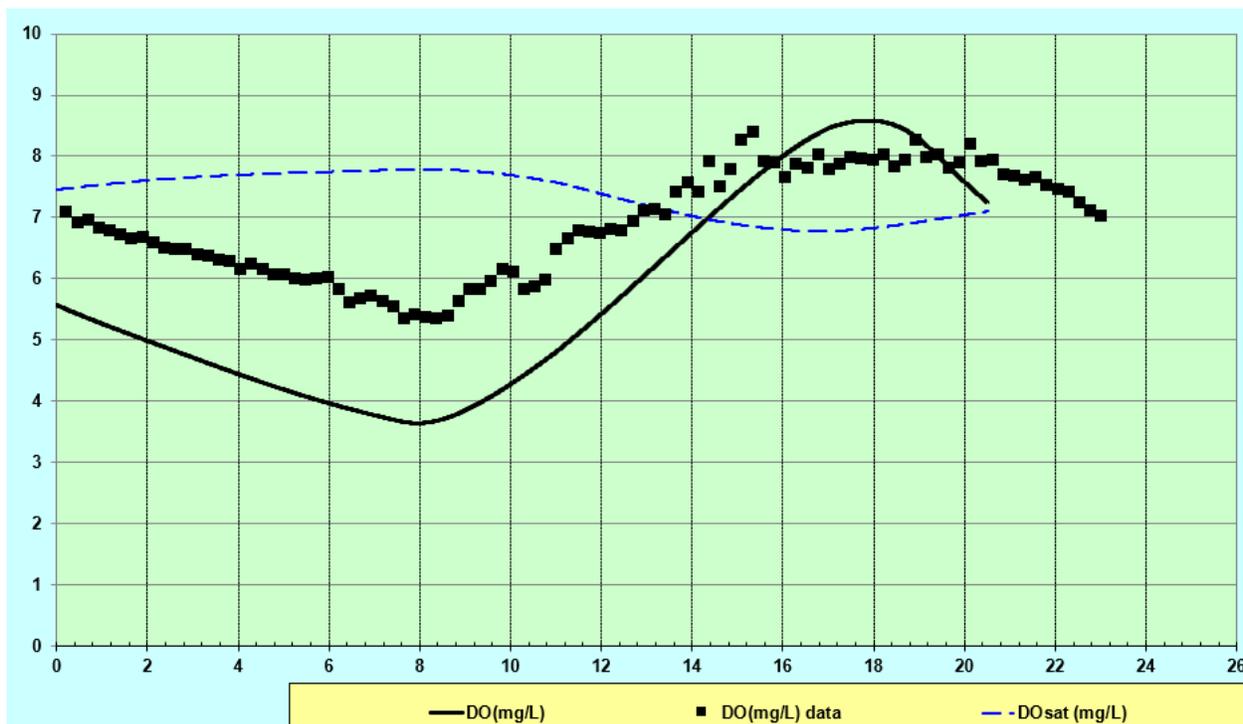
X axis: Distance upstream from cove downstream boundary (km)

COG Exhibit 620 – Run C2 - Critical conditions at low lake level with 1.0 MGD discharge at full permit limits

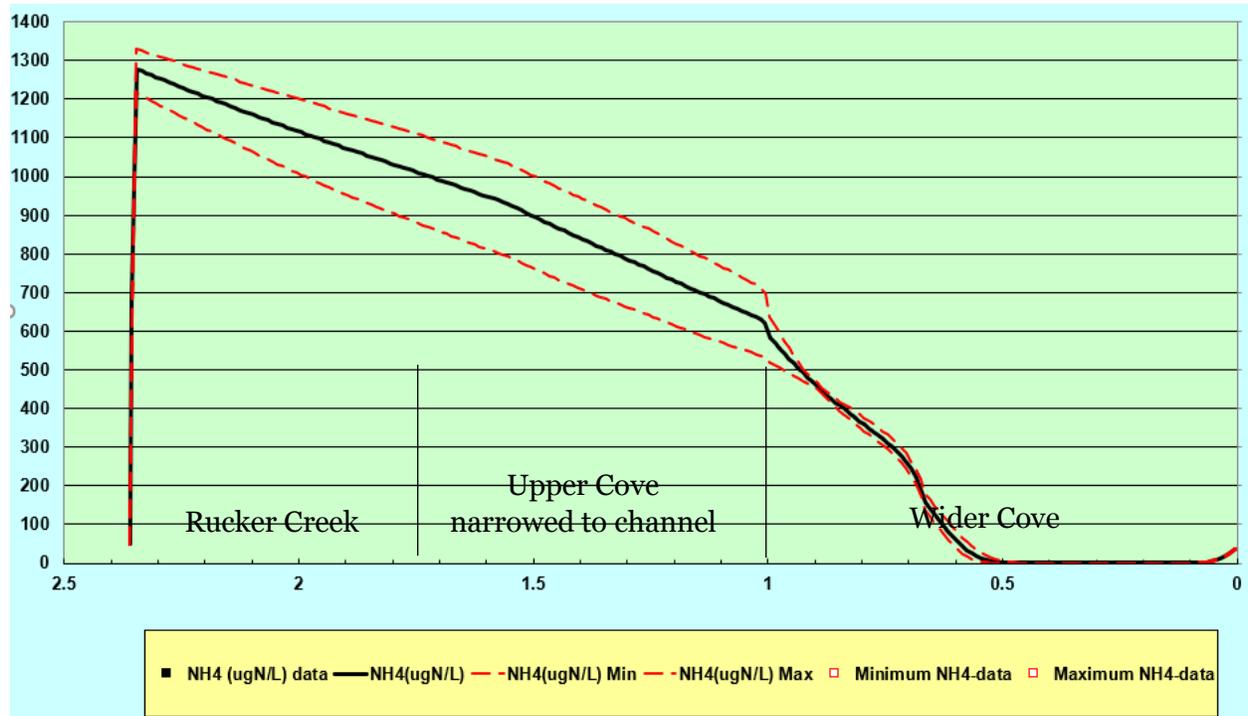
**CALIBRATED QUALI<sub>2</sub>K – CRITICAL CONDITIONS AND LOW LAKE LEVEL 686 – INTERIM 1.0MGD FULL PERMIT LIMITS**



