

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration

CENTRAL DISTRICT • INDIAN RIVER LAGOON BASIN

TMDL Report

**Dissolved Oxygen and Nutrient TMDLs for
Eight Tributary Segments of the Indian River
Lagoon
(Appendices)**

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. In 1994, the Department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the state's water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations.

Chapter 62-40, F.A.C., also requires the water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG had been developed for Newnans Lake when this report was published.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as municipal separate storm sewer systems (MS4s). However, because the master drainage systems of most local governments in Florida are interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the 15 counties meeting the population criteria. EPA authorized the Department to implement the NPDES stormwater program (with the exception of Indian lands) in October 2000.

An important difference between the federal NPDES and the state's stormwater/environmental resource permitting programs is that the NPDES Program covers both new and existing discharges, while the state's program focuses on new discharges only. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 1,000 people. These revised rules require that these additional activities obtain permits by 2003.

While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that all MS4 permits issued in Florida include a re-

opener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Aggregation of FLUCCS Level III Land Use Categories into a Seven-Land Use Classification System Used by the SJRWMD to Develop HSPF models.

Level III FLUCCS Code	HSPF Landuse	Level III FLUCCS Code	HSPF Landuse	Level III FLUCCS Code	HSPF Landuse
1000	High-Intensity use urban	2000	Agriculture	5400	Wetlands
1100	Low-Intensity use urban	2100	Agriculture	5430	Wetlands
1180	Open land	2110	Agriculture	5500	Wetlands
1190	Low-Intensity use urban	2120	Agriculture	5600	Wetlands
1200	Medium-intensity use urban	2130	Agriculture	6000	Wetlands
1290	Medium-intensity use urban	2140	Agriculture	6100	Wetlands
1300	High-Intensity use urban	2143	Agriculture	6110	Wetlands
1390	High-Intensity use urban	2150	Agriculture	6120	Wetlands
1400	High-Intensity use urban	2160	Agriculture	6170	Wetlands
1460	High-Intensity use urban	2200	Agriculture	6180	Wetlands
1480	Low-Intensity use urban	2210	Agriculture	6181	Wetlands
1490	High-Intensity use urban	2240	Forest	6182	Wetlands
1500	High-Intensity use urban	2300	Agriculture	6200	Wetlands
1510	High-Intensity use urban	2310	Agriculture	6210	Wetlands
1520	High-Intensity use urban	2320	Agriculture	6220	Wetlands
1523	High-Intensity use urban	2400	Agriculture	6250	Wetlands
1530	High-Intensity use urban	2410	Agriculture	6300	Wetlands
1540	High-Intensity use urban	2420	Agriculture	6400	Wetlands
1550	High-Intensity use urban	2430	Agriculture	6410	Wetlands
1560	High-Intensity use urban	2431	Agriculture	6420	Wetlands
1561	High-Intensity use urban	2432	Agriculture	6430	Wetlands
1562	High-Intensity use urban	2450	Agriculture	6440	Wetlands
1563	High-Intensity use urban	2500	Agriculture	6460	Wetlands
1590	High-Intensity use urban	2510	Agriculture	6500	Wetlands
1600	Low-Intensity use urban	2520	Agriculture	7000	Open land
1610	Low-Intensity use urban	2540	Agriculture	7100	Low-Intensity use urban
1611	Low-Intensity use urban	2600	Open land	7200	Low-Intensity use urban
1612	Low-Intensity use urban	2610	Open land	7400	Low-Intensity use urban
1613	Low-Intensity use urban	3000	Open land	7410	Low-Intensity use urban
1620	Low-Intensity use urban	3100	Open land	7420	Low-Intensity use urban
1630	Low-Intensity use urban	3200	Open land	7430	Open land
1632	Low-Intensity use urban	3300	Open land	8000	High-Intensity use urban
1633	Low-Intensity use urban	4000	Forest	8100	High-Intensity use urban
1640	Low-Intensity use urban	4100	Forest	8110	High-Intensity use urban

Level III FLUCCS Code	HSPF Landuse	Level III FLUCCS Code	HSPF Landuse	Level III FLUCCS Code	HSPF Landuse
1650	Low-Intensity use urban	4110	Forest	8120	Low-Intensity use urban
1660	Low-Intensity use urban	4120	Forest	8130	High-Intensity use urban
1670	Wetlands	4130	Forest	8140	High-Intensity use urban
1700	High-Intensity use urban	4200	Forest	8150	High-Intensity use urban
1730	High-Intensity use urban	4210	Forest	8160	Wetlands
1750	High-Intensity use urban	4280	Forest	8180	High-Intensity use urban
1800	Low-Intensity use urban	4300	Forest	8200	Low-Intensity use urban
1810	Open land	4340	Forest	8300	High-Intensity use urban
1820	Medium-intensity use urban	4370	Forest	8310	High-Intensity use urban
1830	High-Intensity use urban	4400	Forest	8320	Open land
1840	High-Intensity use urban	4410	Forest	8330	High-Intensity use urban
1850	Low-Intensity use urban	4430	Forest	8340	High-Intensity use urban
1860	Open land	5000	Wetlands	8350	High-Intensity use urban
1870	High-Intensity use urban	5100	Wetlands	8360	Wetlands
1890	Low-Intensity use urban	5200	Wetlands	8370	Wetlands
1900	Open land	5250	Wetlands		
1920	Low-Intensity use urban	5300	Wetlands		

Appendix C: Flow Calibration and Validation for HSPF Models Developed by the CDM

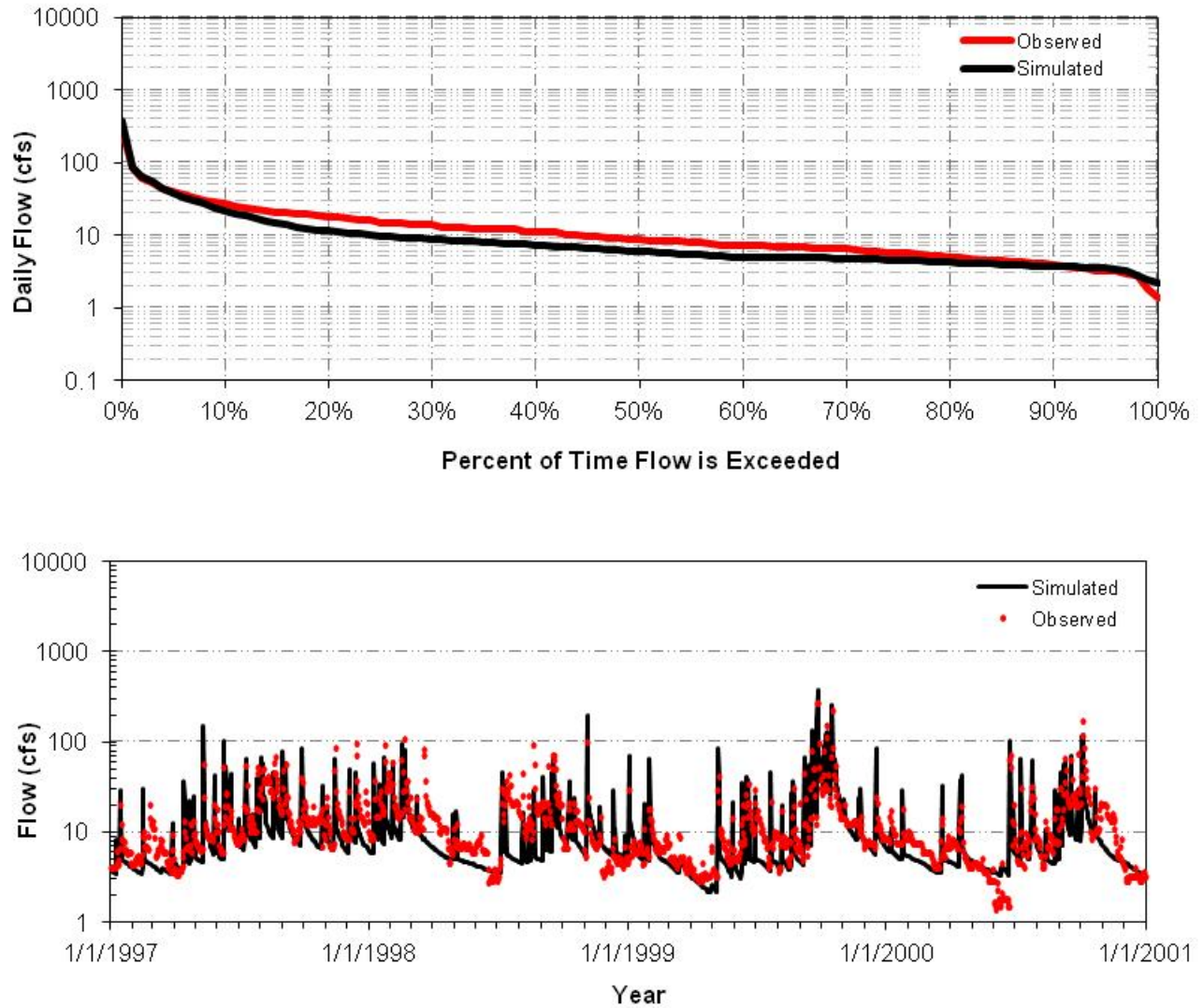


Figure C1-a. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02249007 (Eau Gallie River) During the Calibration Period (1997 through 2000)

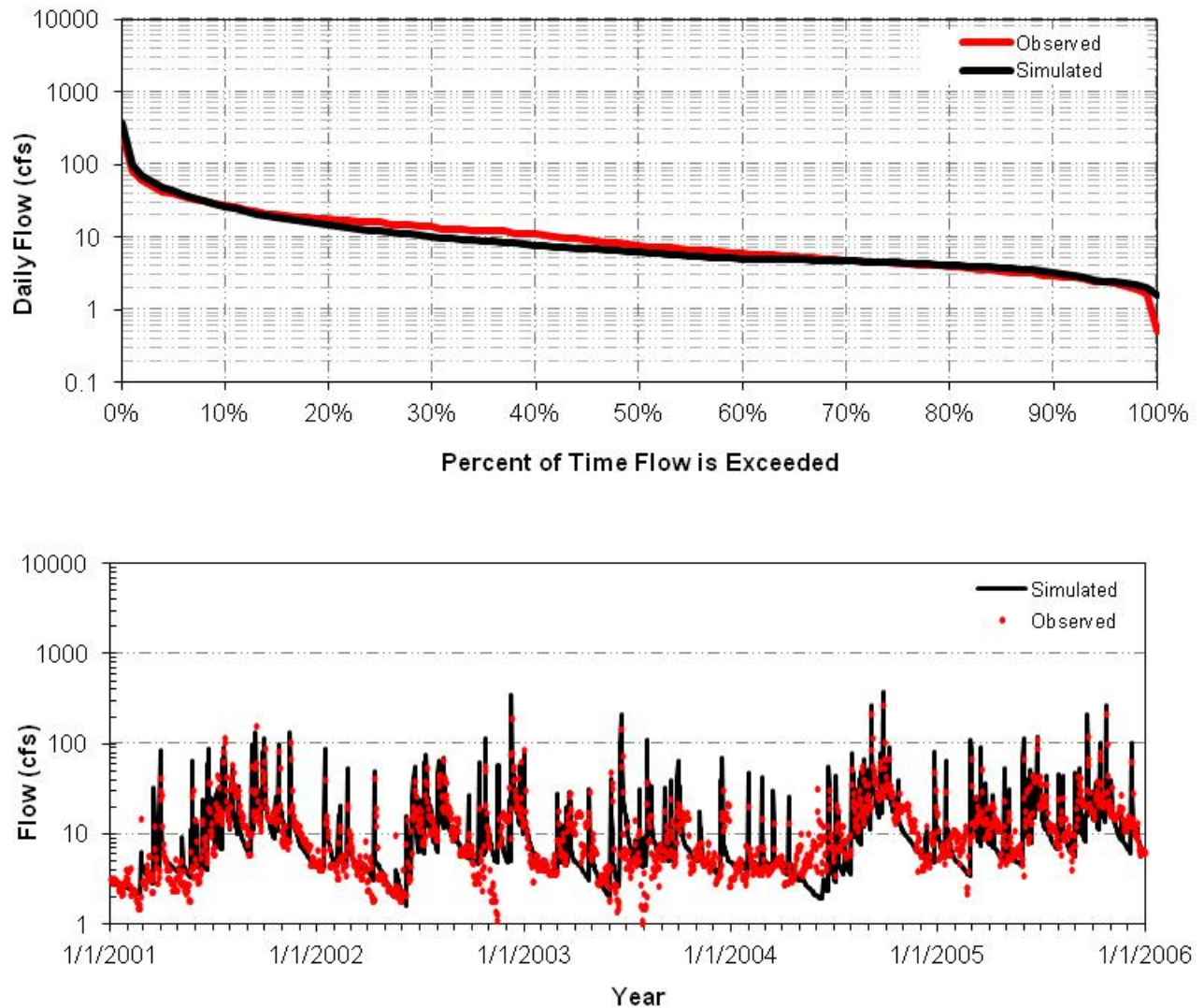


Figure C1-b. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02249007 (Eau Gallie River) During the Validation Period (2001 through 2005)

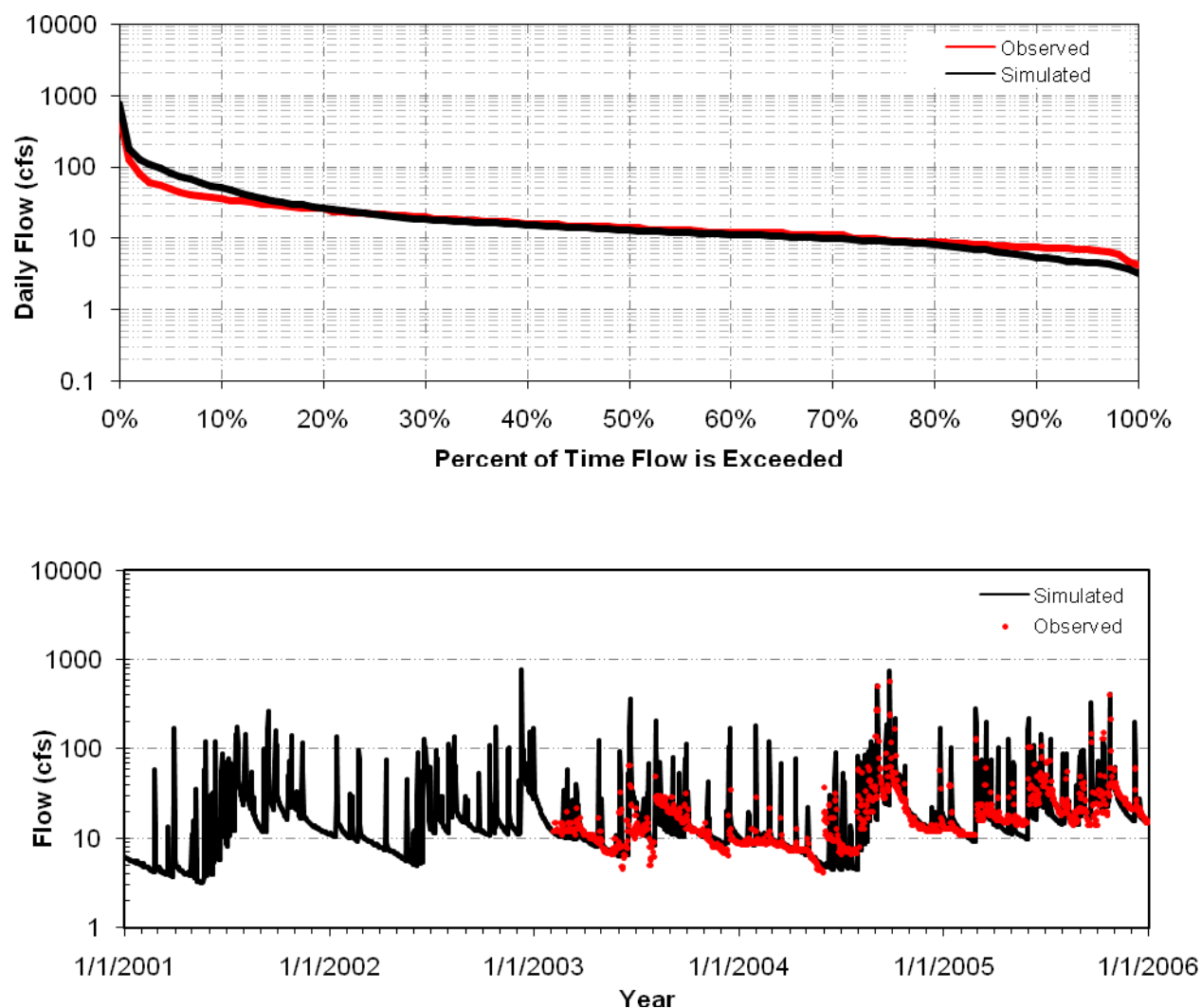


Figure C2-a. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02249500 (Crane Creek) During the Validation Period (2001 through 2005)

Note: Because the flow records at USGS Station 02249500 in Crane Creek started only in February of 2003. No calibration period results can be shown in here.

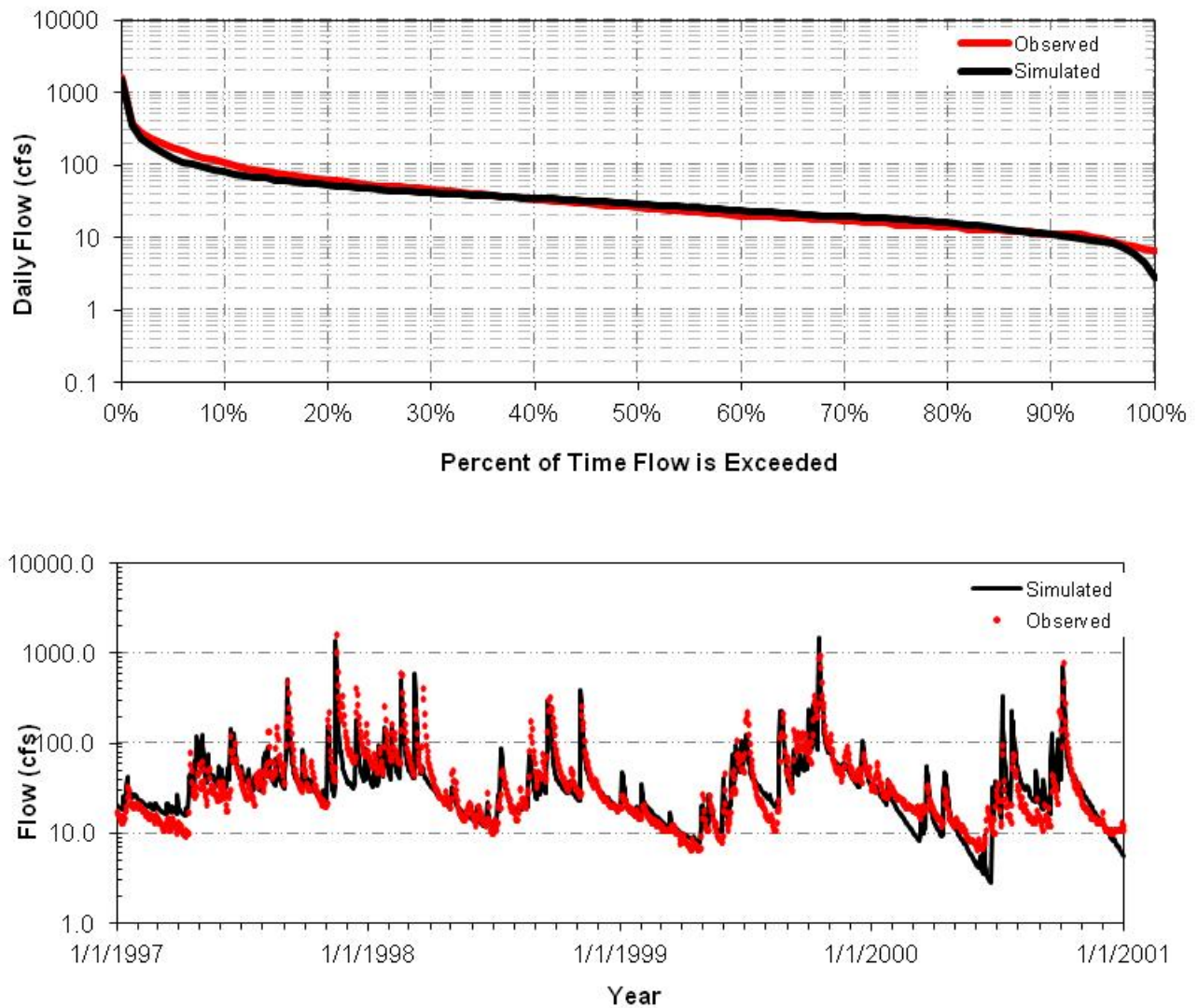


Figure C3-a. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02251500 (North Prong of Sebastian River) During the Calibration Period (1997 through 2000)

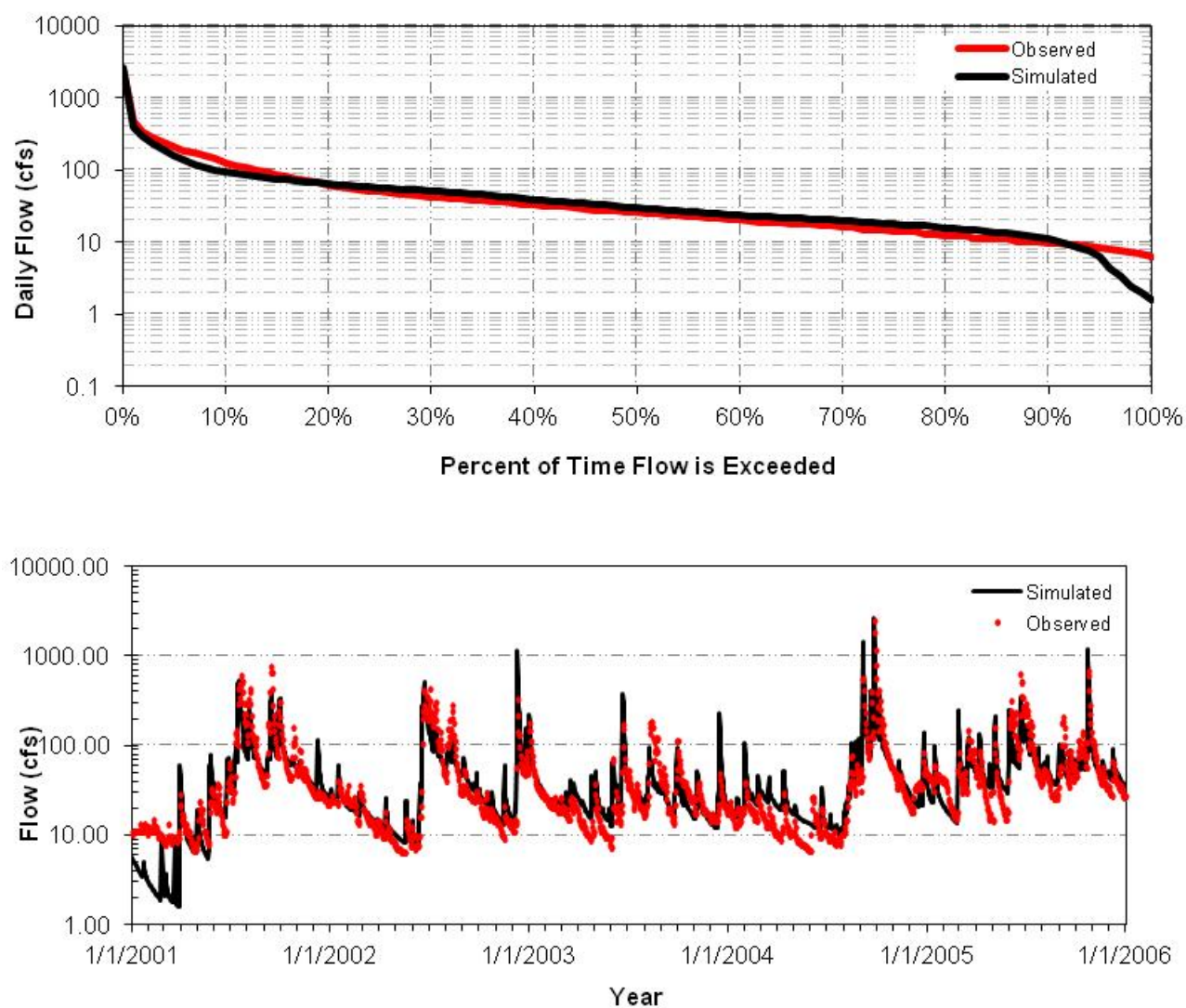


Figure C3-b. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02251500 (North Prong of Sebastian River) During the Validation Period (2001 through 2005)

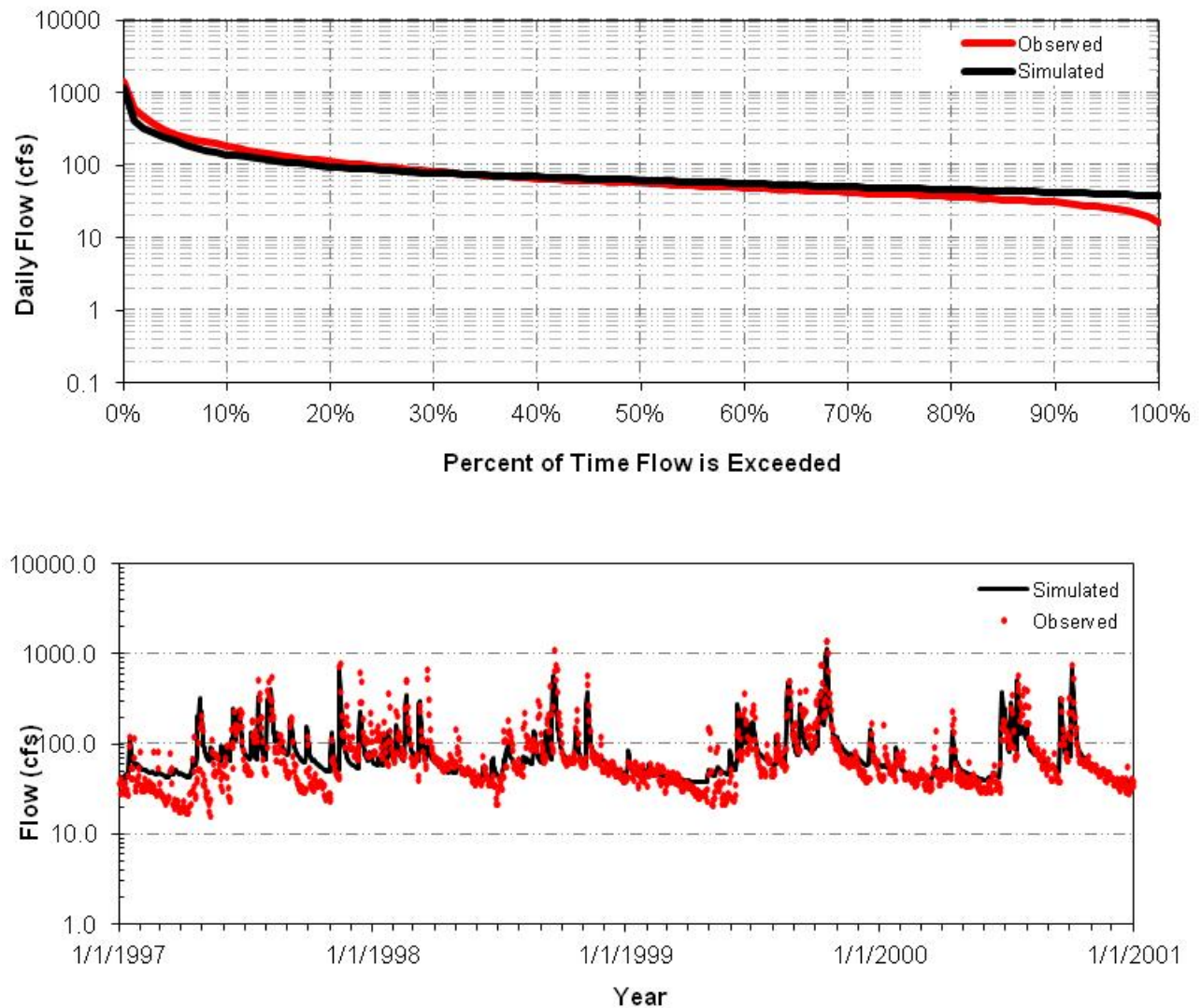


Figure C4-a. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02251767 (Fellsmere Canal) During the Calibration Period (1997 through 2000)

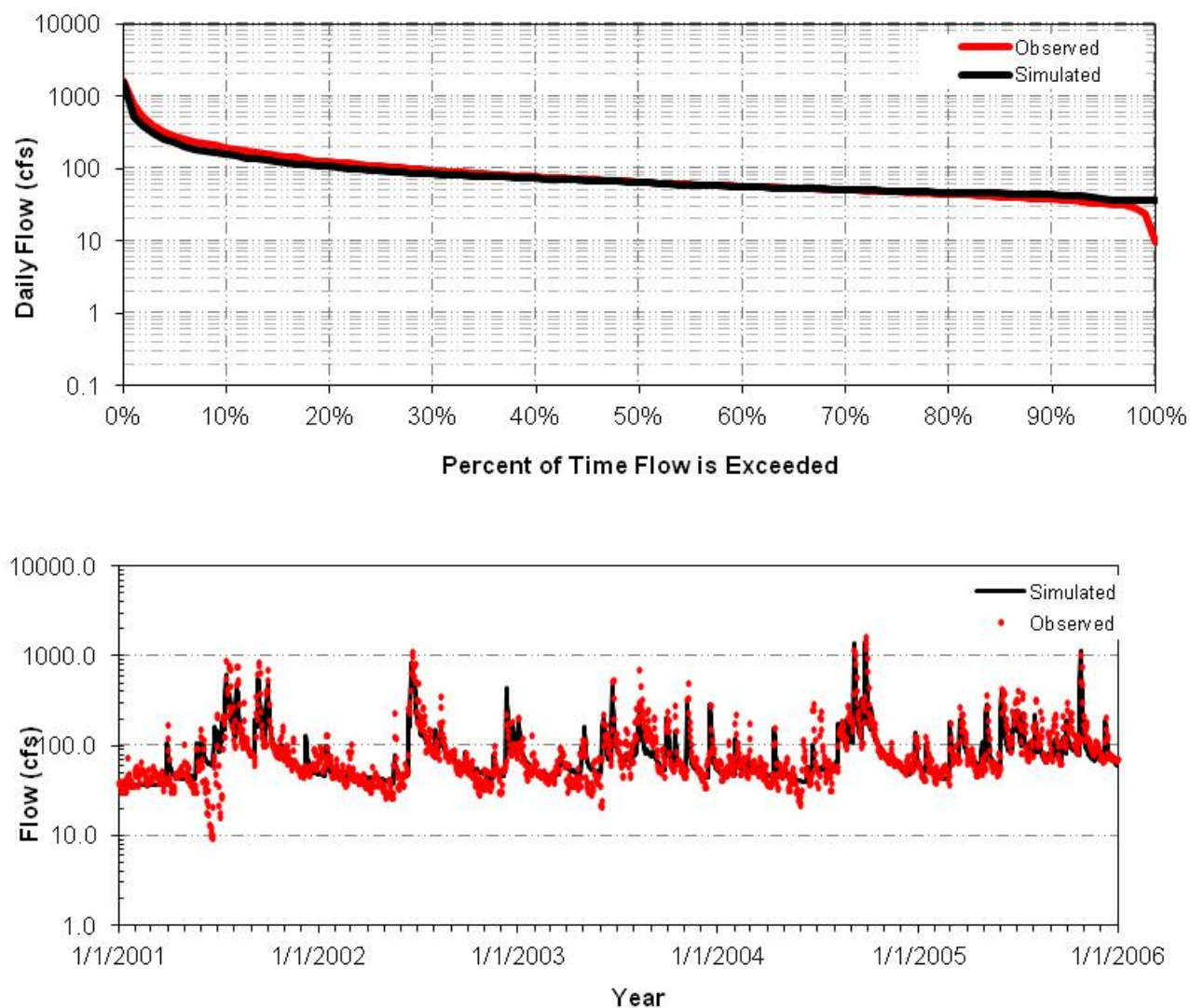


Figure C4-b. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02251767 (Fellsmere Canal) During the Validation Period (2001 through 2005)

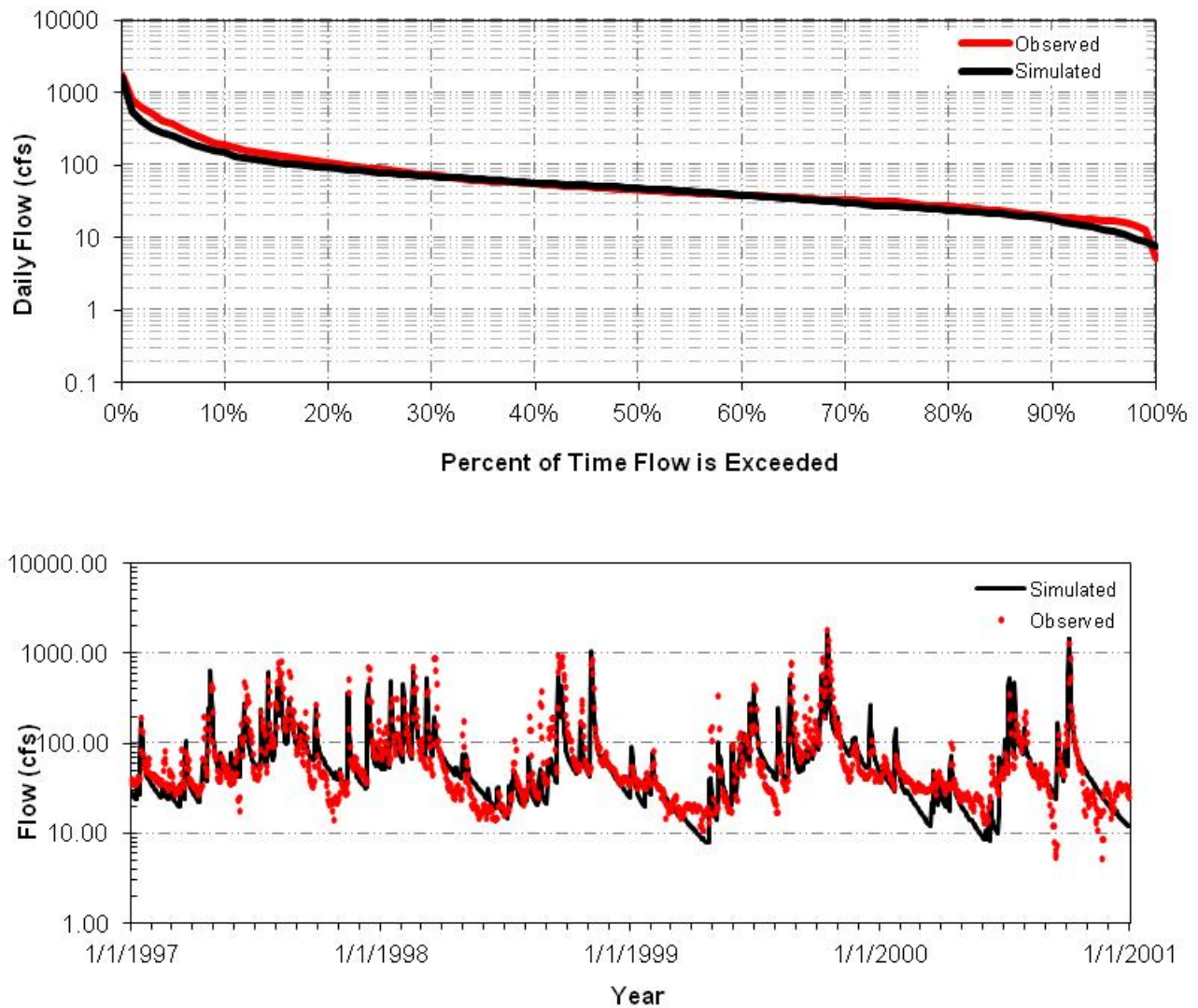


Figure C5-a. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02251000 (South Prong of Sebastian River) During the Calibration Period (1997 through 2000)

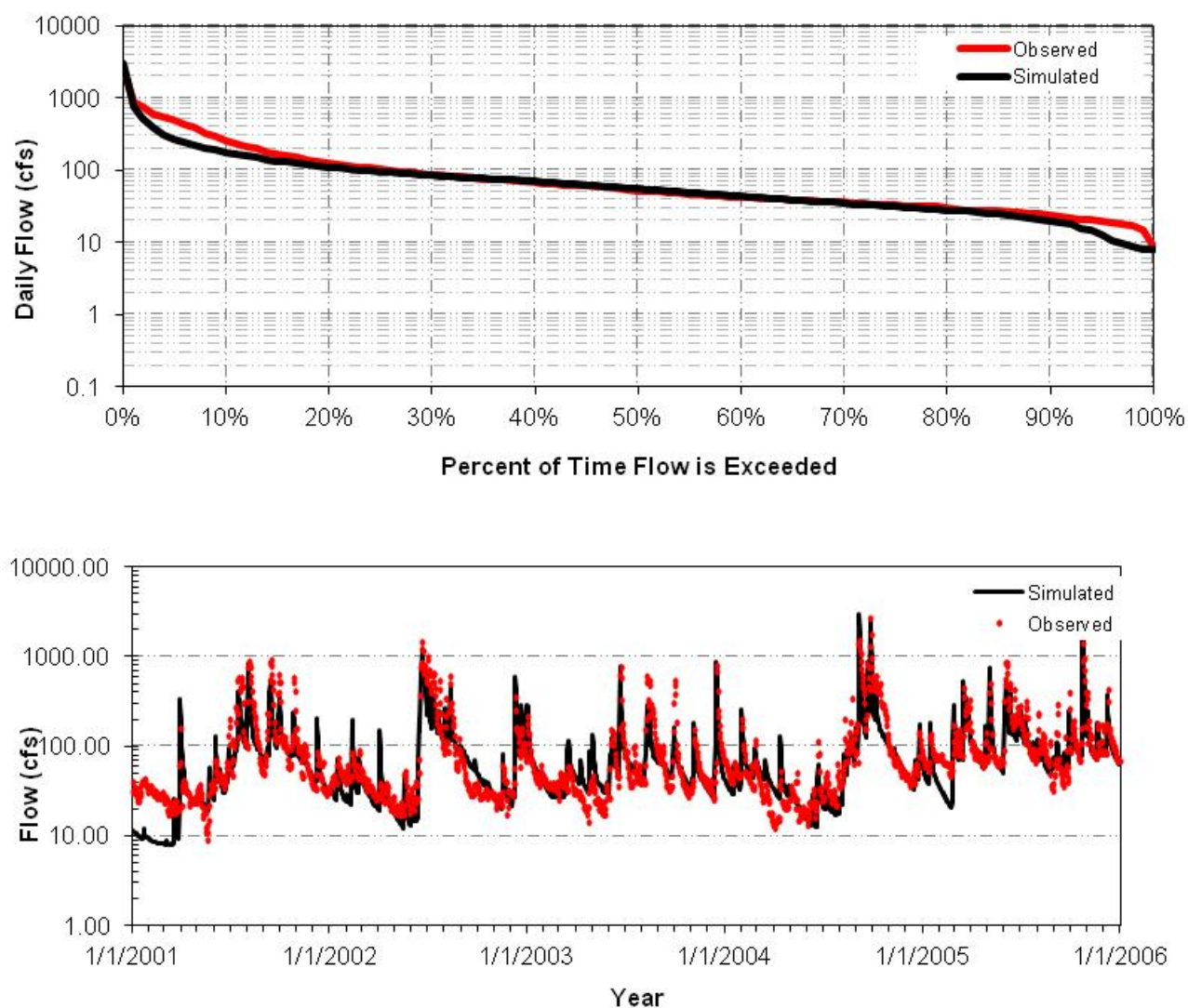


Figure C5-b. Frequency-Exceedance Curve (top), and Log-Scale Flow Time Series (Bottom) for USGS Station 02251000 (South Prong of Sebastian River) During the Validation Period (2001 through 2005)

Appendix D. Results of HSPF Model Water Quality Calibration and Validation

Statistics Report for Temperature - Calibration Period**Wilcoxon Rank Sum Test**

P-Value: 34.5%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 98.3%

Result: Distributions do not appear to be different

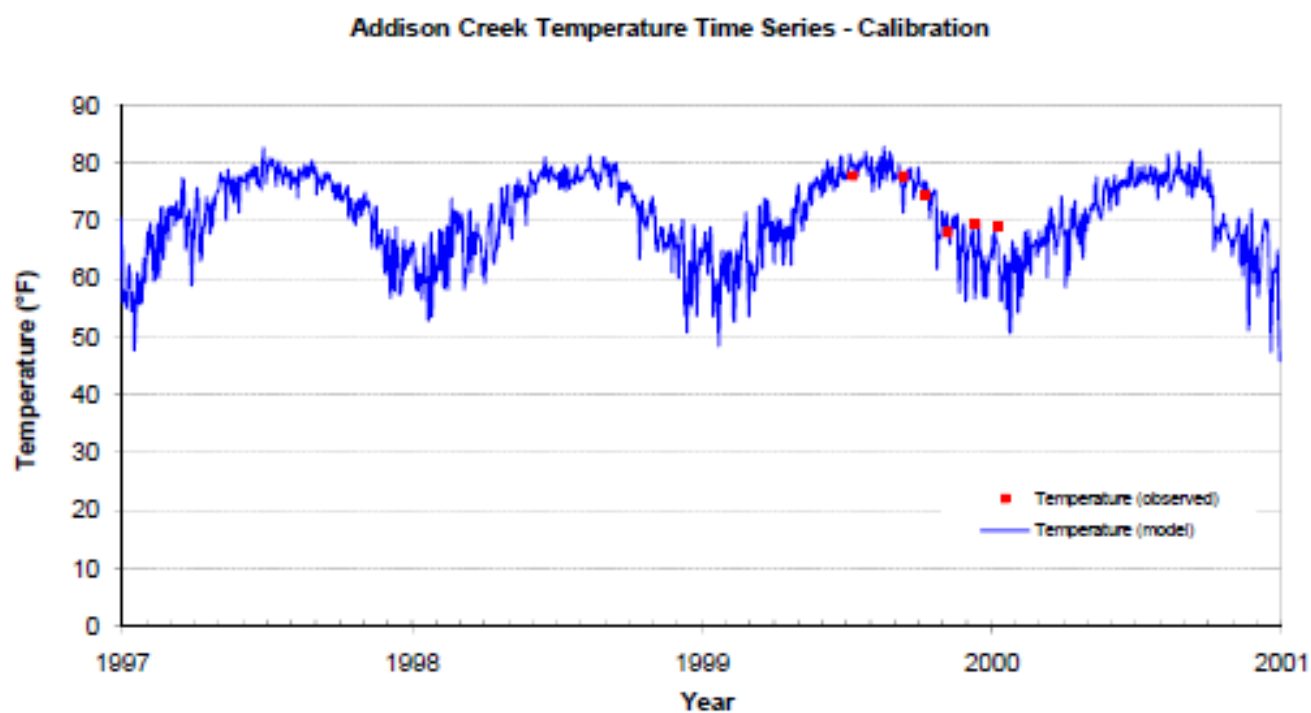


Figure D1-1. Model Simulated and Measured Water Temperature for Addison Creek in the Calibration Period (1997 through 2000)

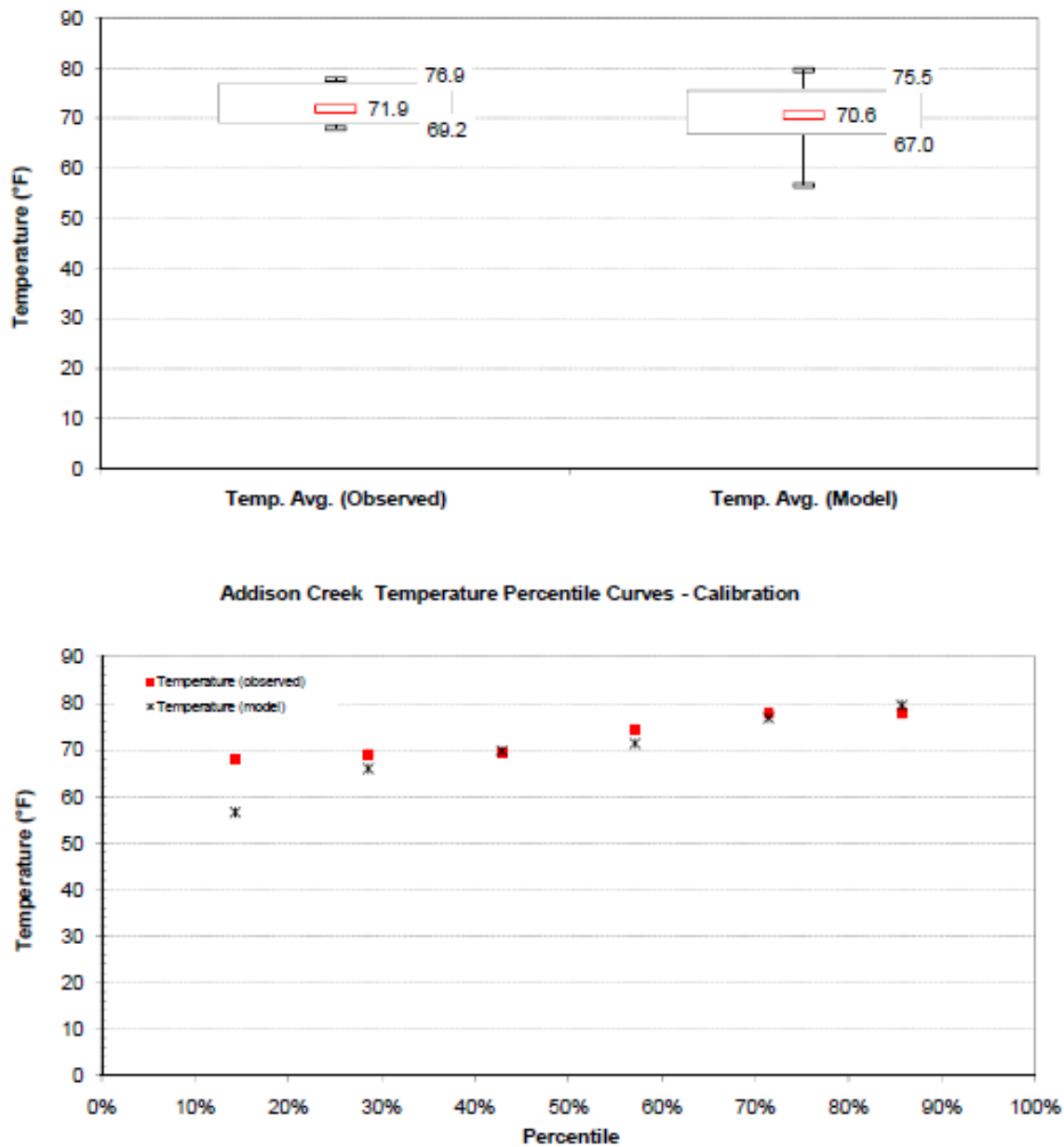


Figure D1-2. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Water Temperature in Addison Creek in the Calibration Period (1997 through 2000)

Statistics Report for Temperature - Validation Period**Wilcoxon Rank Sum Test**

P-Value: 79.3%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 153.3%

Result: Distributions do not appear to be different

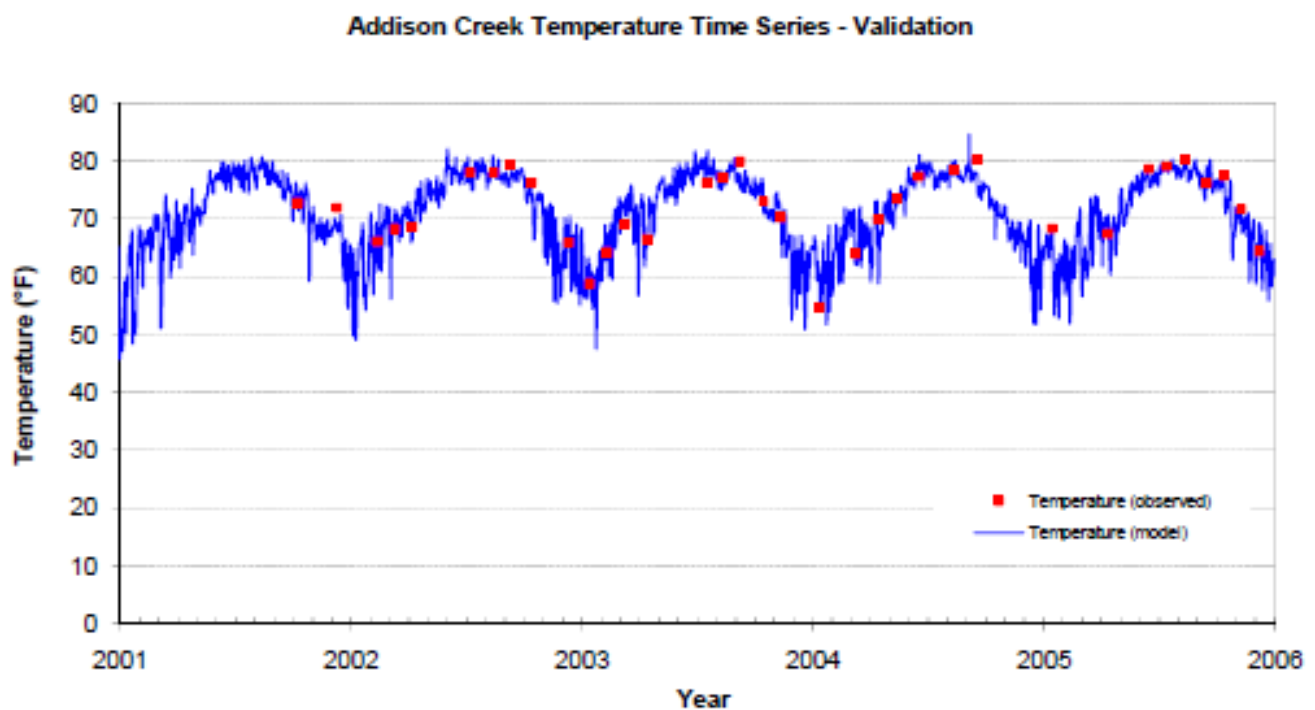


Figure D1-3. Model Simulated and Measured Water Temperature for Addison Creek in the Validation Period (2001 through 2005)

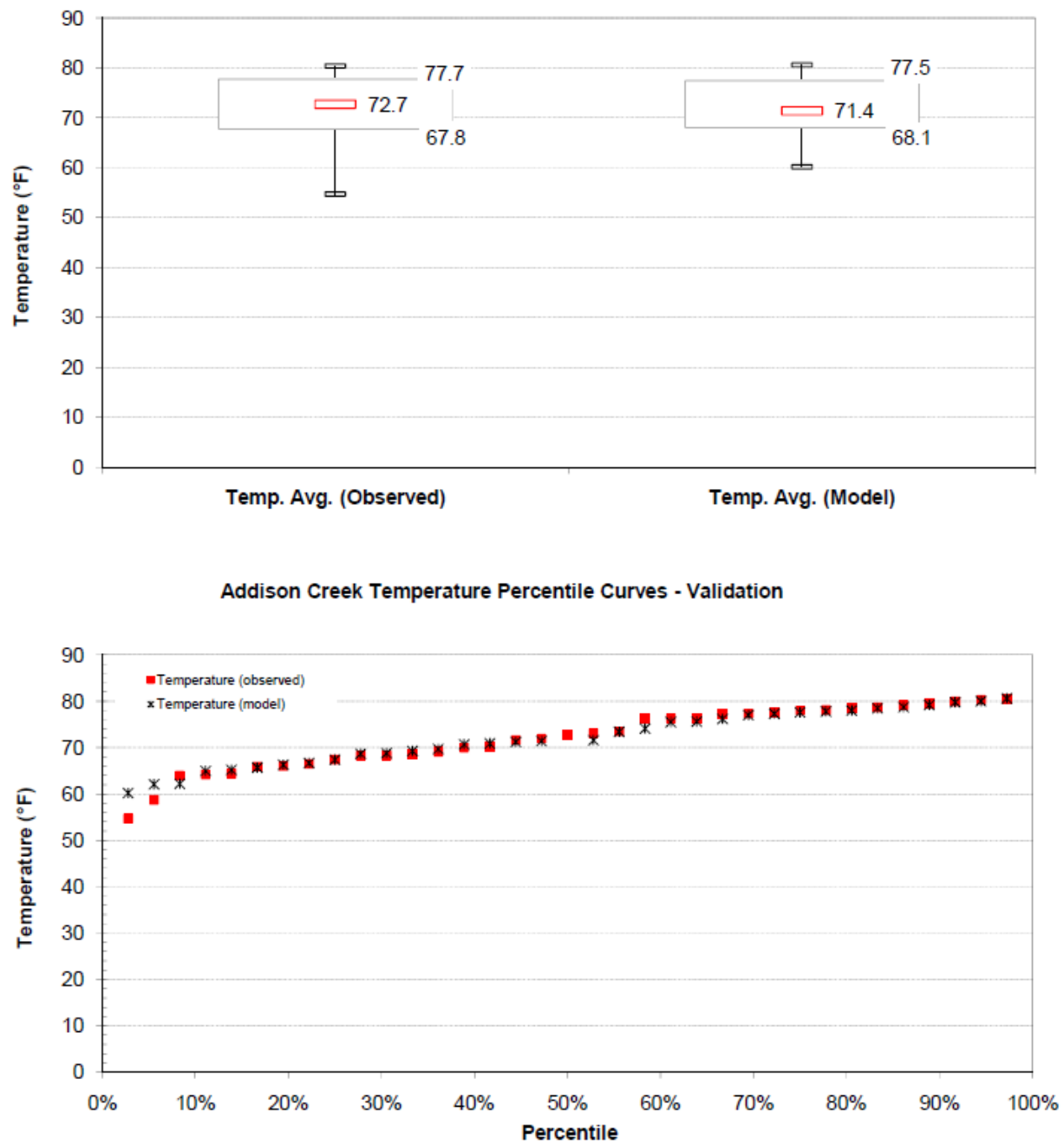


Figure D1-4. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Water Temperature in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Dissolved Oxygen - Calibration Period**Wilcoxon Rank Sum Test**

P-Value: 46.3%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 32.1%

Result: Distributions do not appear to be different

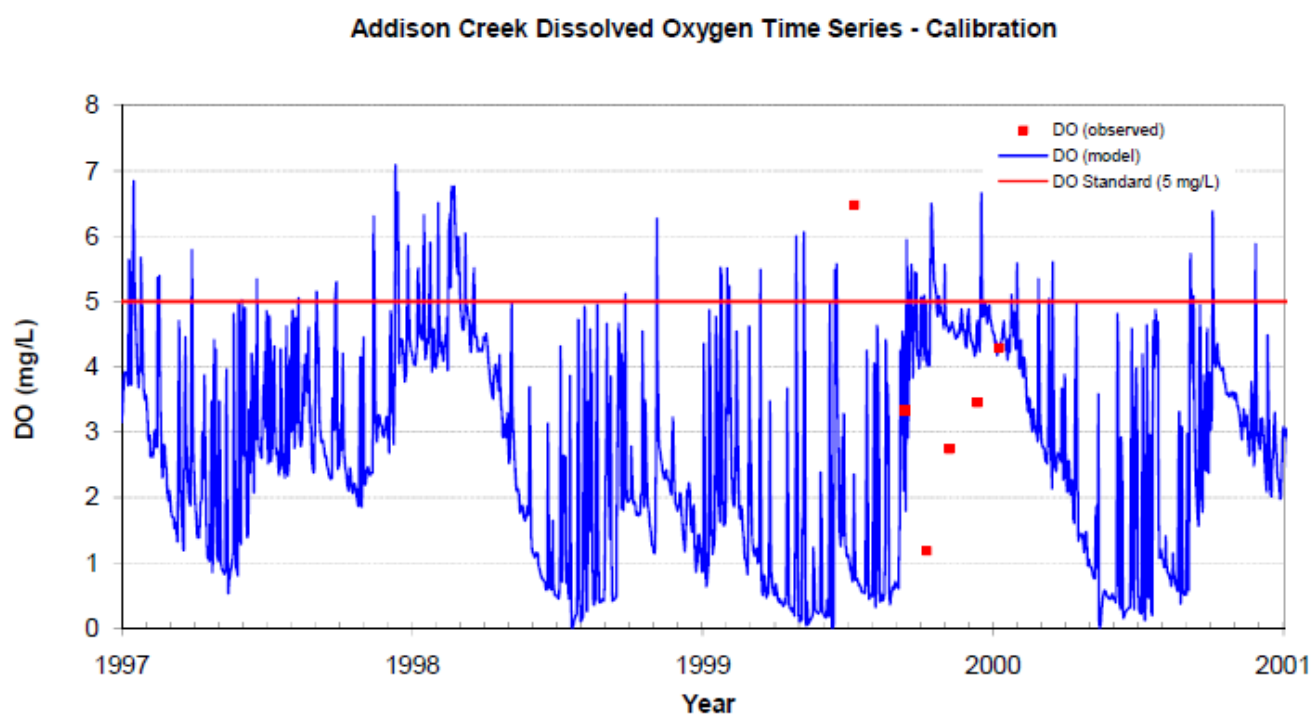


Figure D1-5. Model Simulated and Measured Dissolved Oxygen for Addison Creek in the Calibration Period (1997 through 2000)

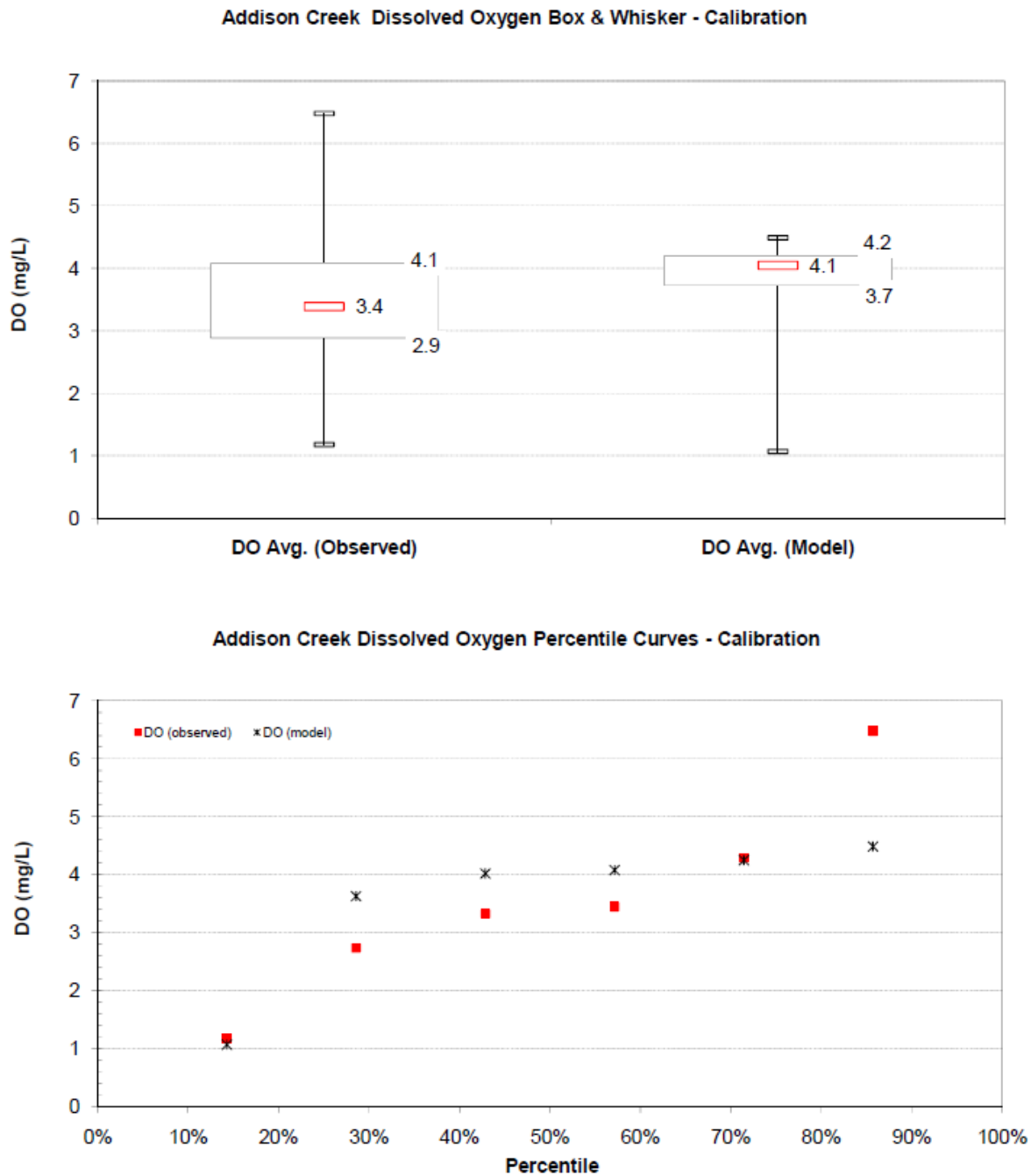


Figure D1-6. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in Addison Creek in the Calibration Period (1997 through 2000)

Statistics Report for Dissolved Oxygen - Validation Period

Wilcoxon Rank Sum Test

P-Value: 56.7%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 8.5%

Result: Distributions do not appear to be different

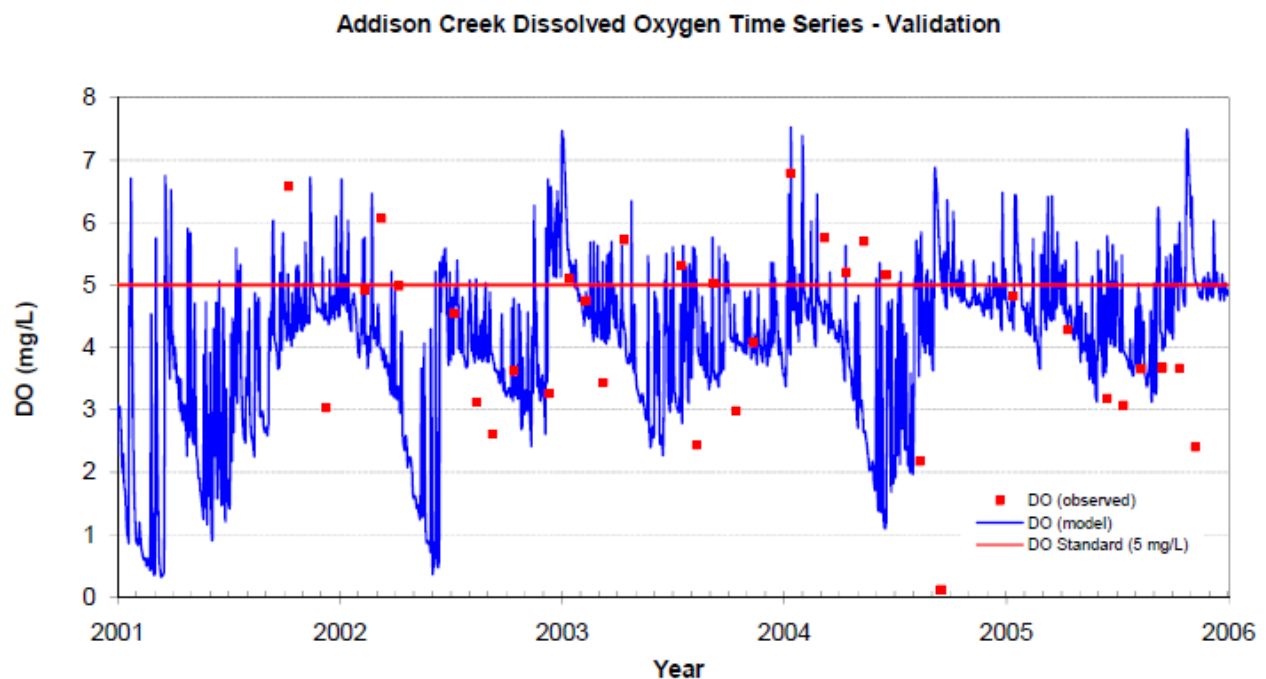


Figure D1-7. Model Simulated and Measured Dissolved Oxygen for Addison Creek in the Validation Period (2001 through 2005)

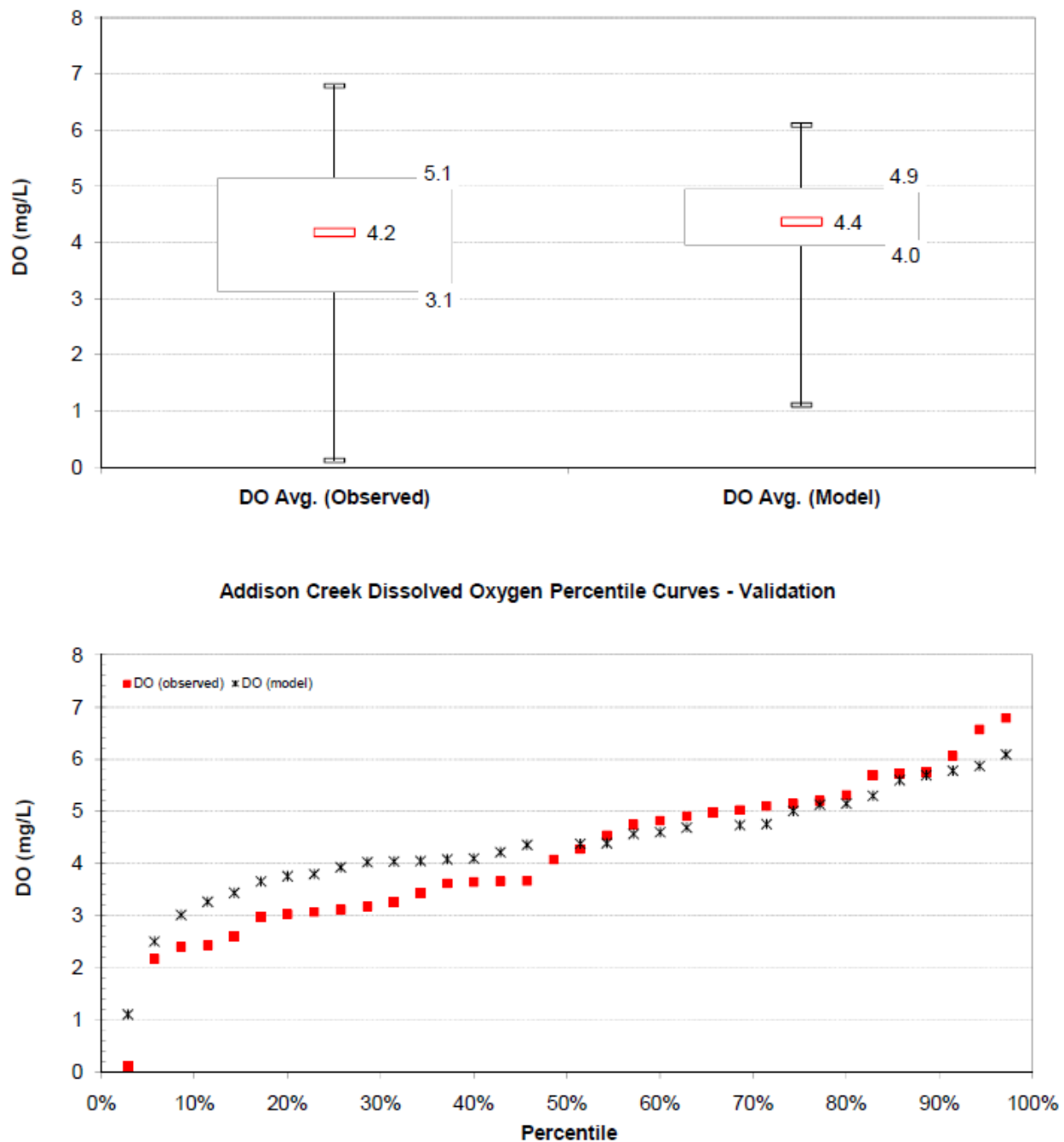


Figure D1-8. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Dissolved Oxygen - Validation Period

Wilcoxon Rank Sum Test

P-Value: 100.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 43.2%

Result: Distributions do not appear to be different

NOTE: Observed CBODu values are estimates based on an ultimate-to-5 day ratio of 3.2 for observed 5-day BOD measurements

Addison Creek Ultimate CBOD Time Series - Validation

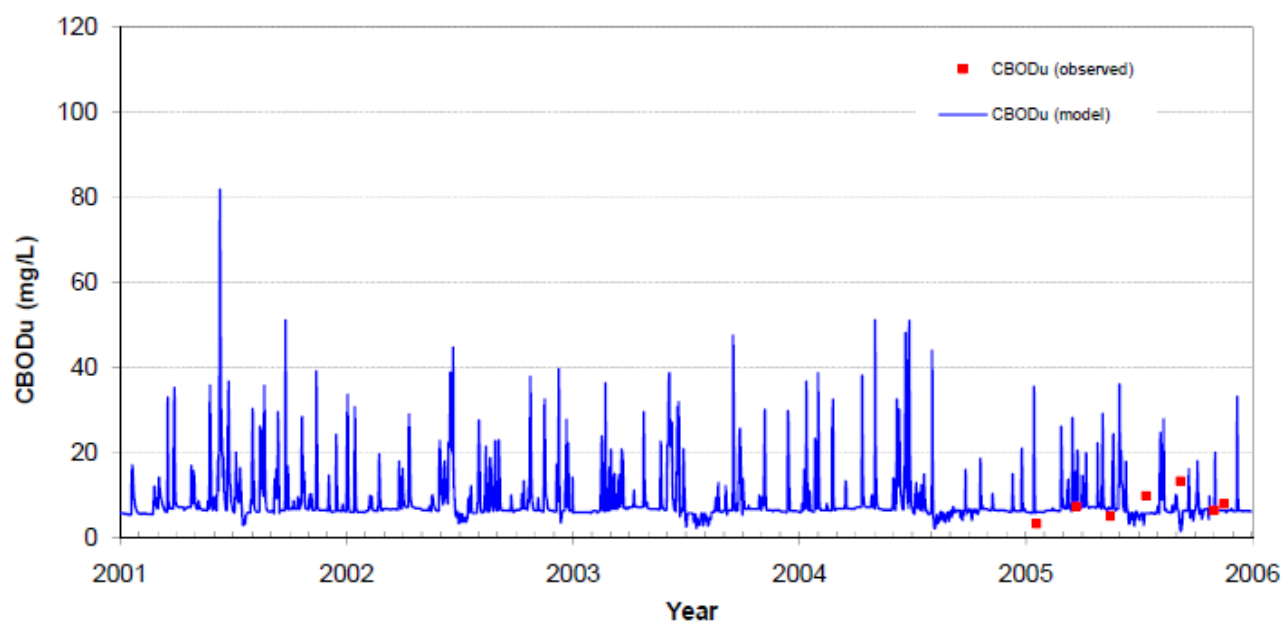


Figure D1-9. Model Simulated and Measured BOD for Addison Creek in the Validation Period (2001 through 2005)

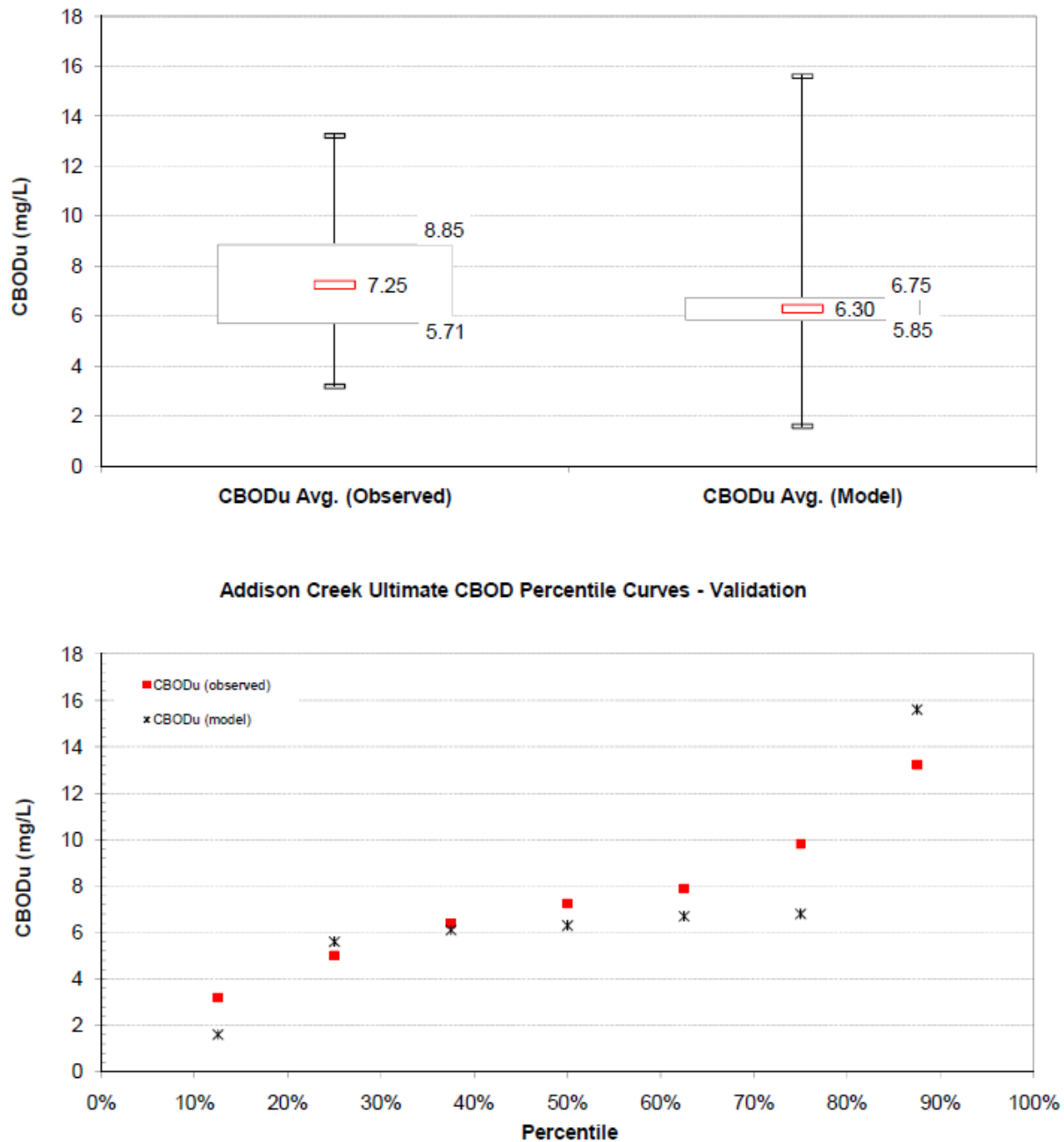


Figure D1-10. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated BOD in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Total Phosphorus - Calibration Period**Wilcoxon Rank Sum Test**

P-Value: 46.5%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 55.7%

Result: Distributions do not appear to be different

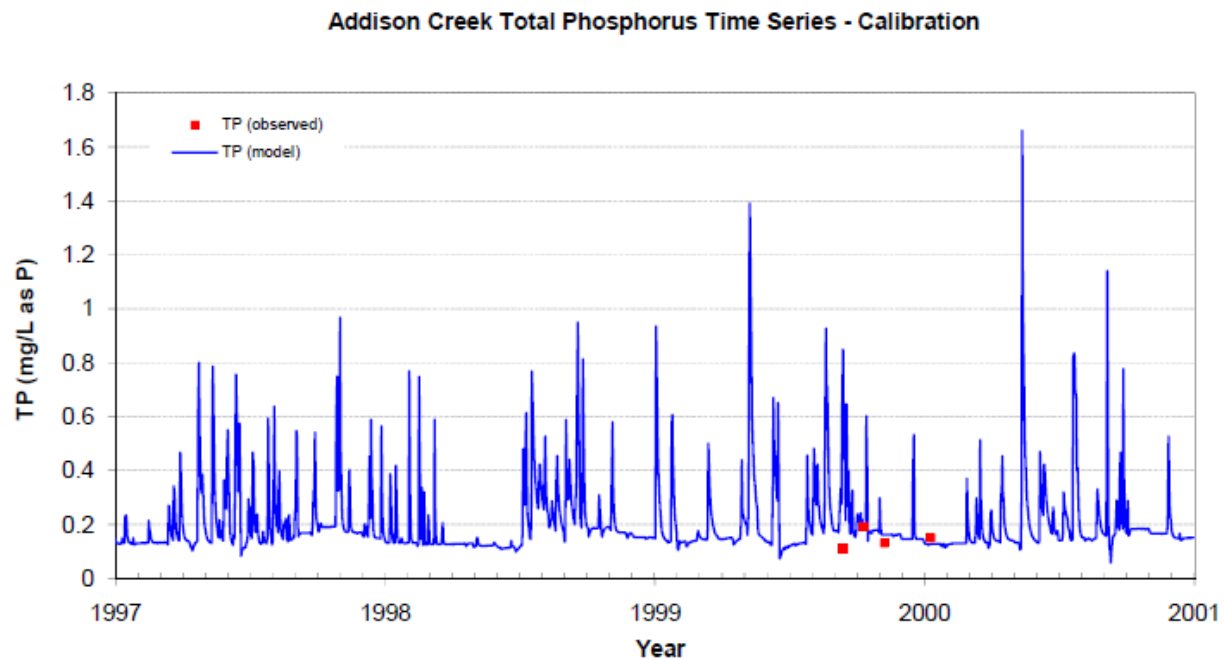


Figure D1-11. Model Simulated and Measured Total Phosphorus for Addison Creek in the Calibration Period (1997 through 2000)

