Conservation Effectiveness Partnership: Floras Creek Technical Summary

The Conservation Effectiveness Partnership (CEP) has a mission to describe the effectiveness of cumulative conservation and restoration actions in achieving ecological outcomes through collaborative monitoring, evaluation, and reporting. CEP partners have agreed on the following goals and objectives for the partnership, with an emphasis on water quality and watershed health:

- Build an understanding of the extent of the investment in watershed improvement and the watershed response through the agencies' collective grant programs.
- Develop a clearer understanding of how local organizations are utilizing the agencies respective grant programs, in concert.
- Evaluate the effects of conservation and restoration investments on water quality and watershed condition.
- Design tools and methods of reporting results of investments.

The CEP identifies watersheds with significant agency investment and with specific water quality issues, and then engages with on-the-ground partners to identify specific questions about the effects of restoration investments on ecological outcomes.

Background

Floras Creek was chosen as a retrospective watershed case study in 2019. The CEP determined that the study area was a location of interest in relation to Oregon Department of Agriculture Water Quality Program efforts, Oregon Department of Fish and Wildlife (ODFW) coho planning efforts, and restoration investments from various state and federal grant funding sources. CEP technical staff worked with the local partners from the Curry Watersheds Partnership (CWP) to understand the relevant restoration and monitoring projects within the study area over the last 20 years and compile existing datasets and local knowledge required to complete the study. The Floras Creek technical summary provides findings from the data analysis conducted by the CEP technical team.

Study Area

Floras Creek is located in Curry County in the south coast of Oregon near the town of Langlois. The surrounding watershed is 82 square miles, including significant (approximately 23 %) agricultural practices; primarily cranberry production, pasture, and livestock grazing with the majority of the agriculture located in the lowlands. Floras Creek is a drinking water source for the City of Langlois, as well as important fish habitat for coho, Chinook, steelhead, and cutthroat trout.

Floras Creek (defined as three HUC-10 watersheds, Assessment Unit ID: OR_SR_1710030601_02_106304) is listed as impaired in DEQ's 2018/2020 Integrated Report

for Fish and Aquatic Life. The category 5 (at least one beneficial use is not supported and a TMDL is needed) impairments are for Biocriteria and temperature. The North Fork, East Fork, and South Fork Floras Creeks lower segments are listed for temperature along with the lower segment of Willow Creek.

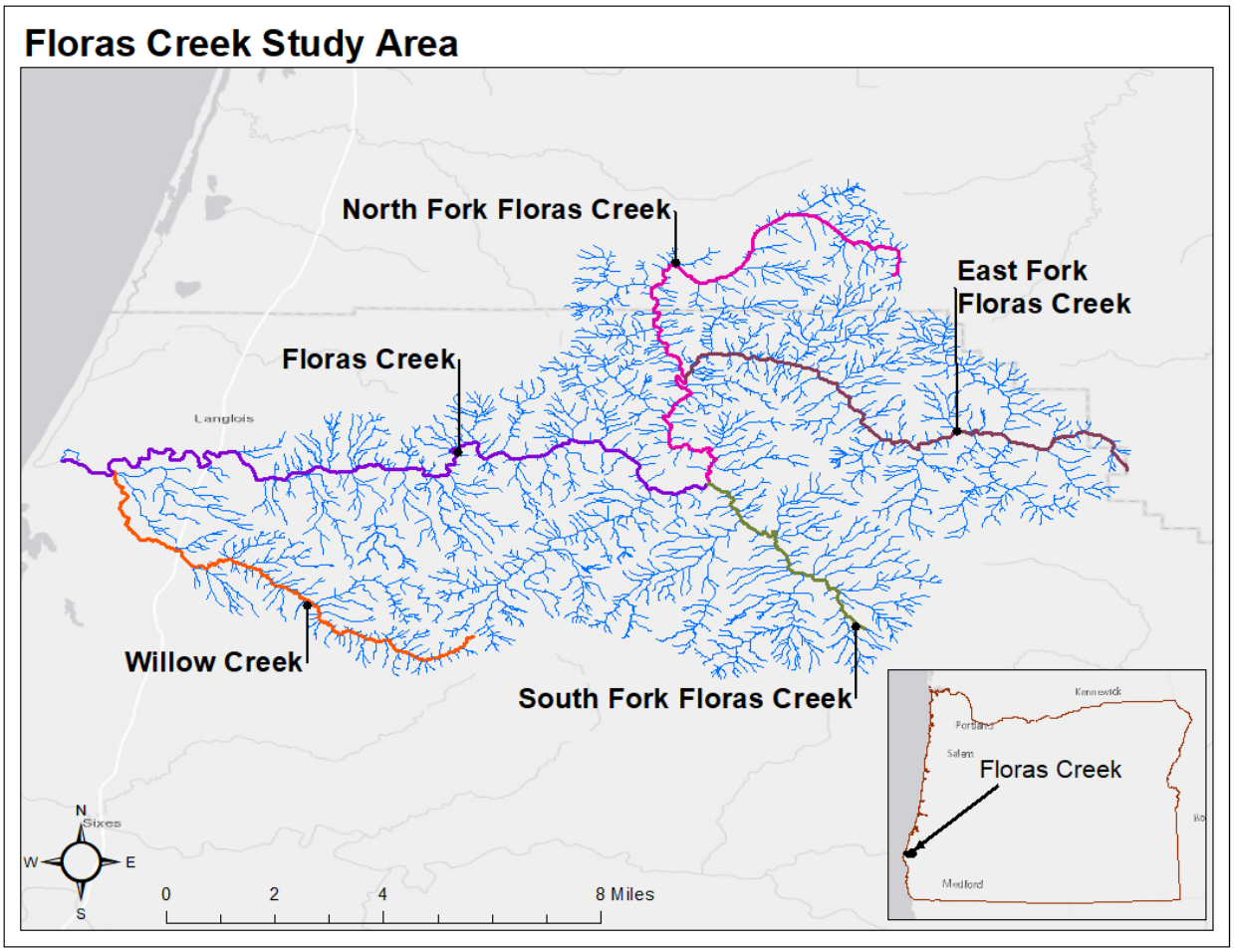


Figure 1: Map of the Floras Creek Watershed Study Area

The Floras Creek watershed is an area of significant restoration investment with over $1.5 million dollars reported in the Oregon Watershed Restoration Inventory (Appendix A, Table A-1). Funds were spent in the watershed from 1999 to 2018 by federal, state, local, and private partners. This investment resulted in over 50 miles of instream and riparian areas treated, 4 miles of improved fish habitat accessibility, 3 miles of improved road surface drainage, and another 615 acres of riparian, upland, and wetland areas treated. Additionally, 57 road or stream crossings were improved for both fish passage and stream flow, and 81 non-stream crossings were improved for surface drainage (Appendix A, Table A-2). The local partners have enrolled private landowners in the Conservation Reserve Enhancement Program (CREP) to protect and restore riparian buffers along approximately eight stream miles across the entire Floras Creek Watershed (Appendix A, Figure A-1). NRCS has also invested an additional $614,110 in Environmental Quality Incentives Program (EQIP) funds in Floras Creek to

implement a variety of conservation practices to minimize agricultural impacts to water quality (Appendix A, Table A-3 and A-4), improve soil health, and increase irrigation efficiency.

Monitoring and Results

Water Quality

Monitoring data was compiled from monitoring conducted by the Oregon Department of Environmental Quality (ODEQ), Oregon Water Resources Department (OWRD), and the CWP from the late 1990s to 2020. Local partners were instrumental in providing the on-the-ground knowledge of historical monitoring activities that built the framework for analysis of the data. The majority of the sample collection in the Floras Creek study area was for temperature with a mixture of grab and continuous temperature sampled over multiple summers, but some infrequent sampling occurred for total suspended solids (TSS), turbidity, *E. Coli*, fecal coliform, and total phosphorus (TP) (See Appendix).

Although most of the TSS, turbidity, *E. Coli*, and TP data was collected on the mainstem Floras Creek, all segments appear to exhibit a similar pattern. These parameters were measured during periods of increased flow in the Floras Creek watershed and exhibit higher values. A possible cause for this could be increased erosion and runoff during storm events. Monitoring data shows maximum concentrations of TSS, TP, and *E. Coli* decrease year to year beginning between 2005 to 2010, while turbidity remains consistent with the exception of a spike in 2016 during a high flow period. Trends and relationships between a water quality response and conservation actions were not clear due to the sampling occurring over a range of locations, years and parameters.

Water temperature data was collected in all of the segments from around 1998 to 2005 with data available at some sites in 2009. The results show temperatures exceeding healthy levels for salmon and trout rearing (18 degrees Celsius, OAR 340-041-0028) during low flows in the summer months with peak values generally rising over this period of time. An Oregon Water Resources Department (OWRD) station located on Floras Creek roughly 1.75 miles upstream from Highway 101 contains more recent water temperature data for the mainstem that suggests the possibility that peak values may have lowered in more recent years, although gaps in temperature data provide uncertainty in establishing a trend. Further ongoing continuous water temperature monitoring would be required to determine if Floras Creek water temperatures are significantly changing over time. There is no available water temperature data within the last 10 years for any of the fork segments of Floras Creek or Willow Creek.

Macroinvertebrates

Macroinvertebrate data was collected by the Curry Watershed Partnership in a variety of locations in the Floras Creek watershed in 2011 using the Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) reach-wide sampling protocol in streams. The results were used in the PREDATOR assessment to synthesize a number of

different variables associated with macroinvertebrates and habitat quality into a single number. This assessment is based on reference sites in which primarily riffles were sampled in fast-moving streams. On average the Floras Creek PREDATOR scores was 0.331. PREDATOR is a predictive model and values less than 1.0 indicate a loss of commonly expected native species. Therefore, this score indicates that a lower number of expected taxa were found at Floras Creek, which could indicate degraded habitat conditions compared to the expected reference conditions. In addition, the macroinvertebrate data were assessed using the OWEB Level III multi-metric method. This method found the Floras Creek sites to be moderately to severely impaired. See Table 1 and Figure 2 to compare Floras Creek to other watersheds that were sampled on the South Coast in 2011.

Table 1. Results of the PREDATOR model analysis for macroinvertebrate samples collected across the South Coast, 2011.*

Site Name	O/E
Lost Lake outlet at BLM trail crossing	0.254
Fourmile Creek in riffle reach (d/s of Hwy 101)	0.254
New River: Bethel Creek at bridge near mouth, u/s of New Lake outlet	0.254
New River: Butte Creek at D/S Bridge	0.127
New River: Morton Creek at D/S end of flow	0.127
New River: South Langlois Creek at S bend	0.127
Floras Creek: mainstem 1.3 RM u/s of Wh Eleph Br	0.382
Floras Creek at County Rd Br	0.451
Floras Creek upstream of Willow Creek	0.326
Floras: Willow Creek at County Road Bridge	0.318
Floras: Willow Creek at County Road Bridge dup	0.381
Floras Lake: Boulder Creek	0.130
Sixes: South Fork nr mouth	0.589
Sixes: Dry Creek	0.254
Sixes: Edson Creek	0.509
Sixes: Edson Creek dup	0.382
Sixes River d/s of Edson Creek	0.325
Sixes: Crystal Creek	0.317
Sixes: Orchard Hole tributary to estuary	0.254
Elk: Bald Mountain Cr nr mouth	0.650
Elk River u/s of hatchery	0.389
Elk River u/s of hatchery dup	0.389
Elk: Bagley Creek	0.571
Elk: Indian Creek	0.740
Elk River near Iron Head boat ramp	0.317
Elk: Cedar Creek at McKenzie Road Bridge	0.190

*Table from "They Curry Watersheds Partnership, Watershed Monitoring Program, Long-Term Plan, 2020.

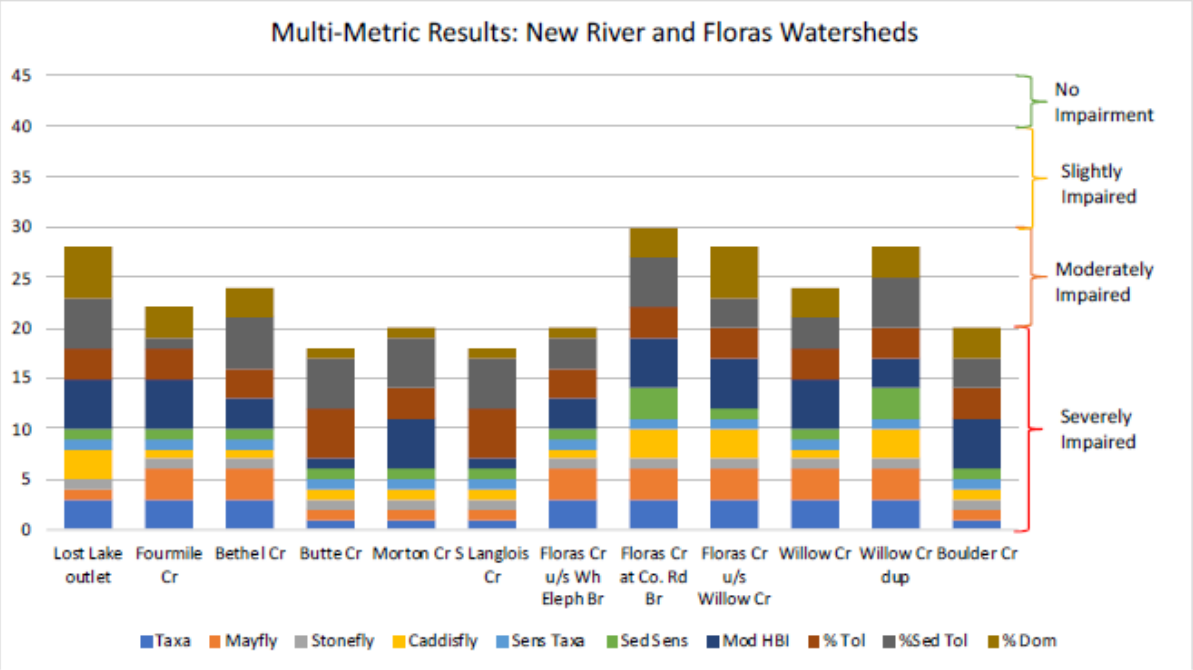


Figure 2. Results of the multi-metric Level III assessment.*
*Table from "They Curry Watersheds Partnership, Watershed Monitoring Program, Long-Term Plan, 2020.

