

Plum Creek WPP Implementation Monitoring Update



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Monitoring Parameter List

- Bacteria Parameters = *E. coli*.
- Field Parameters = Dissolved Oxygen, Temperature, Specific Conductance, & pH.
- Conventional Parameters = Total Suspended Solids (TSS), Turbidity, Ammonia, Nitrate, Total Kjelhdahl Nitrogen (TKN), Total Phosphorus, Hardness, Chloride, Sulfate, Chlorophyll-a, & Pheophytin.
- WWTF Parameters = Conventions + Biochemical Oxygen Demand (BOD), Carbonaceous Biochemical Oxygen Demand (CBOD), & Chemical Oxygen Demand (COD).

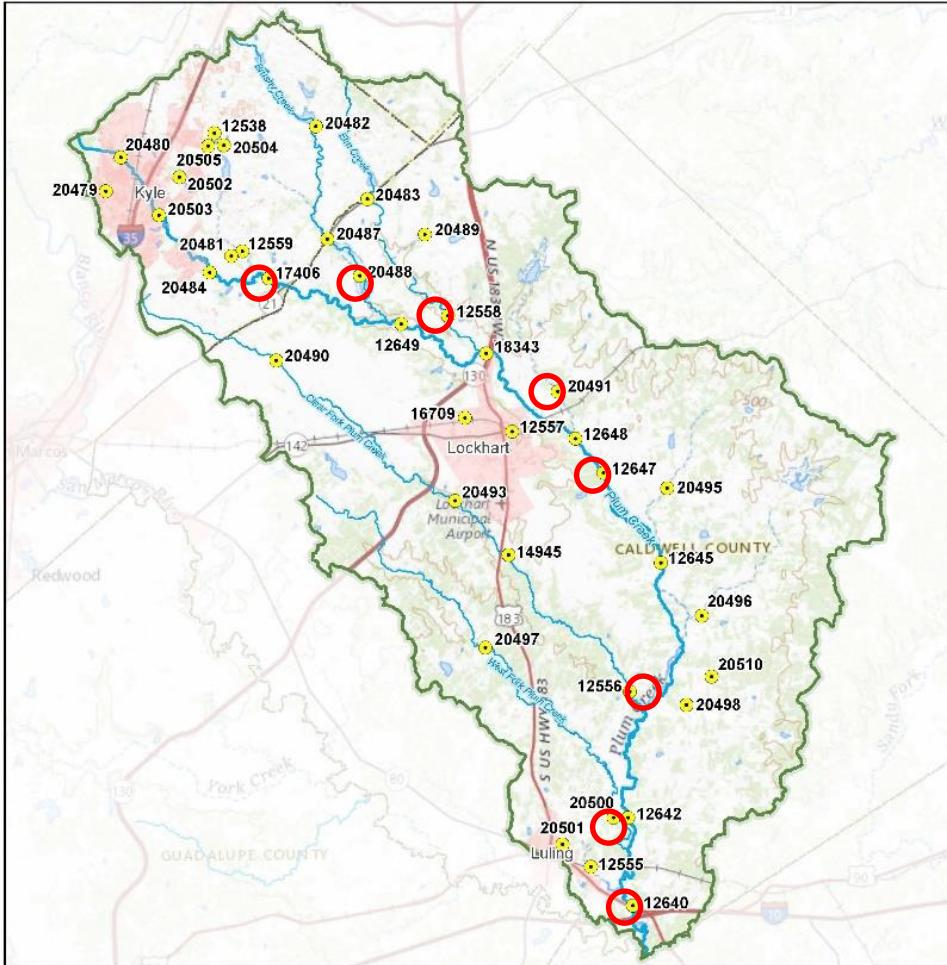


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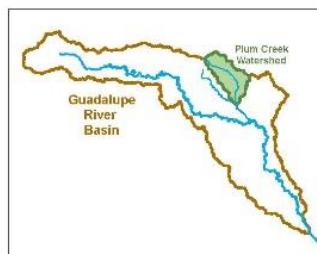
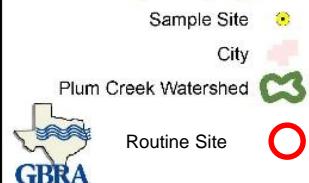
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Routine & Targeted Monitoring Station Map

- 8 Routine Stations Monthly
- 26 Wet and Dry Weather Targeted Stations 2x/Quarter



Plum Creek Watershed
Water Quality Sampling Sites



DISCLAIMER: The data contained in this map is not survey grade and is provided for informational and reference purposes only. GBRA makes no claim or guarantee for the accuracy or validity of the information presented herein.

Date: 24/2/2020



Plum Creek Main Stem *E. coli* & Total Phosphorus Concentrations (02/2008 – 12/2019)

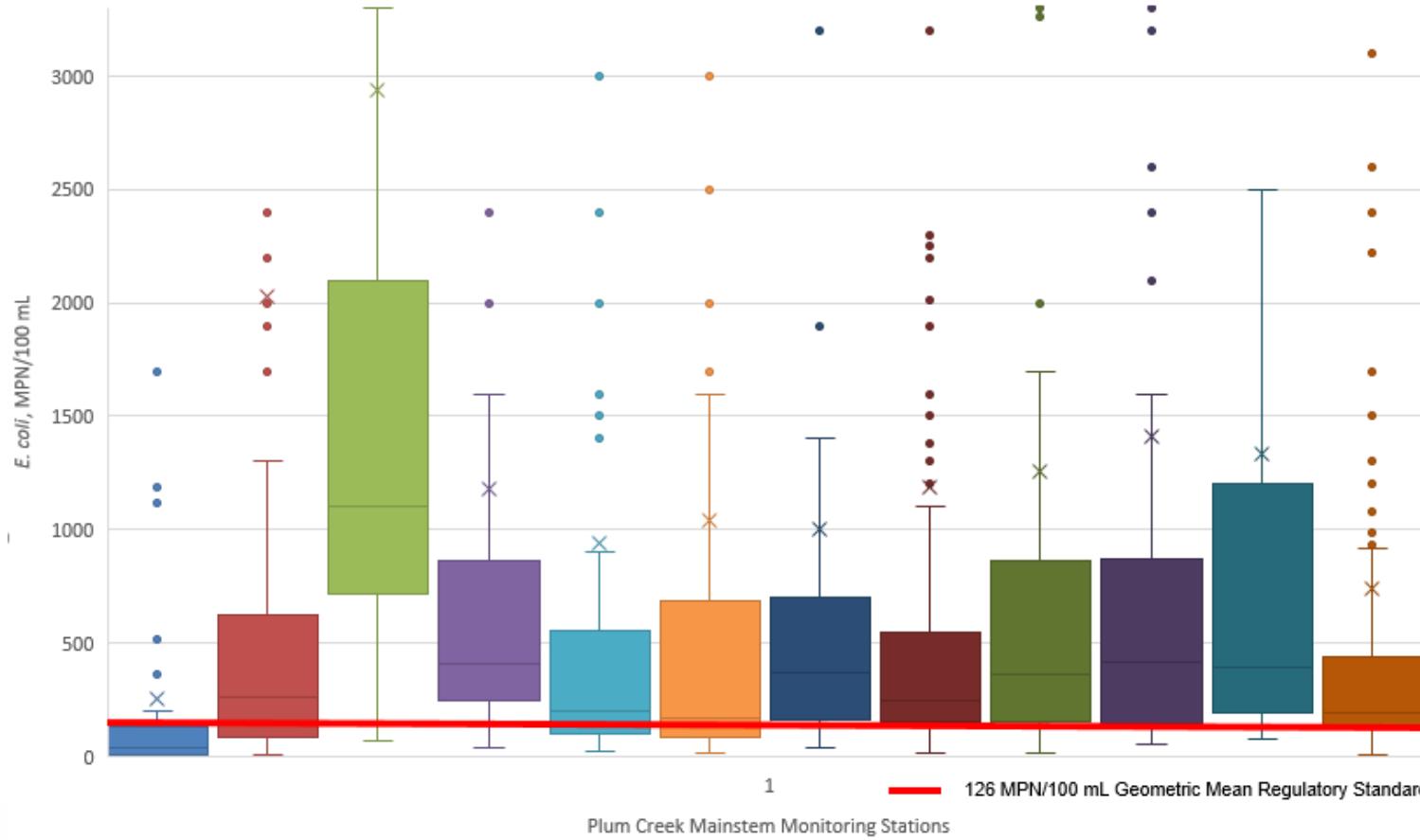
Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	E. coli (MPN/100 mL) Geomean	E. coli (MPN/100 mL) Geomean Wet	E. coli (MPN/100 mL) Geomean Dry	Total P (mg/L) Mean	Total P (mg/L) Mean Wet	Total P (mg/L) Mean Dry
Plum Creek at NRCS #1 (20480)	0.0	0.6	0.0	41	77	17	0.22	0.20	0.25
Plum Creek at Lehman (20503)	0.6	3.7	0.10	255	474	131	0.05	0.07	0.03
Plum Creek at Heidenreich (20484)	4.1	10.0	2.7	1324	1652	1092	2.47	1.69	3.25
Plum Creek at PC Rd (17406)	4.7	23.5	2.2	484	761	379	1.95	0.98	2.47
Plum Creek at CR 233 (12649)	7.4	34.0	2.7	288	643	129	1.47	0.90	2.04
Plum Creek at HWY 183 (18343)	8.0	90.0	3.2	240	643	84	1.18	0.80	1.59
Plum Creek at CR 186 (12648)	7.3	49.0	3.8	389	690	207	0.88	0.72	1.06
Plum Creek at CR 202 (12647)	10.0	54.0	6.3	324	654	210	1.01	0.74	1.18
Plum Creek at CR 197 (12645)	9.5	44.0	5.4	439	819	196	0.93	0.76	1.14
Plum Creek at FM 1322 (12555)	12.5	60.0	6.4	449	1134	168	0.83	0.74	0.93
Plum Creek at CR 131 (12642)	19.0	91.5	7.4	475	1047	205	0.76	0.76	0.76
Plum Creek at CR 135 (12640)	19.0	69.0	10.0	245	616	138	0.71	0.64	0.75

Highlighted stations have an *E. coli* geometric mean concentration greater than the regulatory standard of 126 MPN/100 ml or a Total Phosphorus concentration greater than the regulatory screening criteria of 0.69 mg/L during base flows.