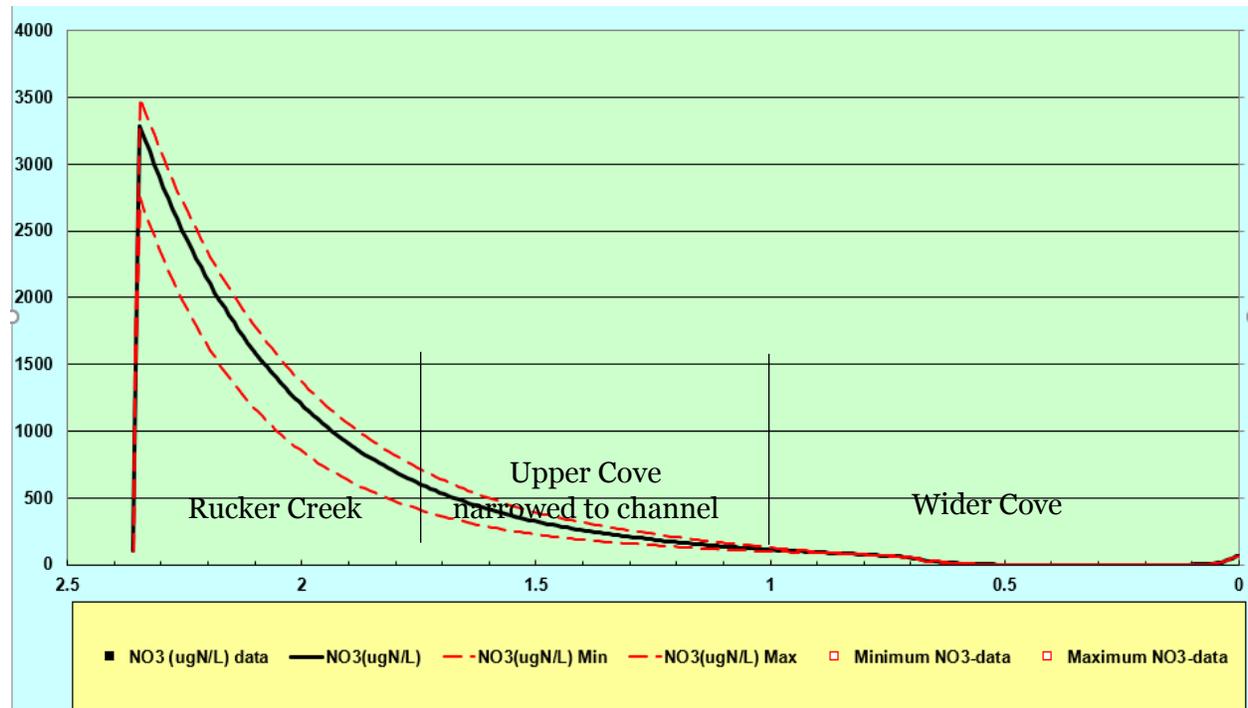
X axis: Distance upstream from cove downstream boundary (km)



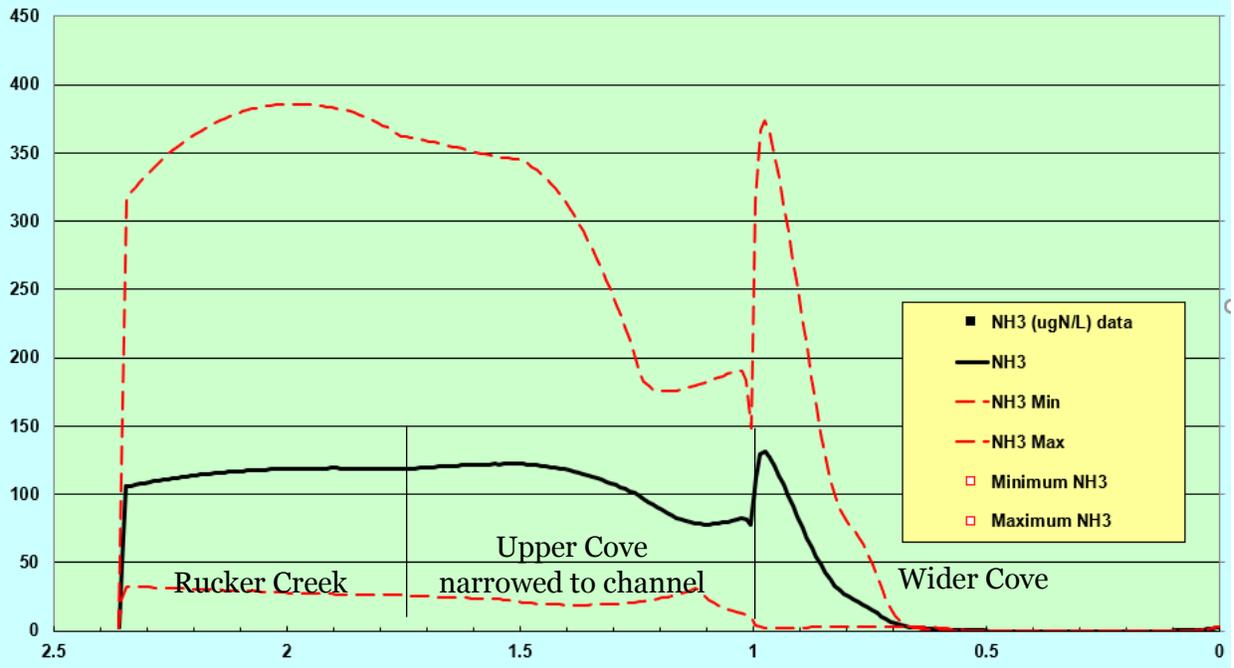
X axis: Time (hour of day)



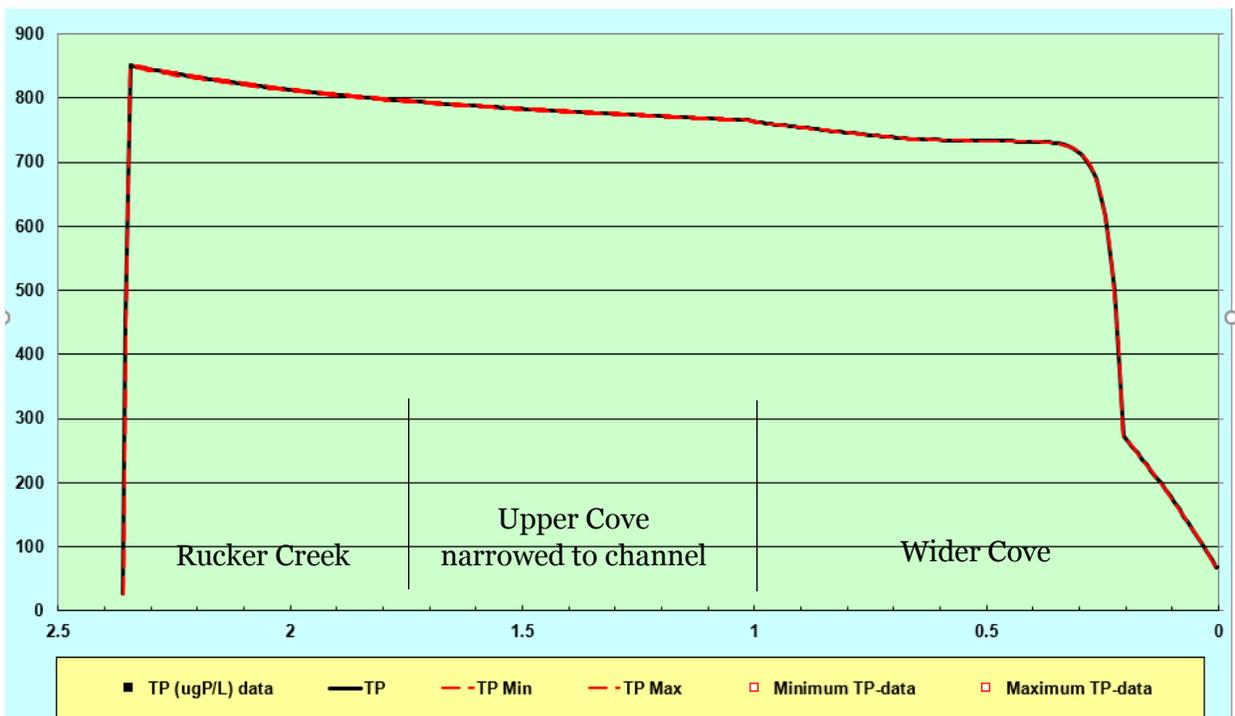
X axis: Distance upstream from cove downstream boundary (km)