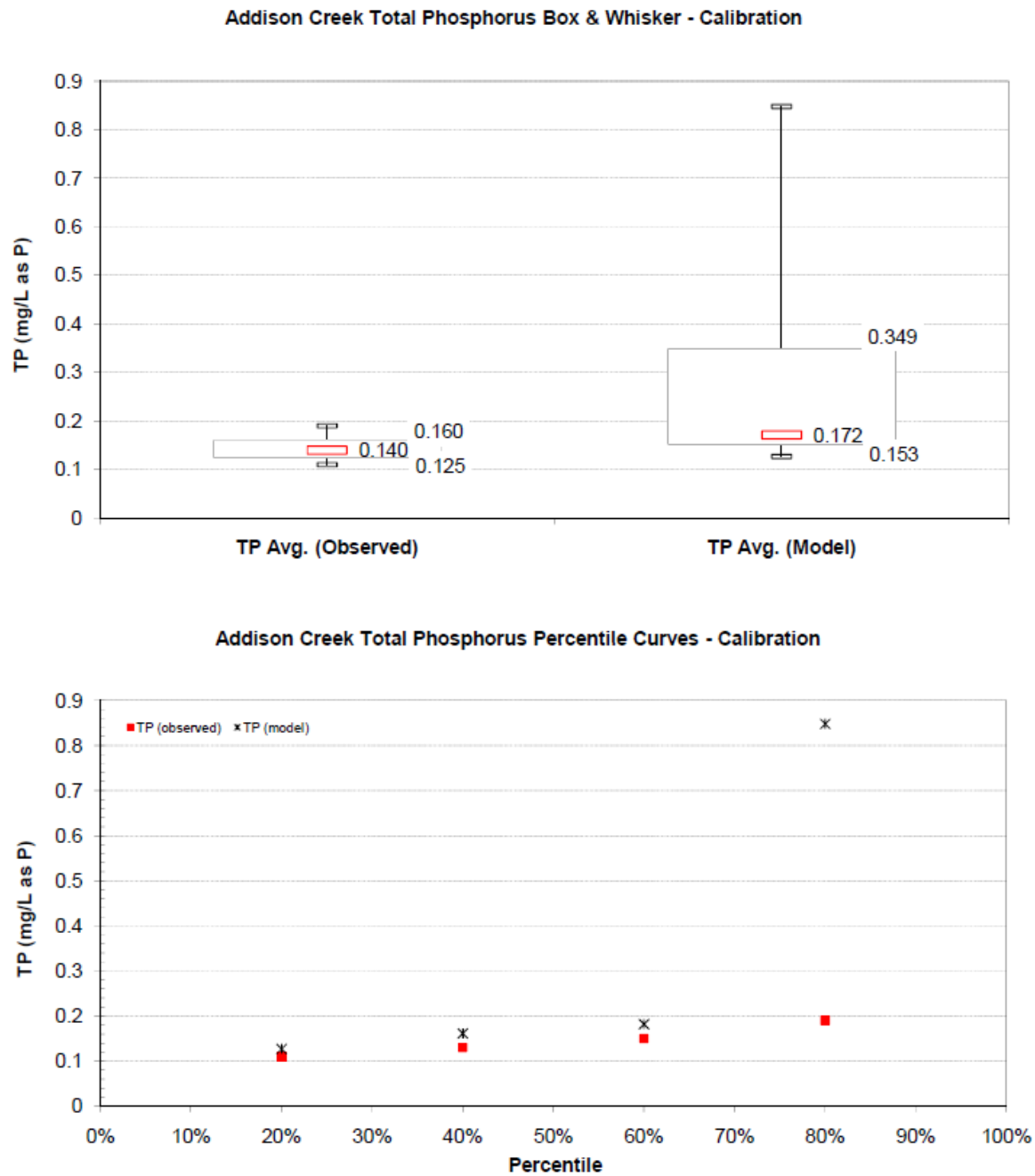


Figure D1-12. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in Addison Creek in the Calibration Period (1997 through 2000)

Statistics Report for Total Phosphorus - Validation Period**Wilcoxon Rank Sum Test**

P-Value: 14.5%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 7.7%

Result: Distributions do not appear to be different

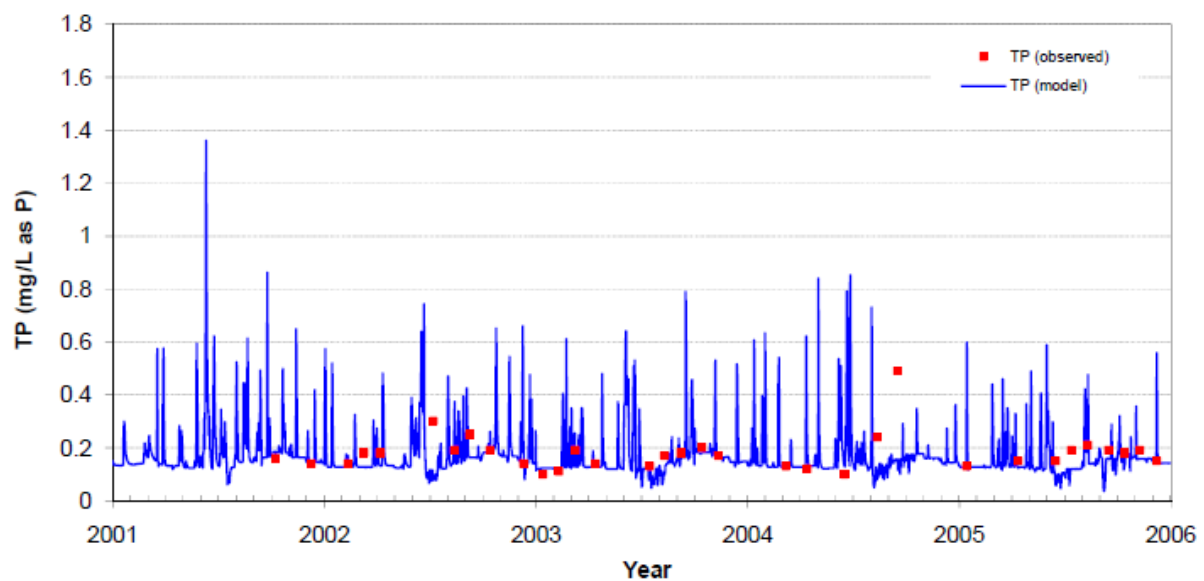
Addison Creek Total Phosphorus Time Series - Validation

Figure D1-13. Model Simulated and Measured Total Phosphorus for Addison Creek in the Validation Period (2001 through 2005)

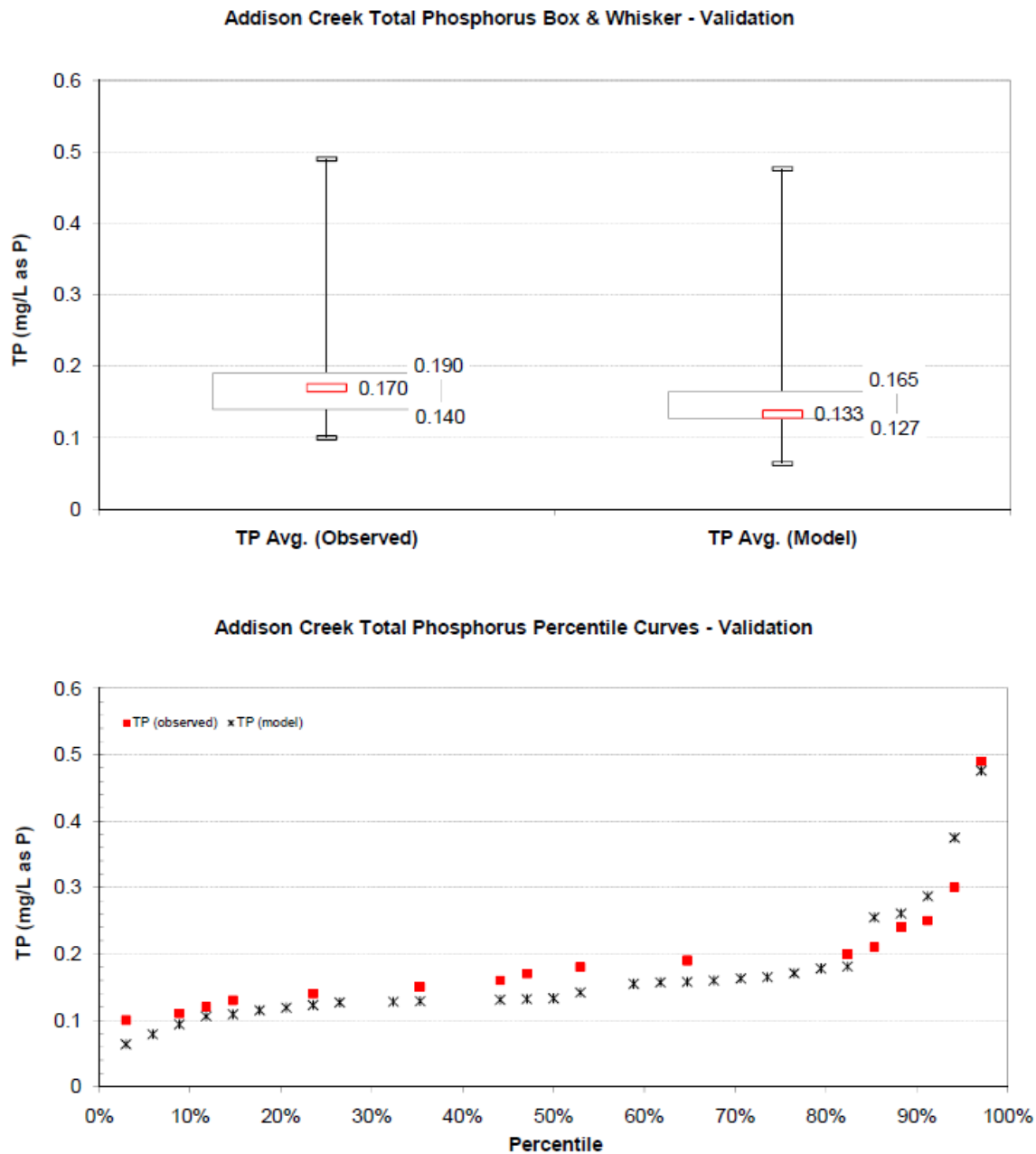


Figure D1-14. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Orthophosphate (Total) - Calibration Period**Wilcoxon Rank Sum Test**

P-Value: 14.4%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 55.7%

Result: Distributions do not appear to be different

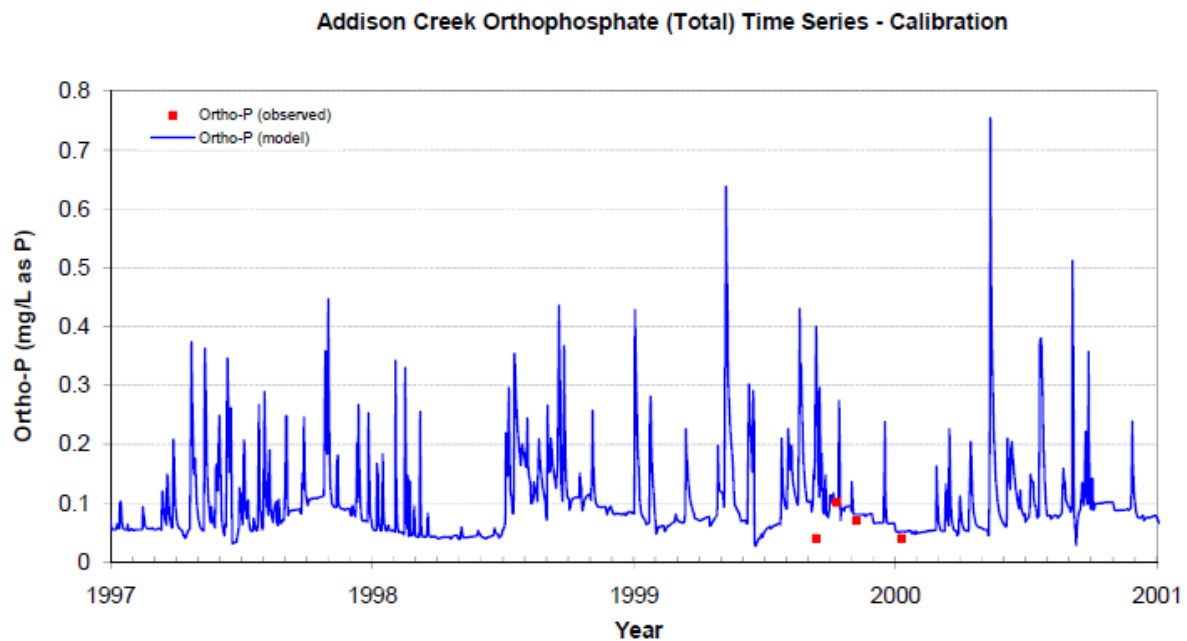


Figure D1-15. Model Simulated and Measured Orthophosphate for Addison Creek in the Calibration Period (1997 through 2000)

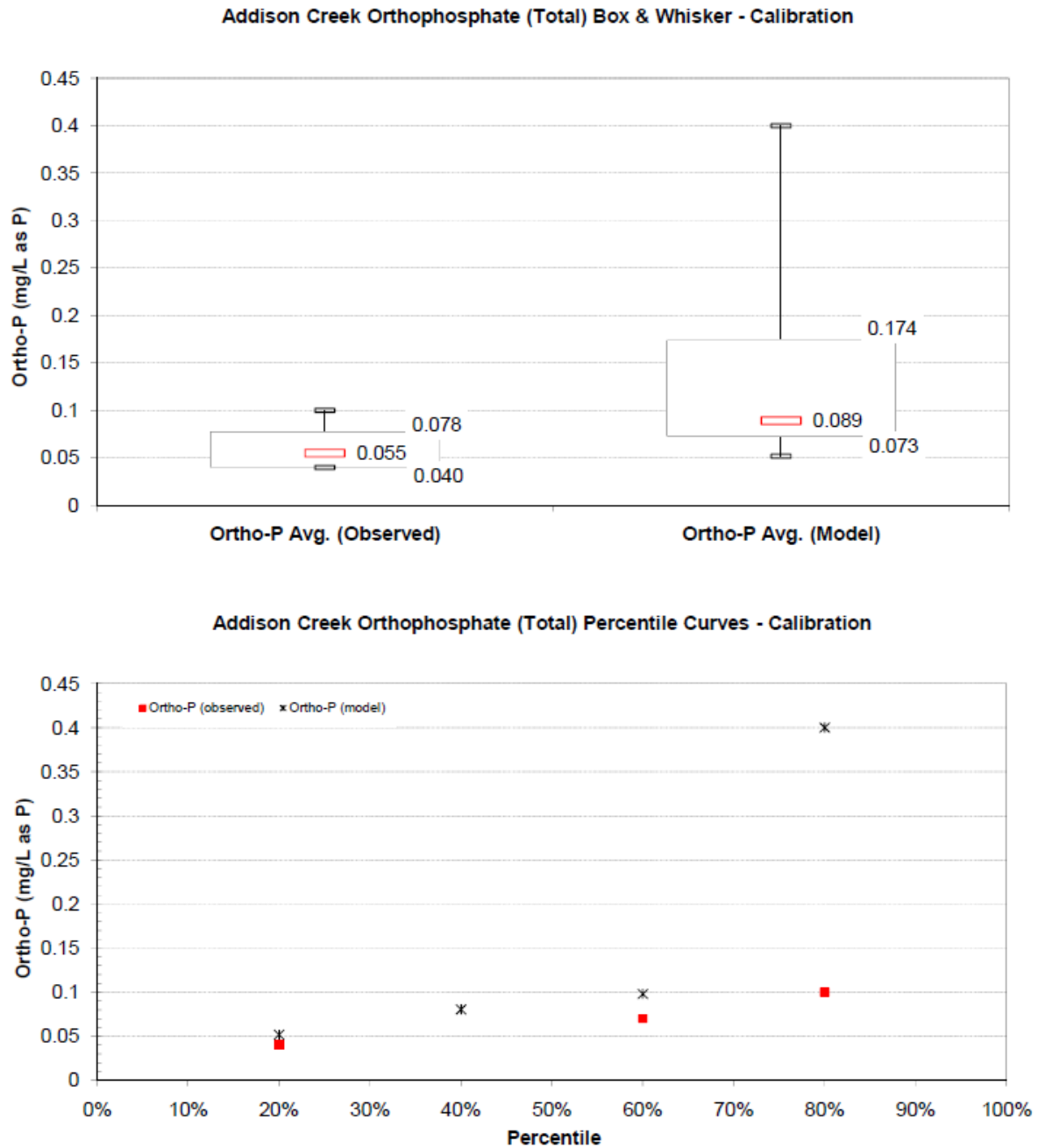


Figure D1-16. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in Addison Creek in the Calibration Period (1997 through 2001)

Statistics Report for Orthophosphate (Total) - Validation Period**Wilcoxon Rank Sum Test**

P-Value: 11.3%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 3.6%

Result: Distributions appear to be different

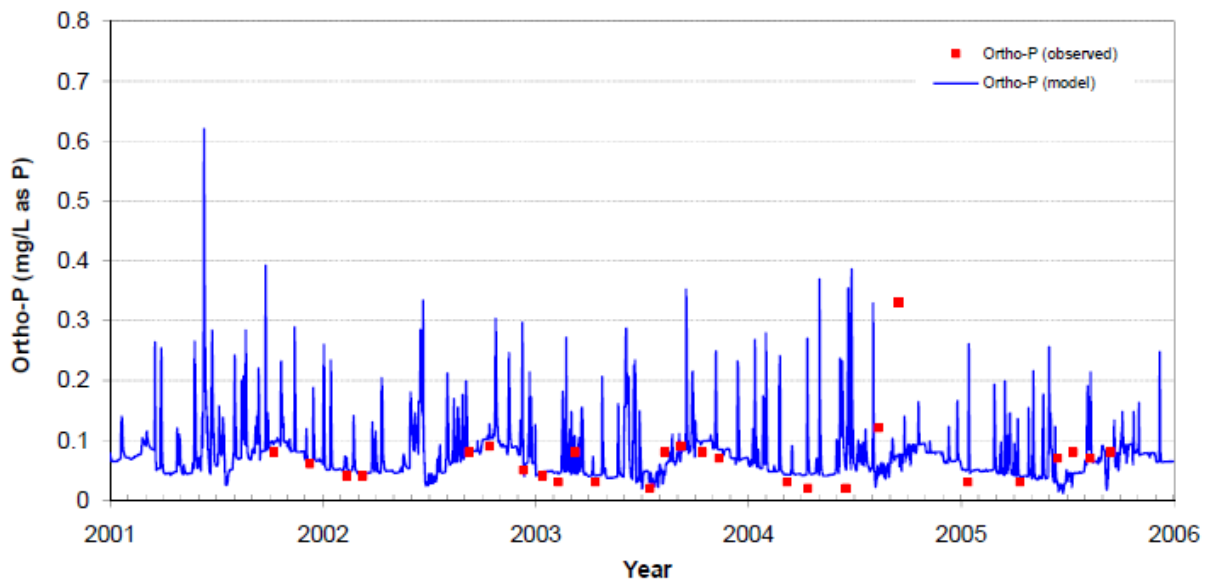
Addison Creek Orthophosphate (Total) Time Series - Validation

Figure D1-17. Model Simulated and Measured Orthophosphate for Addison Creek in the Validation Period (2001 through 2005)

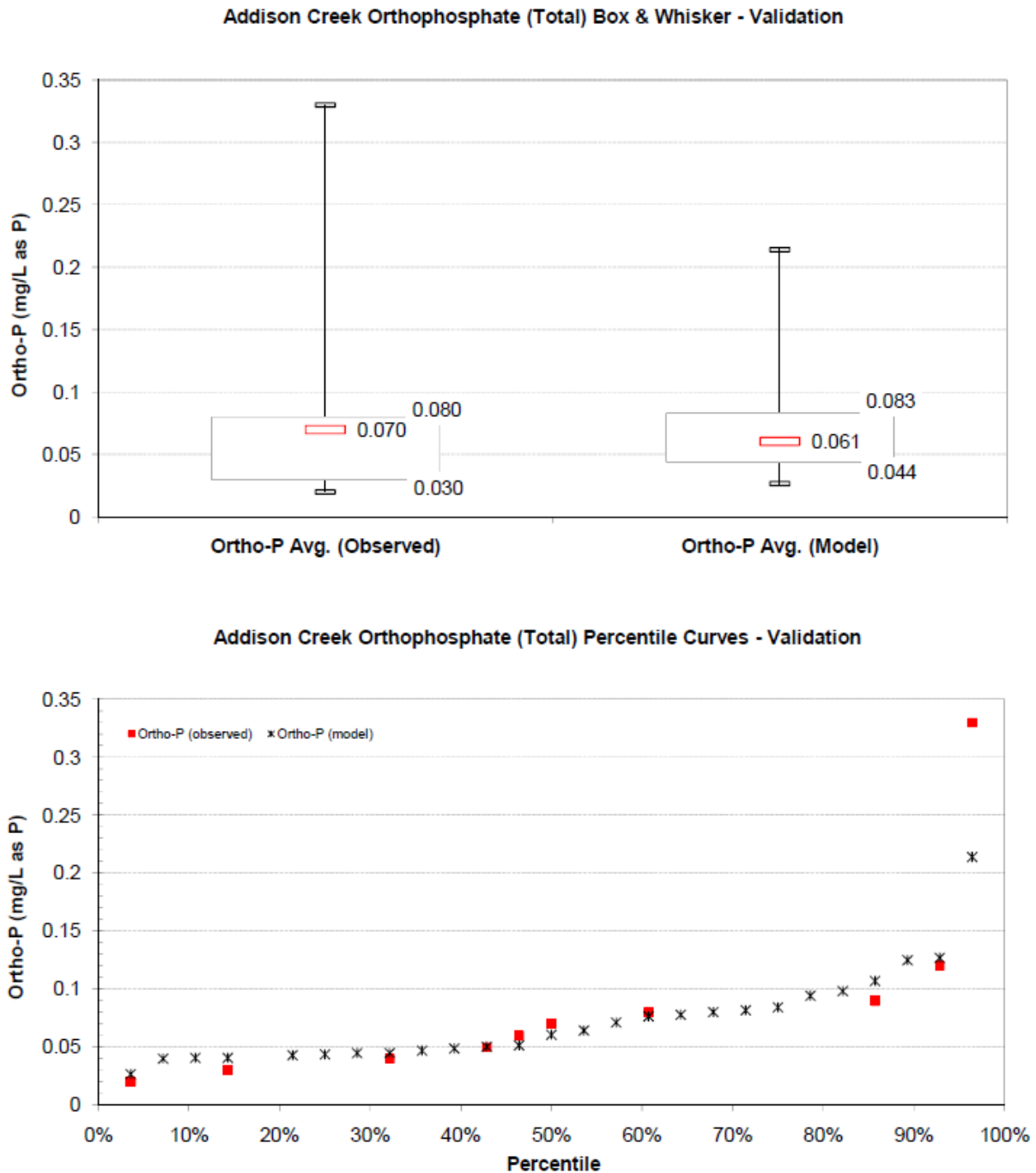


Figure D1-18. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Total Nitrogen - Calibration Period**Wilcoxon Rank Sum Test**

P-Value: 71.5%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 10.8%

Result: Distributions do not appear to be different

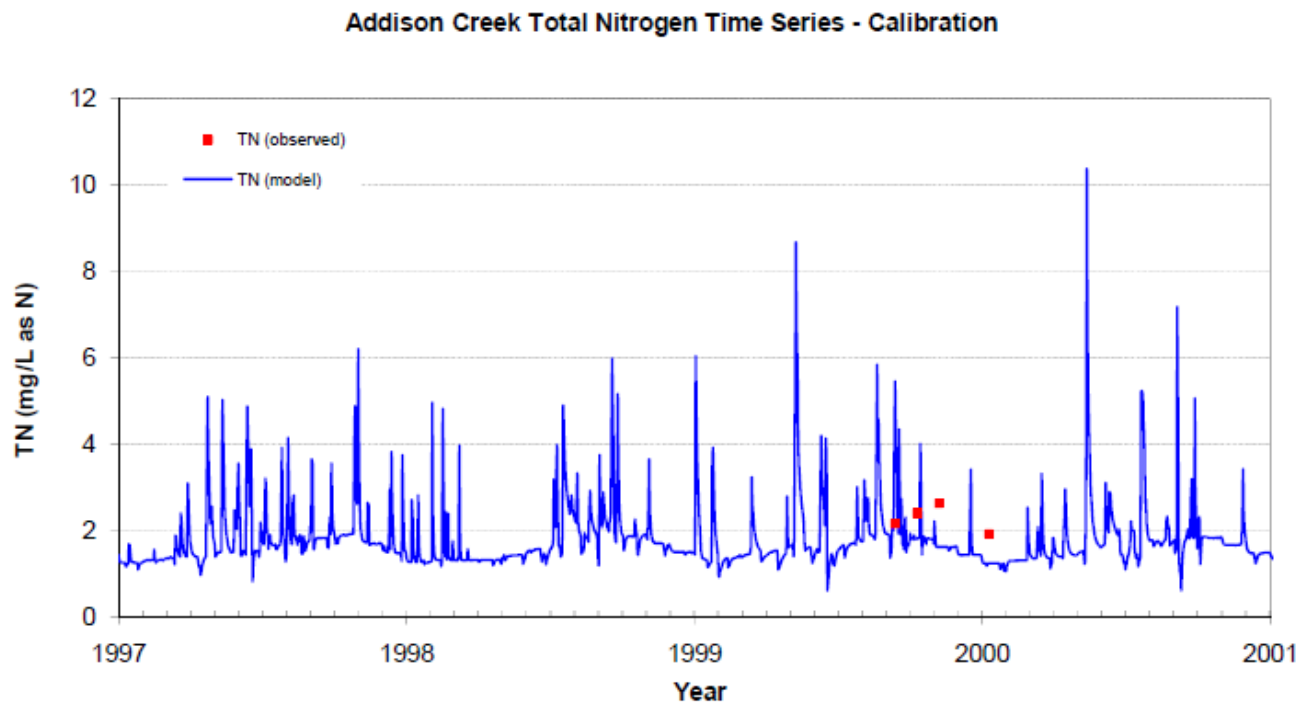


Figure D1-19. Model Simulated and Measured Total Nitrogen for Addison Creek in the Calibration Period (1997 through 2000)

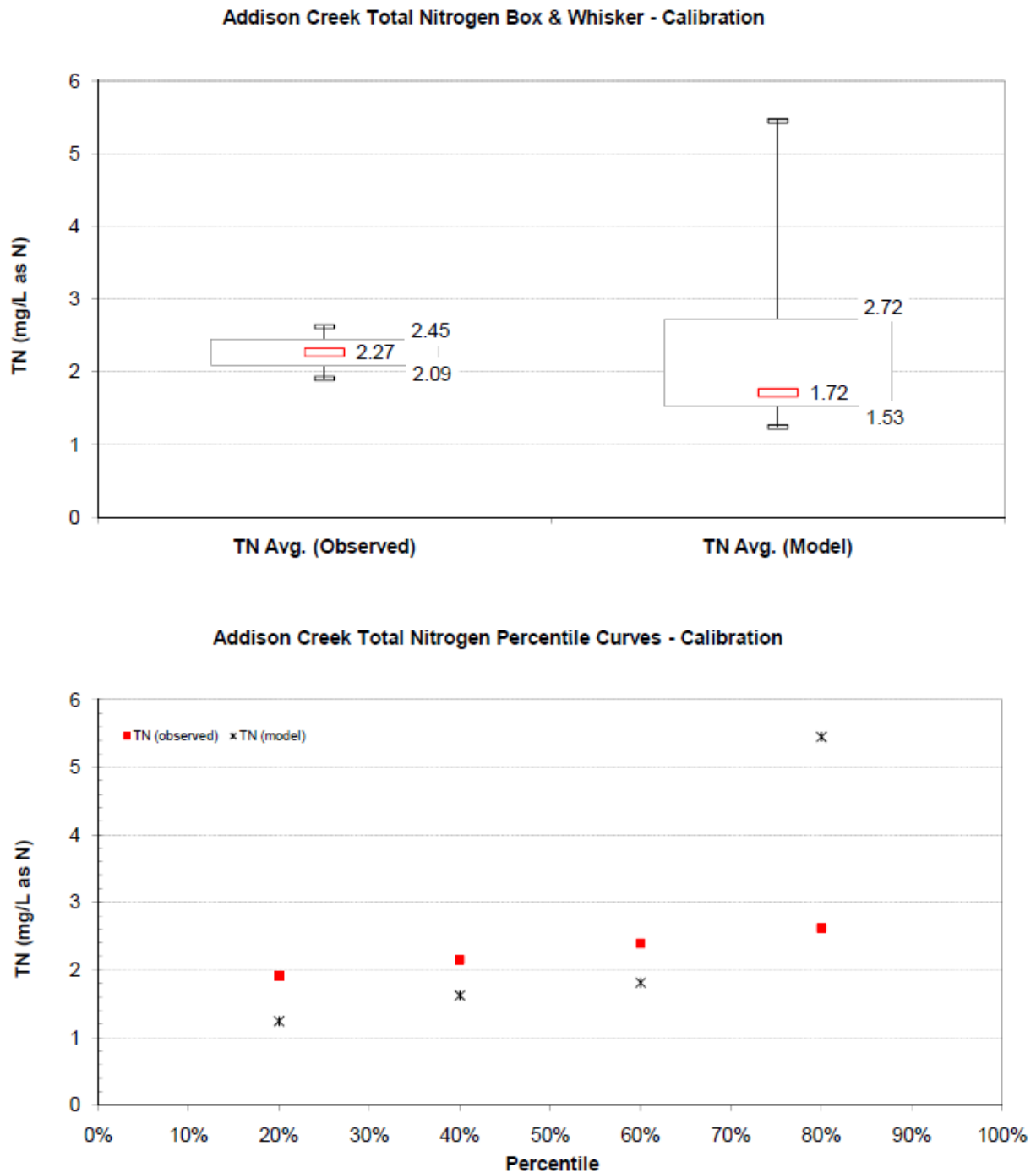


Figure D1-20. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in Addison Creek in the Calibration Period (1997 through 2000)

Statistics Report for Total Nitrogen - Validation Period**Wilcoxon Rank Sum Test**

P-Value: 9.2%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 23.3%

Result: Distributions do not appear to be different

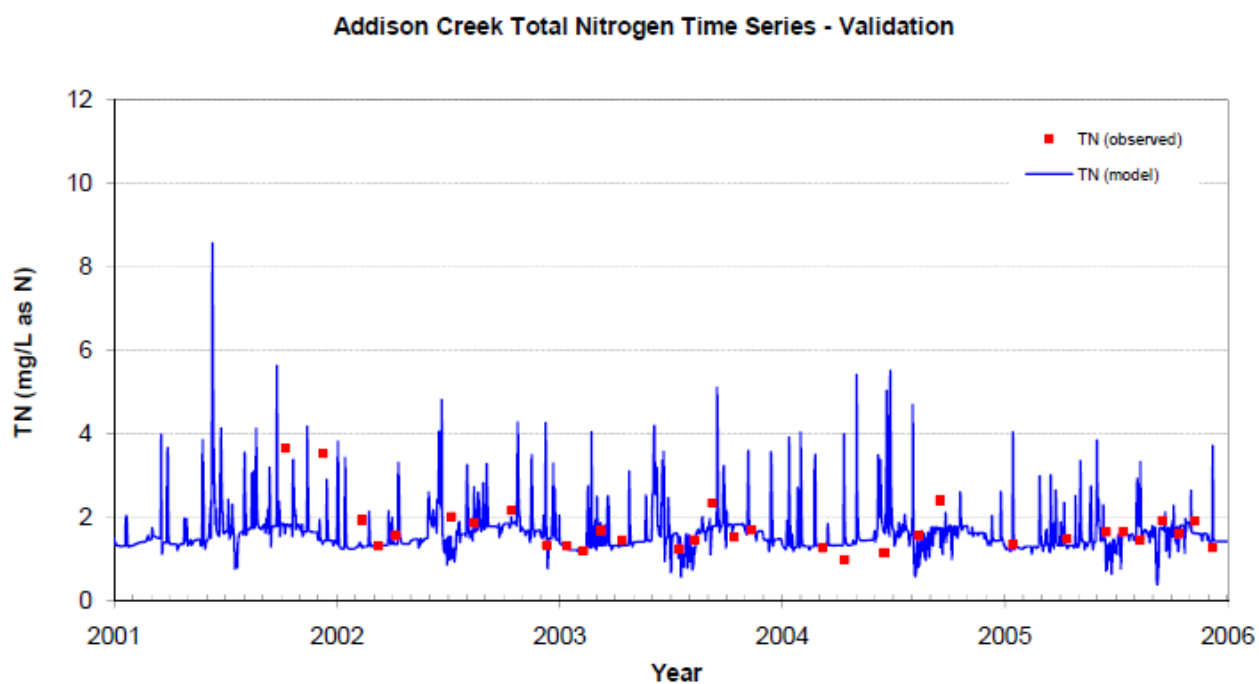


Figure D1-21. Model Simulated and Measured Total Nitrogen for Addison Creek in the Validation Period (2001 through 2005)

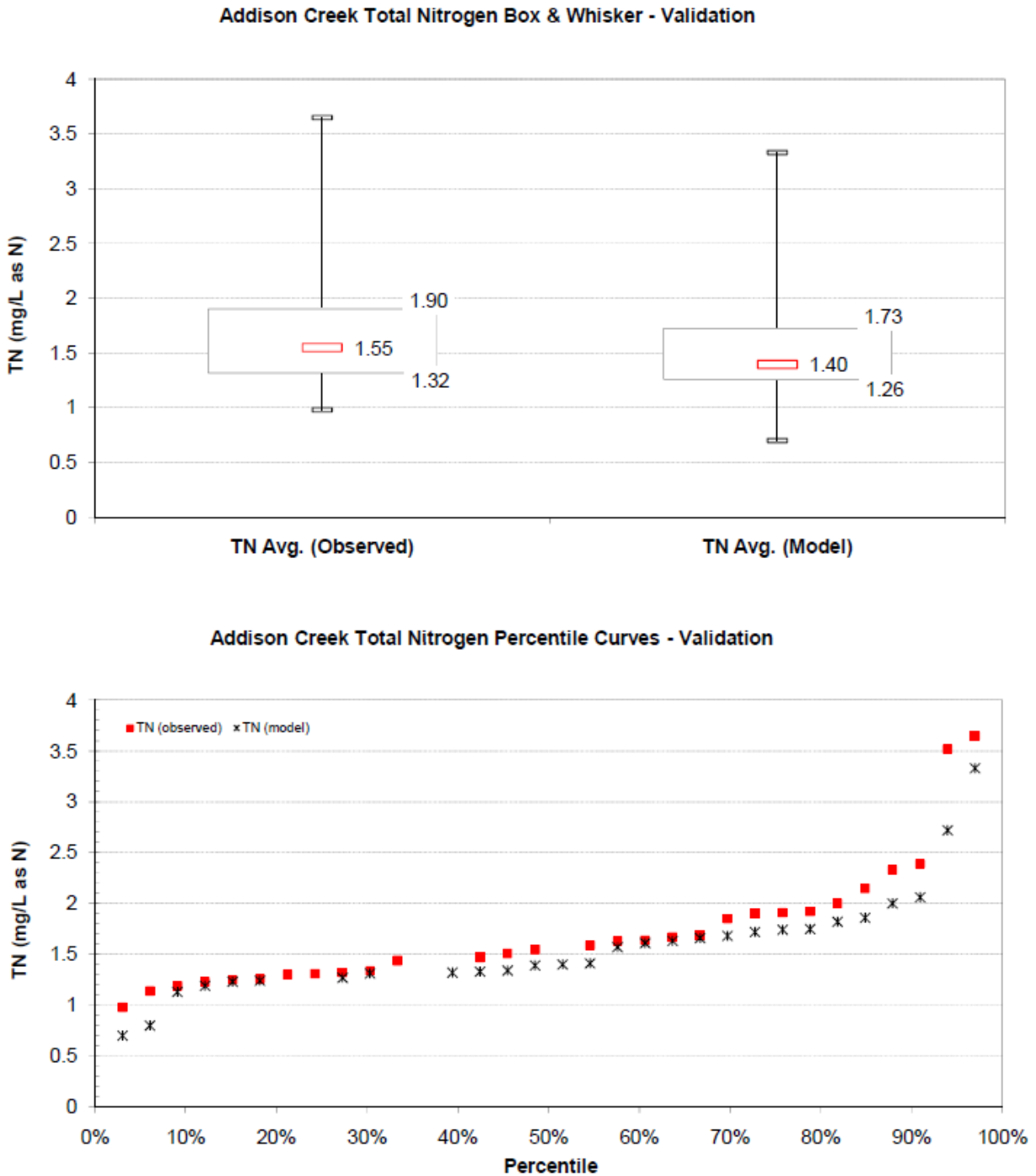


Figure D1-22. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Ammonia Nitrogen - Validation Period**Wilcoxon Rank Sum Test**

P-Value: 100.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 174.4%

Result: Distributions do not appear to be different

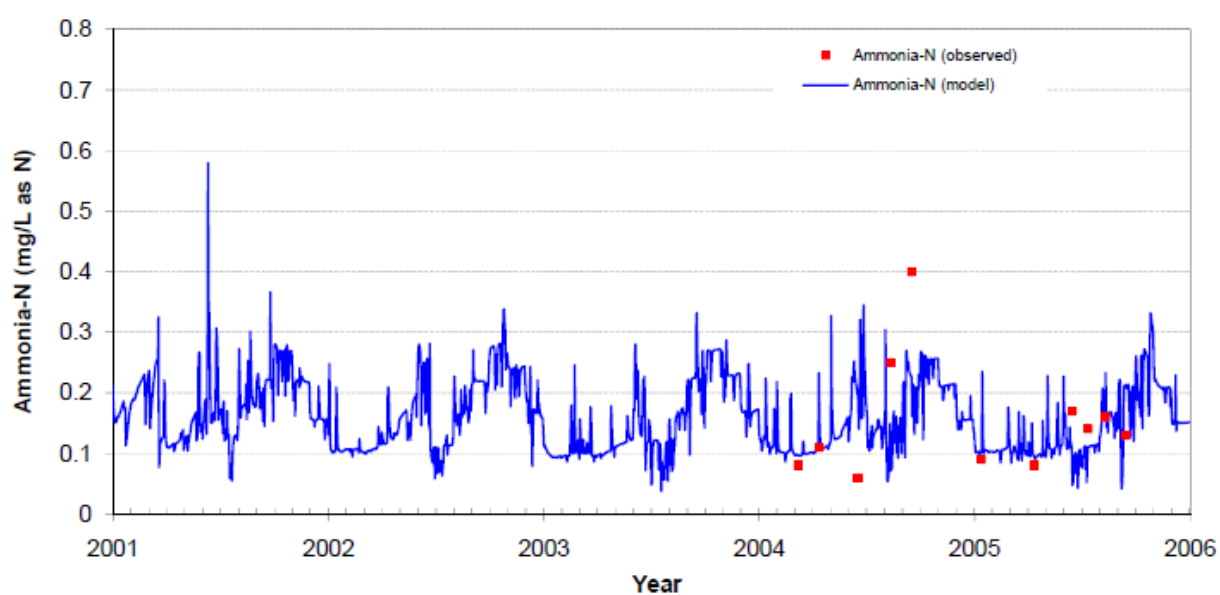
Addison Creek Ammonia Nitrogen Time Series - Validation

Figure D1-23. Model Simulated and Measured Ammonia Nitrogen for Addison Creek in the Validation Period (2001 through 2005)

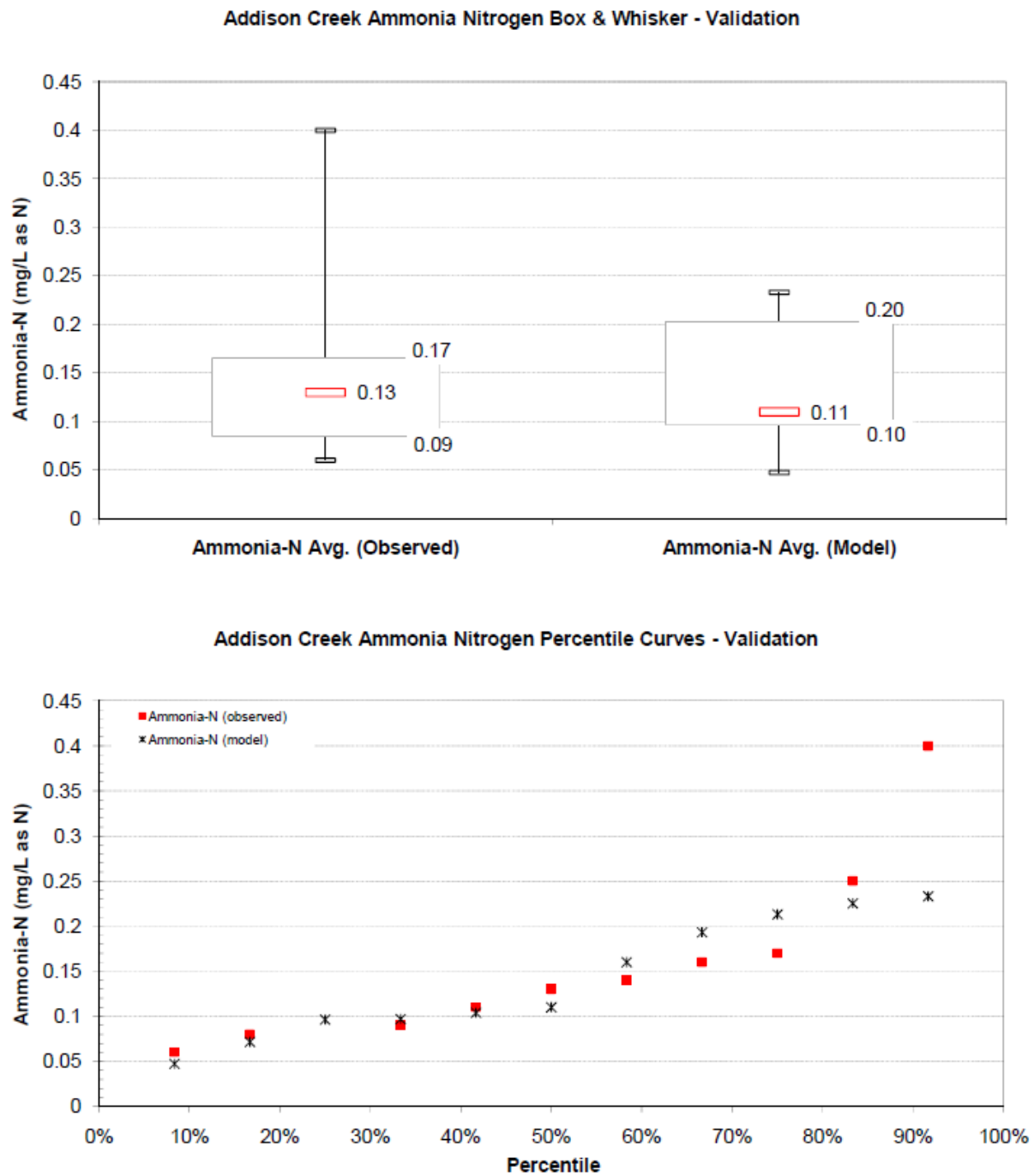


Figure D1-24. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Ammonia Nitrogen in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Nitrite + Nitrate - Calibration Period**Wilcoxon Rank Sum Test**

P-Value: 6.8%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 10.8%

Result: Distributions do not appear to be different

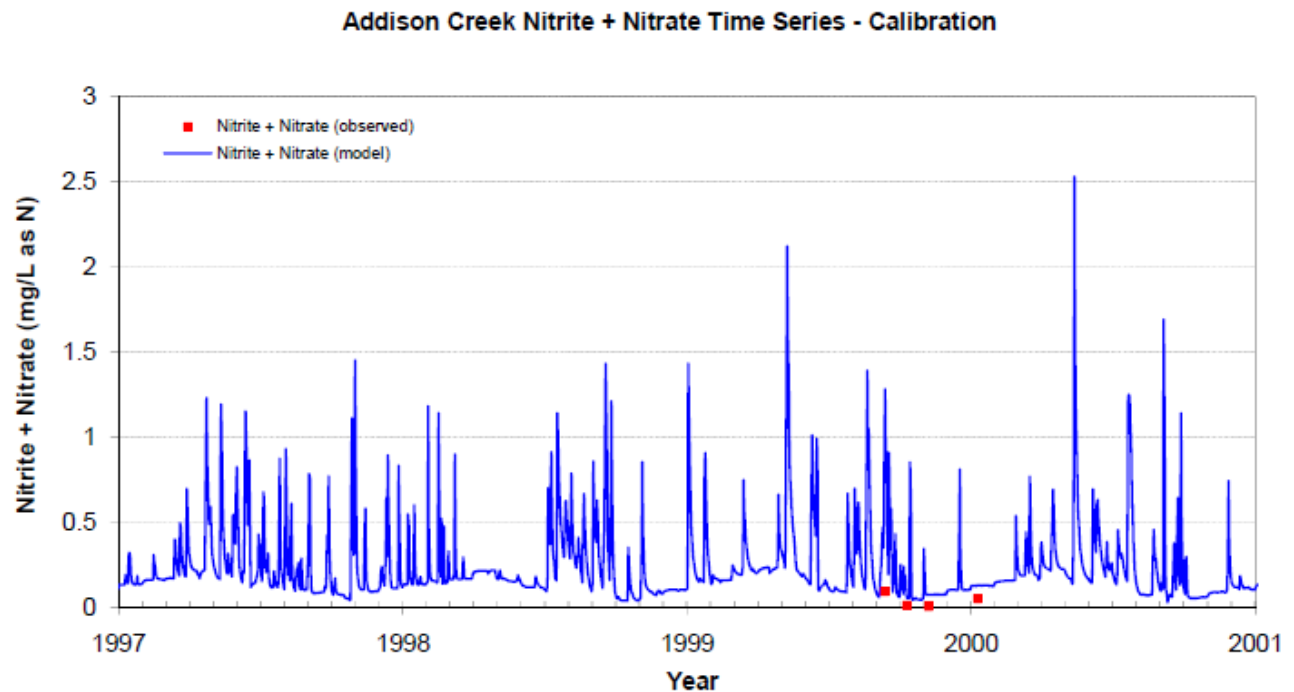


Figure D1-25. Model Simulated and Measured Nitrate Nitrogen for Addison Creek in the Calibration Period (1997 through 2000)

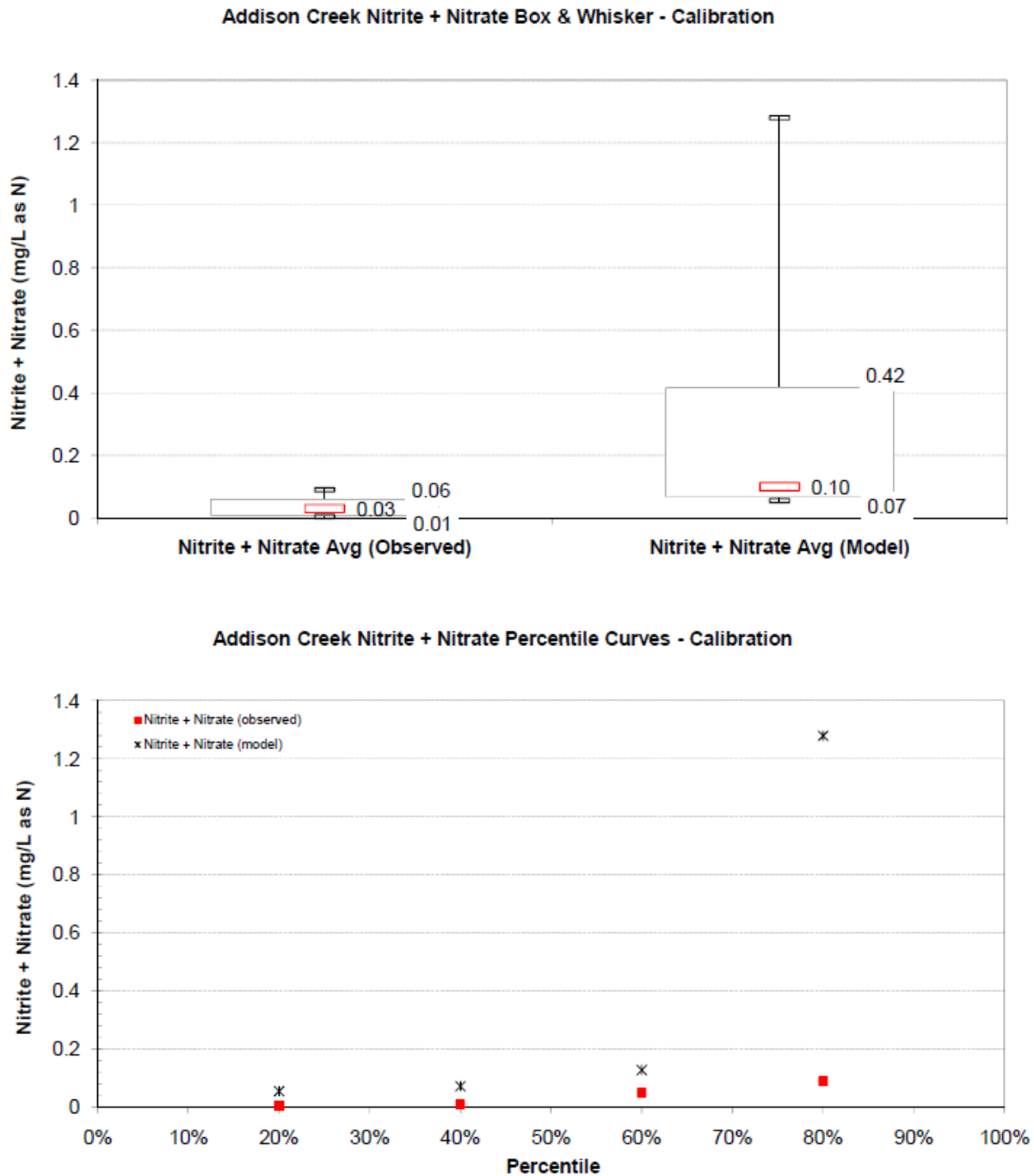


Figure D1-26. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in Addison Creek in the Calibration Period (1997 through 2000)

Statistics Report for Nitrite + Nitrate - Validation Period**Wilcoxon Rank Sum Test**

P-Value: 35.8%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 32.4%

Result: Distributions do not appear to be different

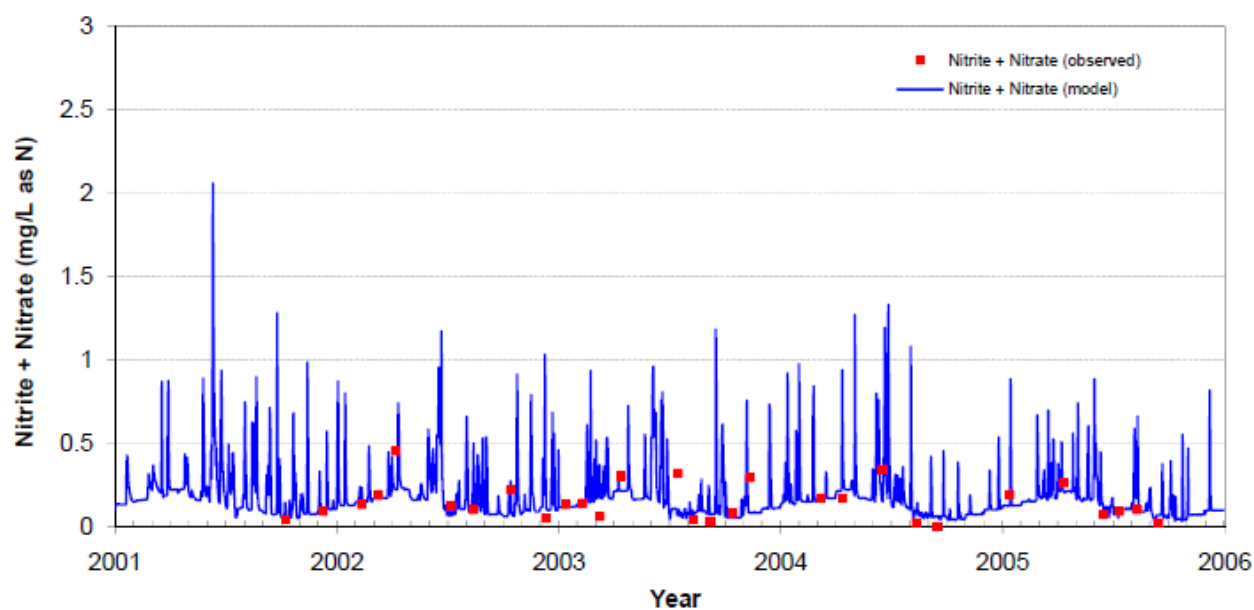
Addison Creek Nitrite + Nitrate Time Series - Validation

Figure D1-27. Model Simulated and Measured Nitrate Nitrogen for Addison Creek in the Validation Period (2001 through 2005)

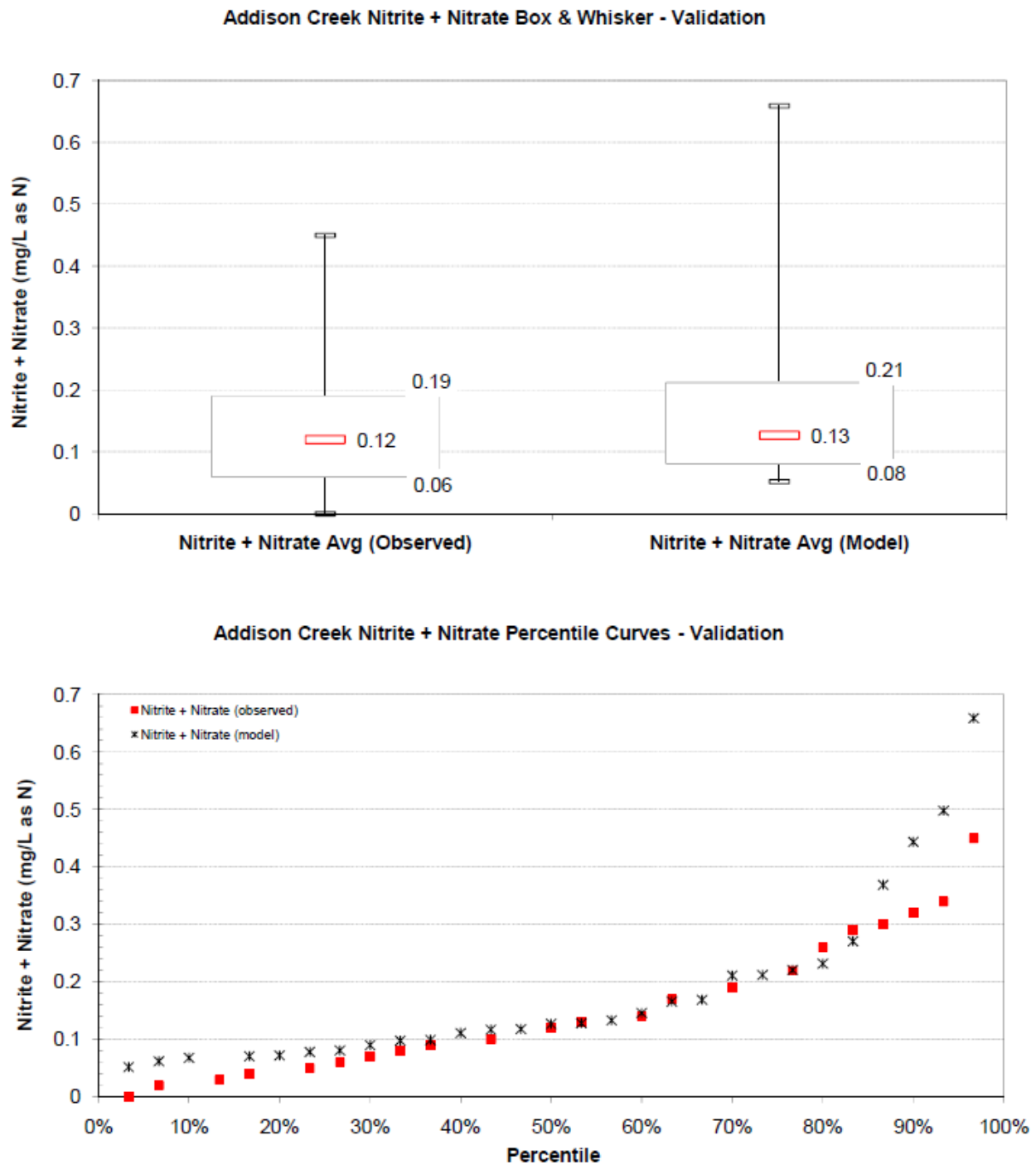


Figure D1-28. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in Addison Creek in the Validation Period (2001 through 2005)

Statistics Report for Chlorophyll-a - Calibration Period**Wilcoxon Rank Sum Test**

P-Value: 65.5%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 103.8%

Result: Distributions do not appear to be different

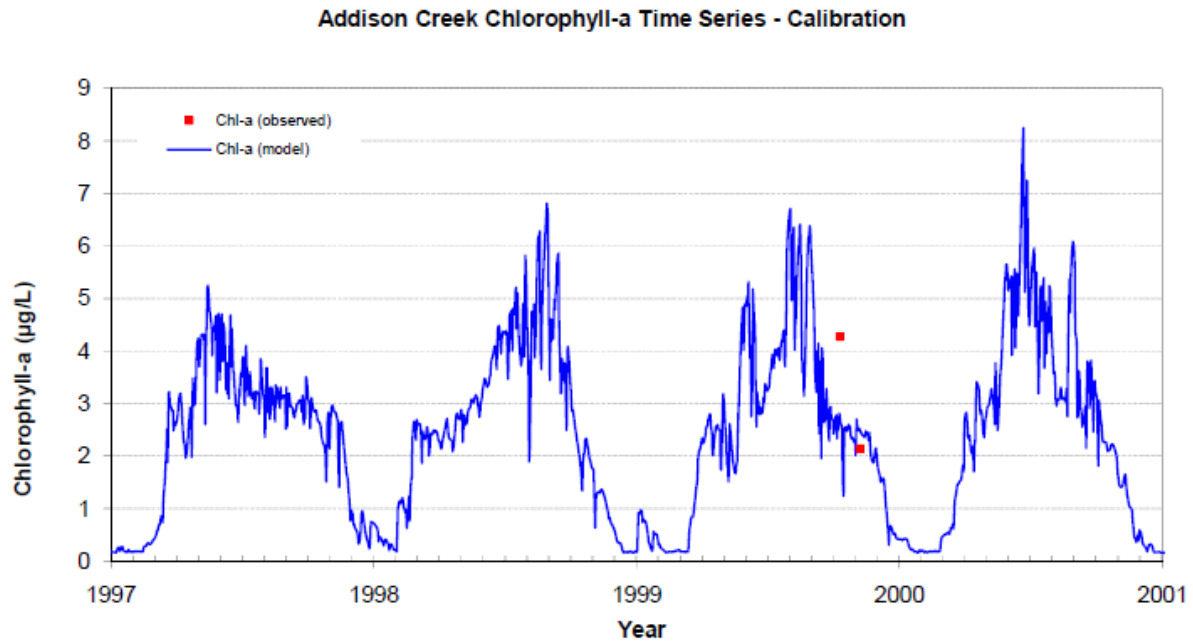


Figure D1-29. Model Simulated and Measured Chlorophyll a for Addison Creek in the Calibration Period (1997 through 2000)

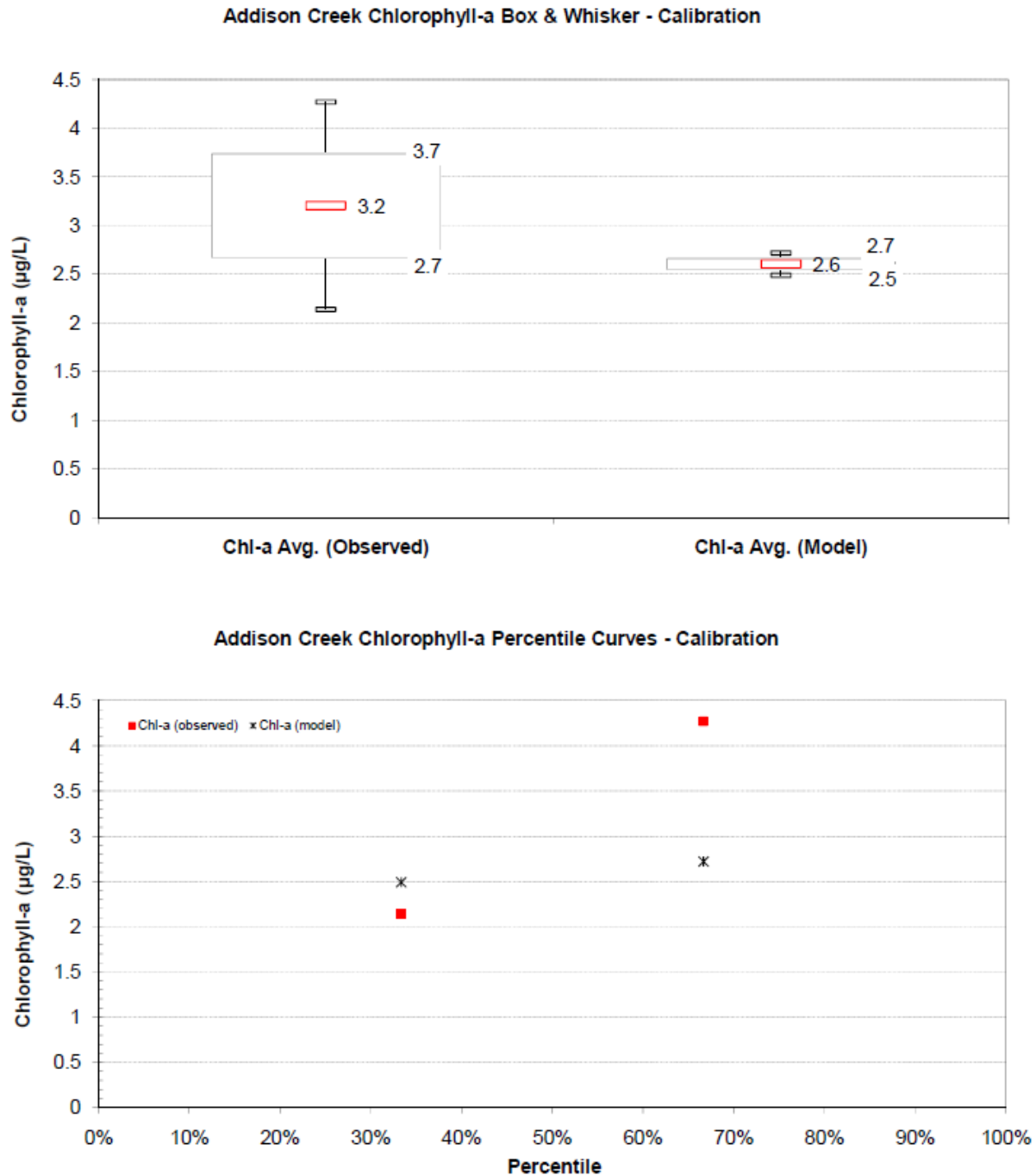


Figure D1-30. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in Addison Creek in the Calibration Period (1997 through 2000)

Statistics Report for Chlorophyll-a - Validation Period**Wilcoxon Rank Sum Test**

P-Value: 28.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 0.3%

Result: Distributions appear to be different

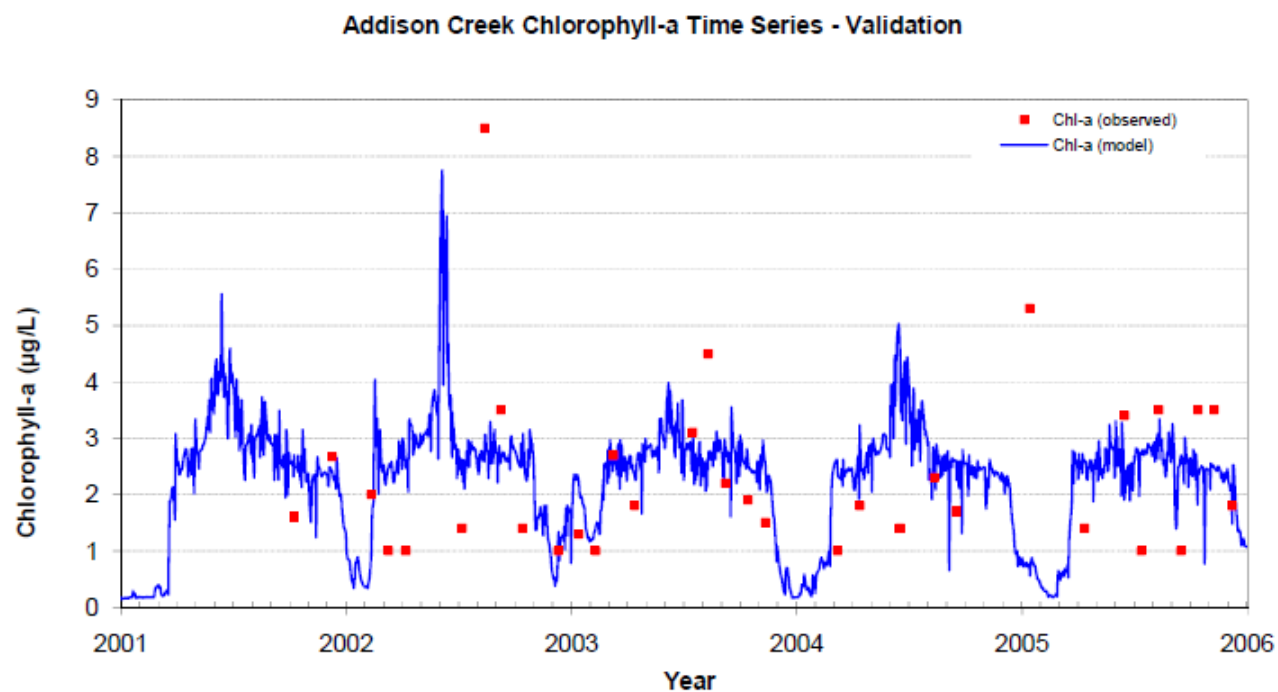


Figure D1-31. Model Simulated and Measured Chlorophyll a for Addison Creek in the Validation Period (2001 through 2005)

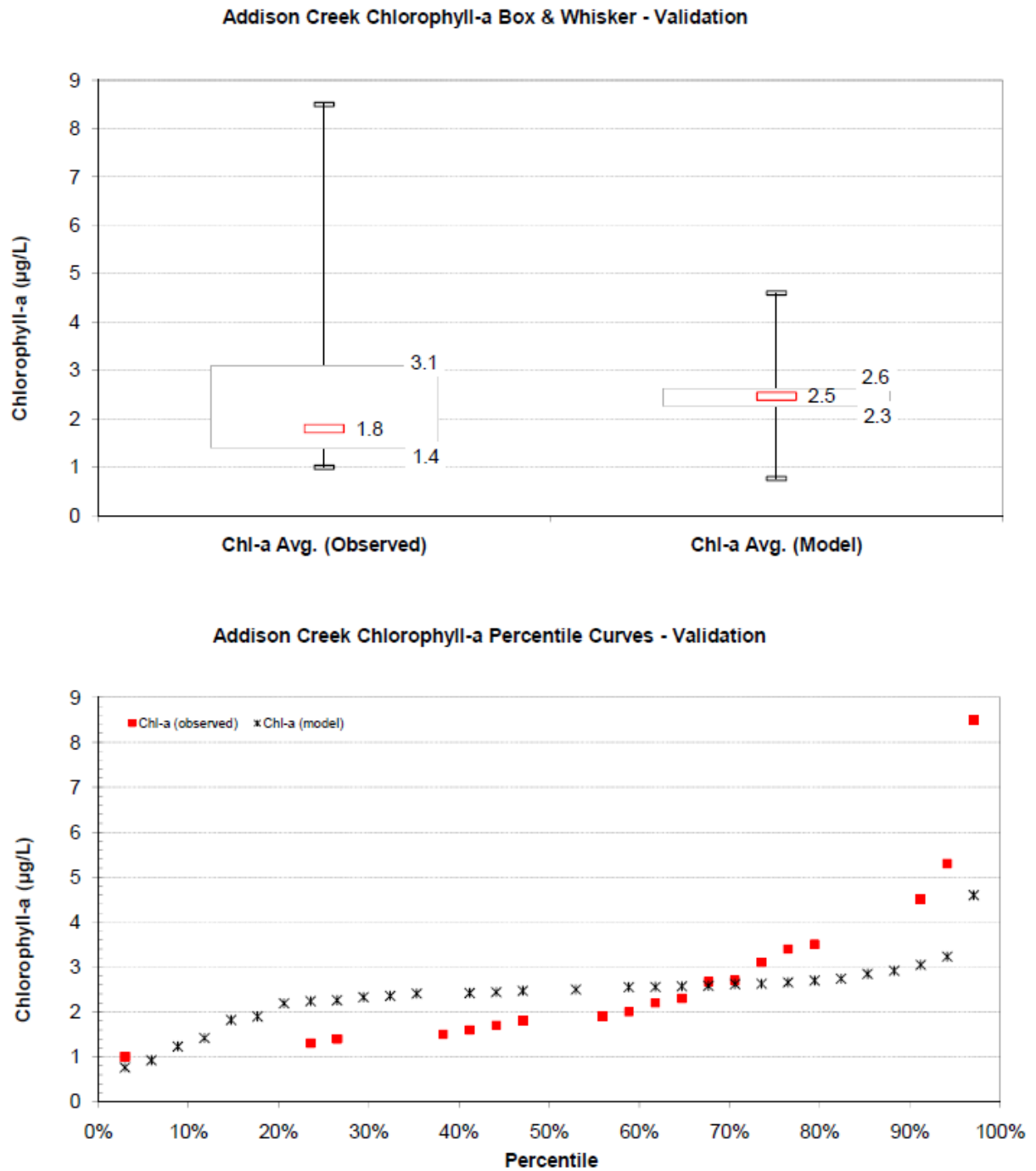


Figure D1-32. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in Addison Creek in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 100.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 211.0%

Result: Distributions do not appear to be different

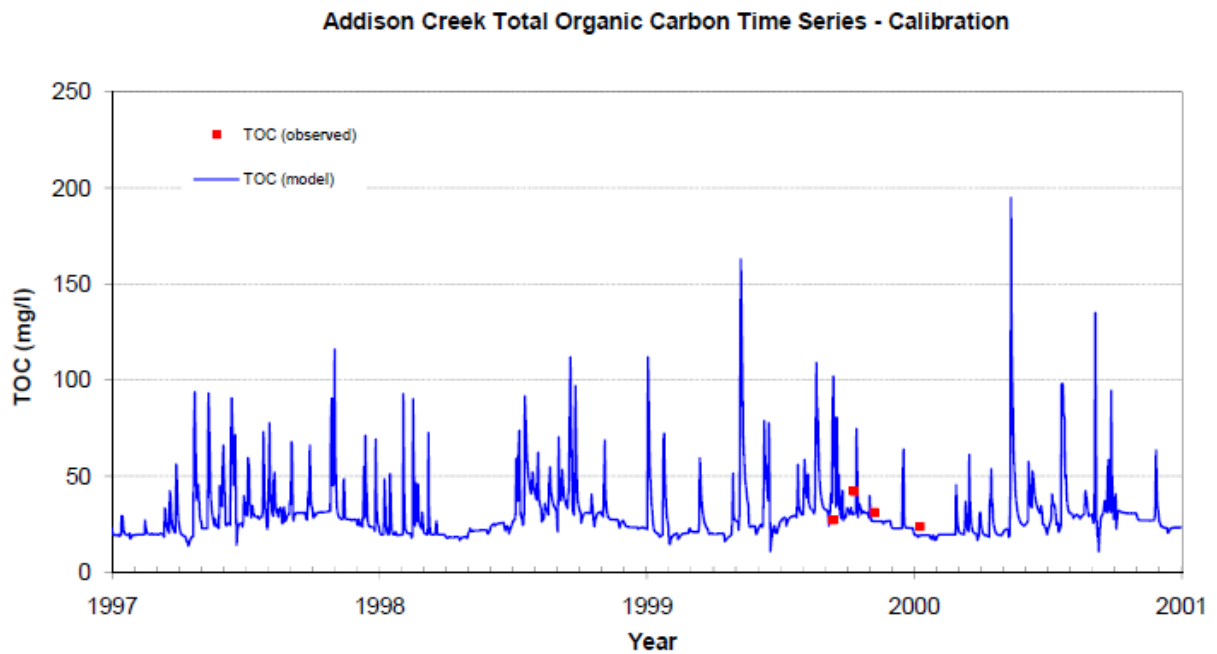


Figure D1-33. Model Simulated and Measured Total Organic Carbon for Addison Creek in the Calibration Period (1997 through 2000)

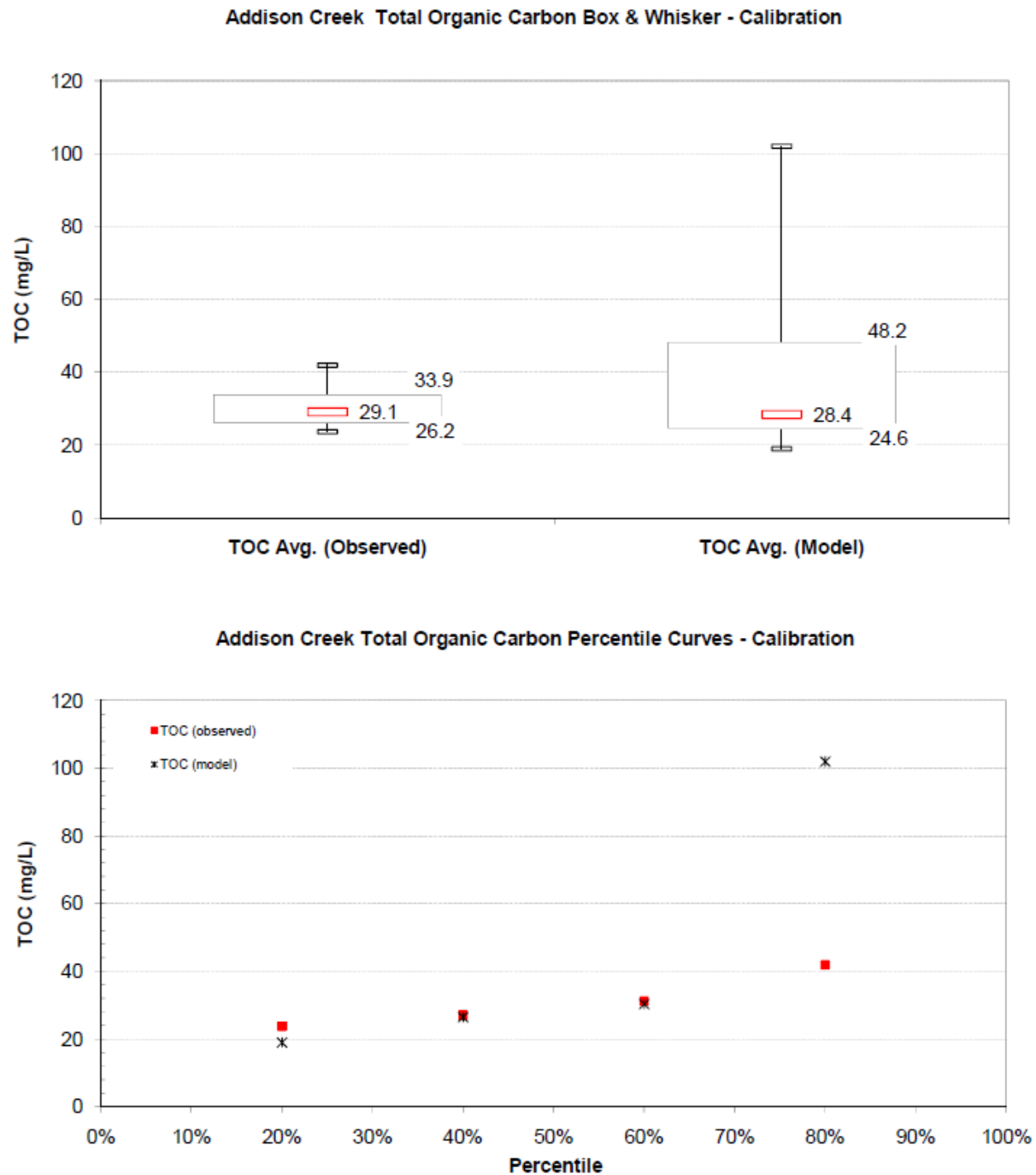


Figure D1-34. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Organic Carbon in Addison Creek in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 15.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 96.5%

Result: Distributions do not appear to be different

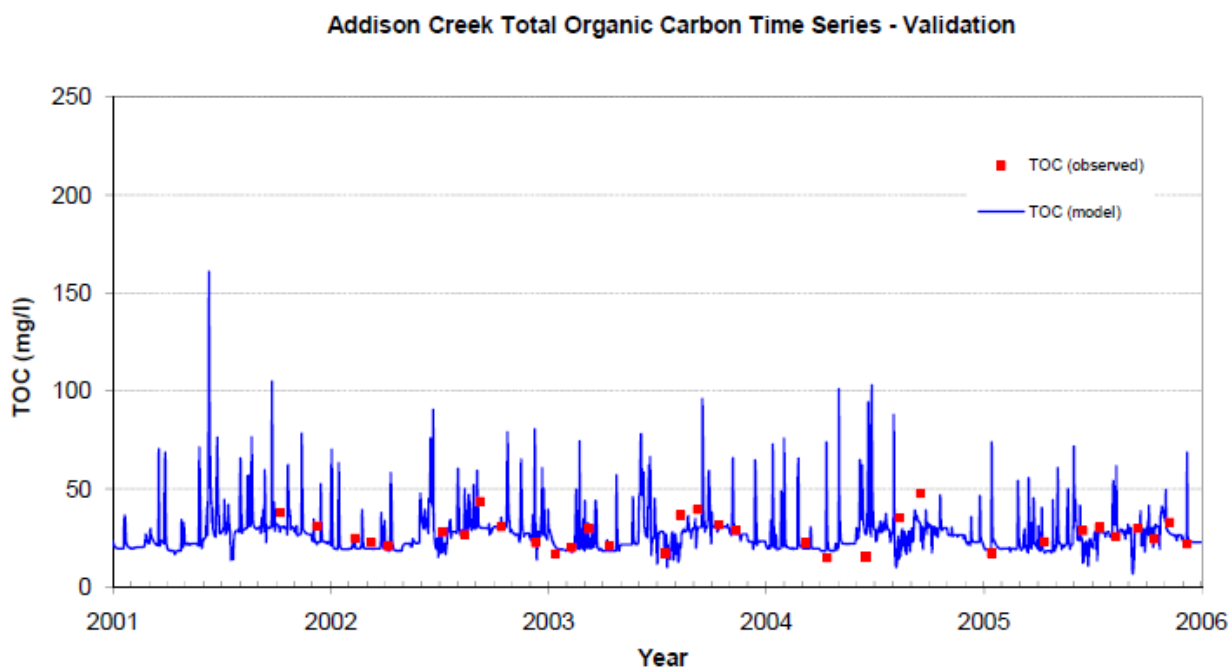


Figure D1-35. Model Simulated and Measured Total Organic Carbon for Addison Creek in the Validation Period (2001 through 2005)