Plum Creek Main Stem *E. coli* Concentrations (02/2008 – 12/2019)

E. coli Concentrations at Plum Creek Mainstem Monitoring Stations (02/2008 - 12/2019)



20480 - Plum Creek at NRCS #1 (Headwaters)	20503 - Plum Creek at Lehman
20484 - Plum Creek at Heidenreich Downstream of Kyle)	17406 - Plum Creek at PC Rd (Downstream of Buda & Kyle)
12649 - Plum Creek at CR 233	18343 - Plum Creek at HWY 183
12648 - Plum Creek at CR 186 (Upstream of Lockhart)	12647 - Plum Creek at CR 202 (Downstream of Lockhart)
12645 - Plum Creek at CR 197	12643 - Plum Creek at FM 1322
12642 - Plum Creek at CR 131 (Upstream of Luling)	12640 - Plum Creek at CR 135 (Downstream of Luling)

Plum Creek Main Stem Nitrate & Ammonia Nitrogen Concentrations (02/2008 – 12/2019)

Monitoring Station	Median Flow (cfs)	Median Flow Wet	Median Flow Dry	NO3-N (mg/L) Mean	NO3-N Mean Wet	NO3-N Mean Dry	NH3-N (mg/L) Mean	NH3-N Mean Wet	NH3-N Mean Dry
Plum Creek at NRCS #1 (20480)	0.0	0.6	0.0	0.51	0.39	0.69	0.25	0.15	0.39
Plum Creek at Lehman (20503)	0.6	3.7	0.10	0.64	0.75	0.52	0.15	0.15	0.14
Plum Creek at Heidenreich (20484)	4.1	10.0	2.7	11.05	9.17	12.93	1.97	1.09	2.82
Plum Creek at PC Rd (17406)	4.7	23.5	2.2	9.70	4.87	12.31	0.92	0.72	1.02
Plum Creek at CR 233 (12649)	7.4	34.0	2.7	5.98	3.39	8.56	0.23	0.24	0.21
Plum Creek at HWY 183 (18343)	8.0	90.0	3.2	3.54	2.12	5.05	0.32	0.44	0.19
Plum Creek at CR 186 (12648)	7.3	49.0	3.8	5.07	2.68	7.69	0.16	0.16	0.16
Plum Creek at CR 202 (12647)	10.0	54.0	6.3	5.31	3.43	6.48	0.18	0.15	0.19
Plum Creek at CR 197 (12645)	9.5	44.0	5.4	3.75	2.86	4.87	0.17	0.15	0.21
Plum Creek at FM 1322 (12555)	12.5	60.0	6.4	3.16	2.27	4.13	0.16	0.16	0.15
Plum Creek at CR 131 (12642)	19.0	91.5	7.4	2.46	2.20	2.74	0.18	0.19	0.18
Plum Creek at CR 135 (12640)	19.0	69.0	10.0	2.34	2.31	2.35	0.17	0.17	0.18

Highlighted stations have a Nitrate Nitrogen concentration greater than the regulatory screening criteria of 1.95 mg/L or an Ammonia Nitrogen concentration greater than the regulatory screening criteria of 0.33 mg/L during base flows.



Plum Creek Targeted Station *E. coli* & Total Phosphorus Concentrations (02/2008 – 12/2019)

Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	E. coli (MPN/100mL) Geomean	E. coli Geomean Wet	E. coli Geomean Dry	Total P (mg/L) Mean	Total P Mean Wet	Total P Mean Dry
Unnamed at FM 150 (20479)	0.30	0.60	0.25	316	338	267	0.05	0.05	0.05
Andrew's at CR 131 (12538)	1.30	1.90	1.05	324	511	202	0.23	0.18	0.28
Richmond at Dacy (20505)	0.10	0.40	0.01	380	645	220	0.08	0.07	0.09
Unnamed at Quail Cove (20504)	0.03	0.06	0.01	552	858	39	0.12	0.13	0.03
Porter at Dairy Lane (12559)	1.70	5.00	1.10	454	816	211	0.11	0.14	0.08
Cowpen at Schuelke (20489)	2.40	2.60	0.00	1151	1268	820	0.25	0.25	0.25
Bunton at Dacy (20502)	0.35	2.40	0.04	144	386	52	0.08	0.10	0.07
Bunton at Heidenreich (20481)	1.05	6.40	0.40	321	486	165	0.07	0.08	0.04
Brushy at FM 2001 (20482)	0.08	0.08	0.05	98	234	15	0.12	0.12	0.11
Brushy at SH21 (20487)	0.80	6.80	0.01	244	766	57	0.11	0.13	0.07
Brushy Creek at Rocky Rd (20488)	0.01	0.10	0.00	210	785	83	0.12	0.14	0.11
Elm Creek at SH 21 (20483)	0.02	0.10	0.01	194	377	40	0.11	0.11	0.09
Elm Creek at CR 233 (12558)	0.00	0.50	0.00	158	645	51	0.17	0.19	0.15
Clear Fork at Farmers Rd (20490)	0.02	0.02	0.04	59	88	35	0.10	0.11	0.08
Clear Fork at PR10 (20493)	1.80	3.55	1.20	167	368	74	0.09	0.13	0.04
Clear Fork at Old Luling Rd (14945)	1.60	4.70	0.90	157	304	79	0.10	0.15	0.05

Highlighted stations have an *E. coli* geometric mean concentration greater than the regulatory standard of 126 MPN/100 ml or a Total Phosphorus concentration greater than the regulatory screening criteria of 0.69 mg/L during base flows.



Plum Creek Targeted Station *E. coli* & Total Phosphorus Concentrations (02/2008 – 12/2019)

Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	E. coli (MPN/100mL) Geomean	E. coli Geomean Wet	E. coli Geomean Dry	Total P (mg/L) Mean	Total P Mean Wet	Total P Mean Dry
Town Branch at Stueve Ln (16709)	0.00	0.00	0.00	498	445	2400	0.67	0.70	0.30
Town Branch at E. Market St (12557)	1.40	1.55	0.84	566	960	312	0.09	0.14	0.04
Dry Creek at FM 672 (20491)	0.20	0.85	0.00	551	1059	160	0.29	0.31	0.26
Dry Creek at FM 713 (20495)	0.50	1.10	0.00	963	1554	354	0.23	0.25	0.18
Tenney Creek at Tenney Crk Rd (20496)	4.00	4.70	0.15	845	1044	112	0.34	0.35	0.24
Hines Branch at Tenney Crk Rd (20510)	0.00	0.00	0.00	350	487	68	0.27	0.29	0.18
Copperas at Tenney Crk Rd (20498)	0.06	0.20	0.01	730	1011	366	0.78	1.01	0.30
West Fork at FM 671 (20497)	0.05	0.15	0.01	448	616	135	0.15	0.17	0.07
West Fork at Biggs Rd (20500)	0.01	0.02	0.01	134	418	58	0.41	0.37	0.44
Salt Branch at Salt Flat Rd (20501)	0.01	0.06	0.00	847	1140	566	0.33	0.26	0.44
Salt Branch at FM 1322 (12555)	0.30	0.70	0.20	343	602	185	2.61	1.49	3.85

Highlighted stations have an *E. coli* geometric mean concentration greater than the regulatory standard of 126 MPN/100 ml or a Total Phosphorus concentration greater than the regulatory screening criteria of 0.69 mg/L during base flows.