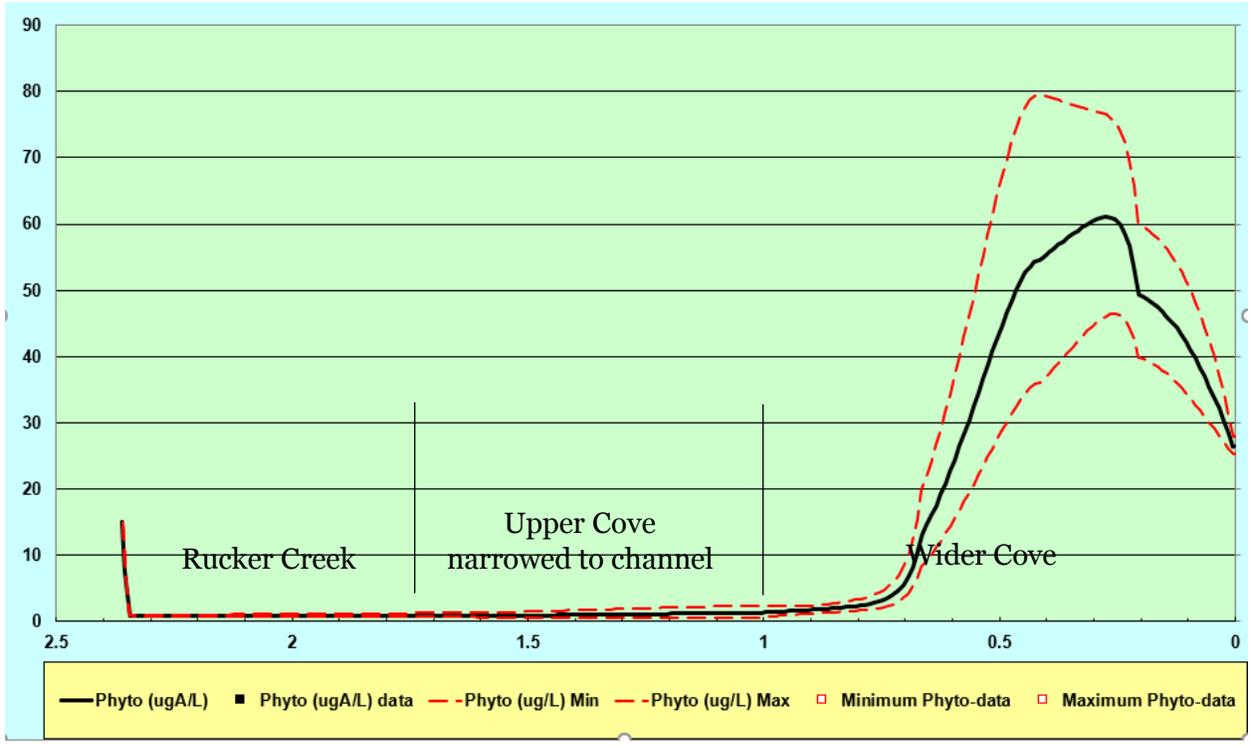
X axis: Distance upstream from cove downstream boundary (km)



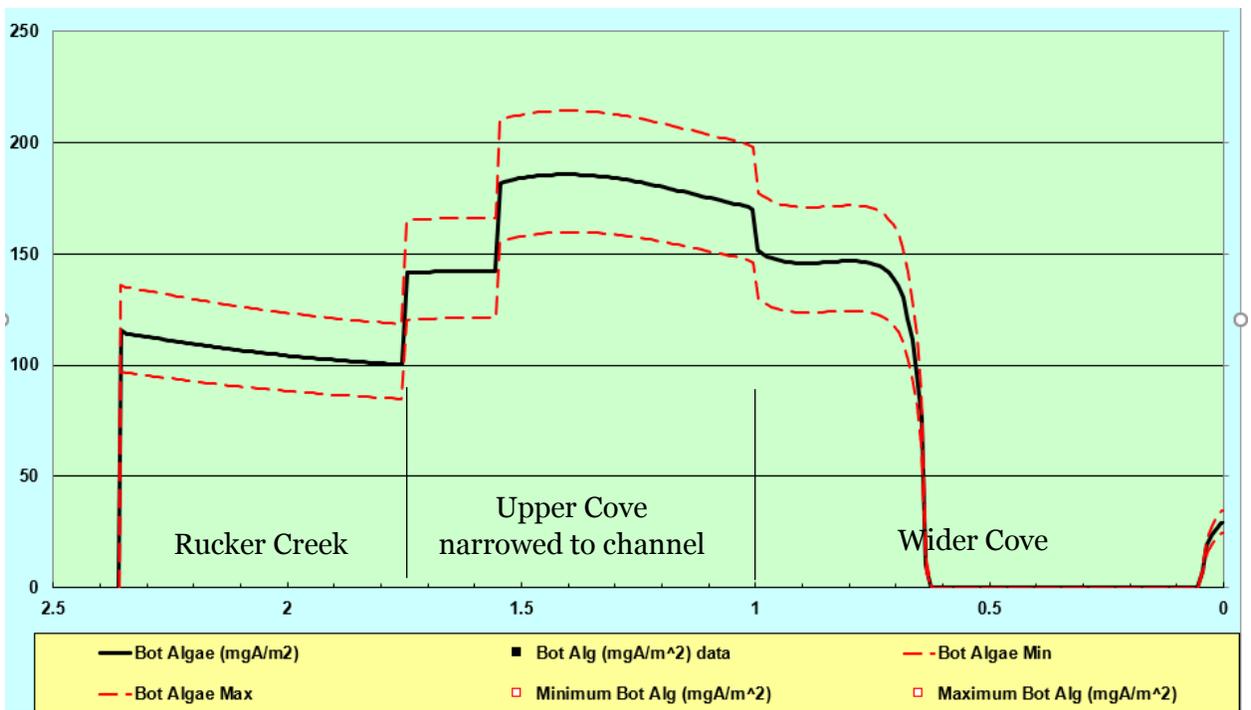
X axis: Distance upstream from cove downstream boundary (km)