Fish Habitat and Population Assessment

The Floras Creek Coho Population (Figure 3) is one of 21 independent populations that make up the Oregon Coast Coho Evolutionarily Significant Unit (OC Coho ESU). The OC Coho ESU is listed as Threatened under the Federal Endangered Species Act. Stream complexity and water quality are primary and secondary limiting factors for the Floras Creek population (Oregon Coast Coho Conservation Plan, ODFW 2007).

Stream complexity refers to the ability of the stream to provide a variety of habitats. The most limiting habitats for over-winter rearing include large wood, wood quantity, pools, connected off-channel alcoves, beaver ponds, lakes, connected floodplains, and wetlands.

Limiting factors in water quality for OC Coho ESU typically include fine sediment and high summer water temperatures. Summer water temperatures and low flows are likely to become increasingly important as climate change continues to drive changes in habitat conditions.

Eighteen of the twenty-one independent populations within the OC Coho ESU were recently evaluated for instream habitat quality (Strickland et al., 2018). The evaluation indicated that of the eighteen, the Floras Creek basin supported the highest winter rearing capacity for juvenile salmon and had reached approximately 85% of the Oregon Coast Coho Conservation Plan (OCCCP) habitat goal.

Biological criteria related to viability and recovery was also assessed in the evaluation. It was determined that the Floras Creek population had not achieved broad sense recovery and to do so would require sustained conservation over several decades. However, population persistence, and

sustainability criterion have continued to improve over time. An updated population viability analysis using the best fitting recruitment model predicts a 99% persistence probability that the population will persist over 100 years (i.e., < 1% risk of extinction). The sustainability trend is largely attributable to improvements in spawner density at low abundance and spawner distribution. The sustainability criterion indicates that the population has moderate to high certainty of sustainability into the foreseeable future.

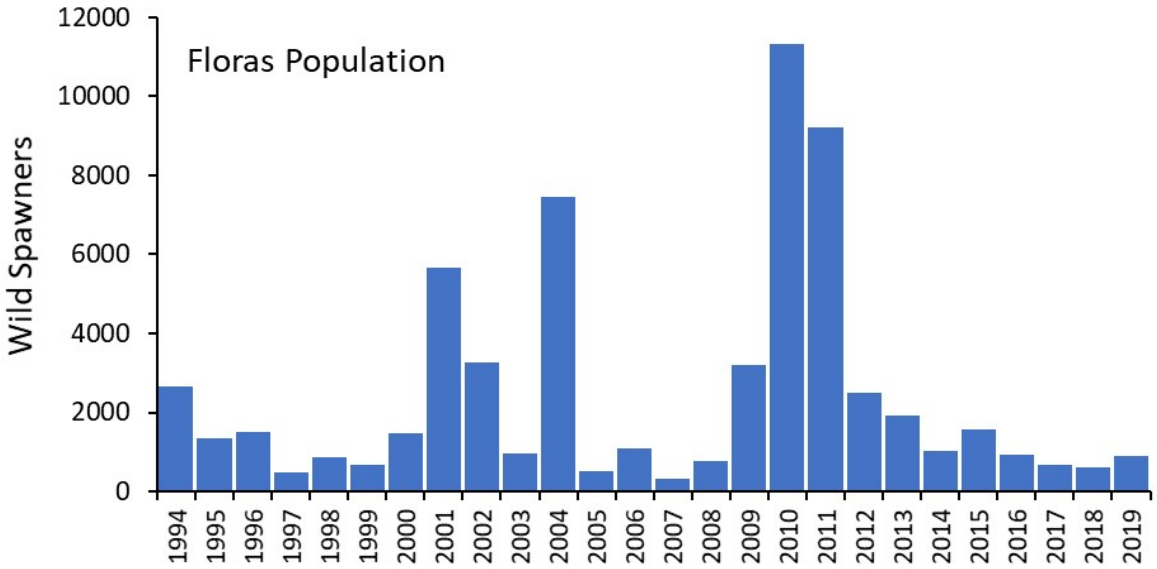


Figure 3: Abundance of wild coho salmon spawners in the Floras Creek Population, 1994-2019.

Conclusion

Local partners have focused conservation efforts across the watershed to address a variety of issues, leveraging state and federal sources of funding for conservation and restoration in their work with private landowners. The watershed has varied land use, and it is difficult to detect the influence of specific actions within the freshwater system.

Although macroinvertebrate data collected at Floras Creek indicated a moderate level of impairment, the water quality monitoring data collected for Floras Creek do not show definitive trends. Temperature data indicates expected seasonal variation, with high temperature at times of low flow. Bacteria levels do not indicate impairment. There is a slight trend towards lower spikes of bacteria associated with storm events in recent years.

Over a decade of water quality monitoring show response to storm events through measurements in turbidity, temperature, bacteria, and phosphorous. Although this information is not directly linked to the conservation and restoration investments, it has proven valuable. Curry Watershed Partnership have used this long-term data, including measurements from citizen science Storm Chasers, to develop a long-term monitoring plan across the South Coast including Floras Creek.

Future Monitoring

Future monitoring to collect information upstream and downstream of projects may be useful to see how water quality variables, including temperature and bacteria, change over time and space. For example, the trend towards lower spikes of bacteria associated with storm events could be further explored using data collected from citizen science Storm Chaser events. Continuous summer temperature monitoring throughout Floras Creek and its forks would help to determine if temperatures are changing over time. Monitoring for stream complexity, summer temperature, and sediment would help to better understand and address the primary and secondary limiting factors affecting the threatened Floras Creek coho population.

Appendix A: Restoration Investment

Tables A-1 through A-4 provide a summary of the restoration activity investment within the Floras Creek Watershed as provided by the Oregon Watershed Restoration Inventory Database. Figure A-1 displays where CREP activities have been implemented.

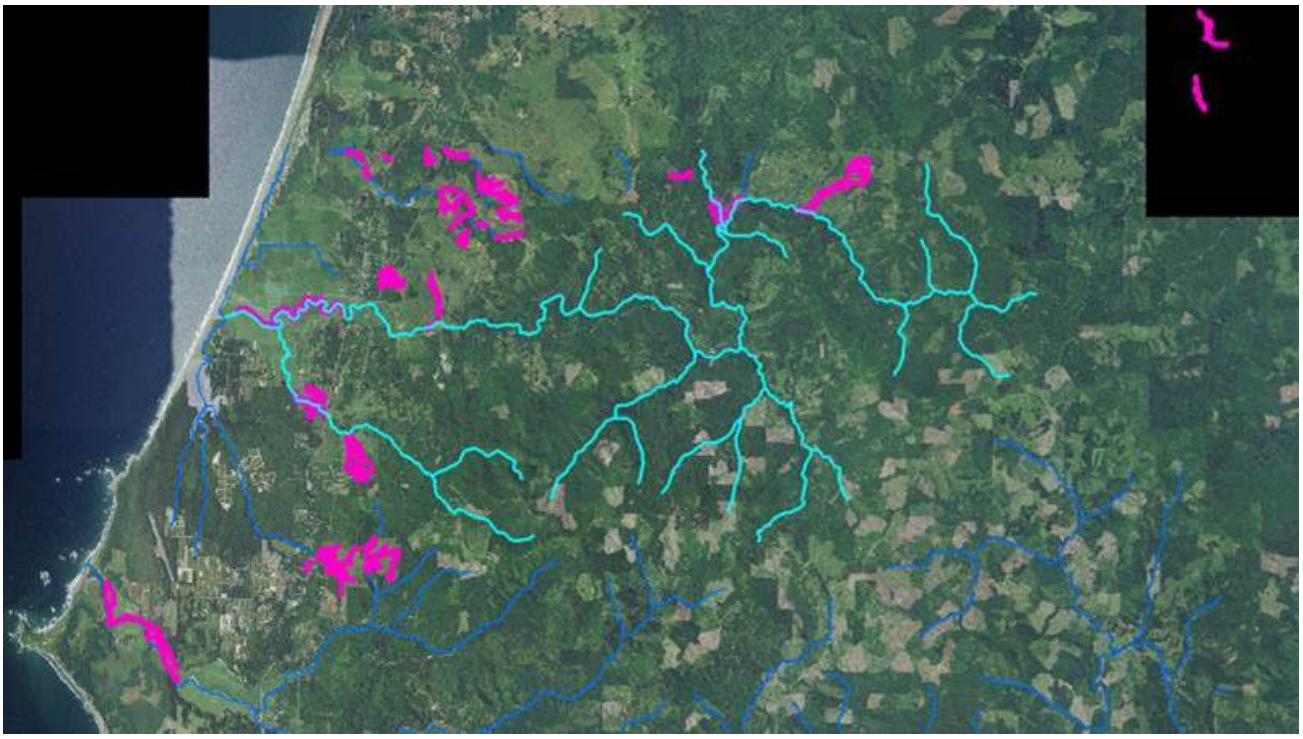


Figure A-1: Map of CREP activities in the Floras Creek Watershed

Table A-1: Investment in Dollars in Floras Creek by Activity type as Reported in OWRI, 1999-2018.

Cost By Activity Type	
Activity Type	**Total Cost**
Fish Passage	$174,143
Instream	$193,542
Riparian	$365,480
Road	$336,908
Upland	$456,644
Wetland	$14,088
Total	**$1,540,805**

Table A-2: Enumeration of Restoration Actions in Floras Creek by Project Type, 1999-2018.

Project Type	Total Units
Instream miles	6.59
Riparian miles	45.60
Riparian acres	362.80
Fish passage crossings	14
Fish passage miles opened	4.24
Road sd structures	81
Upland acres	252.27
Wetland acres	0.75

Table A-3: NRCS EQIP Funds invested in Floras Creek Fiscal year 2007-2019.

Fiscal Year	Funds Obligated
2007	$ 137,550
2008	$ 37,853
2010	$ 39,973
2011	$ 22,110
2012	$ 45,057
2013	$ 40,329
2015	$ 30,951
2016	$ 58,688
2018	$ 187,841
2019	$ 13,759
Total	**$ 614,110**

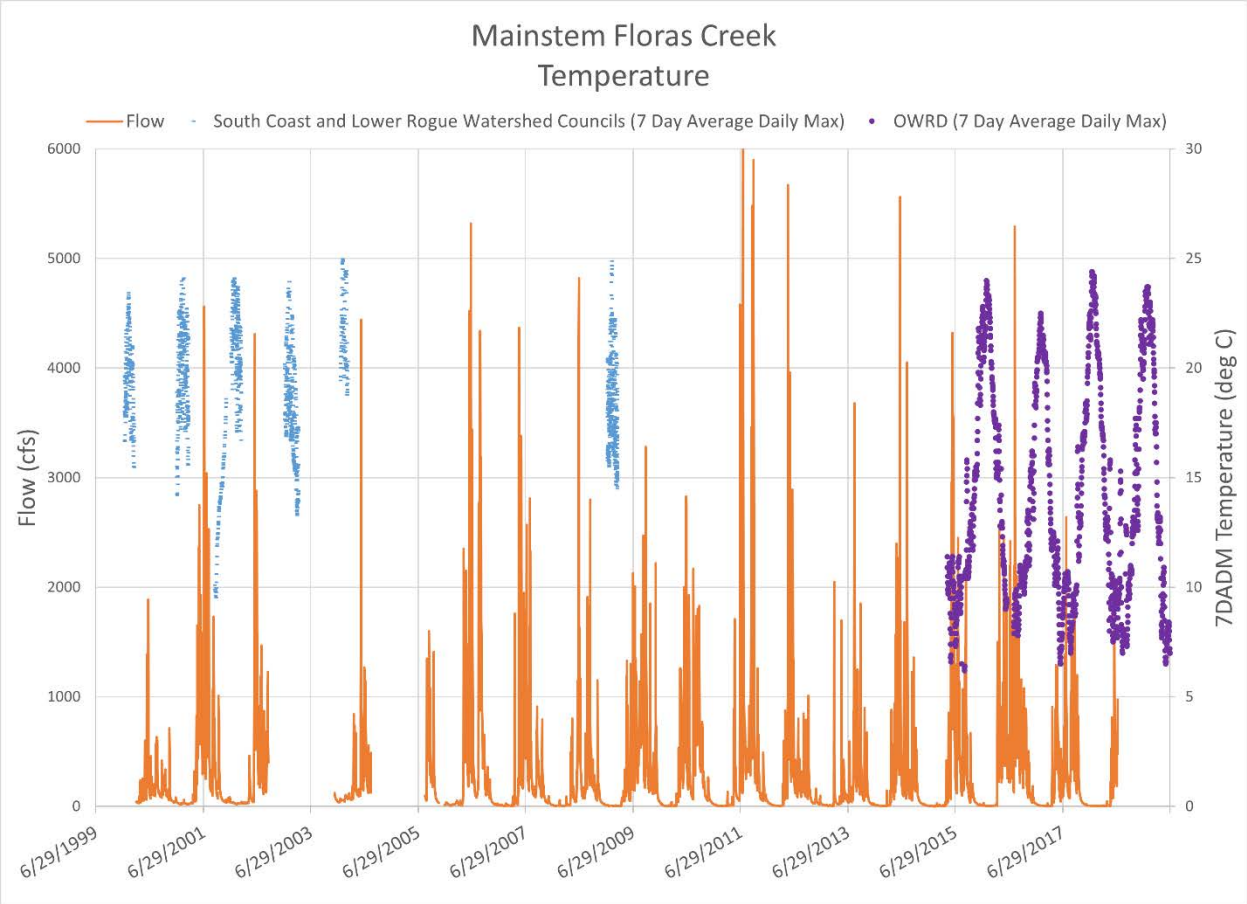
Table A-4: Enumeration of NRCS EQIP Conservation Practices in Floras Creek, FY2007-2019