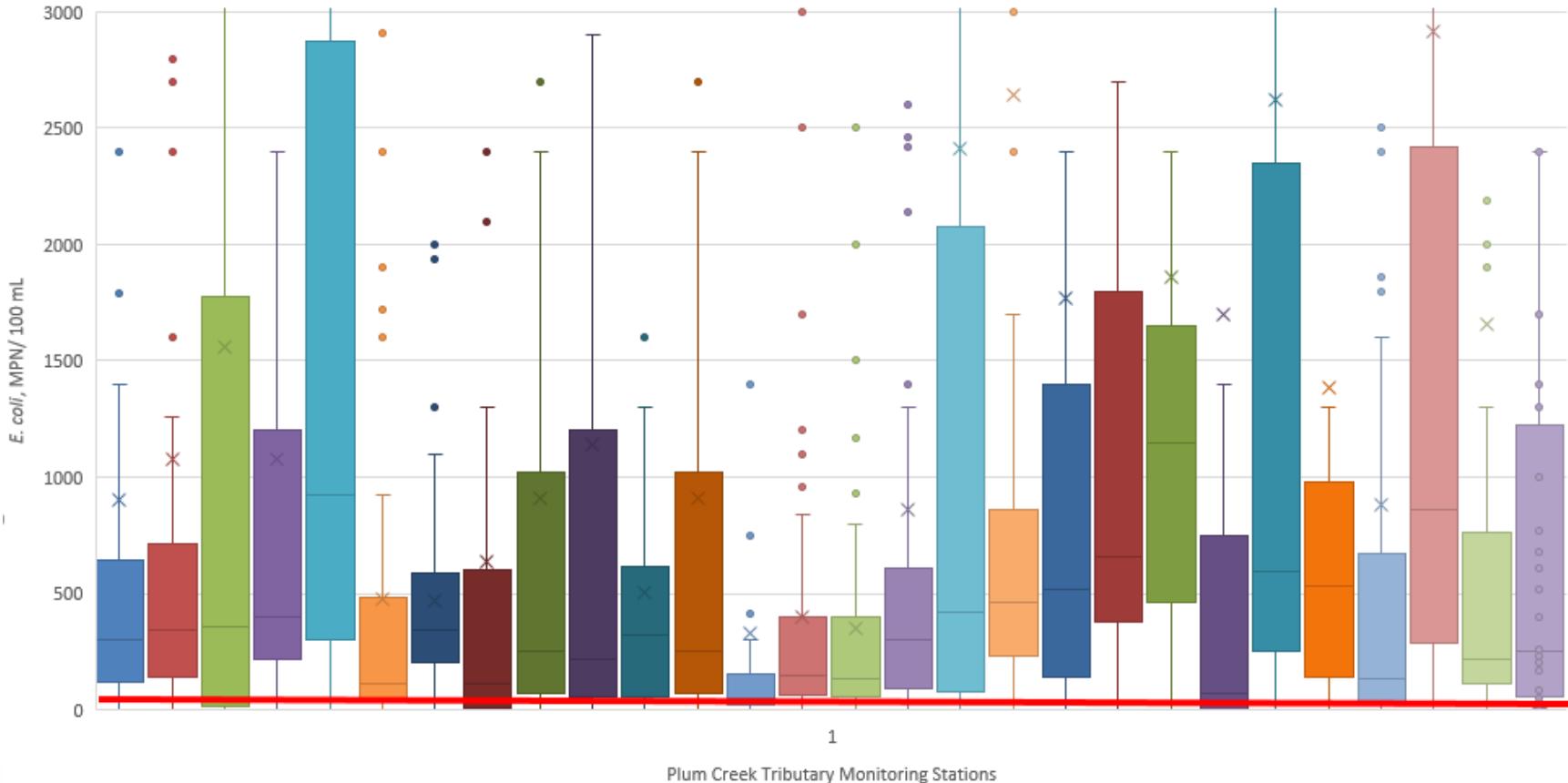


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Plum Creek Tributary *E. coli* Concentrations (02/2008 – 12/2019)

E. coli Concentrations at Plum Creek Tributary Monitoring Stations (02/2008 - 12/2019)



- Andrew's at CR 131
- Cowpen at Schuelke
- Brushy at SH21
- Clear Fork at Farmers Rd
- Town Branch at Stueve Ln
- Tenney Creek at Tenney Crk Rd
- West Fork at Biggs Rd
- Richmond at Dacy
- Bunton at Dacy
- Clear Fork at PR10
- Town Branch at E. Market St
- Hines Branch at Tenney Crk Rd
- Salt Branch at Salt Flat Rd
- Unnamed at Quail Cove
- Bunton at Heidenreich
- Elm Creek at SH 21
- Dry Creek at FM 672
- Copperas at Tenney Crk Rd
- Porter at Dairy Lane
- Brushy at FM 2001
- Elm Creek at CR 233
- Clear Fork at Salt Flat Rd
- Dry Creek at FM 713
- West Fork at FM 671
- Unnamed at FM 150
- Salt Branch at FM 1322
- Unnamed at FM 1322

Plum Creek Targeted Station Nitrate & Ammonia Nitrogen Concentrations (02/2008 – 12/2019)

Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	NO3-N Mean (mg/L)	NO3-N Mean Wet	NO3-N Mean Dry	NH3-N Mean (mg/L)	NH3-N Mean Wet	NH3-N Mean Dry
Unnamed at FM 150 (20479)	0.30	0.60	0.25	1.36	1.57	0.85	0.17	0.18	0.16
Andrew's at CR 131 (12538)	1.30	1.90	1.05	10.57	7.28	13.96	0.19	0.19	0.20
Richmond at Dacy (20505)	0.10	0.40	0.01	0.63	0.93	0.30	0.30	0.16	0.45
Unnamed at Quail Cove (20504)	0.03	0.06	0.01	0.35	0.40	0.06	0.16	0.17	0.10
Porter at Dairy Lane (12559)	1.70	5.00	1.10	0.83	0.70	1.02	0.20	0.18	0.22
Cowpen at Schuelke (20489)	2.40	2.60	0.00	0.51	0.60	0.17	0.25	0.28	0.12
Bunton at Dacy (20502)	0.35	2.40	0.04	0.36	0.50	0.21	0.17	0.16	0.17
Bunton at Heidenreich (20481)	1.05	6.40	0.40	3.51	0.60	8.17	0.16	0.16	0.17
Brushy at FM 2001 (20482)	0.08	0.08	0.05	0.31	0.39	0.11	0.15	0.17	0.13
Brushy at SH21 (20487)	0.80	6.80	0.01	0.43	0.56	0.21	0.18	0.14	0.22
Brushy Creek at Rocky Rd (20488)	0.01	0.10	0.00	0.29	0.44	0.19	0.19	0.16	0.21
Elm Creek at SH 21 (20483)	0.02	0.10	0.01	0.28	0.34	0.15	0.14	0.16	0.10
Elm Creek at CR 233 (12558)	0.00	0.50	0.00	0.23	0.38	0.11	0.19	0.18	0.20
Clear Fork at Farmers Rd (20490)	0.02	0.02	0.04	5.64	4.51	7.16	0.14	0.16	0.12
Clear Fork at PR10 (20493)	1.80	3.55	1.20	3.74	2.86	4.64	0.18	0.16	0.21
Clear Fork at Old Luling Rd (14945)	1.60	4.70	0.90	2.58	1.98	3.20	0.17	0.18	0.17
Clear Fork at Salt Flat Rd (12556)	2.90	6.65	1.30	1.47	1.57	1.41	0.17	0.15	0.18

Highlighted stations have a Nitrate Nitrogen concentration greater than the regulatory screening criteria of 1.95 mg/L, or an Ammonia Nitrogen concentration greater than the regulatory screening criteria of 0.33 mg/L during base flows.



Plum Creek Targeted Station Nitrate & Ammonia Nitrogen Concentrations (02/2008 – 12/2019) - Continued

Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	NO3-N Mean (mg/L)	NO3-N Mean Wet	NO3-N Mean Dry	NH3-N Mean (mg/L)	NH3-N Mean Wet	NH3-N Mean Dry
Town Branch at Stueve Ln (16709)	0.00	0.00	0.00	1.67	1.22	8.03	0.29	0.29	0.26
Town Branch at E. Market St (12557)	1.40	1.55	0.84	11.07	10.19	12.06	0.18	0.17	0.19
Dry Creek at FM 672 (20491)	0.20	0.85	0.00	0.37	0.49	0.16	0.21	0.20	0.24
Dry Creek at FM 713 (20495)	0.50	1.10	0.00	0.31	0.31	0.32	0.19	0.18	0.19
Tenney Creek at Tenney Crk Rd (20496)	4.00	4.70	0.15	0.31	0.33	0.17	0.14	0.14	0.16
Hines Branch at Tenney Crk Rd (20510)	0.00	0.00	0.00	0.51	0.60	0.05	0.23	0.23	0.24
Copperas at Tenney Crk Rd (20498)	0.06	0.20	0.01	0.26	0.34	0.09	0.90	1.12	0.32
West Fork at FM 671 (20497)	0.05	0.15	0.01	0.28	0.34	0.05	0.16	0.14	0.22
West Fork at Biggs Rd (20500)	0.01	0.02	0.01	0.27	0.26	0.28	0.18	0.18	0.19
Salt Branch at Salt Flat Rd (20501)	0.01	0.06	0.00	0.24	0.19	0.31	0.71	0.21	1.38
Salt Branch at FM 1322 (12555)	0.30	0.70	0.20	10.68	5.14	16.75	0.37	0.33	0.41

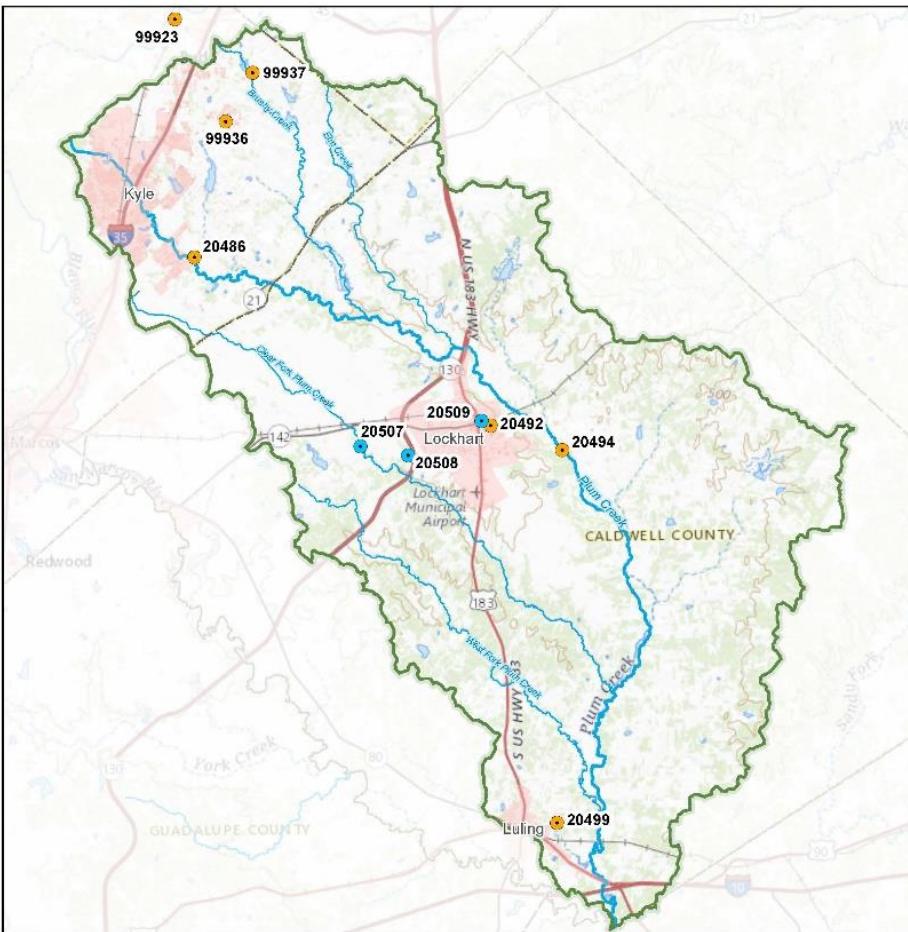
Highlighted stations have a Nitrate Nitrogen concentration greater than the regulatory screening criteria of 1.95 mg/L, or an Ammonia Nitrogen concentration greater than the regulatory screening criteria of 0.33 mg/L during base flows.