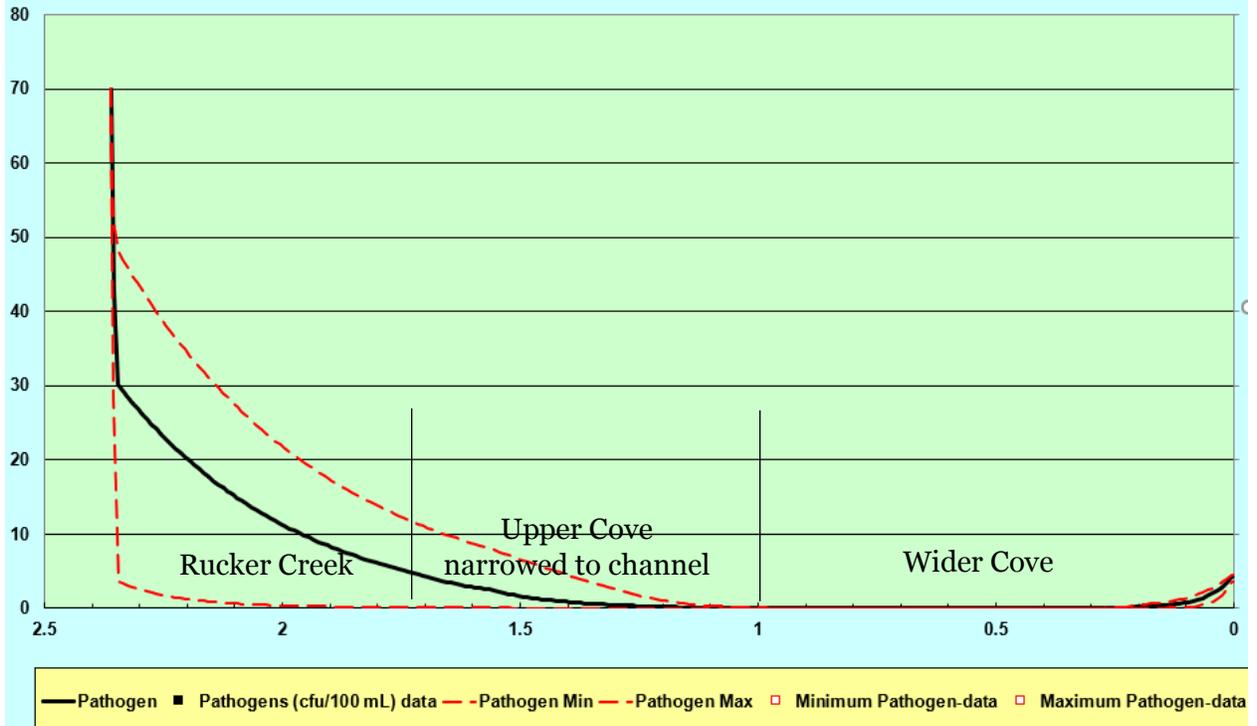
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)



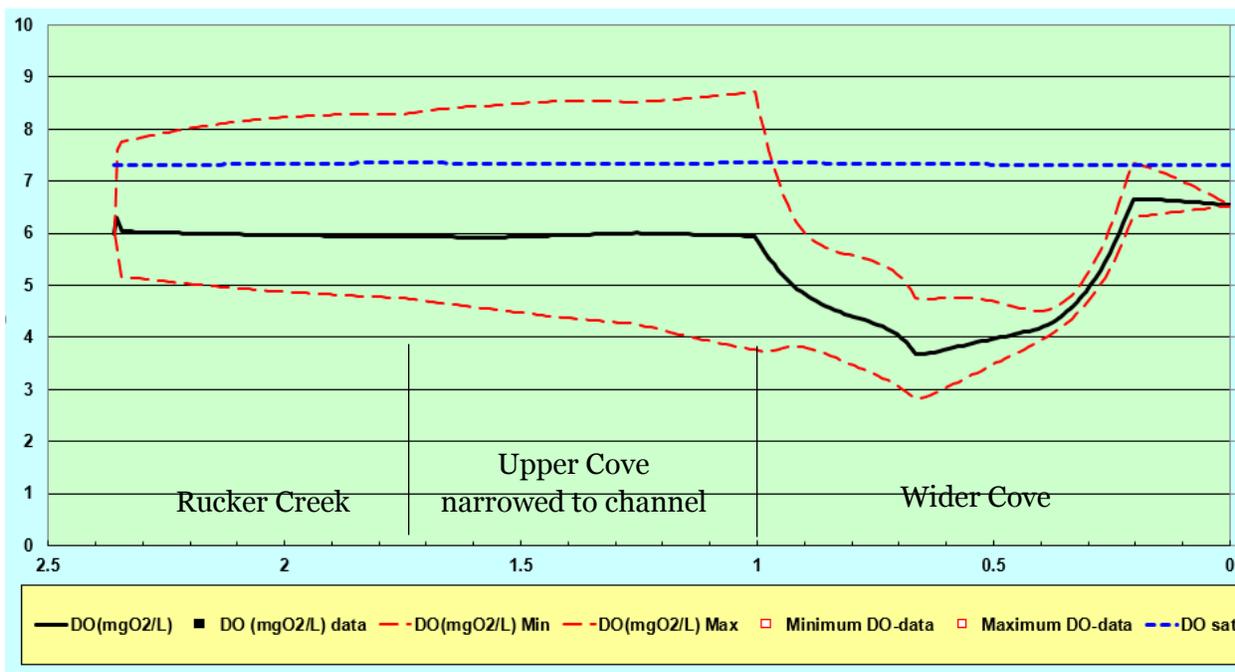
X axis: Distance upstream from cove downstream boundary (km)



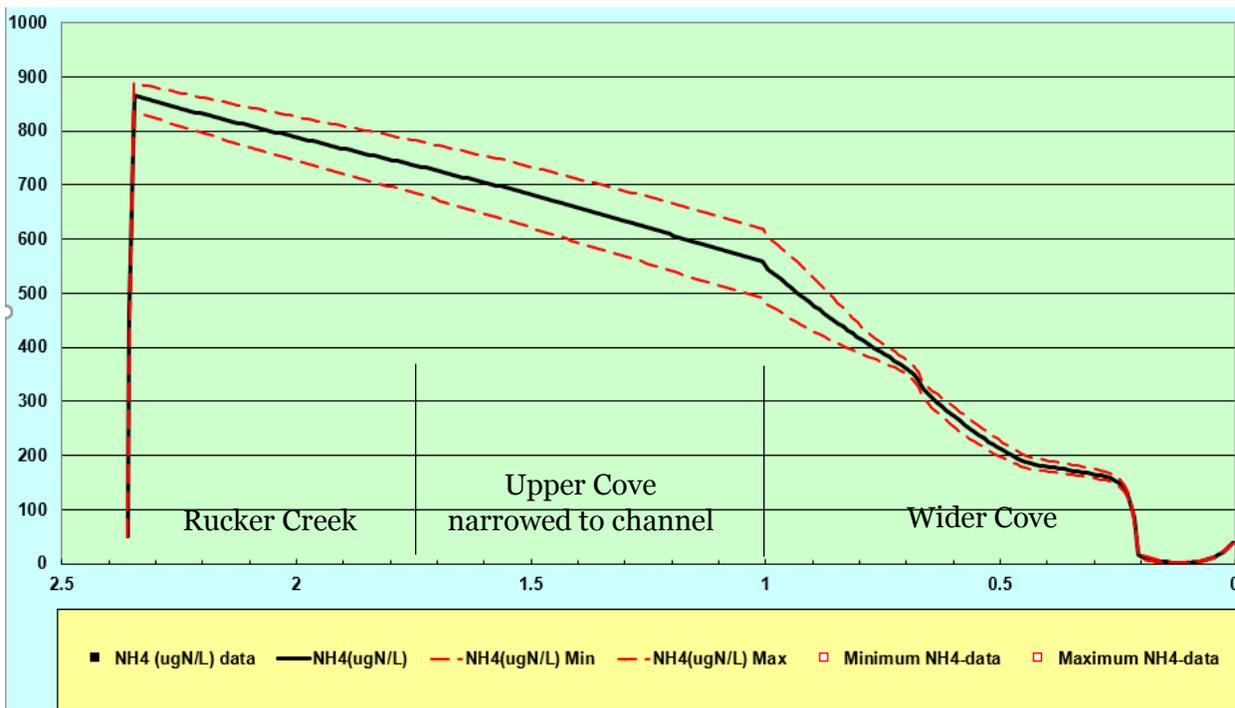
X axis: Distance upstream from cove downstream boundary (km)