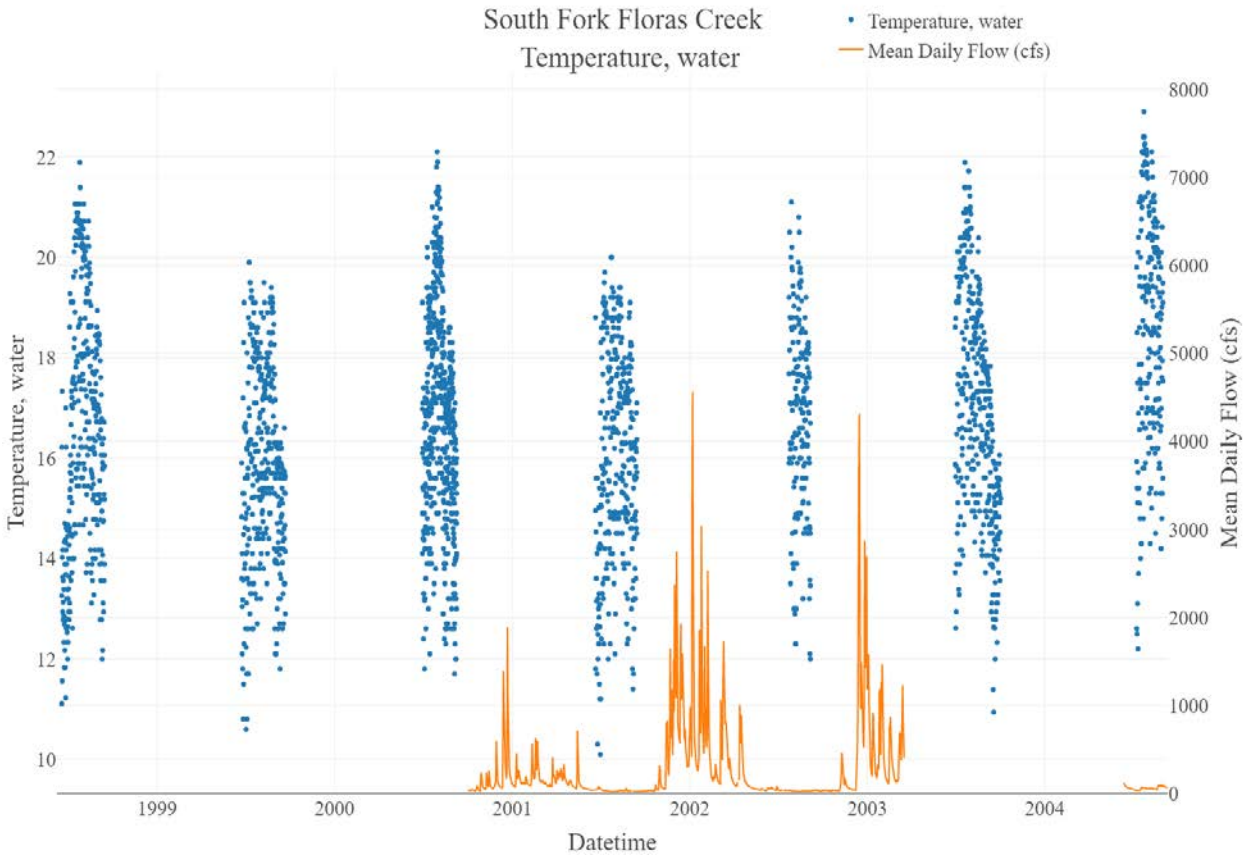
Conservation Practice Name - Code (units)	Total Amt.	Total # of Fields
Access Control - 472 (Ac)	921	23
Aquatic Organism Passage - 396 (Mi)	5	5
Conservation Cover - 327 (Ac)	4	3
Cover Crop - 340 (Ac)	7	1
Fence - 382 (Ft)	12,972	7
Forest Stand Improvement - 666 (Ac)	345	9
Heavy Use Area Protection - 561 (SqFt)	3,389	1
Irrigation Pipeline - 430 (Ft)	9,743	3
Irrigation Water Management - 449 (Ac)	549	13
Livestock Pipeline - 516 (Ft)	746	1
Prescribed Grazing - 528 (Ac)	404	6
Pumping Plant - 533 (No)	9	6
Seasonal High Tunnel System for Crops - 798 (SqFt)	3,360	2
Sprinkler System - 442 (Ac)	633	13
Structure for Water Control - 587 (No)	48	1
Structures for Wildlife - 649 (No)	18	18
Tree/Shrub Establishment - 612 (Ac)	223	9
Tree/Shrub Site Preparation - 490 (Ac)	213	15
Watering Facility - 614 (No)	1	1

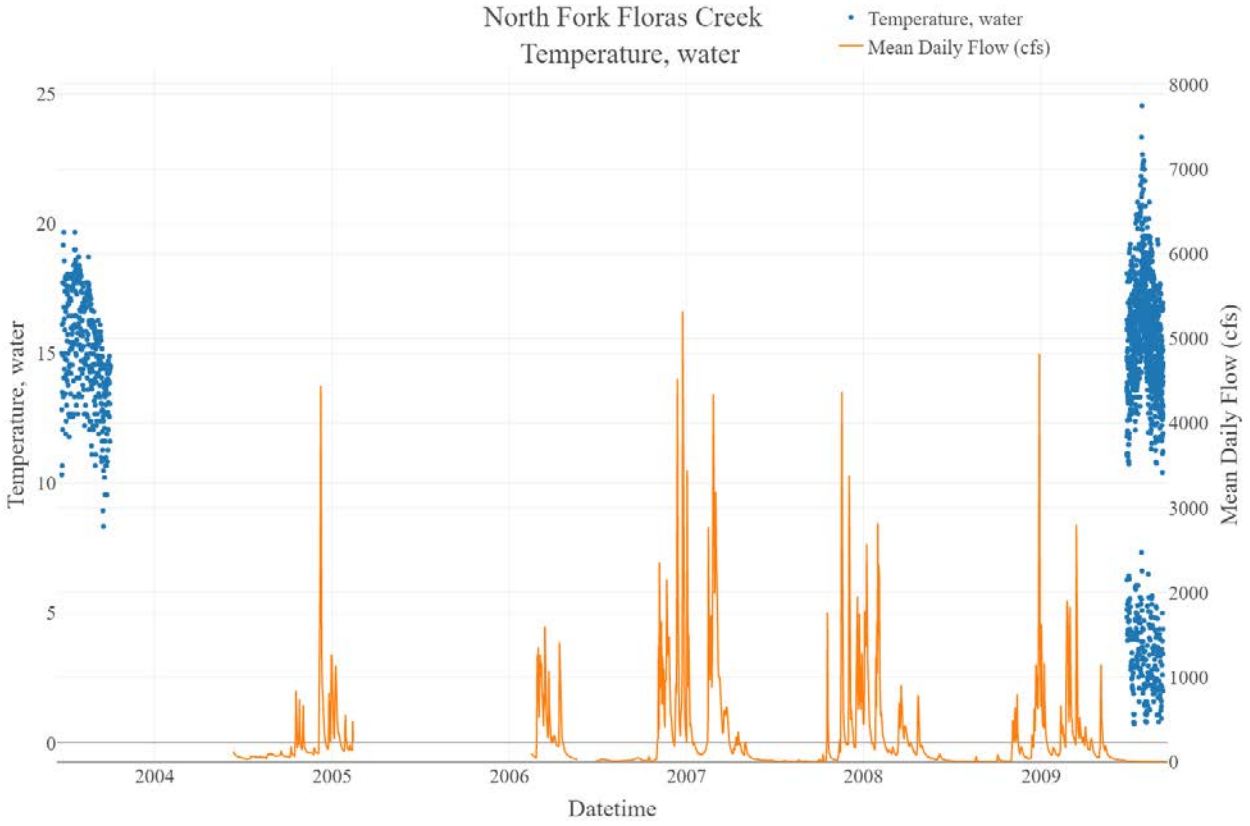
Appendix B: Plots of Available Data

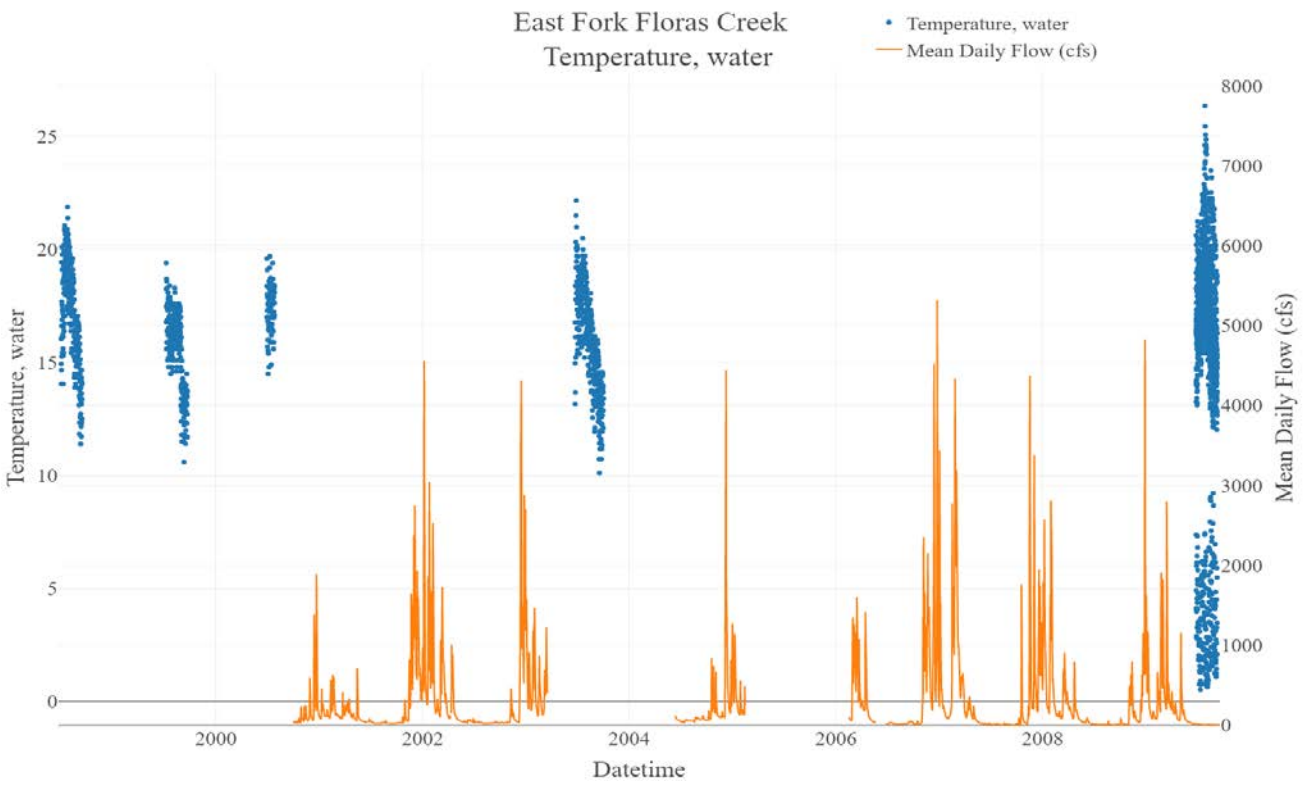
The following plots show available data at South Fork Floras Creek, North Fork Floras Creek, East Fork Floras Creek, and Willow Creek plotted against stream flow data from the OWRD station on the mainstem Floras creek. The mainstem flow gauge is the only gauge available for the Floras Creek watershed. Flow data is included to show the general time of year where low flow is typically late summer and where the low flow is for all segments. Graphs of data for Dissolved Oxygen and pH collected by DEQ and by watershed partners are also included.