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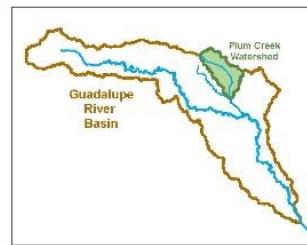
Plum Creek WWTF & Spring Monitoring



- 7 Wastewater Treatment Facilities Monthly
- 3 Seasonal Spring Stations 1x/Quarter



Plum Creek Watershed
Water Quality Sampling Sites
● Spring Sample Site
● WWTF Sample Site
City 
Plum Creek Watershed 



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Date: 2/10/2020



Plum Creek Wastewater Treatment Facility Bacteria & Wastewater Parameter Concentrations (02/2008 – 12/2019)

Station	Median Flow (CFS)	Geometric Mean E. coli (MPN/100 mL)	Mean TSS (mg/L)	Mean Dissolved Oxygen (mg/L)	Mean Total Phosphorus (mg/L)	Mean Nitrate Nitrogen (mg/L)	Mean Ammonia Nitrogen (mg/L)	Mean BOD (mg/L)	Mean CBOD (mg/L)
Stream Screening Criteria	NA	126	NA	5	0.69	1.95	0.33	5	5
Buda WWTF (9923)	1.6	2.3	1	8.2	0.39	15.50	0.38	1.6	1.3
Kyle WWTF (20486)	3	69.2	11	7.9	3.63	19.67	1.94	4.1	4.1
Sunfield WWTF (99937)	0.1	1.4	1	8.6	0.54	39.49	0.21	1.5	1.5
Shadow Creek WWTF (99936)	0.2	2.9	1	7.8	0.52	14.71	0.85	1.5	1.4
Lockhart #2 WWTF (20494)	1.5	12.8	5	8.4	2.59	6.67	0.49	1.6	1.8
Lockhart #1 WWTF (20492)	0.7	2.3	3	8.2	2.97	17.22	0.62	2.0	2.2
Luling North WWTF (20499)	0.3	2.6	11	8.1	4.33	29.86	0.46	2.1	2.5

Highlighted stations have nutrient mean concentrations greater than stream regulatory screening criteria of 0.69 mg/L for Total Phosphorus, 1.95 mg/L for Nitrate Nitrogen, and 0.33 mg/L for Ammonia Nitrogen.



Seasonal Spring Station Bacteria & Conventional Concentrations (02/2008 – 12/2019)

Station	Median Flow (CFS)	Geometric Mean E. coli (MPN/100 mL)	Mean TSS (mg/L)	Mean Dissolved Oxygen (mg/L)	Mean Total Phosphorus (mg/L)	Mean Nitrate Nitrogen (mg/L)	Mean Ammonia Nitrogen (mg/L)
Stream Screening Criteria	NA	126	NA	5	0.69	1.95	0.33
Boggy Creek Springs at Boggy Creek Road (20508)	0.3	208	8.1	7.6	0.05	6.90	0.23
Clear Fork Springs at Borchert Loop (20507)	1.0	281	9.5	8.7	0.04	7.13	0.14
Lockhart Springs	0.9	272	2.6	9.1	0.05	11.59	0.15

Highlighted stations have an *E. coli* geometric mean concentration greater than the regulatory standard of 126 MPN/100 ml or a Nitrate Nitrogen concentration greater than the regulatory screening criteria of 1.95 mg/L during base flows.



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Statistical Trend Analysis

- Performed Linear Regression at all Routine Monitoring Stations.
- Model acceptance criteria:
 - t statistic >2 (size of effect)
 - p value <0.05 (95% probability of change over time effect)
- Observations:
 - All routine stations analyzed had >100 data points except Elm Creek & Dry Creek.
 - Stream flow is increasing throughout the watershed.

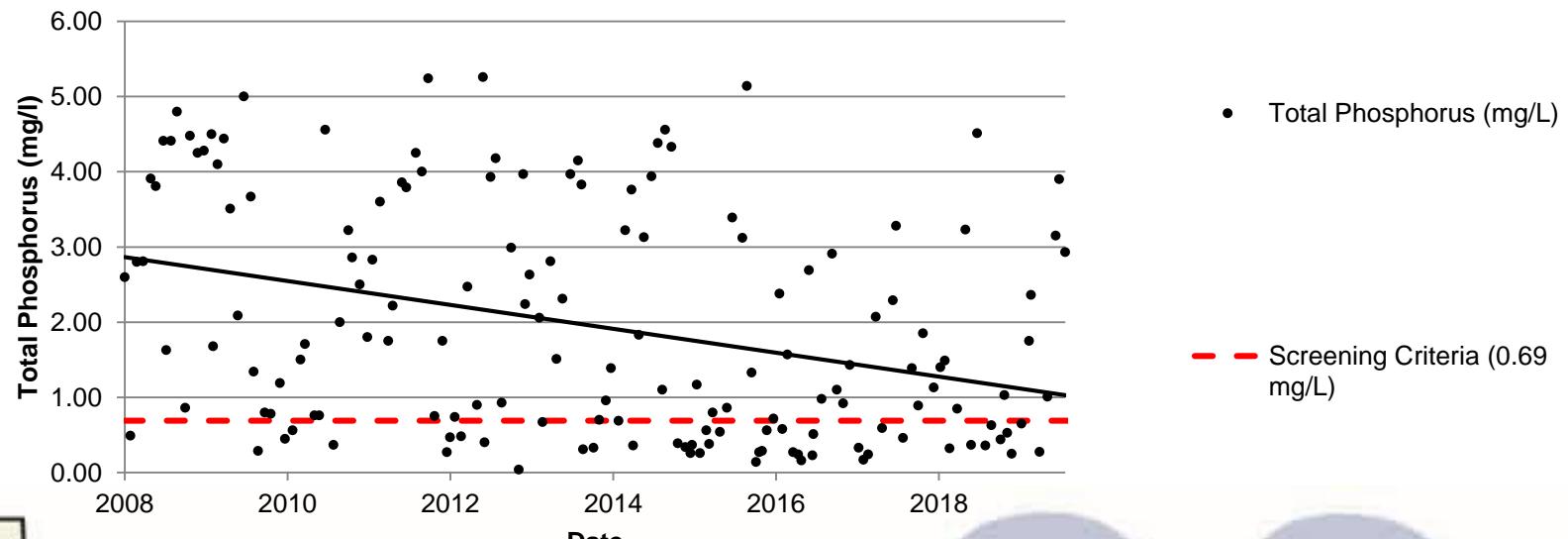


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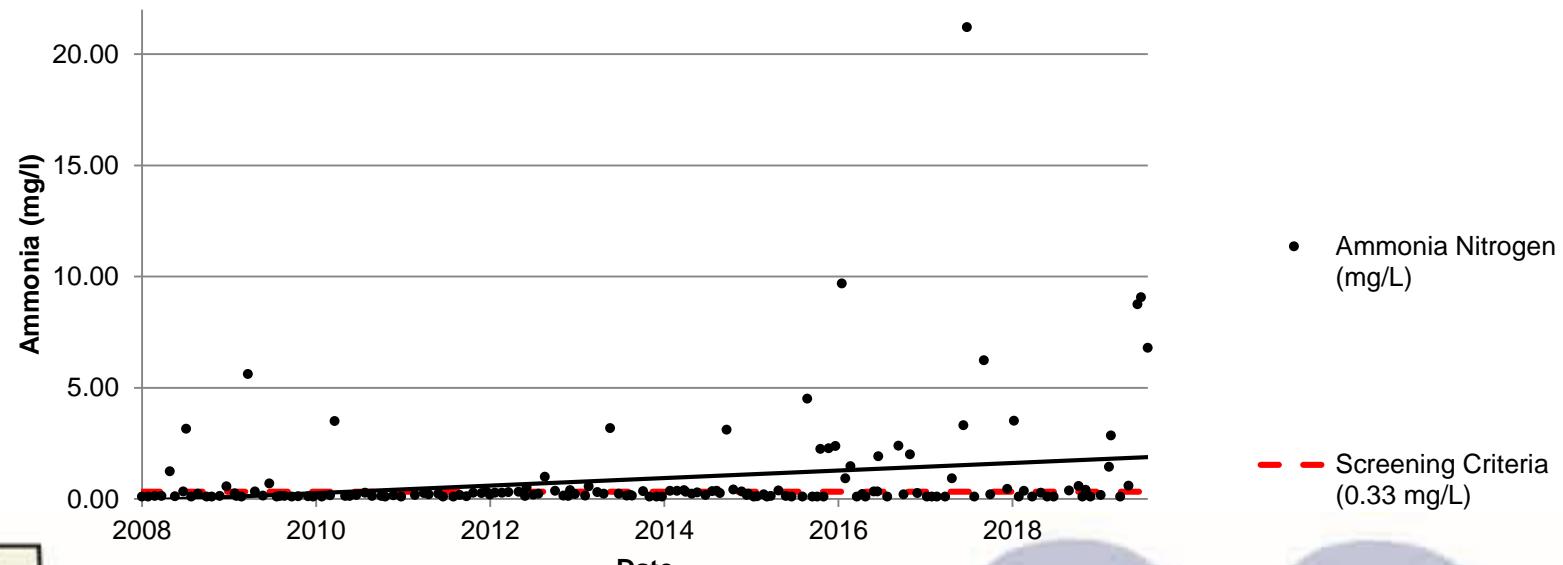
Decreasing Total Phosphorus Trend at Plum Creek at Plum Creek Road (Uhland)

Total Phosphorus (mg/L) Versus Time at Station 17406 - Plum Creek at Plum Creek Road



Increasing Ammonia Nitrogen Trend at Plum Creek at Plum Creek Road (Uhland)

Ammonia Nitrogen (mg/L) Versus Time at Station 17406 - Plum Creek at Plum Creek Road