COG Exhibit 621 – Run C3 - Critical conditions at low lake level with 2.0 MGD discharge at full permit limits

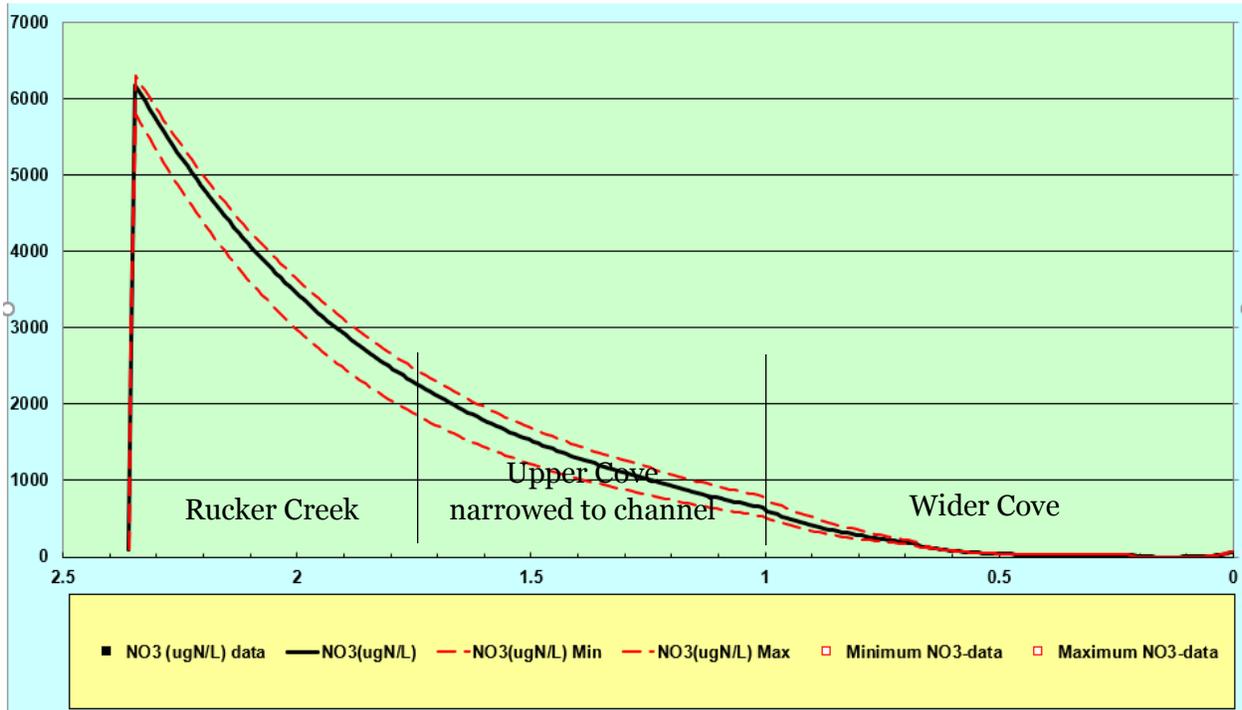
**CALIBRATED QUAL2K – CRITICAL CONDITIONS AND LOW LAKE LEVEL 686 – FINAL 2.0MGD FULL PERMIT LIMITS**



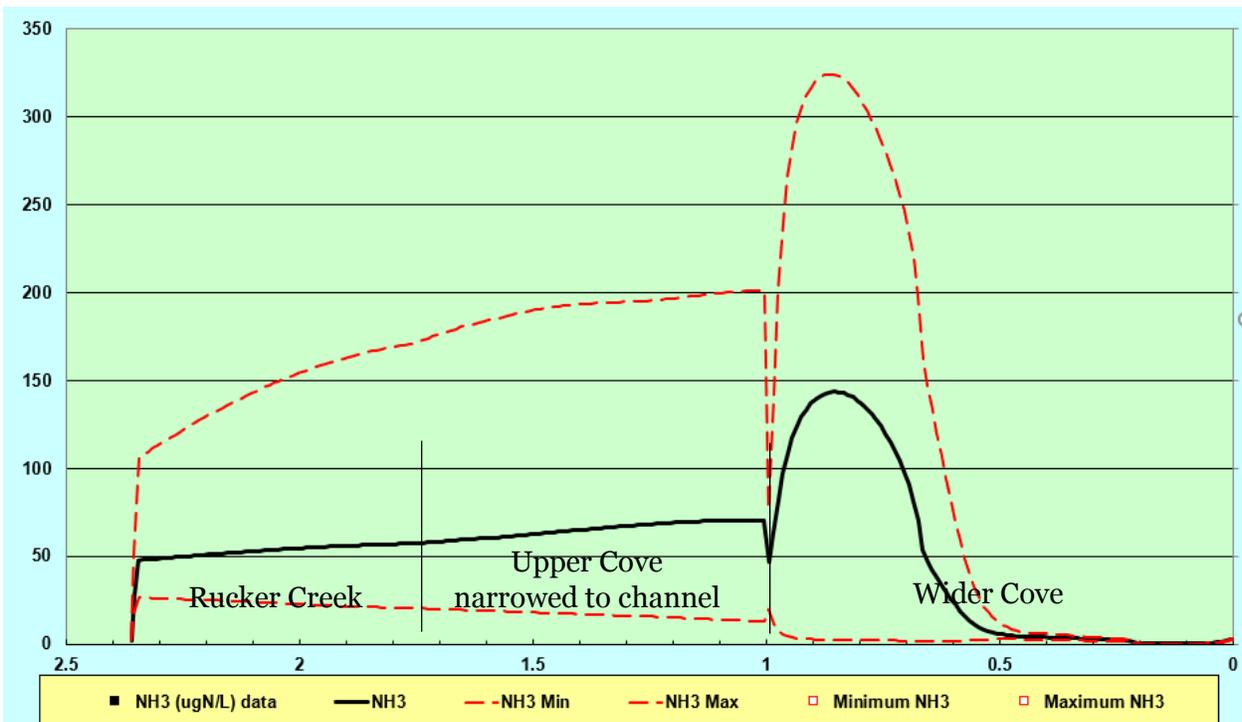
X axis: Distance upstream from cove downstream boundary (km)