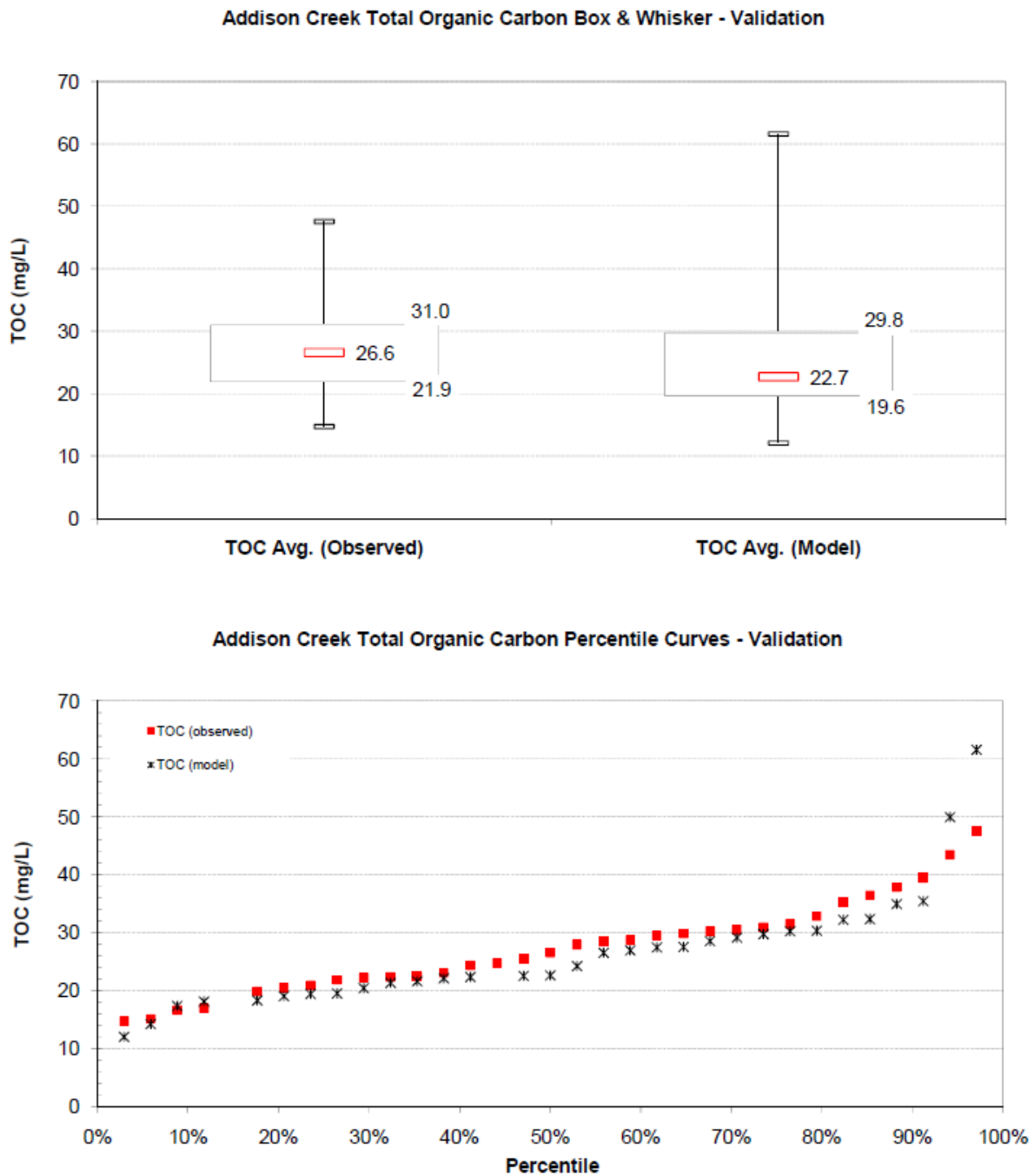


Figure D1-36. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Organic Carbon in Addison Creek in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 0.3%

Result: Medians appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 37.9%

Result: Distributions do not appear to be different

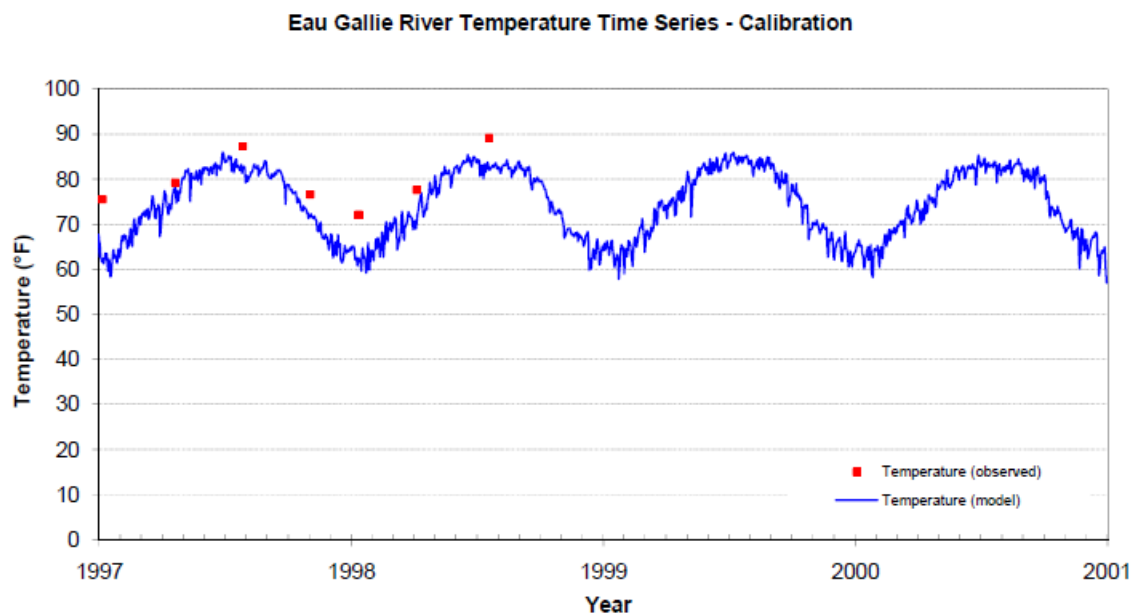


Figure D2-1. Model Simulated and Measured Temperature for the Eau Gallie River in the Calibration Period (1997 through 2000)

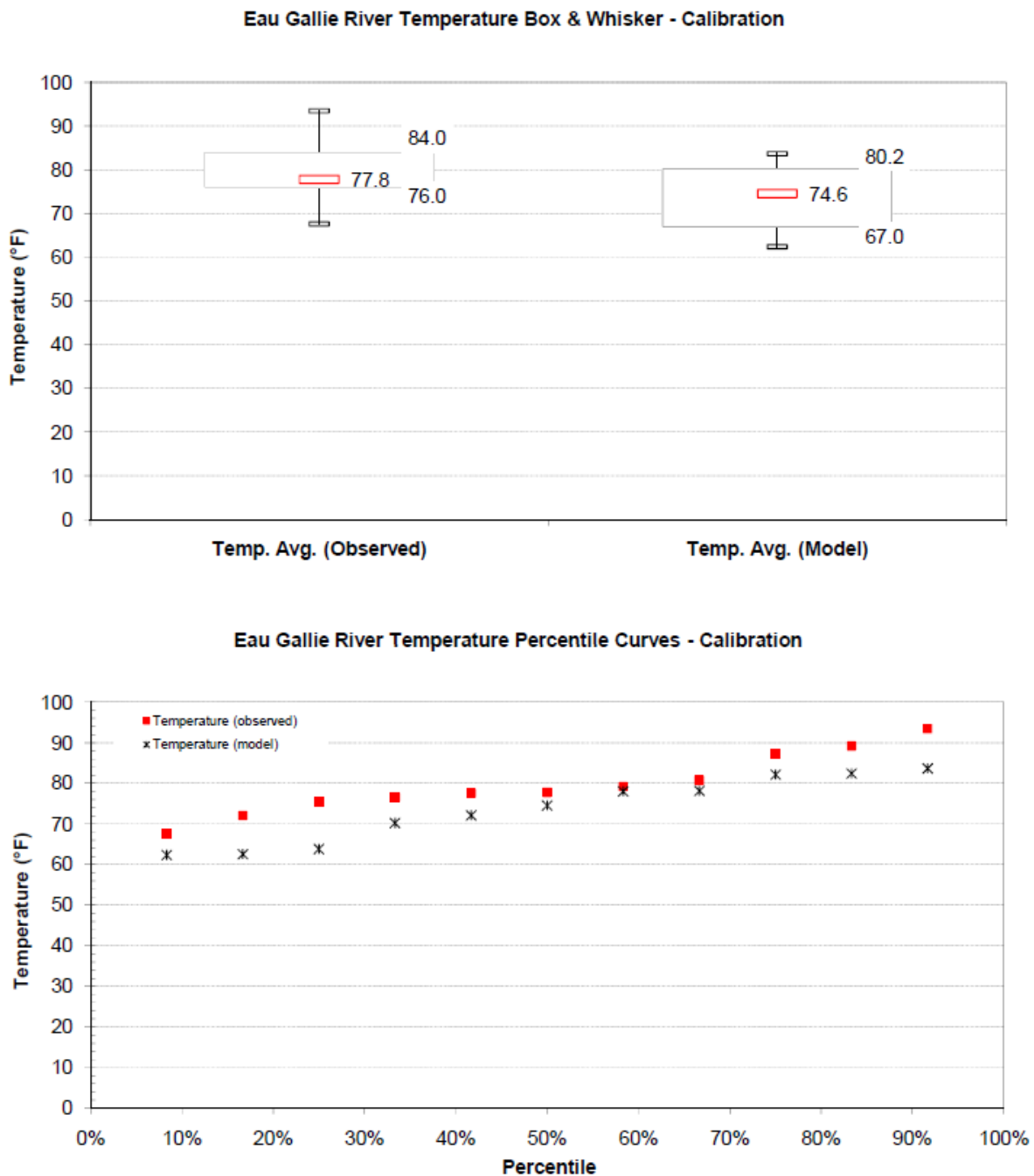


Figure D2-2. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Temperature in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 8.7%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 50.4%

Result: Distributions do not appear to be different

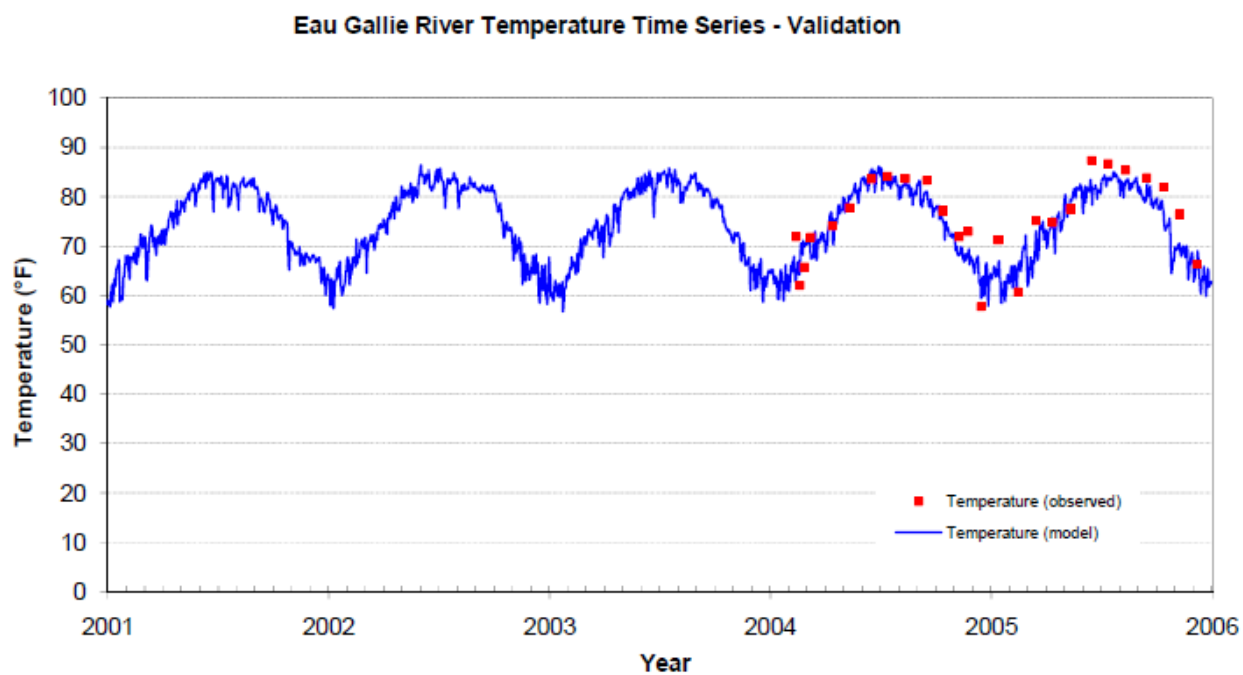


Figure D2-3. Model Simulated and Measured Temperature for the Eau Gallie River in the Validation Period (2001 through 2005)

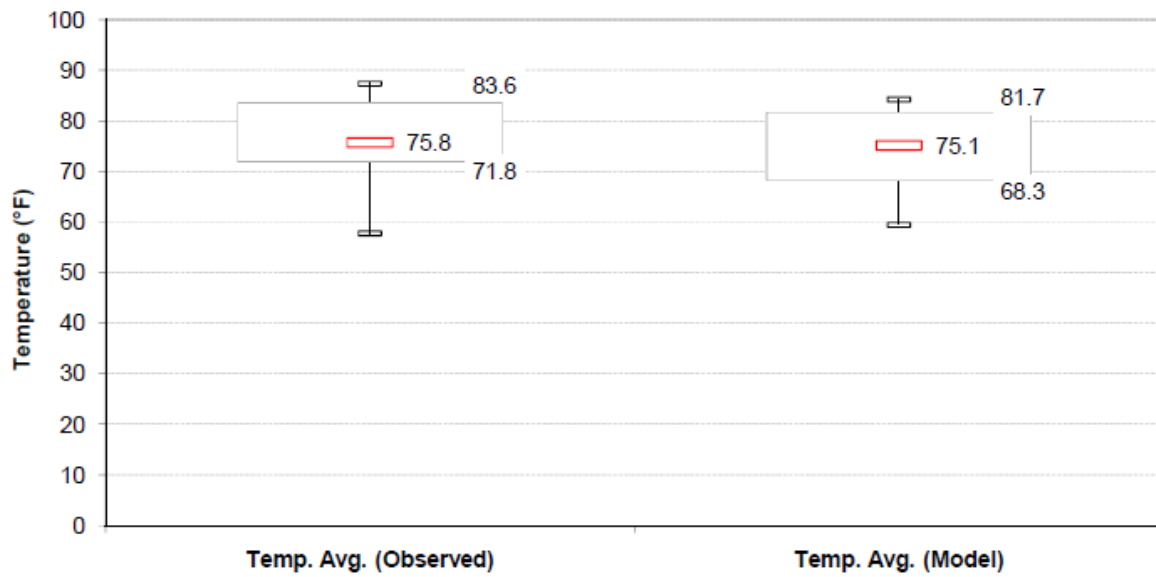
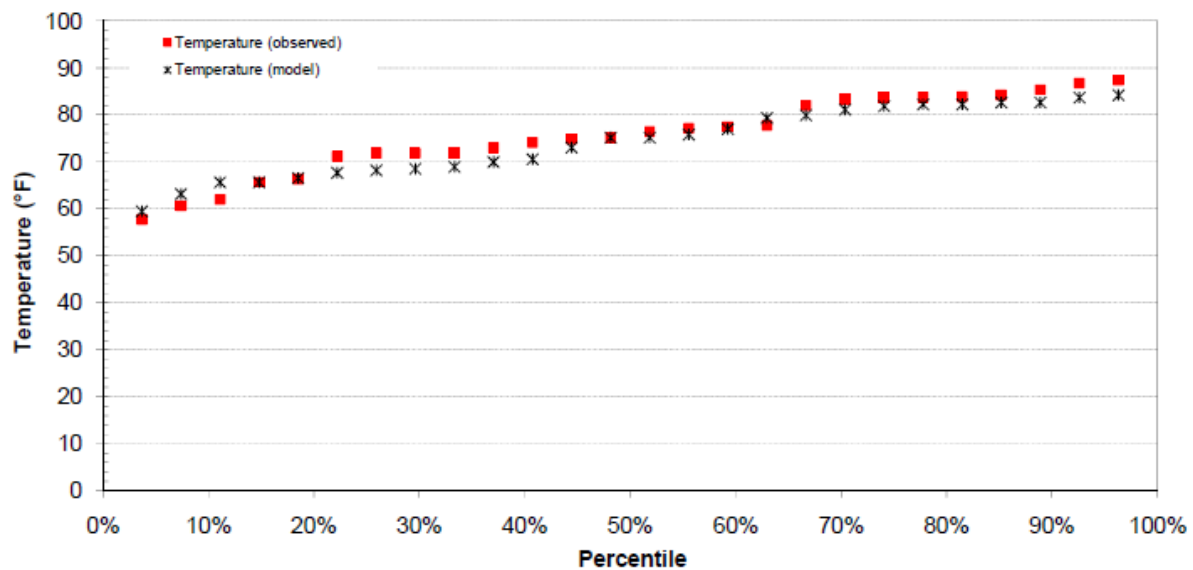
Eau Gallie River Temperature Box & Whisker - Validation**Eau Gallie River Temperature Percentile Curves - Validation**

Figure D2-4. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Temperature in the Eau Gallie River in the Valiation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 0.4%

Result: Medians appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 0.0%

Result: Distributions appear to be different

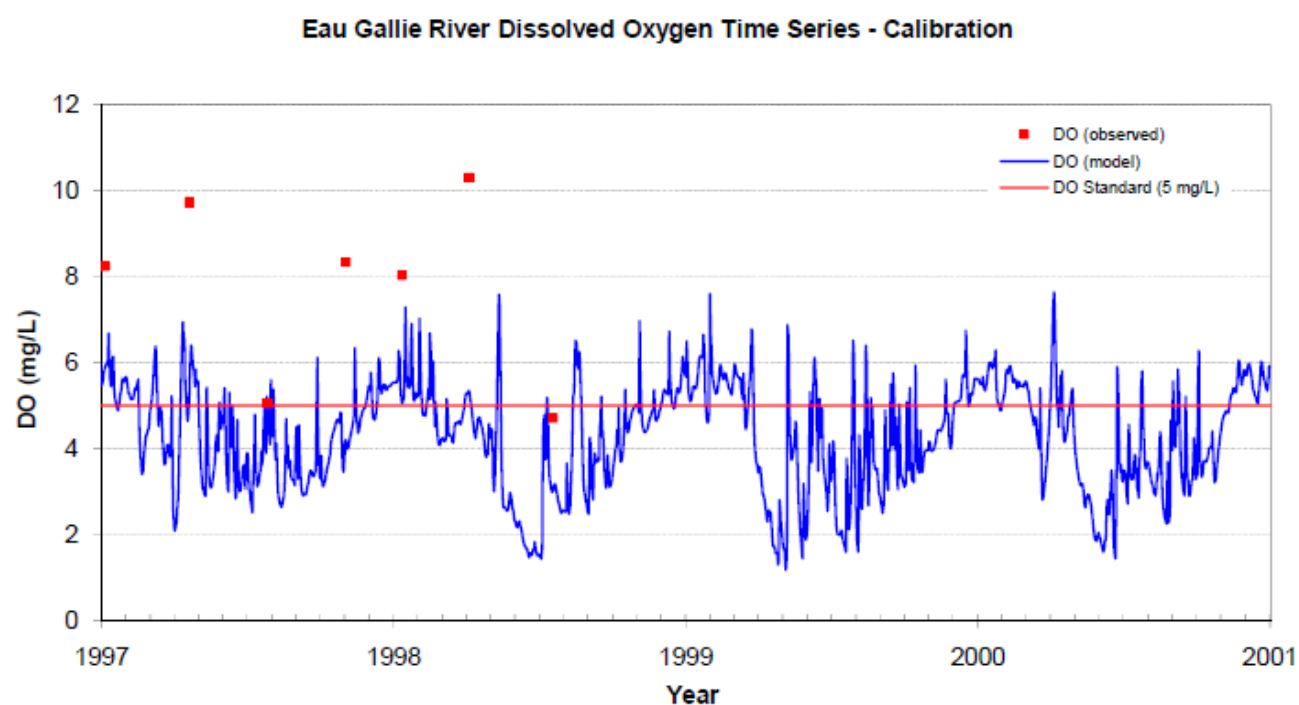


Figure D2-5. Model Simulated and Measured Dissolved Oxygen for the Eau Gallie River in the Calibration Period (1997 through 2000)

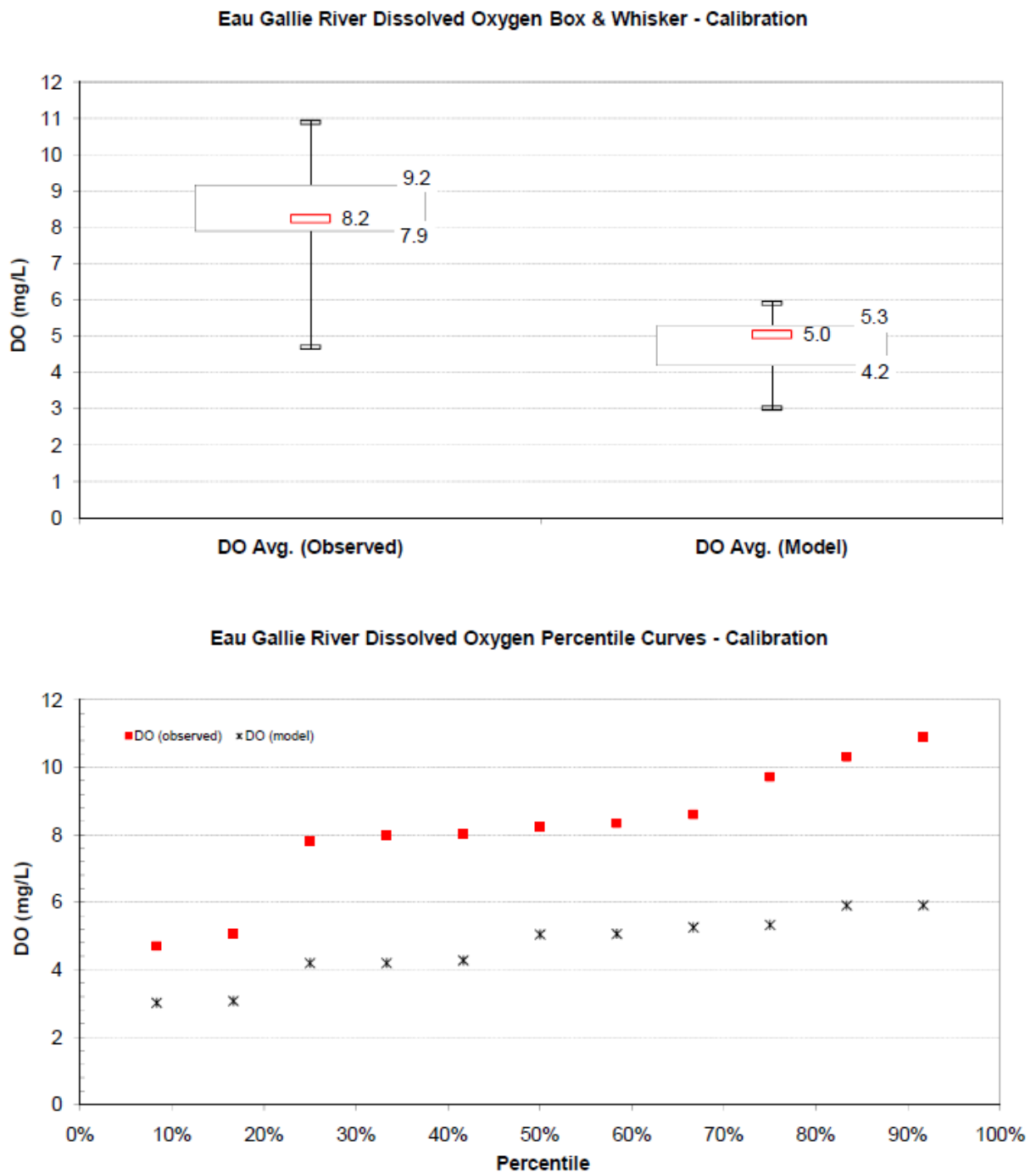


Figure D2-6. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 83.1%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 62.8%

Result: Distributions do not appear to be different

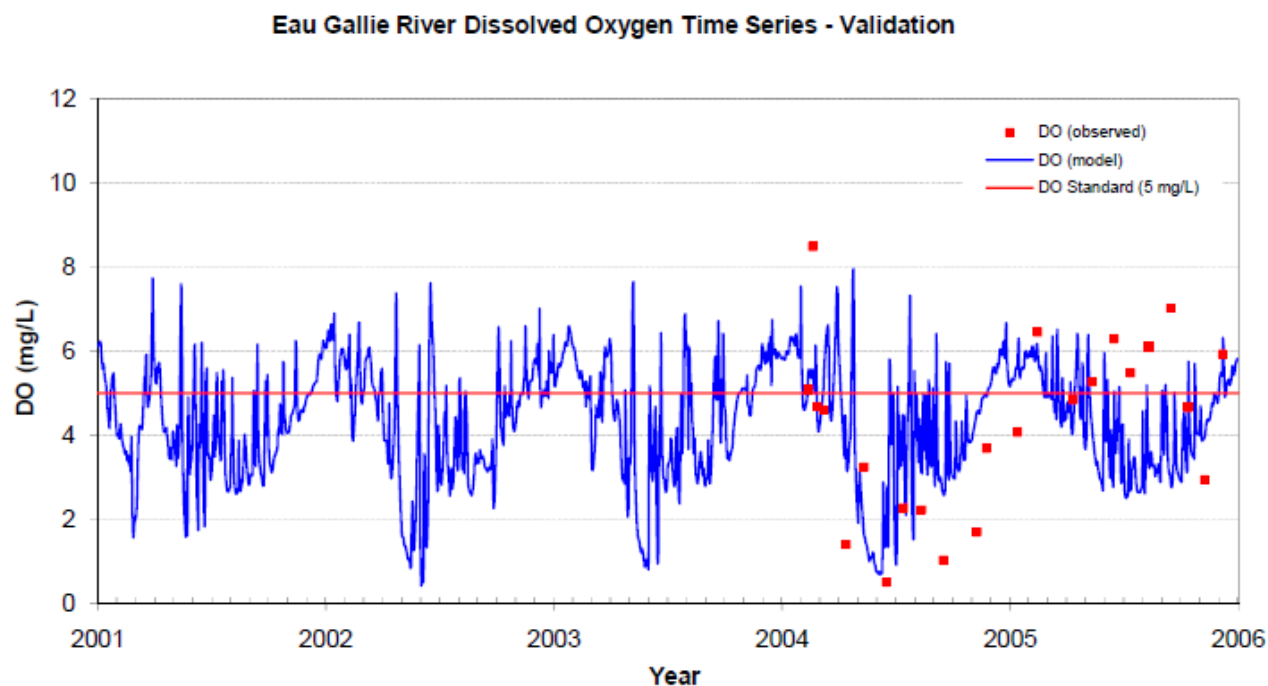


Figure D2-7. Model Simulated and Measured Dissolved Oxygen for the Eau Gallie River in the Validation Period (2001 through 2005)

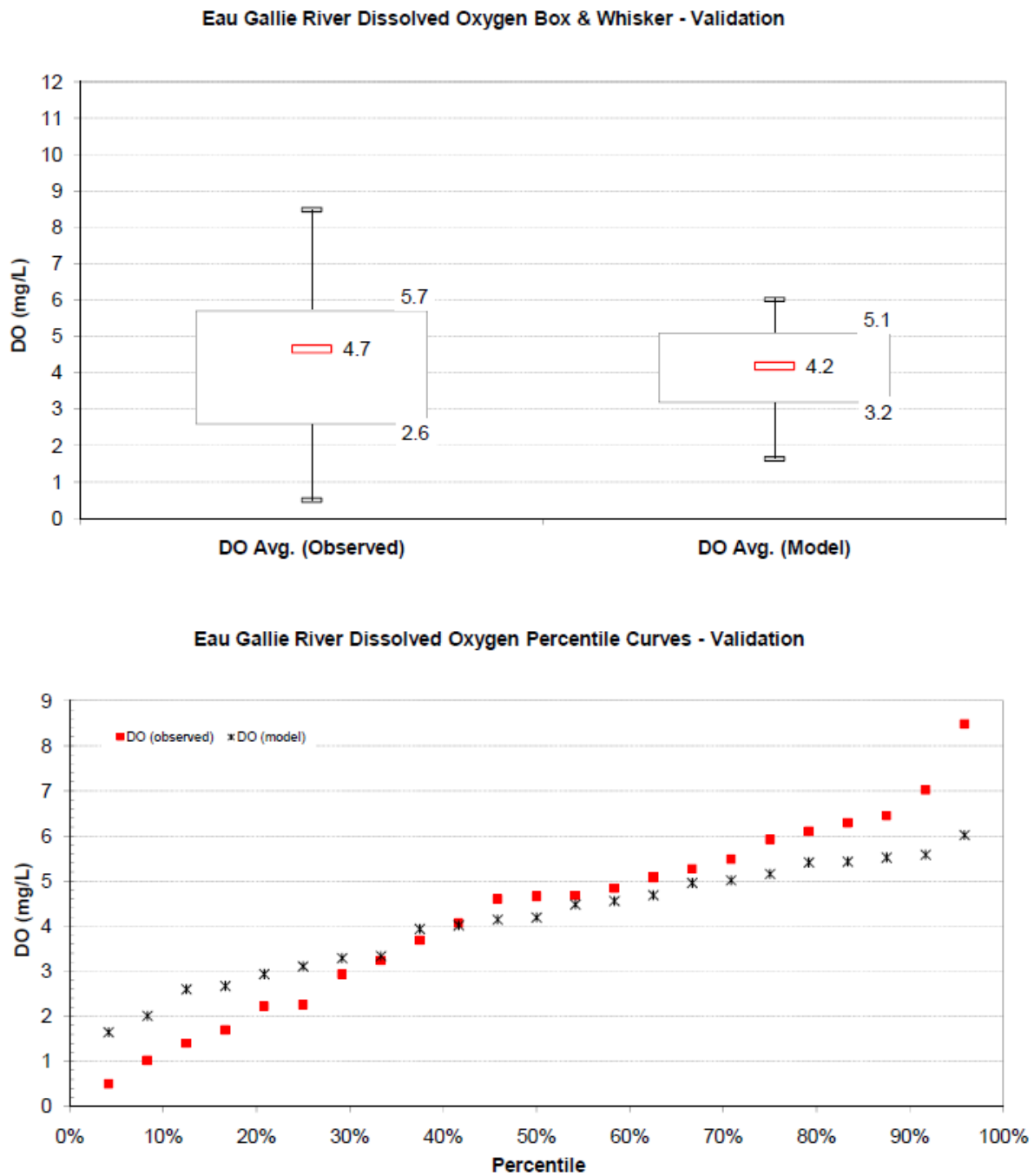


Figure D2-8. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in the Eau Gallie River in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 28.6%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 1.2%

Result: Distributions appear to be different

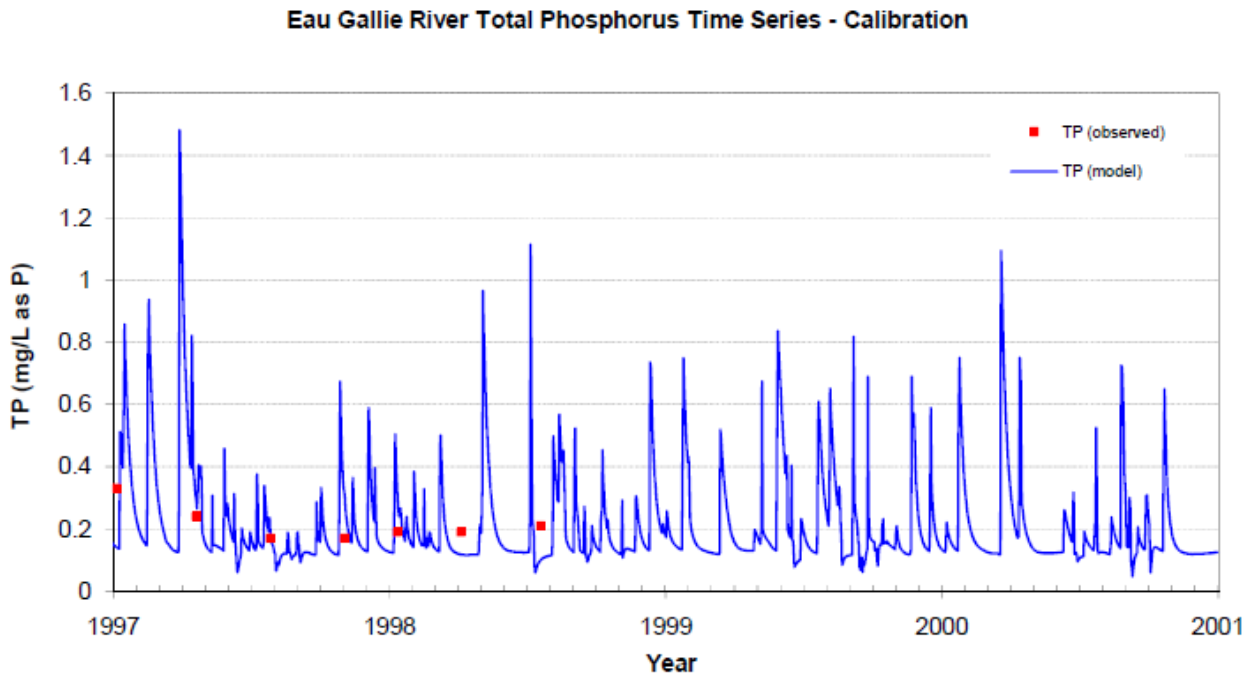


Figure D2-9. Model Simulated and Measured Total Phosphorus for the Eau Gallie River in the Calibration Period (1997 through 2000)

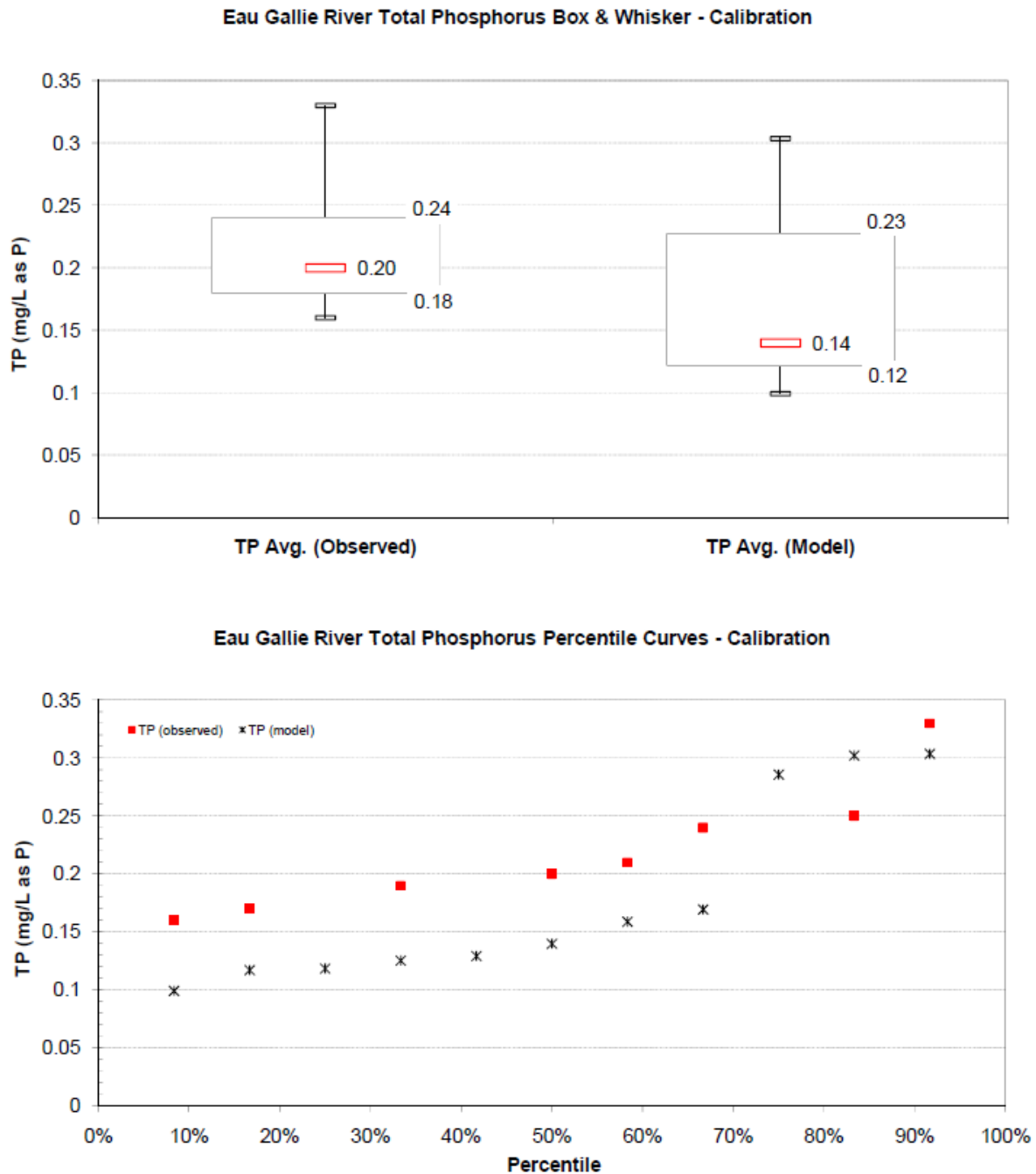


Figure D2-10. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 9.5%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 0.5%

Result: Distributions appear to be different

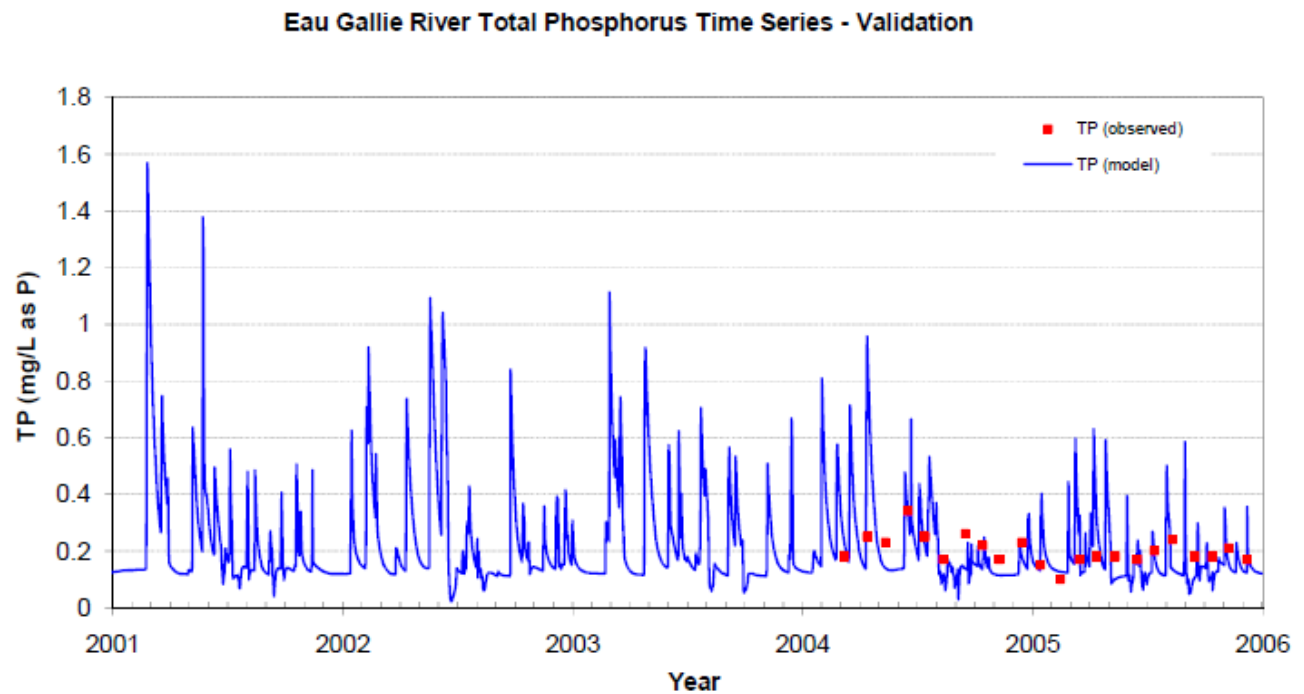


Figure D2-11. Model Simulated and Measured Total Phosphorus for the Eau Gallie River in the Validation Period (2001 through 2005)

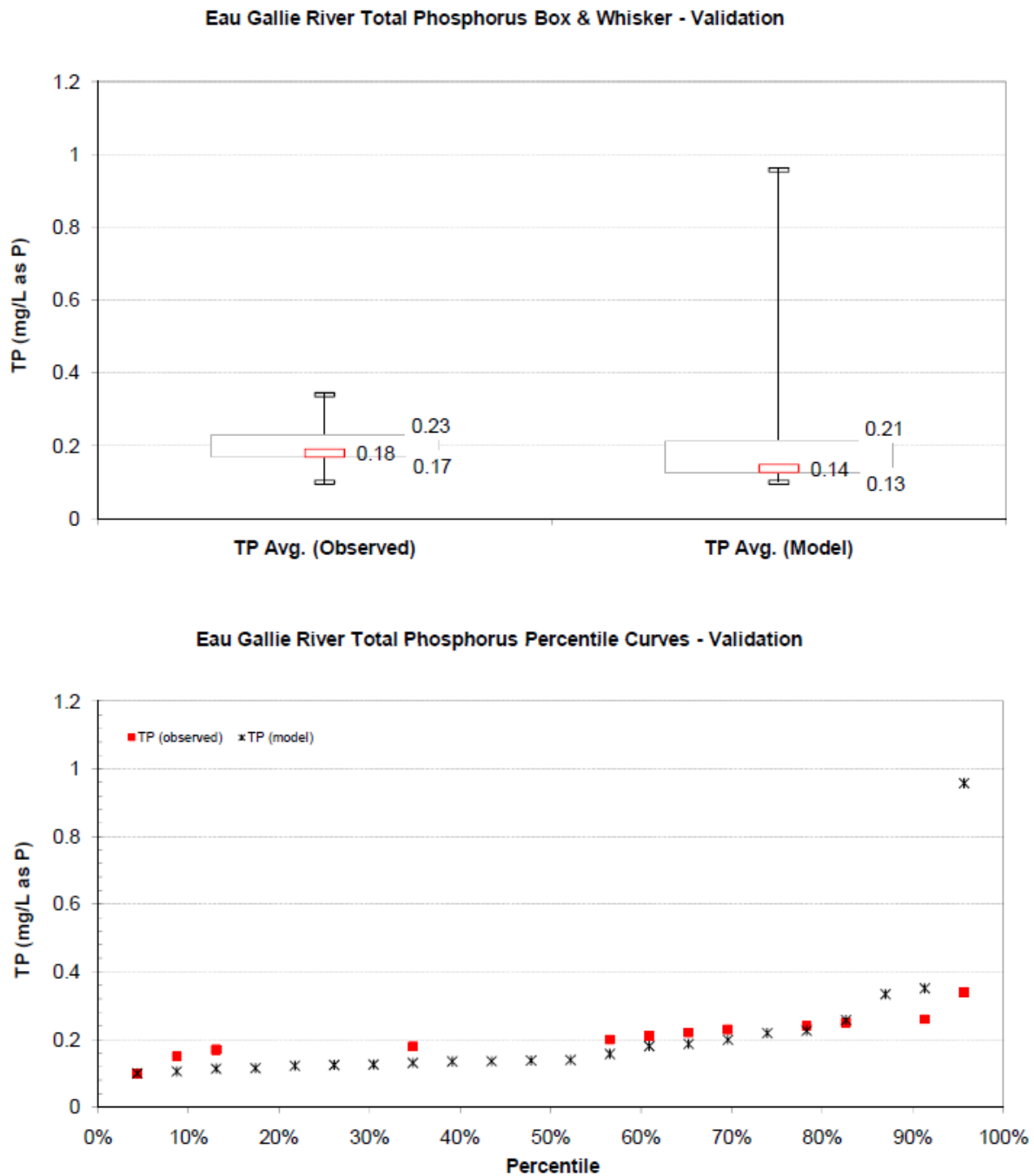


Figure D2-12. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in the Eau Gallie River in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 1.0%

Result: Medians appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 0.0%

Result: Distributions appear to be different

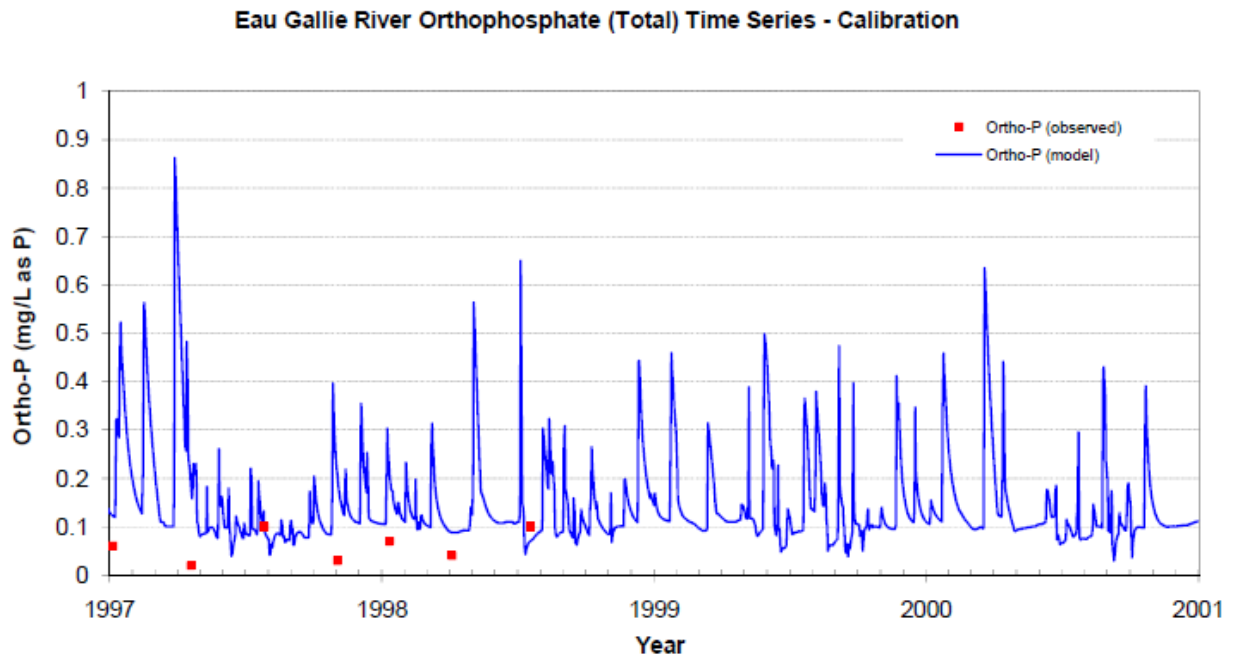


Figure D2-13. Model Simulated and Measured Orthophosphate for the Eau Gallie River in the Calibration Period (1997 through 2000)

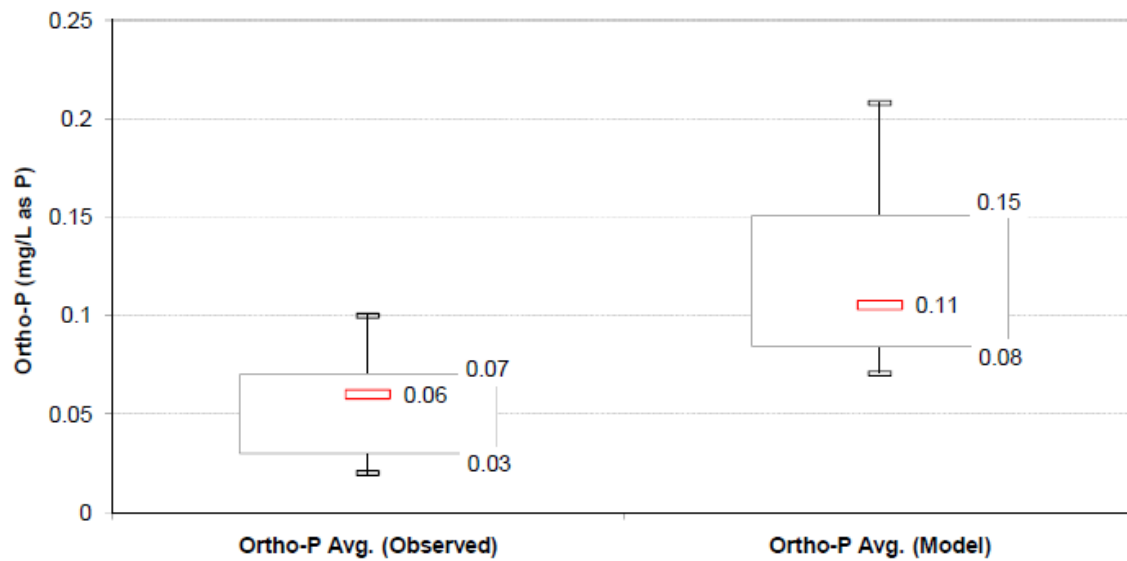
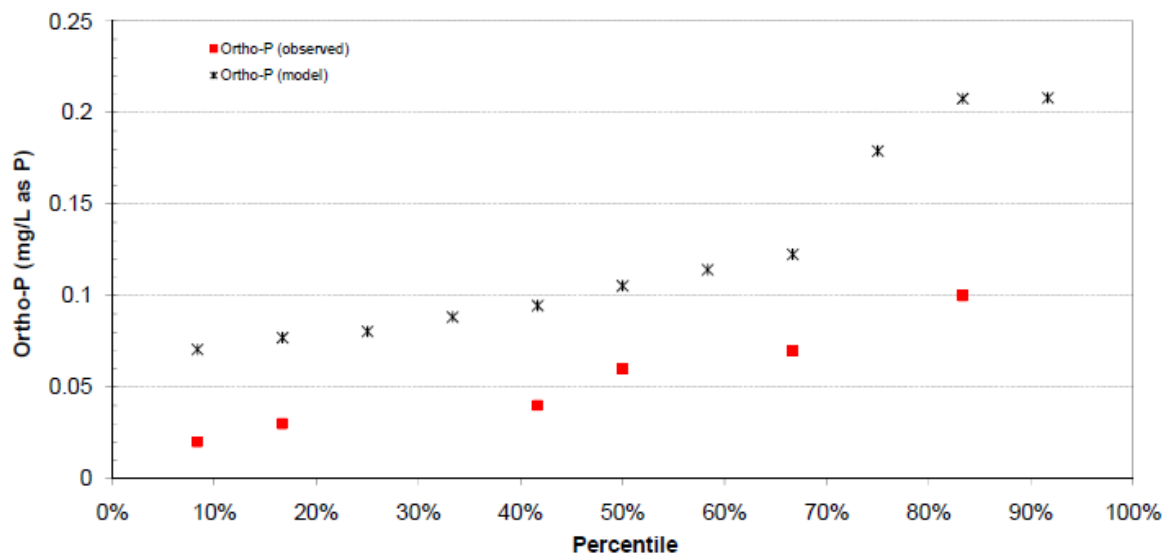
Eau Gallie River Orthophosphate (Total) Box & Whisker - Calibration**Eau Gallie River Orthophosphate (Total) Percentile Curves - Calibration**

Figure D2-14. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 91.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 59.0%

Result: Distributions do not appear to be different

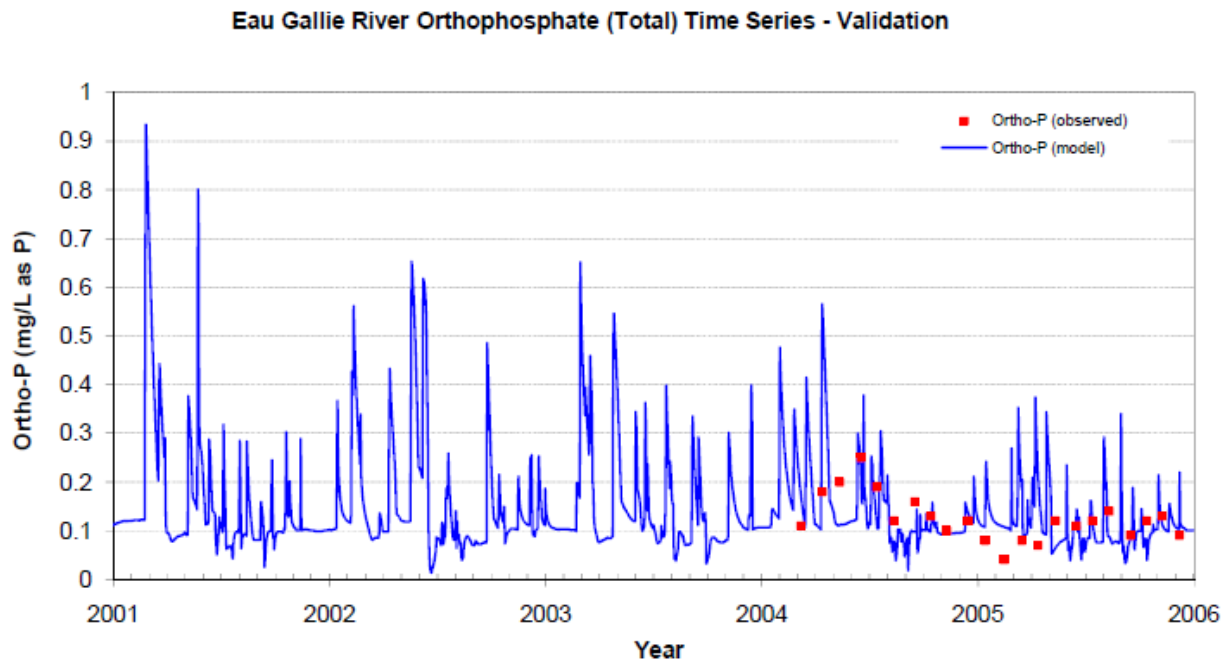


Figure D2-15. Model Simulated and Measured Orthophosphate for the Eau Gallie River in the Validation Period (2001 through 2005)

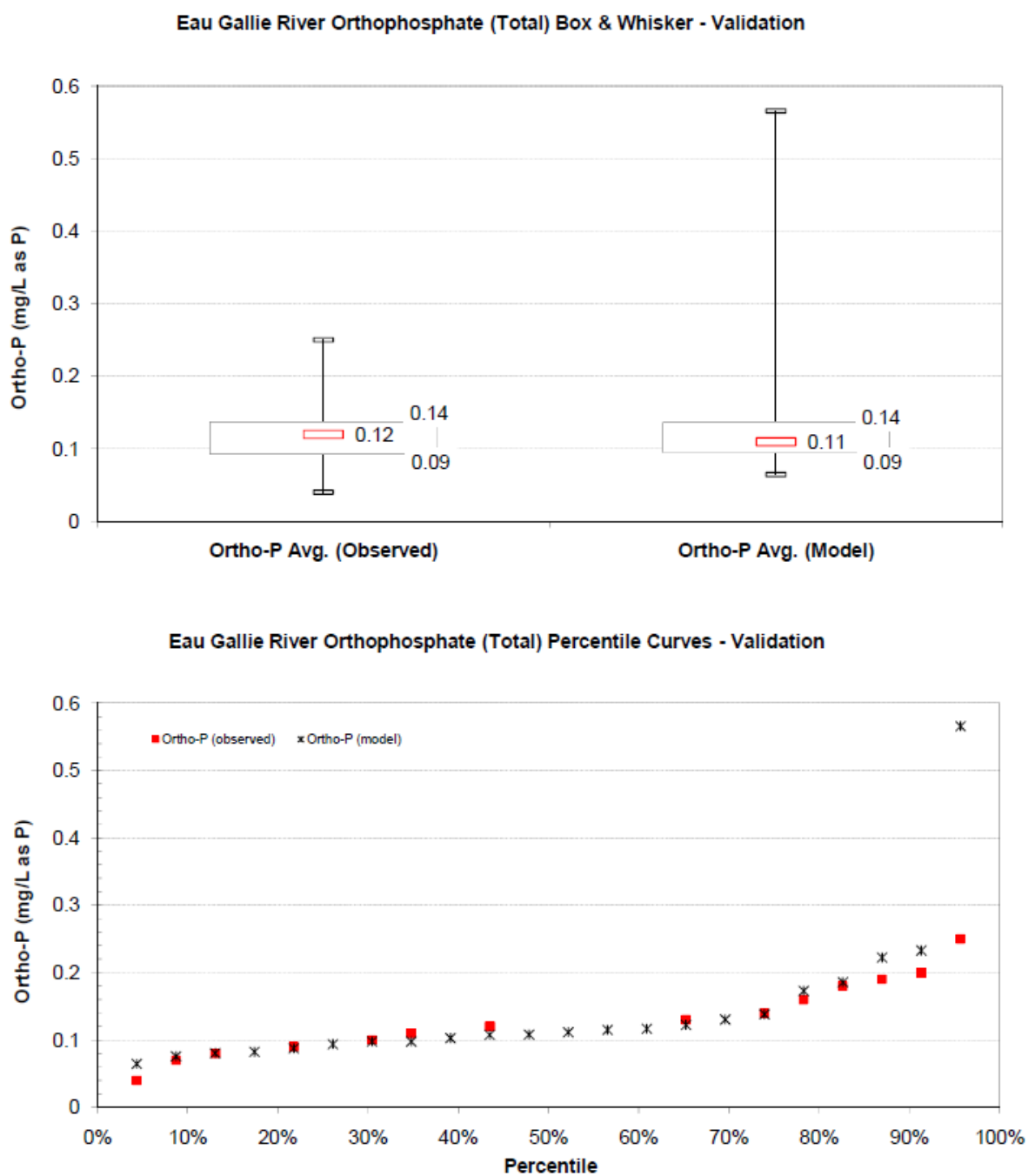


Figure D2-16. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in the Eau Gallie River in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 92.9%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 37.9%

Result: Distributions do not appear to be different

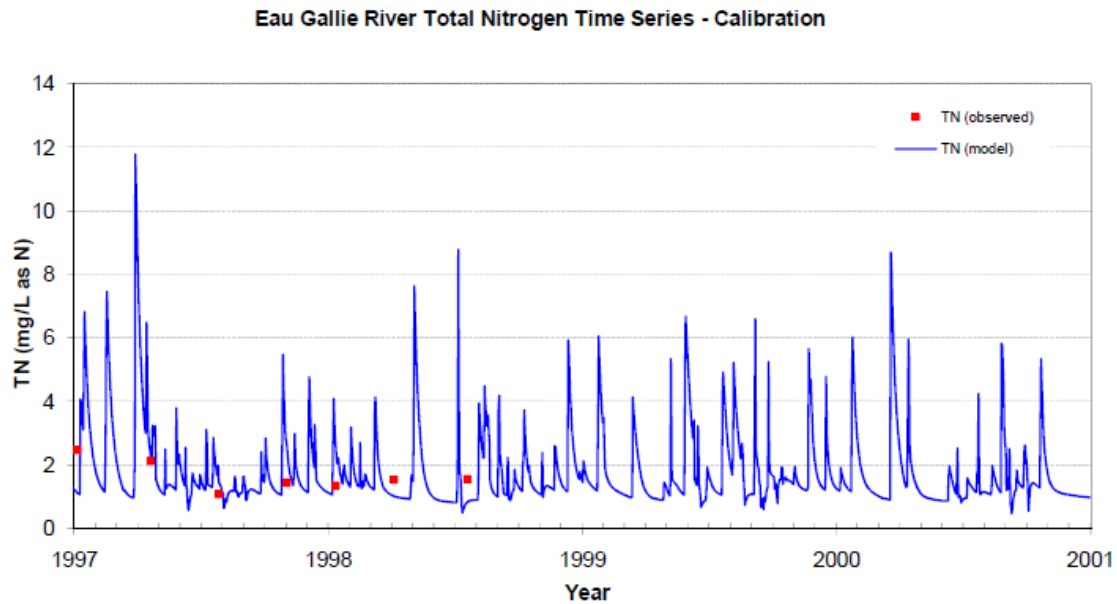


Figure D2-17. Model Simulated and Measured Total Nitrogen for the Eau Gallie River in the Calibration Period (1997 through 2000)

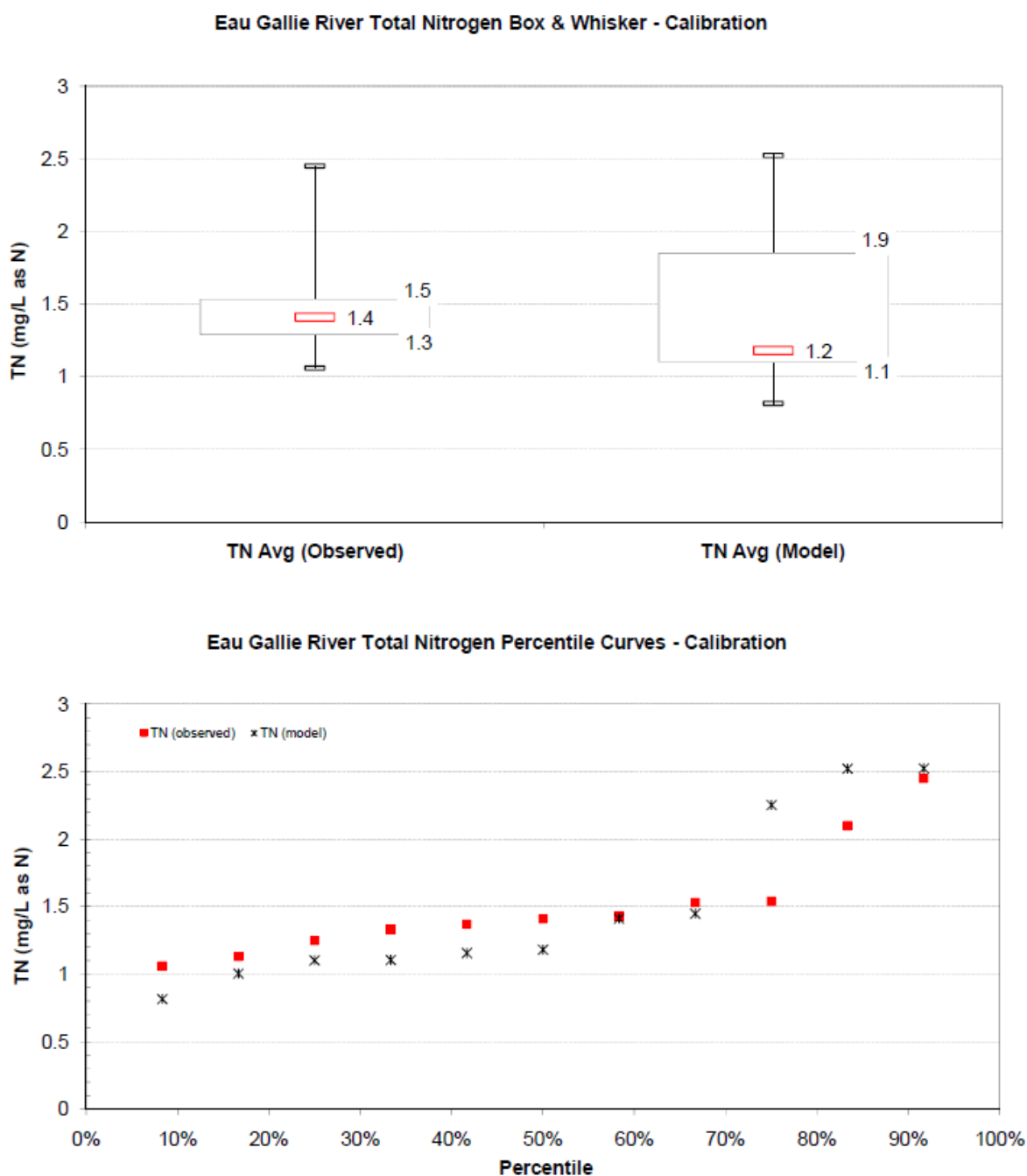


Figure D2-18. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 0.0%

Result: Medians appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 0.0%

Result: Distributions appear to be different

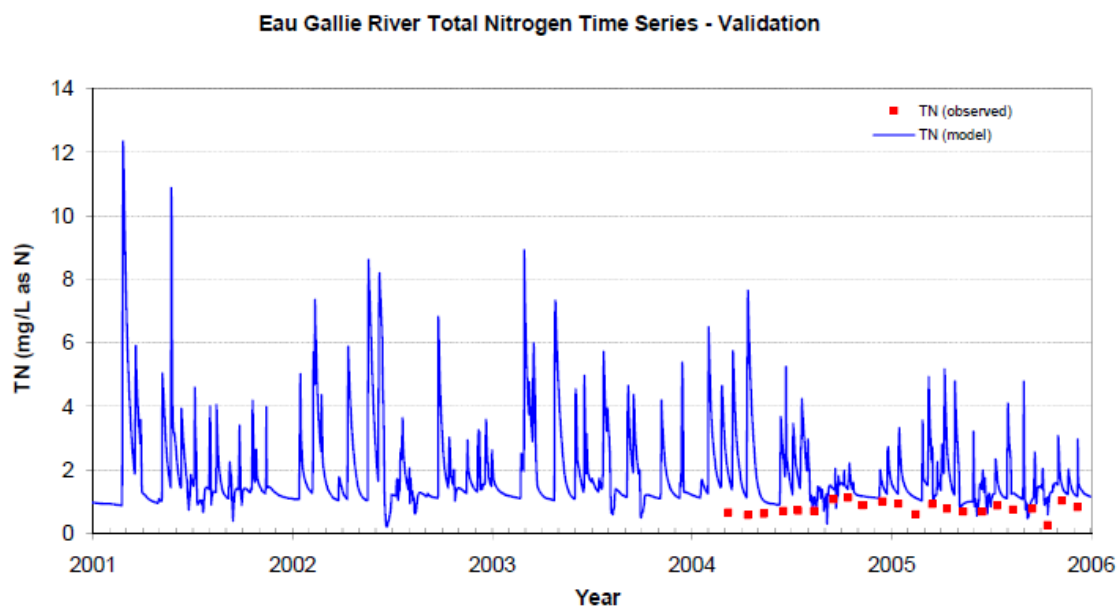


Figure D2-19. Model Simulated and Measured Total Nitrogen for the Eau Gallie River in the Validation Period (2001 through 2005)

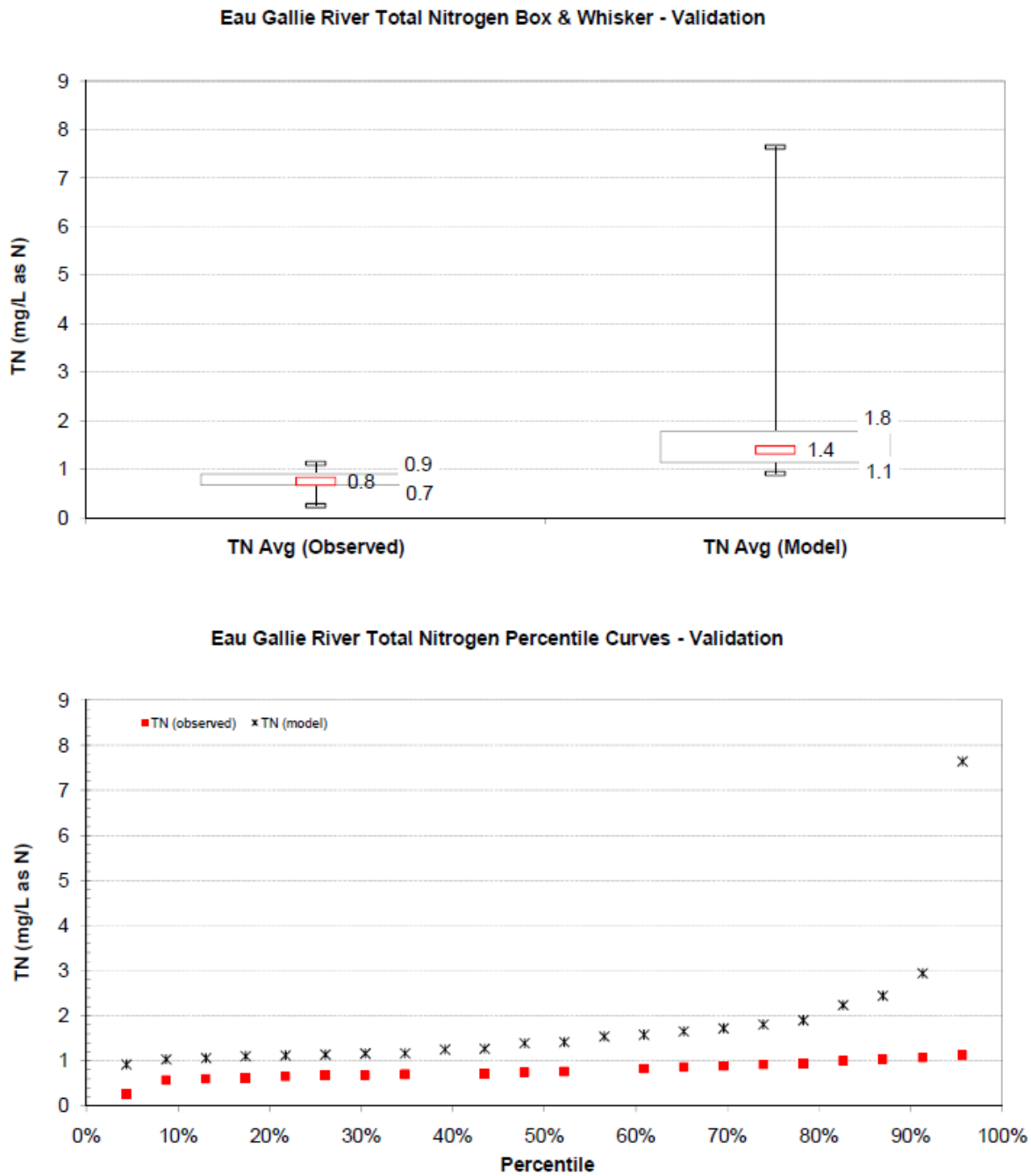


Figure D2-20. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in the Eau Gallie River in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 11.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 14.7%

Result: Distributions do not appear to be different

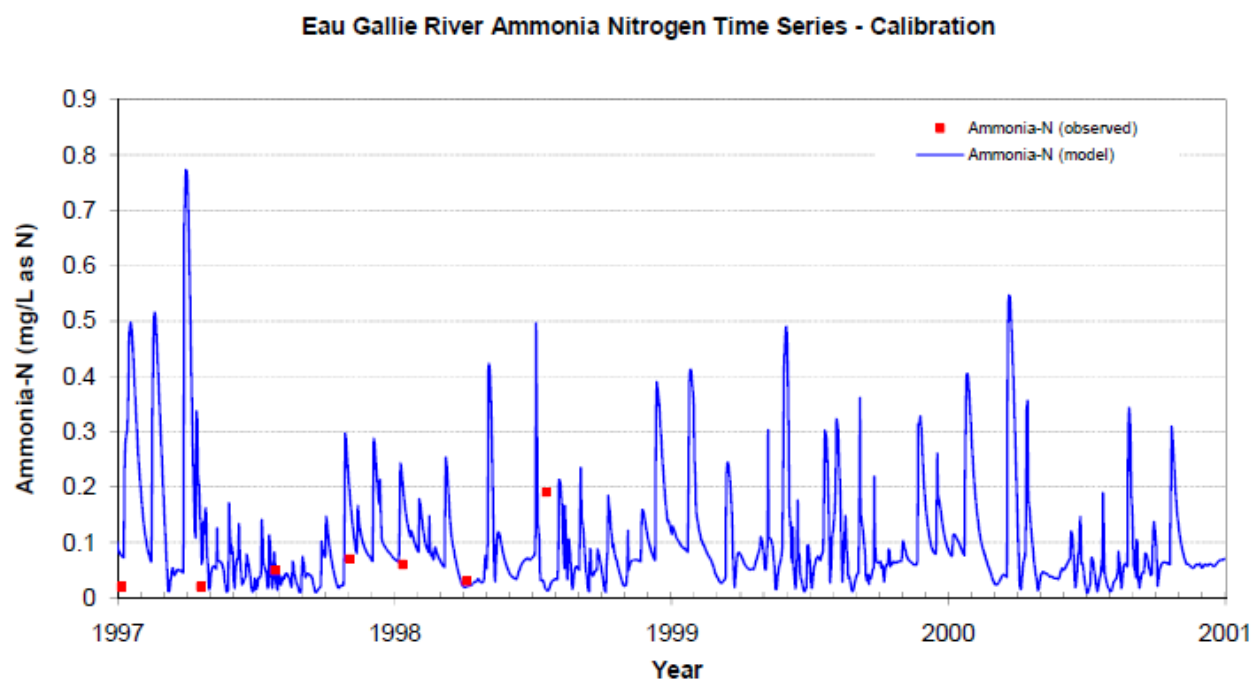


Figure D2-21. Model Simulated and Measured Total Nitrogen for the Eau Gallie River in the Calibration Period (1997 through 2000)

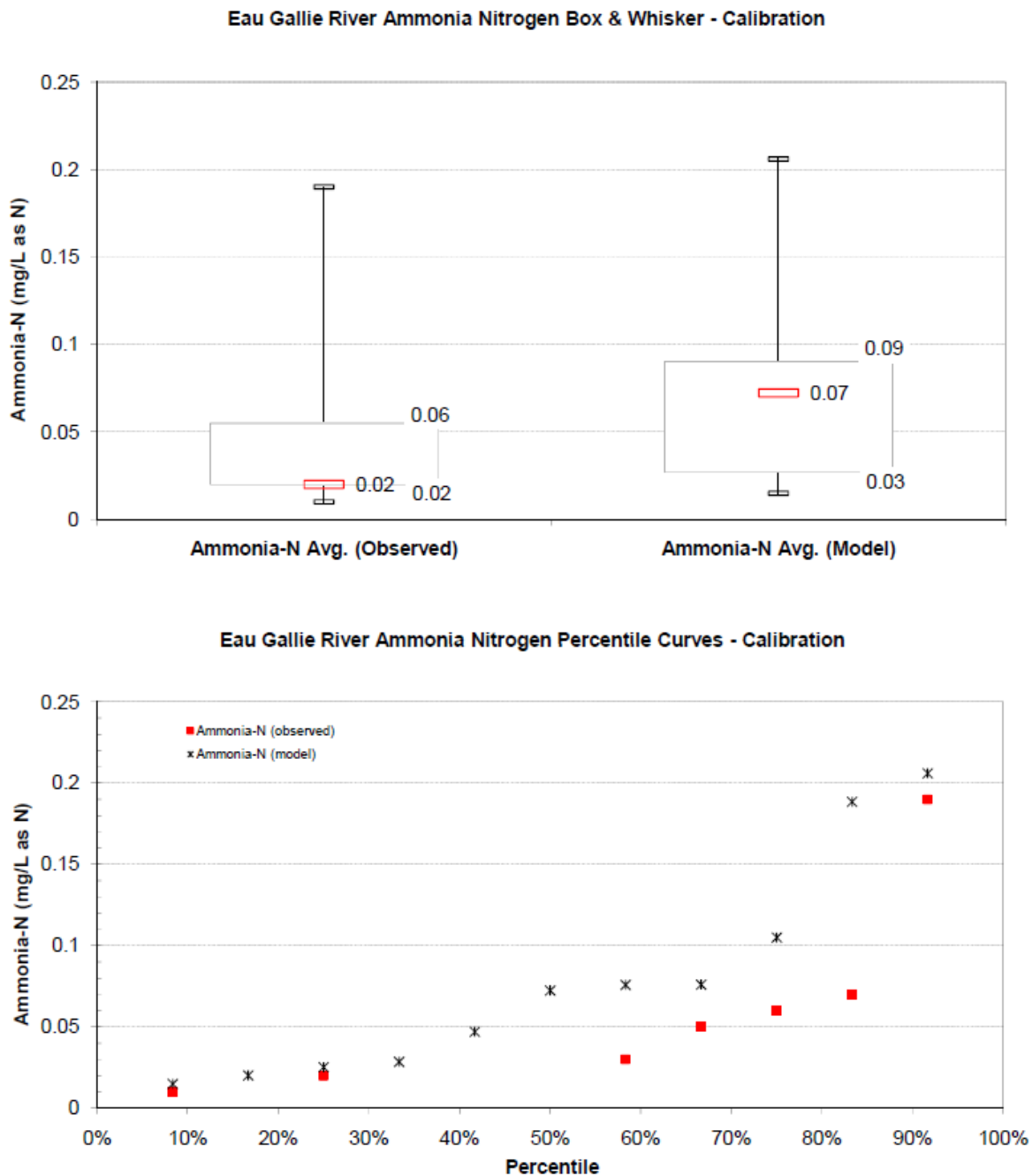


Figure D2-22. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Ammonia Nitrogen in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 14.7%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 11.6%

Result: Distributions do not appear to be different

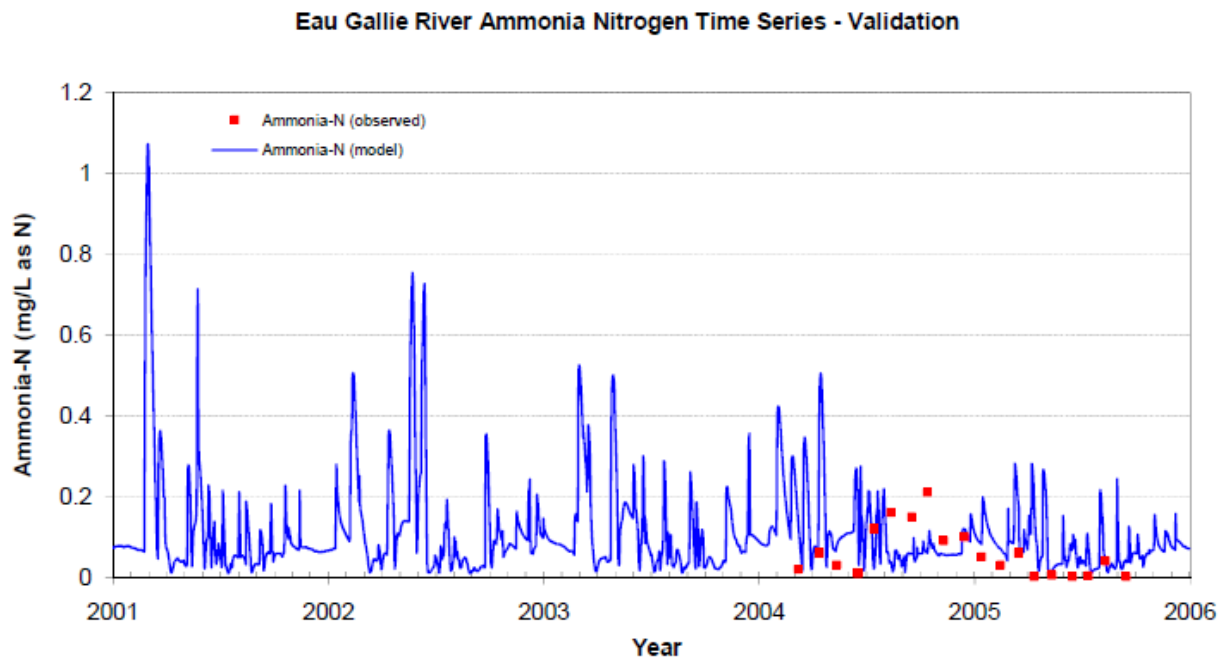


Figure D2-23. Model Simulated and Measured Ammonia Nitrogen for the Eau Gallie River in the Validation Period (2001 through 2005)