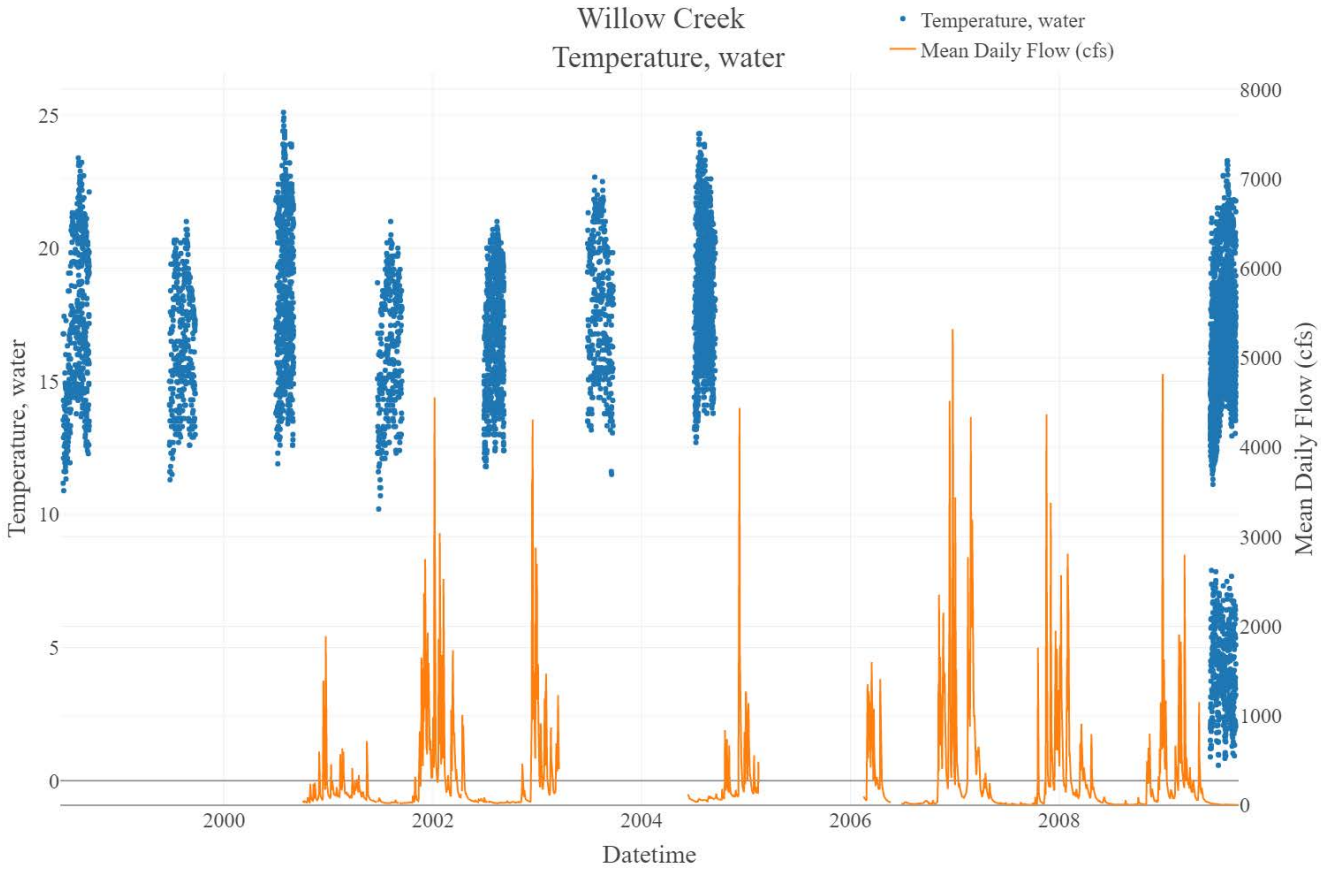
Temperature



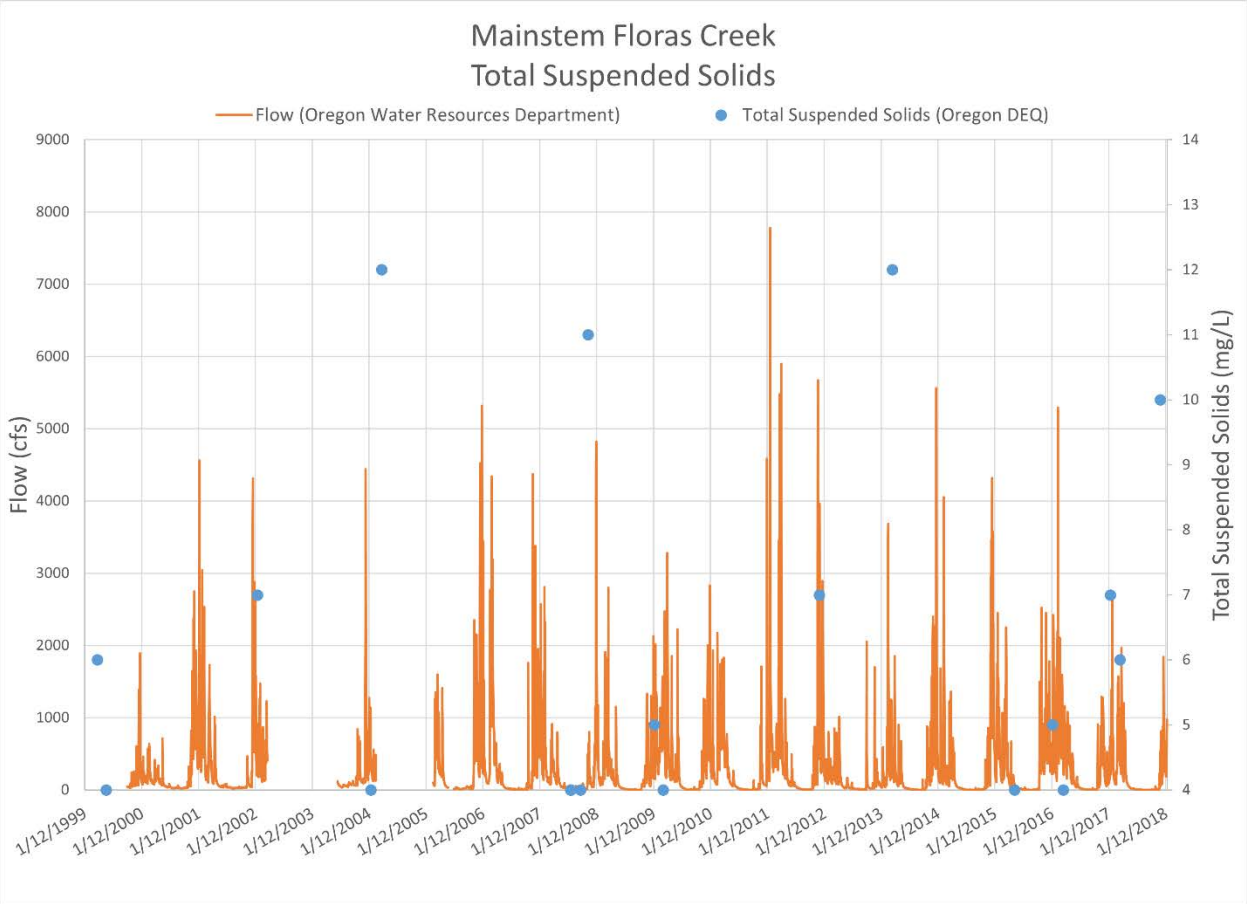

South Fork Floras Creek
Temperature, water
Temperature, water
Mean Daily Flow (cfs)
Temperature, water
Mean Daily Flow (cfs)
Datetime
1999
2000
2001
2002
2003
2004


North Fork Floras Creek
Temperature, water
Temperature, water
Mean Daily Flow (cfs)
Temperature, water
Mean Daily Flow (cfs)
Datetime
2004
2005
2006
2007
2008
2009

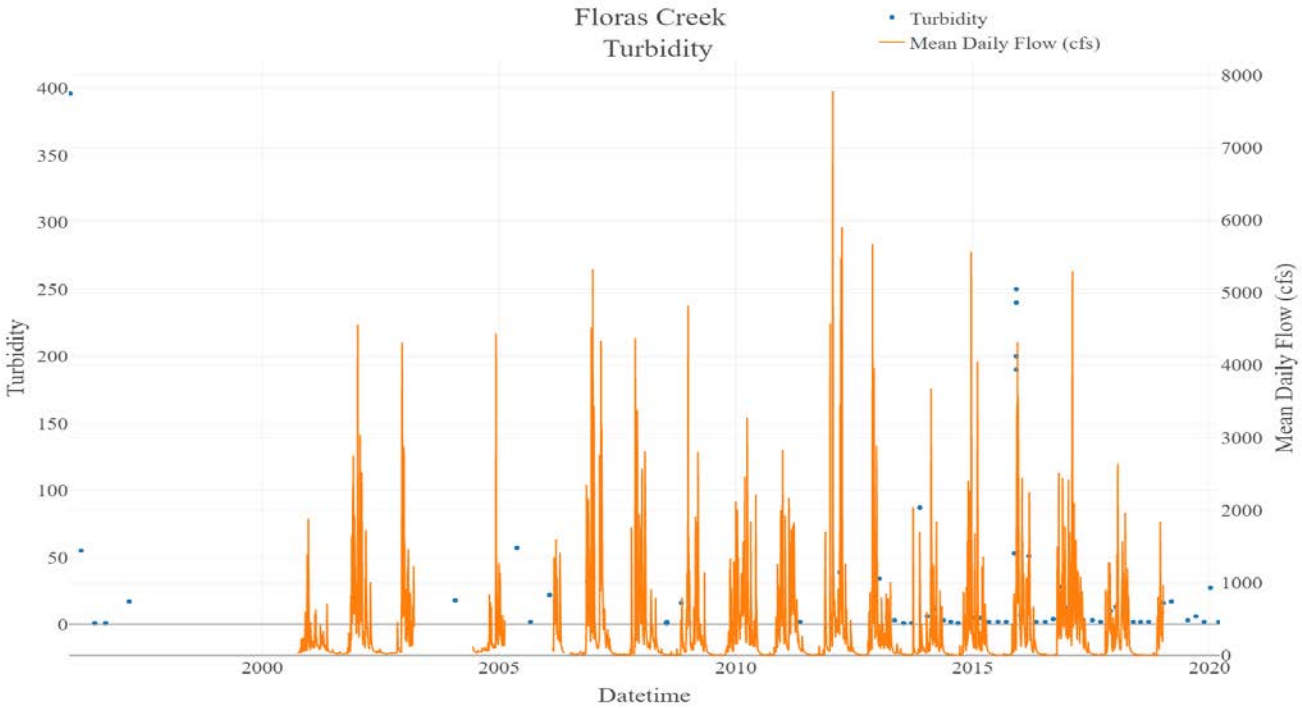

East Fork Floras Creek
Temperature, water
Temperature, water
Mean Daily Flow (cfs)
Temperature, water
Mean Daily Flow (cfs)
Datetime
0
5
10
15
20
25
0
1000
2000
3000
4000
5000
6000
7000
8000
2000
2002
2004
2006
2008

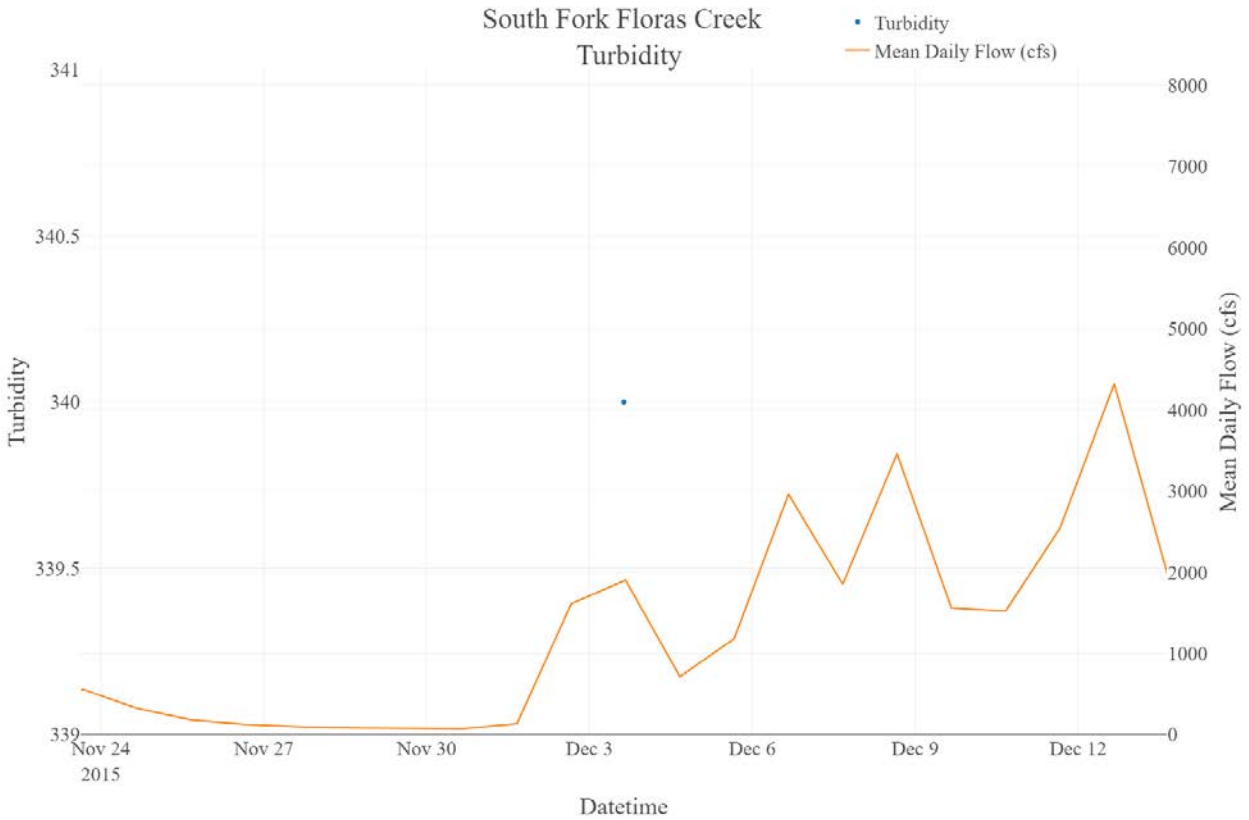

Willow Creek
Temperature, water
Temperature, water
Mean Daily Flow (cfs)
Temperature, water
Mean Daily Flow (cfs)
Datetime
0
5
10
15
20
25
0
1000
2000
3000
4000
5000
6000
7000
8000
2000
2002
2004
2006
2008