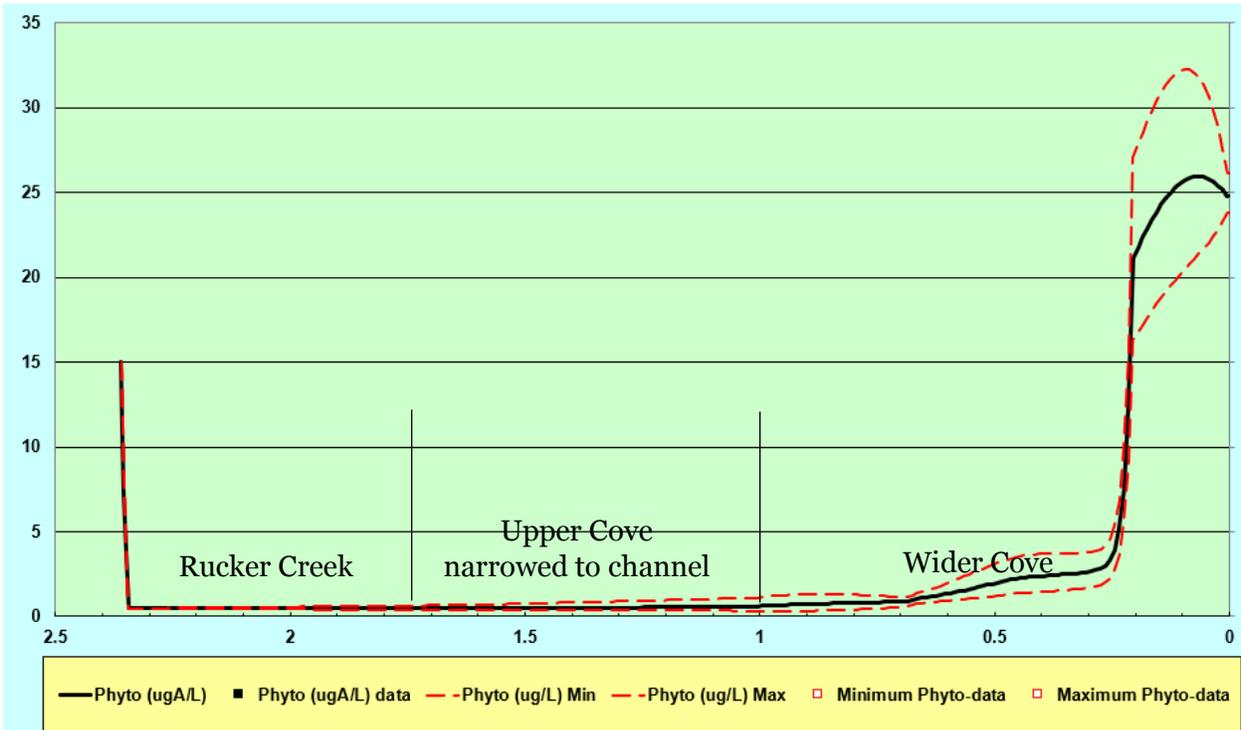
X axis: Distance upstream from cove downstream boundary (km)



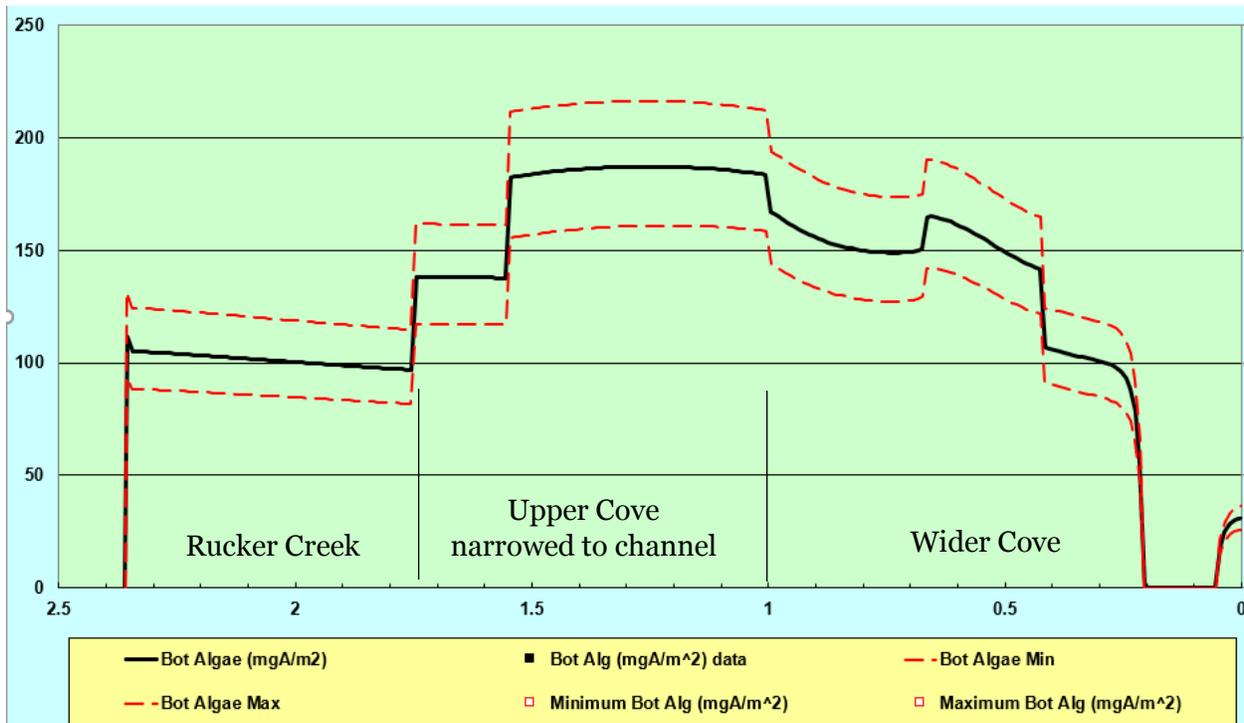
X axis: Distance upstream from cove downstream boundary (km)



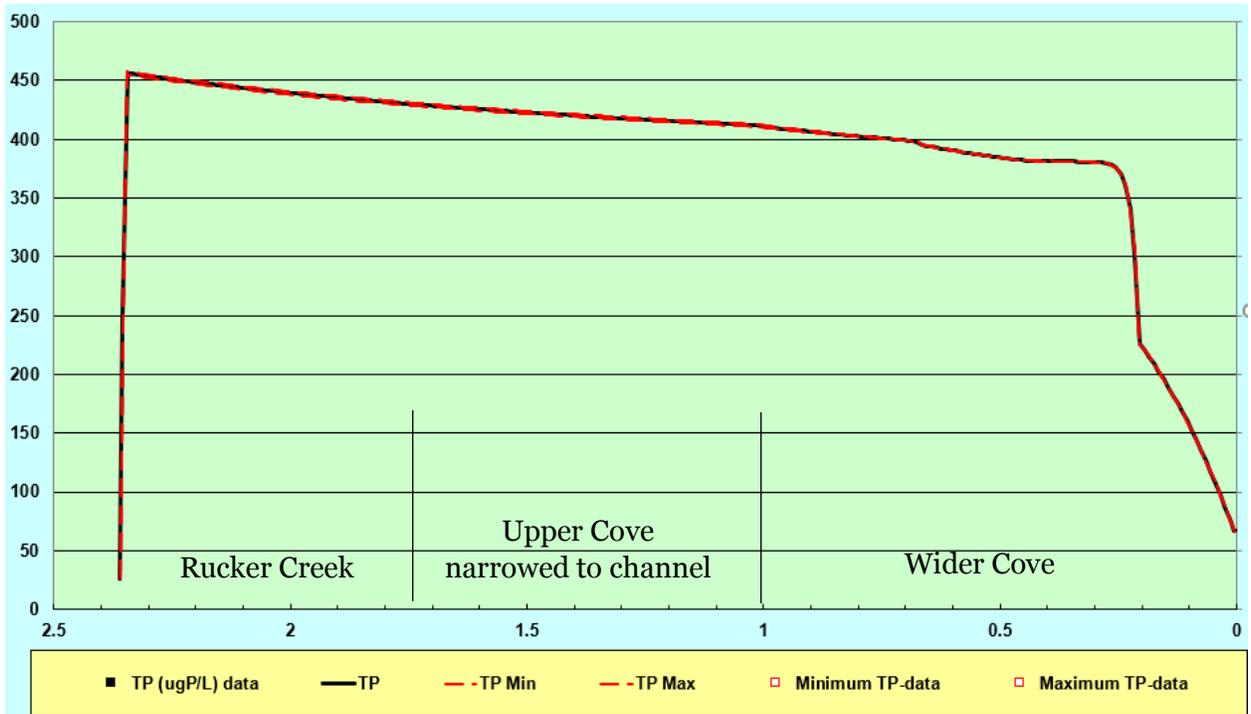
X axis: Distance upstream from cove downstream boundary (km)