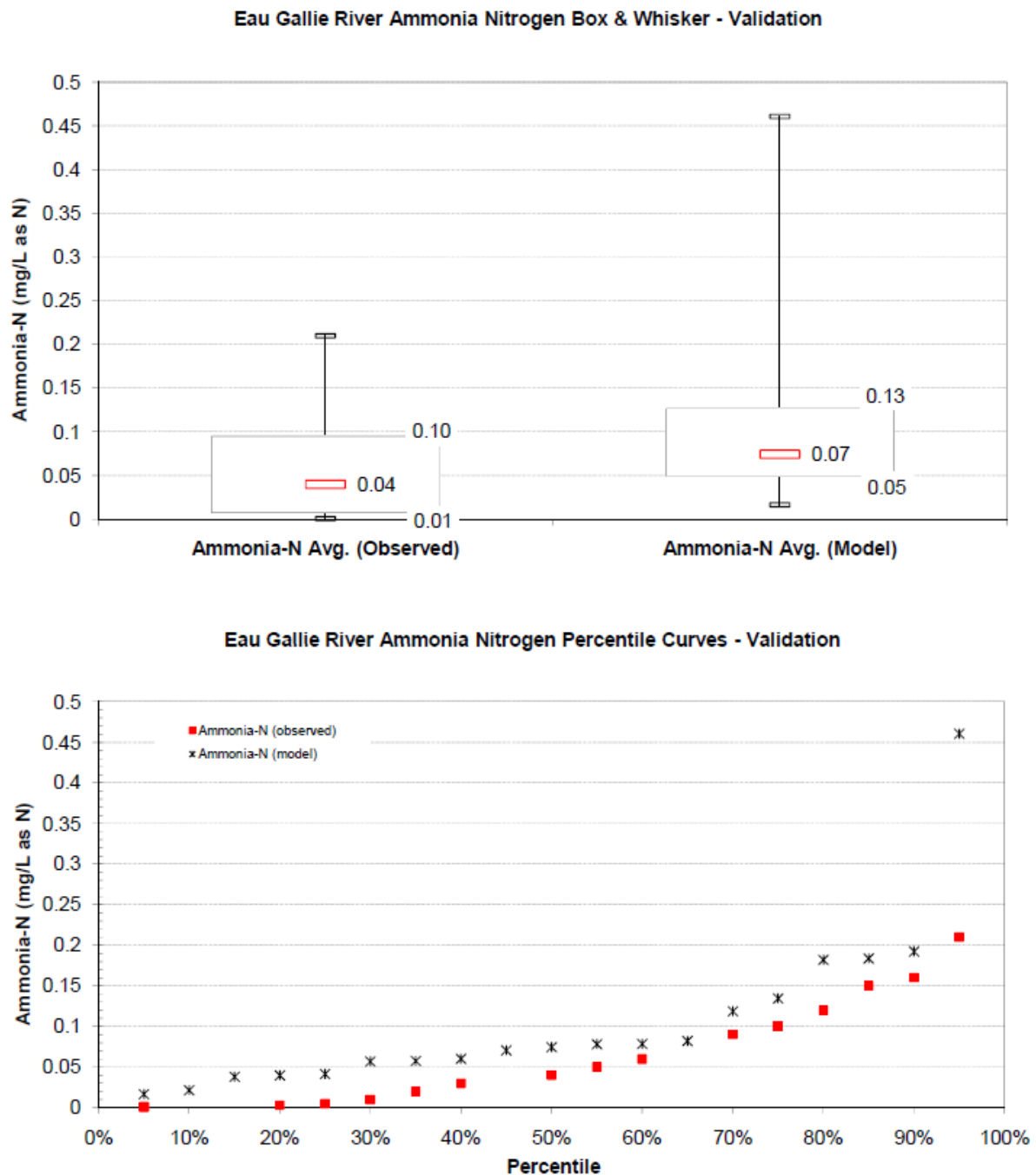


Figure D2-24. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Ammonia Nitrogen in the Eau Gallie River in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 2.6%

Result: Medians appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 1.2%

Result: Distributions appear to be different

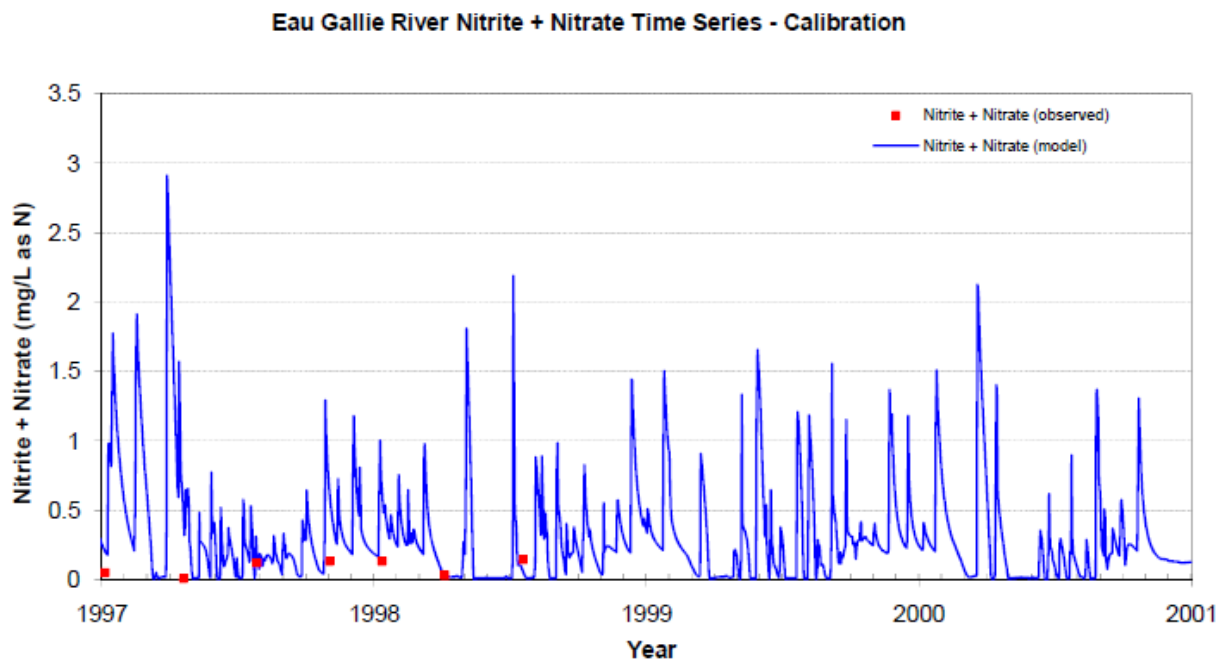


Figure D2-25. Model Simulated and Measured Nitrate Nitrogen for the Eau Gallie River in the Calibration Period (1997 through 2000)

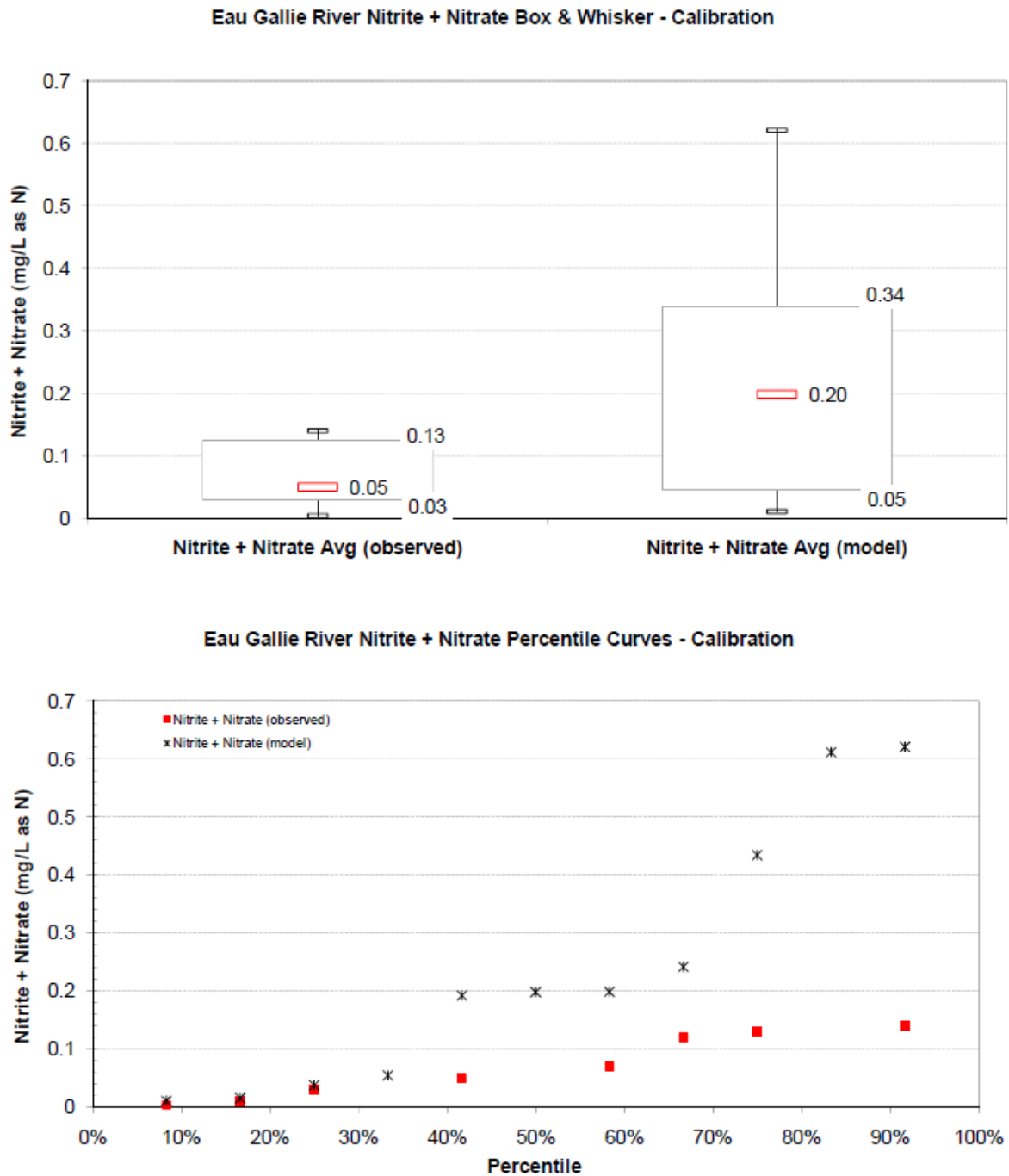


Figure D2-26. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 0.0%

Result: Medians appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 0.0%

Result: Distributions appear to be different

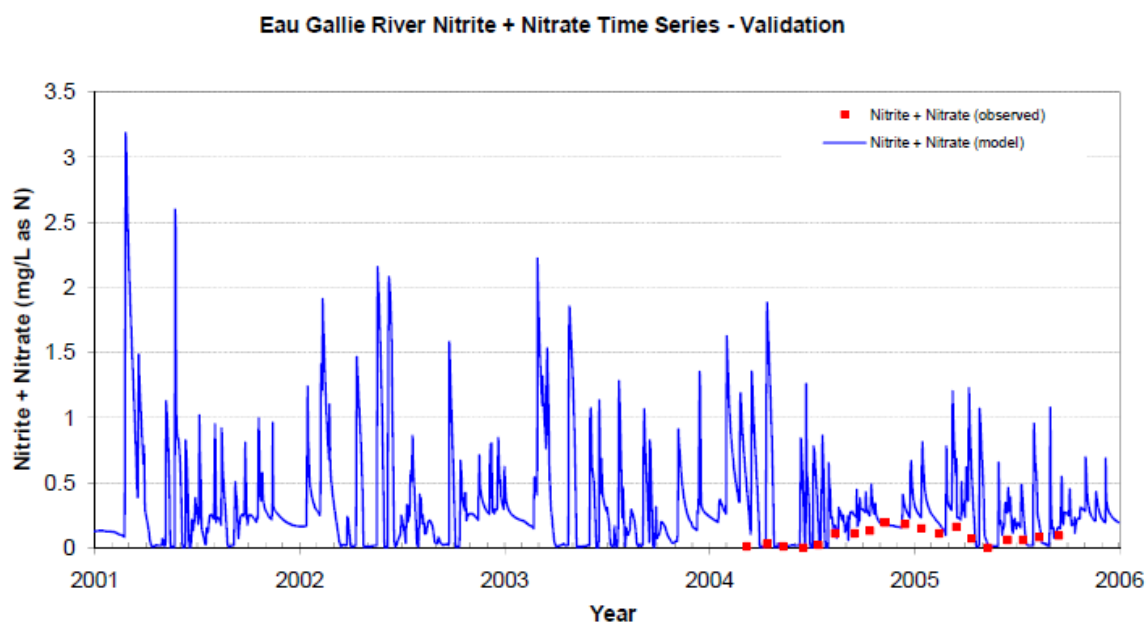
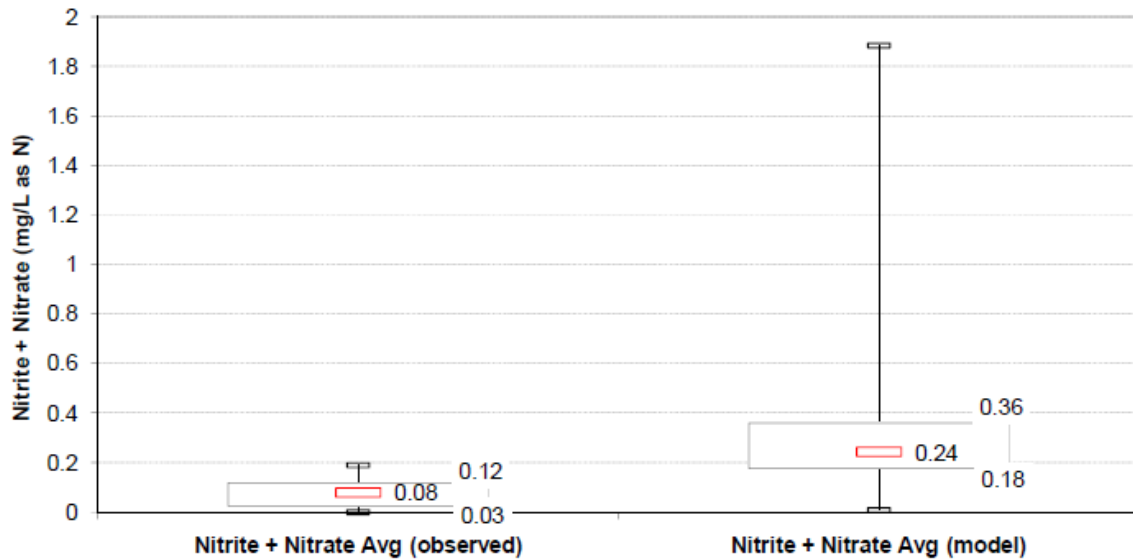


Figure D2-27. Model Simulated and Measured Nitrate Nitrogen for the Eau Gallie River in the Validation Period (2001 through 2005)

Eau Gallie River Nitrite + Nitrate Box & Whisker - Validation



Eau Gallie River Nitrite + Nitrate Percentile Curves - Validation

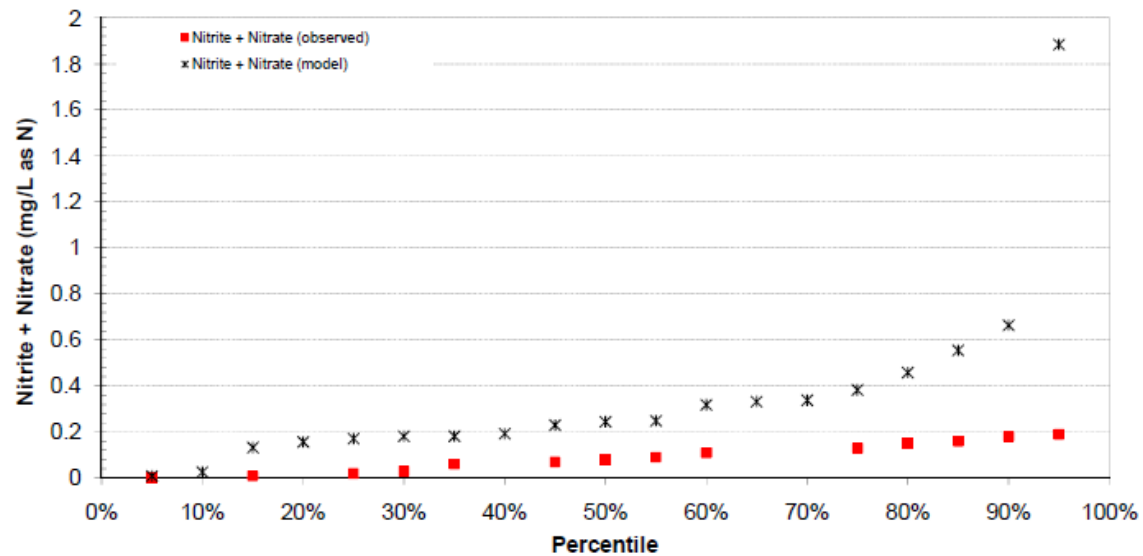


Figure D2-28. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in the Eau Gallie River in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 0.6%

Result: Medians appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 0.0%

Result: Distributions appear to be different

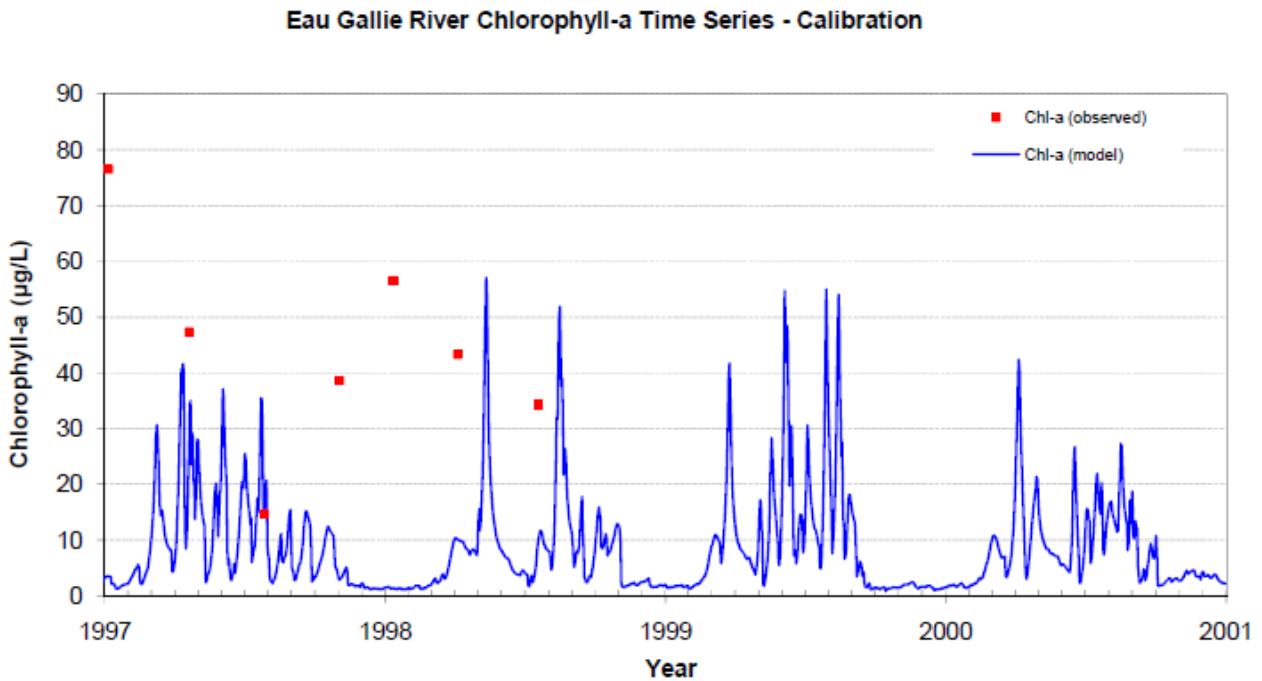


Figure D2-29. Model Simulated and Measured Chlorophyll a for the Eau Gallie River in the Calibration Period (1997 through 2000)

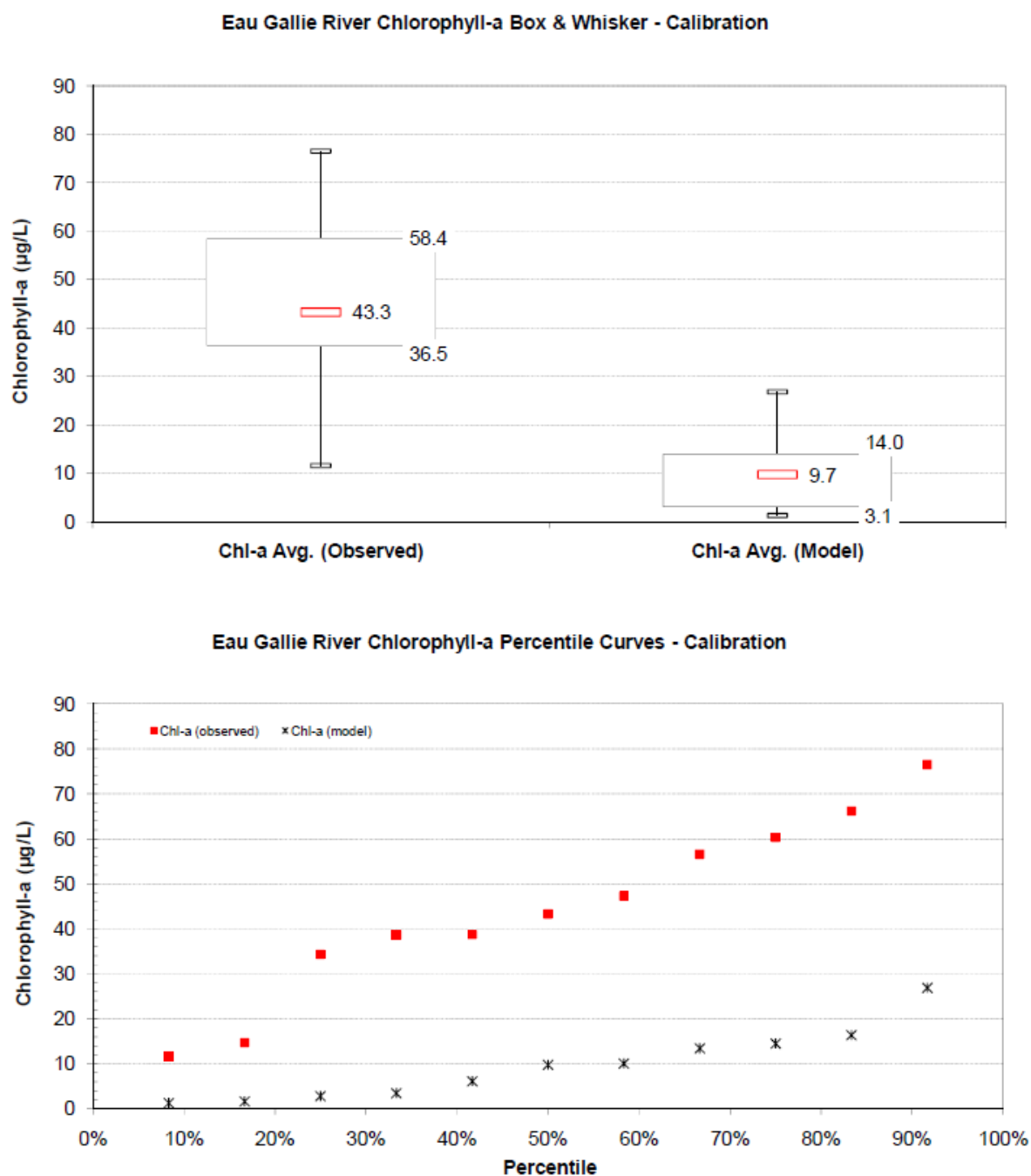


Figure D2-30. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 8.8%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 33.5%

Result: Distributions do not appear to be different

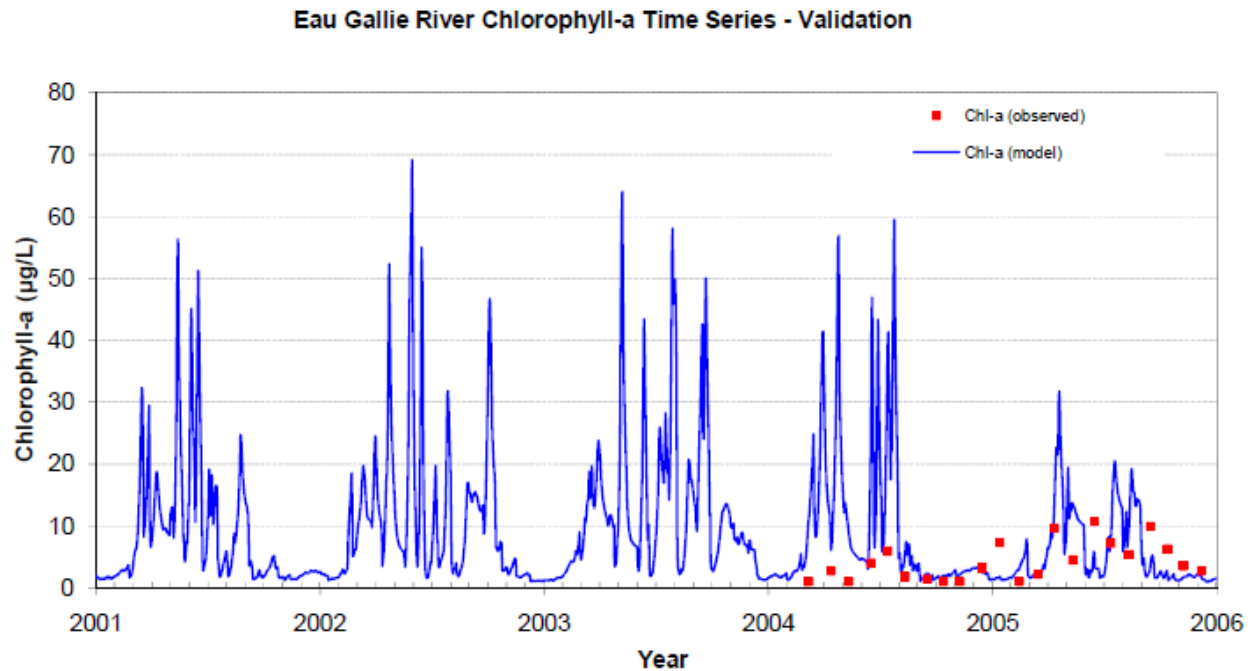
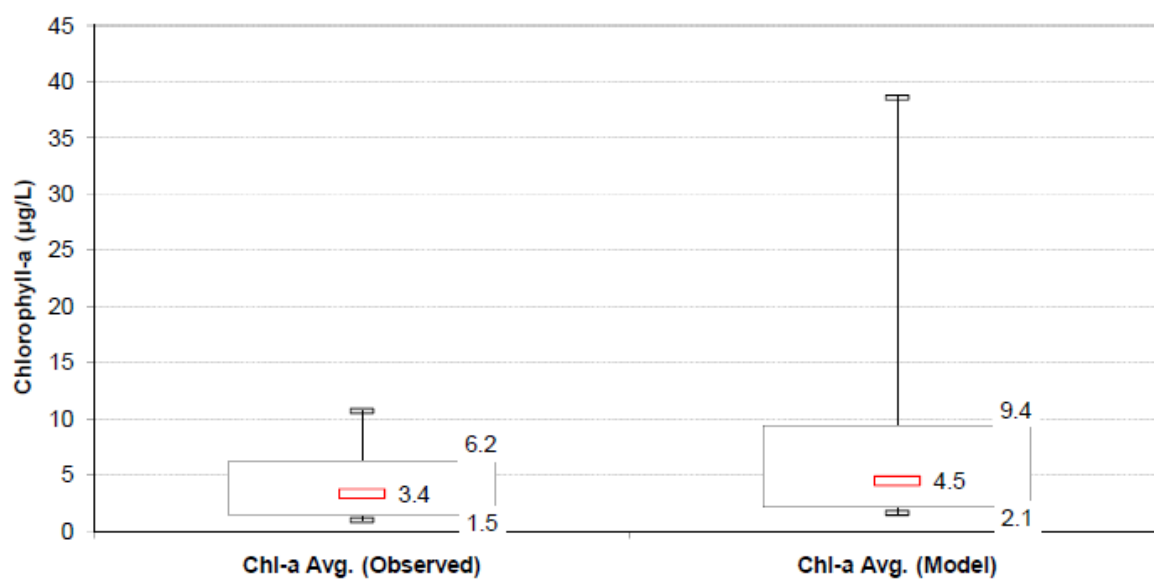


Figure D2-31. Model Simulated and Measured Chlorophyll a for the Eau Gallie River in the Validation Period (2001 through 2005)

Eau Gallie River Chlorophyll-a Box & Whisker - Validation



Eau Gallie River Chlorophyll-a Percentile Curves - Validation

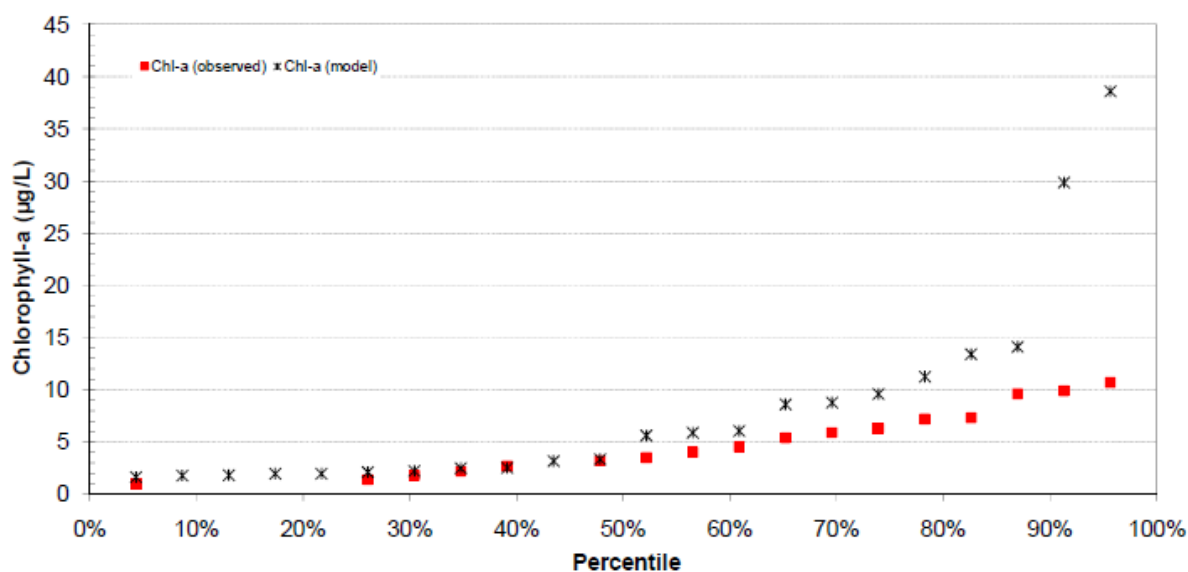


Figure D2-32. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in the Eau Gallie River in the Validation Period (2001 through 2005)

Wilcoxon Rank Sum Test

P-Value: 31.0%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 43.2%

Result: Distributions do not appear to be different

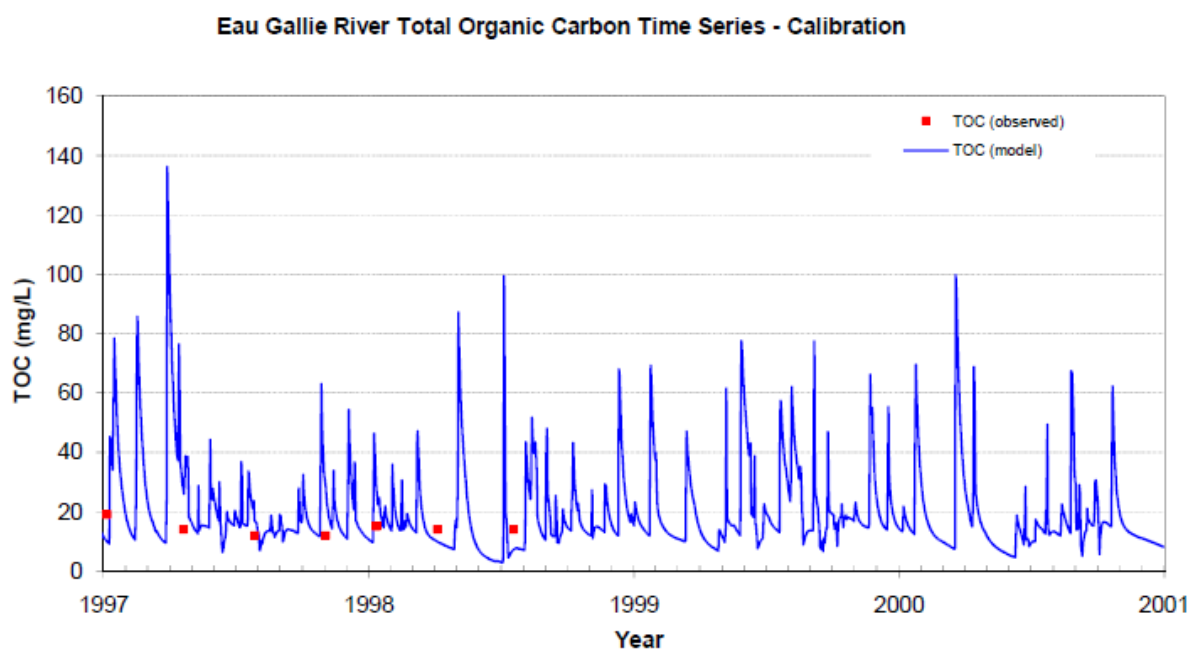


Figure D2-33. Model Simulated and Measured Total Organic Carbon for the Eau Gallie River in the Calibration Period (1997 through 2000)

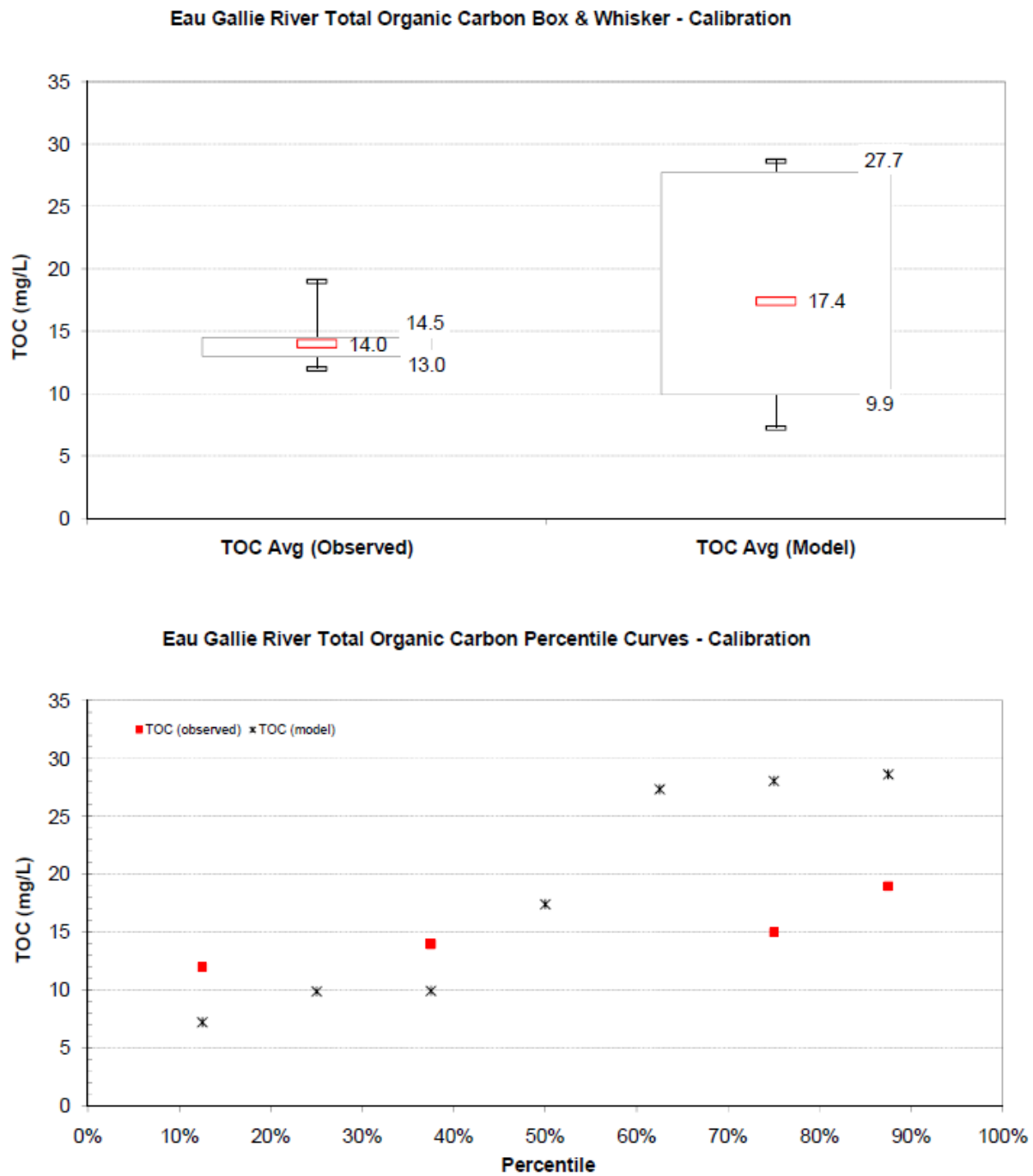


Figure D2-34. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Organic Carbon in the Eau Gallie River in the Calibration Period (1997 through 2000)

Wilcoxon Rank Sum Test

P-Value: 23.6%

Result: Medians do not appear to be different

2-Sided Kolmogorov-Smirnov Test

P-Value: 17.5%

Result: Distributions do not appear to be different

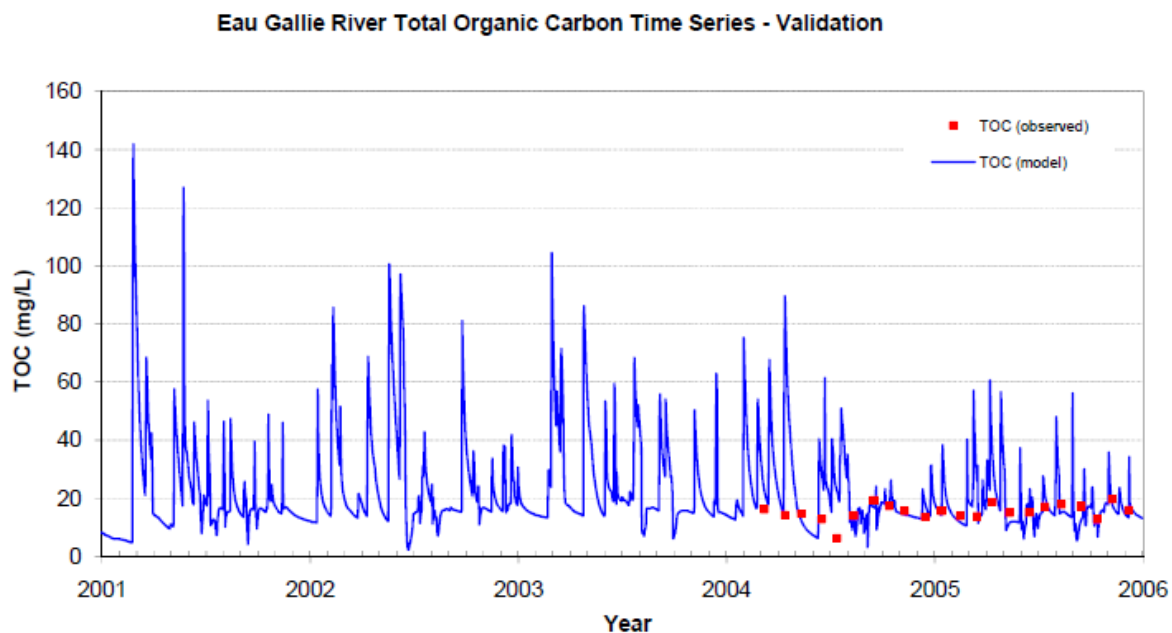


Figure D2-35. Model Simulated and Measured Total Organic Carbon for the Eau Gallie River in the Validation Period (2001 through 2005)

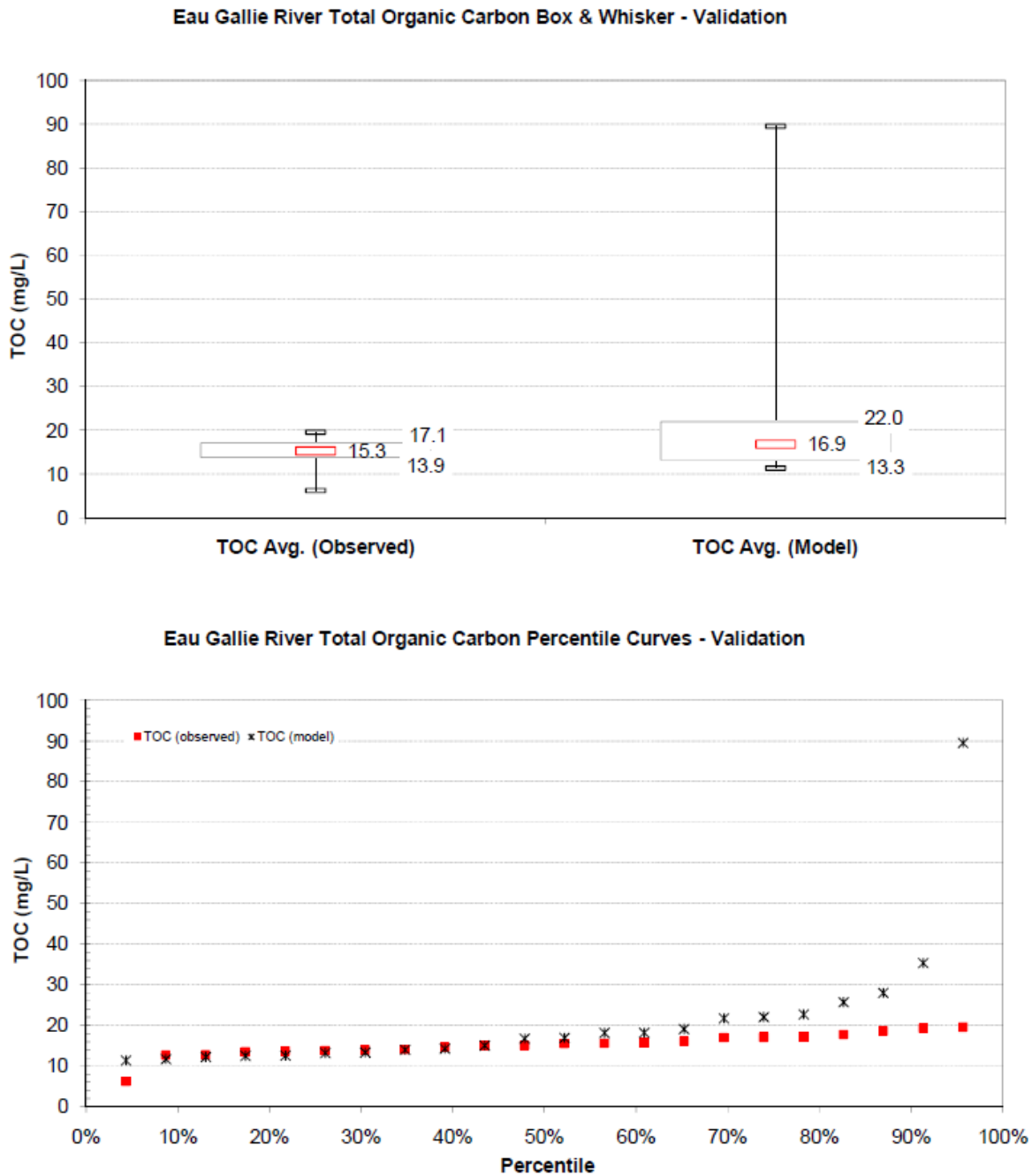


Figure D2-36. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Organic Carbon in the Eau Gallie River in the Validation Period (2001 through 2005)

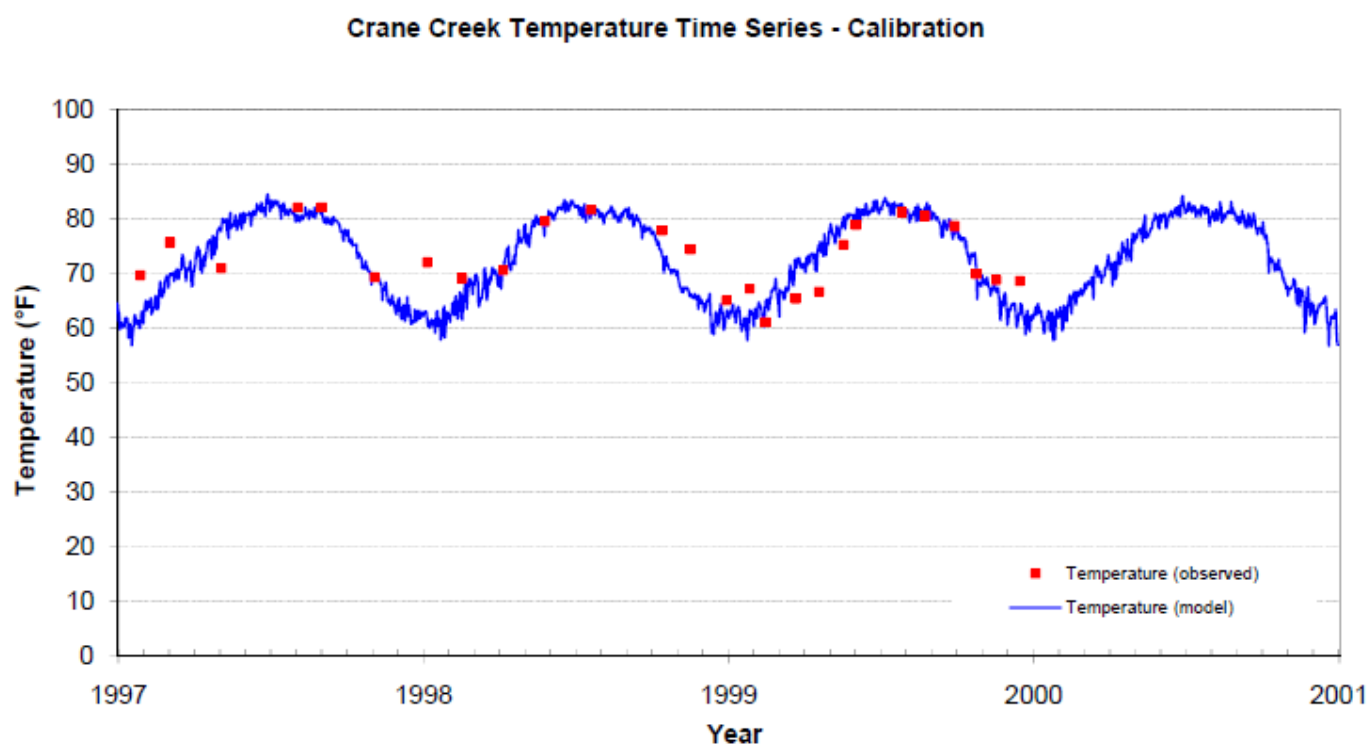


Figure D3-1. Model Simulated and Measured Temperature for Crane Creek in the Calibration Period (1997 through 2000)

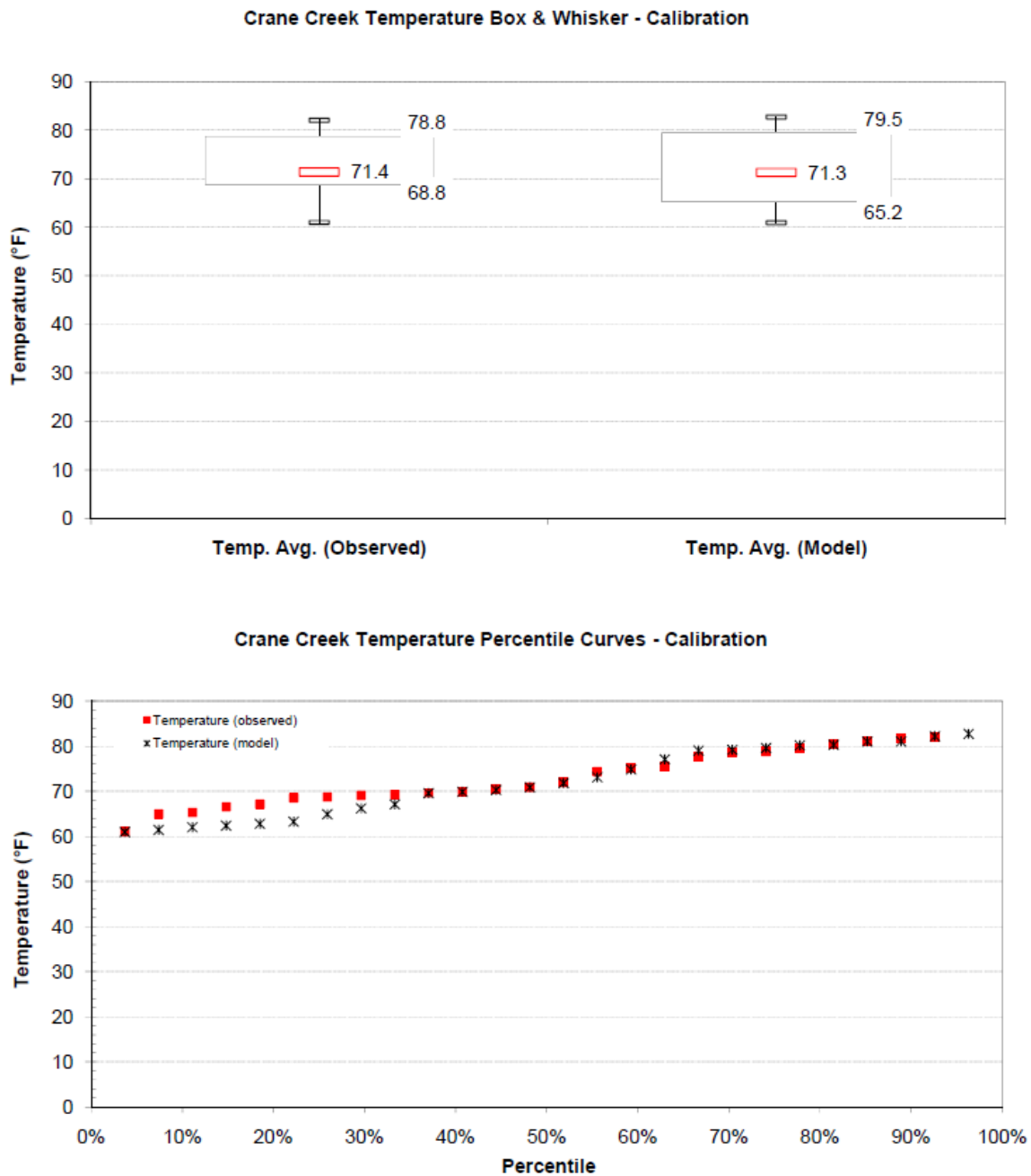


Figure D3-2. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Temperature in Crane Creek in the Calibration Period (1997 through 2000)

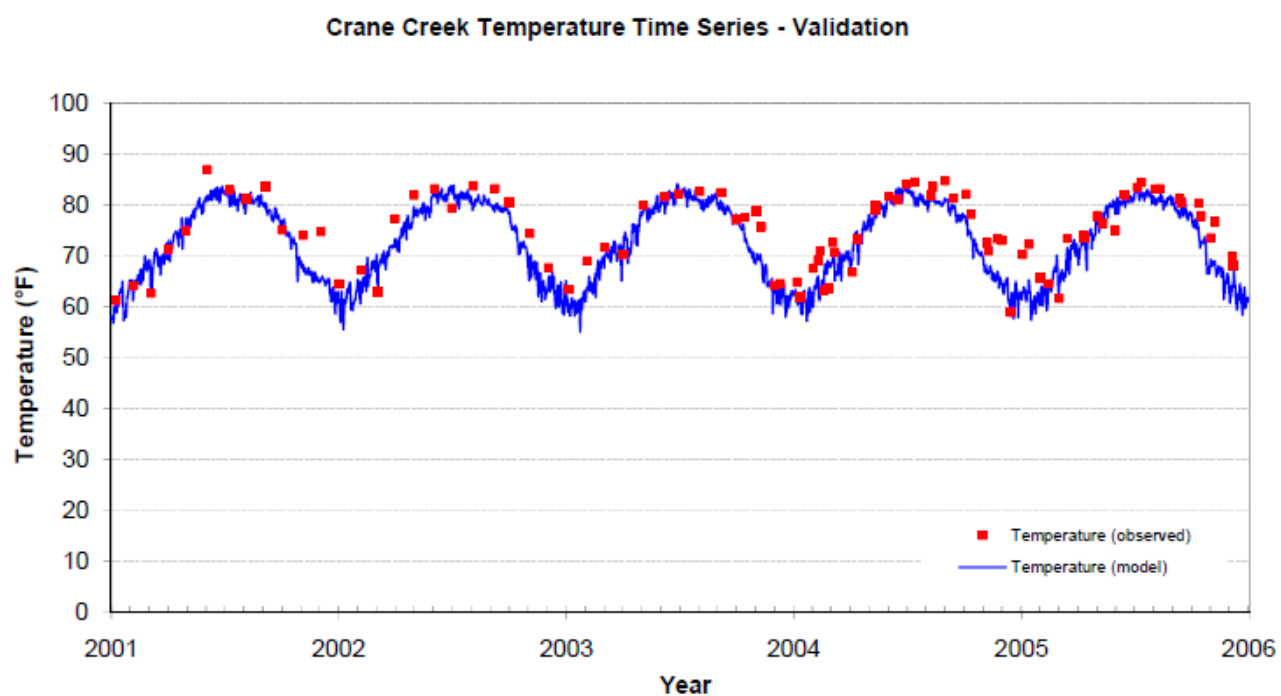


Figure D3-3. Model Simulated and Measured Temperature for the Crane Creek in the Validation Period (2001 through 2005)

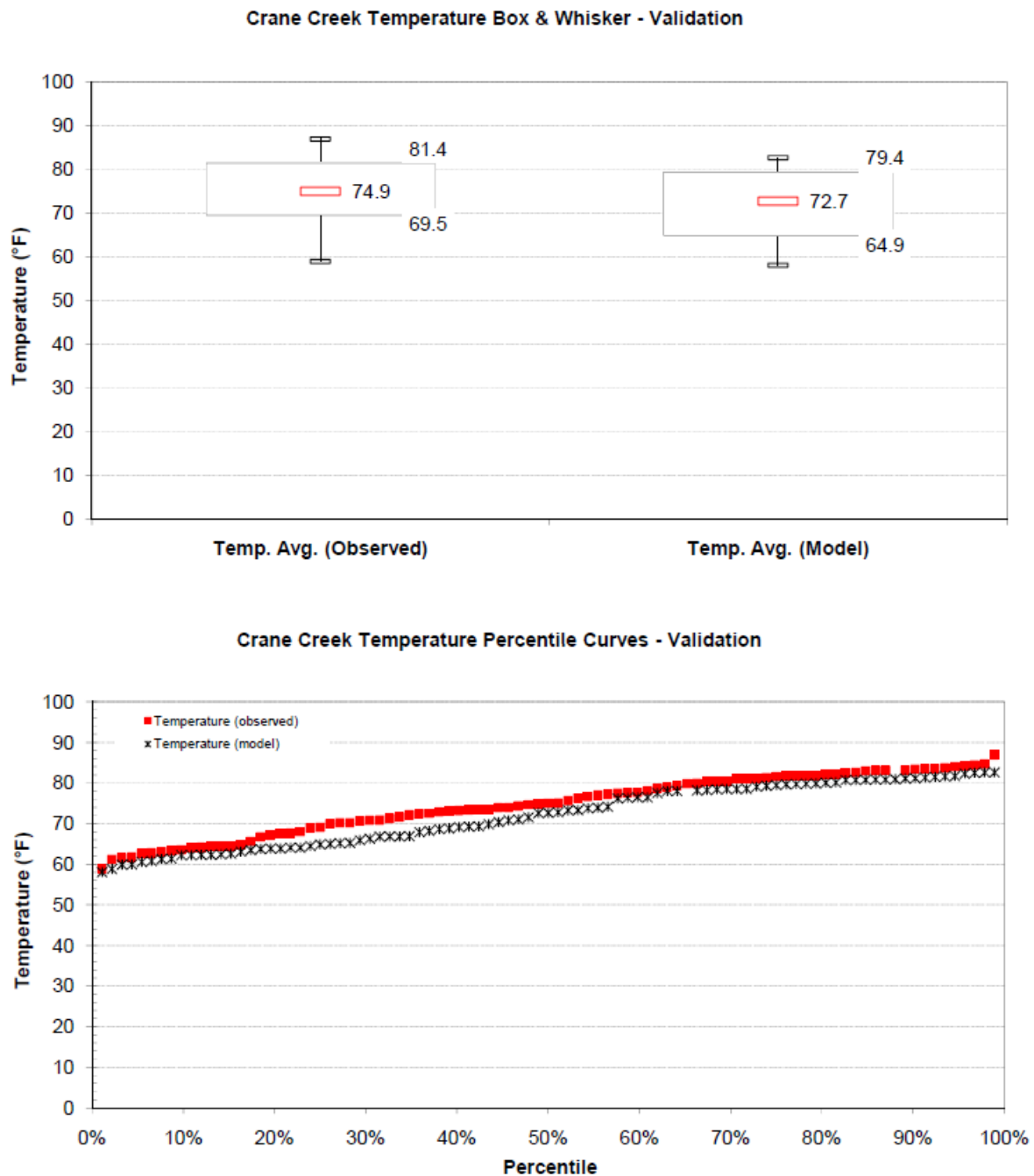


Figure D3-4. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Temperature in Crane Creek in the Validation Period (2001 through 2005)

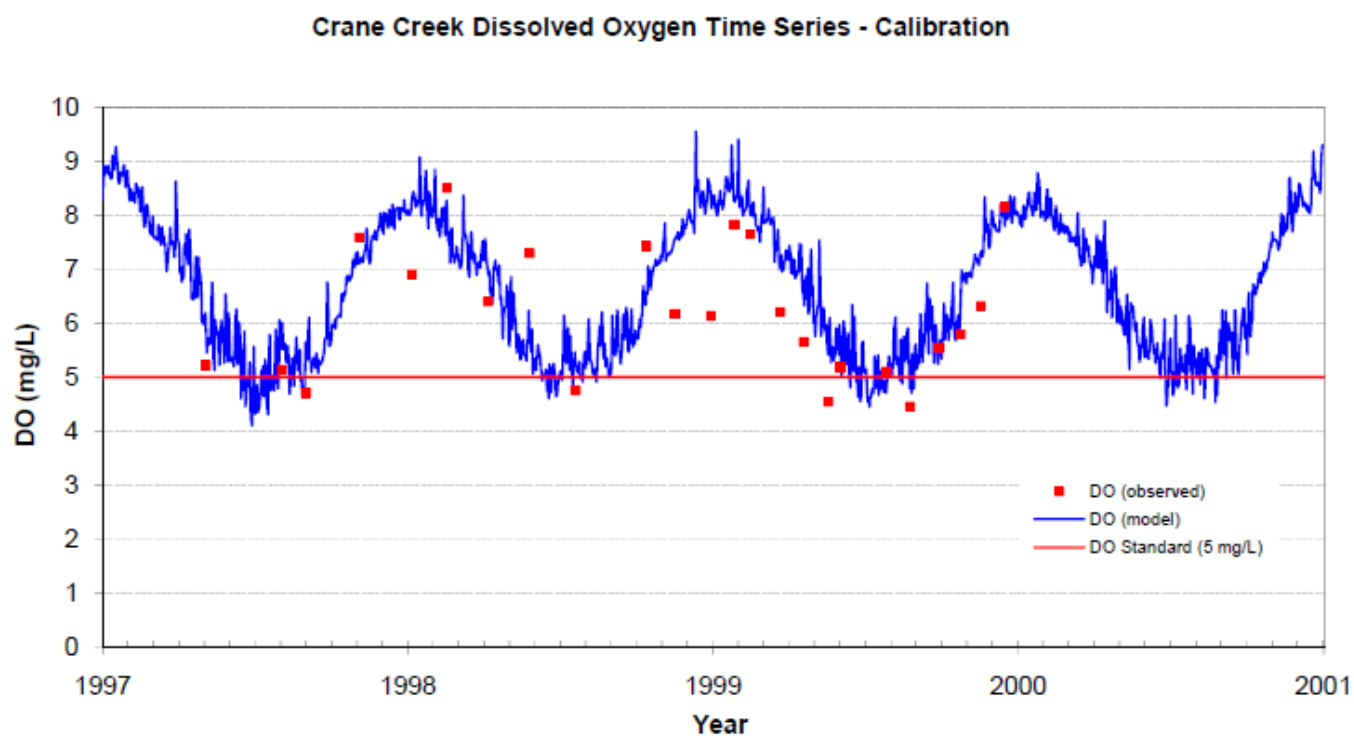


Figure D3-5. Model Simulated and Measured Dissolved Oxygen for the Crane Creek in the Calibration Period (1997 through 2000)

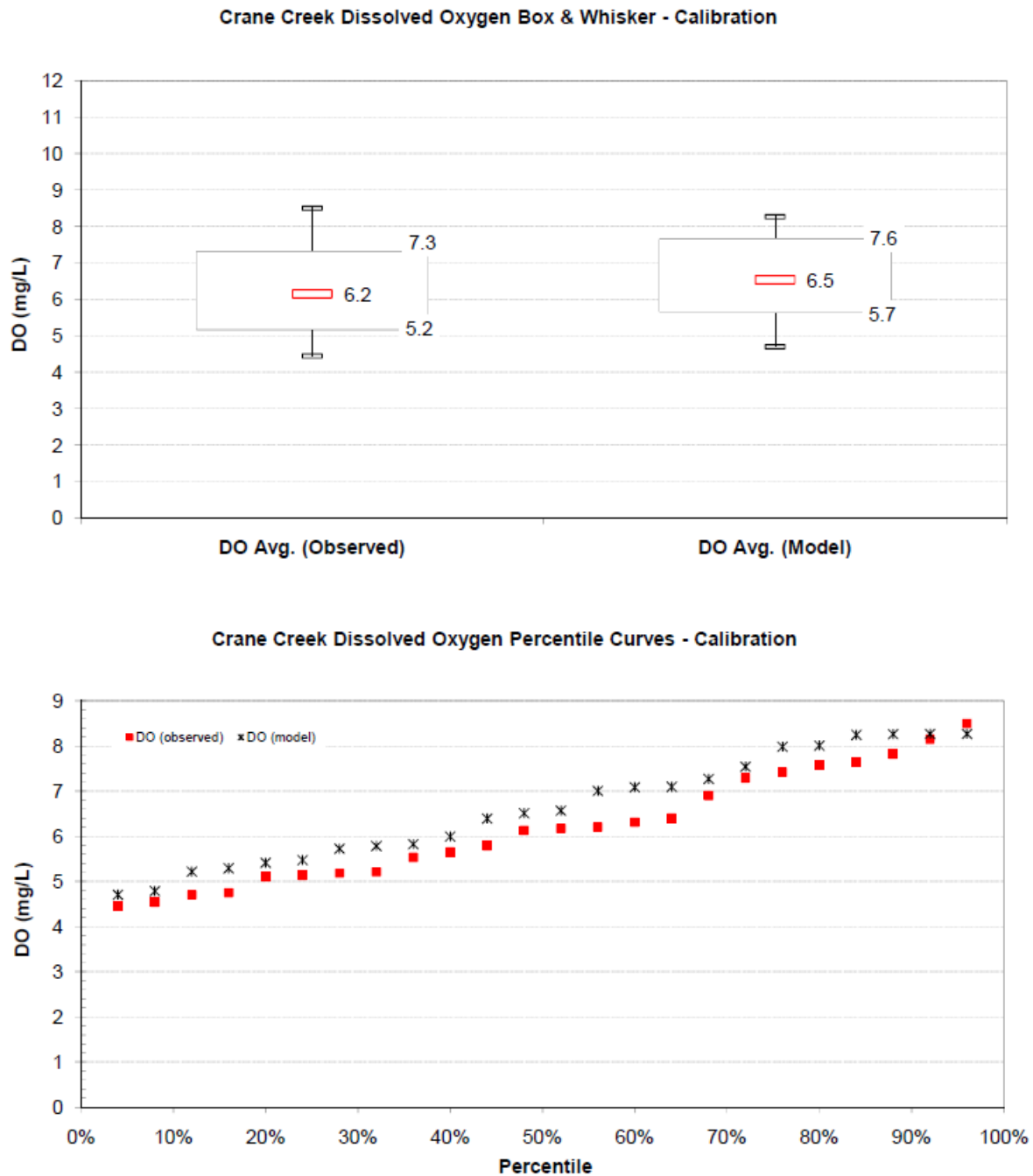


Figure D3-6. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in Crane Creek in the Calibration Period (1997 through 2000)

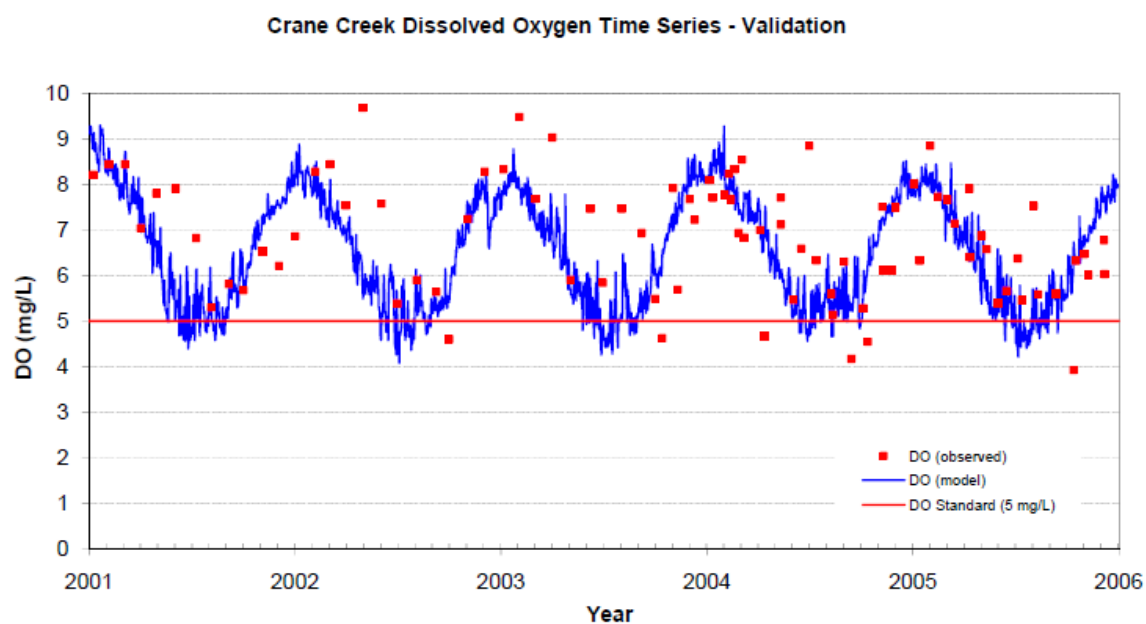
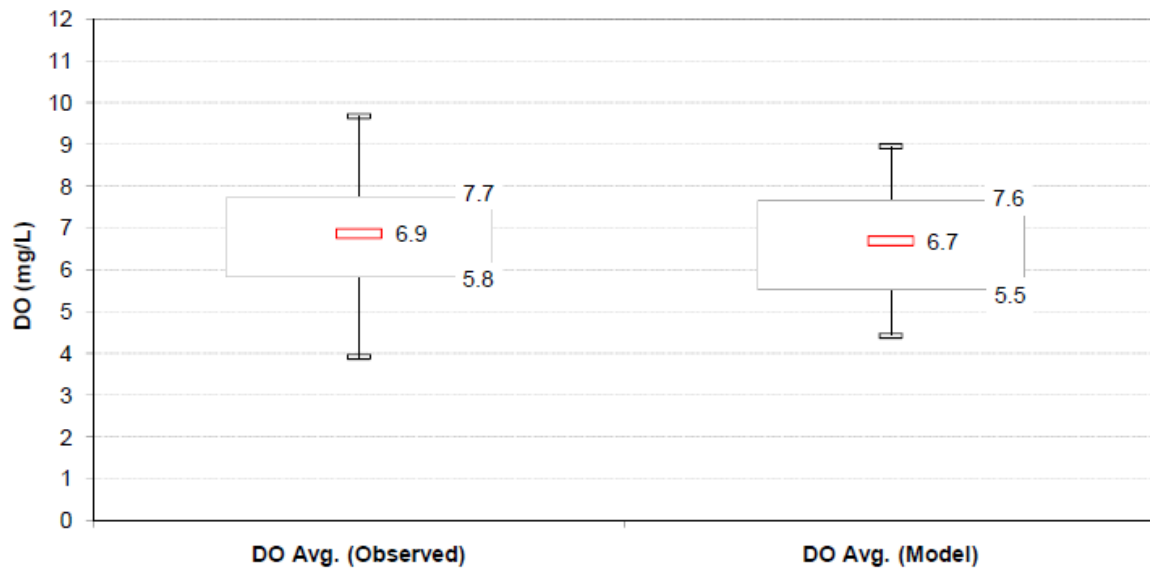


Figure D3-7. Model Simulated and Measured Dissolved Oxygen for the Crane Creek in the Validation Period (2001 through 2005)

Crane Creek Dissolved Oxygen Box & Whisker - Validation



Crane Creek Dissolved Oxygen Percentile Curves - Validation

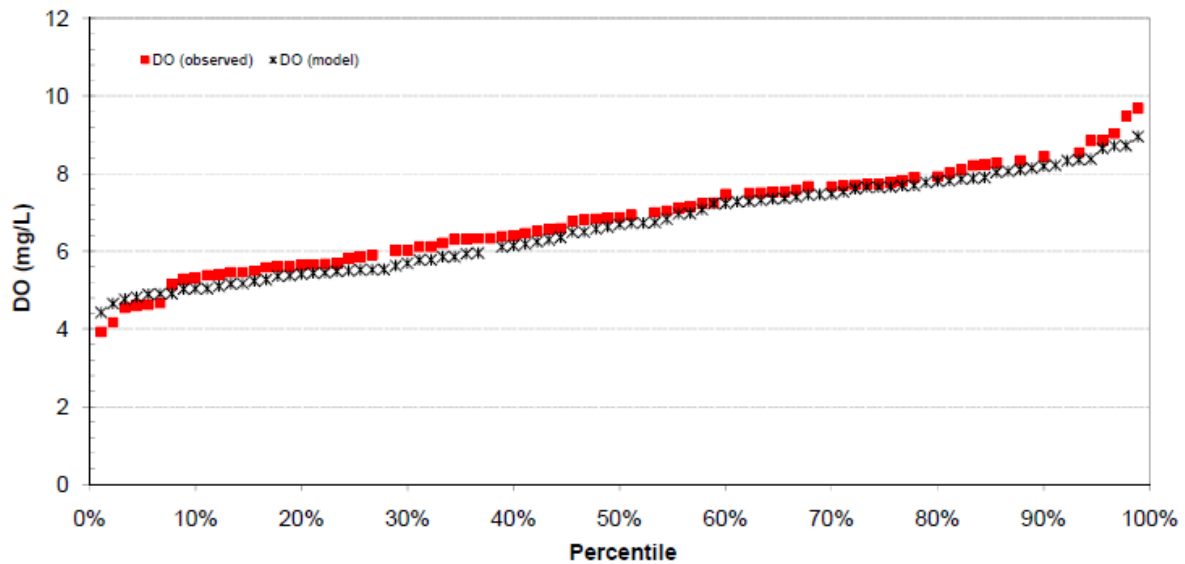


Figure D3-8. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in Crane Creek in the Validation Period (2001 through 2005)

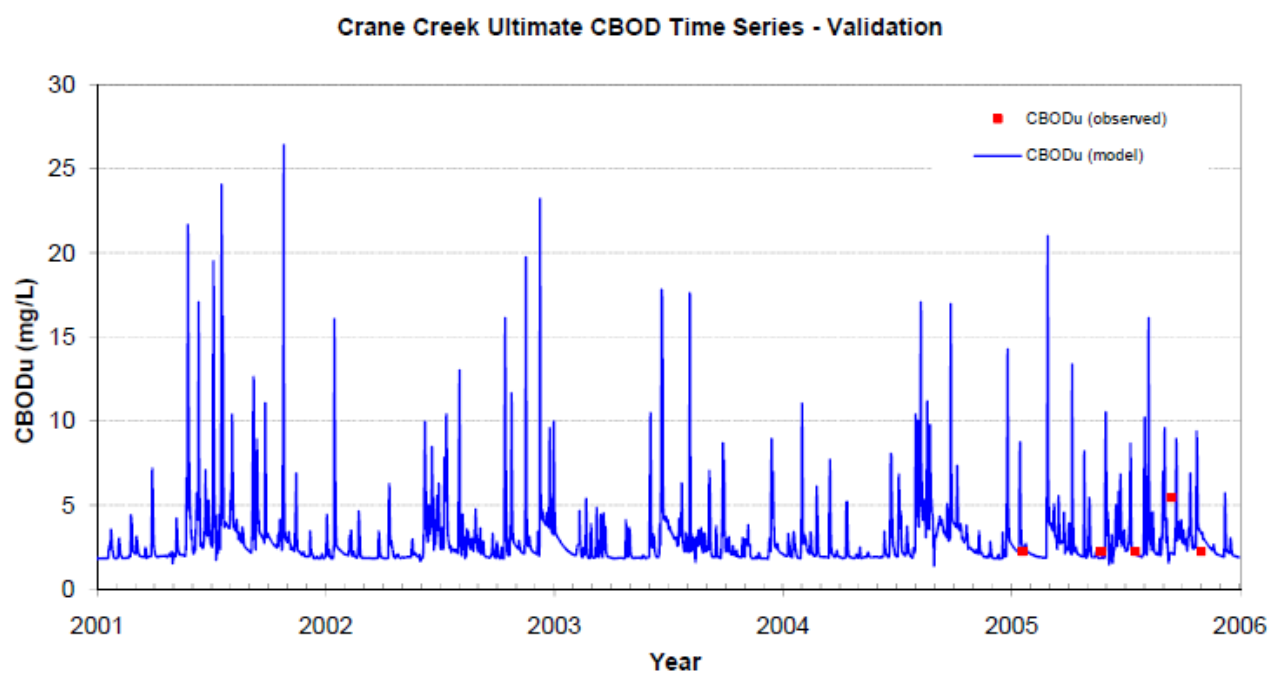


Figure D3-9. Model Simulated and Measured BOD for Crane Creek in the Validation Period (2001 through 2005)

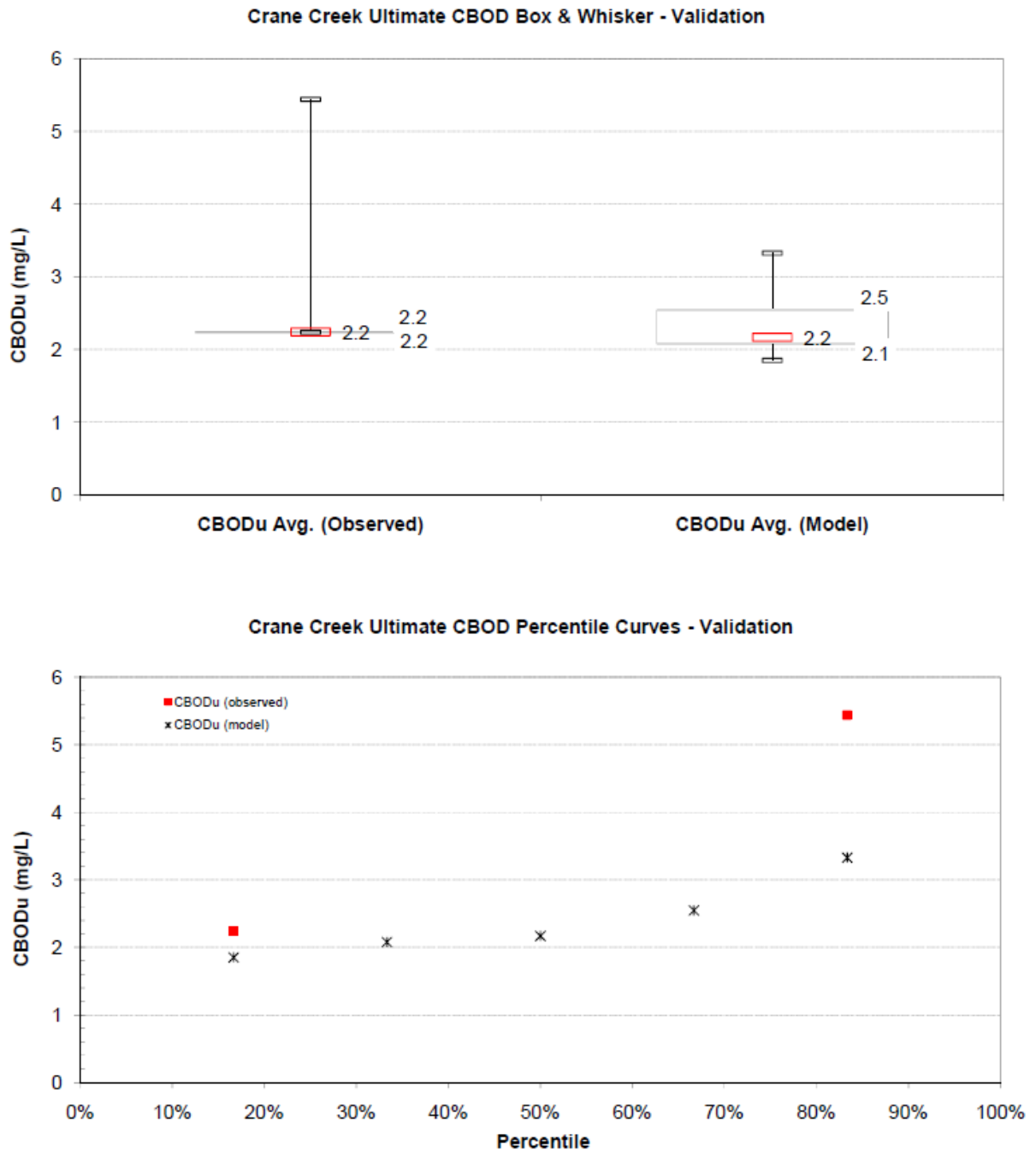


Figure D3-10. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated BOD in Crane Creek in the Validation Period (2001 through 2005)