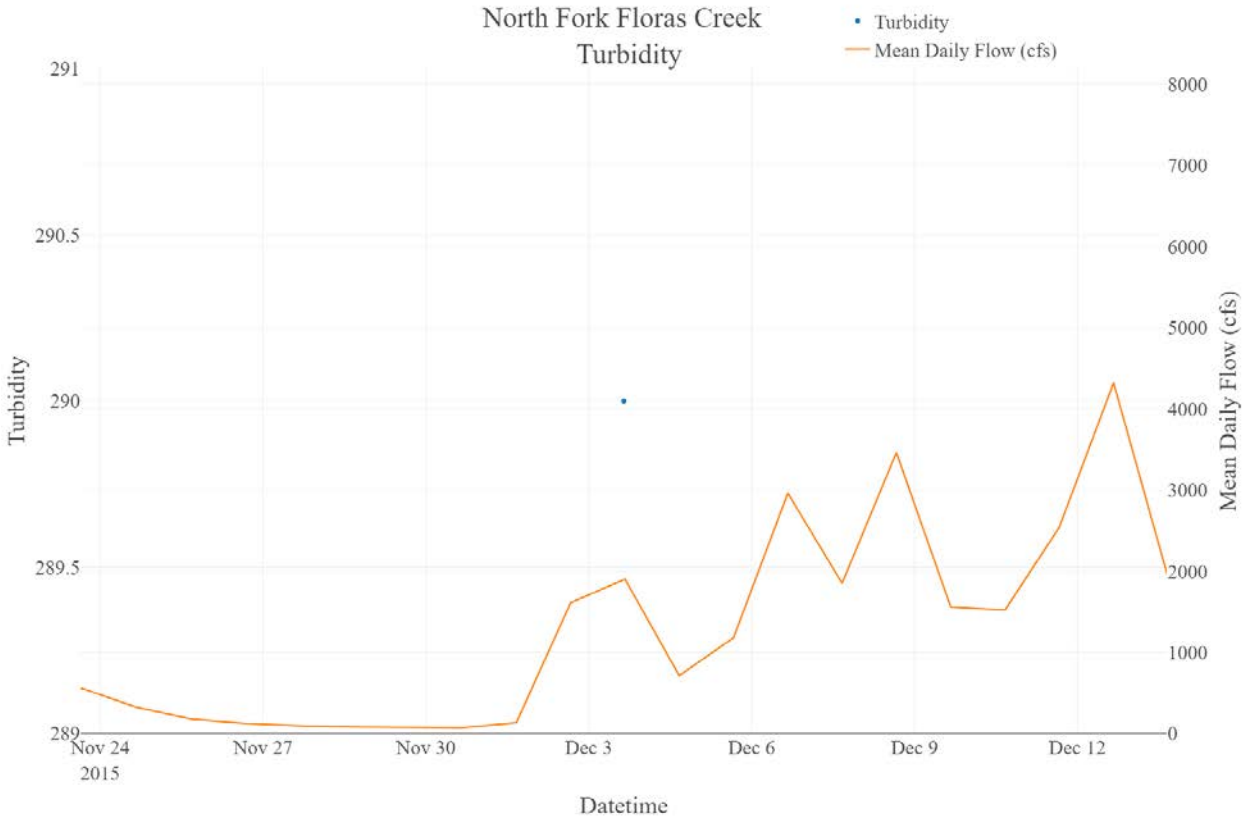
Total Suspended Solids

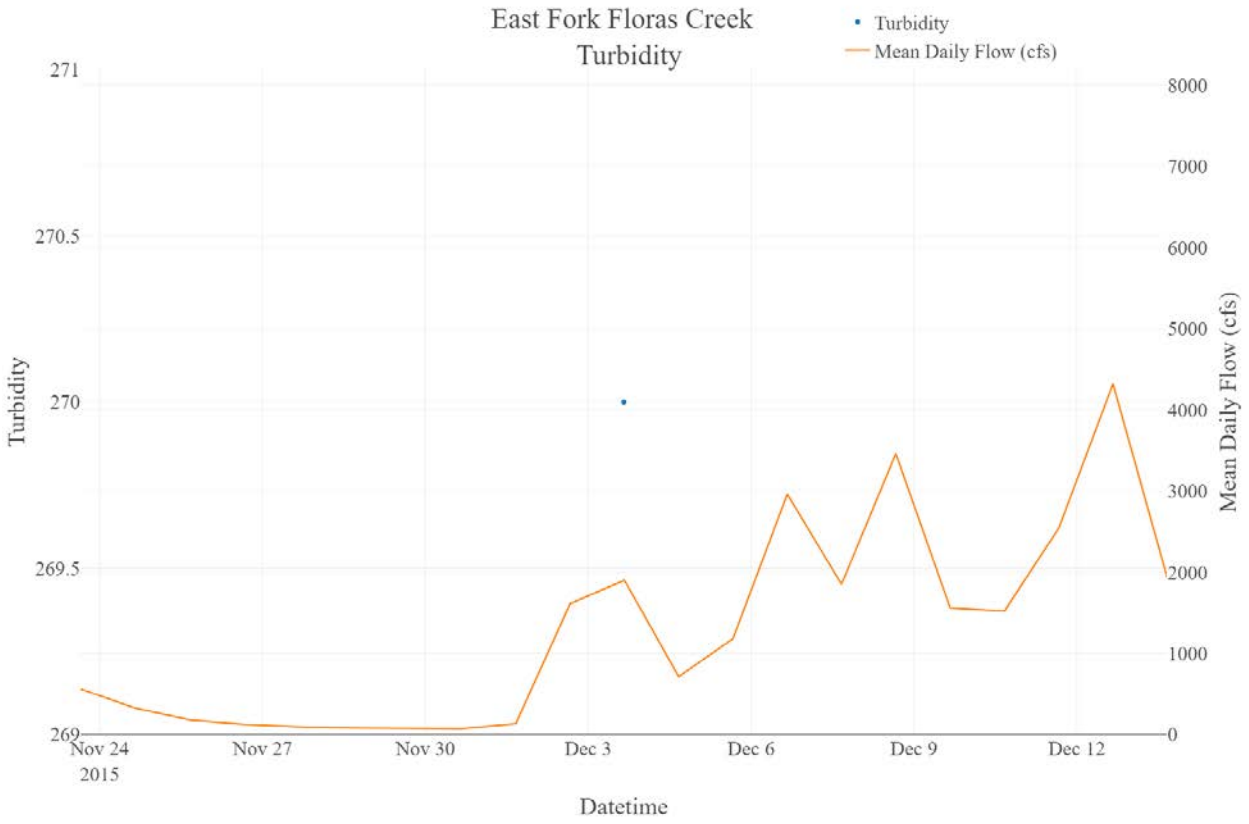


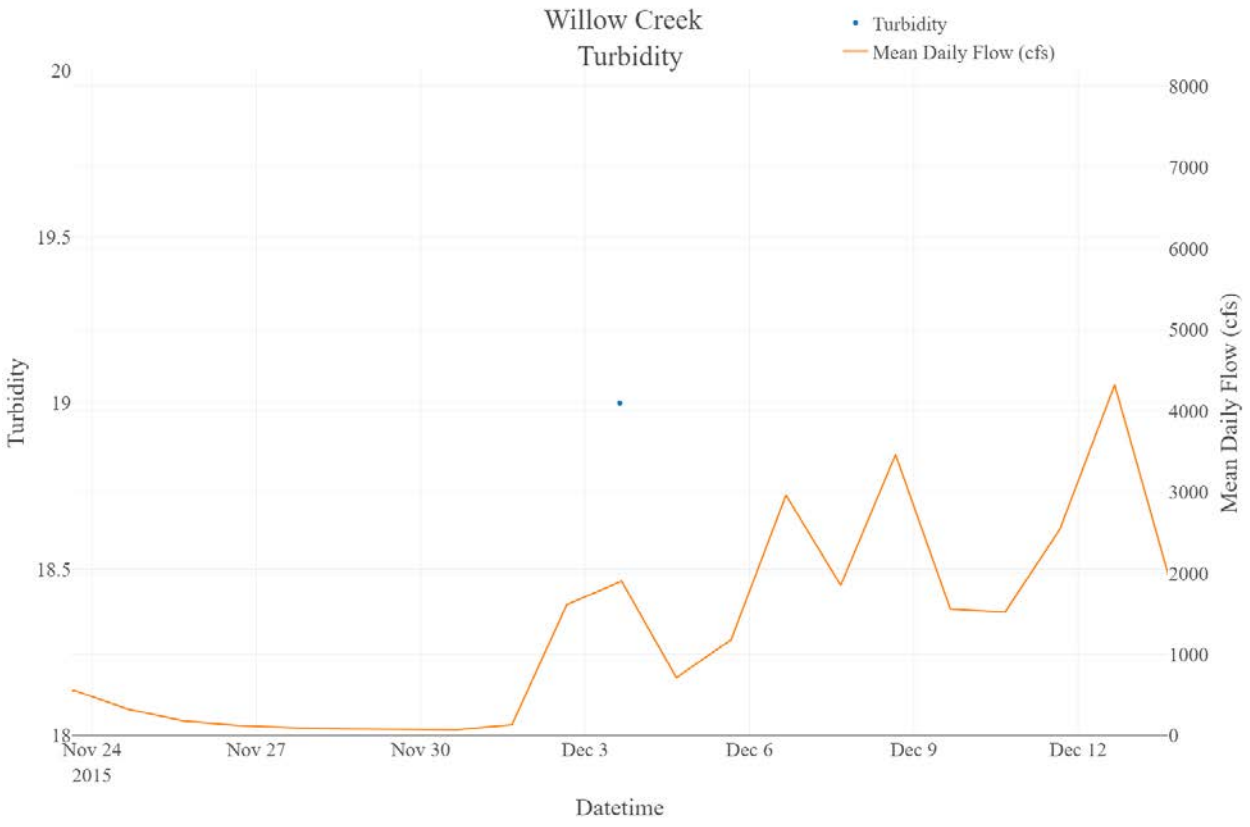
Turbidity


Floras Creek
Turbidity
Turbidity
Mean Daily Flow (cfs)
Turbidity
Mean Daily Flow (cfs)
Datetime
2000
2005
2010
2015
2020

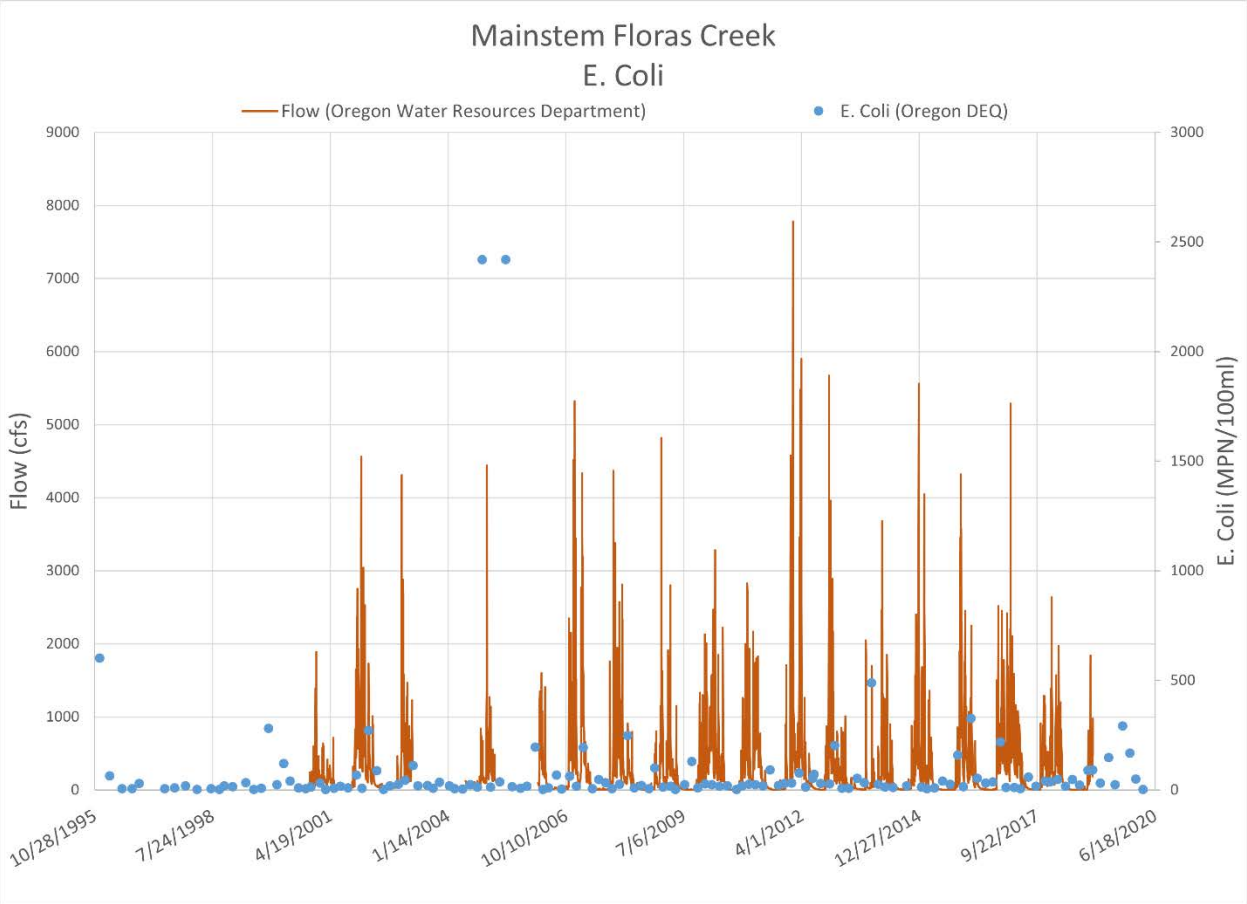

South Fork Floras Creek
Turbidity
Turbidity
Mean Daily Flow (cfs)
Turbidity
Mean Daily Flow (cfs)
Datetime
Nov 24
2015
Nov 27
Nov 30
Dec 3
Dec 6
Dec 9
Dec 12