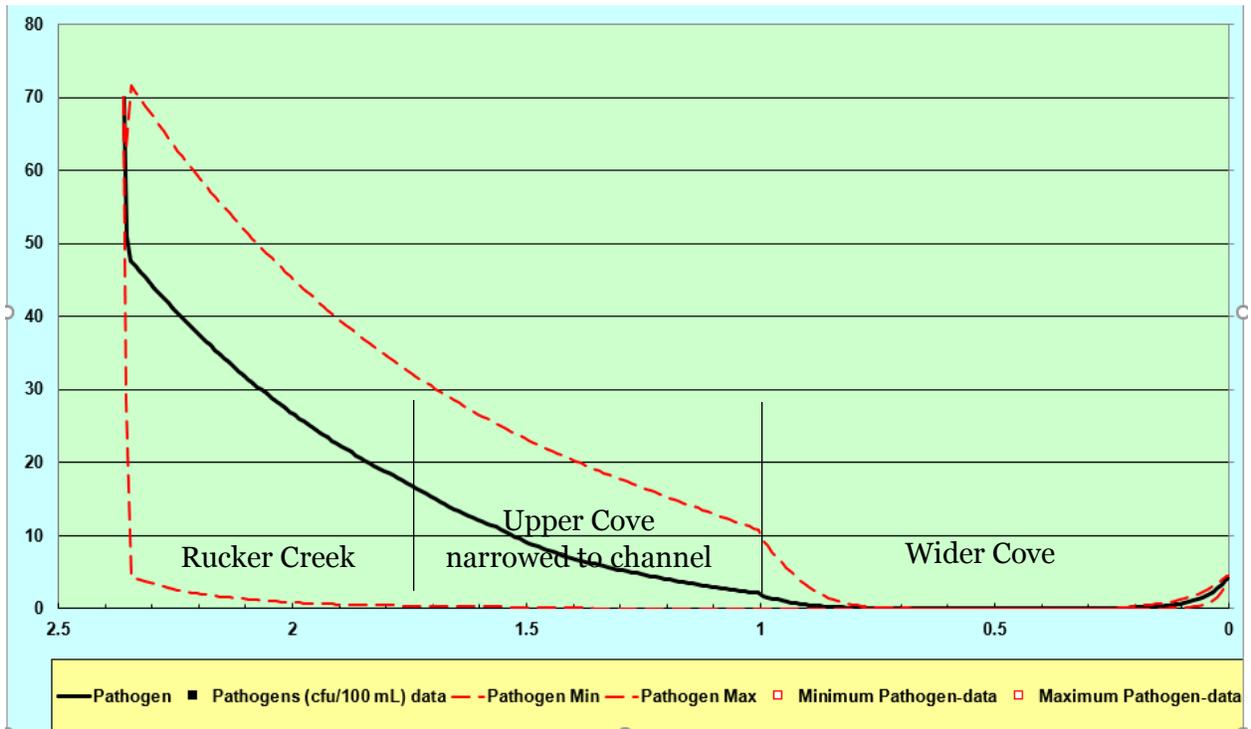
X axis: Distance upstream from cove downstream boundary (km)



X axis: Distance upstream from cove downstream boundary (km)



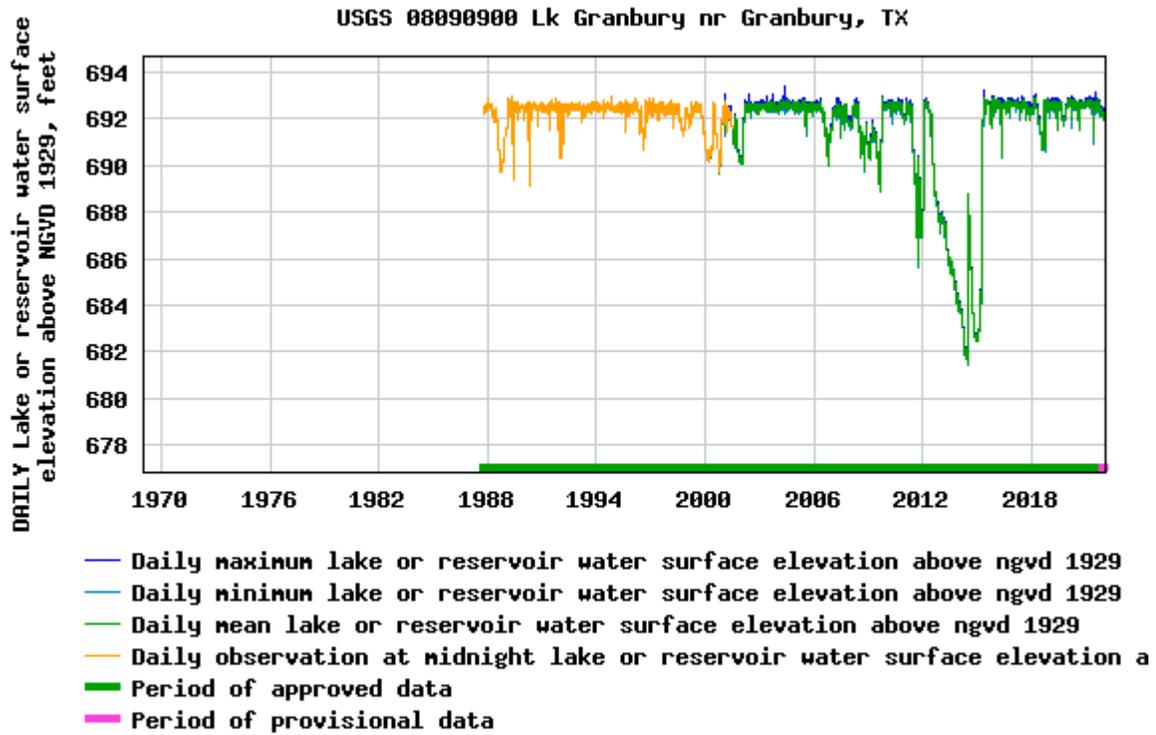
X axis: Distance upstream from cove downstream boundary (km)