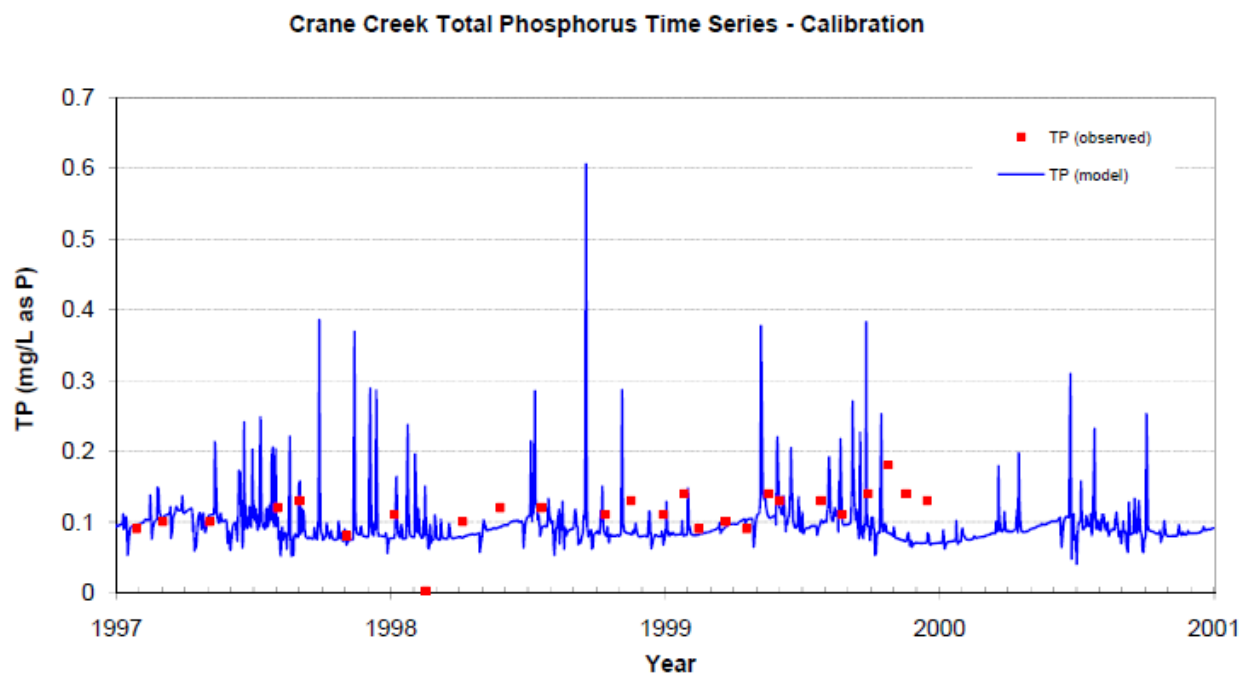


Figure D3-11. Model Simulated and Measured Total Phosphorus for Crane Creek in the Calibration Period (1997 through 2000)

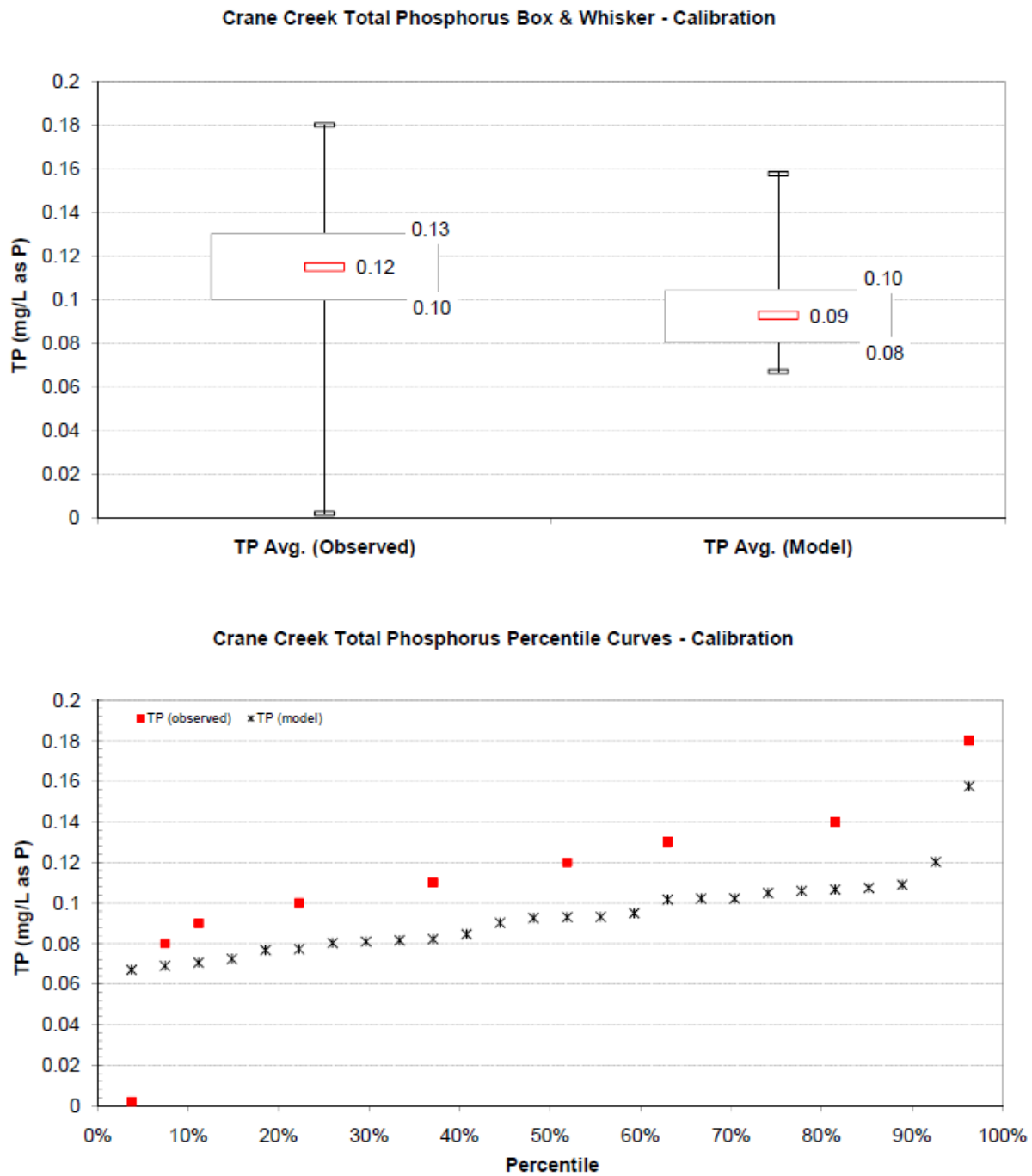


Figure D3-12. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in Crane Creek in the Calibration Period (1997 through 2000)

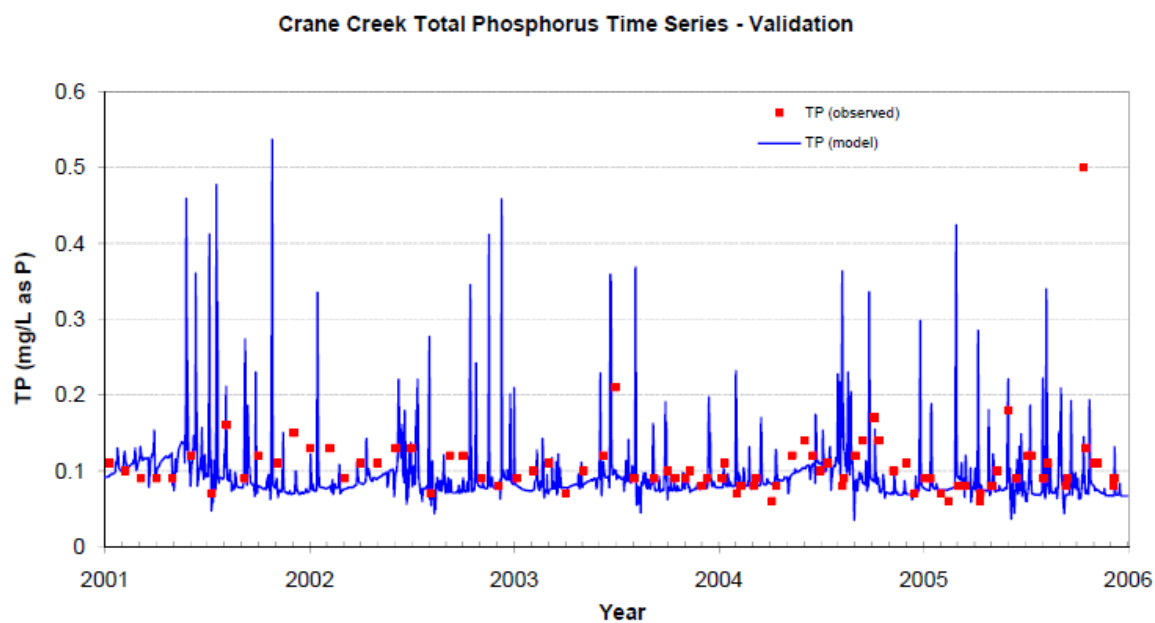


Figure D3-13. Model Simulated and Measured Total Phosphorus for Crane Creek in the Validation Period (2001 through 2005)

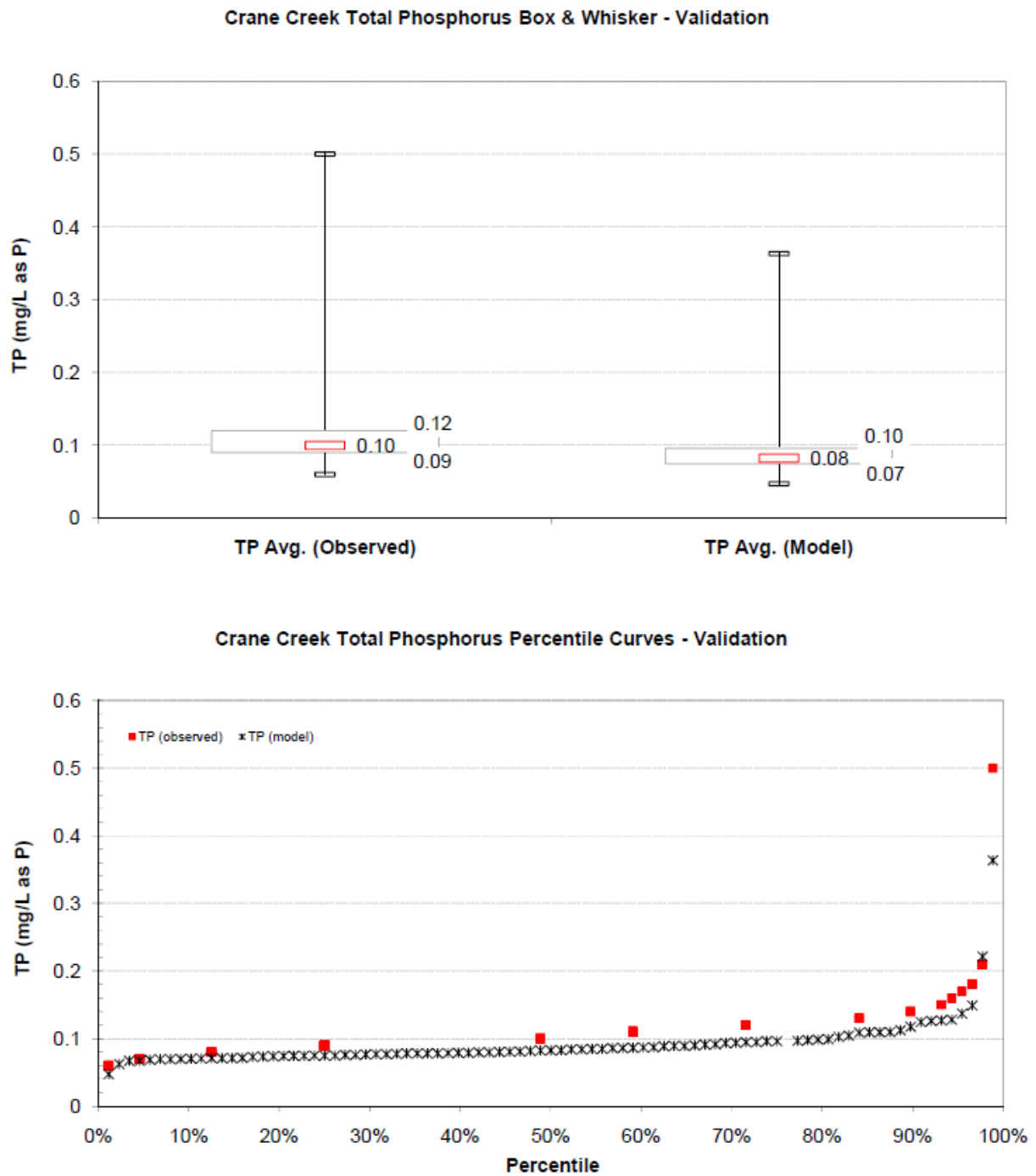


Figure D3-14. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in Crane Creek in the Validation Period (2001 through 2005)

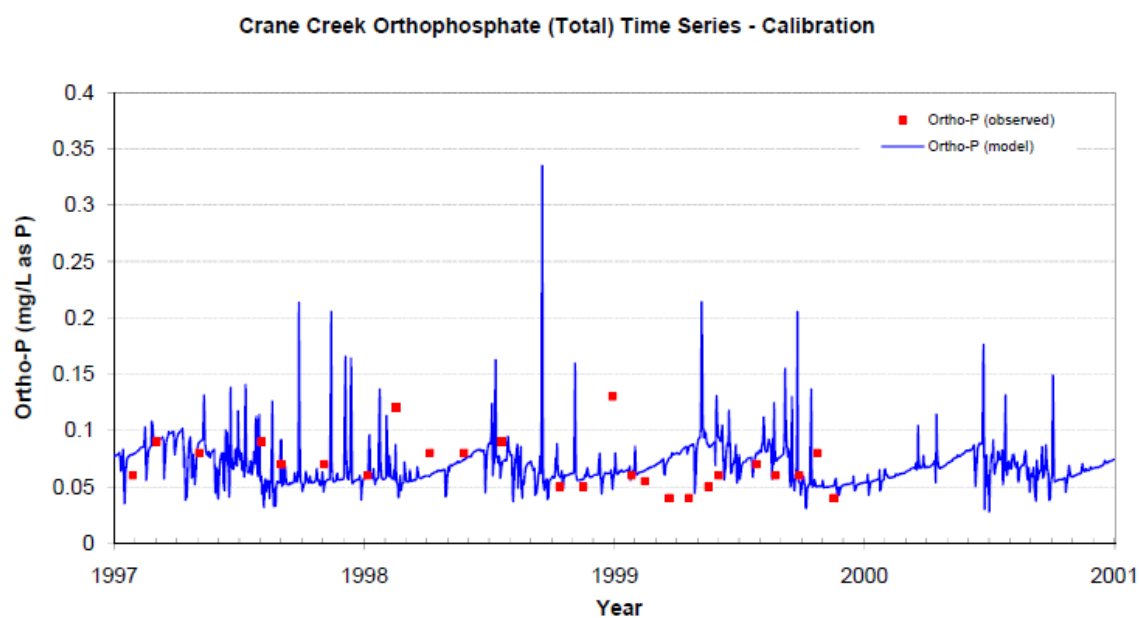


Figure D3-15. Model Simulated and Measured Orthophosphate for Crane Creek in the Calibration Period (1997 through 2000)

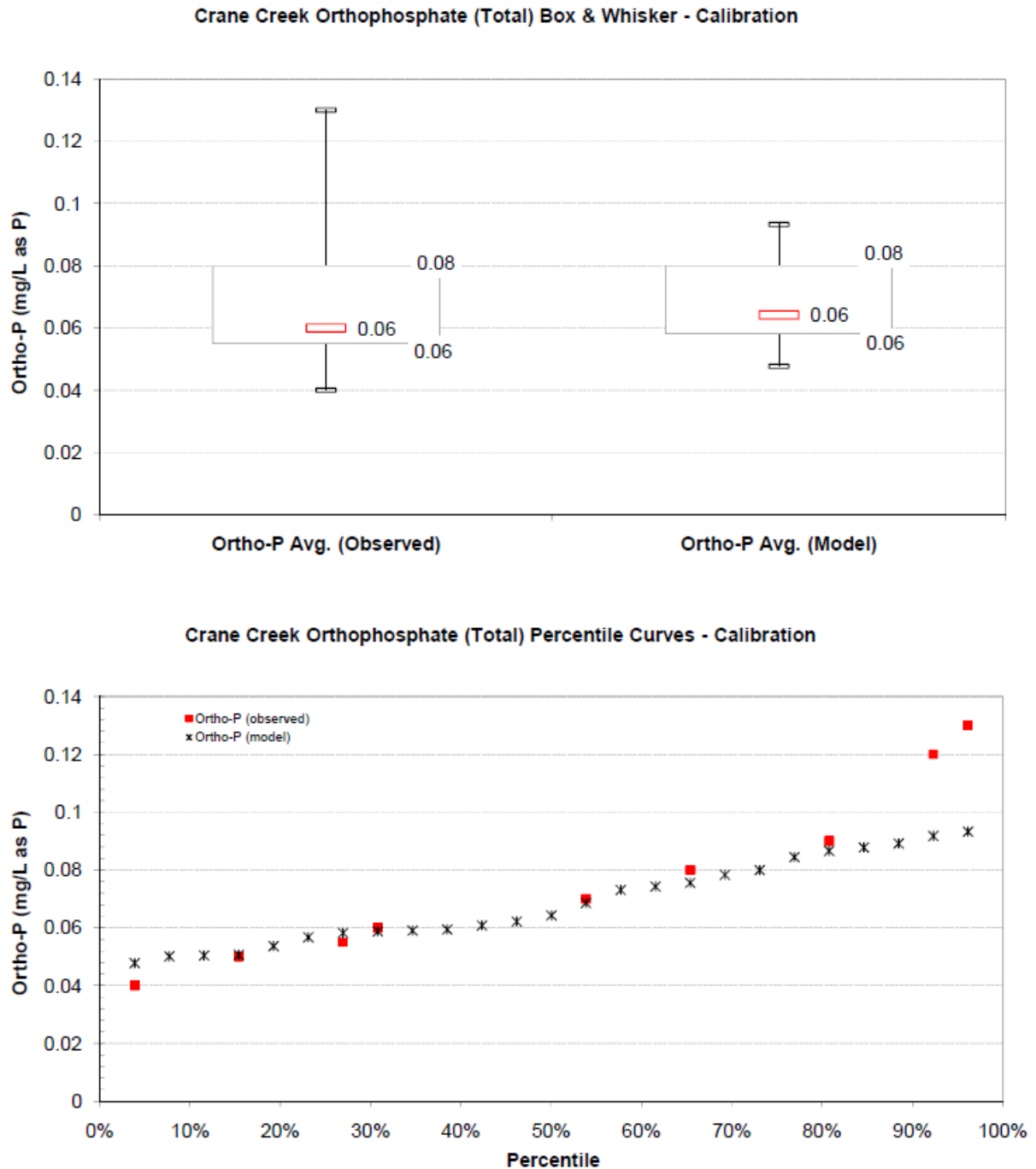


Figure D3-16. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in Crane Creek in the Calibration Period (1997 through 2000)

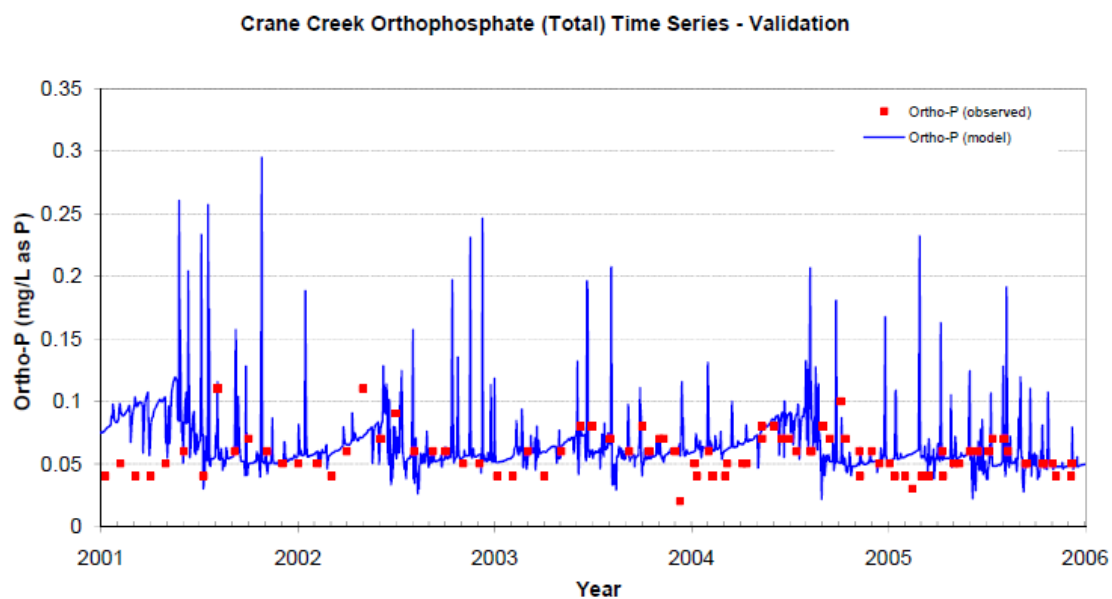


Figure D3-17. Model Simulated and Measured Orthophosphate for Crane Creek in the Validation Period (2001 through 2005)

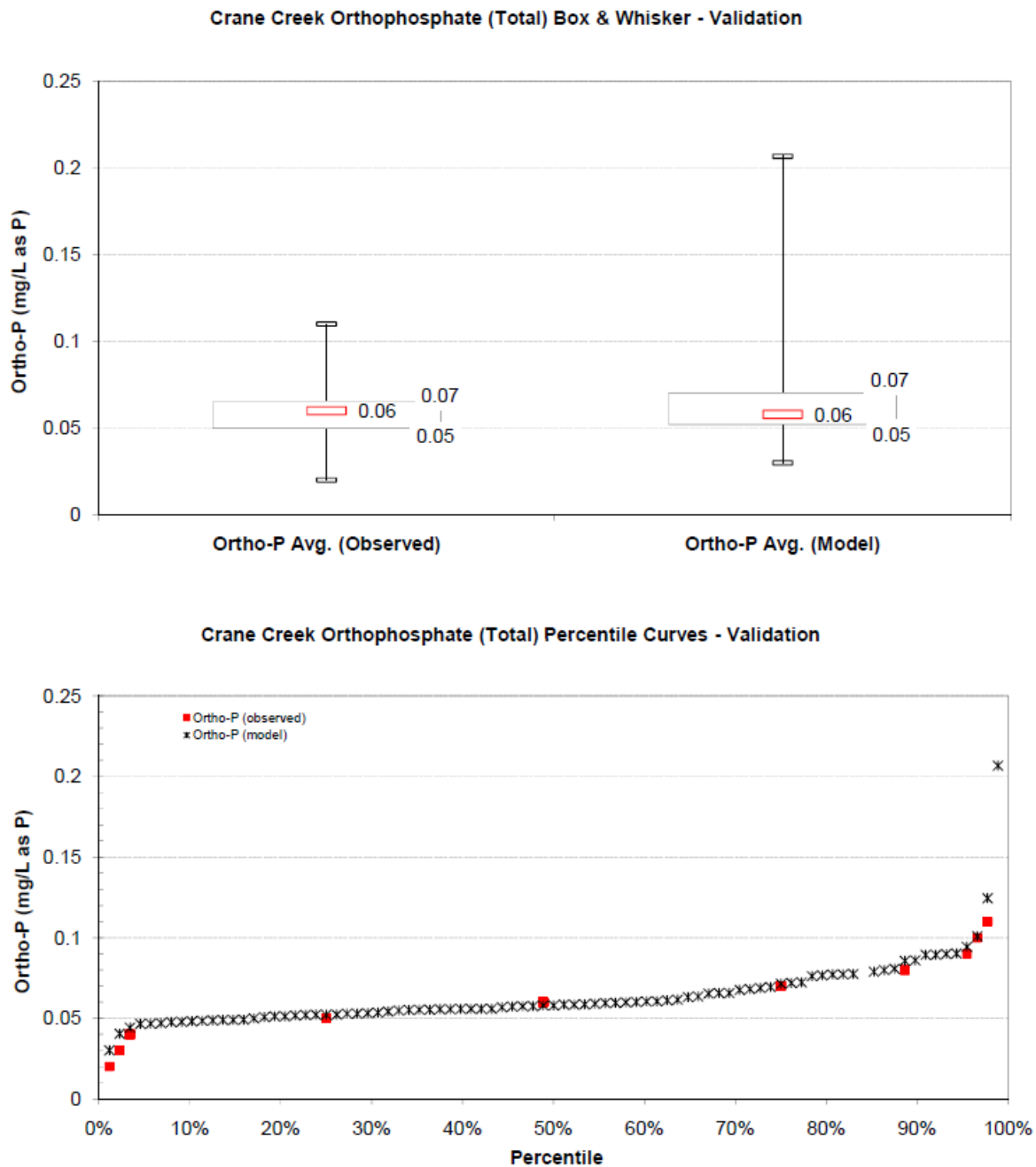


Figure D3-18. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in Crane Creek in the Validation Period (2001 through 2005)

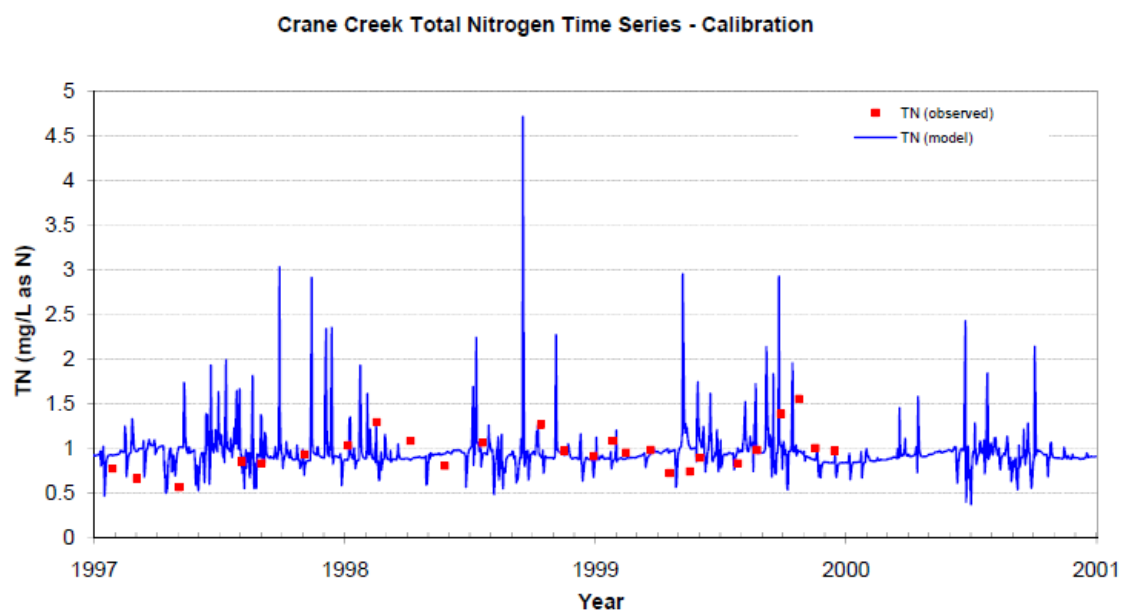


Figure D3-19. Model Simulated and Measured Total Nitrogen for Crane Creek in the Calibration Period (1997 through 2000)

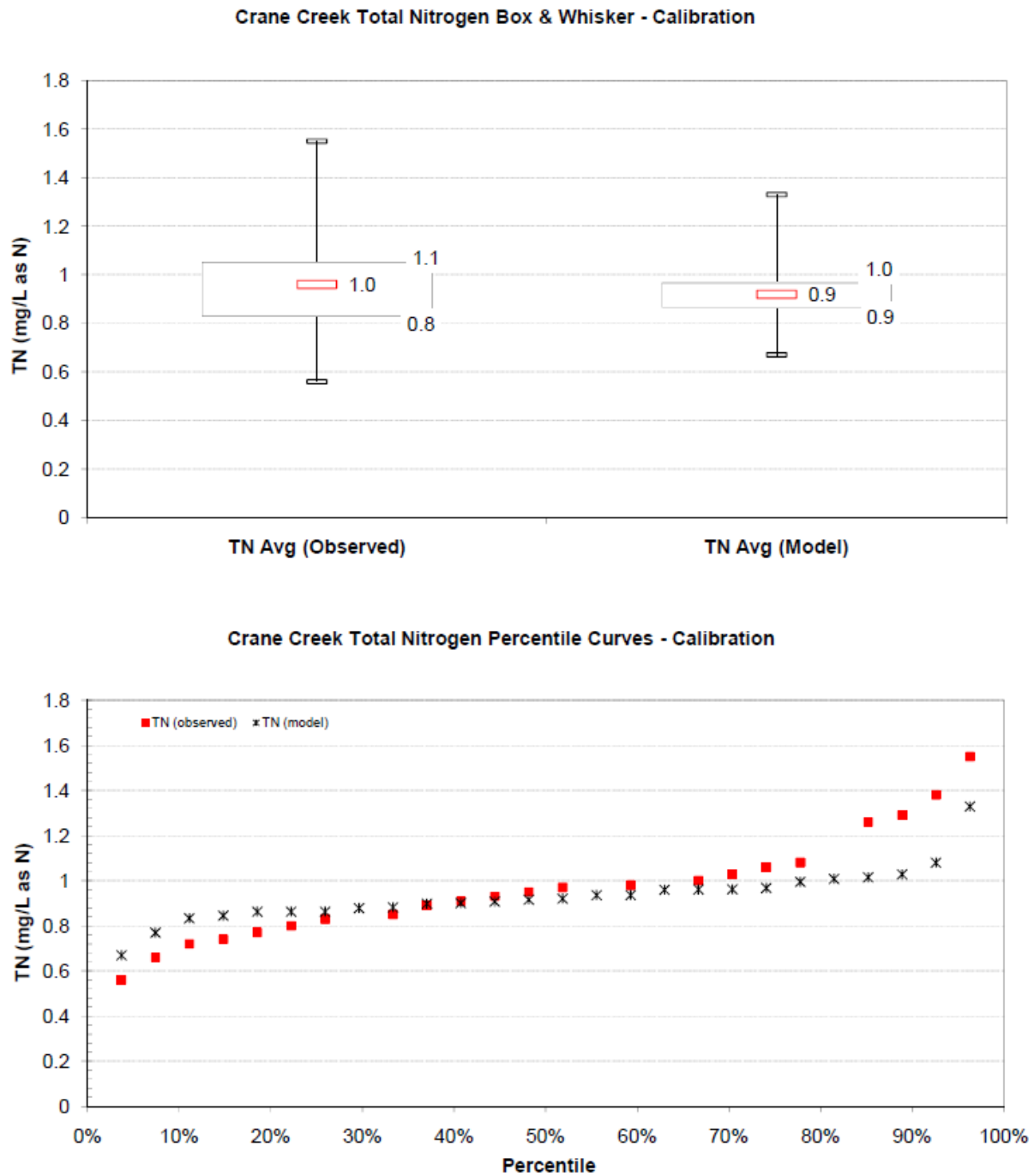


Figure D3-20. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in Crane Creek in the Calibration Period (1997 through 2000)

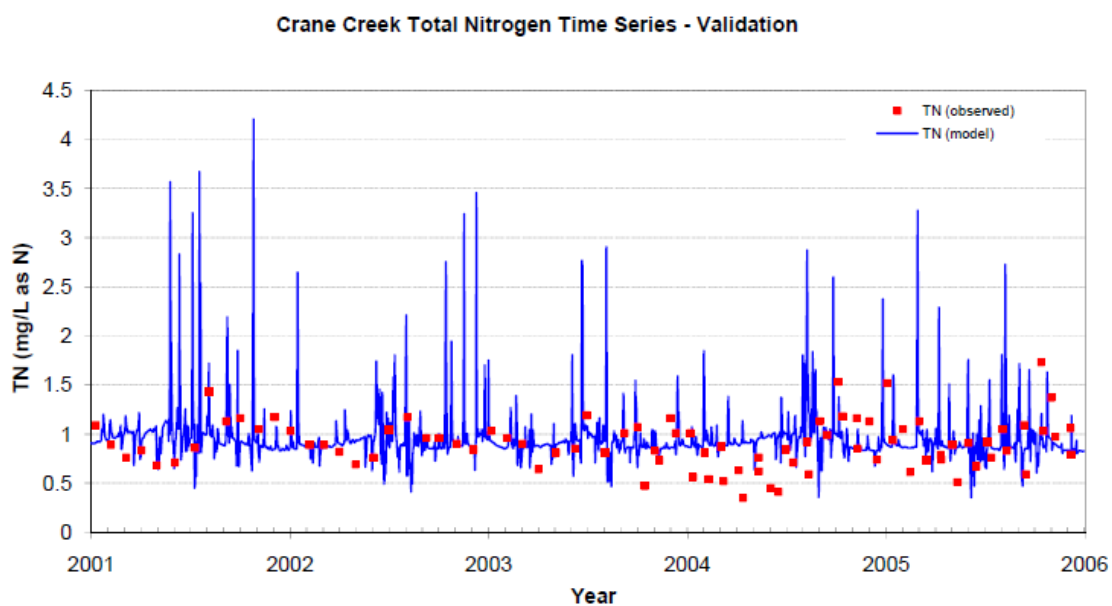


Figure D3-21. Model Simulated and Measured Total Nitrogen for Crane Creek in the Validation Period (2001 through 2005)

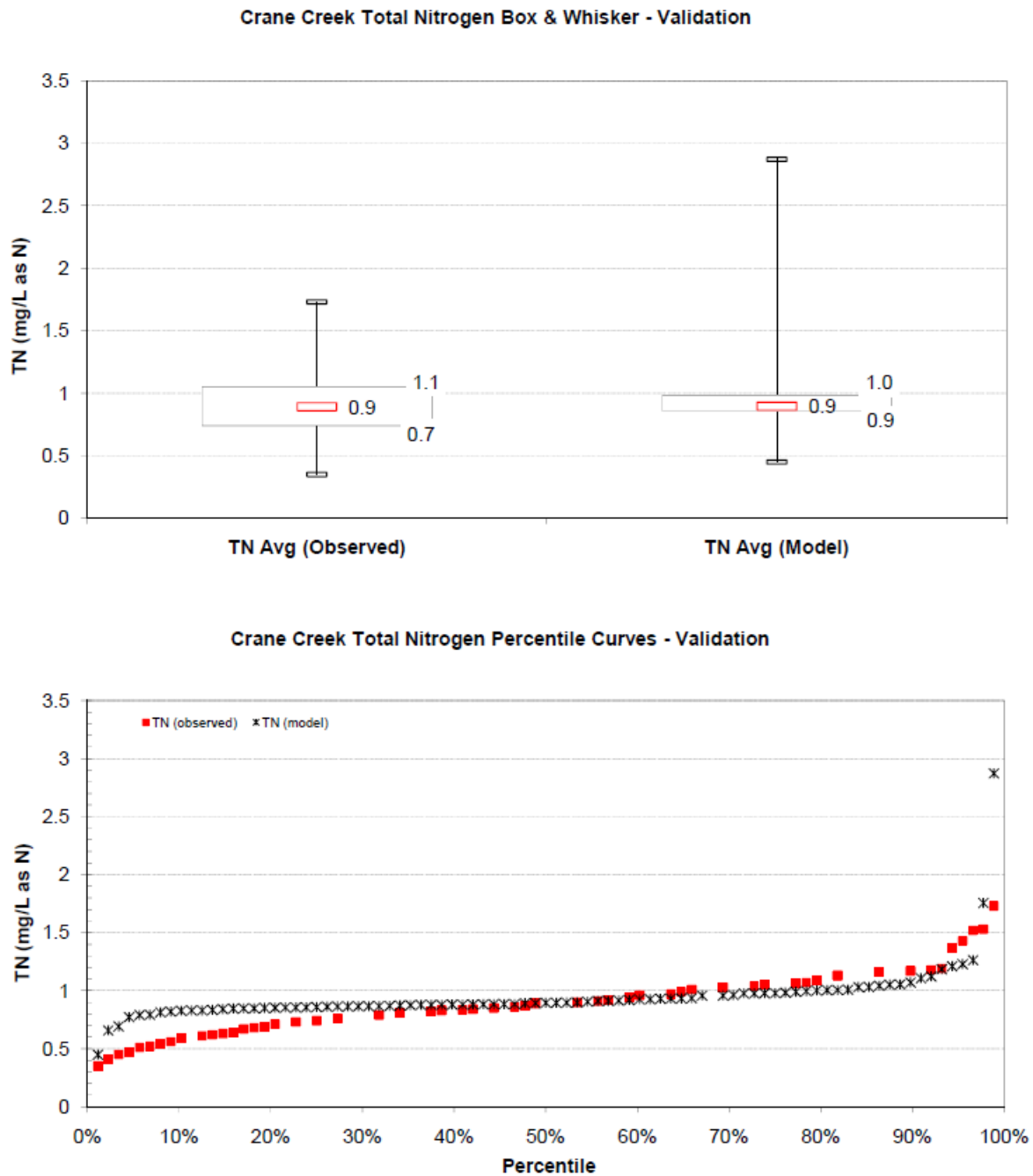


Figure D3-22. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in Crane Creek in the Validation Period (2001 through 2005)

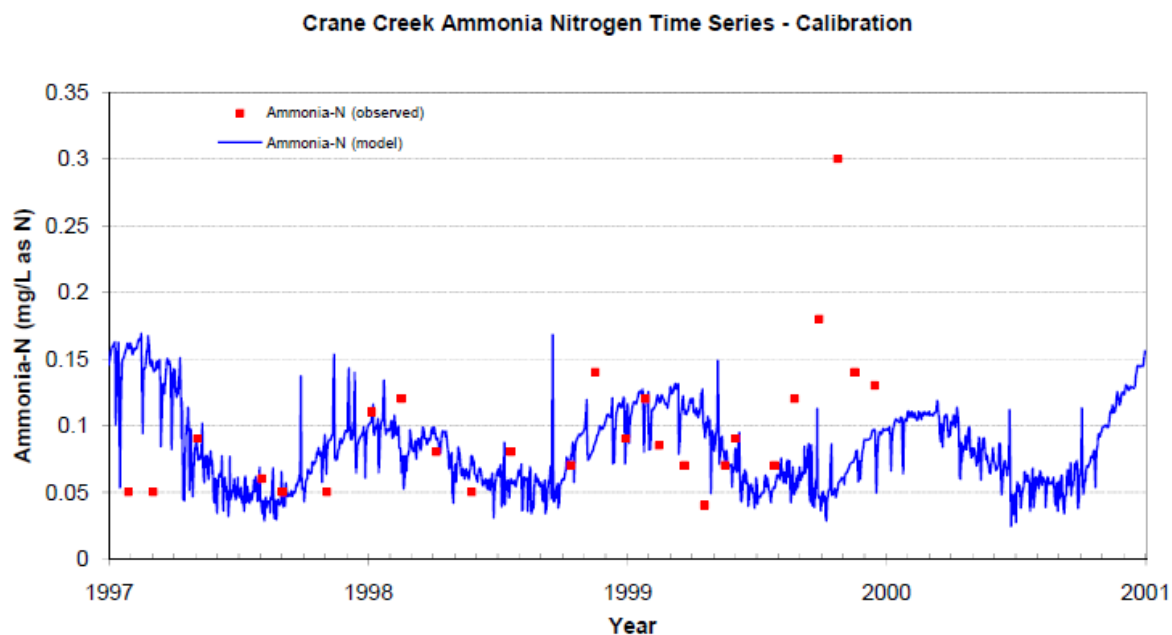


Figure D3-23. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in Crane Creek in the Validation Period (2001 through 2005)

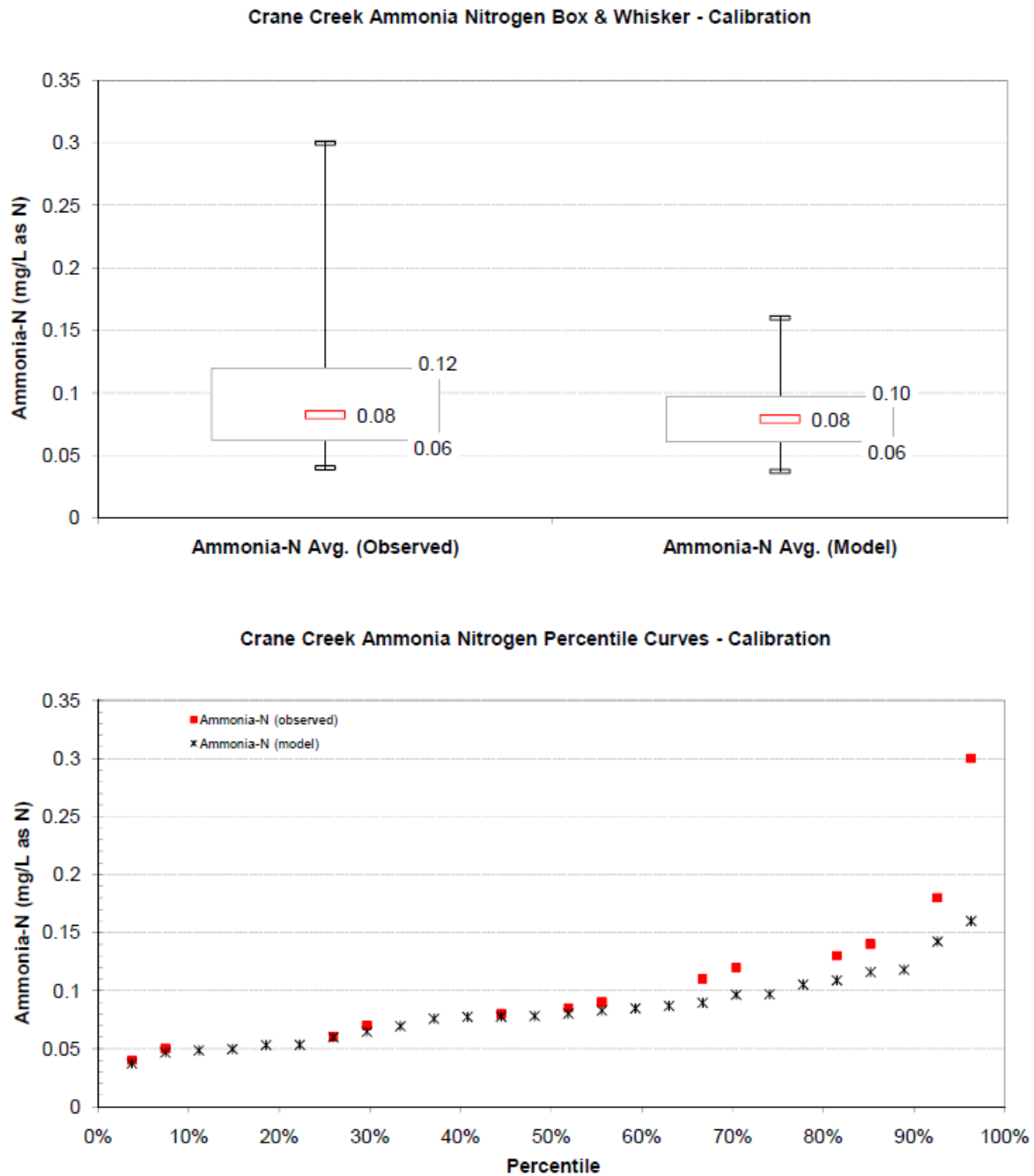


Figure D3-24. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Ammonia Nitrogen in Crane Creek in the Calibration Period (1997 through 2000)

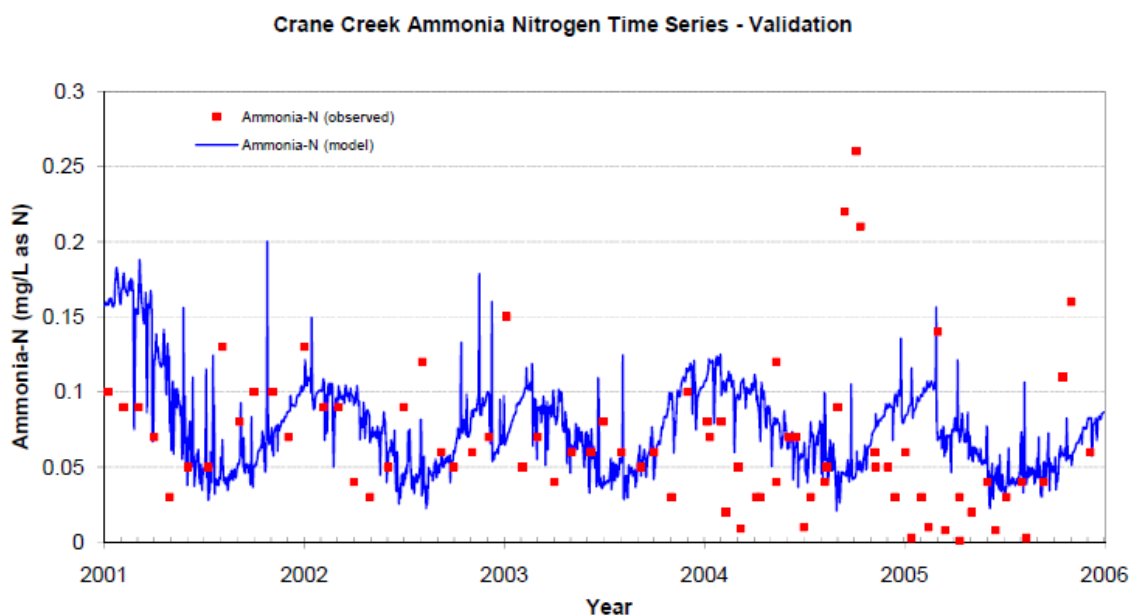


Figure D3-25. Model Simulated and Measured Ammonia for Crane Creek in the Validation Period (2001 through 2005)

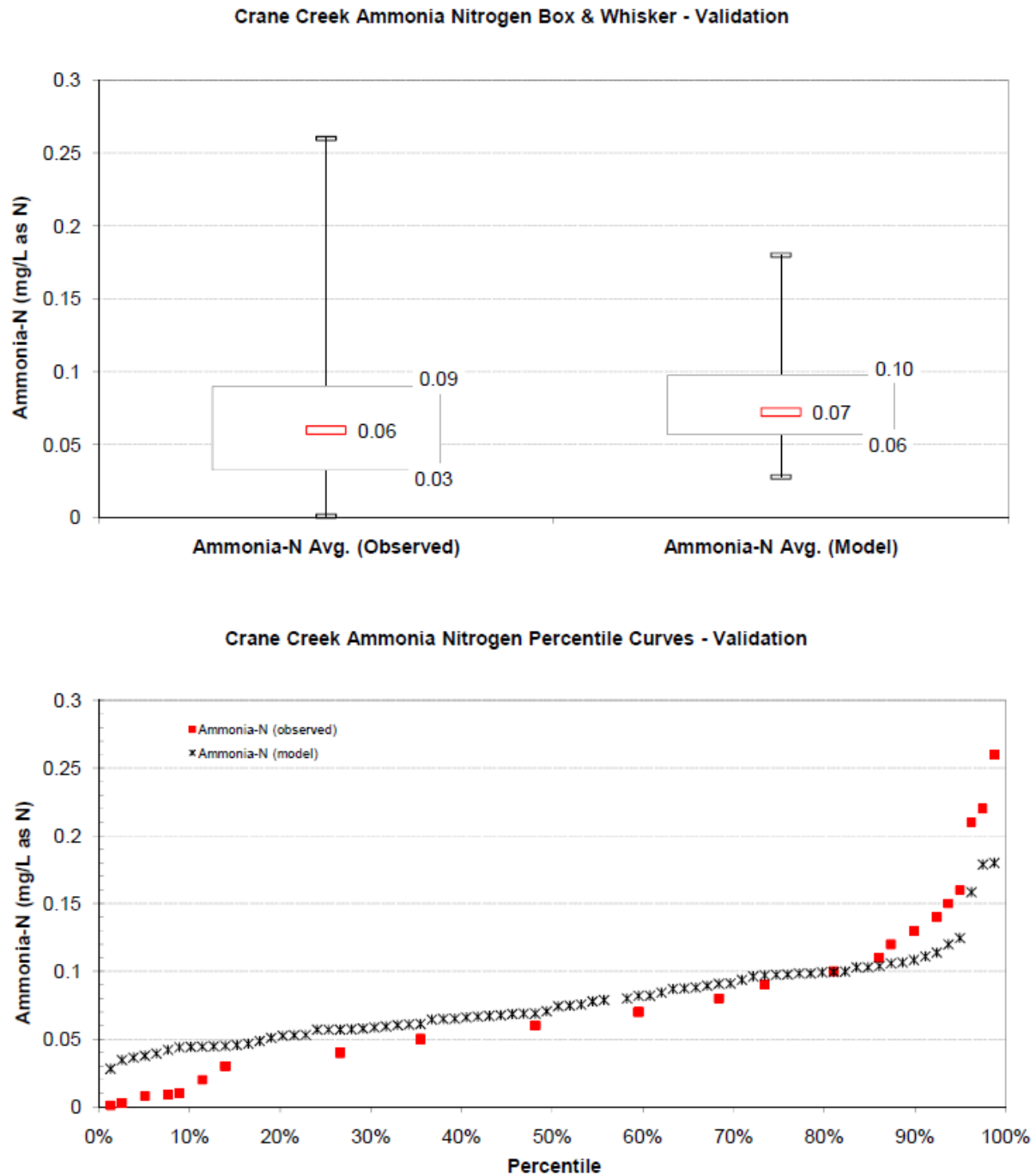


Figure D3-26. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Ammonia Nitrogen in Crane Creek in the Validation Period (2001 through 2005)

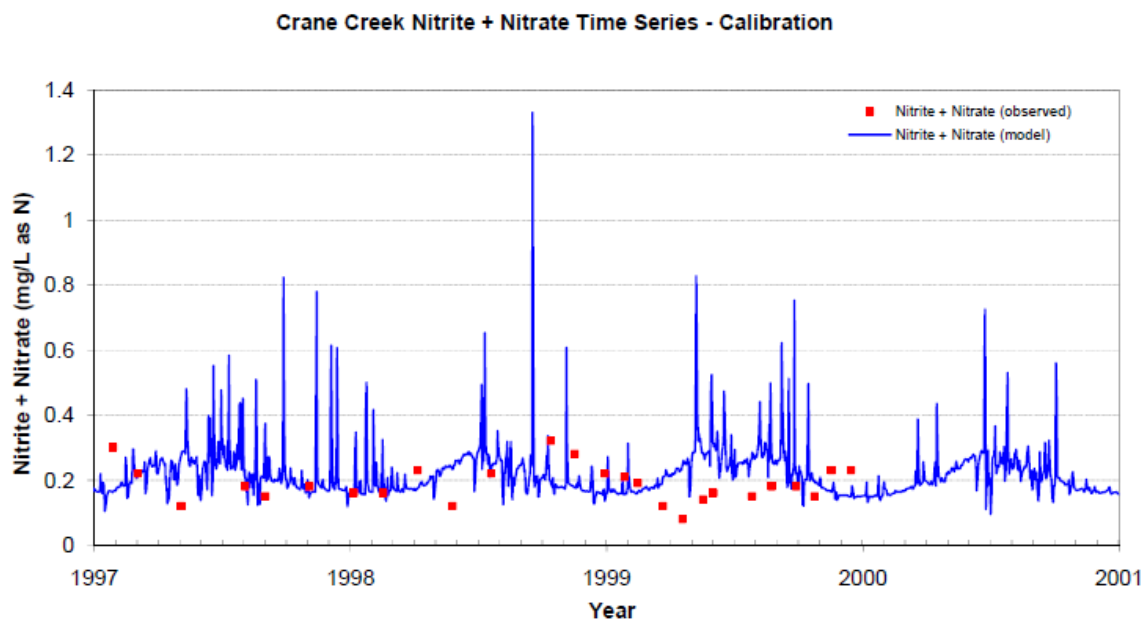


Figure D3-27. Model Simulated and Measured Nitrate Nitrogen for Crane Creek in the Calibration Period (1997 through 2000)

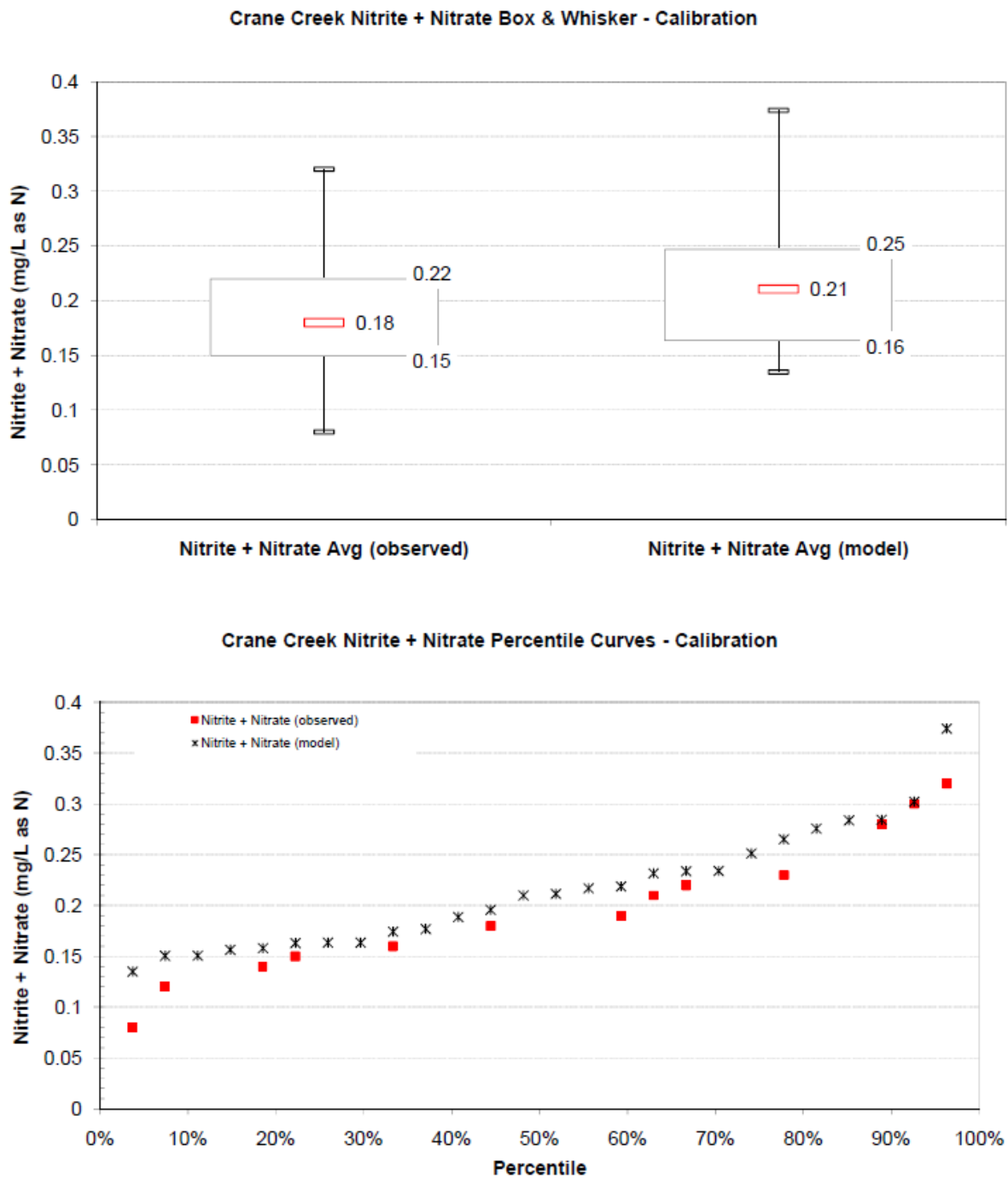


Figure D3-28. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in Crane Creek in the Calibration Period (1997 through 2000)

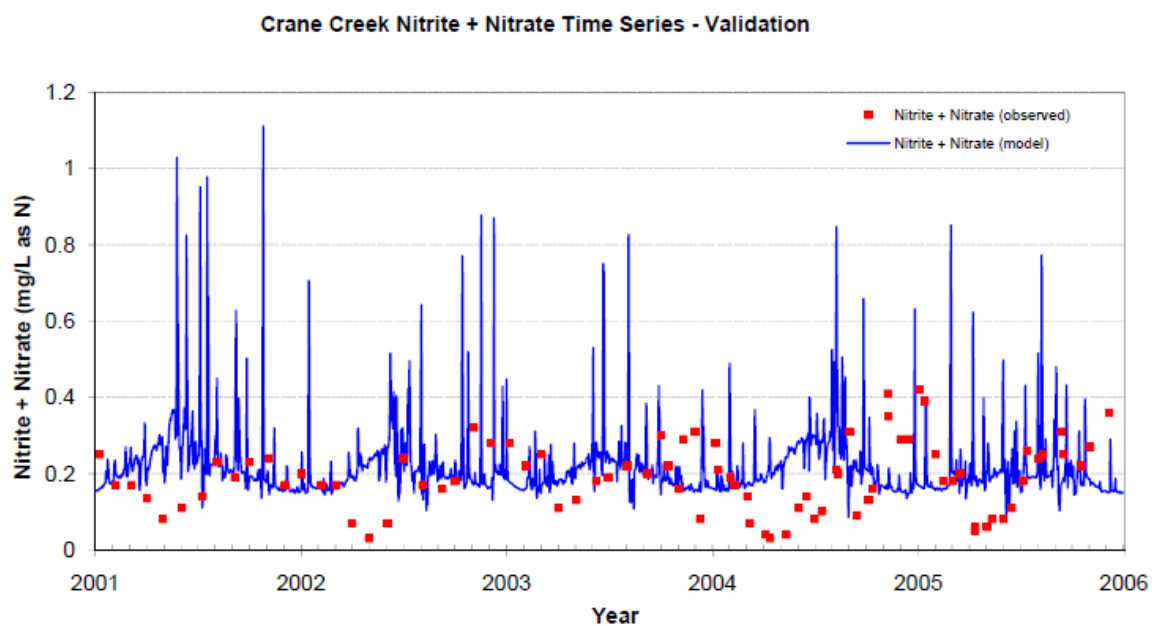


Figure D3-29. Model Simulated and Measured Nitrate Nitrogen for Crane Creek in the Validation Period (2001 through 2005)

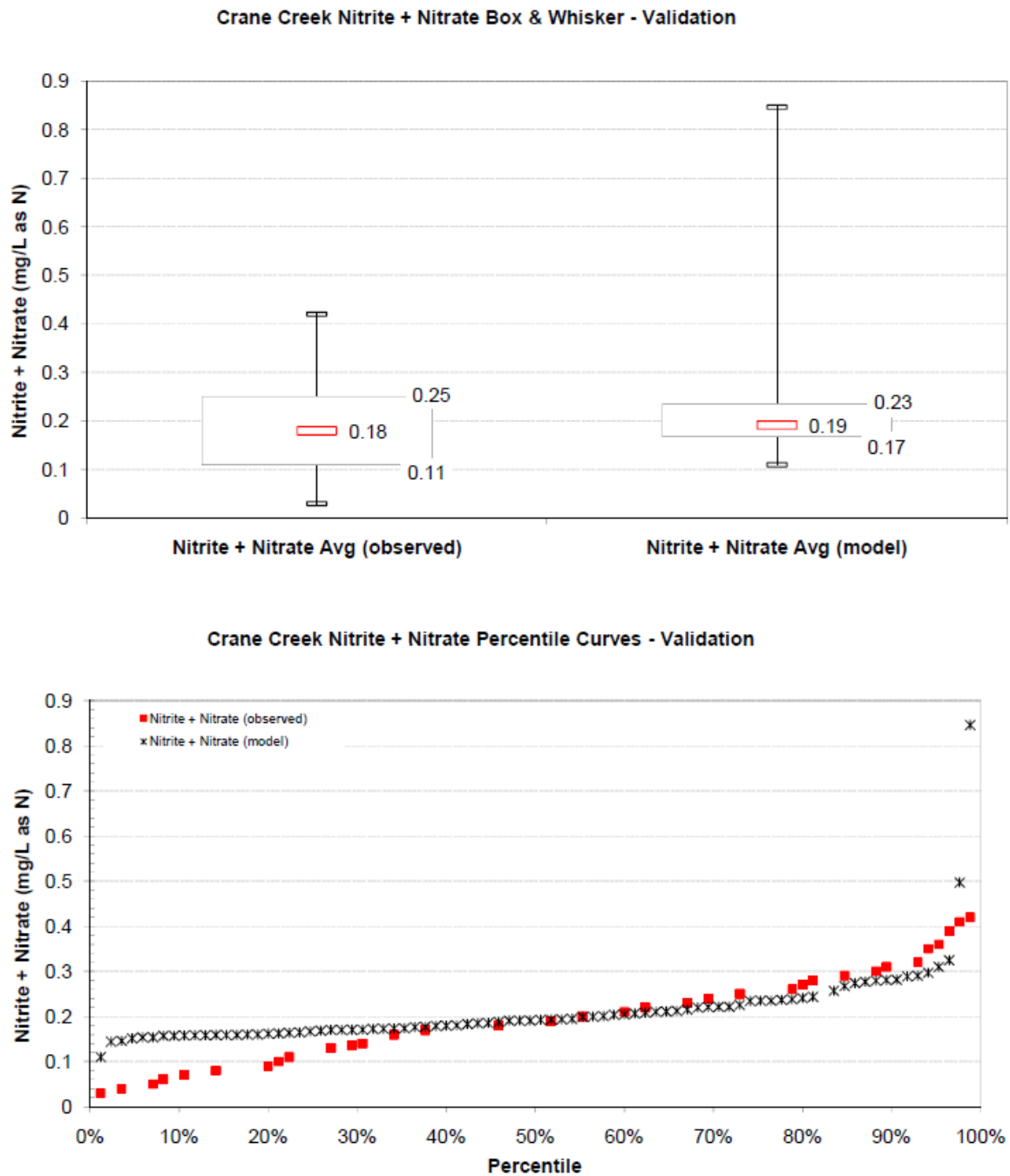


Figure D3-30. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in Crane Creek in the Validation Period (2001 through 2005)



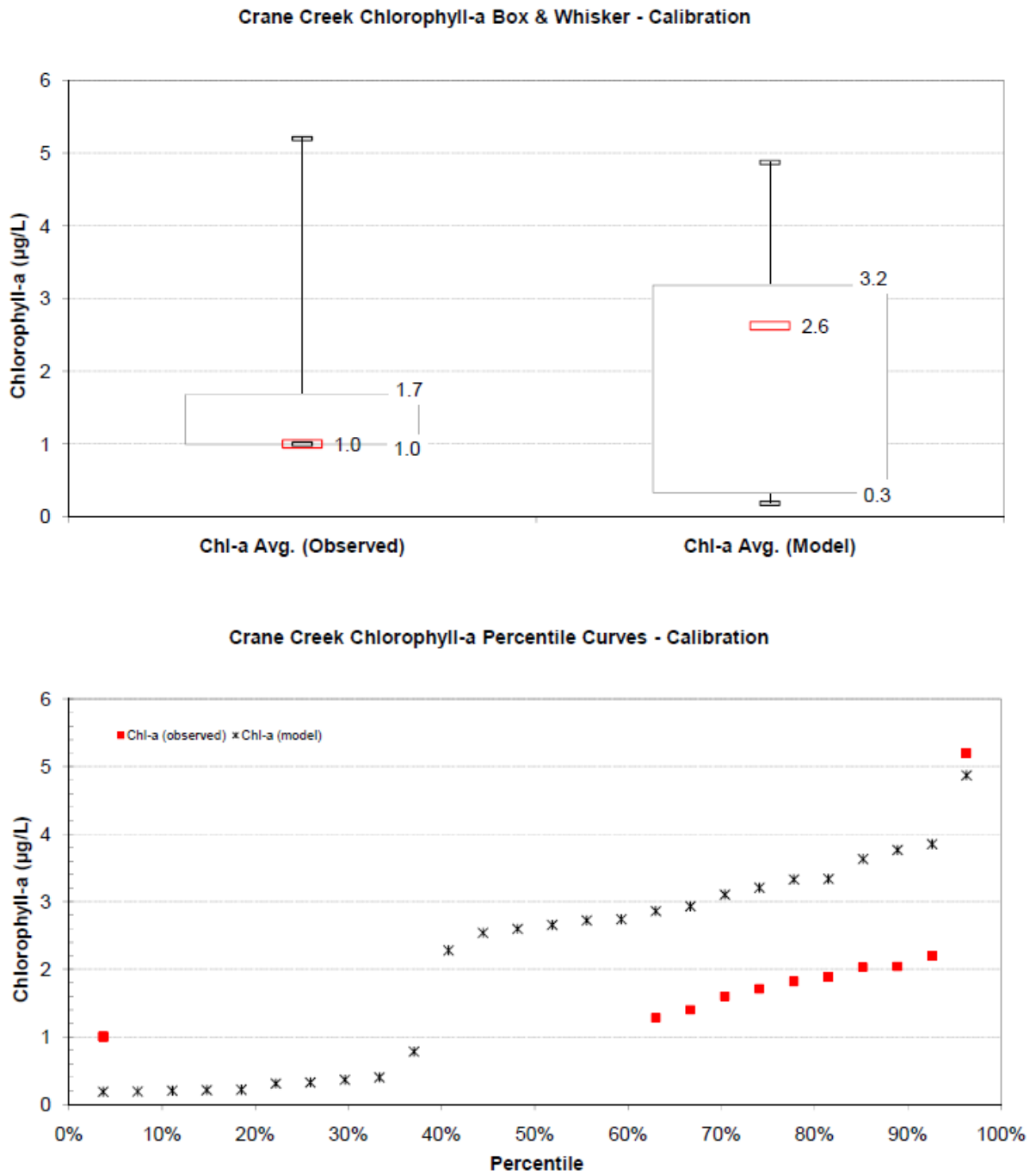


Figure D3-32. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in Crane Creek in the Calibration Period (1997 through 2000)

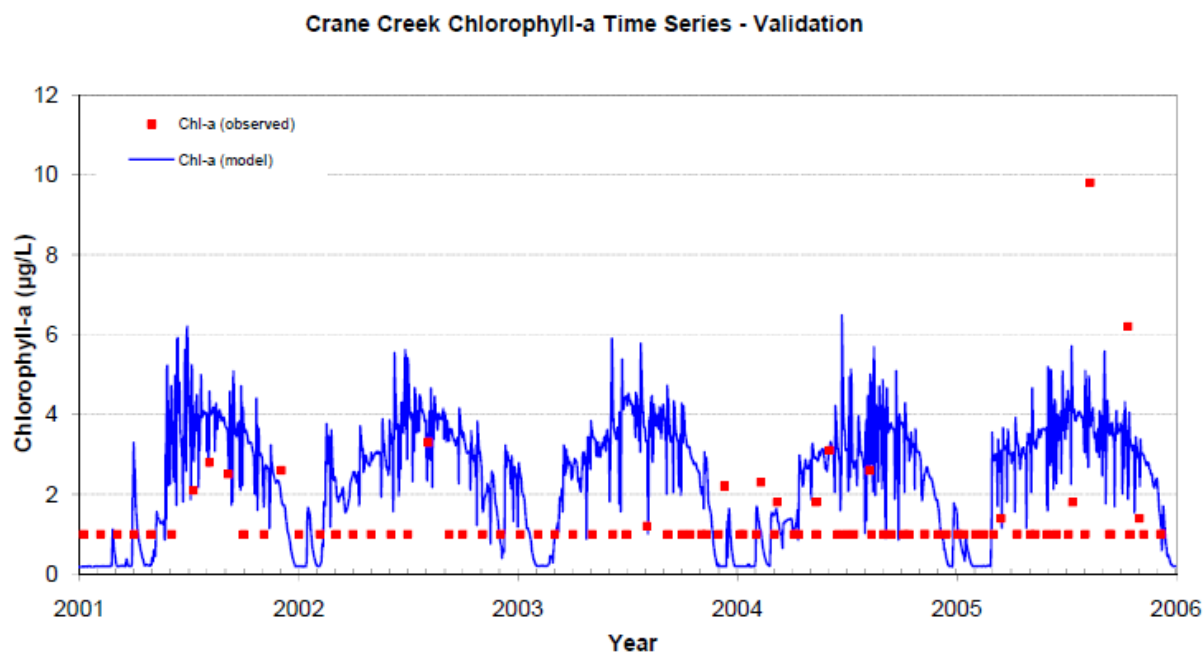


Figure D3-33. Model Simulated and Measured Chlorophyll a for Crane Creek in the Validation Period (2001 through 2005)

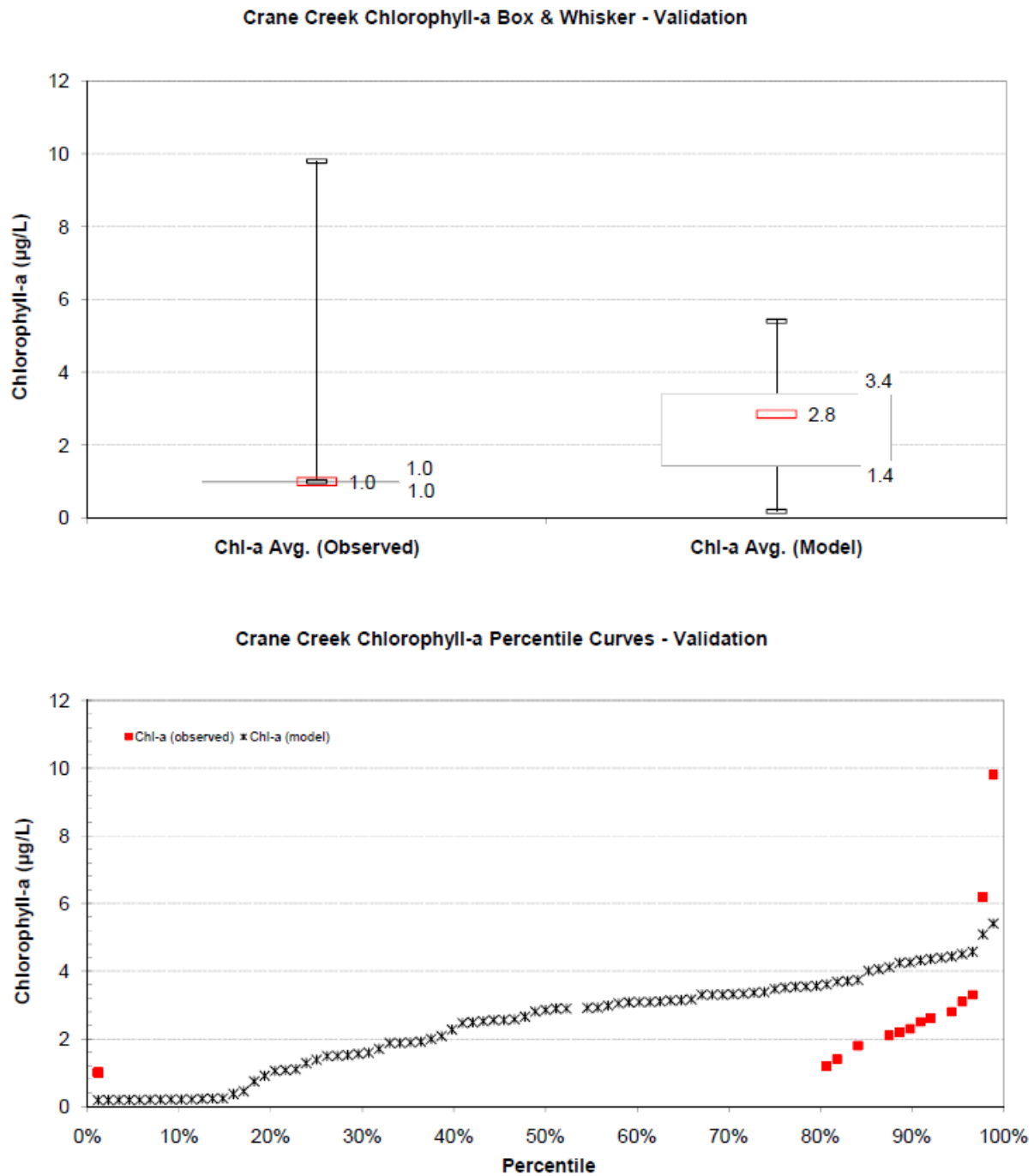
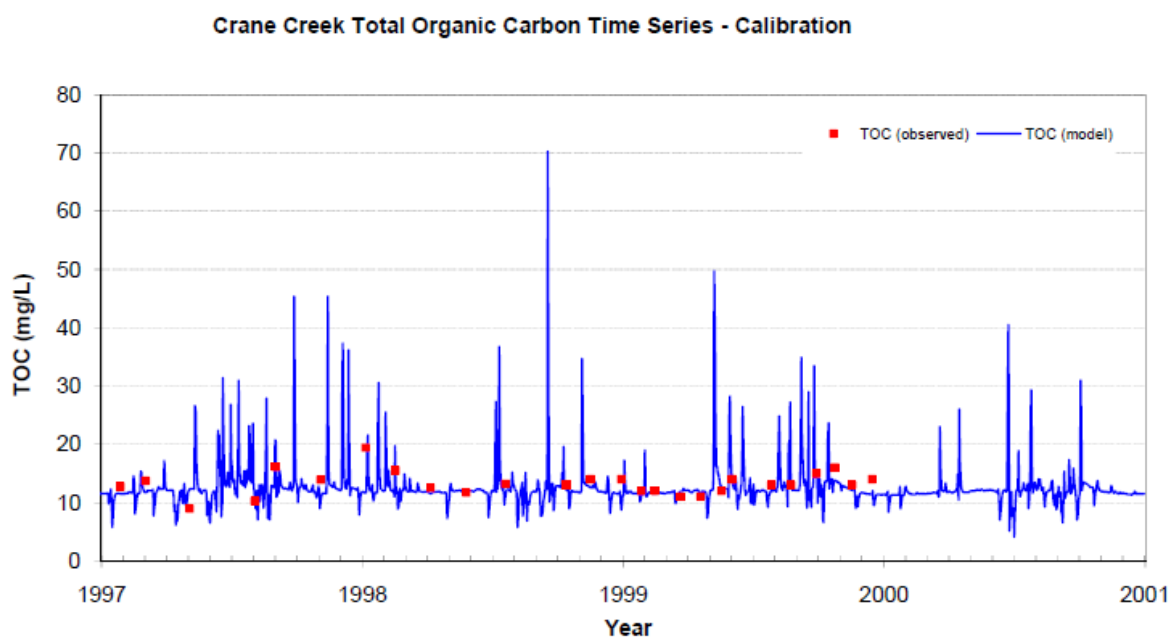


Figure D3-34. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in Crane Creek in the Validation Period (2001 through 2005)



1. Figure D3-35. Model Simulated and Measured Total Organic Carbon for Crane Creek in the Calibration Period (1997 through 2000)

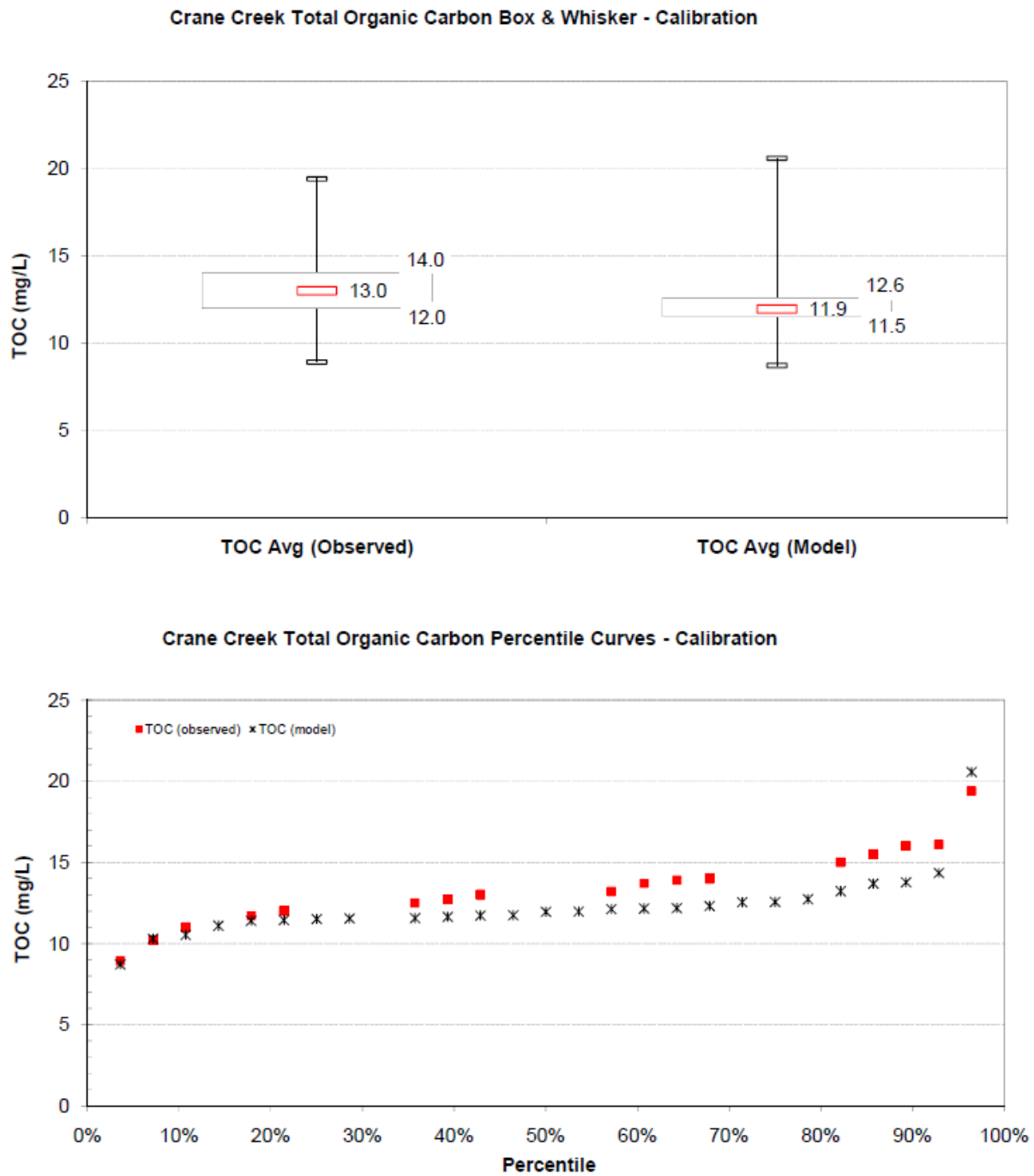


Figure D3-36. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Organic Carbon in Crane Creek in the Calibration Period (1997 through 2000)