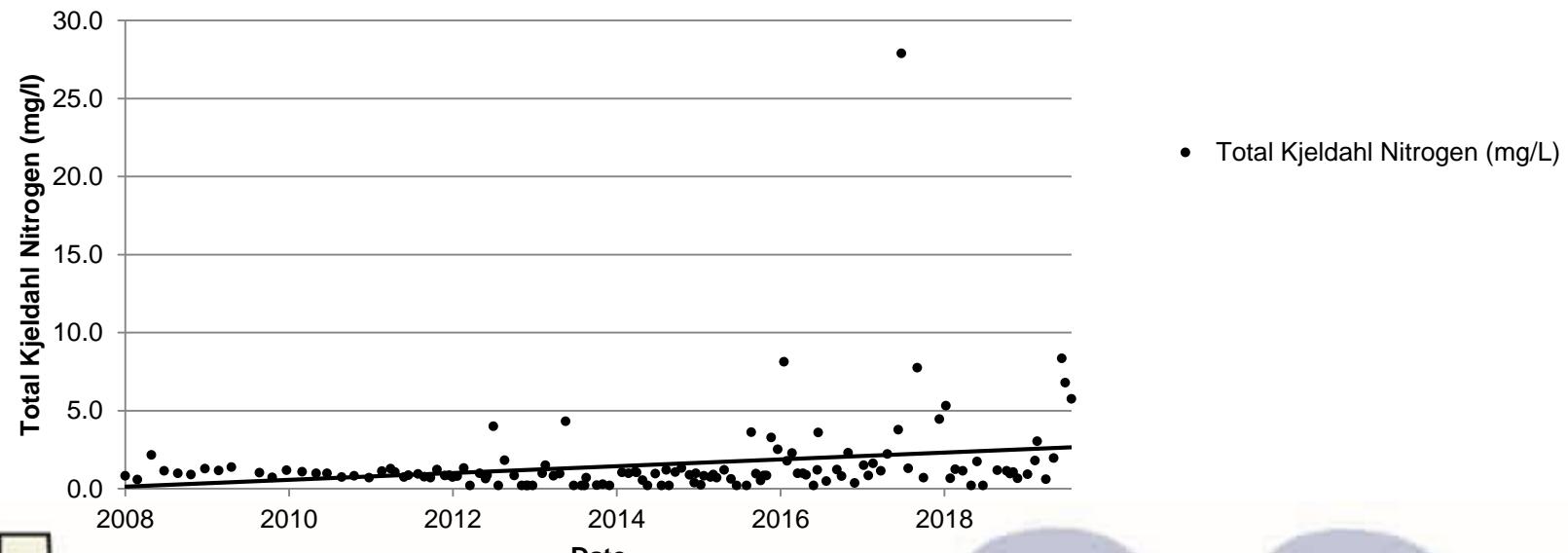


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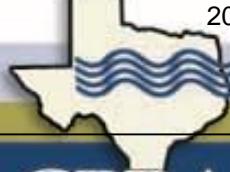
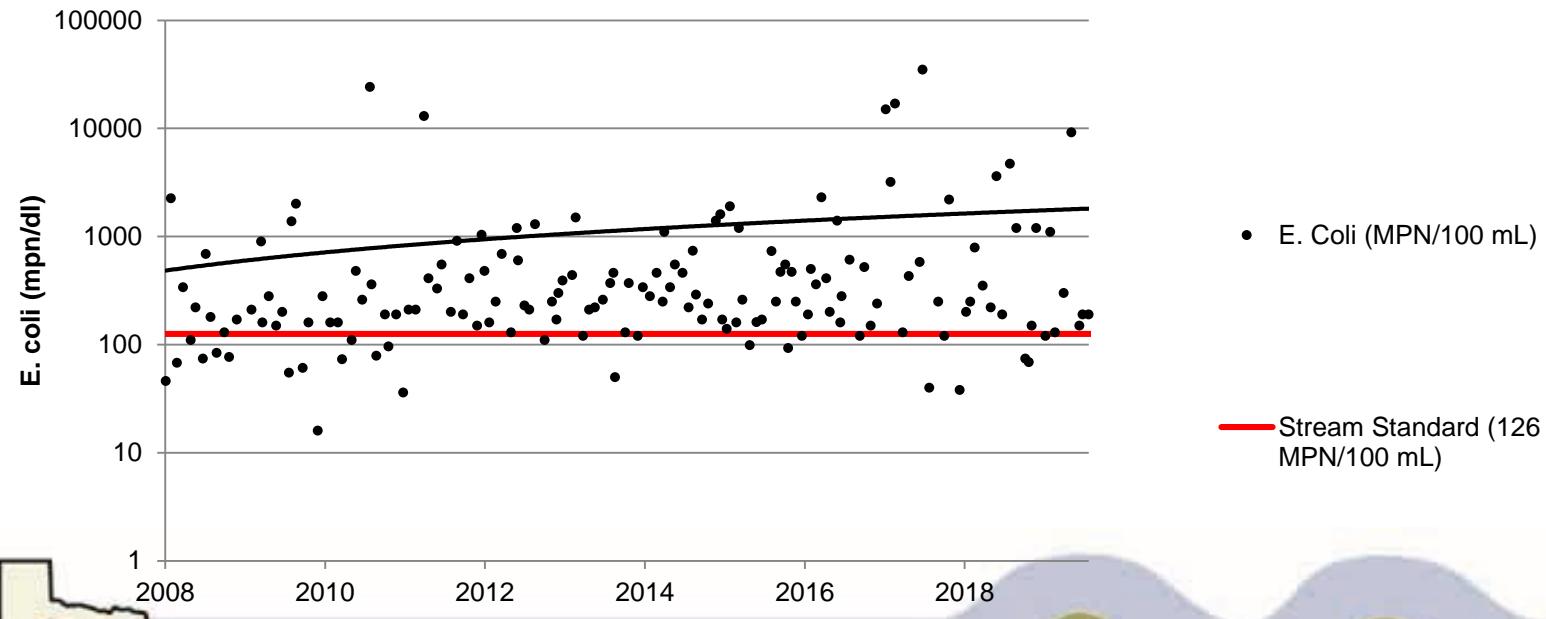
Increasing TKN Trend at Plum Creek at Plum Creek Road (Uhland)

Total Kjeldahl Nitrogen (mg/L) Versus Times at Station 17406 - Plum Creek at Plum Creek Road



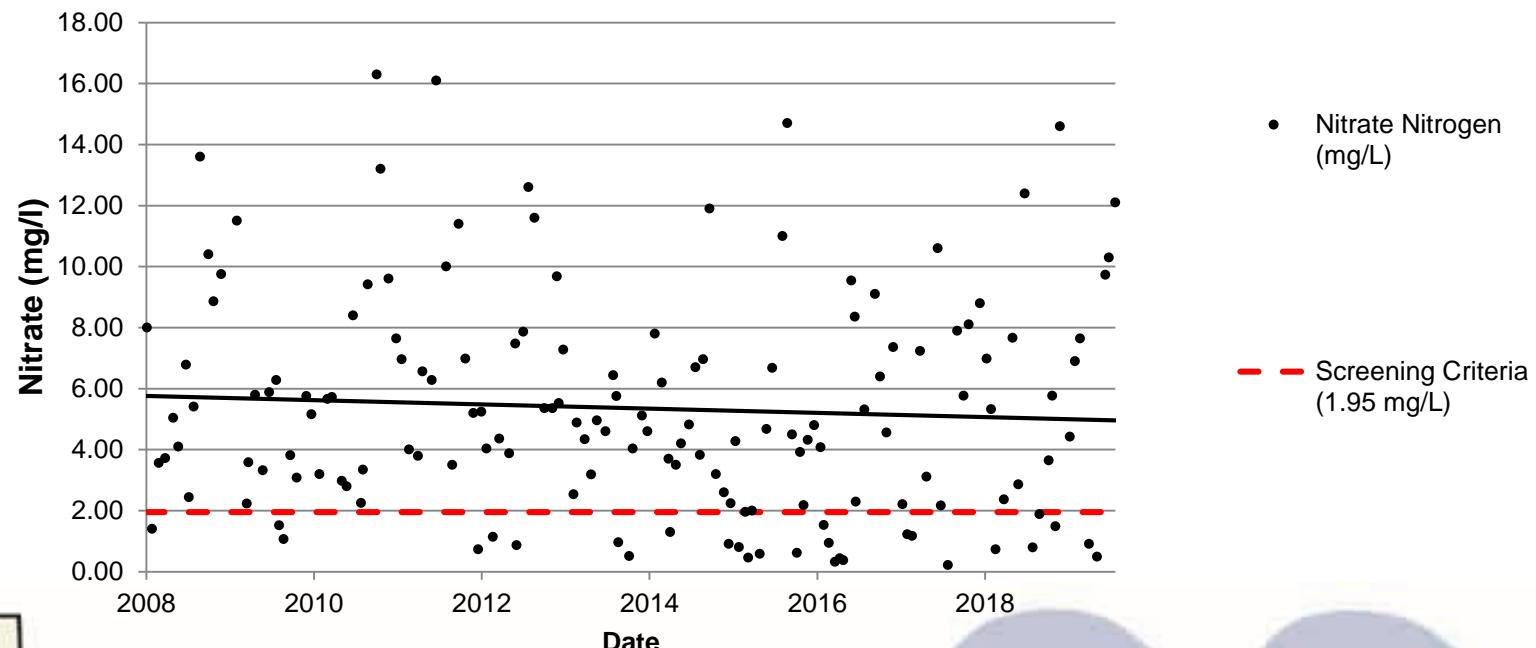
Increasing Log of *E. coli* Trend at Plum Creek at CR 202 (Lockhart)