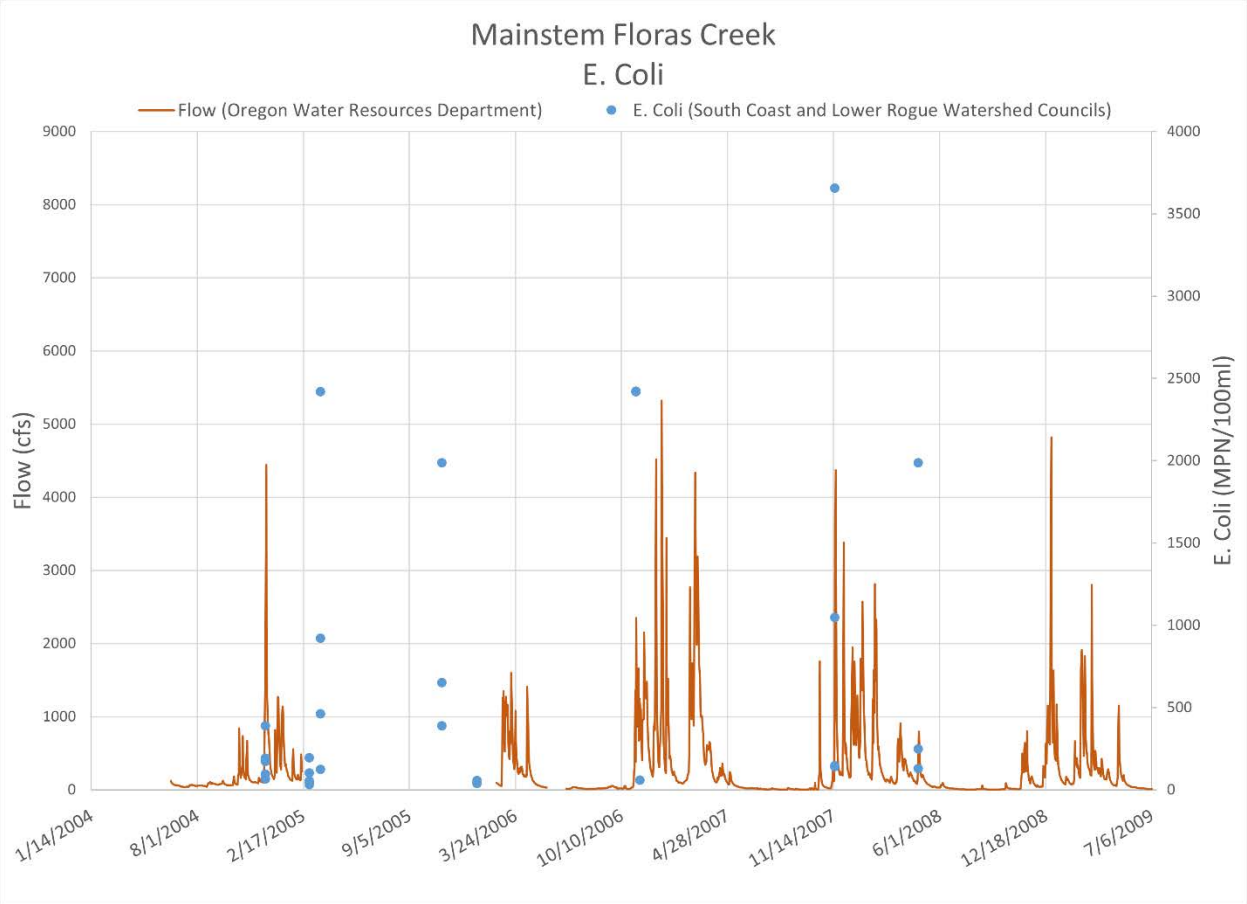

North Fork Floras Creek
Turbidity
Turbidity
Mean Daily Flow (cfs)
291
290.5
290
289.5
289
Turbidity
8000
7000
6000
5000
4000
3000
2000
1000
0
Mean Daily Flow (cfs)
Nov 24
2015
Nov 27
Nov 30
Dec 3
Dec 6
Dec 9
Dec 12
Datetime


East Fork Floras Creek
Turbidity
Turbidity
Mean Daily Flow (cfs)
271
270.5
270
269.5
269
Turbidity
8000
7000
6000
5000
4000
3000
2000
1000
0
Mean Daily Flow (cfs)
Nov 24
2015
Nov 27
Nov 30
Dec 3
Dec 6
Dec 9
Dec 12
Datetime


Willow Creek
Turbidity
Turbidity
Mean Daily Flow (cfs)
20
19.5
19
18.5
18
Turbidity
8000
7000
6000
5000
4000
3000
2000
1000
0
Mean Daily Flow (cfs)
Nov 24
2015
Nov 27
Nov 30
Dec 3
Dec 6
Dec 9
Dec 12
Datetime

E. Coli


Mainstem Floras Creek
E. Coli
Flow (Oregon Water Resources Department)
E. Coli (Oregon DEQ)
Flow (cfs)
E. Coli (MPN/100ml)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
3000
2500
2000
1500
1000
500
0
10/28/1995
7/24/1998
4/19/2001
1/14/2004
10/10/2006
7/6/2009
4/1/2012
12/27/2014
9/22/2017
6/18/2020


Mainstem Floras Creek
E. Coli
Flow (Oregon Water Resources Department)
E. Coli (South Coast and Lower Rogue Watershed Councils)
Flow (cfs)
E. Coli (MPN/100ml)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
4000
3500
3000
2500
2000
1500
1000
500
0
1/14/2004
8/1/2004
2/17/2005
9/5/2005
3/24/2006
10/10/2006
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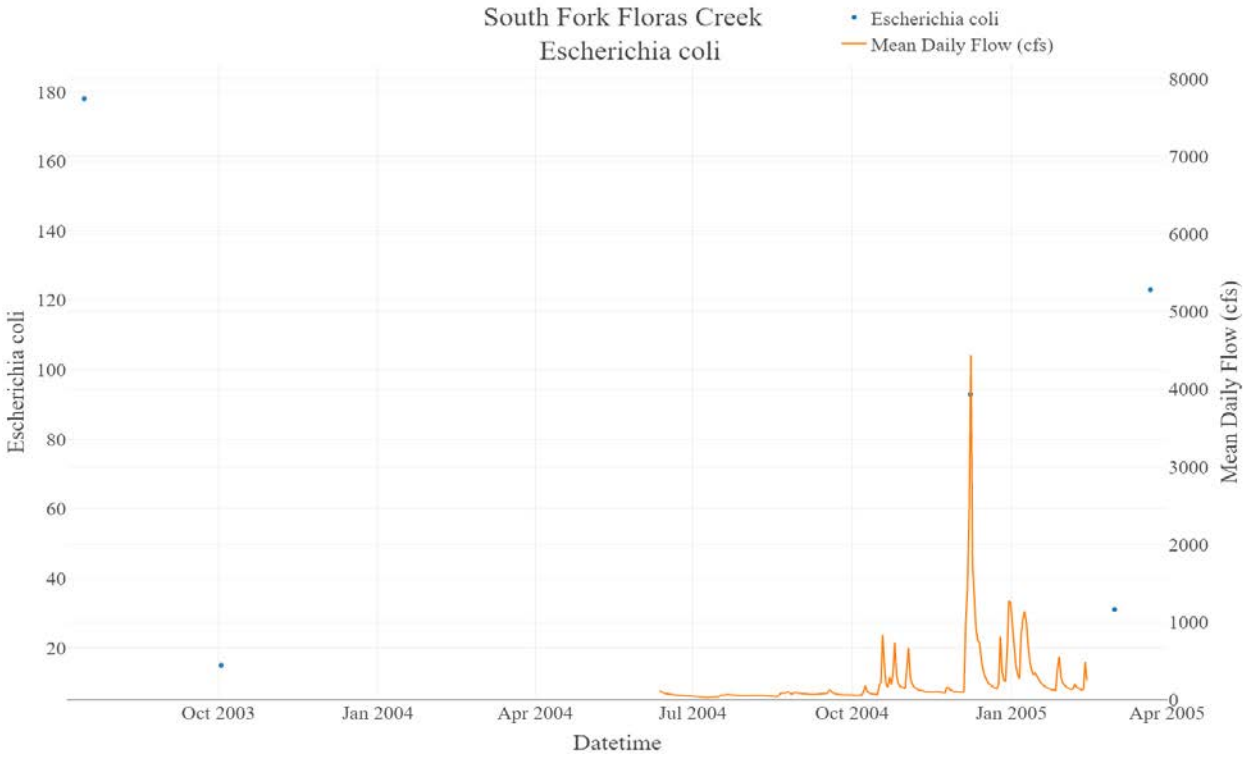
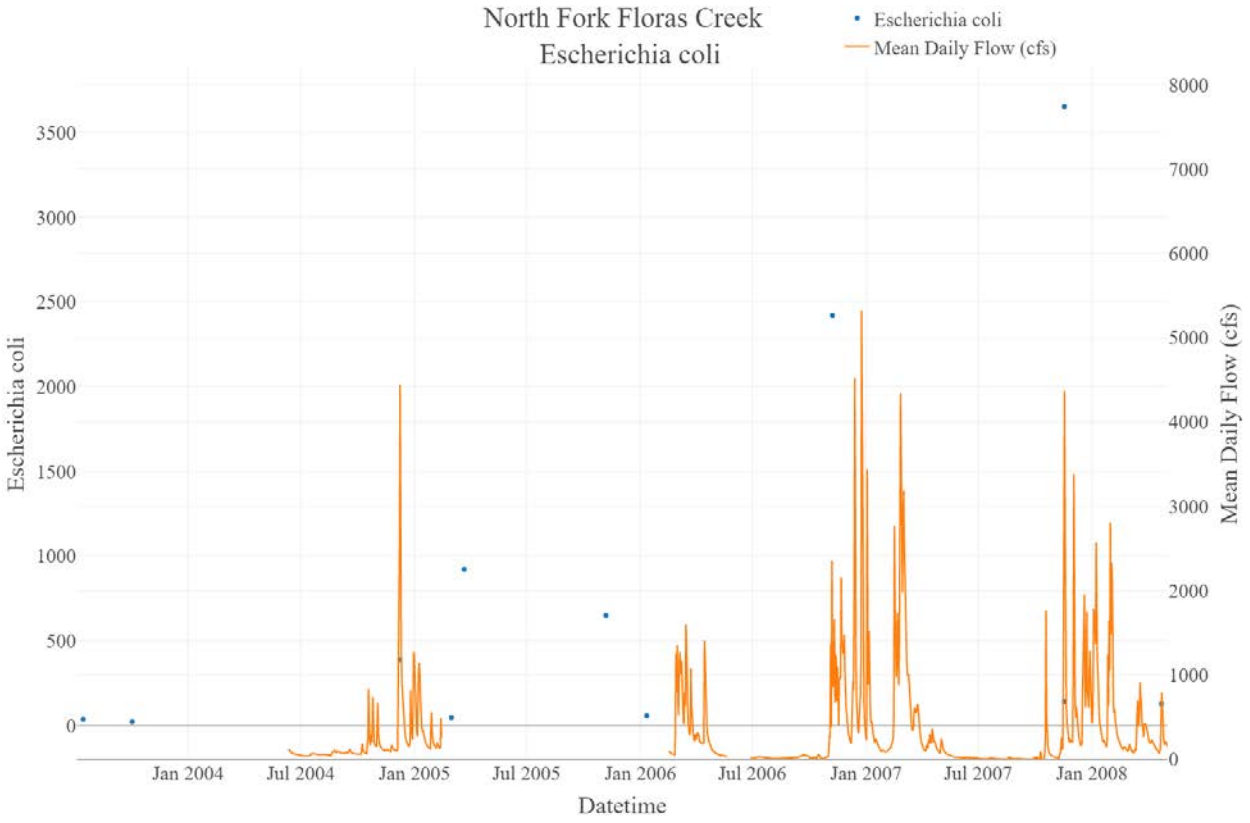
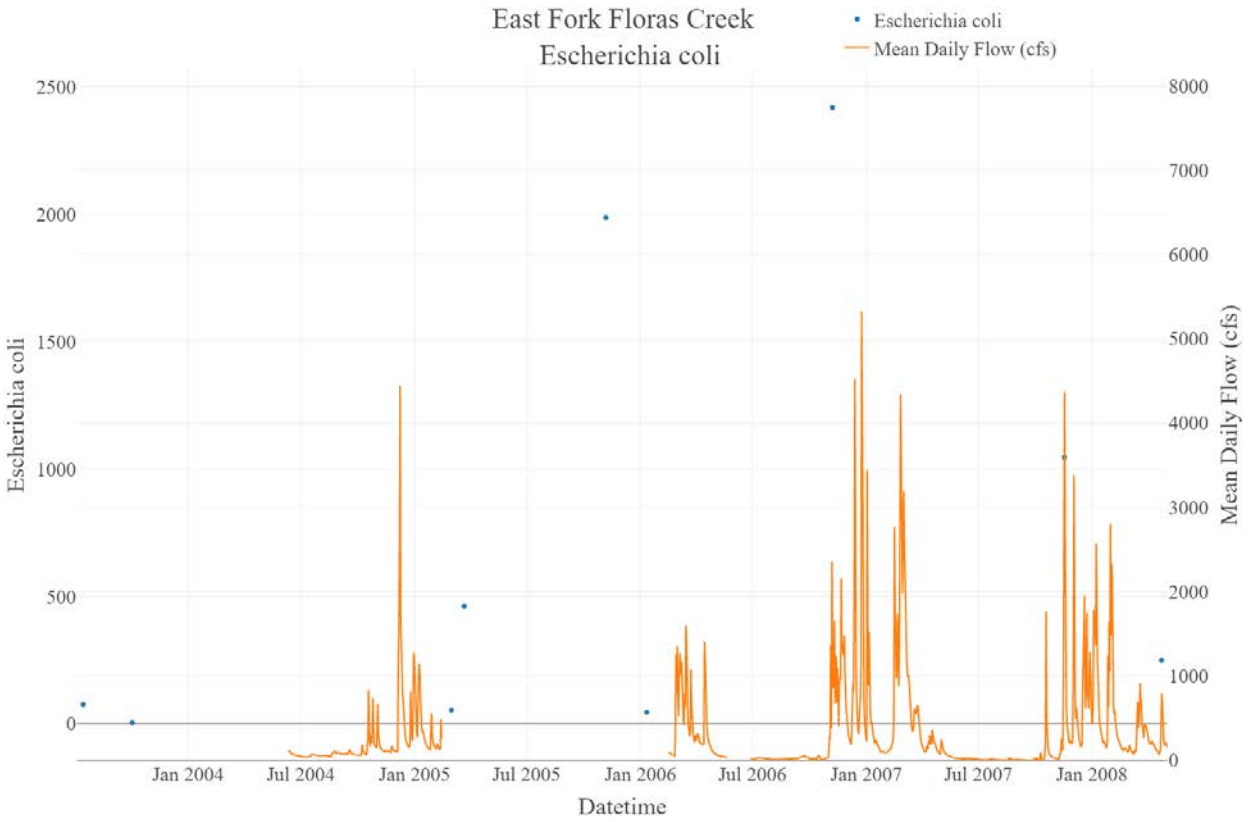
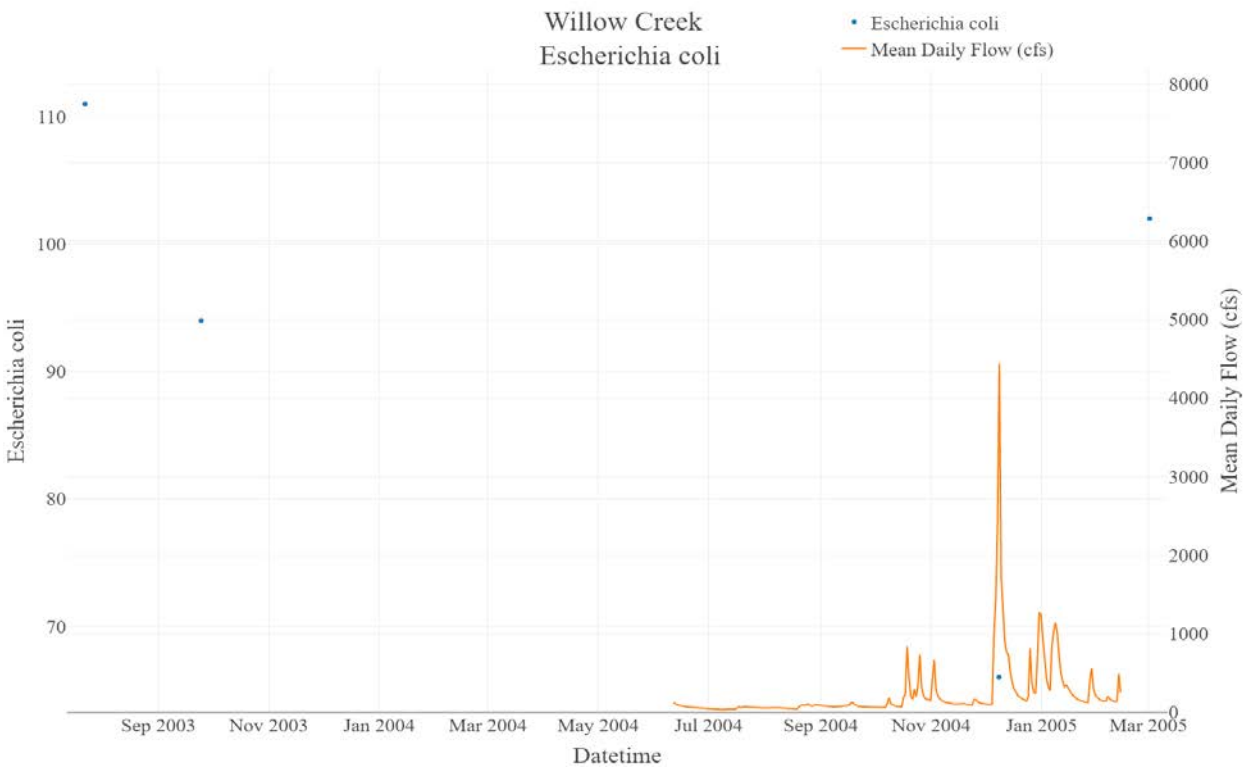
11/14/2007
6/1/2008
12/18/2008
7/6/2009