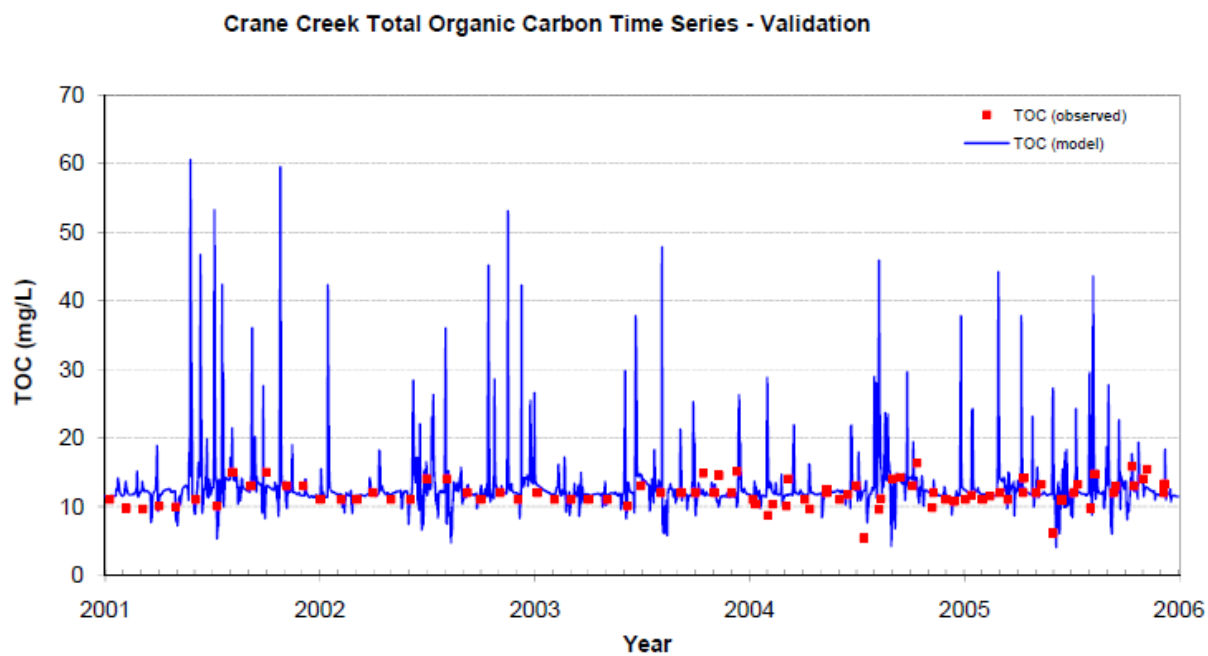


Figure D3-37. Model Simulated and Measured Total Organic Carbon for Crane Creek in the Validation Period (2001 through 2005)

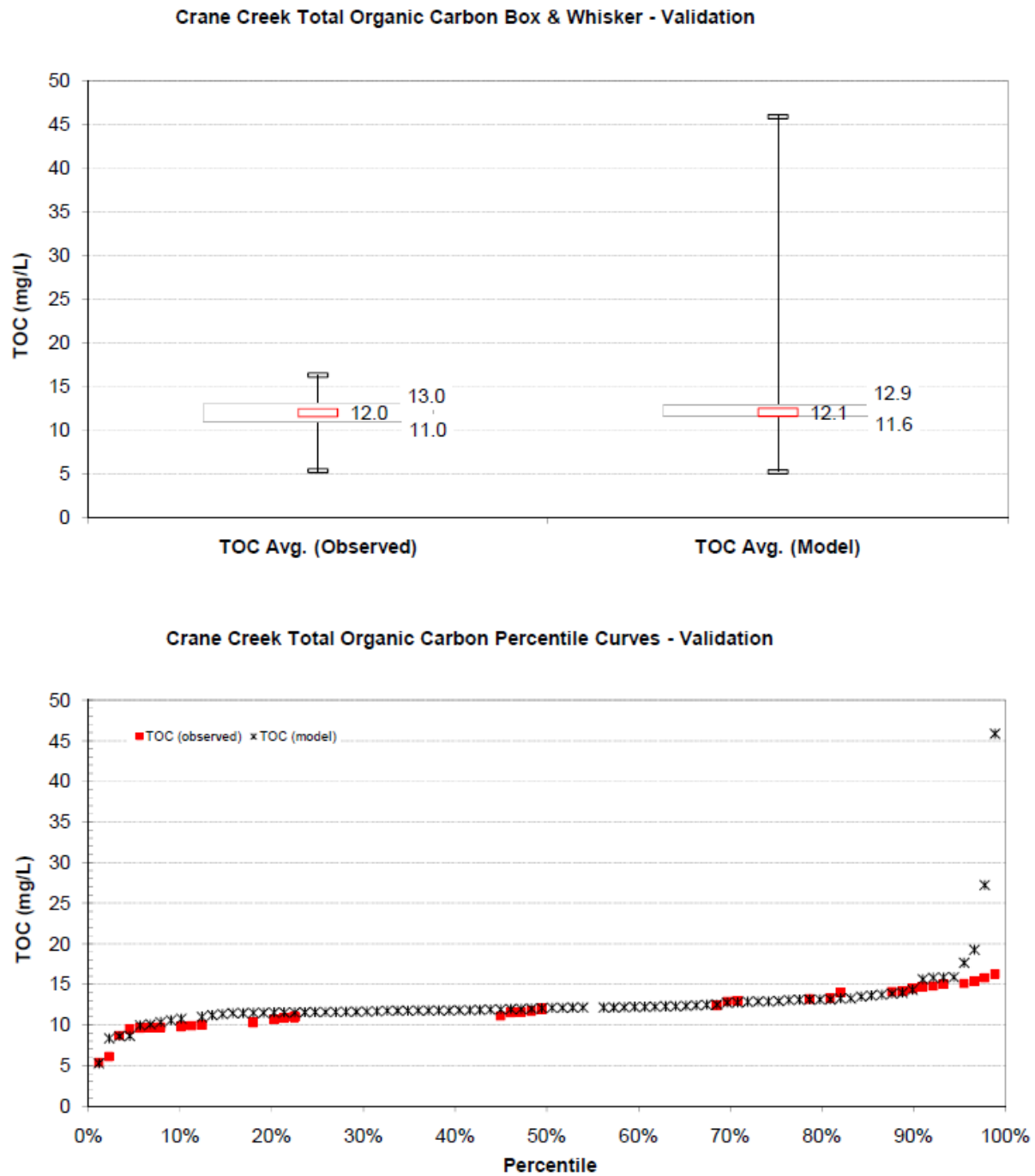


Figure D3-38. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Organic Carbon in Crane Creek in the Validation Period (2001 through 2005)

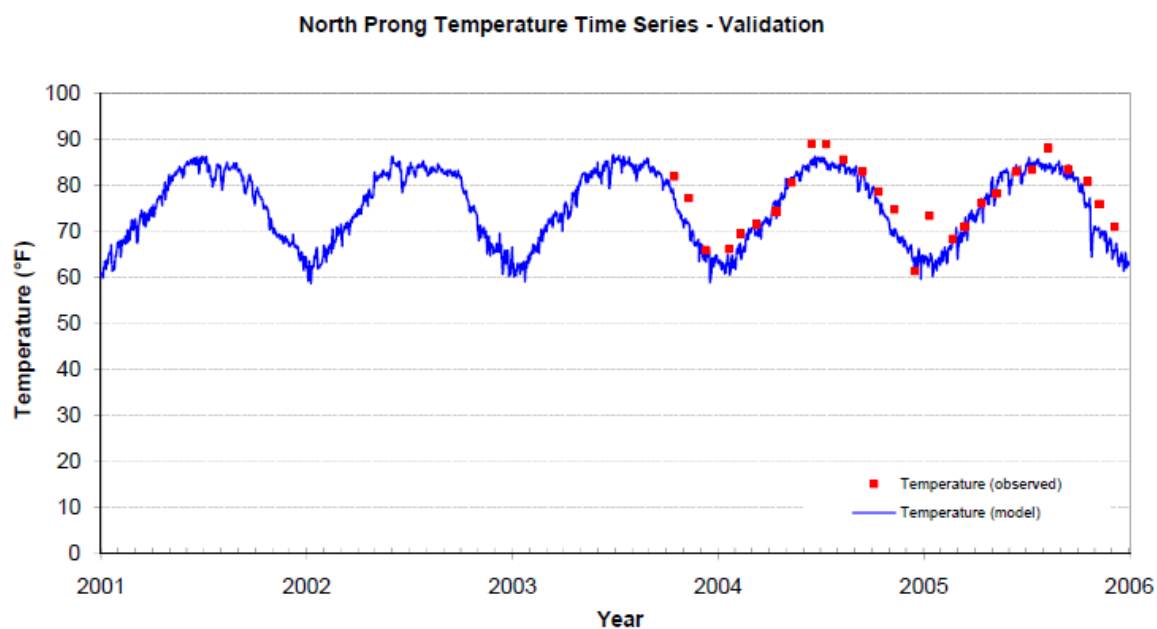


Figure D4-1. Model Simulated and Measured Temperature for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

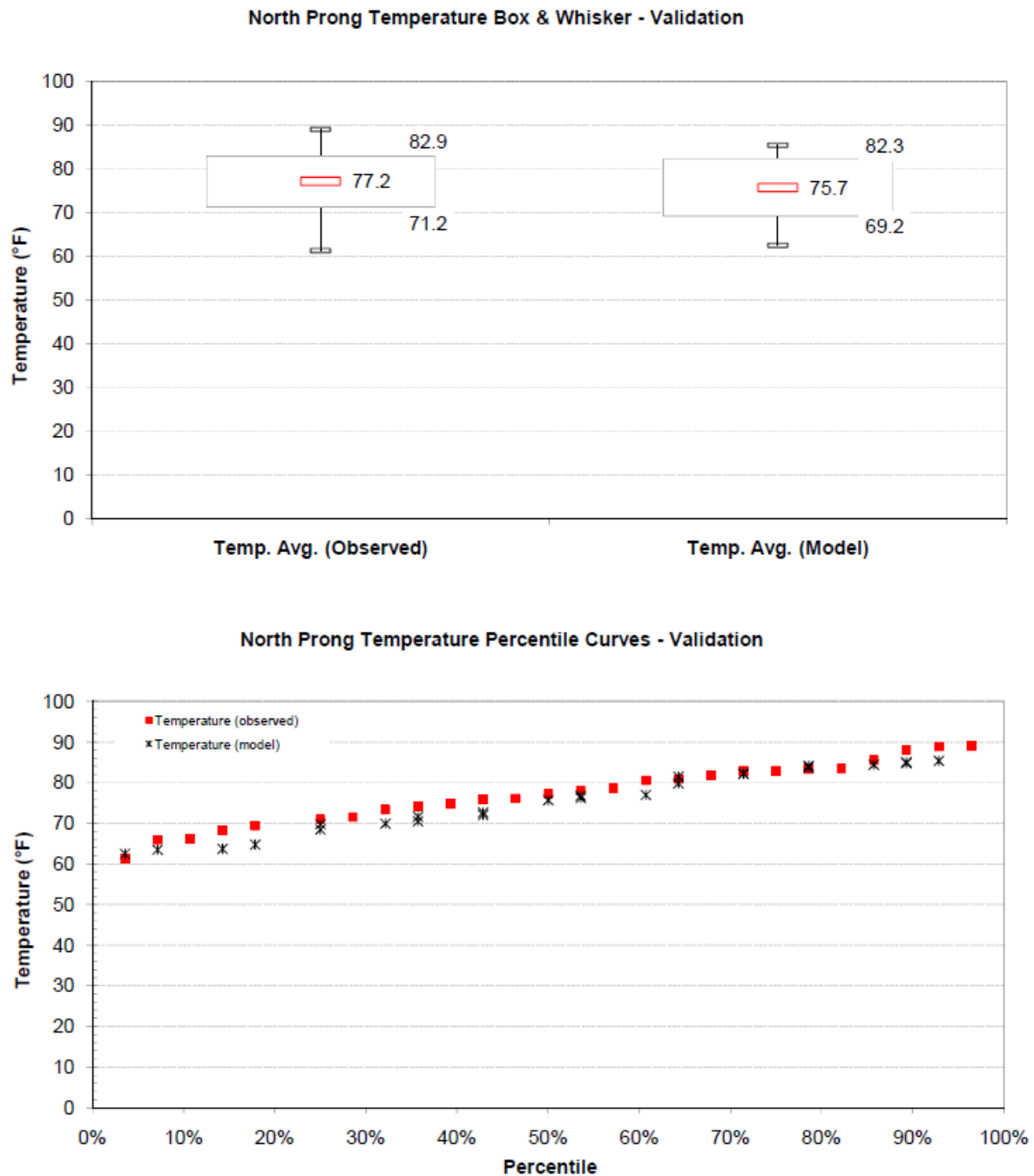


Figure D4-2. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Temperature in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

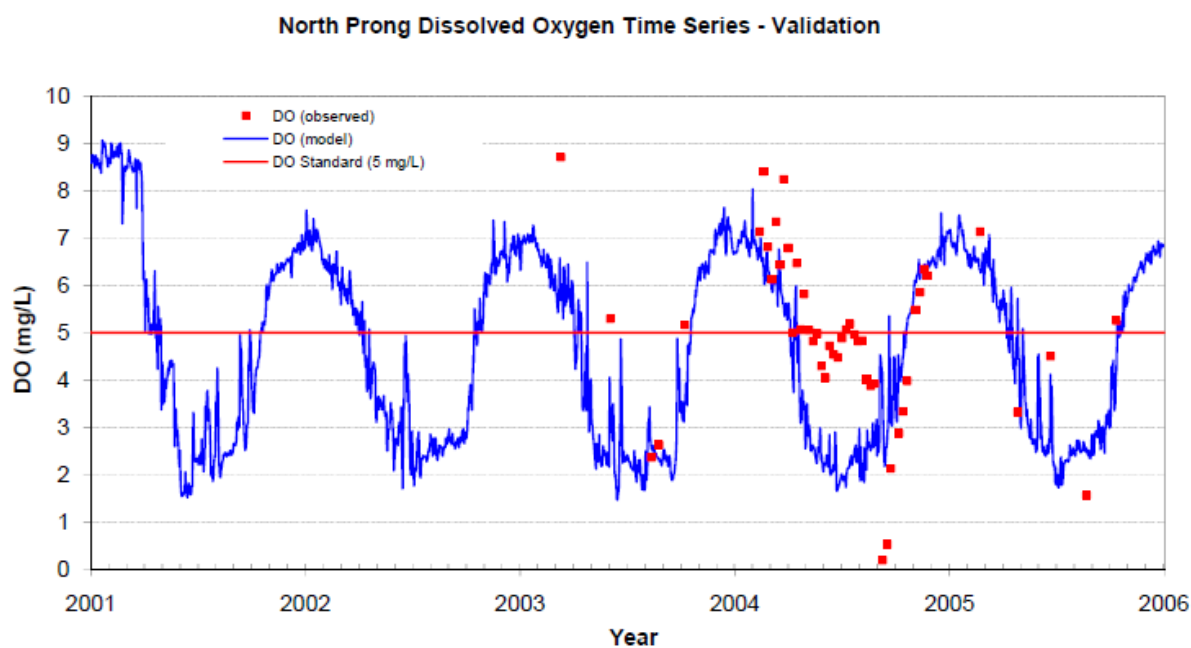


Figure D4-3. Model Simulated and Measured Dissolved Oxygen for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

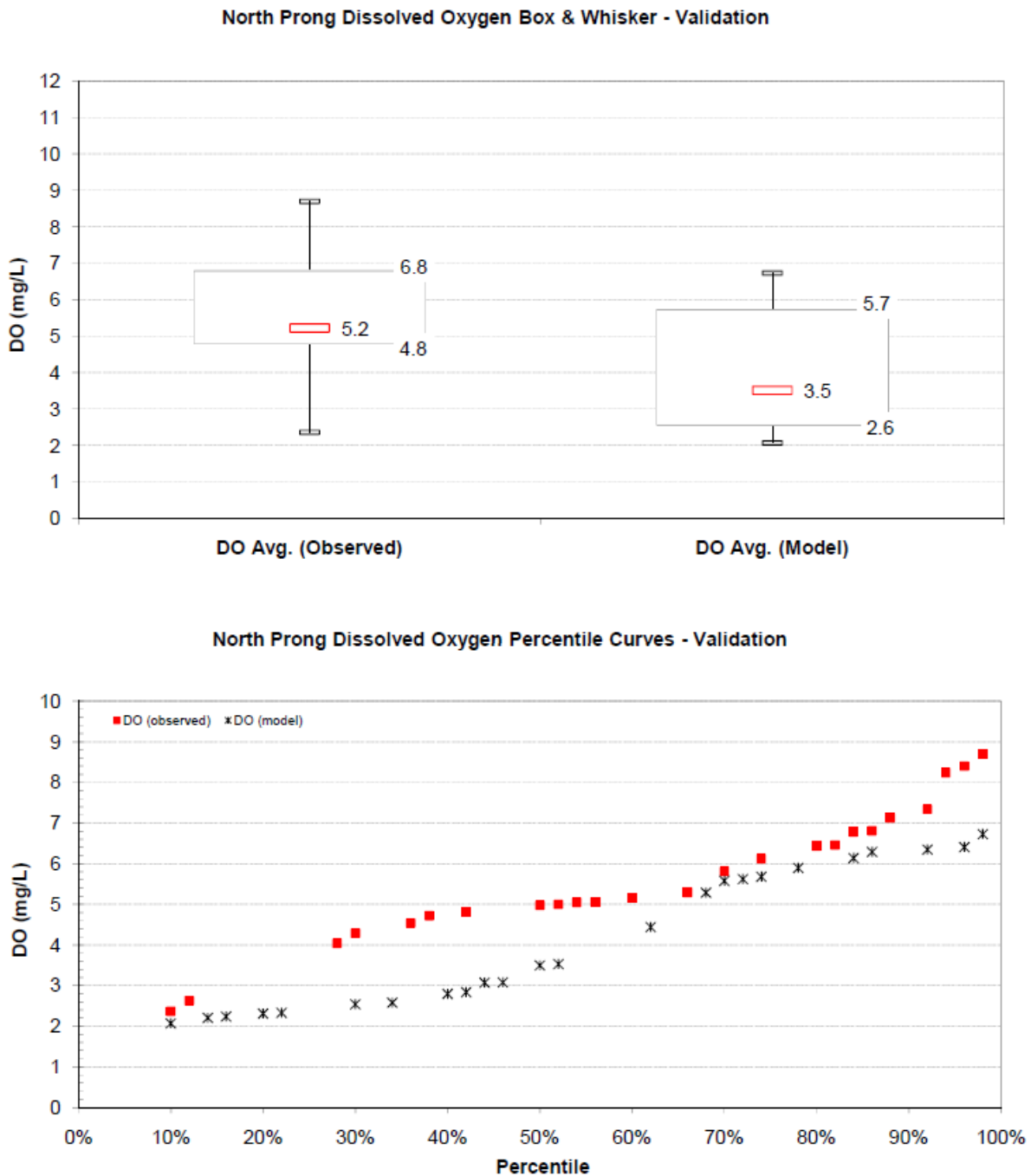


Figure D4-4. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

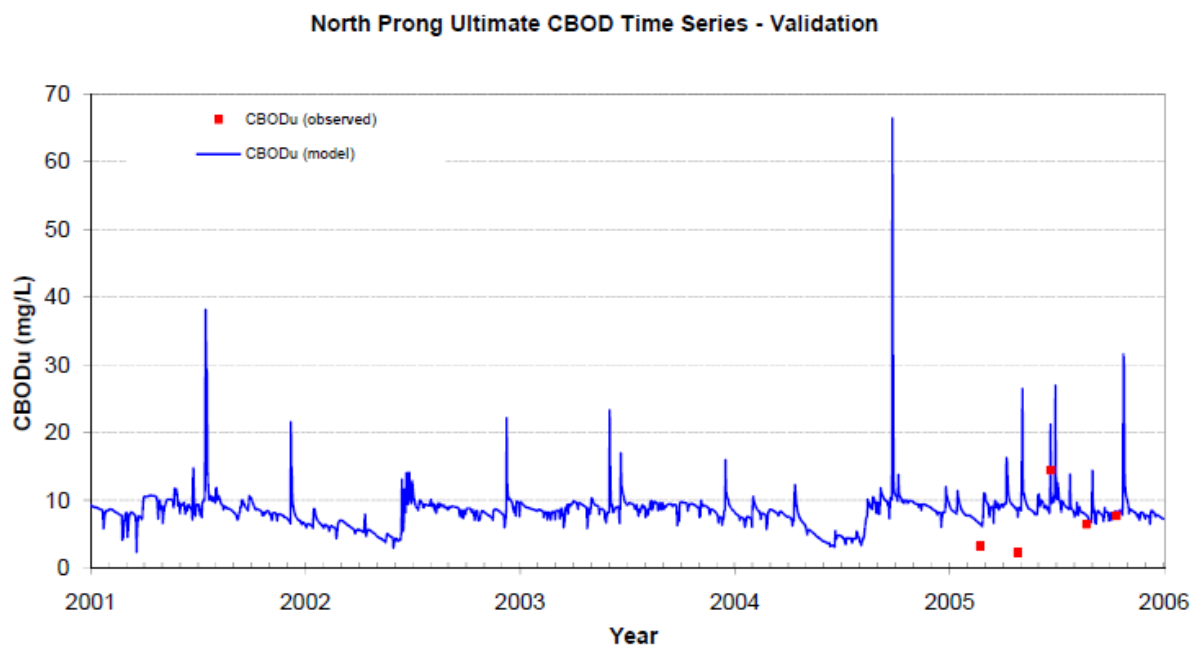


Figure D4-5. Model Simulated and Measured BOD for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

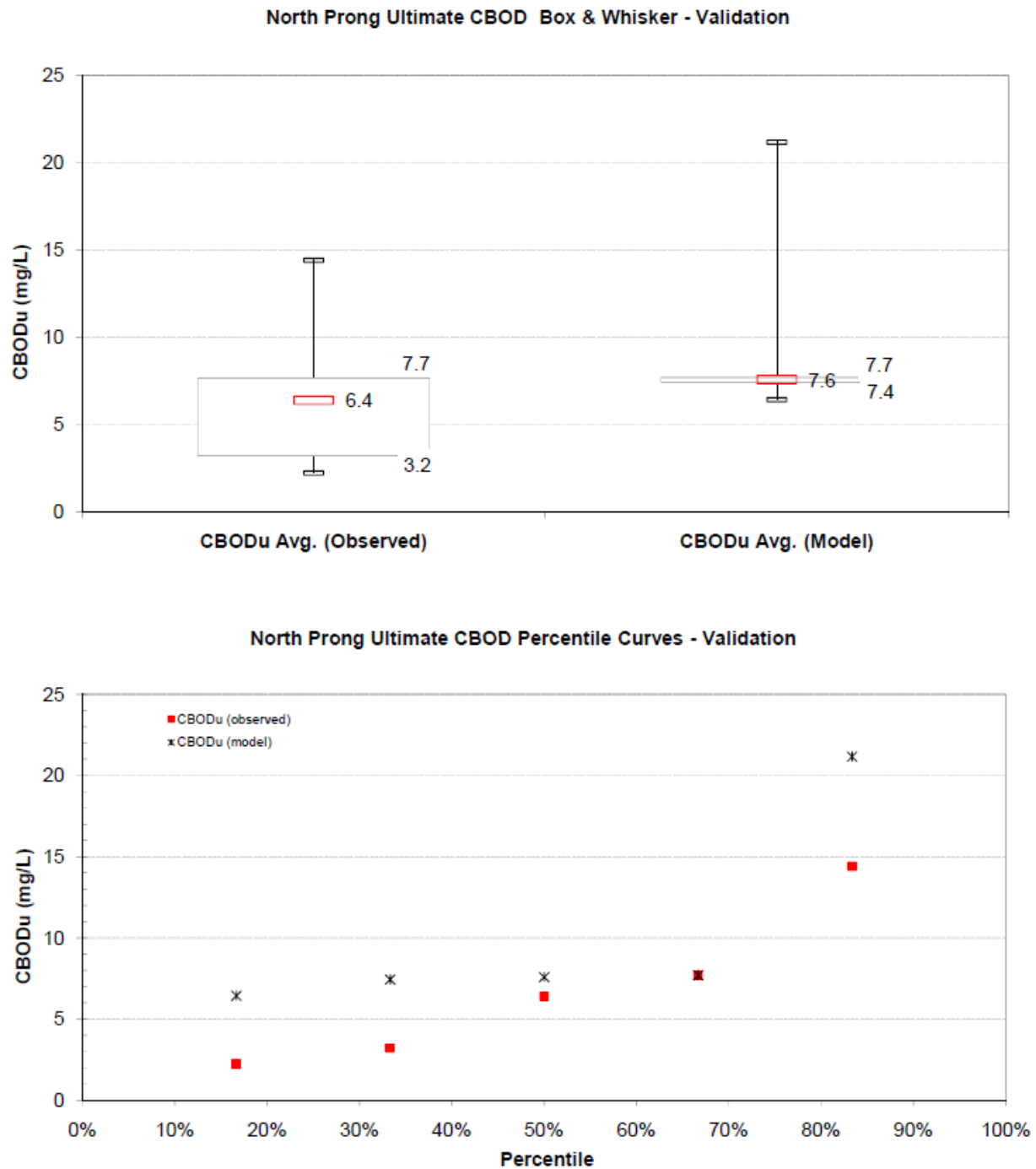


Figure D4-6. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated BOD in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

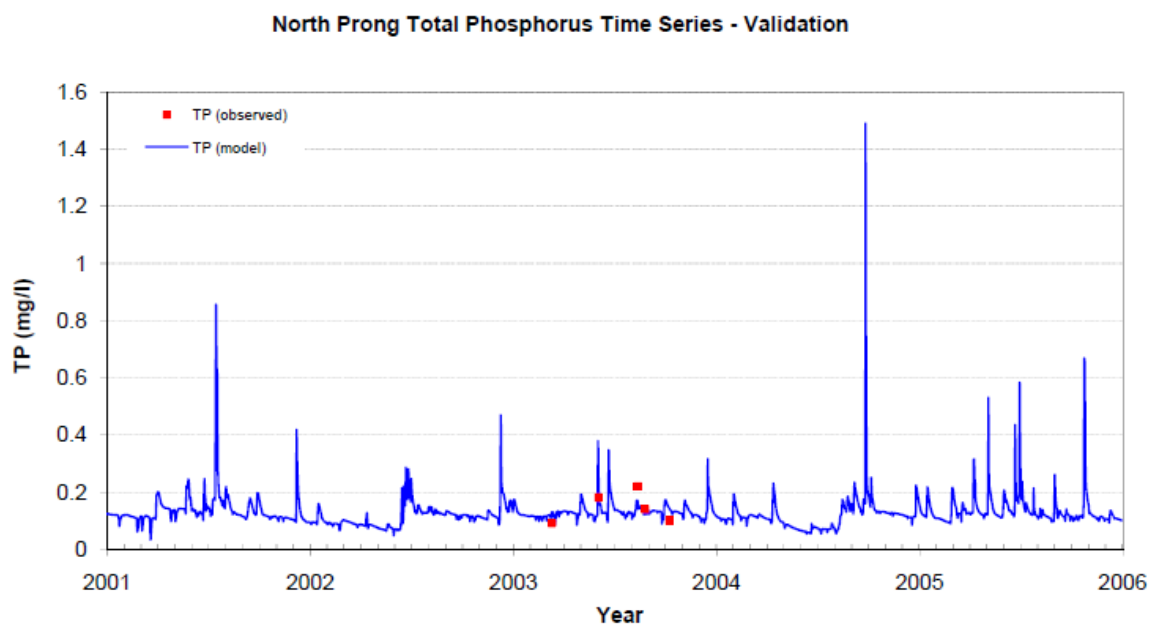


Figure D4-7. Model Simulated and Measured Total Phosphorus for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

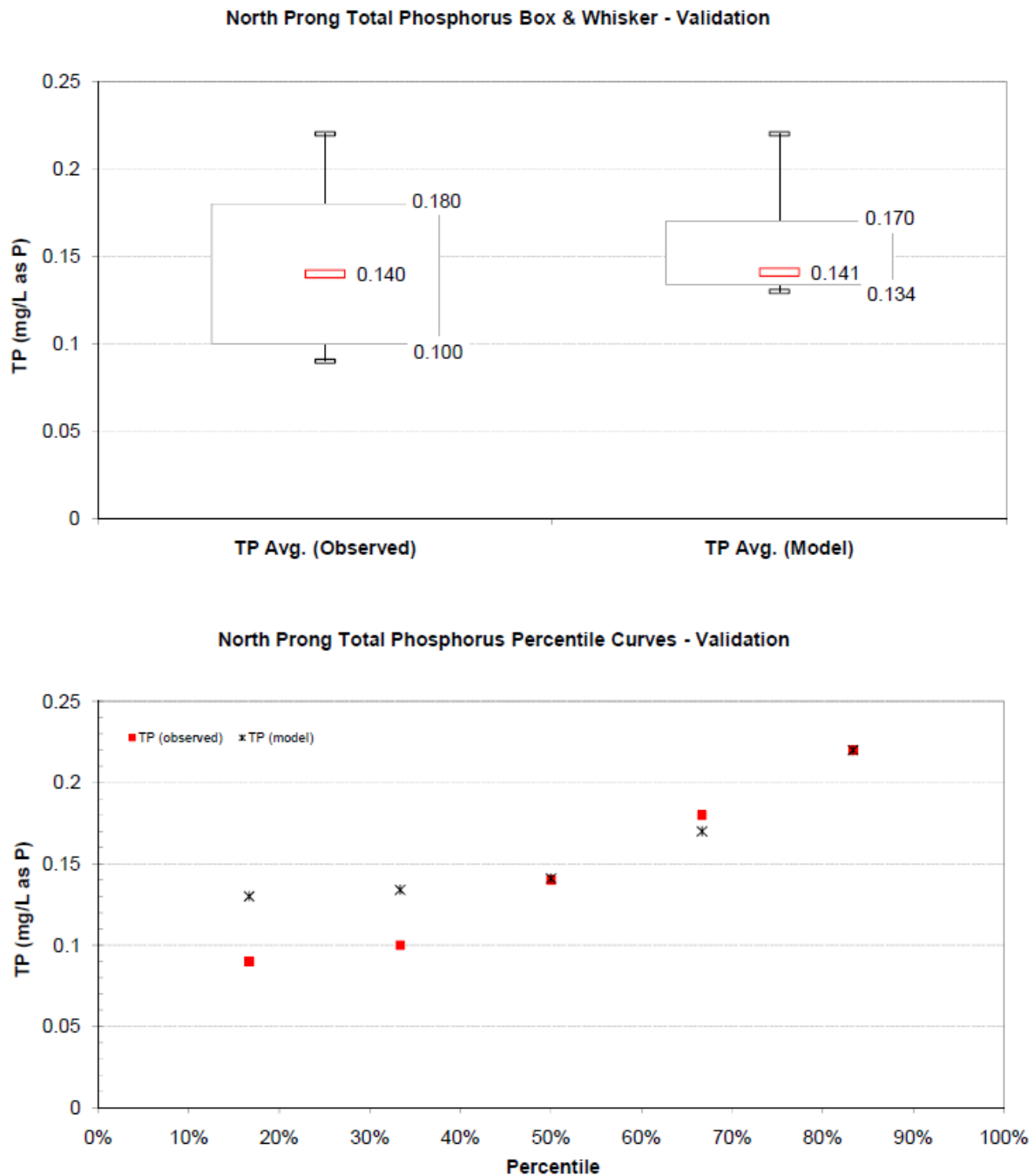


Figure D4-8. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

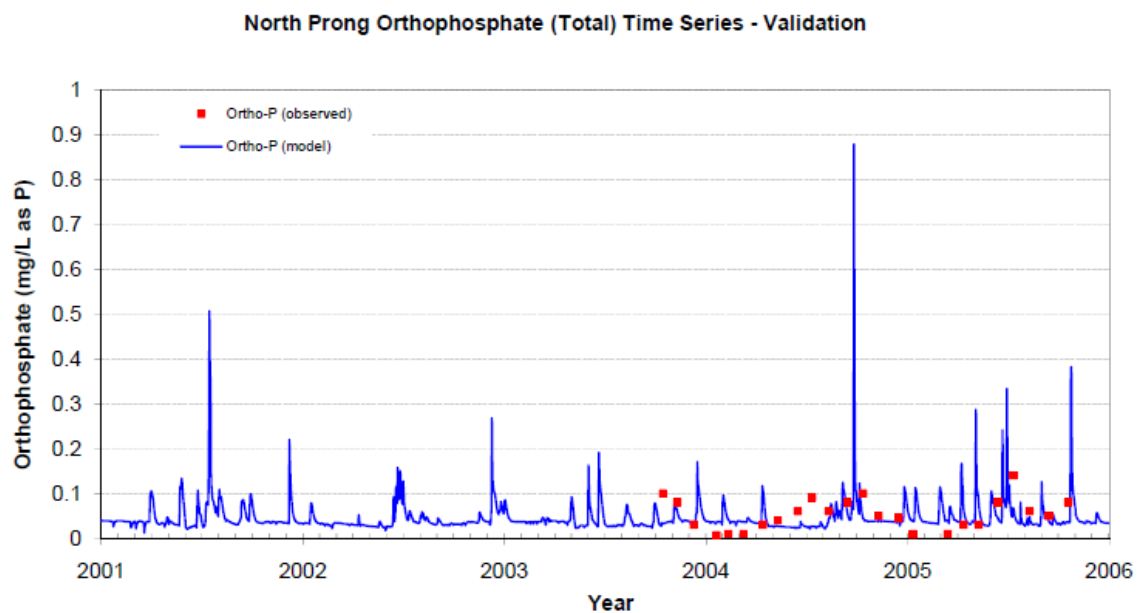


Figure D4-9. Model Simulated and Measured Orthophosphate for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

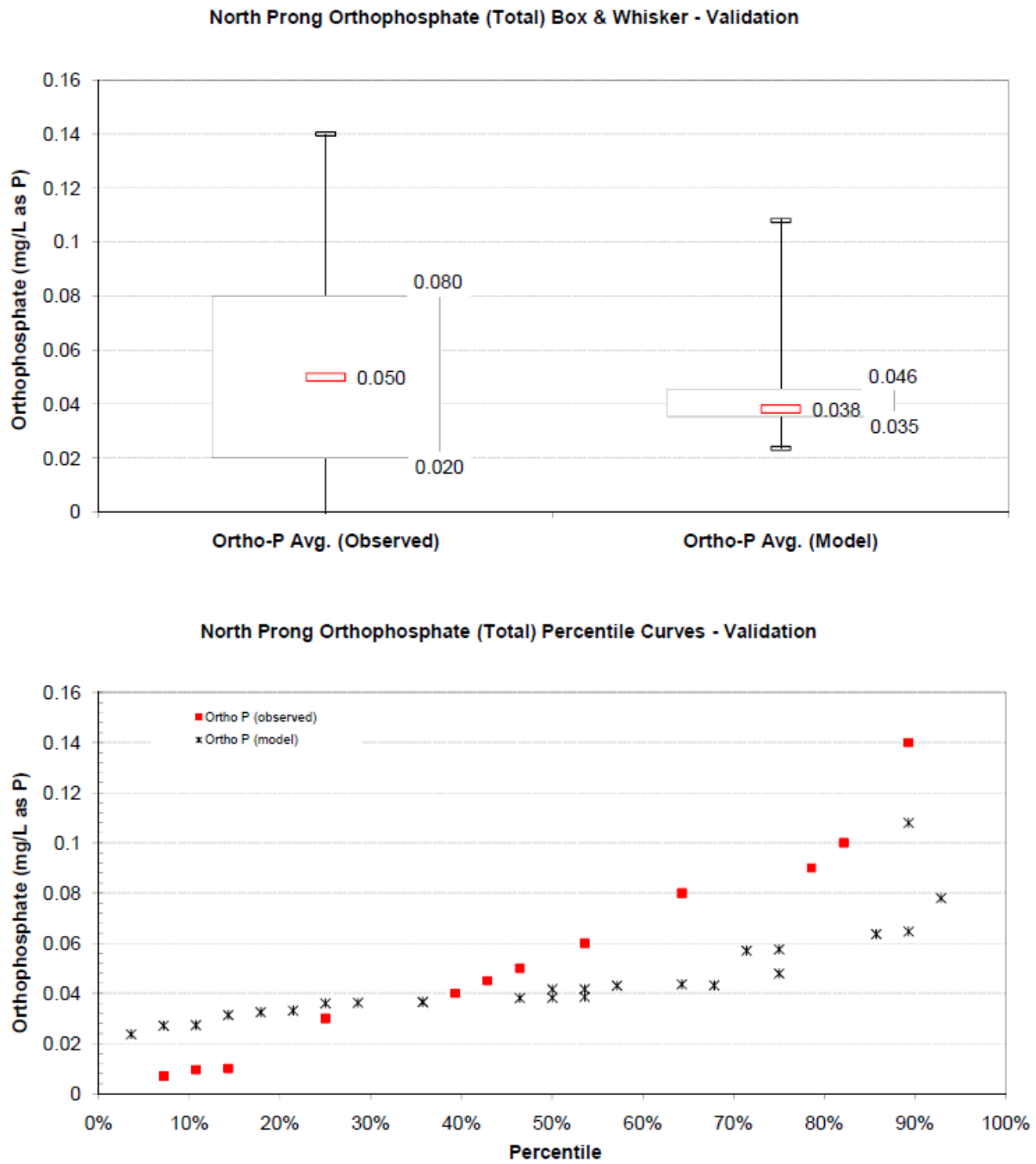


Figure D4-10. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

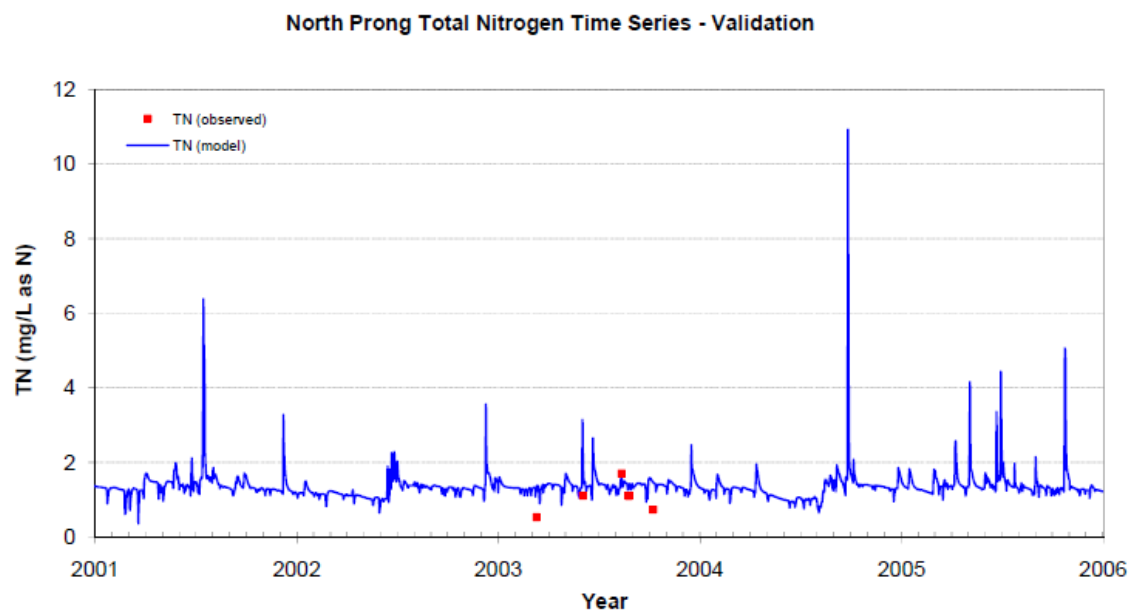


Figure D4-11. Model Simulated and Measured Total Nitrogen for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

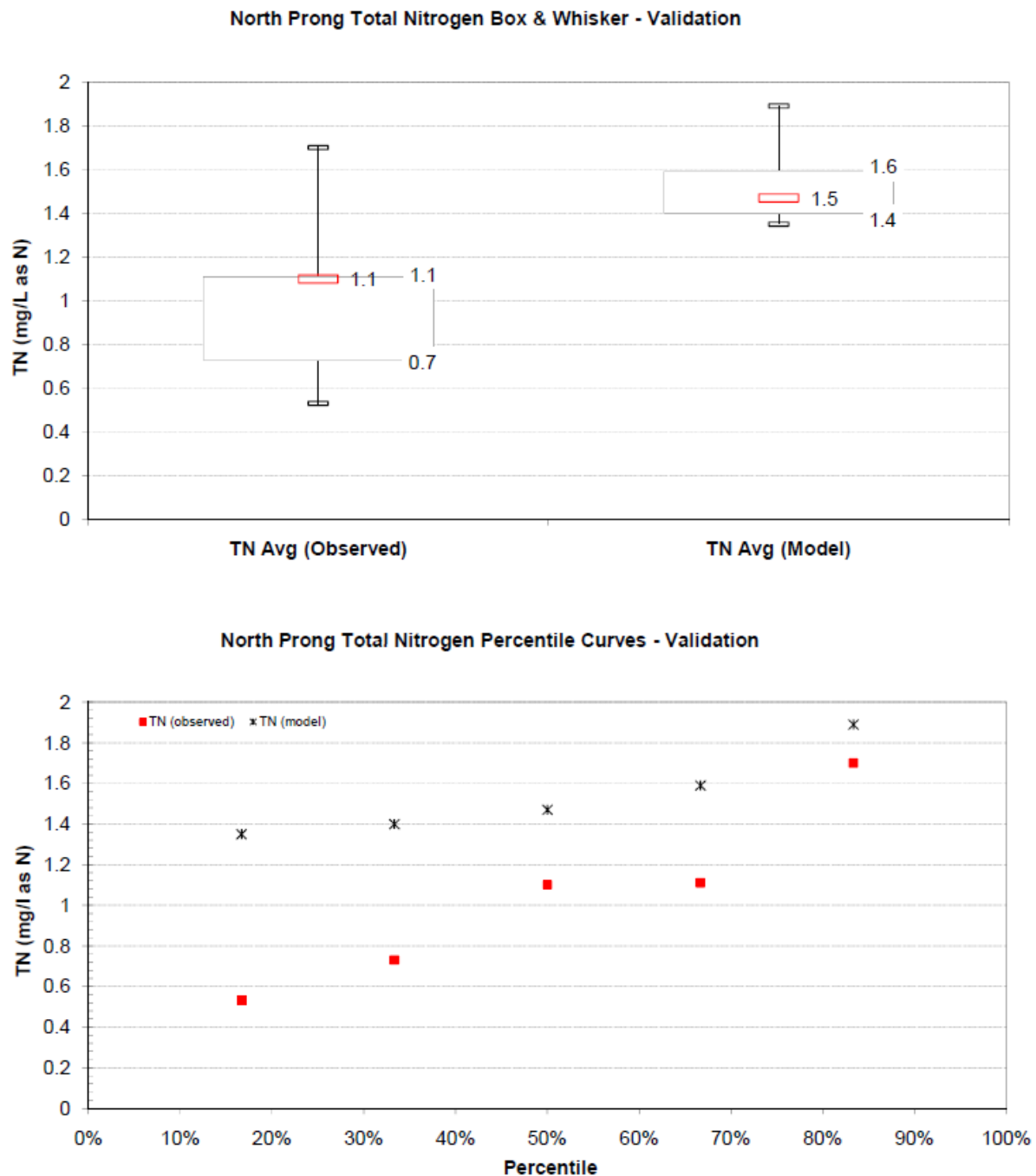


Figure D4-12. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

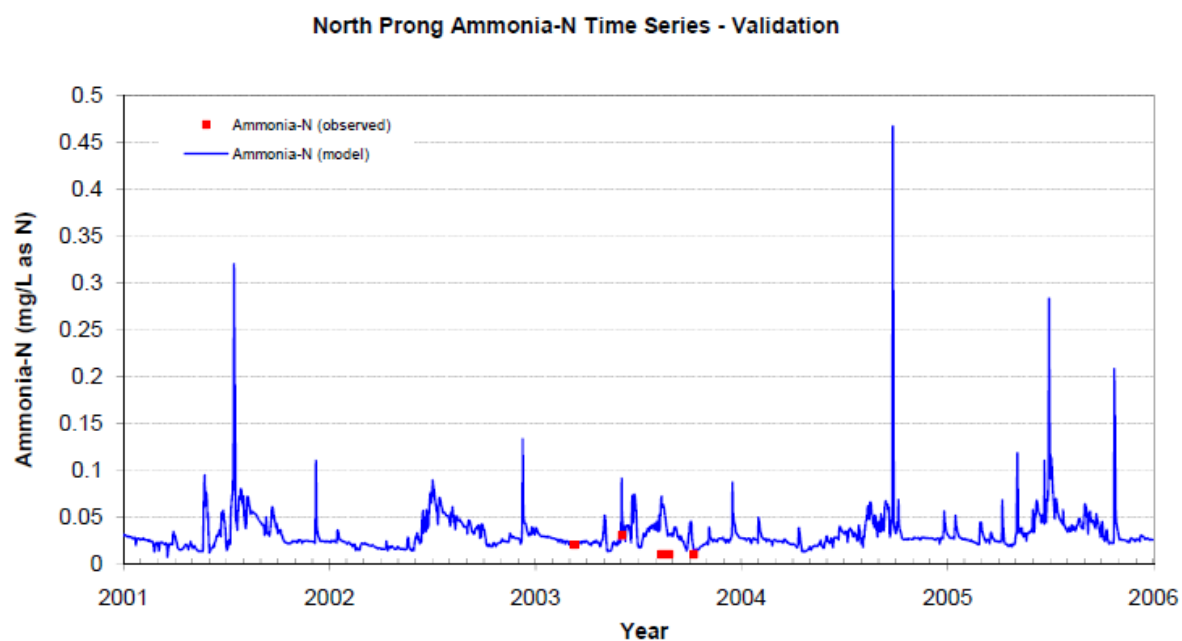


Figure D4-13. Model Simulated and Measured Ammonia Nitrogen for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

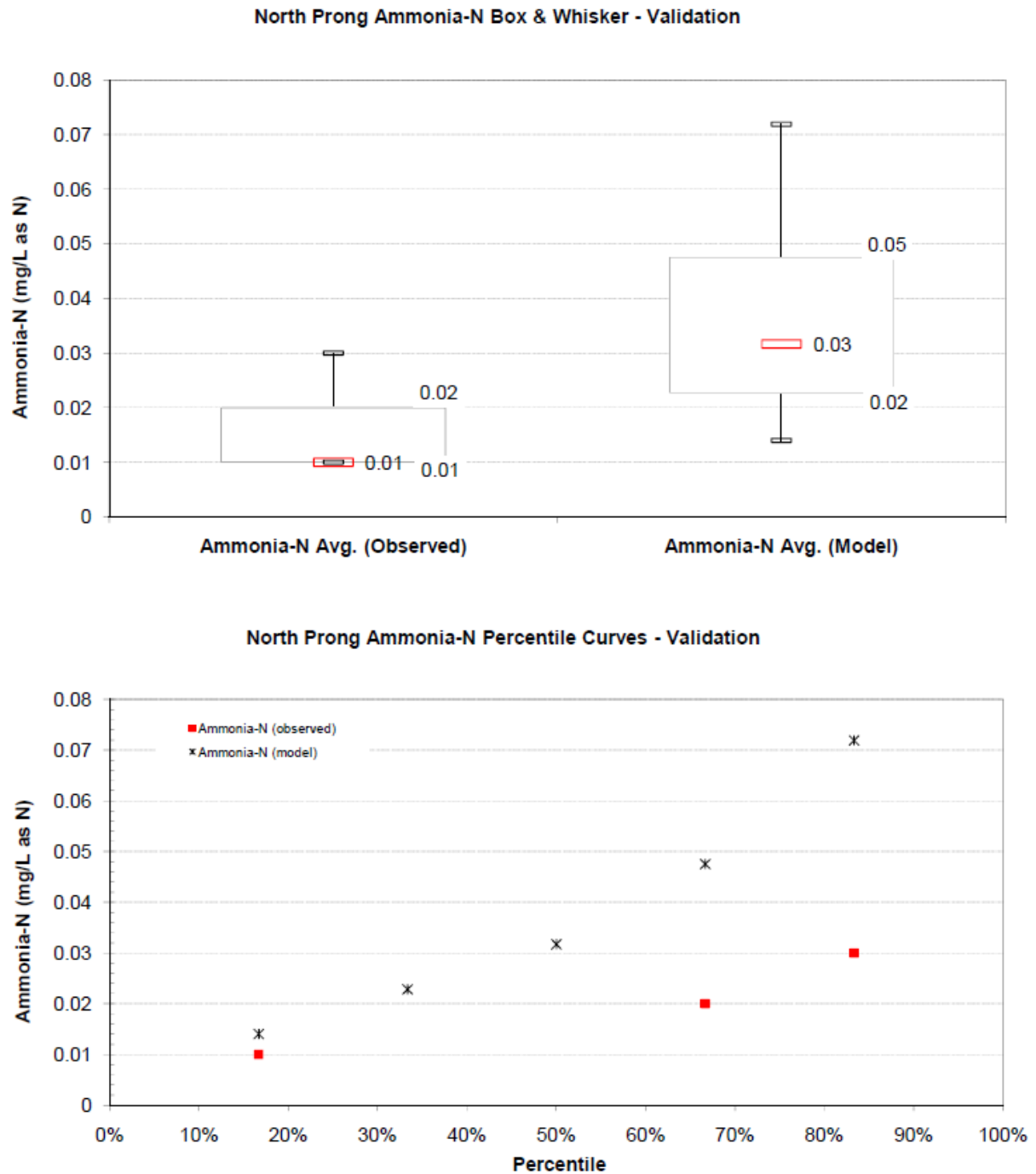


Figure D4-14. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Ammonia Nitrogen in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

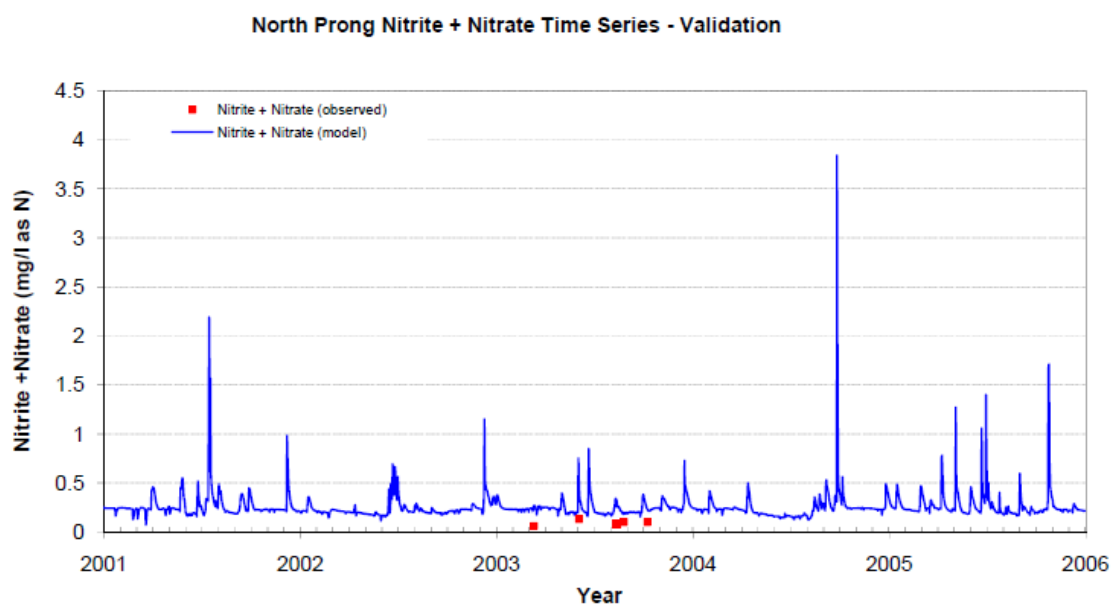


Figure D4-15. Model Simulated and Measured Nitrate Nitrogen for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

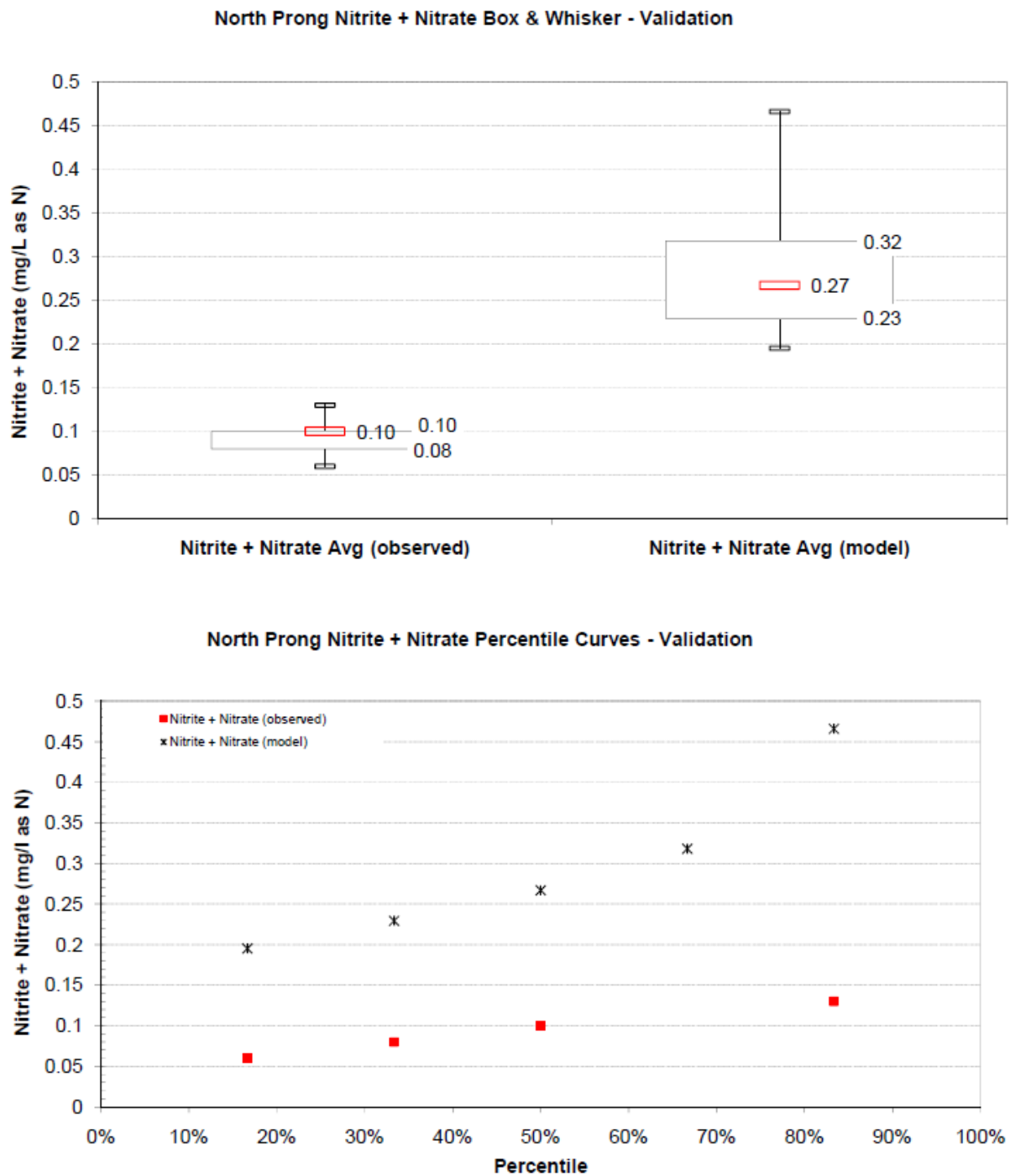


Figure D4-16. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

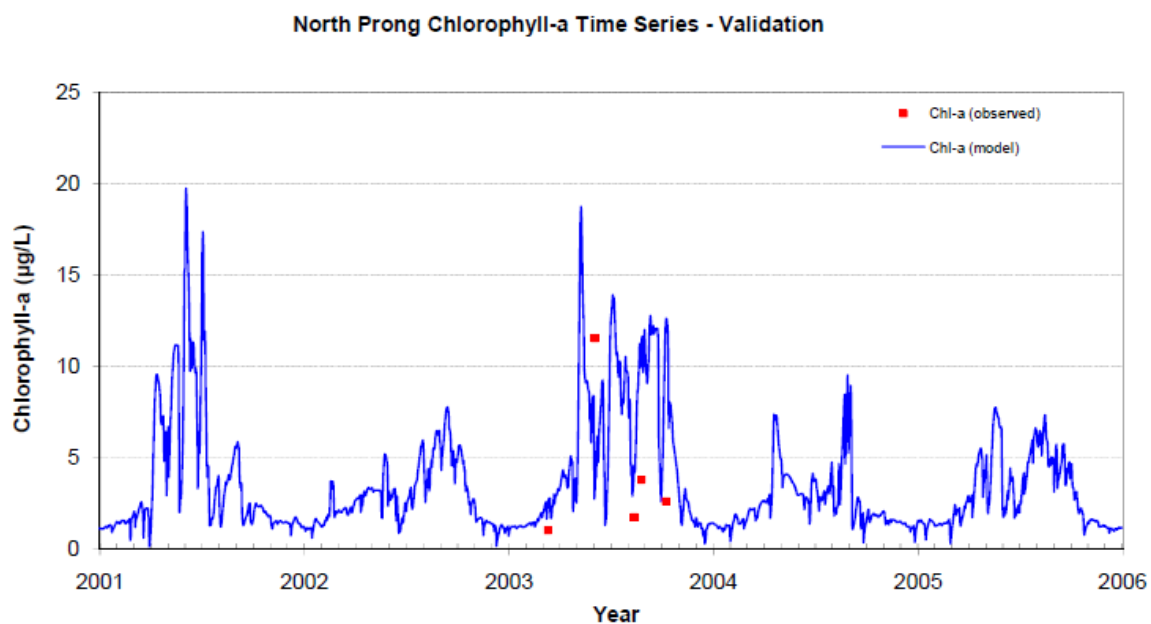


Figure D4-17. Model Simulated and Measured Chlorophyll a for the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

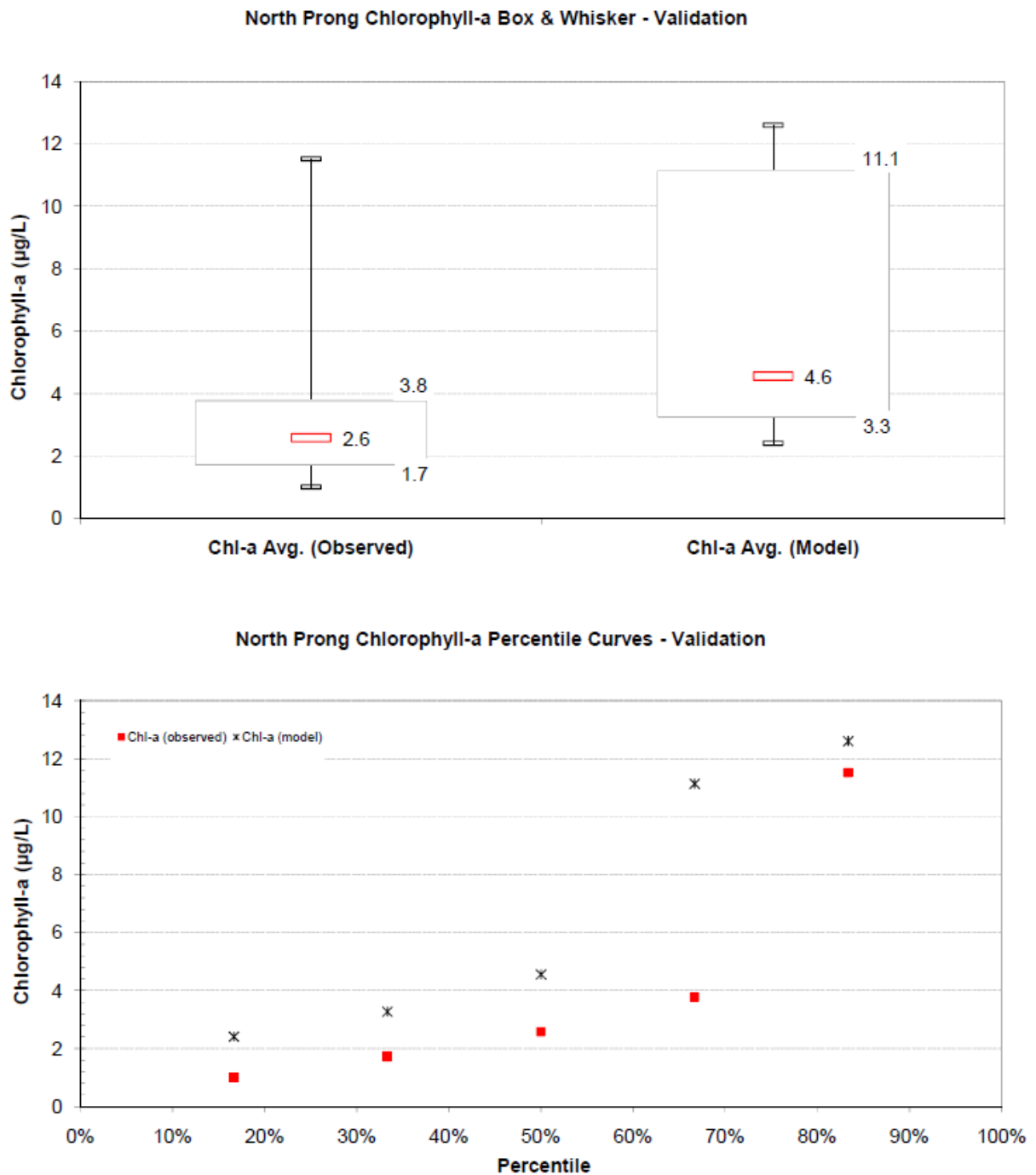


Figure D4-18. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in the North Prong of the Sebastian River in the Validation Period (2001 through 2005)

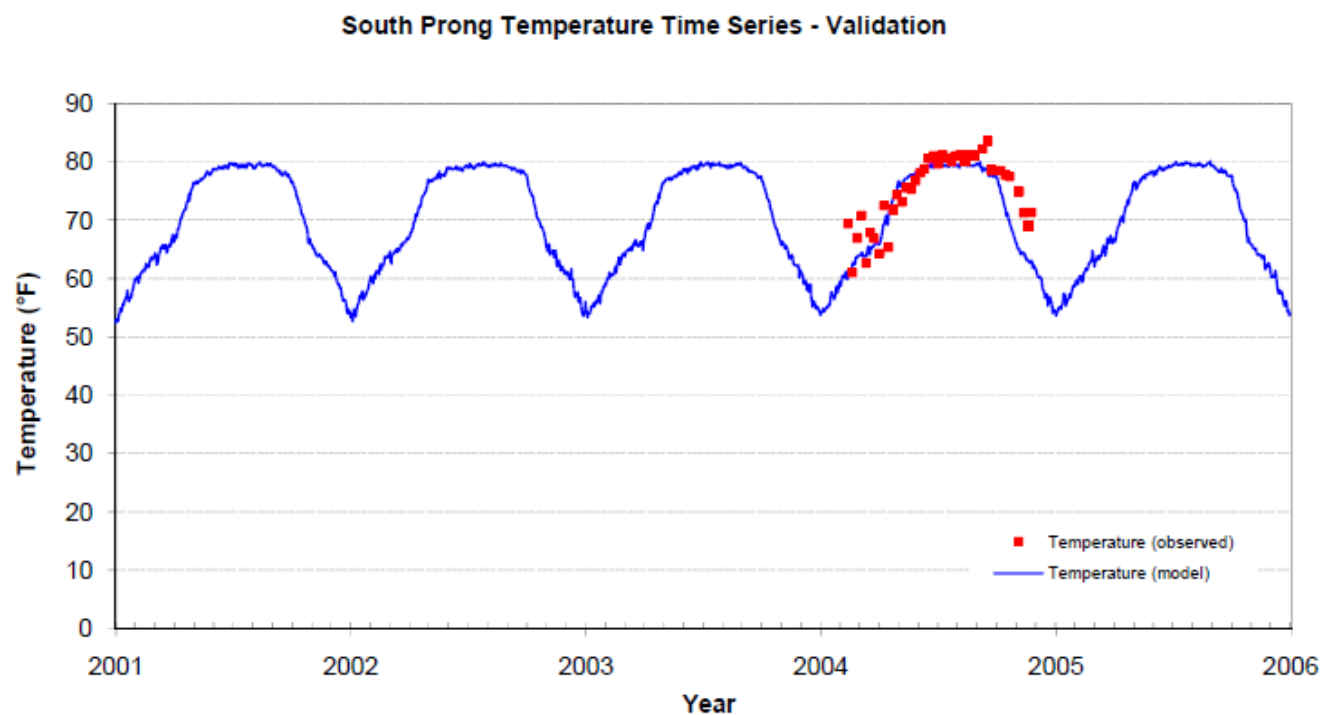


Figure D5-1. Model Simulated and Measured Temperature for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

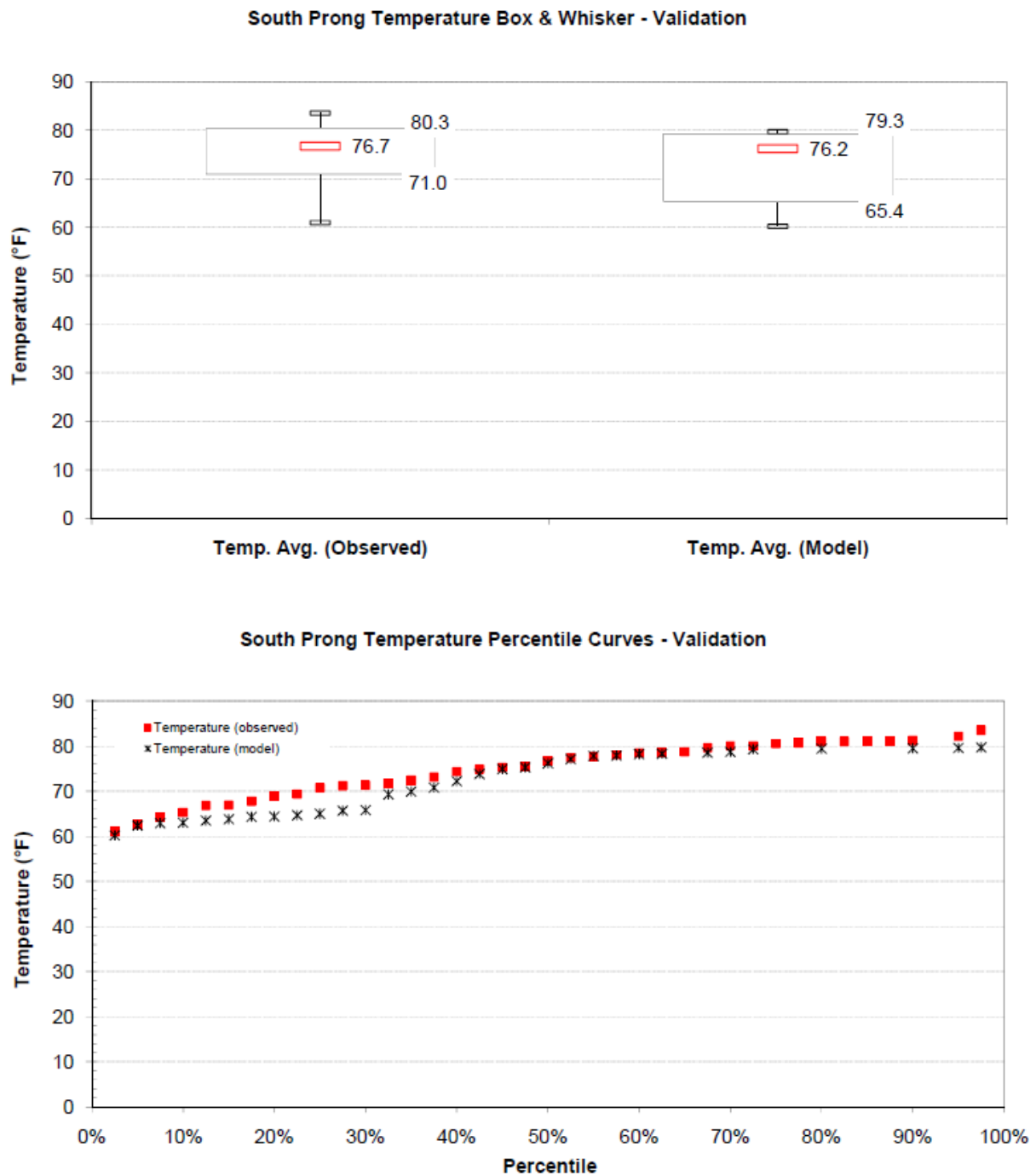


Figure D5-2. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Temperature in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

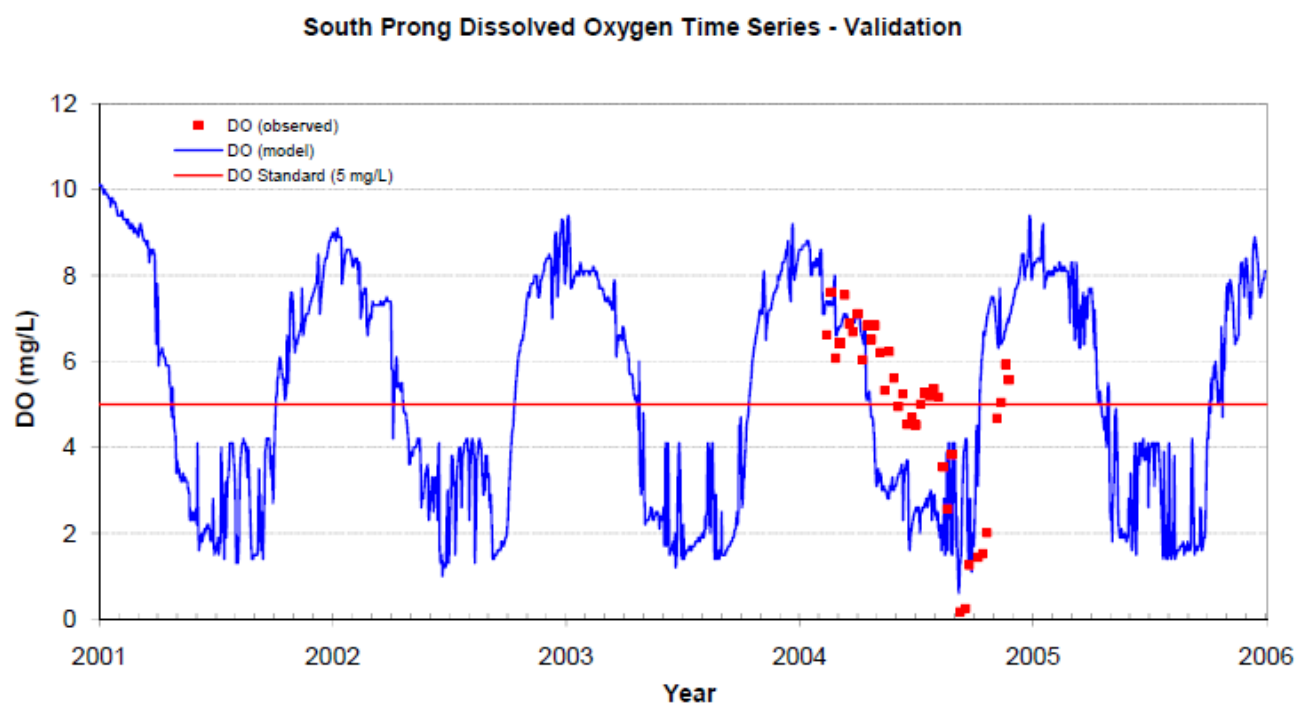


Figure D5-3. Model Simulated and Measured Dissolved Oxygen for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

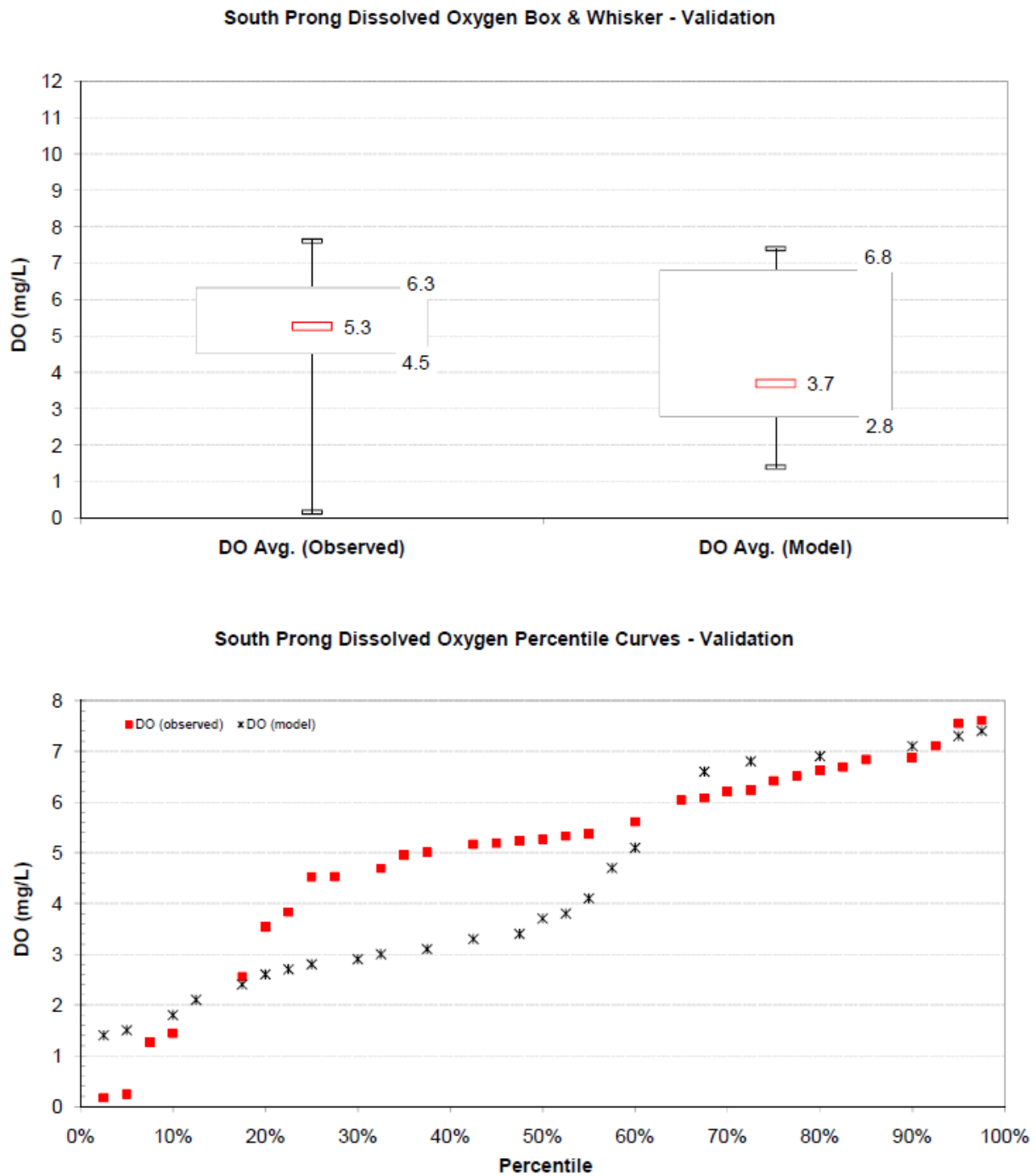


Figure D5-4. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Dissolved Oxygen in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

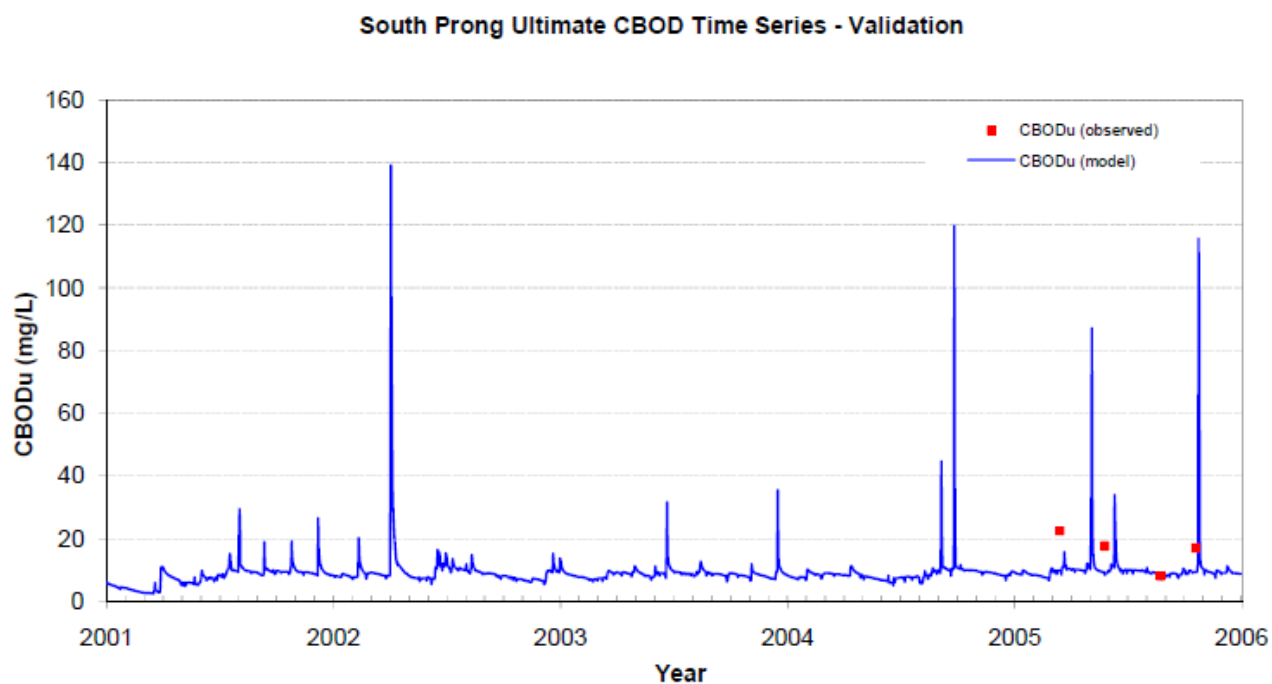


Figure D5-5. Model Simulated and Measured BOD for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