Log of E. Coli (MPN/100 mL) Versus Time at Station 12647 Plum Creek at CR 202



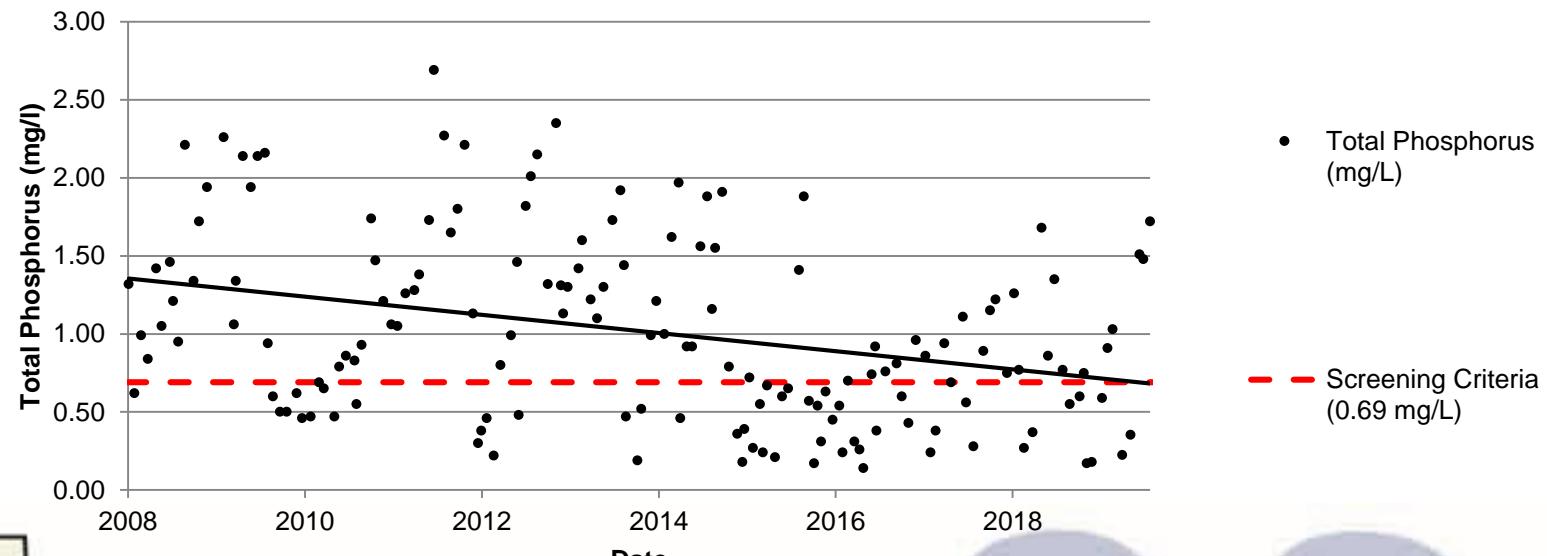
Decreasing Nitrate Nitrogen Trend at Plum Creek at CR 202 (Lockhart)

Nitrate Nitrogen (mg/L) Versus Time at Station 12647 - Plum Creek at CR 202



Decreasing Total Phosphorus Trend at Plum Creek at CR 202 (Lockhart)

Total Phosphorus (mg/L) Versus Time at Station 12647 - Plum Creek at CR 202

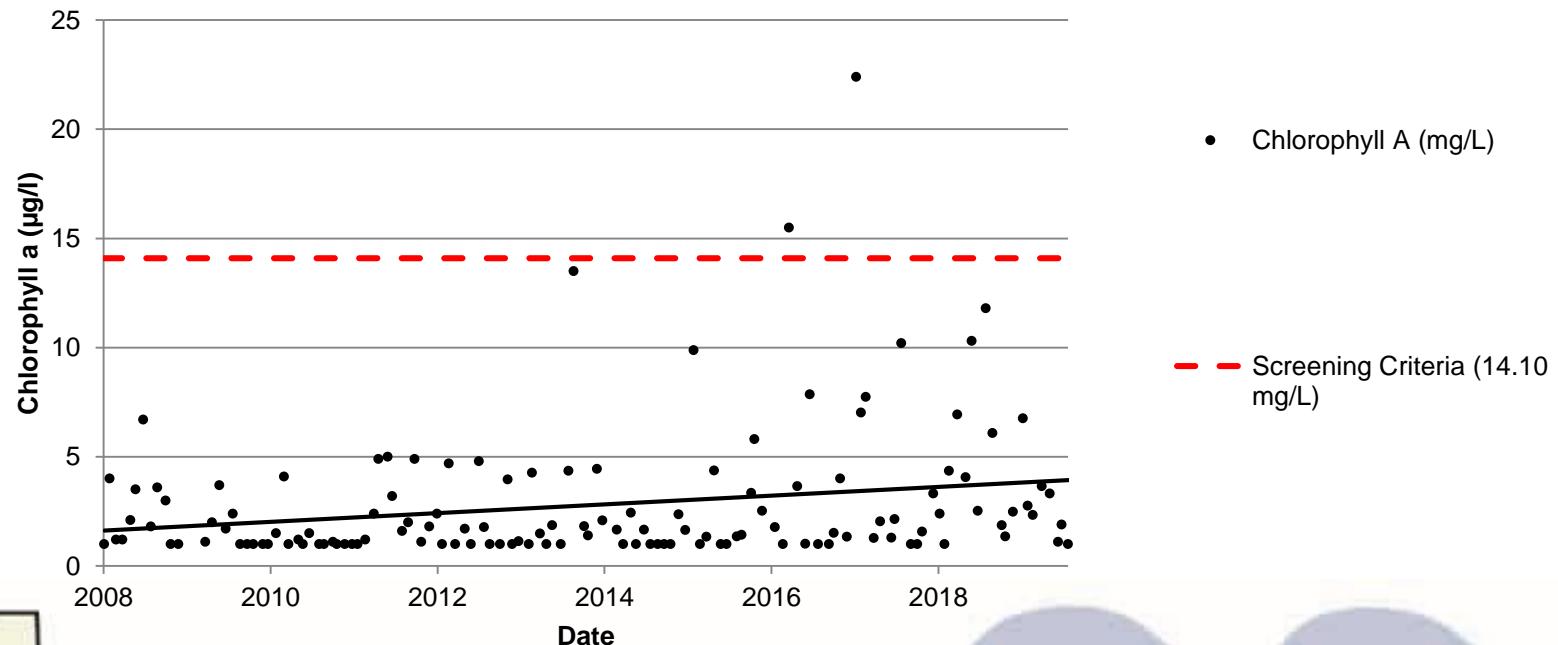


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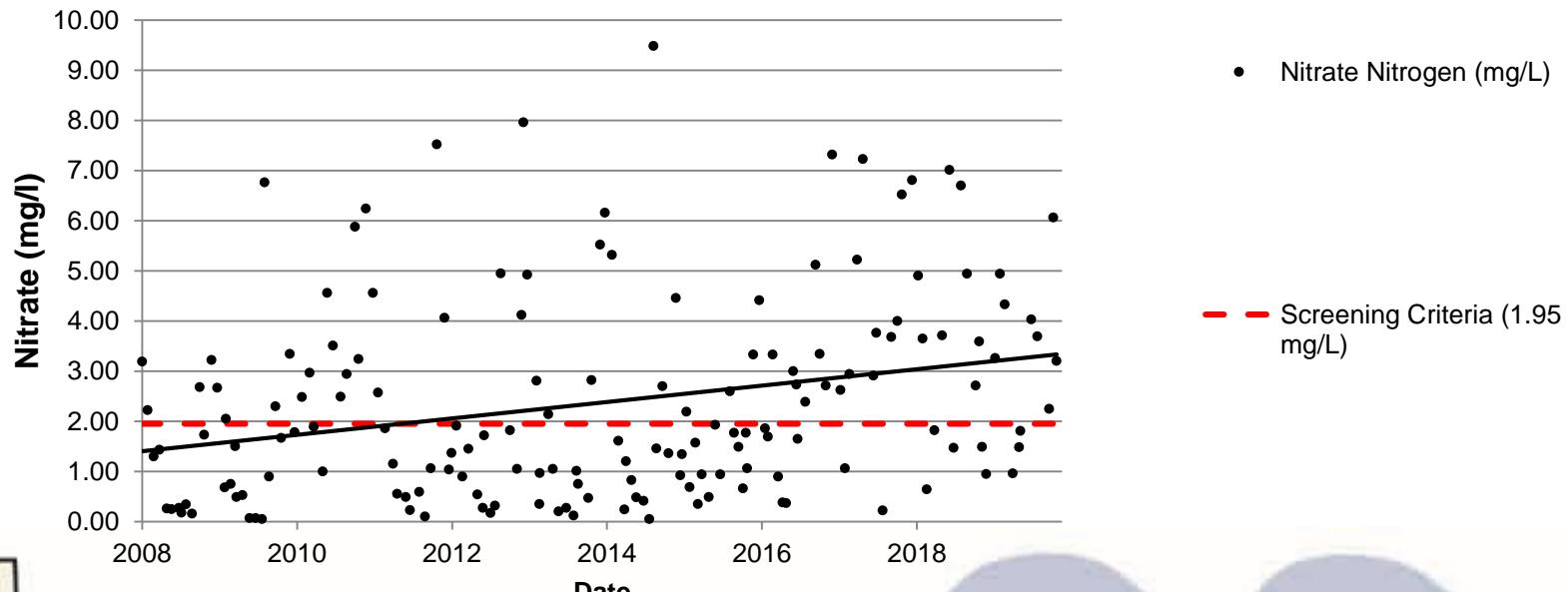
Increasing Chlorophyll-a Trend at Plum Creek at CR 202 (Lockhart)

Chlorophyll a ($\mu\text{g/L}$) Versus Time at Station 12647- Plum Creek at CR 202