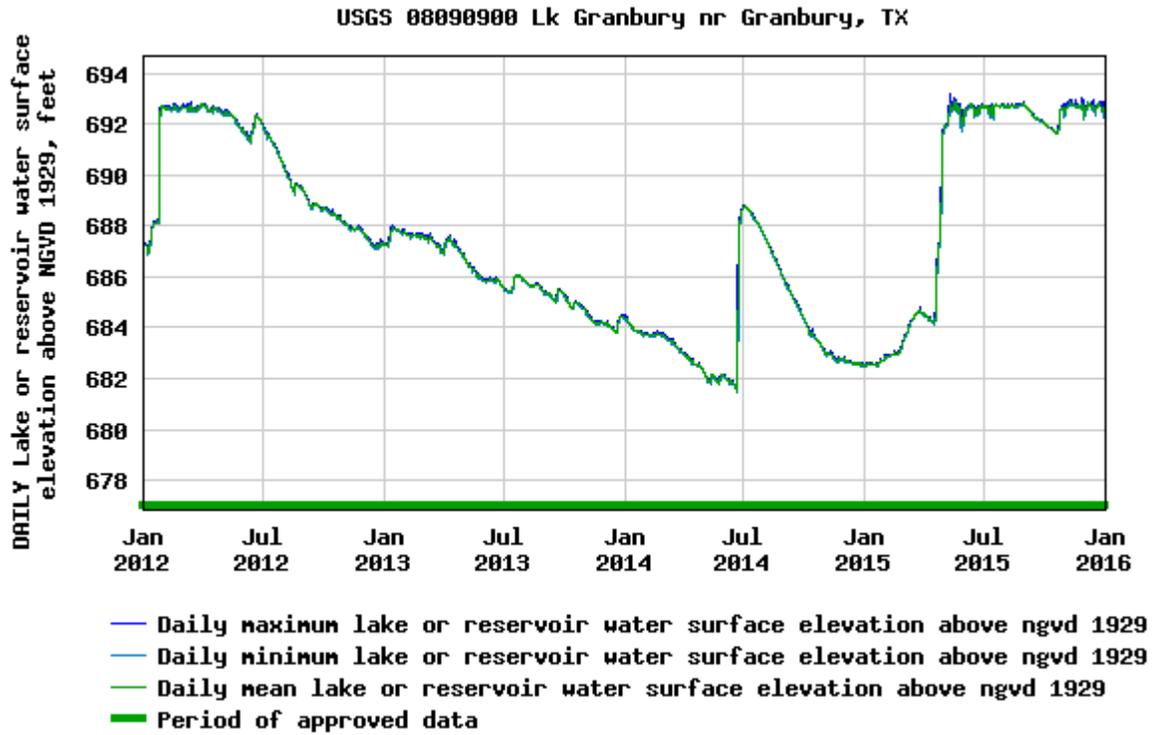
X axis: Distance upstream from cove downstream boundary (km)

COG Exhibit 622 - USGS Observed Lake Levels

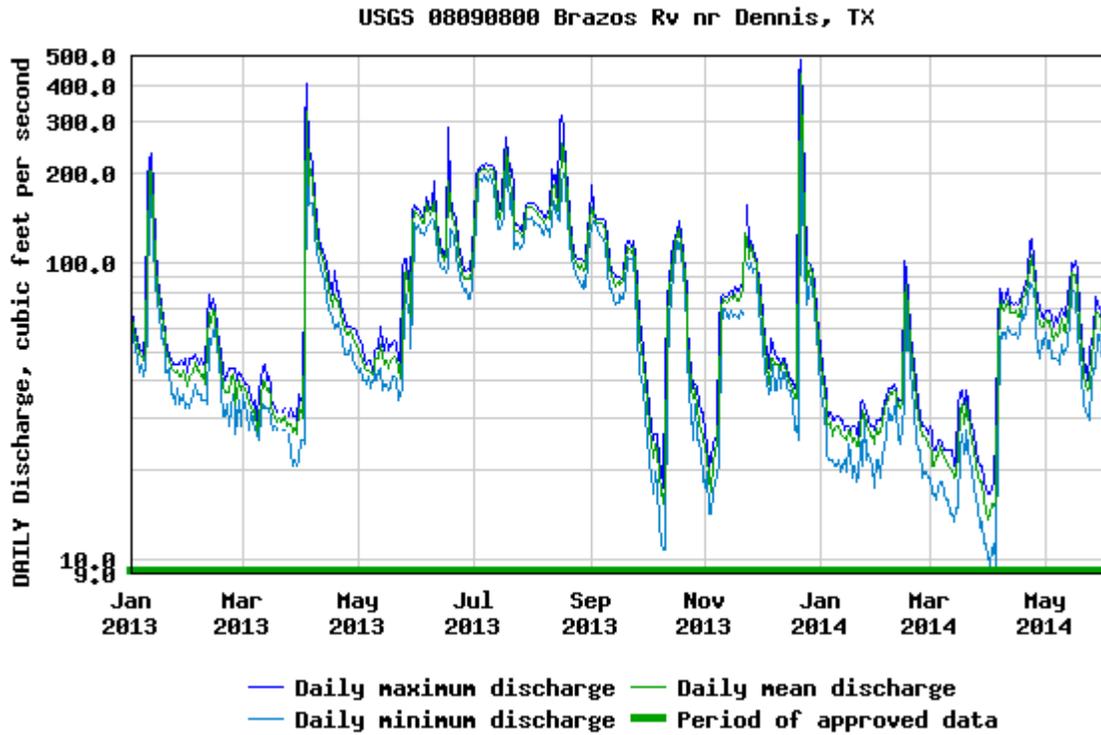
USGS available lake level data at Station 08090900 since completion of the dam, 1969-2022



Lowest recent water levels (2012-2016) – see SUMMER 2013 and SPRING 2014



Flow during low lake level period 2013-2014; TCEQ 7Q2 critical low flow value for 1206 at Dennis is 37cfs



COG Exhibit 623 – Summary plots of observed data in Texas Surface Water Quality Monitoring database for Rucker Creek Segment 1205E and Lake Granbury Segment 1205, 1972-2021

These box and whisker plots are statistical summaries of data reported in TCEQ’s Texas Surface Water Quality Monitoring database.

Values recorded in the database as “<” less than a reporting limit were censored and calculated as one half of the reporting limit value. For example, many nitrate nitrogen values are reported as “< 0.04 mg/L,” and in each case a value of 0.02 mg/L was substituted for the statistical calculation displayed on the box and whisker charts. This is a common practice for values used in modeling assessments where laboratory practices prevent measurement and quantification of substances at low concentrations.

Each box and whisker shows, from top to bottom, 95 percentile (top black whisker), 75 percentile (top of box), average (orange dash line), median (black middle line), 25 percentile (bottom of box), 5 percentile (bottom whisker). Open circles indicate individual data points greater than 95 percentile or less than 5 percentile. The number of observations greater than the maximum display value are counted and reported beneath the plot. For example, on the dissolved oxygen figure, the notation “0 Obs > 25” means that zero observations were greater than 25 mg/L of dissolved oxygen.