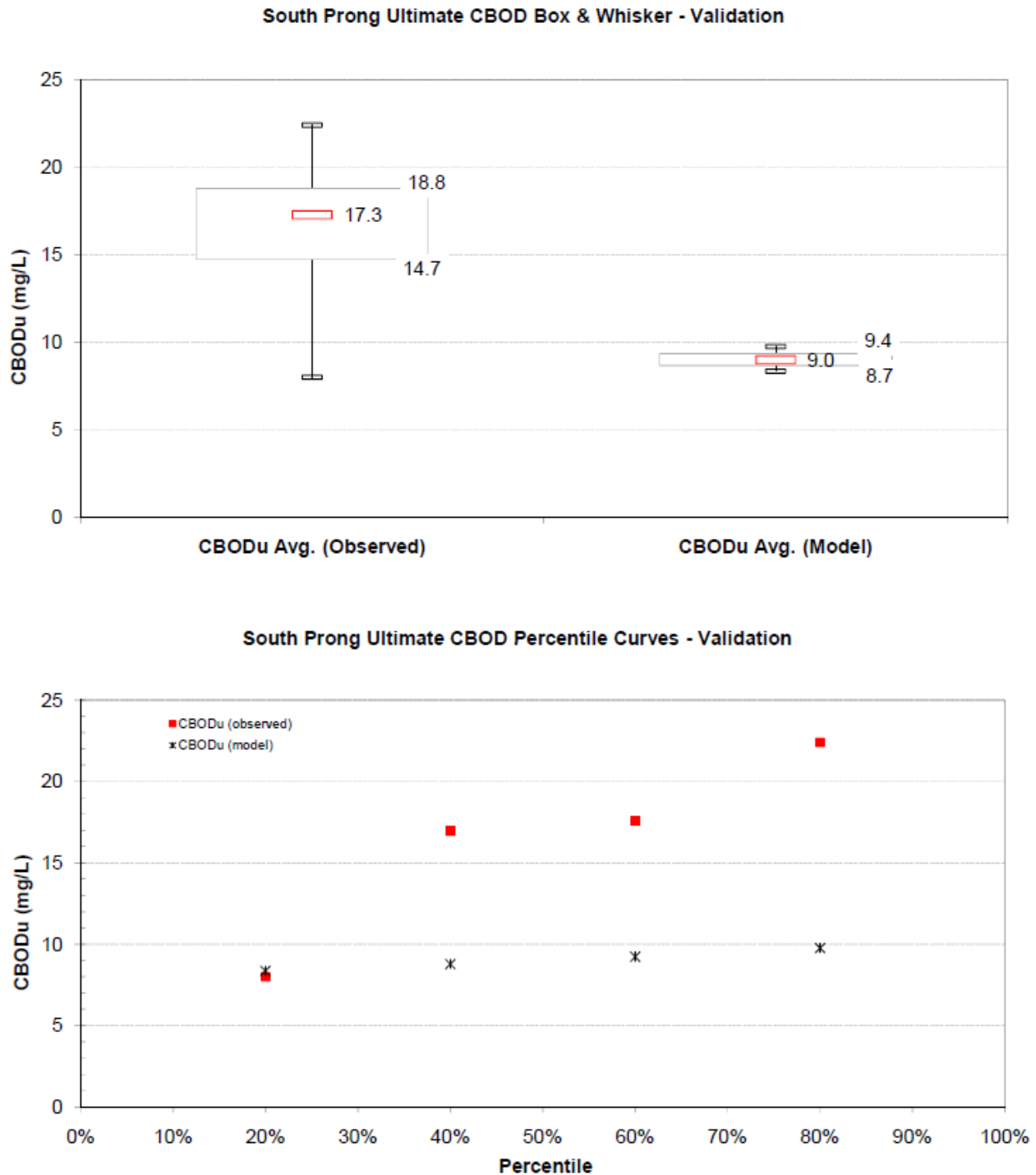


Figure D5-6. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated BOD in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)



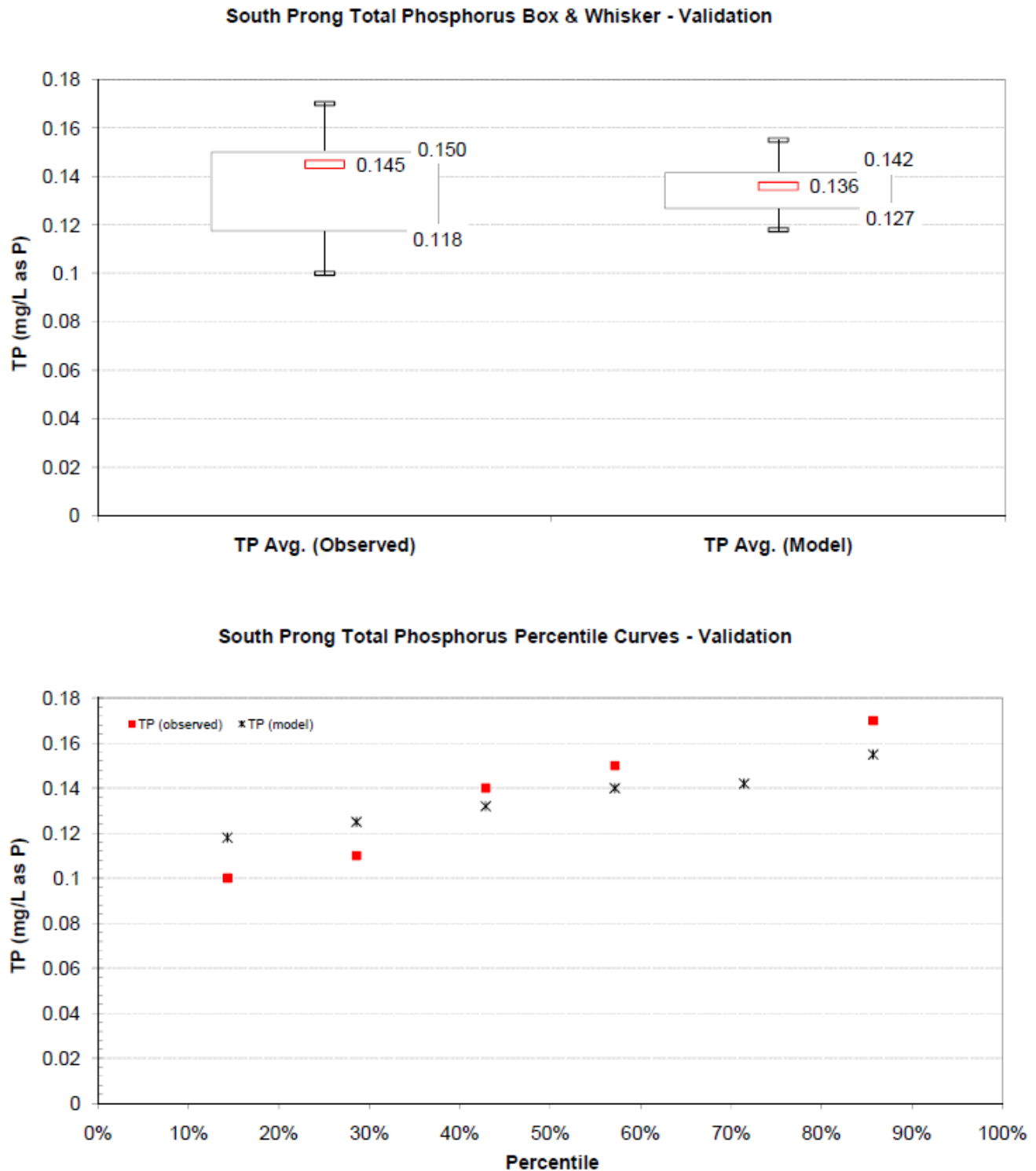


Figure D5-8. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Phosphorus in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

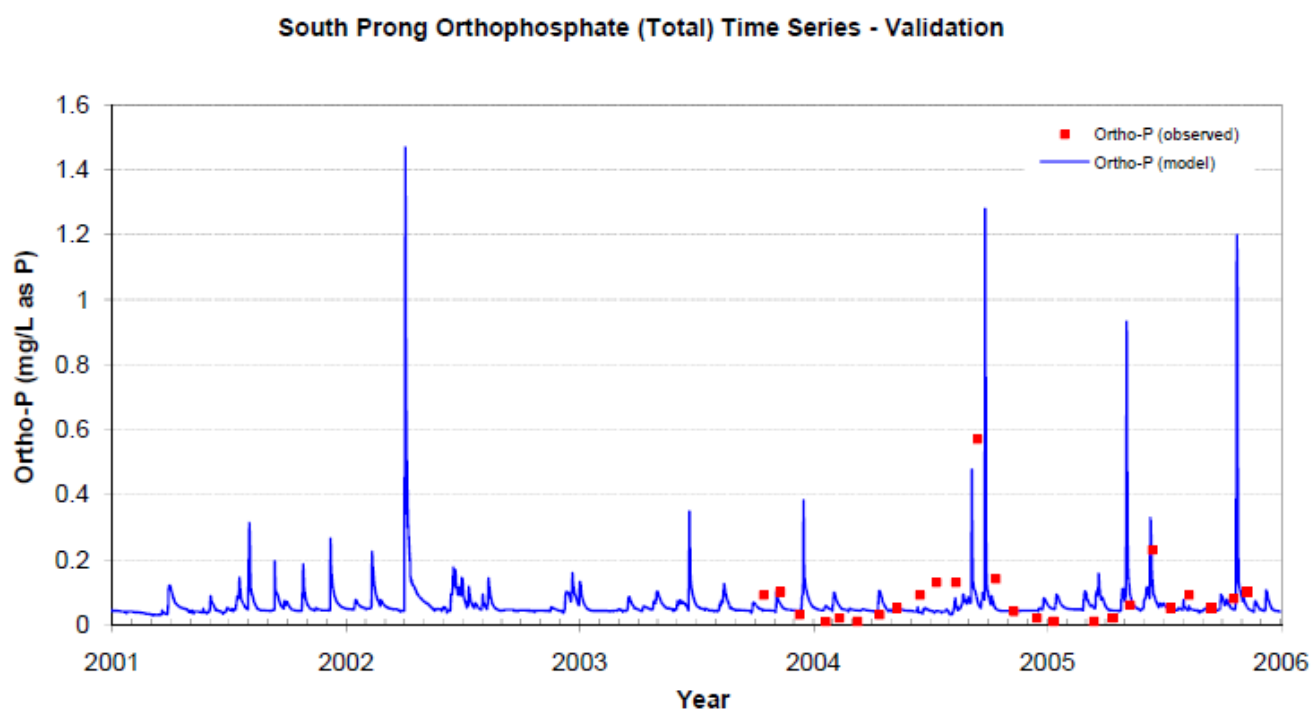


Figure D5-9. Model Simulated and Measured Orthophosphate for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

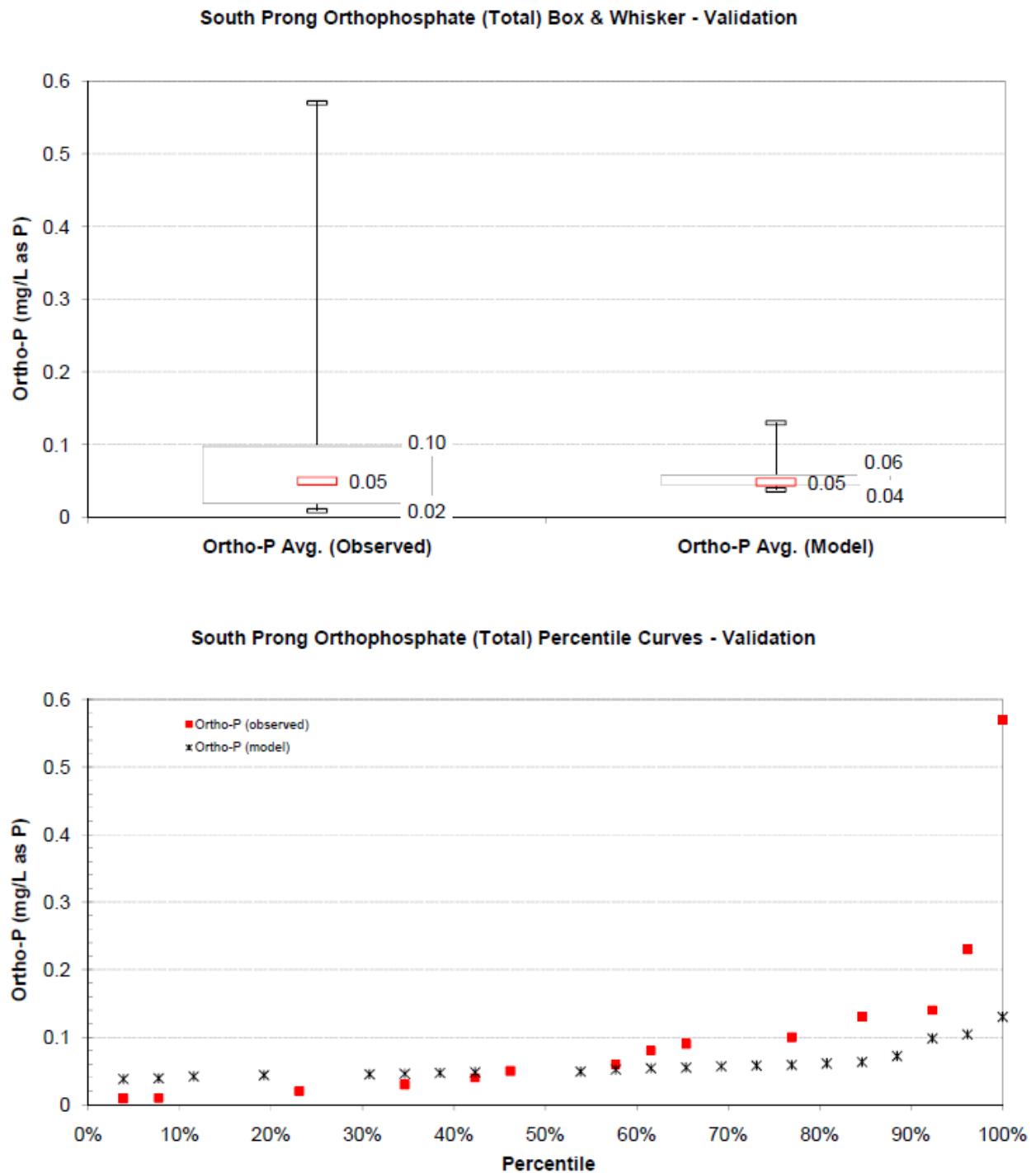


Figure D5-10. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Orthophosphate in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

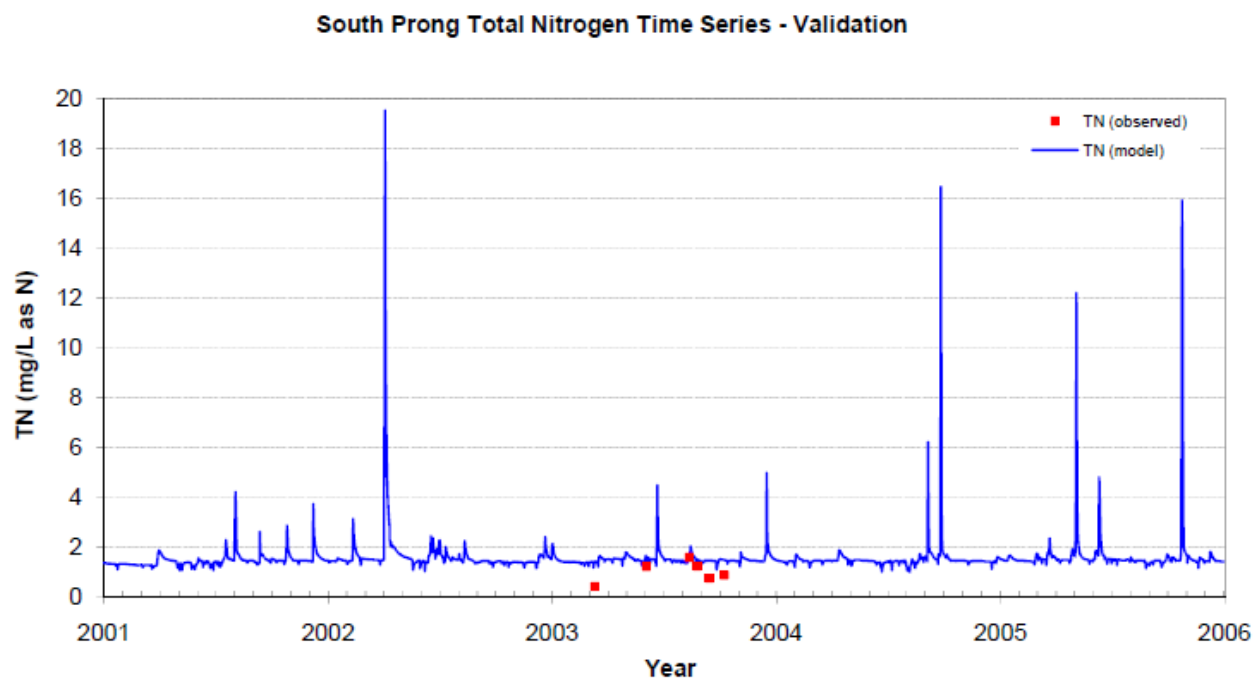


Figure D5-11. Model Simulated and Measured Total Nitrogen for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

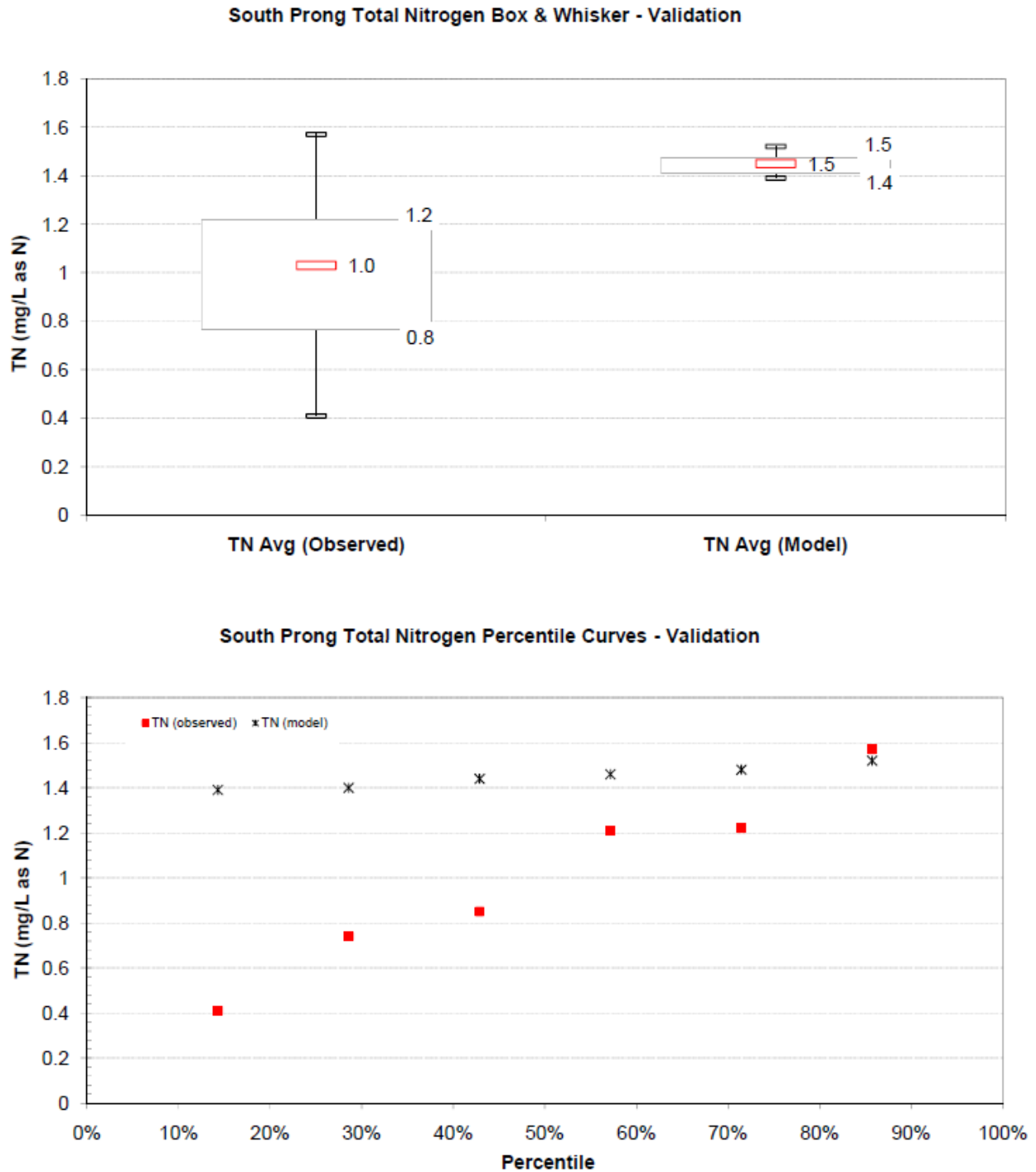


Figure D5-12. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Total Nitrogen in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

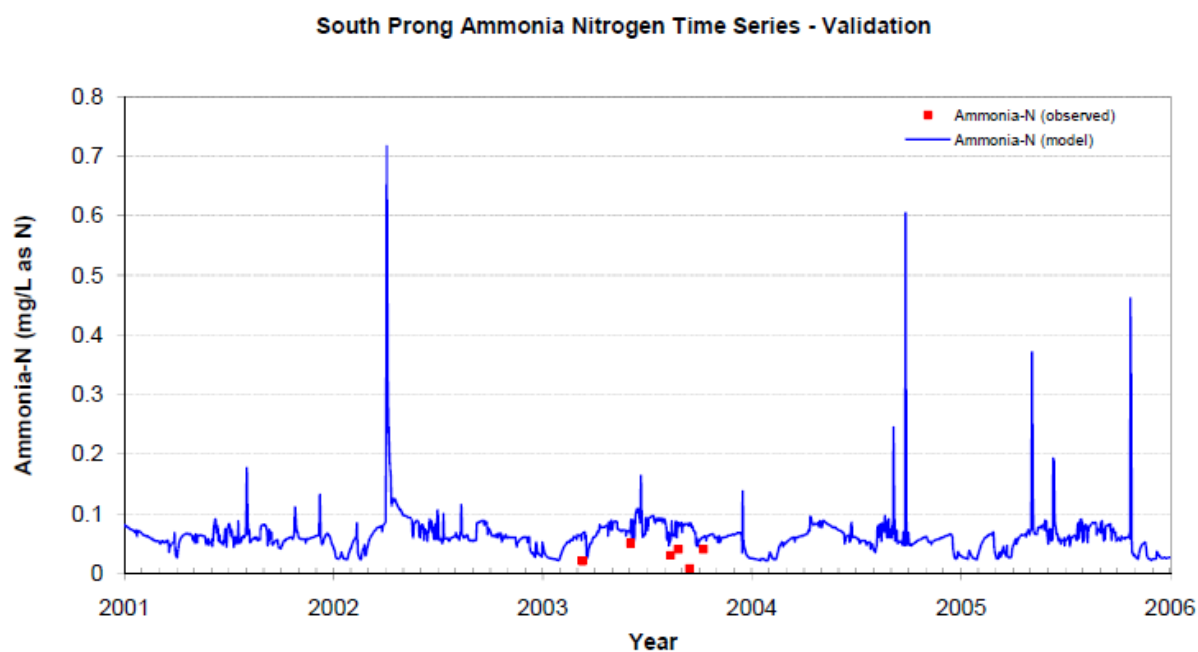


Figure D5-13. Model Simulated and Measured Ammonia Nitrogen for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

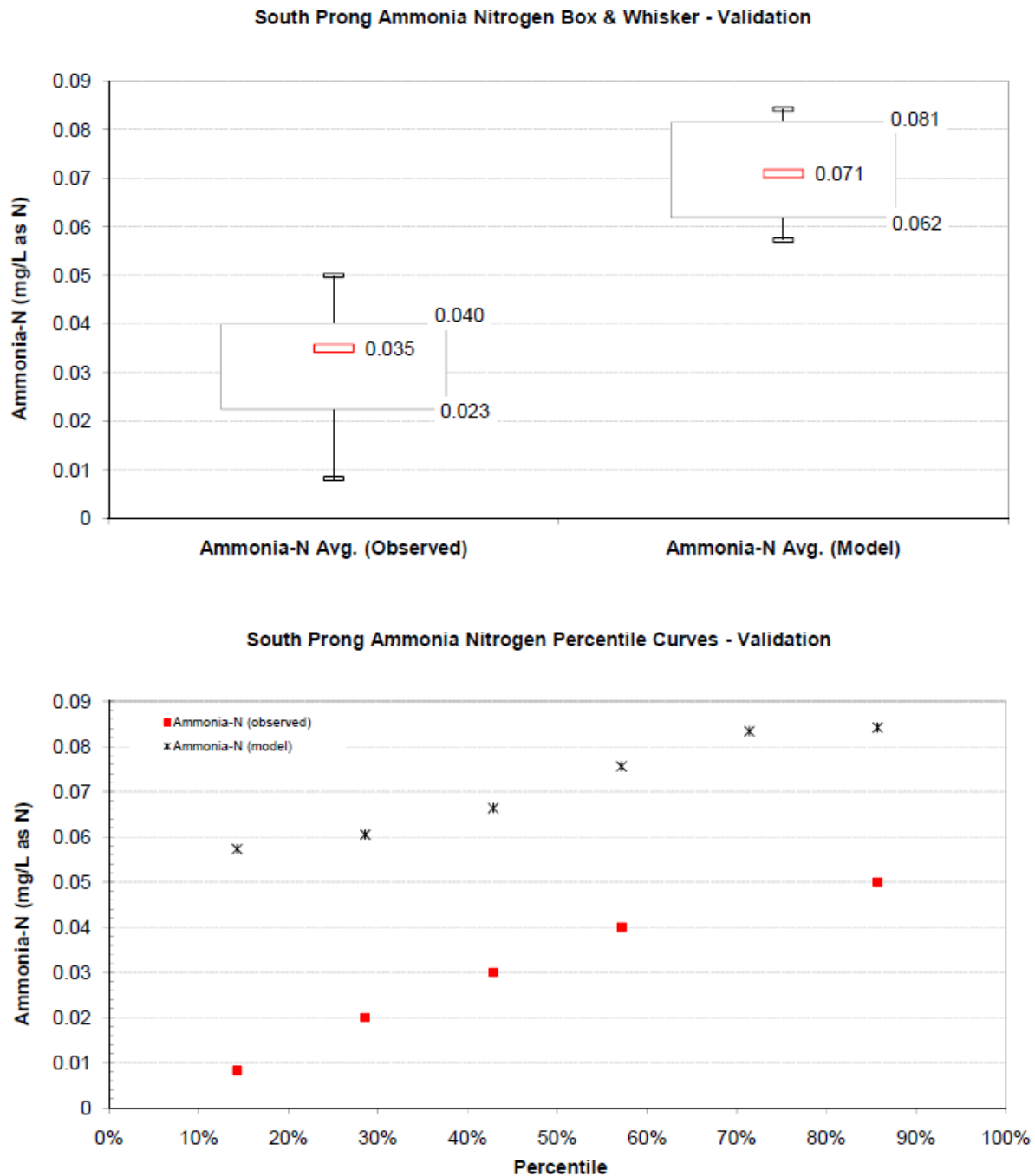


Figure D5-14. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Ammonia Nitrogen in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

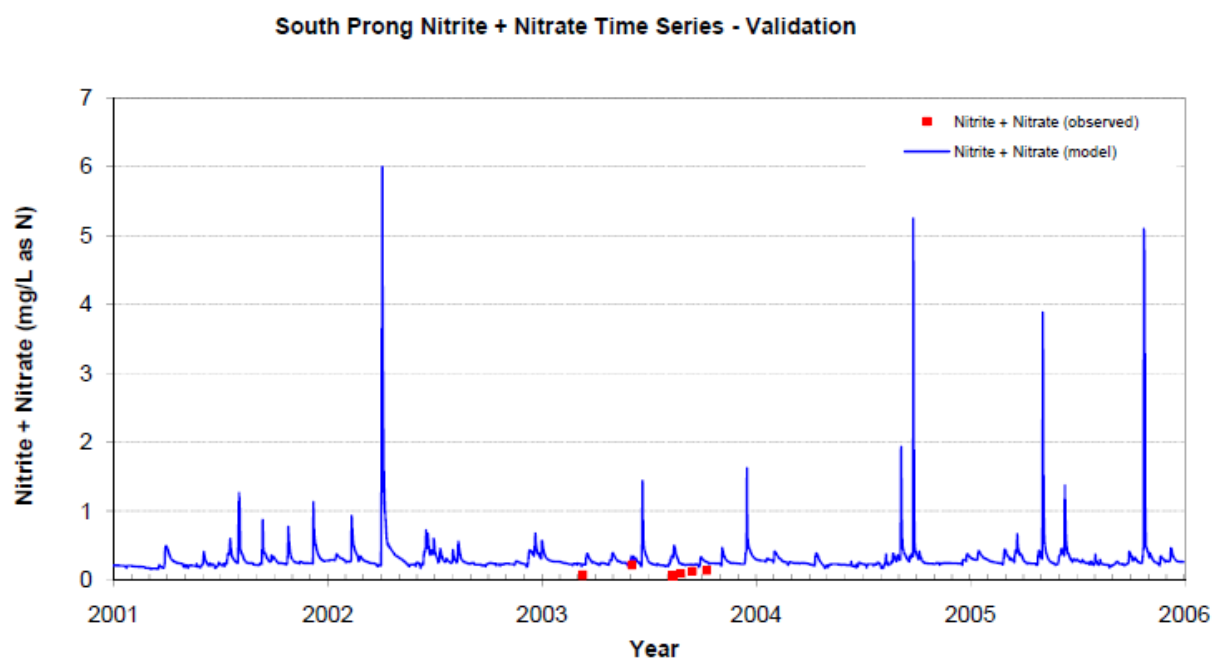


Figure D5-15. Model Simulated and Measured Nitrate Nitrogen for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

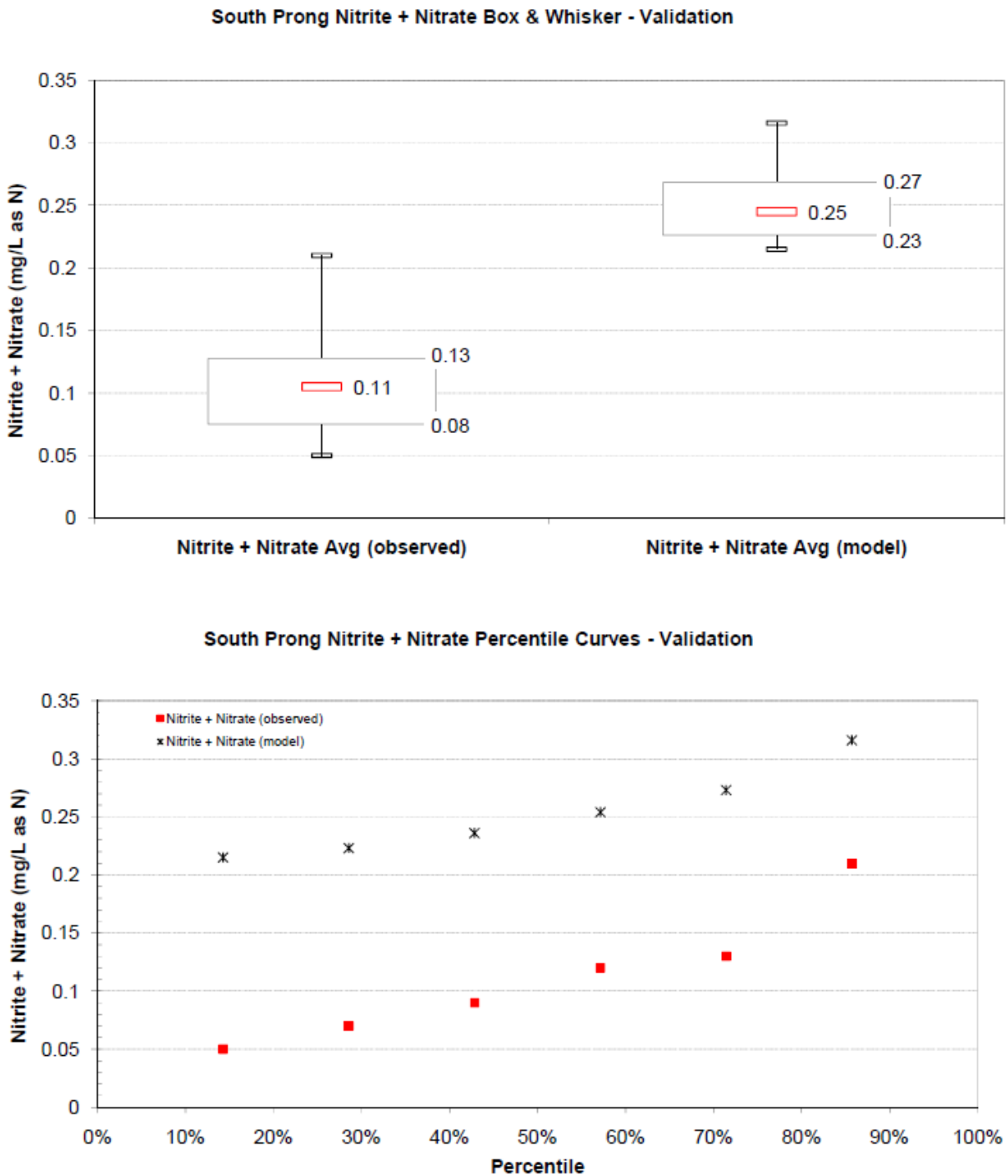


Figure D5-16. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Nitrate Nitrogen in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

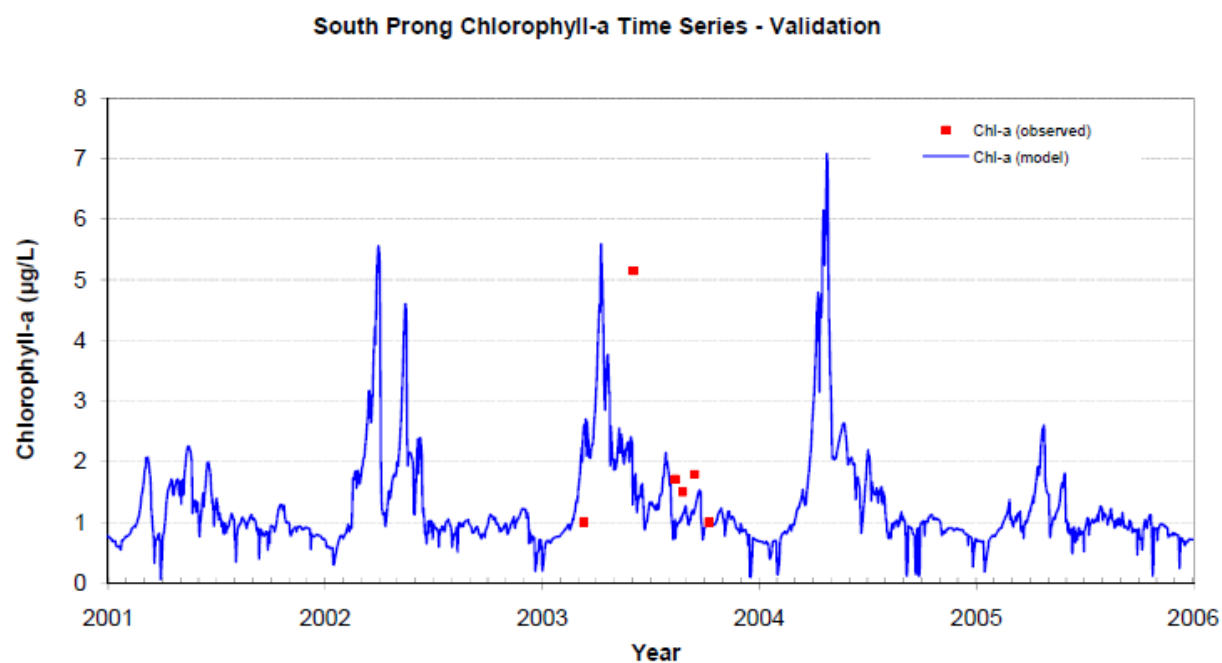


Figure D5-17. Model Simulated and Measured Chlorophyll a for the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

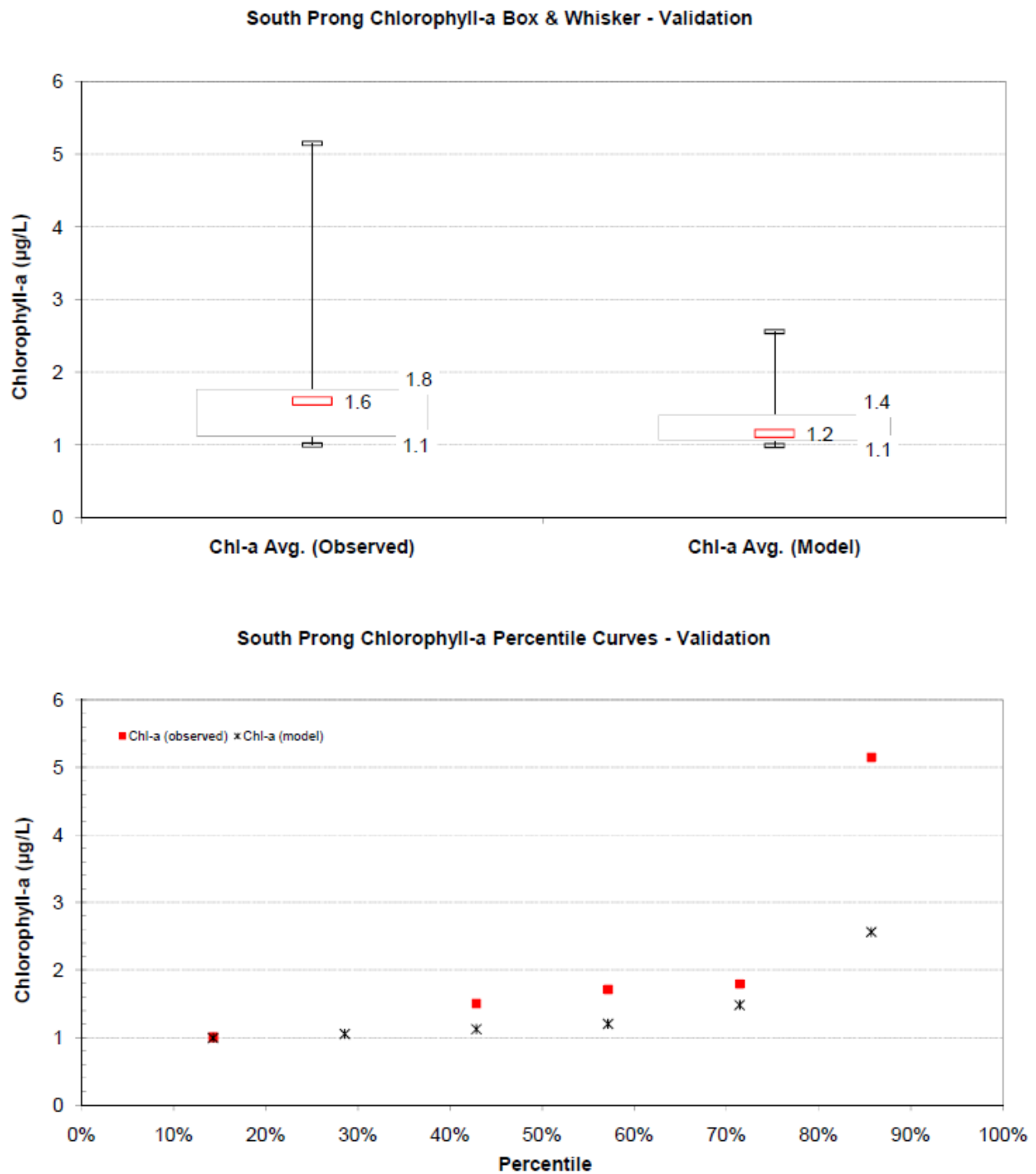


Figure D5-18. Box and Whisker Plot (Top) and Frequency Exceedance Curve (Bottom) of Measured and Model Simulated Chlorophyll a in the South Prong of the Sebastian River in the Validation Period (2001 through 2005)

Appendix E: EFDC Model Parameters and Coefficients

Table E-1. Kinetic Coefficients for Algae

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Maximum growth rate for greens (/day)	N/A	1.75	1.41	1.78	1.60	1.50	1.50	1.41
Basal metabolism rate for greens (/day)	N/A	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Settling velocity for greens (m/day)	N/A	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Predation rate on greens (/day)	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carbon-to-Chla ratio for greens (mg C/mg Chla)	0.065	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrogen-to-carbon (N/C) ratio for greens (g N/g C)	0.167	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant 1 used in determining algae C:P ratio (g C/ g P)	42	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant 2 used in determining algae C: P ratio (g C/g P)	85	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant 3 used in determining algae C:P ratio (g C/g P)	200	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oxygen-to-carbon ratio (g O ₂ /g C)	2.67	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oxygen-to-Nitrogen (NO ₃) ratio (g O ₂ /g N)	4.33	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrogen half-saturation constant for greens (mg P/L)	0.010	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Phosphorus half-saturation constant for greens (mg P/L)	0.001	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Suboptimal temperature coefficient for growth	0.02	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Superoptimal temperature coefficient for growth	0.01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lower optimal temperature for growth (deg-C)	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper optimal temperature for growth (deg-C)	27	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reference temperature for basal metabolism (Deg-C)	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temperature coefficient for basal metabolism	0.069	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Optimal depth for growth (meters)	1.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: not applicable

Table E-2. Light Attenuation Coefficients

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Background light extinction coefficient (1/m)	N/A	0.48	0.61	0.42	0.4	0.32	0.32	0.42
Light extinction due to TSS (1/m per mg/L)	0.52	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Light extinction due to chlorophyll a (1/m per mg/L)	0.031	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Light extinction due to POC (1/m per mg/L)	0.078	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Photosynthetic fraction of incident light (PAR)	0.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: not applicable

Table E-3. Kinetic Coefficients for Organic Carbon

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Algae predation, carbon fraction to RPOC	0.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algae predation, carbon fraction to LPOC	0.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algae predation, carbon fraction to DOC	0.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of basal metabolism excreted as DOC greens	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oxygen half-saturation constant for algae DOC excretion, greens (g O ₂ /m ³)	0.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum dissolution rate of RPOC (/day)	0.005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum dissolution rate of LPOC (/day)	0.075	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum heterotrophic respiration rate of DOC (/day)	0.01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating RPOC dissolution rate to total Chla	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating LPOC dissolution rate to total Chla	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating DOC dissolution rate to total Chla	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reference temperature for dissolution (degC)	20.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reference temperature for mineralization (degC)	20.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temperature effect coefficient for dissolution	0.069	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temperature effect coefficient for mineralization	0.069	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Half-saturation constant for denitrification (g N/M ³)	0.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ratio of denitrification rate to oxic DOC respiration rate	0.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Settling velocity for PROC (m/day)	N/A	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Settling velocity for LPOC (m/day)	N/A	0.10	0.10	0.10	0.10	0.10	0.10	0.10

N/A: not applicable

Table E-4. Kinetic Coefficients for Organic Phosphorus

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Algae predation, phosphorus fraction to RPOP	0.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algae predation, phosphorus fraction to LPOP	0.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algae predation, phosphorus fraction to DOP	0.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized phosphorus produced as RPOP, greens	0.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized phosphorus produced as LPOP	0.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized phosphorus produced as DOP	0.75	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum hydrolysis rate of RPOP (/day)	0.005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum hydrolysis rate of LPOP (/day)	0.075	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum hydrolysis rate of DOP (/day)	0.04	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating hydrolysis rate of RPOP to algae	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating hydrolysis rate of LPOP to algae	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating hydrolysis rate of DOP to algae	0.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Settling velocity for RPOP (m/day)	N/A	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Settling velocity for LPOP (m/day)	N/A	0.10	0.10	0.10	0.10	0.10	0.10	0.10

N/A: not applicable

Table E-5. Kinetic Coefficients for Total Phosphate

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Algae predation, phosphorus fraction to inorganic-P	0.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized phosphorus produced as PO ₄ , greens	0.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Partition coefficient for sorbed/dissolved PO ₄ (to TSS or TAM)	0.04	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: not applicable

Table E-6. Kinetic Coefficients for Organic Nitrogen

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Algae predation, nitrogen fraction to RPON	0.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algae predation, nitrogen fraction to LPON	0.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algae predation, nitrogen fraction to DON	0.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized nitrogen produced as RPON, greens	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized nitrogen produced as LPON	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized nitrogen produced as DON	1.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum hydrolysis rate of RPON (/day)	0.005	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum hydrolysis rate of LPON (/day)	0.075	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Minimum hydrolysis rate of DON (/day)	0.002	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating hydrolysis rate of RPON to algae	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating hydrolysis rate of LPON to algae	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constant relating hydrolysis rate of DON to algae	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Settling velocity for PRON (m/day)	N/A	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Settling velocity for LPON (m/day)	N/A	0.10	0.10	0.10	0.10	0.10	0.10	0.10

N/A: not applicable

Table E-7. Kinetic Coefficients for Ammonia and Nitrate/Nitrate

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Algae predation, nitrogen fraction to DIN	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fraction of metabolized nitrogen produced as DIN, greens	0.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mass NO ₃ reduces per DOC oxidized (gN/gC)	0.933	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maximum nitrification rate (g N/m ³ /day)	0.01	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oxygen half-saturation constant for nitrification (gO ₂ /m ³)	1.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NH ₄ half-saturation constant for nitrification (gN/m ³)	1.00							
Reference temperature for nitrification (degC)	27.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Suboptimal temperature coefficient for nitrification	0.0045	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Superoptimal temperature coefficient for nitrification	0.0045	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: not applicable

Table E-8. Kinetic Coefficients for Chemical Oxygen Demand

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Oxygen half-saturation constant for COD decay (mg/L O ₂)	1.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A
COD decay rate (/day)	0.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reference temperature for COD decay (degC)	20.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temperature rate constant for COD decay	0.041	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: not applicable

Table E-9. Kinetic Coefficients for Dissolved Oxygen

Kinetic Coefficient	Zones							
	Global	1	2	3	4	5	6	7
Reaeration constant (3.933 for O'Connor-Dobbins; 5.32 for Owen Gibbs)	1.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temperature rate constant for reaeration	1.024	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: not applicable

Appendix F: EFDC Model Hydrodynamic Calibration and Validation

Main Stem EFDC Model Hydrodynamic Calibration and Validation

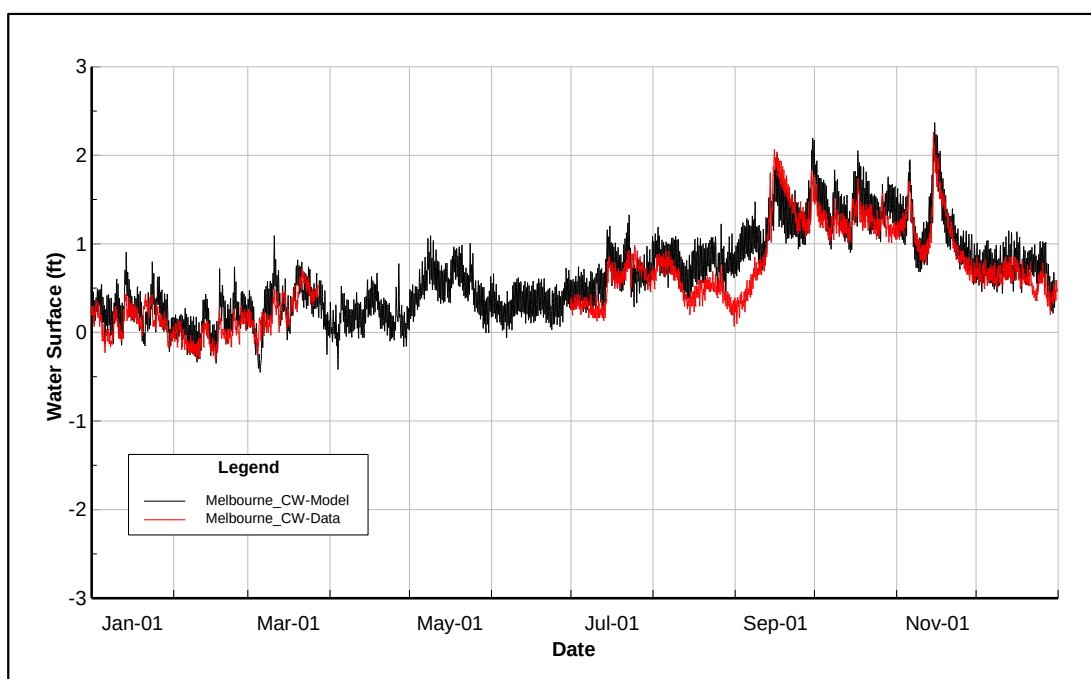
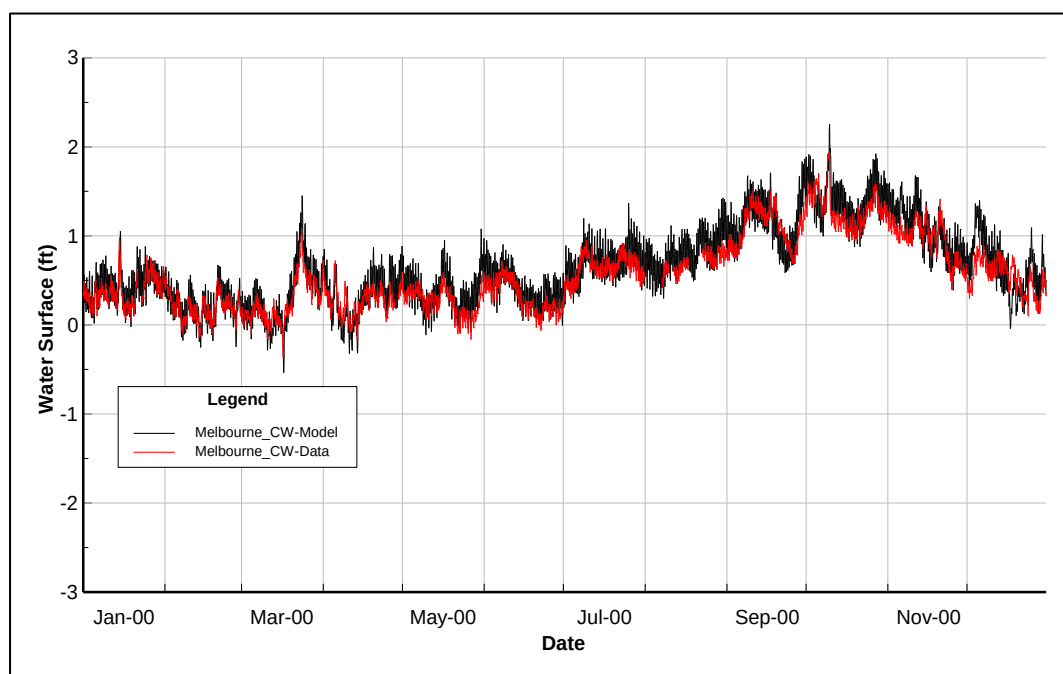