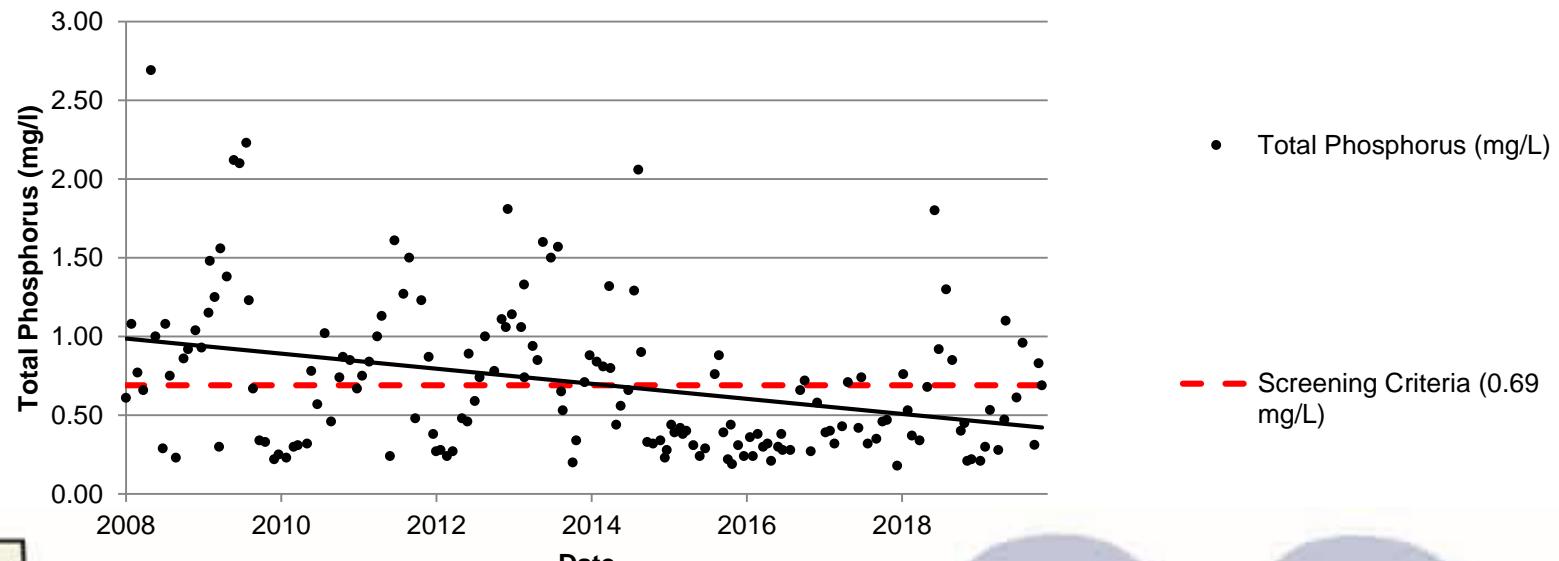
Increasing Nitrate Nitrogen Trend at Plum Creek at CR 135 (Luling)

Nitrate Nitrogen (mg/L) Versus Time at Station 12640 - Plum Creek at CR 135



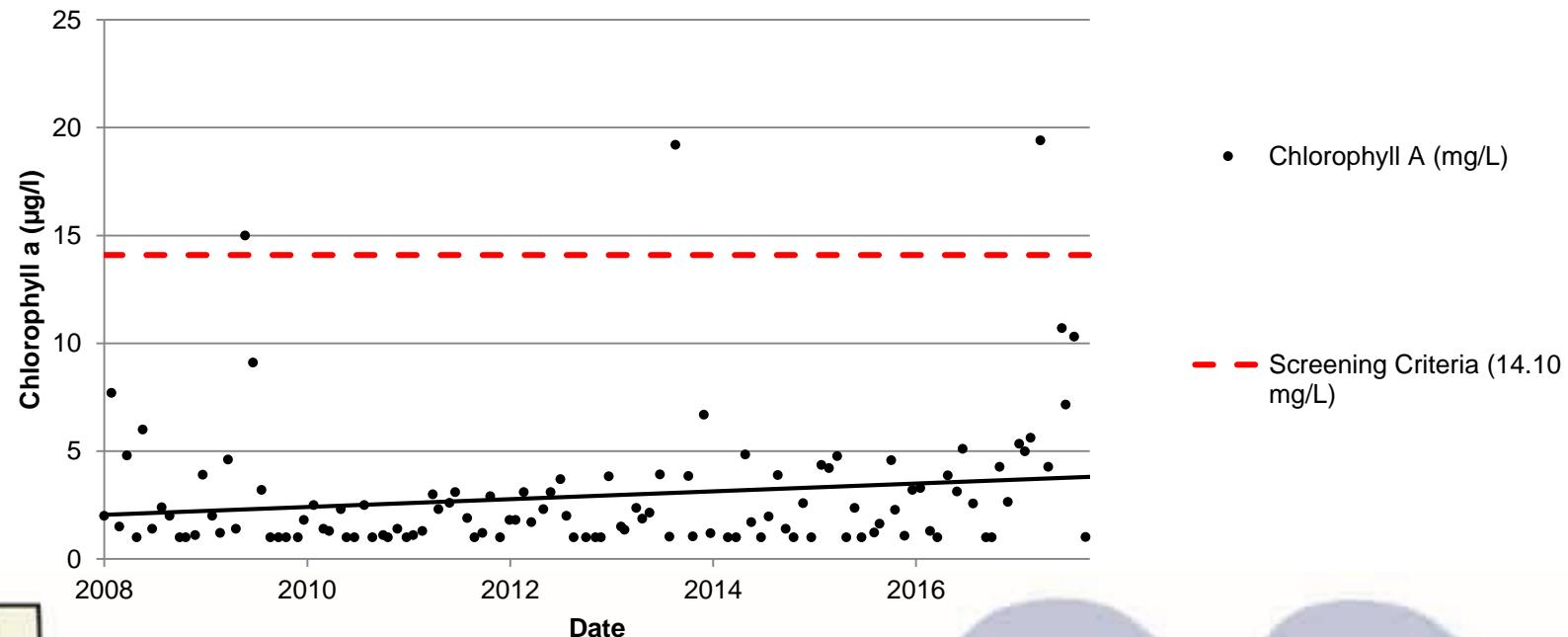
Decreasing Total Phosphorus Trend at Plum Creek at CR 135 (Luling)

Total Phosphorus (mg/L) Versus Time at Station 12640 - Plum Creek at CR 135

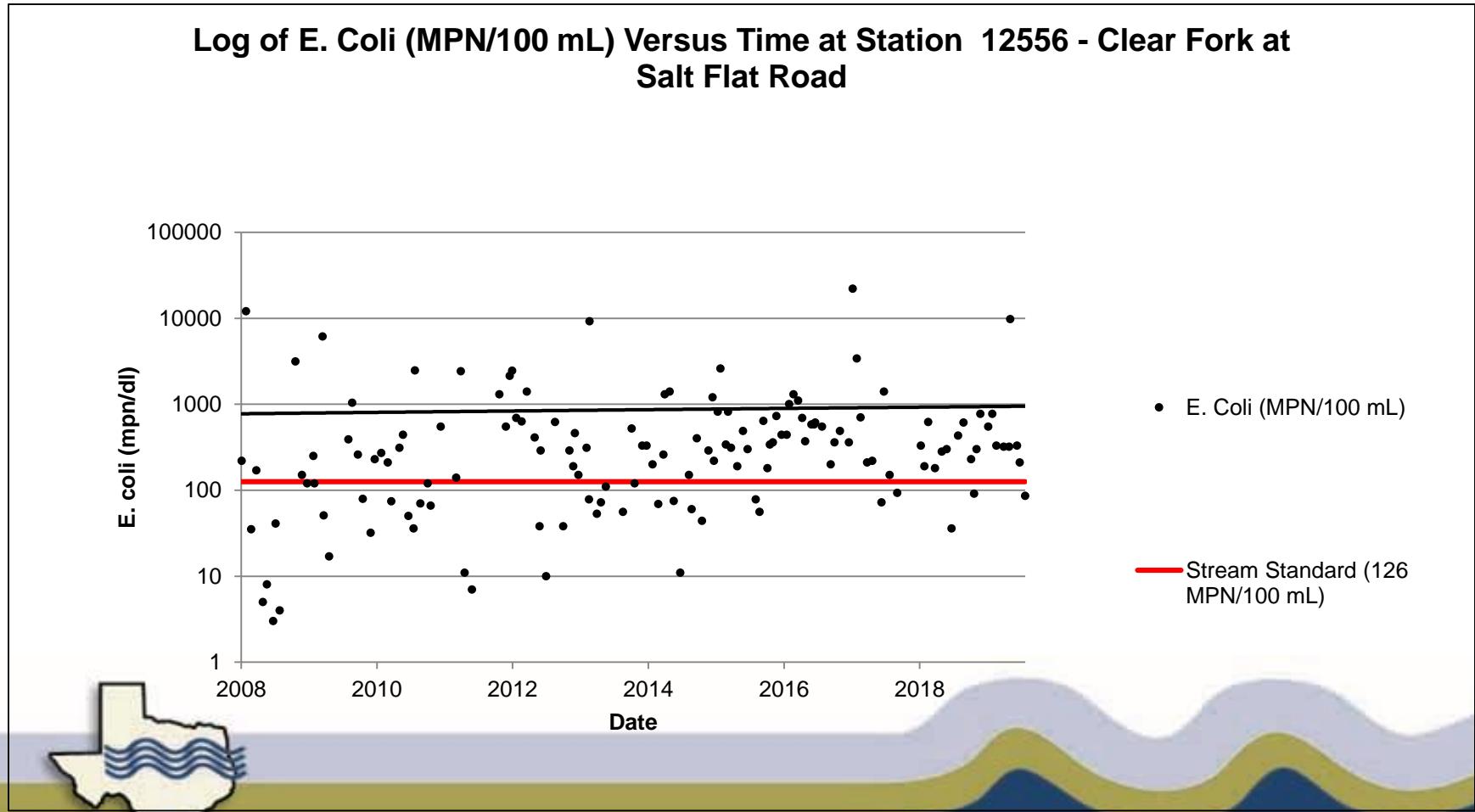


Increasing Chlorophyll-a Trend at Plum Creek at CR 135

Chlorophyll a ($\mu\text{g/L}$) Versus Time at Station 12640 - Plum Creek at CR 135