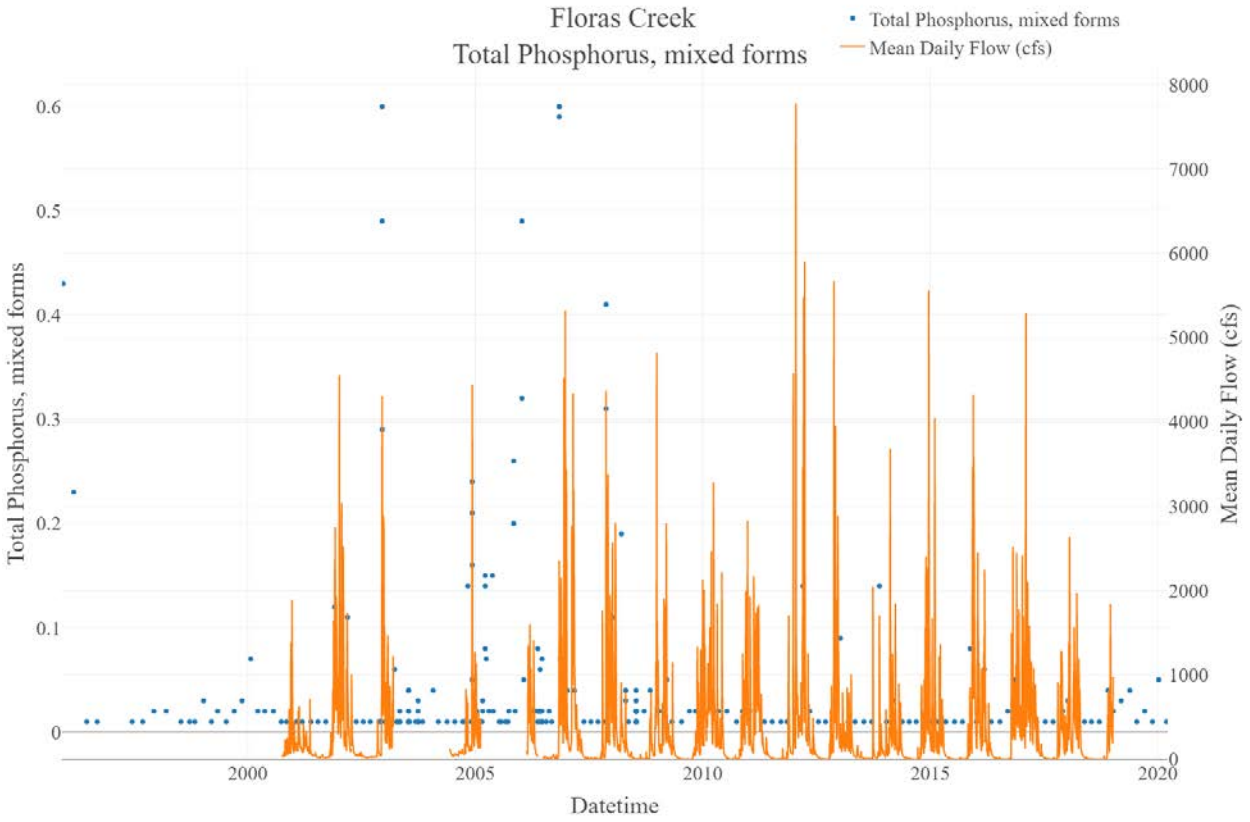

South Fork Floras Creek
Escherichia coli
Escherichia coli
Mean Daily Flow (cfs)
Escherichia coli
180
160
140
120
100
80
60
40
20
8000
7000
6000
5000
4000
3000
2000
1000
0
Mean Daily Flow (cfs)
Oct 2003
Jan 2004
Apr 2004
Jul 2004
Oct 2004
Jan 2005
Apr 2005
Datetime

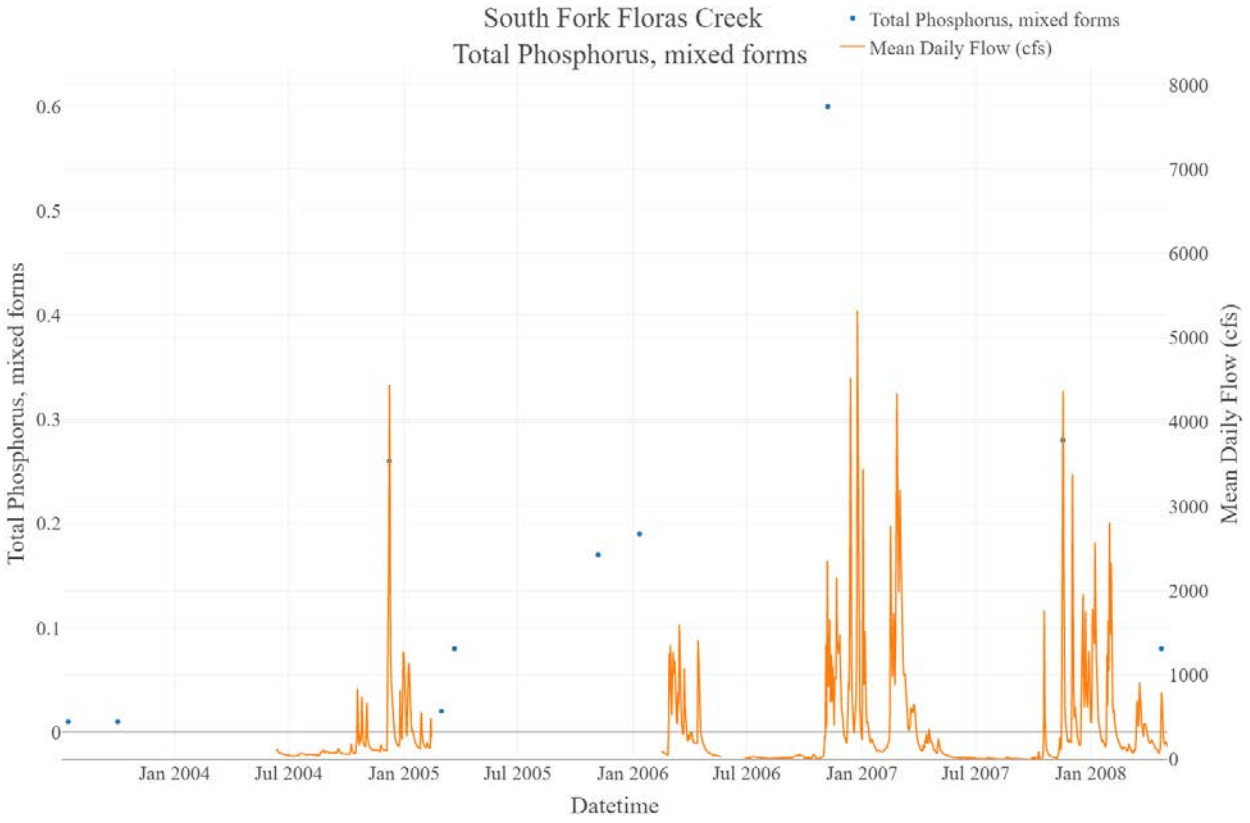

North Fork Floras Creek
Escherichia coli
Escherichia coli
Mean Daily Flow (cfs)
Escherichia coli
Mean Daily Flow (cfs)
Datetime
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006
Jul 2006
Jan 2007
Jul 2007
Jan 2008