Increasing Log of *E. coli* Trend at Clear Fork at Salt Flat Road (Luling)



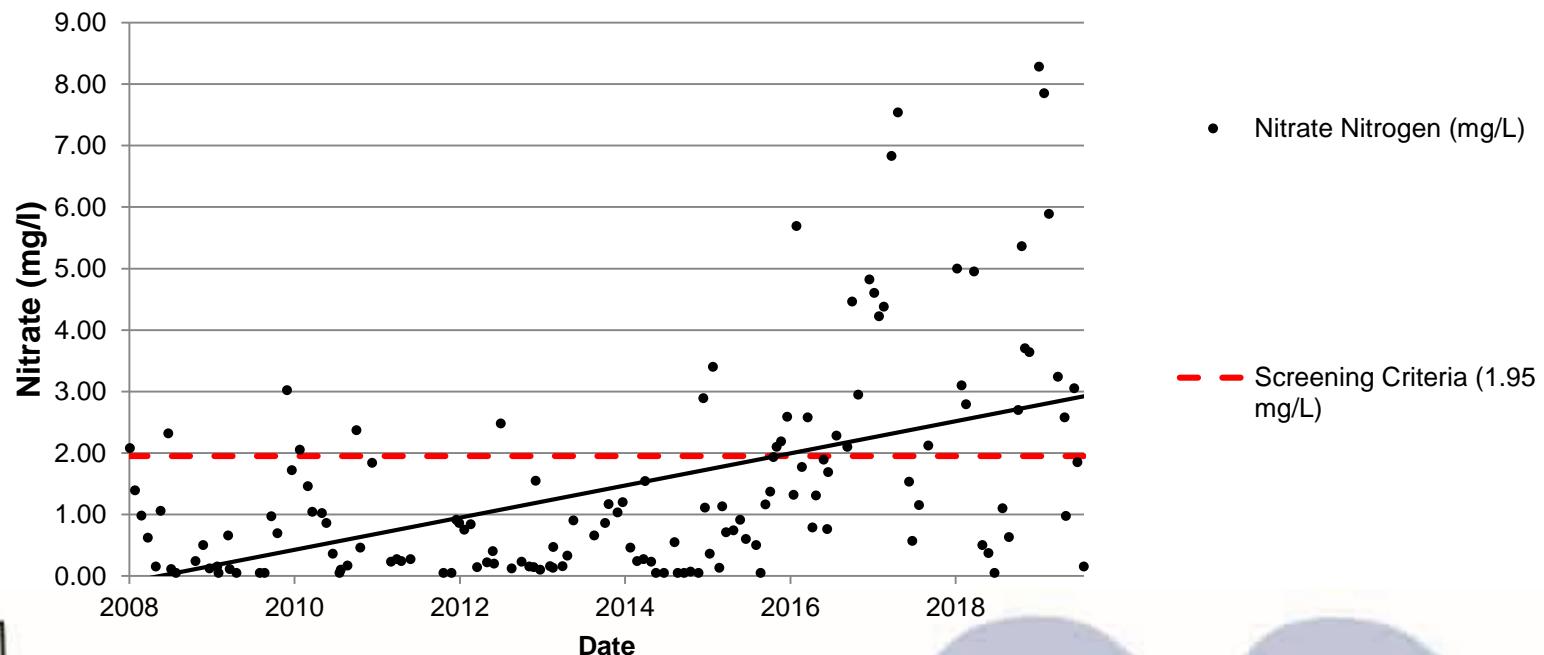
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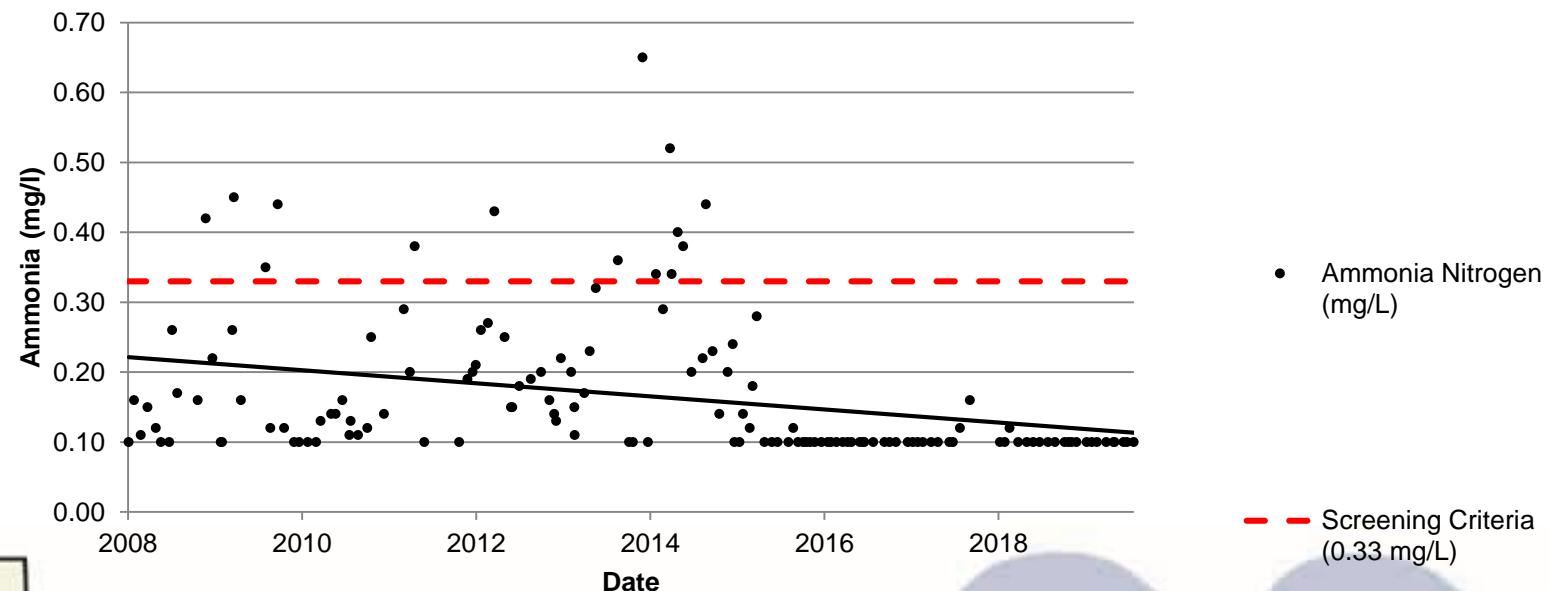
Increasing Nitrate Nitrogen Trend at Clear Fork at Salt Flat Road (Luling)

Nitrate Nitrogen (mg/L) Versus Time at Station 12556 - Clear Fork at Salt Flat Road



Decreasing Ammonia Nitrogen Trend at Clear Fork at Salt Flat Road (Luling)

Ammonia Nitrogen (mg/L) Versus Time at Station 12556 - Clear Fork at Salt Flat Road

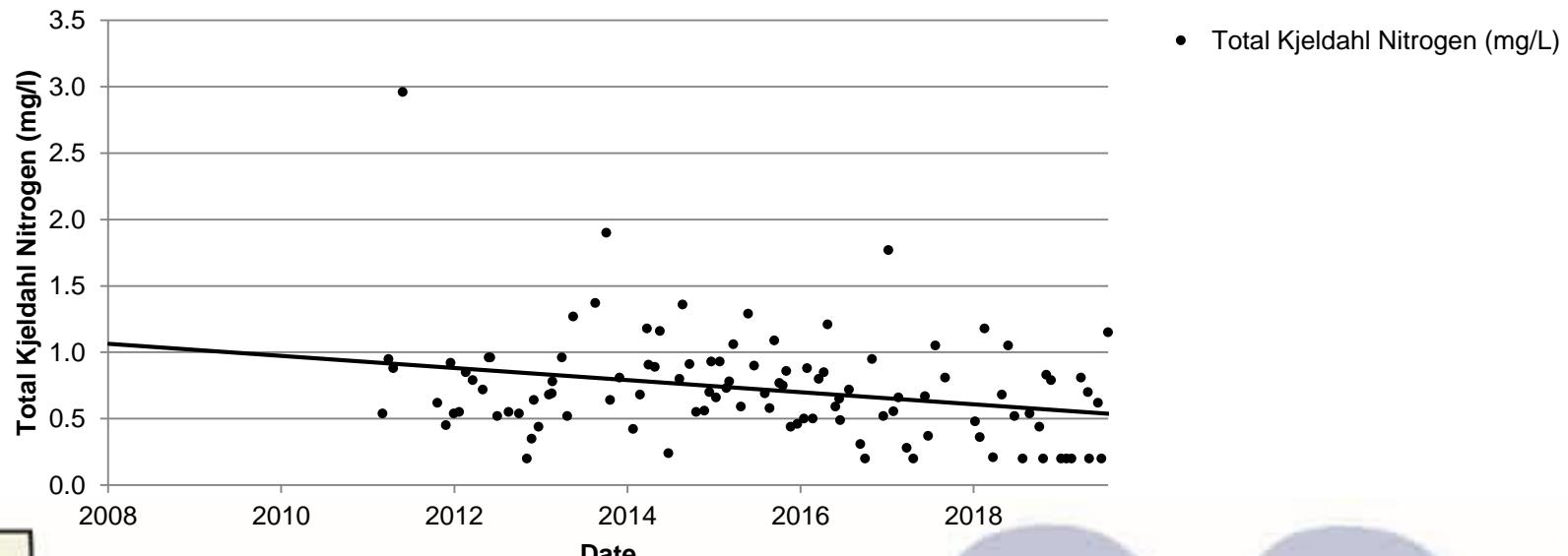


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Decreasing TKN Trend at Clear Fork at Salt Flat Road (Luling)

Total Kheldahl Nitrogen (mg/L) Versus Times at Station 12556 - Clear Fork at Salt Flat Road



QUESTIONS?



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