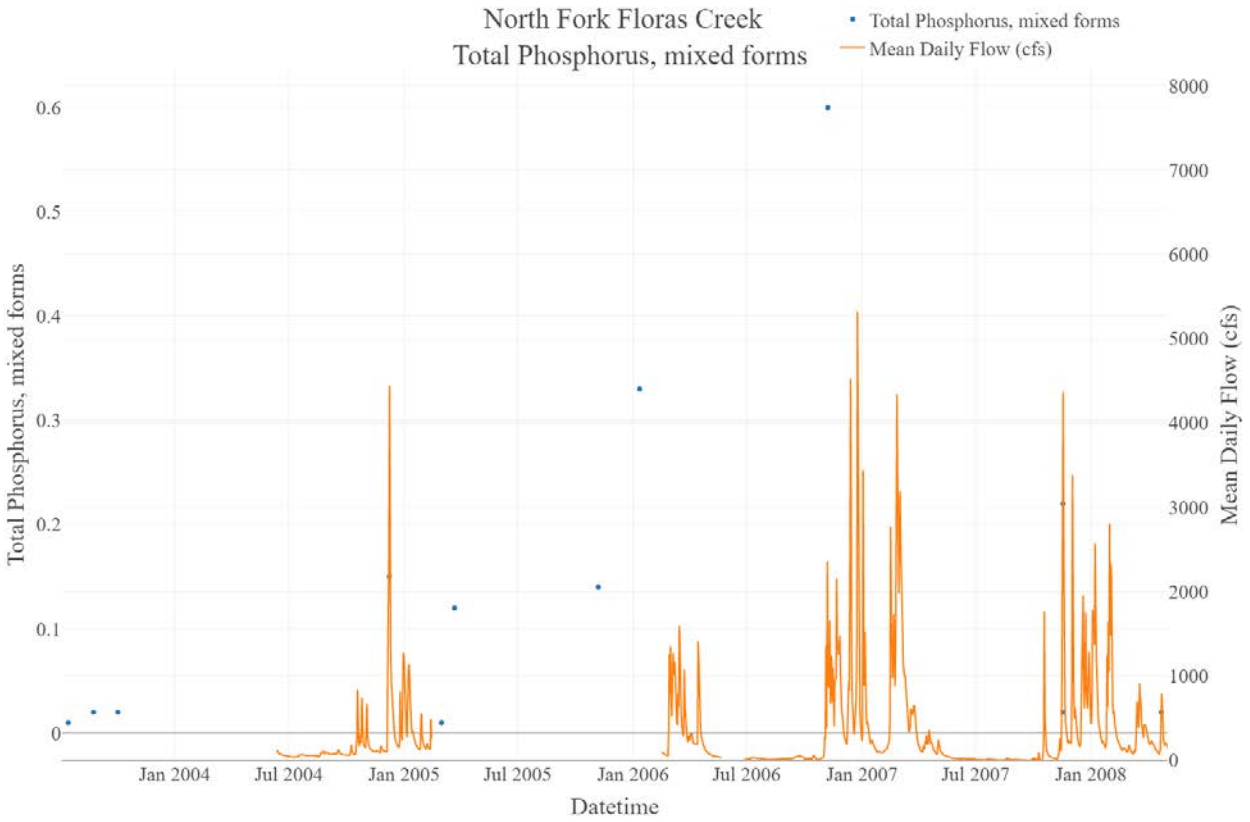

East Fork Floras Creek
Escherichia coli
Escherichia coli
Mean Daily Flow (cfs)
Escherichia coli
Mean Daily Flow (cfs)
Datetime
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006
Jul 2006
Jan 2007
Jul 2007
Jan 2008

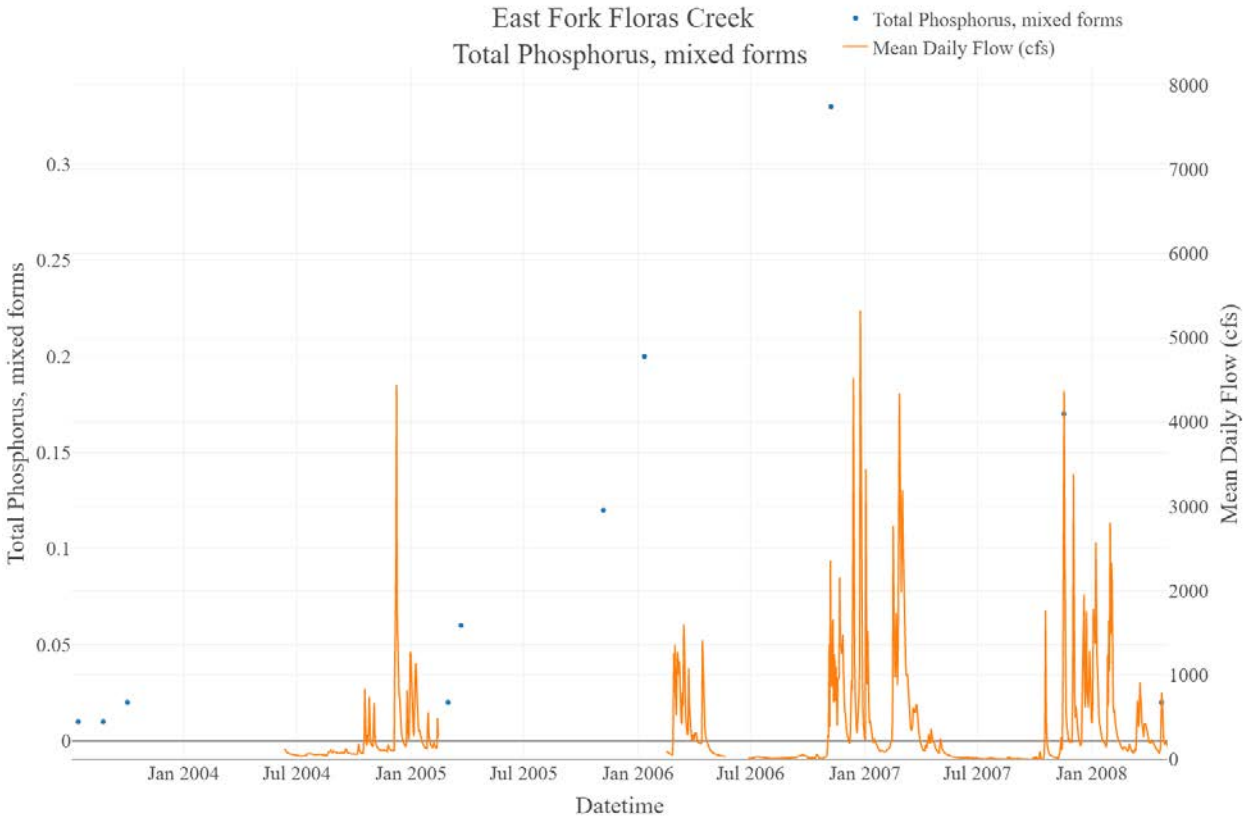


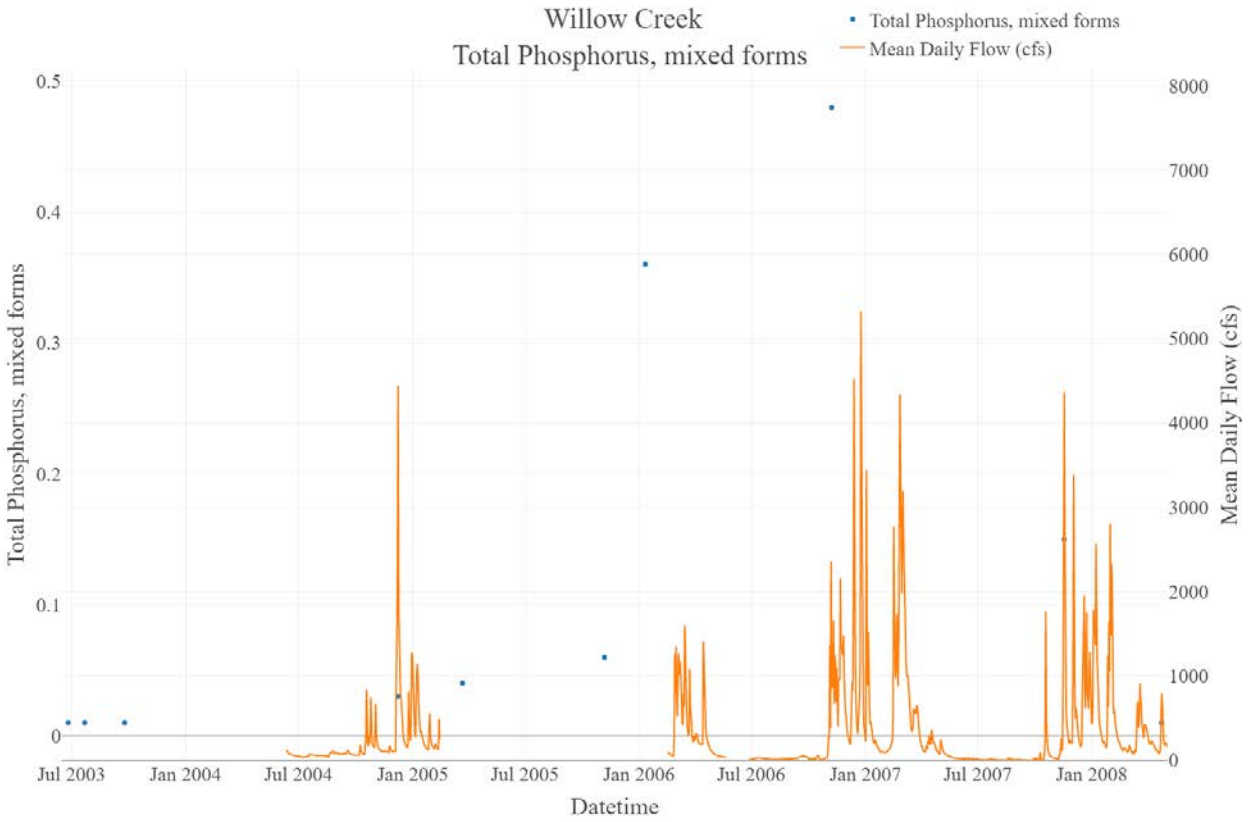
Total Phosphorus

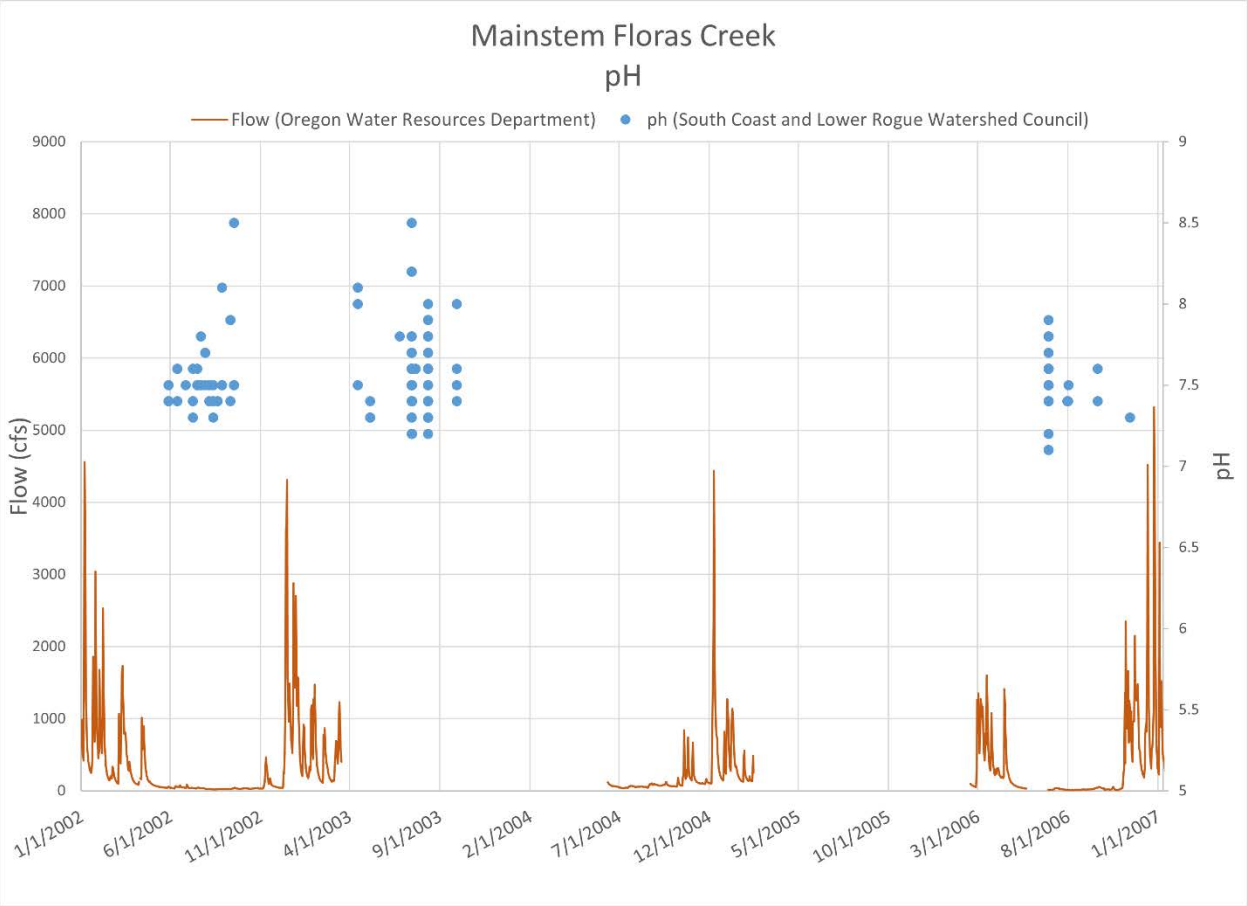



South Fork Floras Creek
Total Phosphorus, mixed forms
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
0.6
0.5
0.4
0.3
0.2
0.1
0
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006
Jul 2006
Jan 2007
Jul 2007
Jan 2008
Datetime


North Fork Floras Creek
Total Phosphorus, mixed forms
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
0.6
0.5
0.4
0.3
0.2
0.1
0
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006
Jul 2006
Jan 2007
Jul 2007
Jan 2008
Datetime


East Fork Floras Creek
Total Phosphorus, mixed forms
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
0.3
0.25
0.2
0.15
0.1
0.05
0
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006
Jul 2006
Jan 2007
Jul 2007
Jan 2008
Datetime


Willow Creek
Total Phosphorus, mixed forms
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
Total Phosphorus, mixed forms
Mean Daily Flow (cfs)
0.5
0.4
0.3
0.2
0.1
0
8000
7000
6000
5000
4000
3000
2000
1000
0
Jul 2003
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006
Jul 2006
Jan 2007
Jul 2007
Jan 2008
Datetime


Mainstem Floras Creek
pH
Flow (Oregon Water Resources Department)
ph (South Coast and Lower Rogue Watershed Council)
Flow (cfs)
pH
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
9
8.5
8
7.5
7
6.5
6
5.5
5
1/1/2002
6/1/2002
11/1/2002
4/1/2003
9/1/2003
2/1/2004
7/1/2004
12/1/2004
5/1/2005
10/1/2005
3/1/2006
8/1/2006
1/1/2007