Figure F1-a. Water surface elevation calibration data at Melbourne Causeway

Figure F1-b. Water surface elevation validation data at Melbourne Causeway

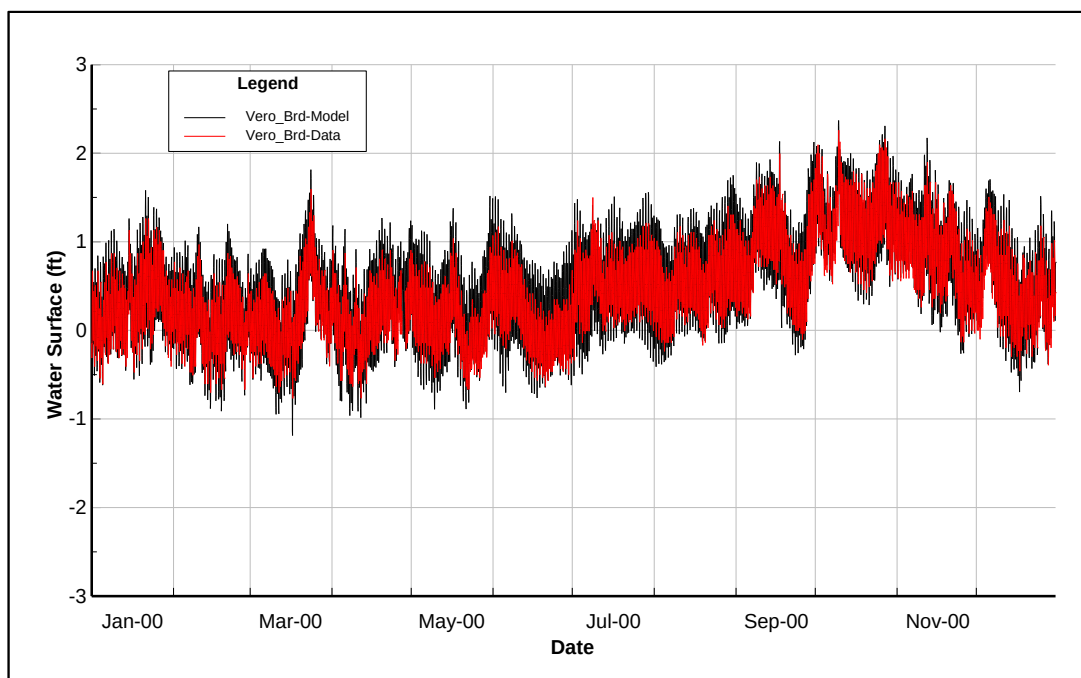


Figure F2-a. Water surface elevation calibration data at Vero Bridge

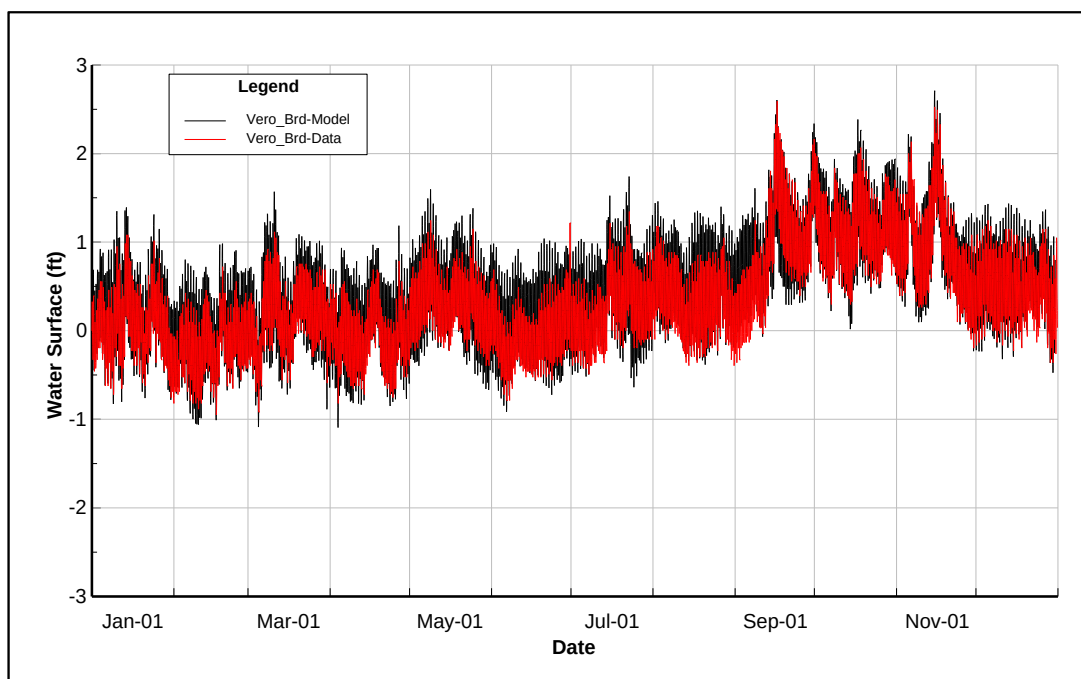


Figure F2-b. Water surface elevation validation data at Vero Bridge

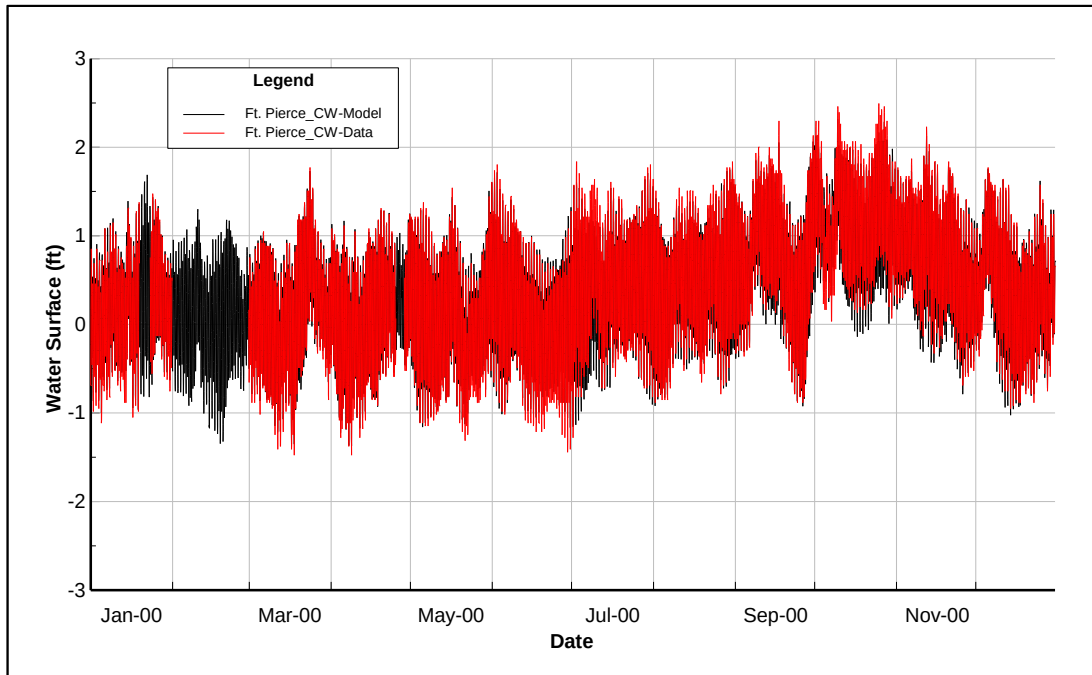


Figure F3-a. Water surface elevation calibration data at Fort Pierce Causeway

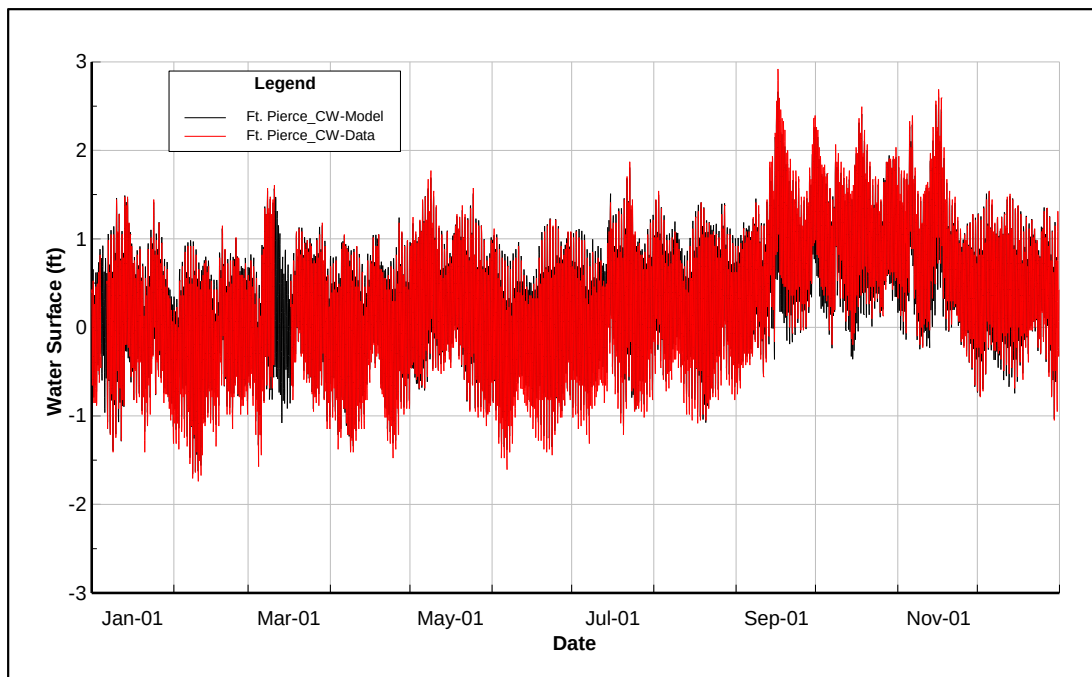


Figure F3-b. Water surface elevation validation data at Fort Pierce Causeway

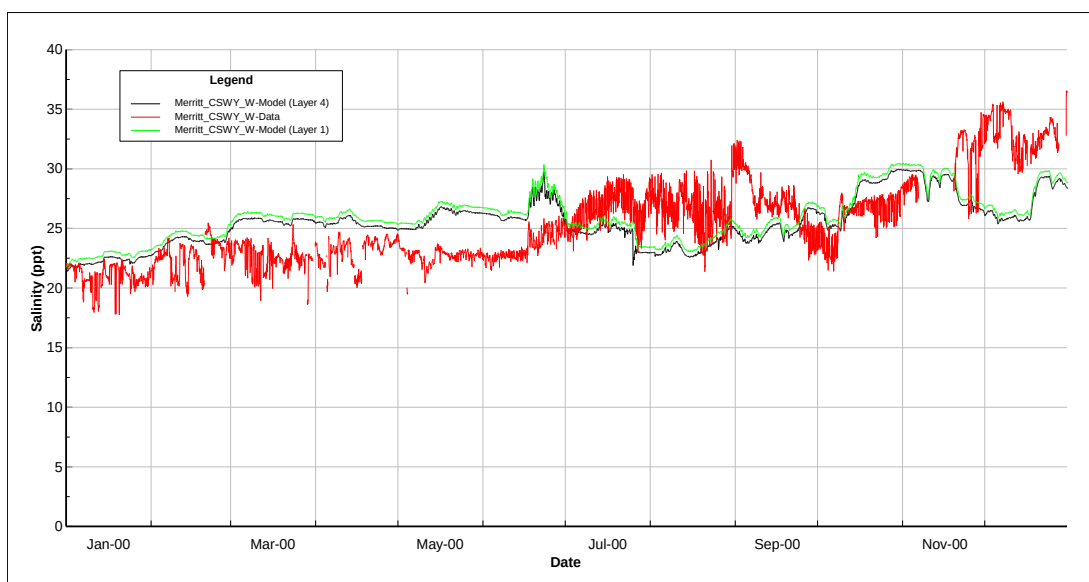


Figure F4-a. Salinity calibration data at Merritt Causeway



Figure F4-b. Salinity validation data at Merritt Causeway

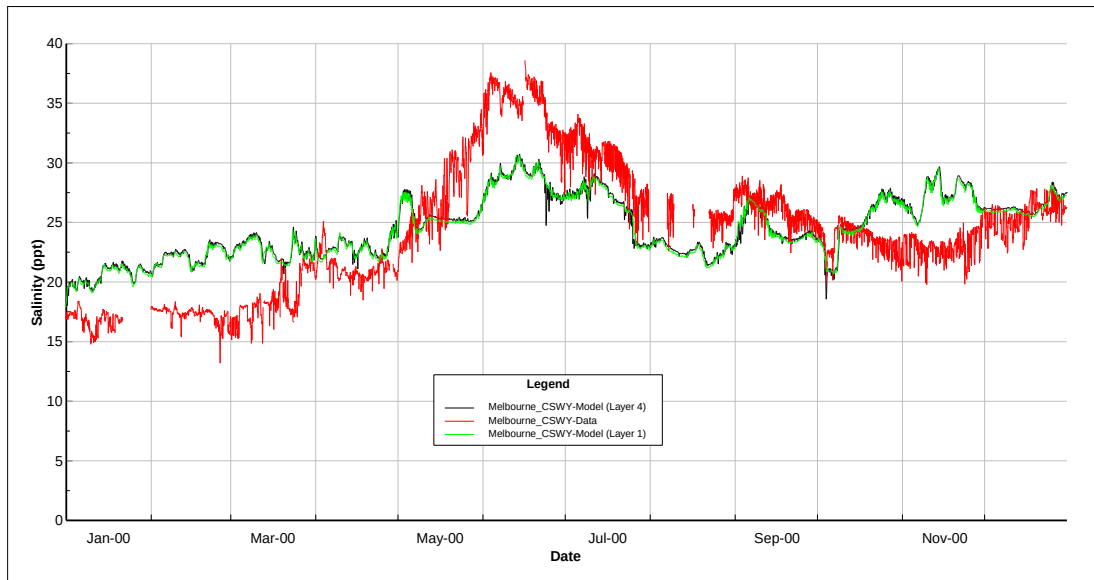


Figure F5-a. Salinity calibration data at Melbourne Causeway



Figure F5-b. Salinity validation data at Melbourne Causeway

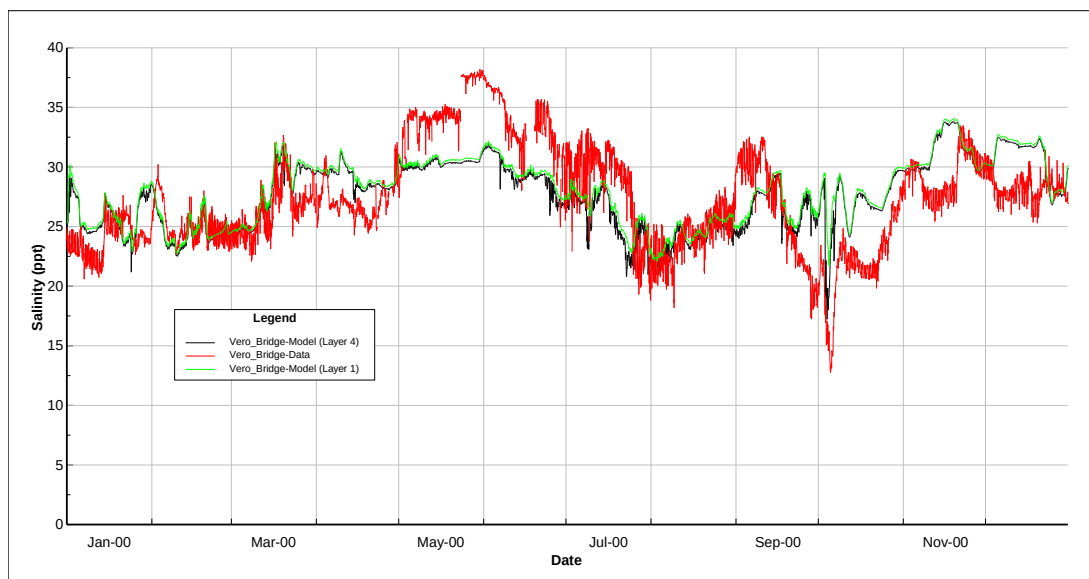


Figure F6-a. Salinity calibration data at Vero Bridge

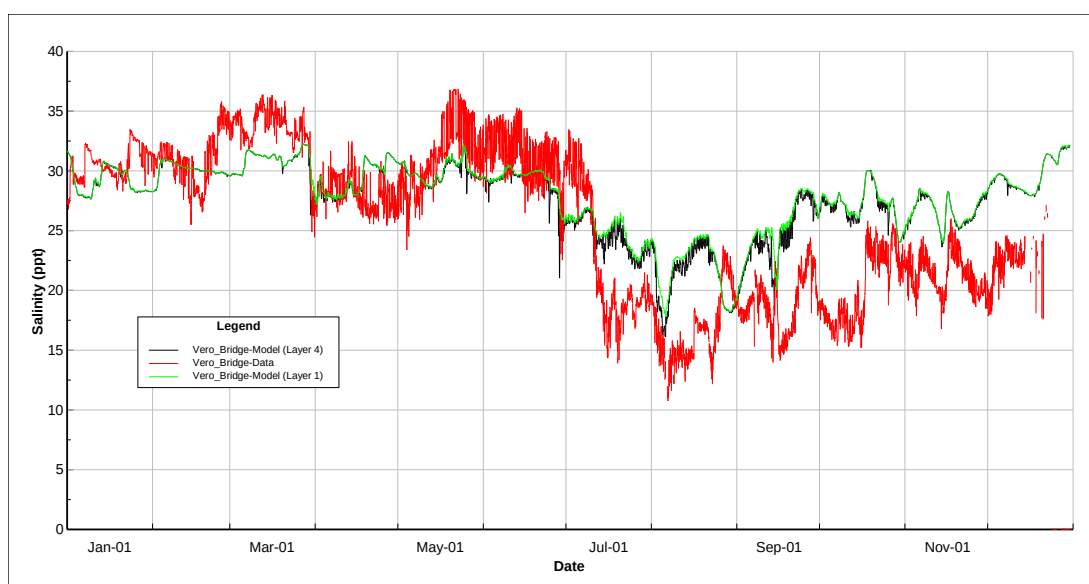


Figure F6-b. Salinity validation data at Vero Bridge

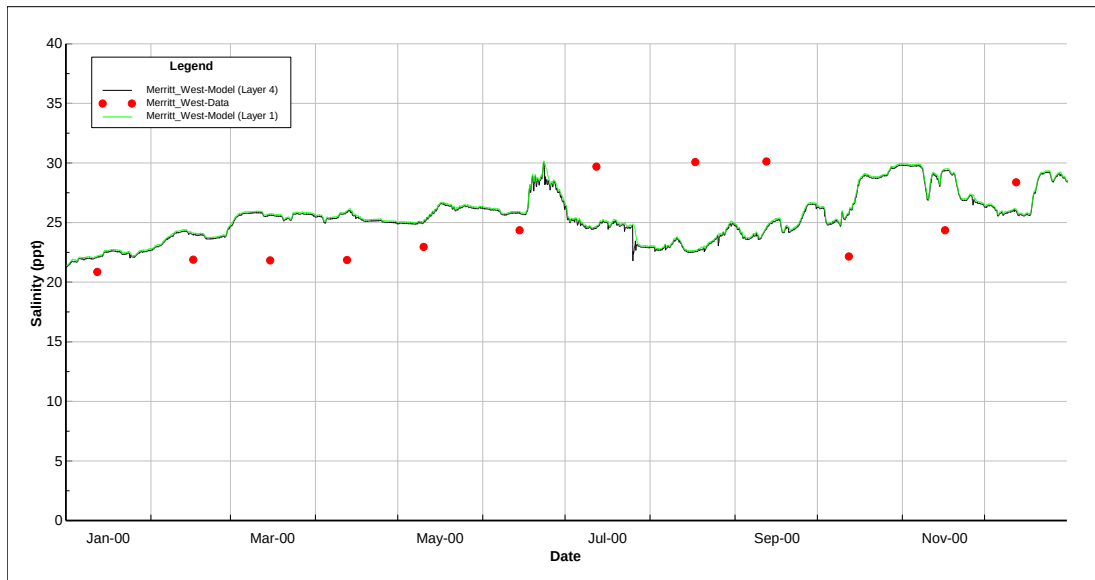


Figure F7-a. Salinity calibration data at Merritt West

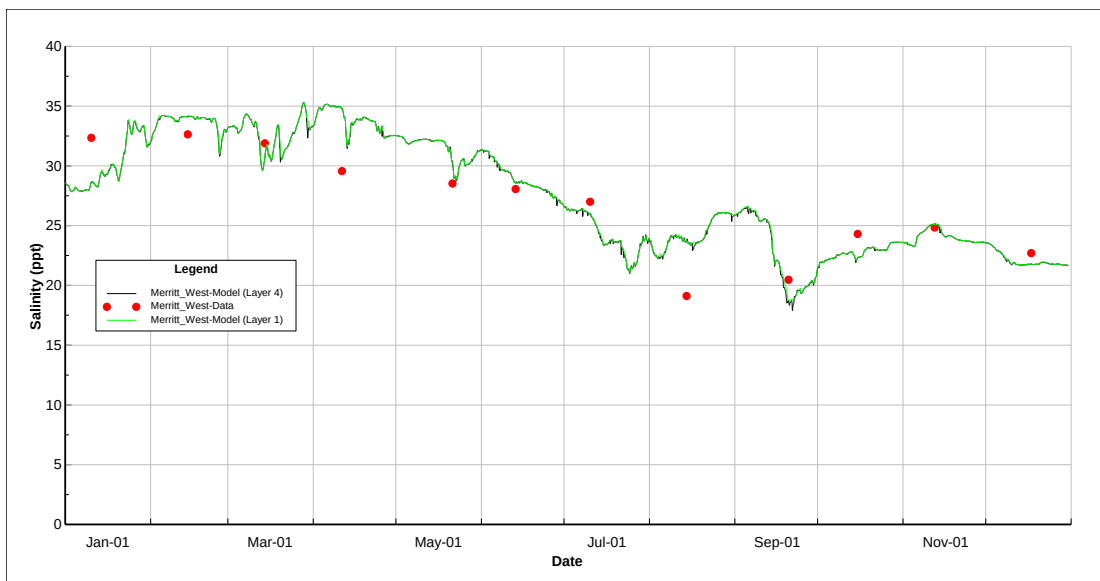


Figure F7-b. Salinity validation data at Merritt West

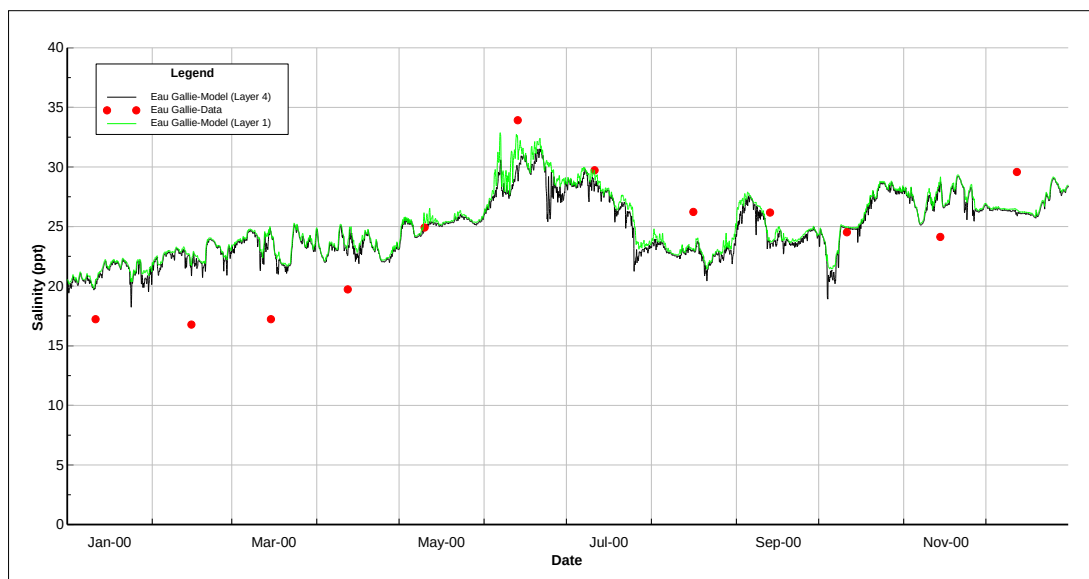


Figure F8-a. Salinity calibration data at Eau Gallie

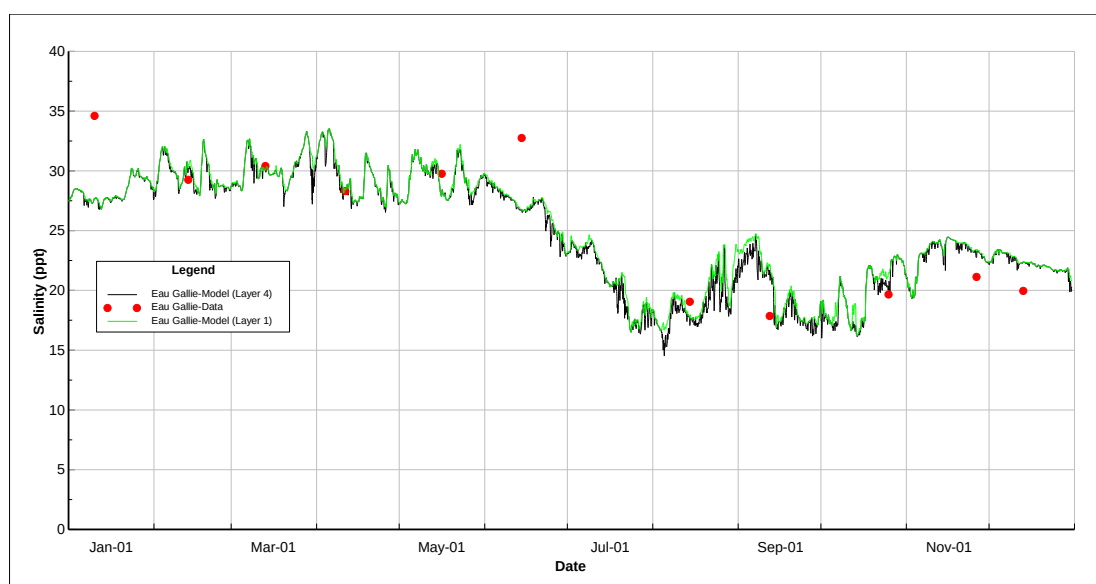


Figure F8-b. Salinity validation data at Eau Gallie

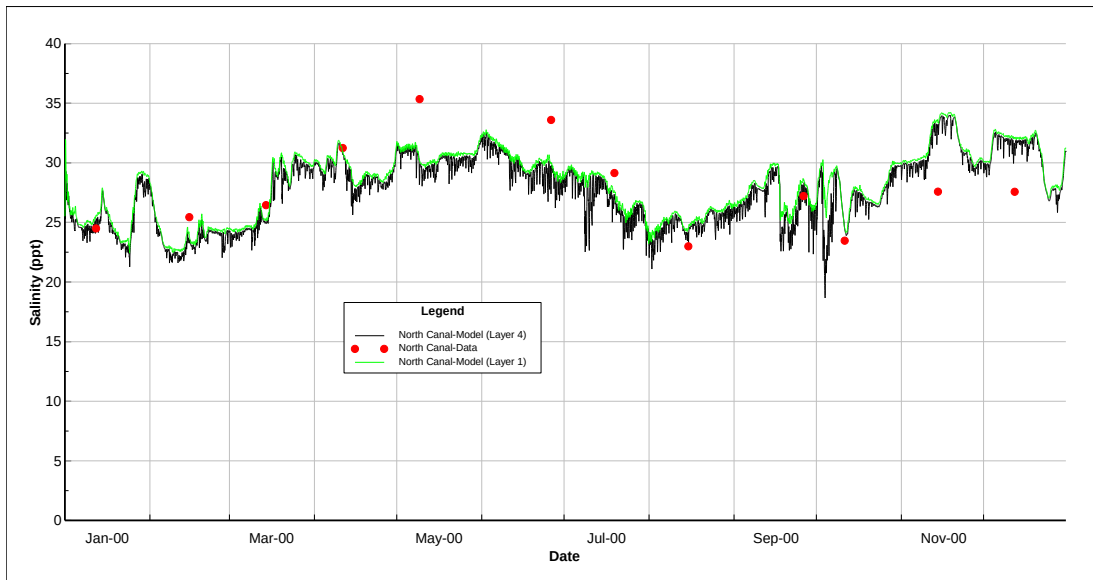


Figure F9-a. Salinity calibration data at North Canal

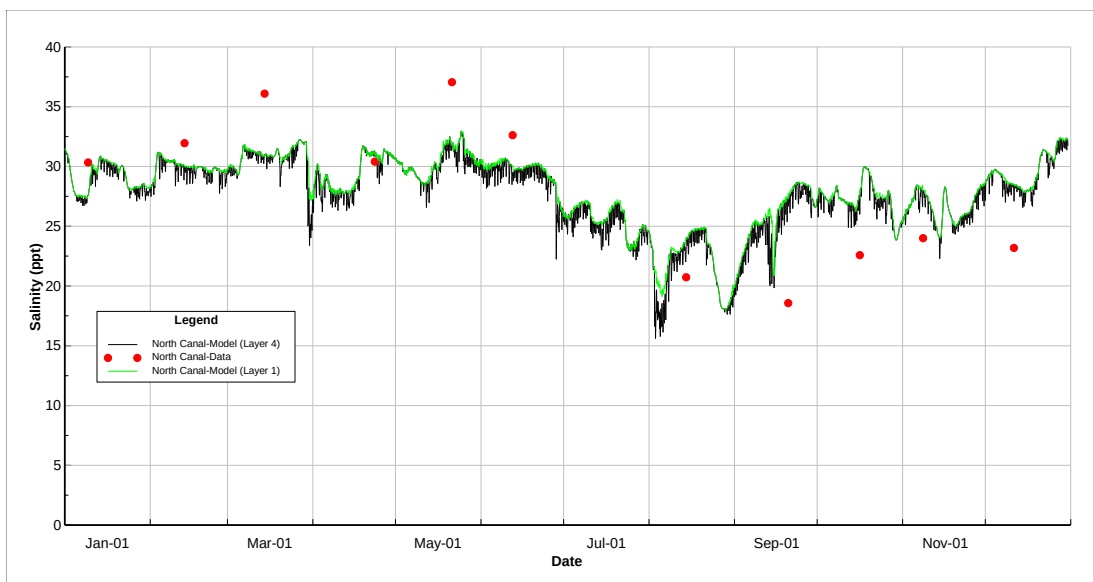


Figure F9-b. Salinity validation data at North Canal

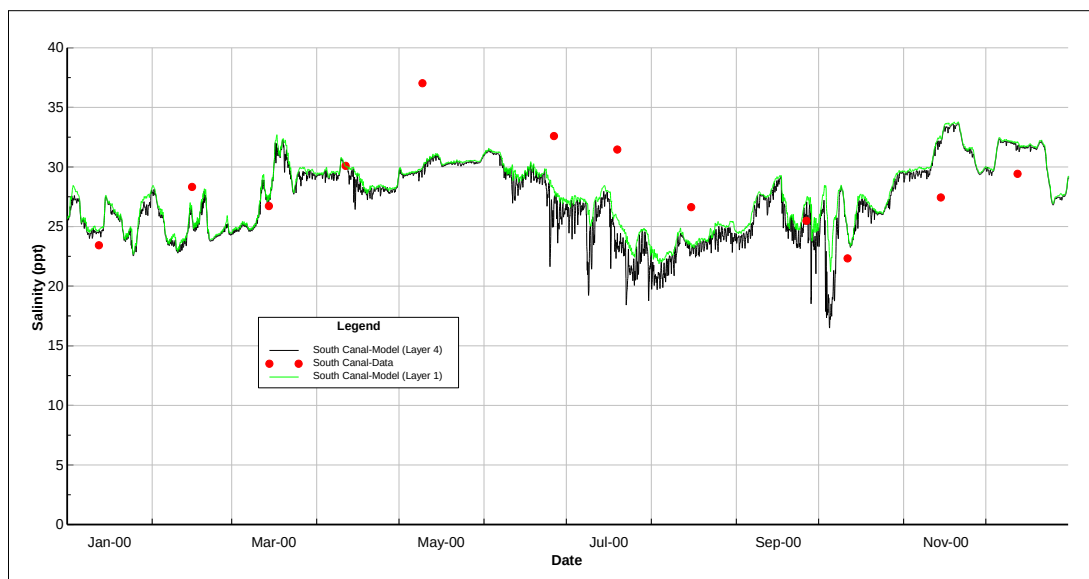


Figure F10-a. Salinity calibration data at South Canal

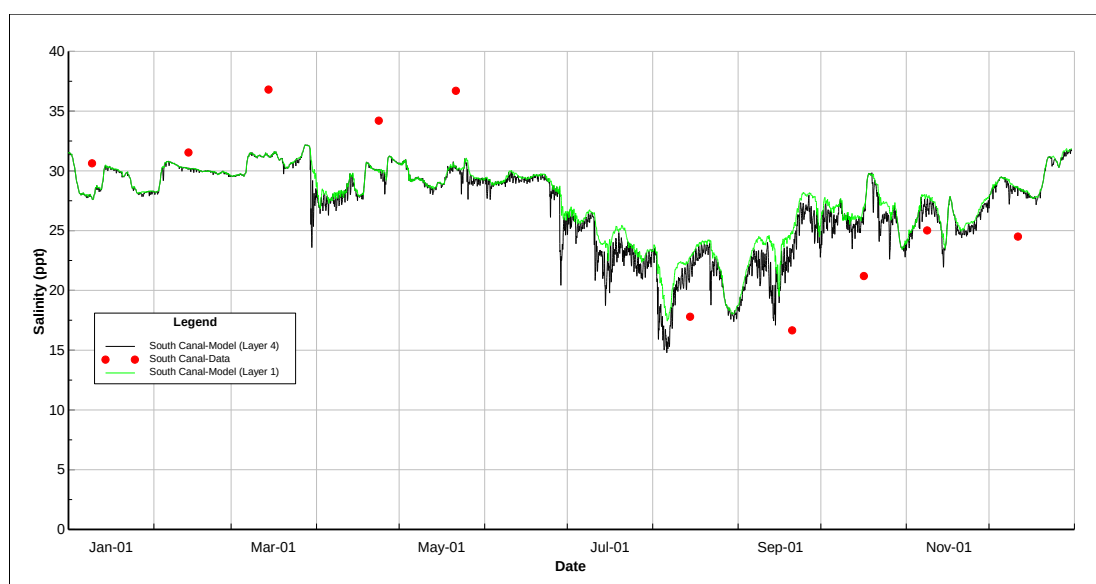


Figure F10-b. Salinity validation data at South Canal

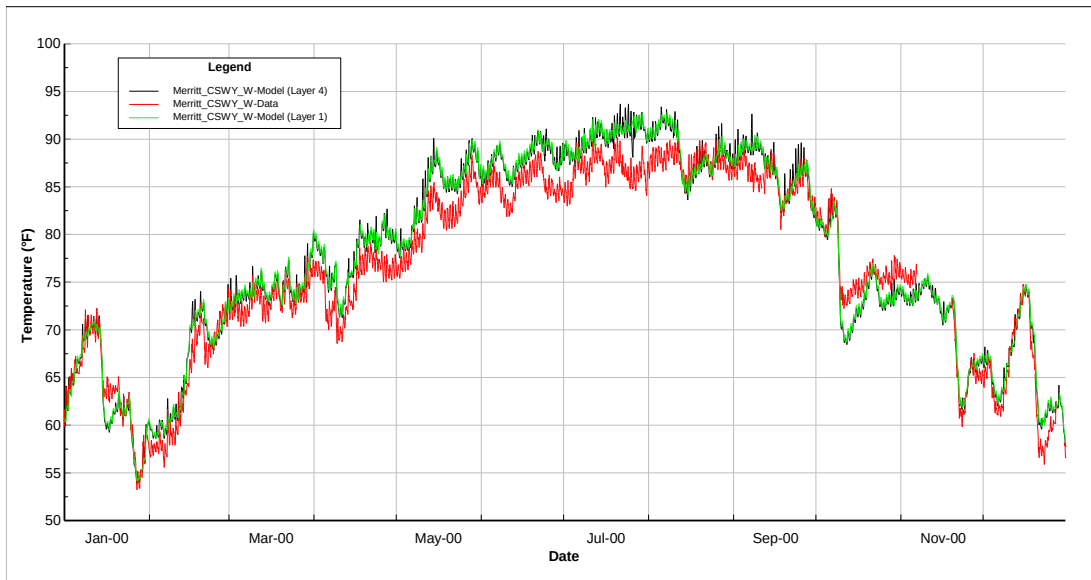


Figure F11-a. Temperature calibration data at Merritt Causeway

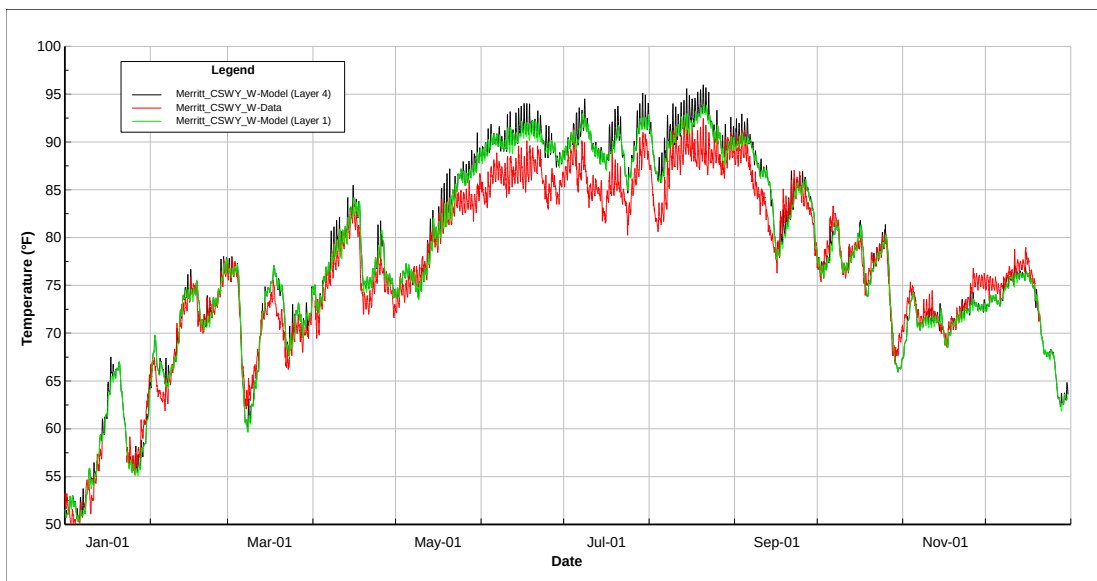


Figure F11-b. Temperature validation data at Merritt Causeway

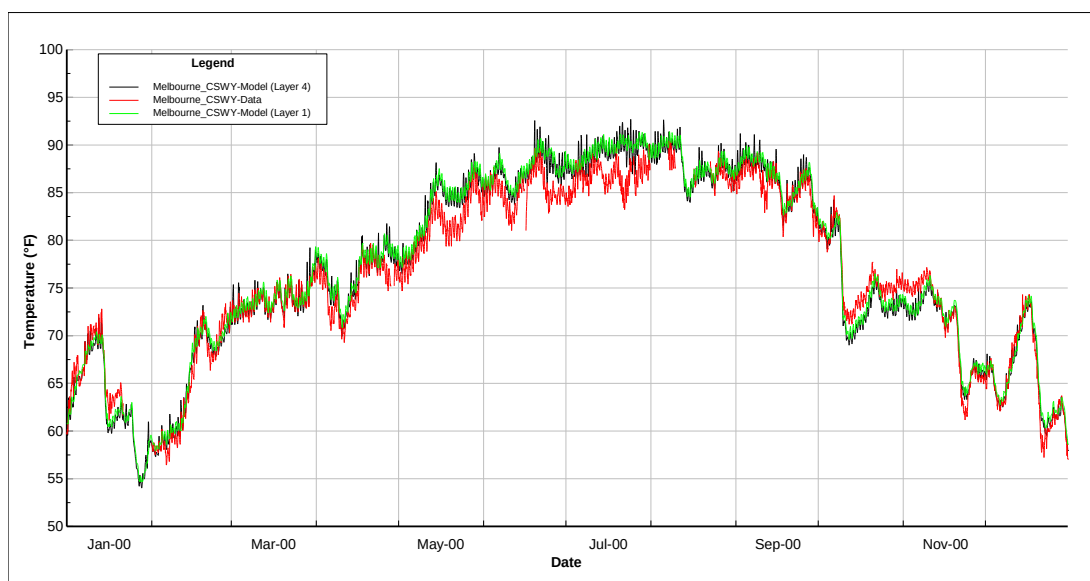


Figure F12-a. Temperature calibration data at Melbourne Causeway

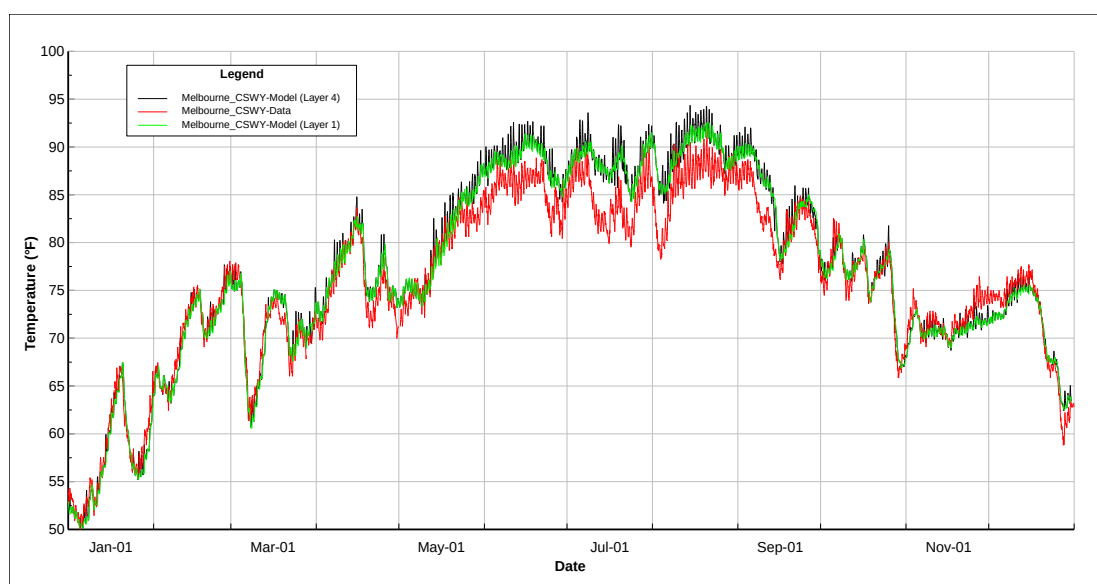


Figure F12-b. Temperature validation data at Melbourne Causeway

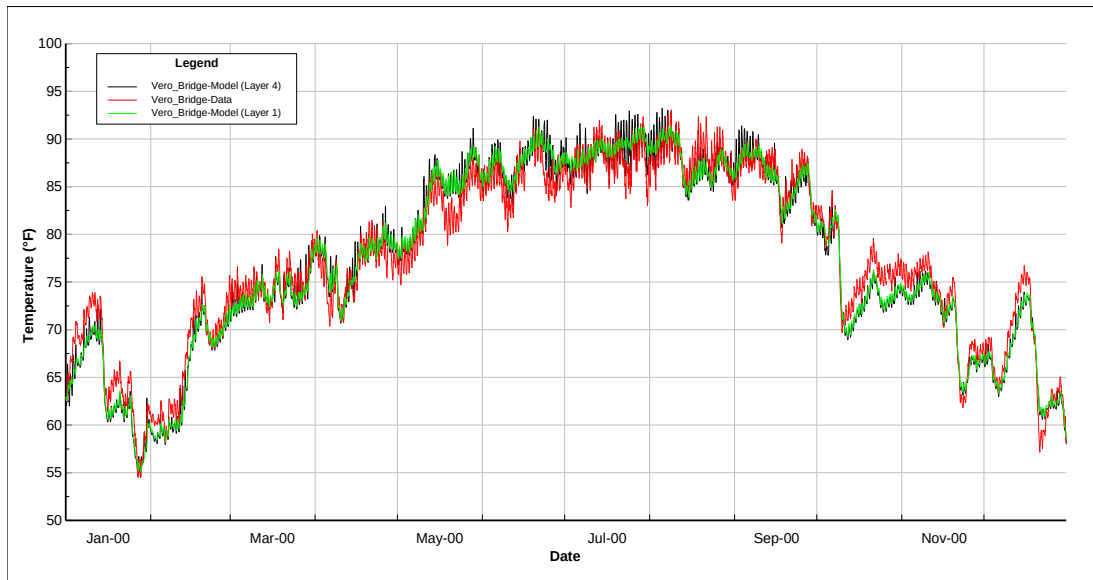


Figure F13-a. Temperature calibration data at Vero Bridge

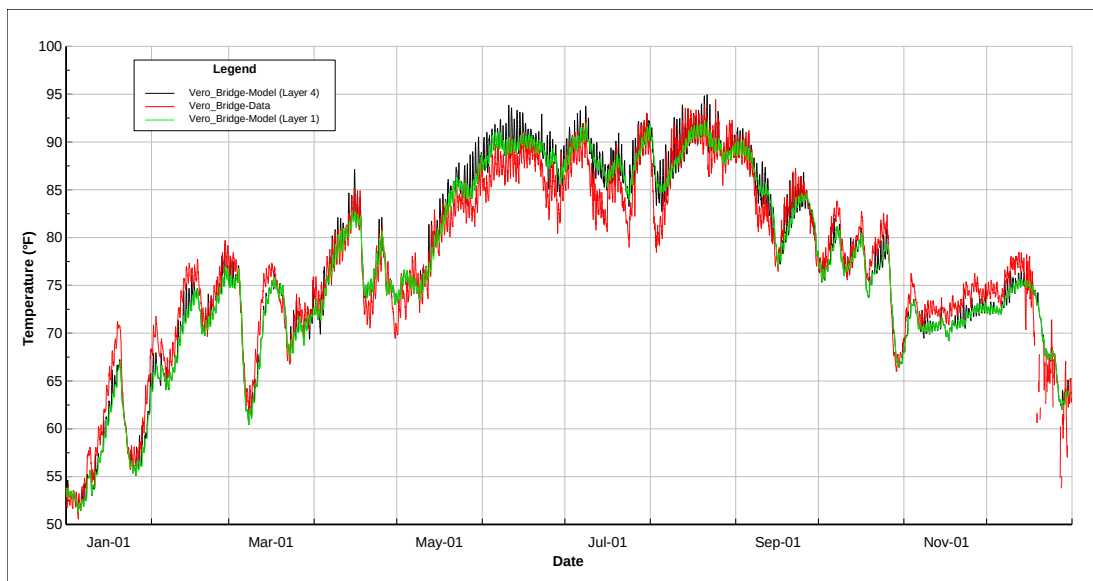


Figure F13-b. Temperature validation data at Vero Bridge

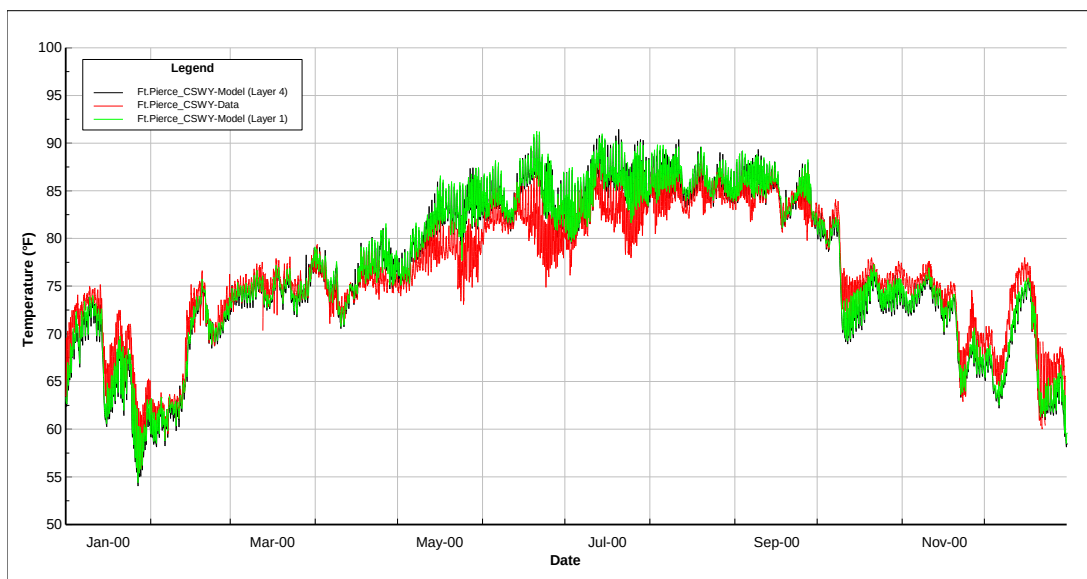


Figure F14-a. Temperature calibration data at Fort Pierce Causeway

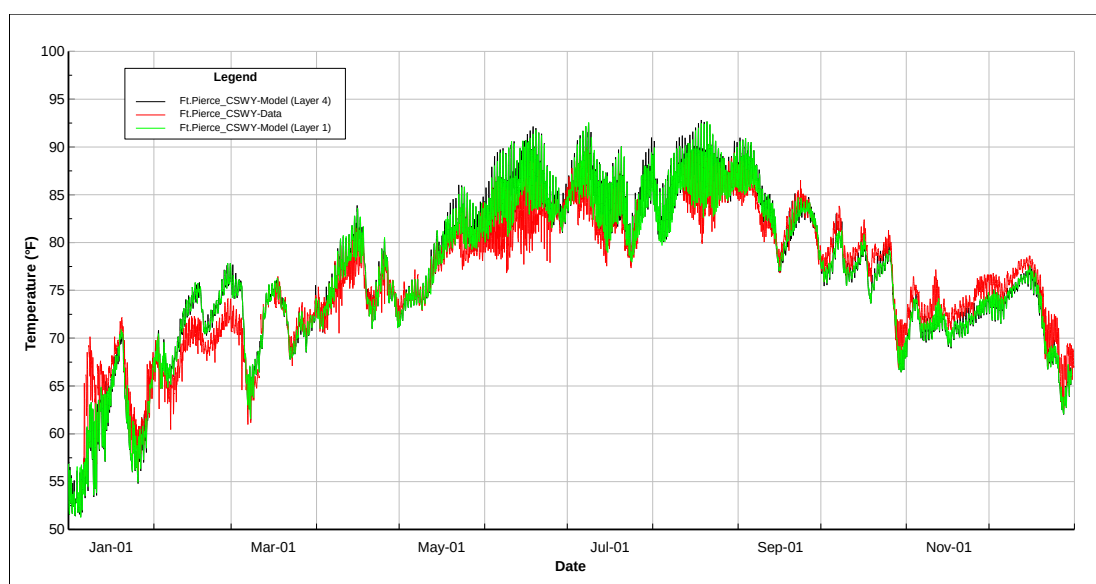


Figure F14-b. Temperature validation data at Fort Pierce Causeway

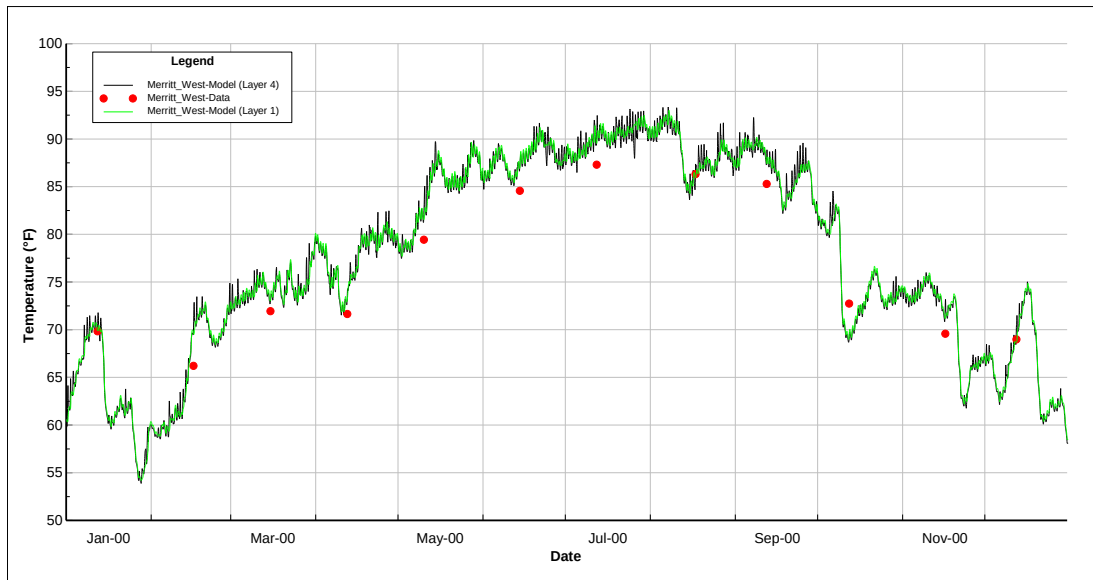


Figure F15-a. Temperature calibration data for Merritt West

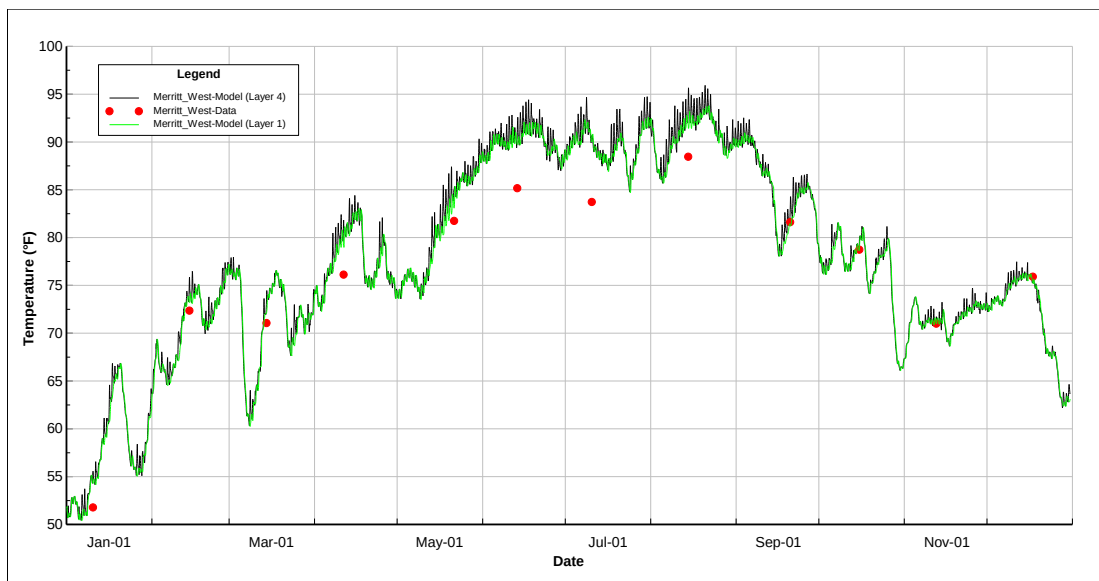


Figure F15-b. Temperature validation data at Merritt West

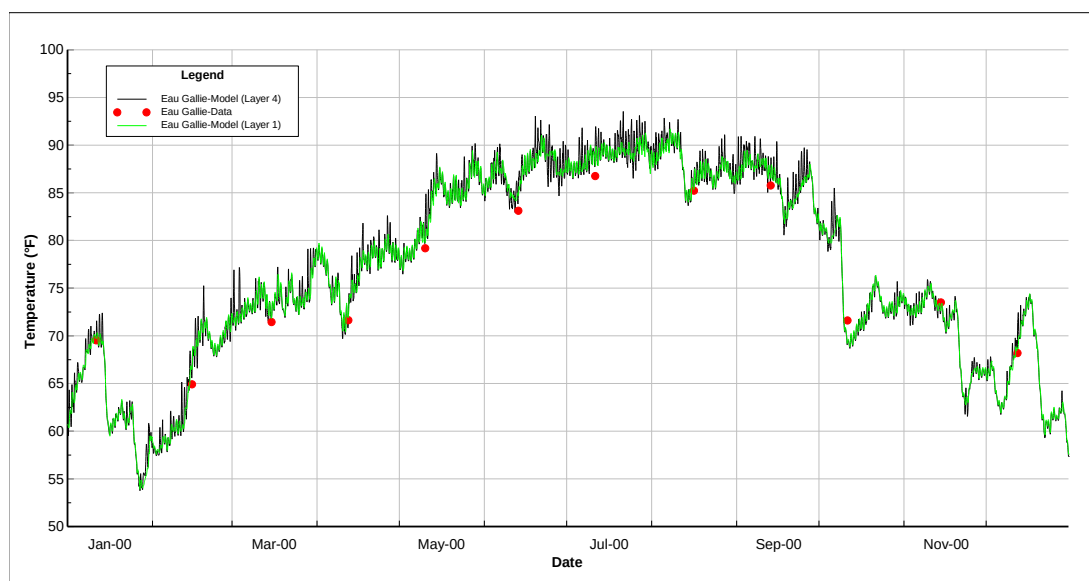


Figure F16-a. Temperature calibration data at Eau Gallie

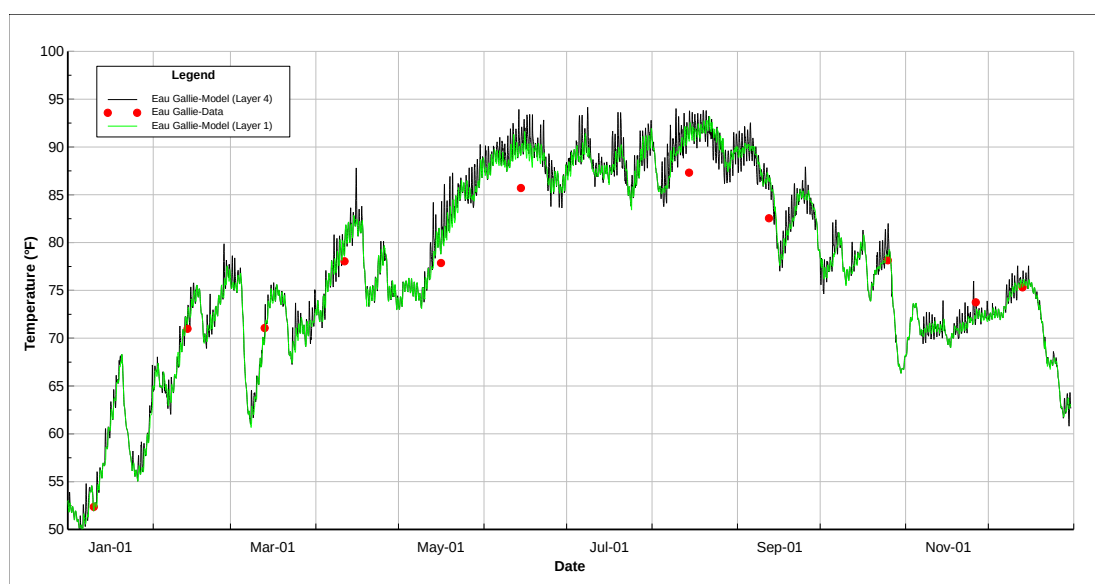


Figure F16-b. Temperature validation data at Eau Gallie

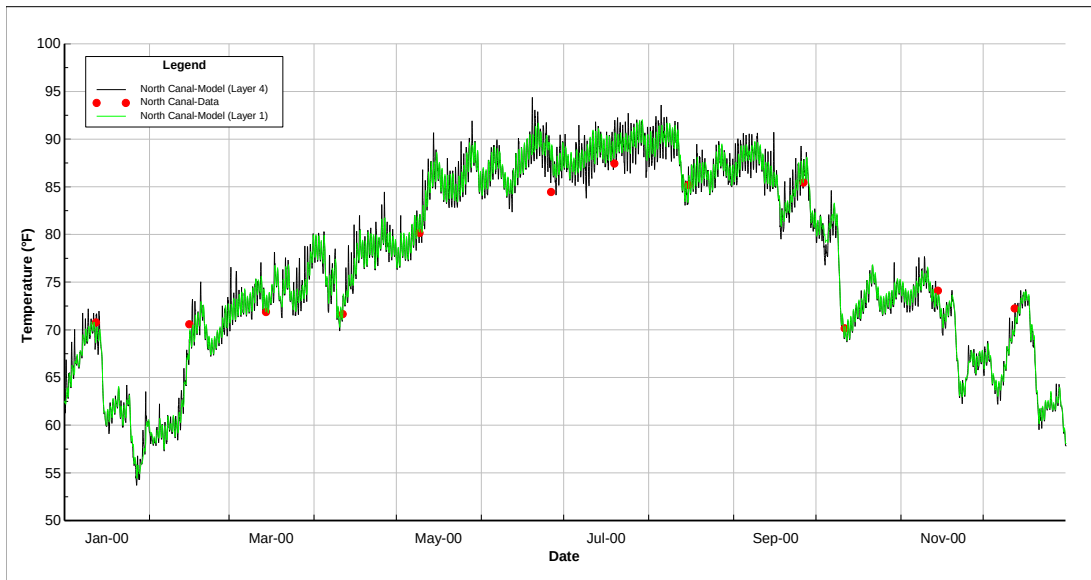


Figure F17-a. Temperature calibration data at North Canal

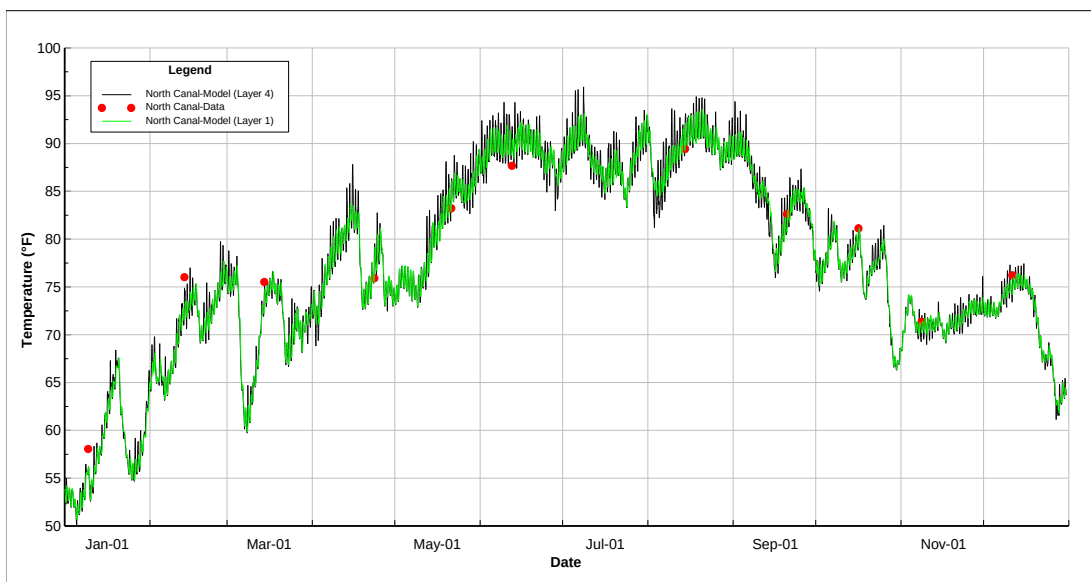


Figure F17-b. Temperature validation data at North Canal

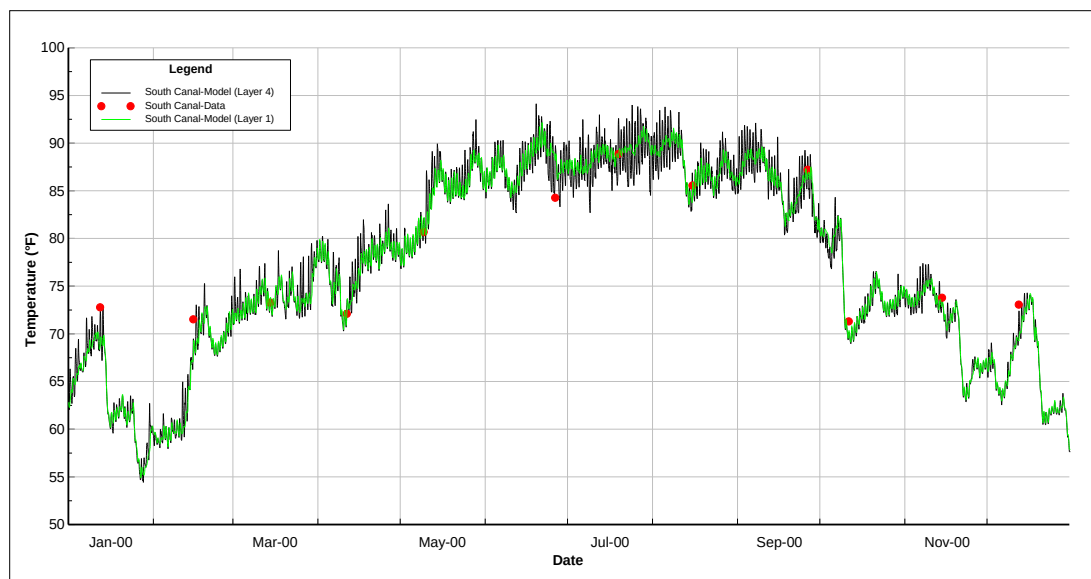


Figure F18-a. Temperature calibration data at South Canal

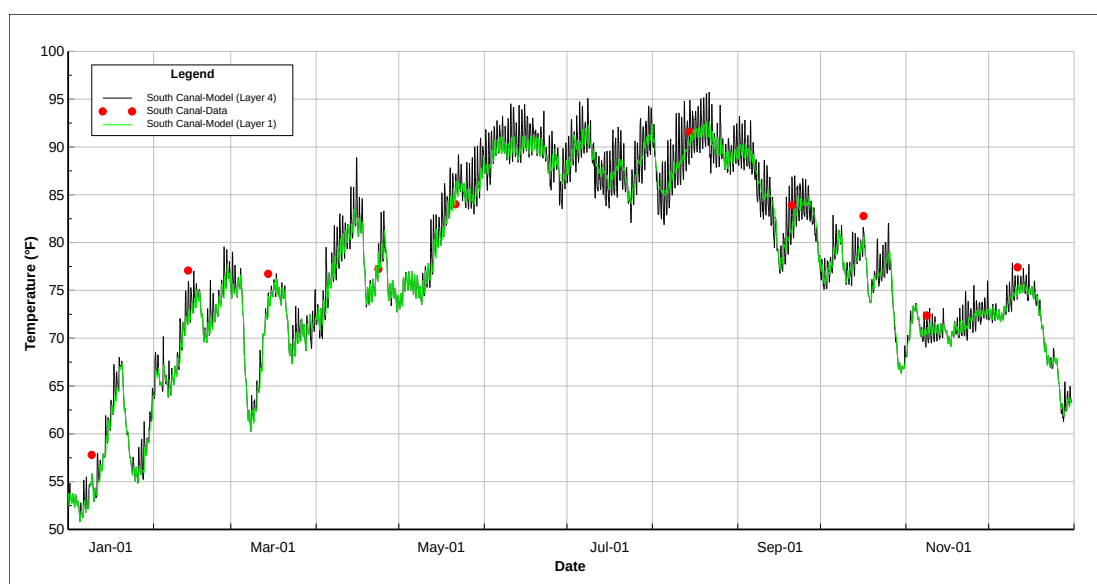


Figure F18-b. Temperature validation data at South Canal

Tributary EFDC Model Hydrodynamic Calibration

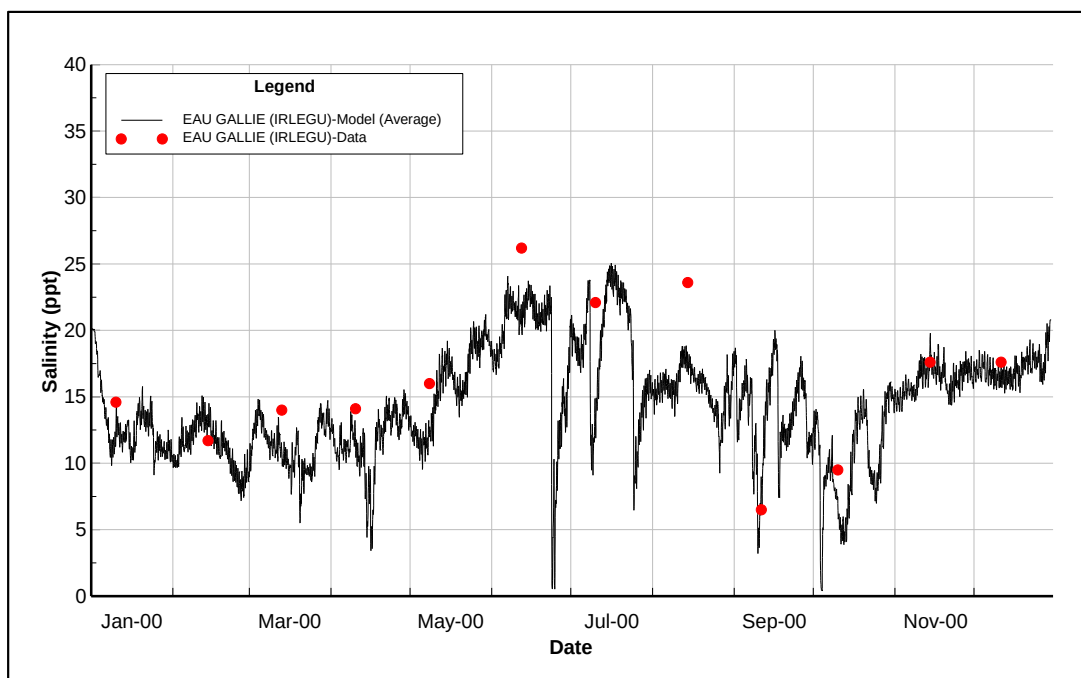


Figure F19-a. Eau Gallie model salinity calibration (Station: IRLEGU)

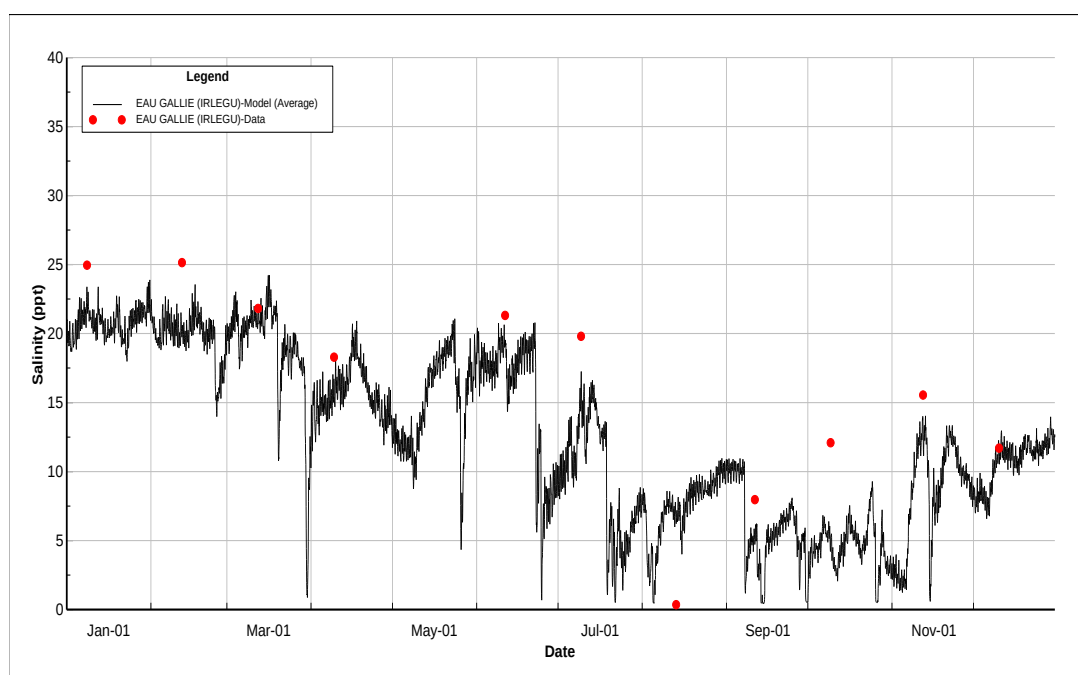


Figure F19-b. Eau Gallie model salinity validation (Station: IRLEGU)

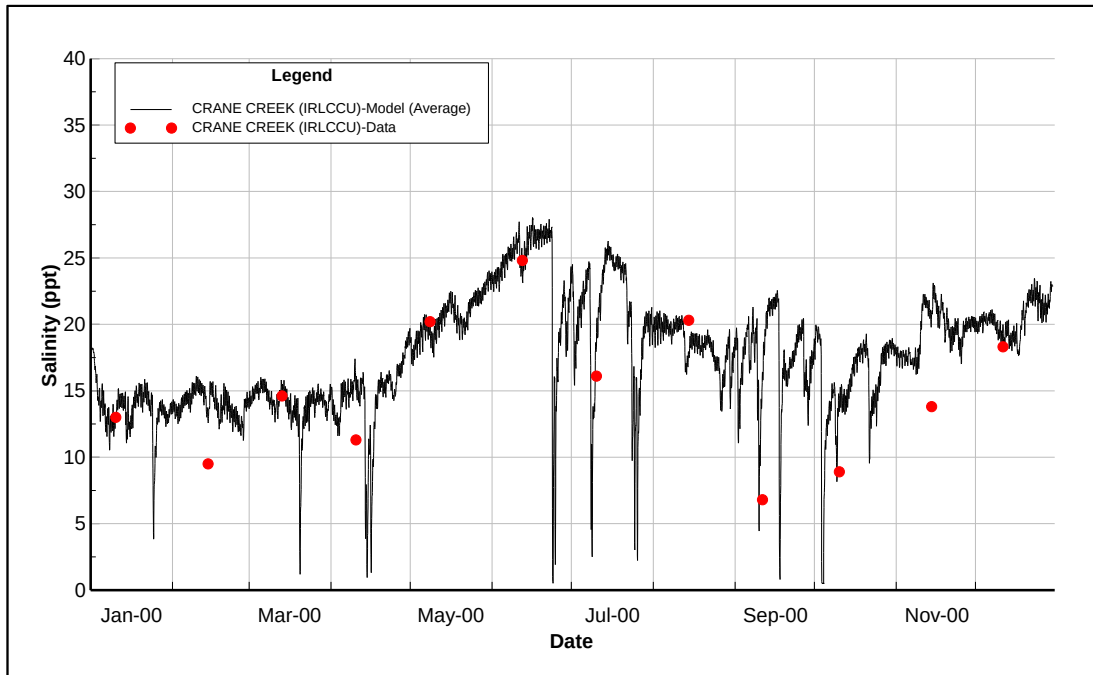


Figure F20-a. Crane Creek model salinity calibration (Station: IRLCCU)

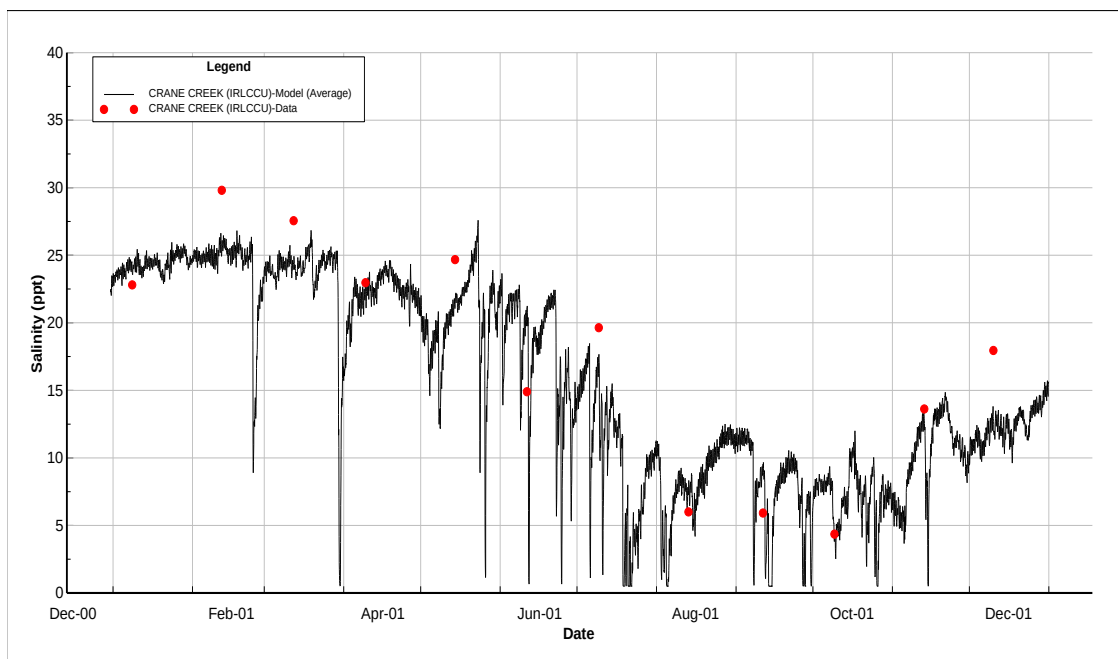


Figure F20-b. Crane Creek model salinity validation (Station: IRLCCU)

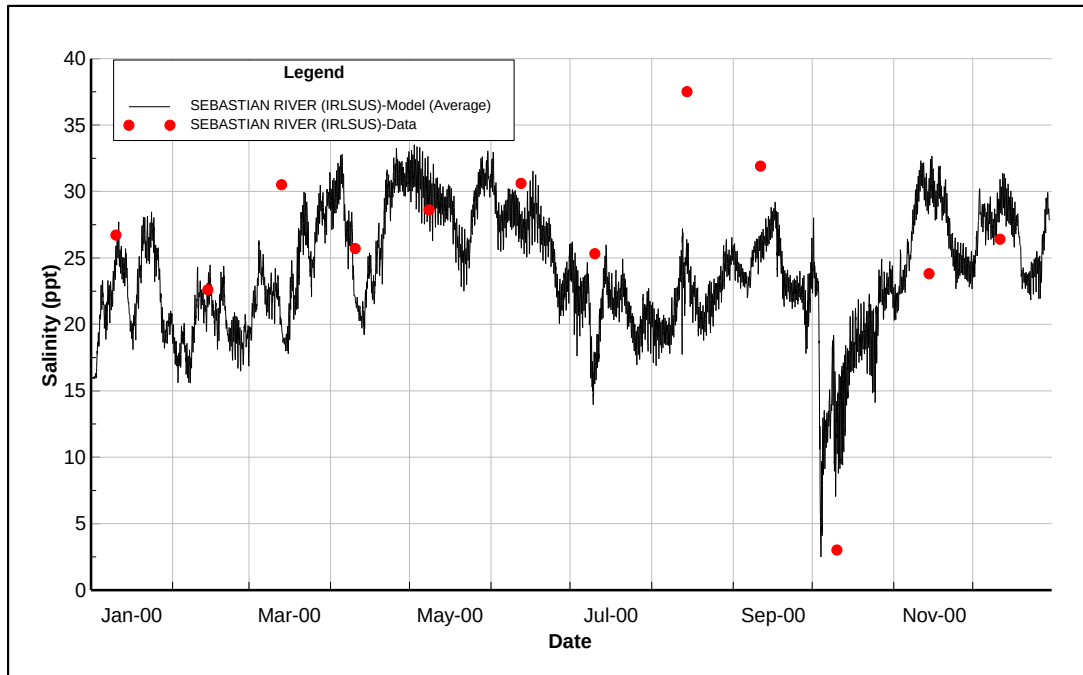


Figure F21-a. Sebastian River model salinity calibration (Station: IRLSUS)

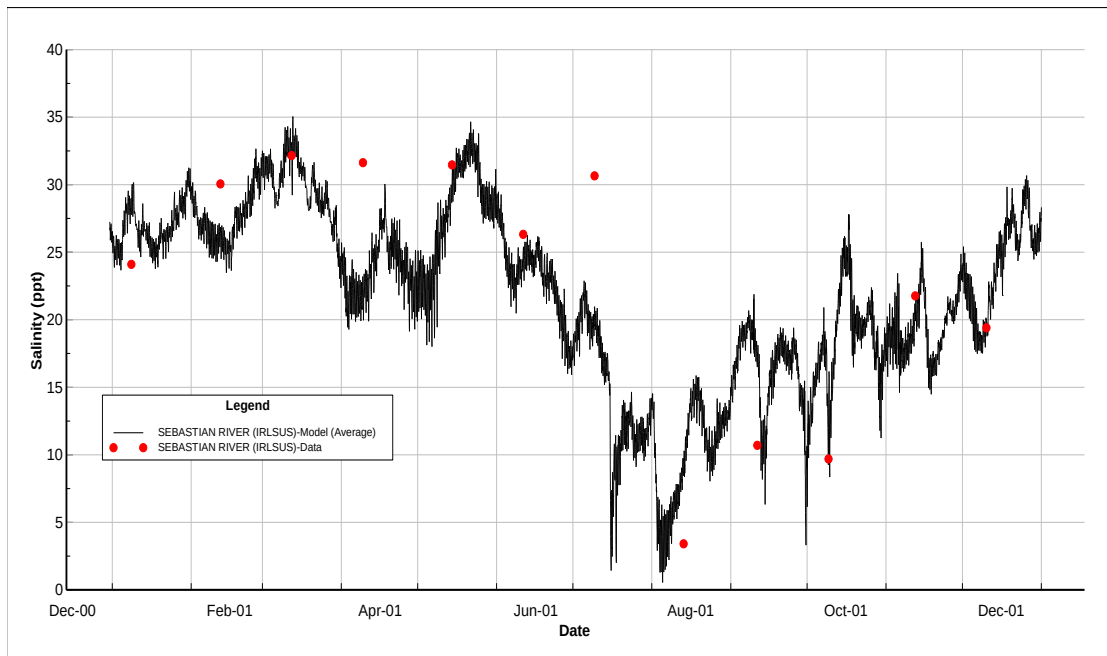


Figure F21-b. Sebastian River model salinity validation (Station: IRLSUS)

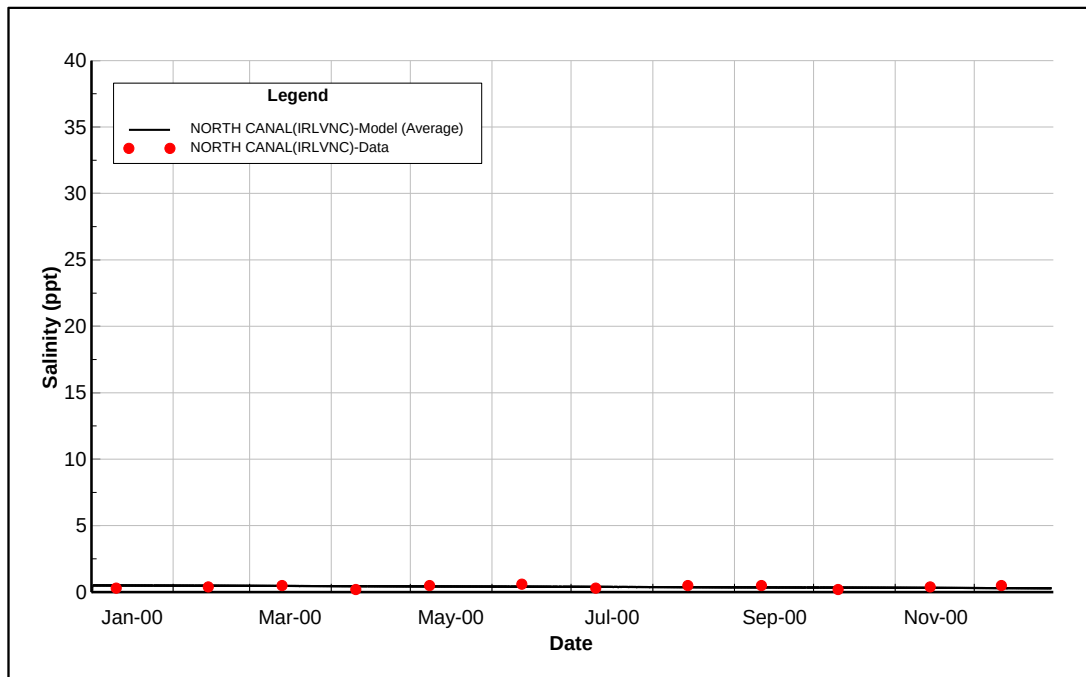


Figure F22-a. North Canal model salinity calibration (Station: IRLVNC)

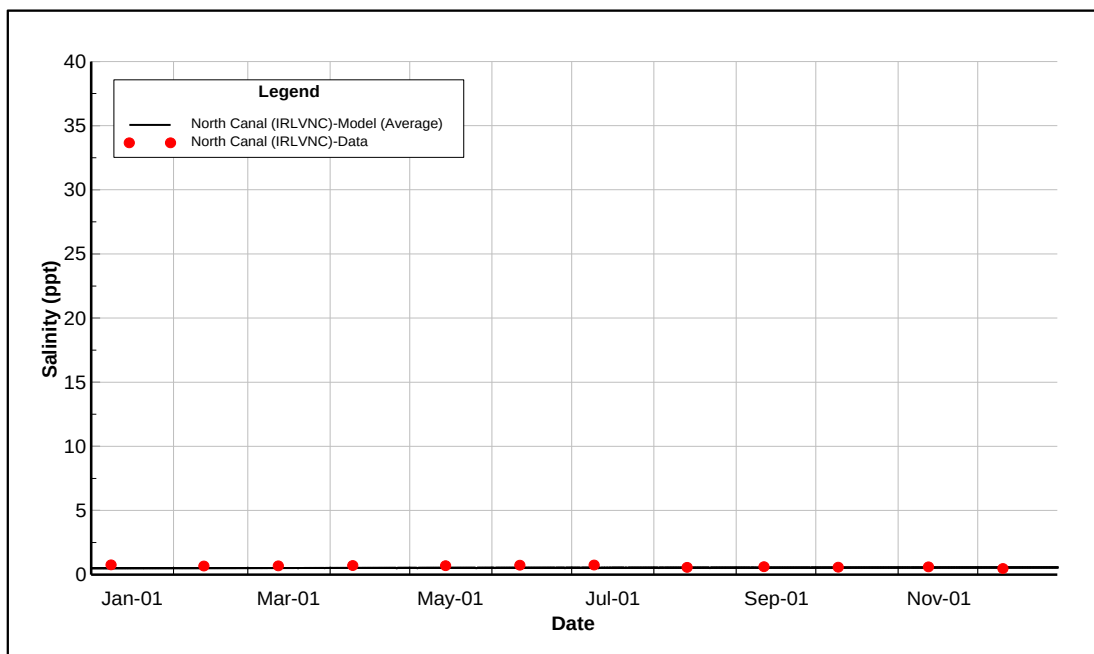


Figure F22-b. North Canal model salinity validation (Station: IRLVNC)

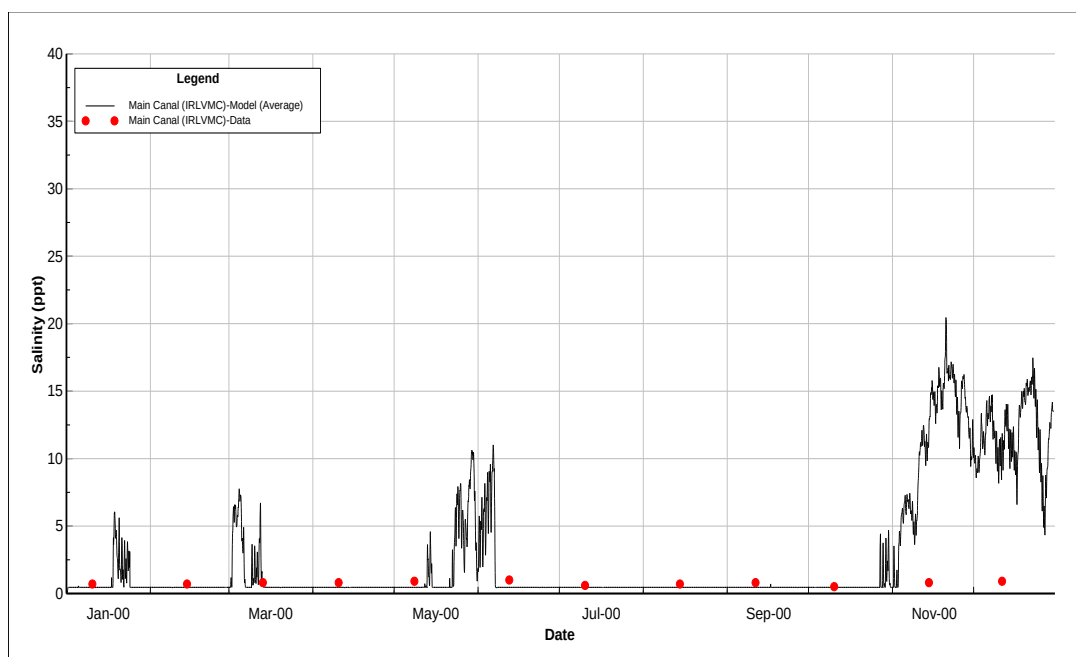


Figure F23-a. Main Canal model salinity calibration (Station: IRLVMC)

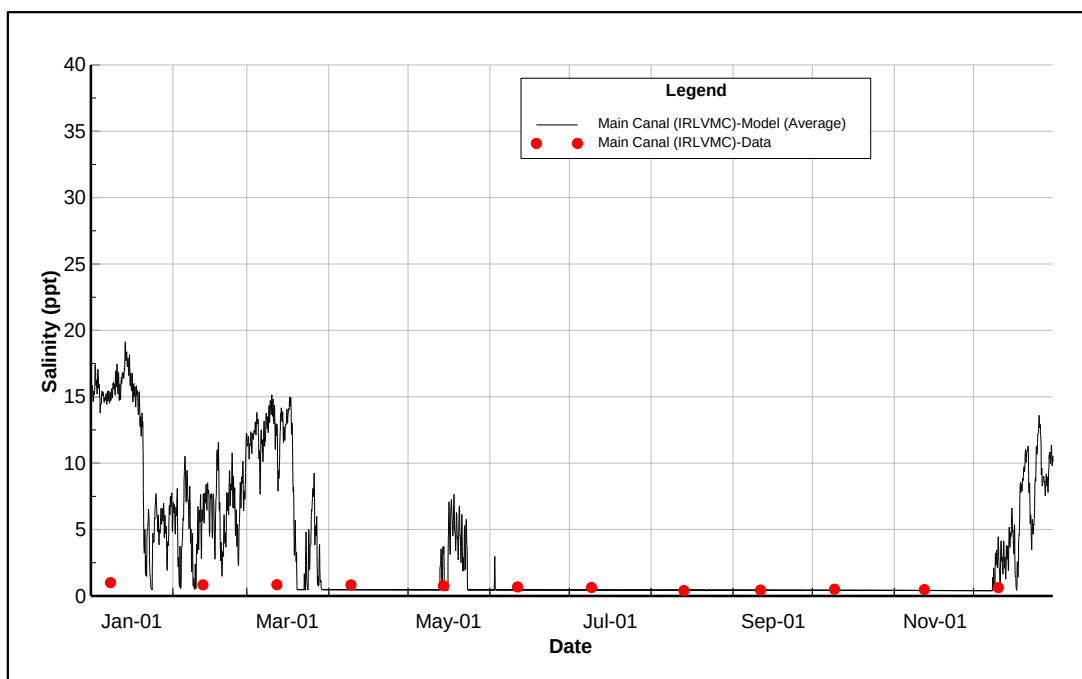


Figure F23-b. Main Canal model salinity validation (Station: IRLVMC)

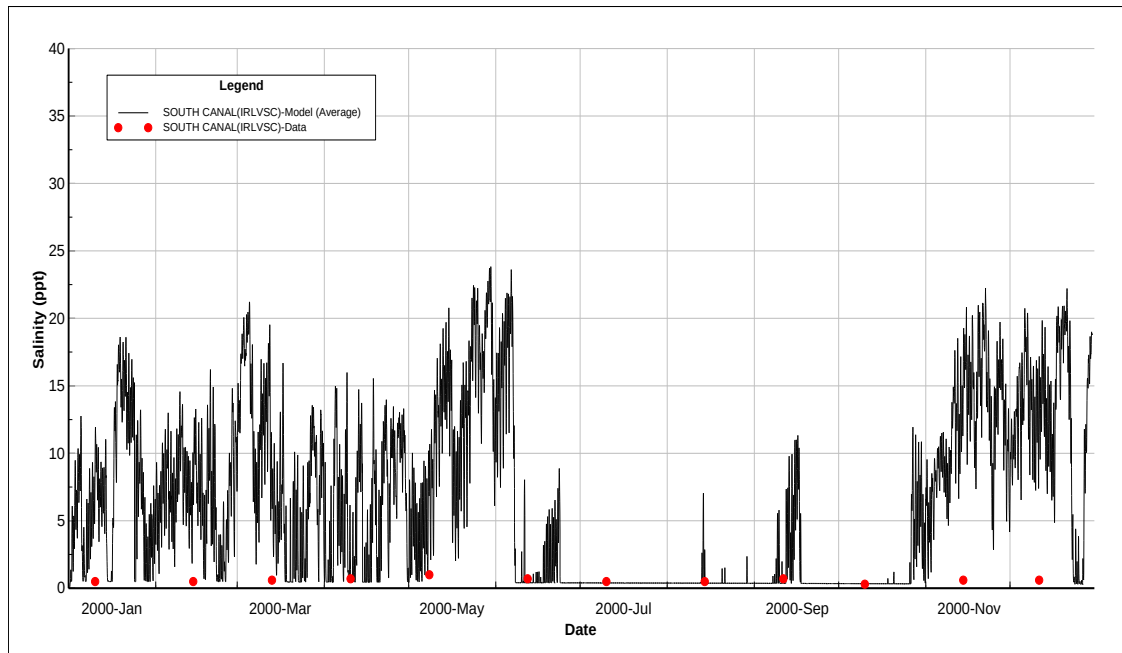


Figure F24-a. South Canal model salinity calibration (Station: IRLVSC)

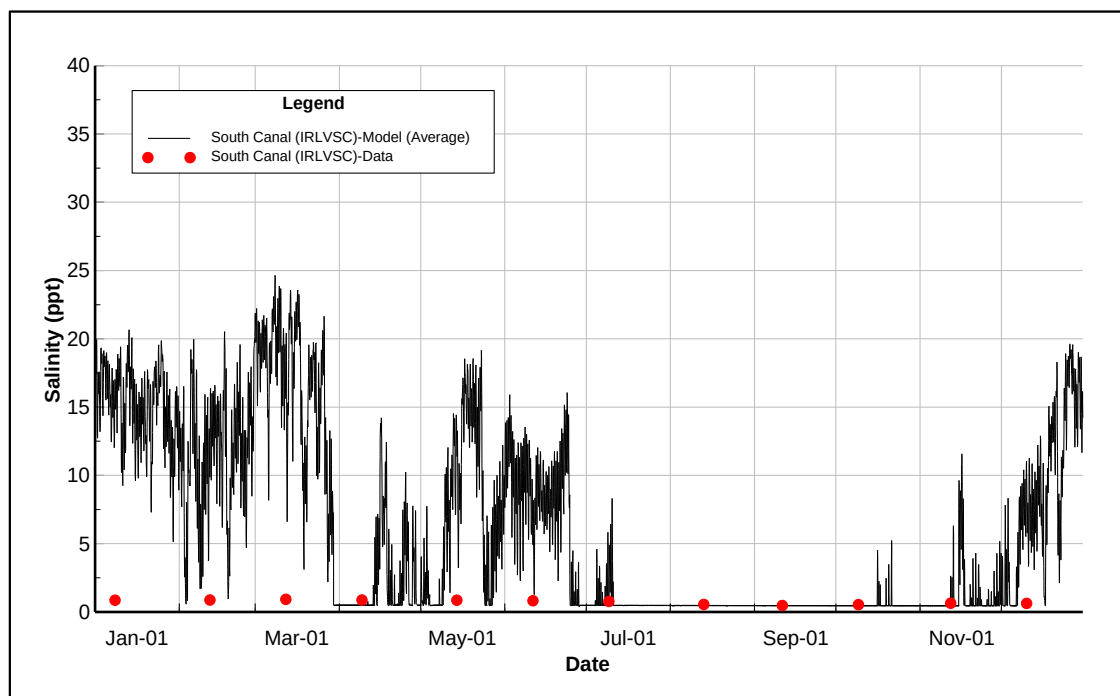


Figure F24-b. South Canal model salinity validation (Station: IRLVSC)

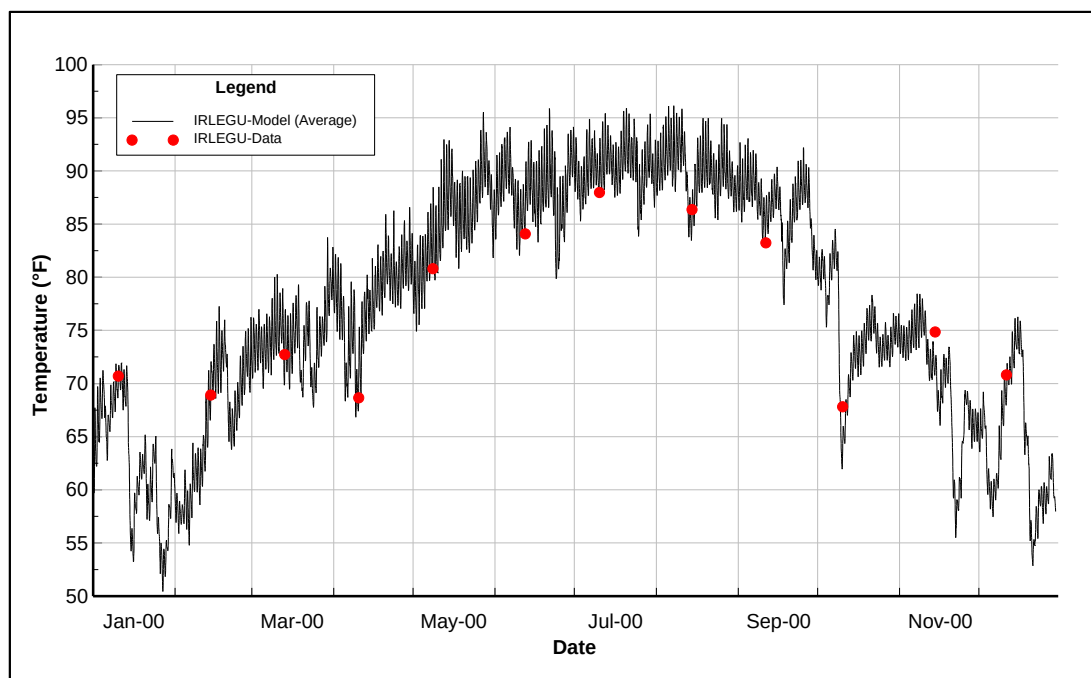


Figure F25-a. Eau Gallie model temperature calibration (Station: IRLEGU)

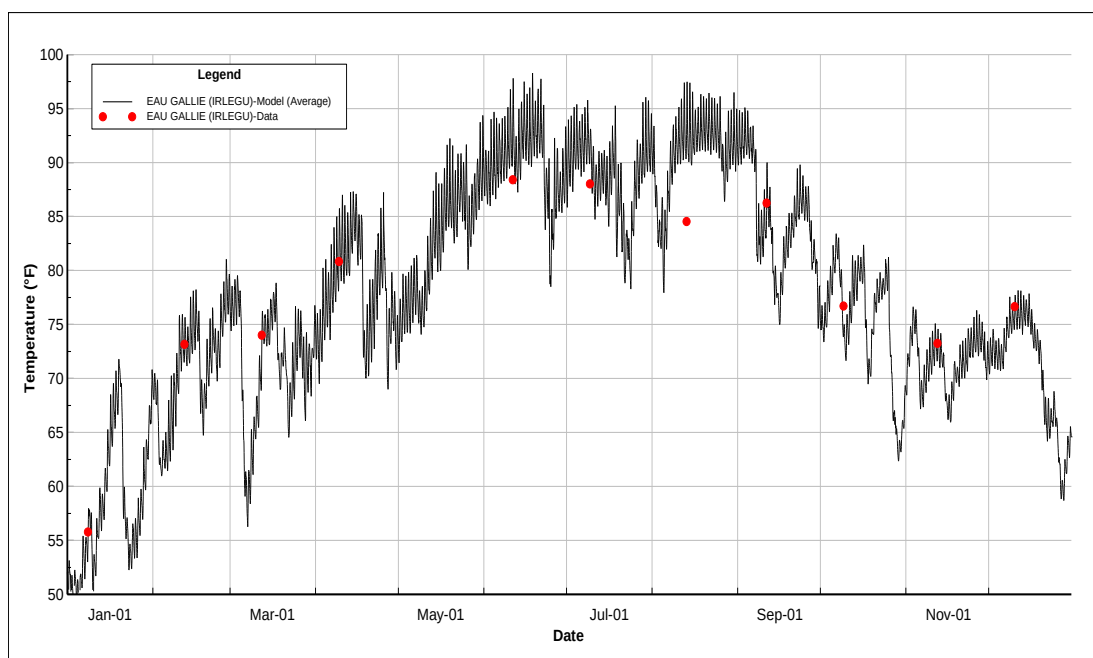


Figure F25-b. Gallie model temperature validation (Station: IRLEGU)

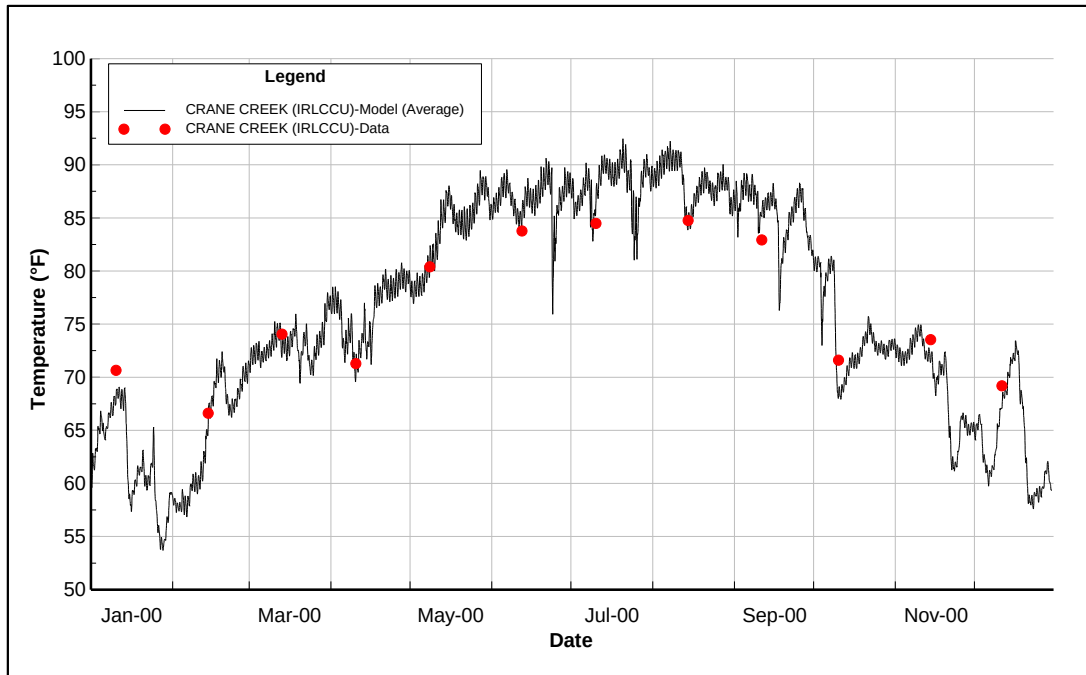


Figure F26-a. Crane Creek model temperature calibration (Station: IRLCCU)

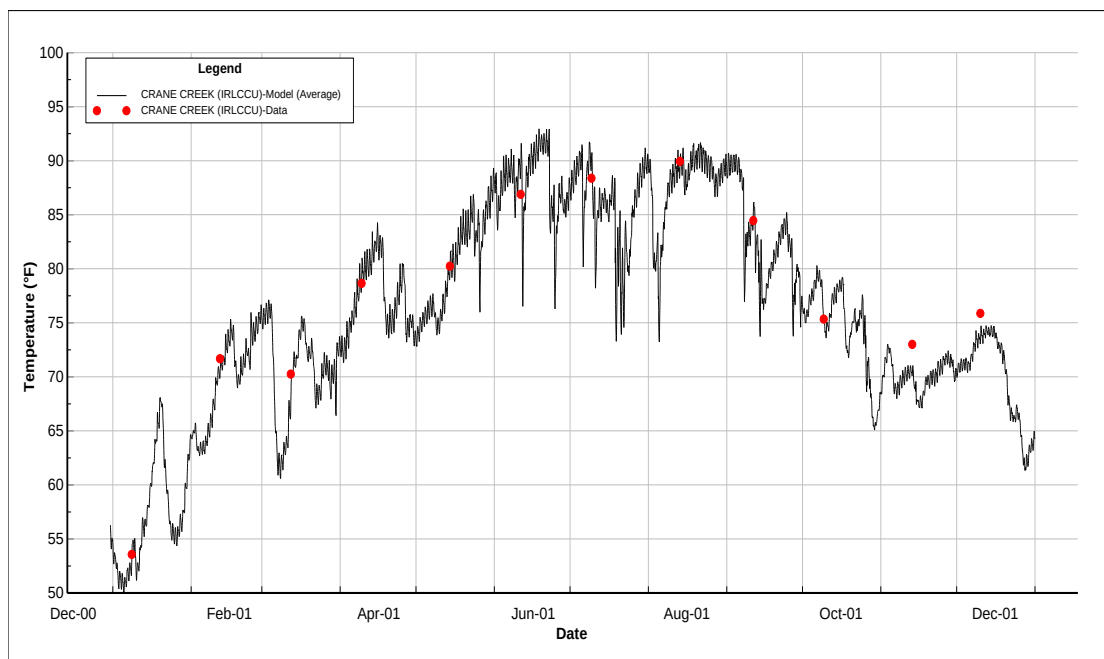


Figure F26-b. Crane Creek model temperature validation (Station: IRLCCU)

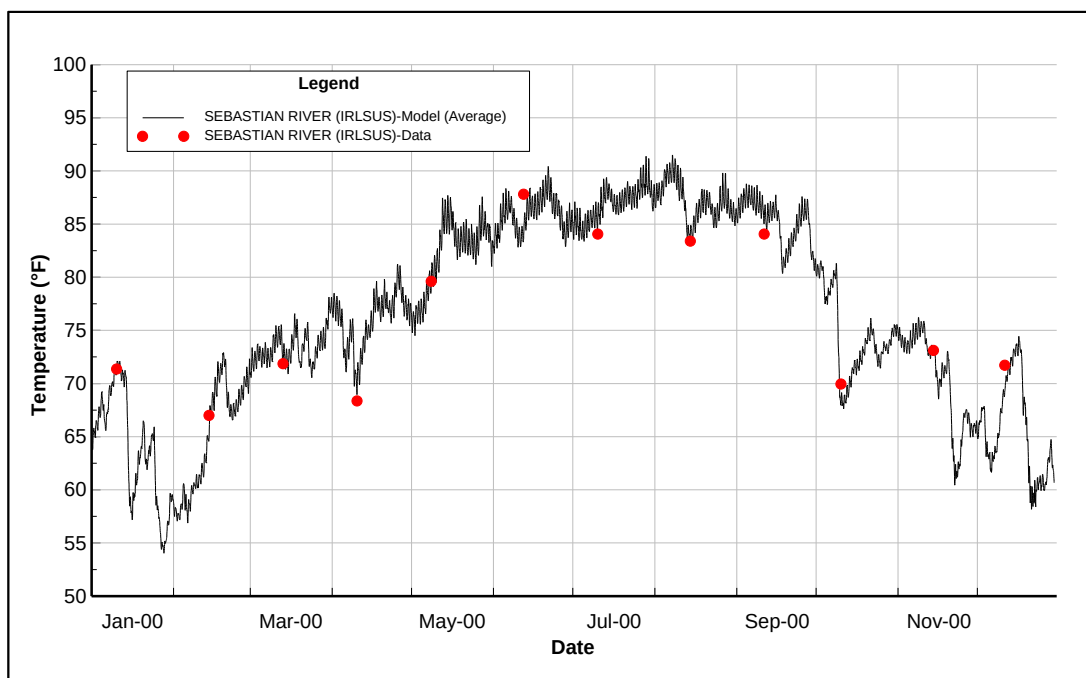


Figure F27-a. Sebastian River model temperature calibration (Station: IRLSUS)

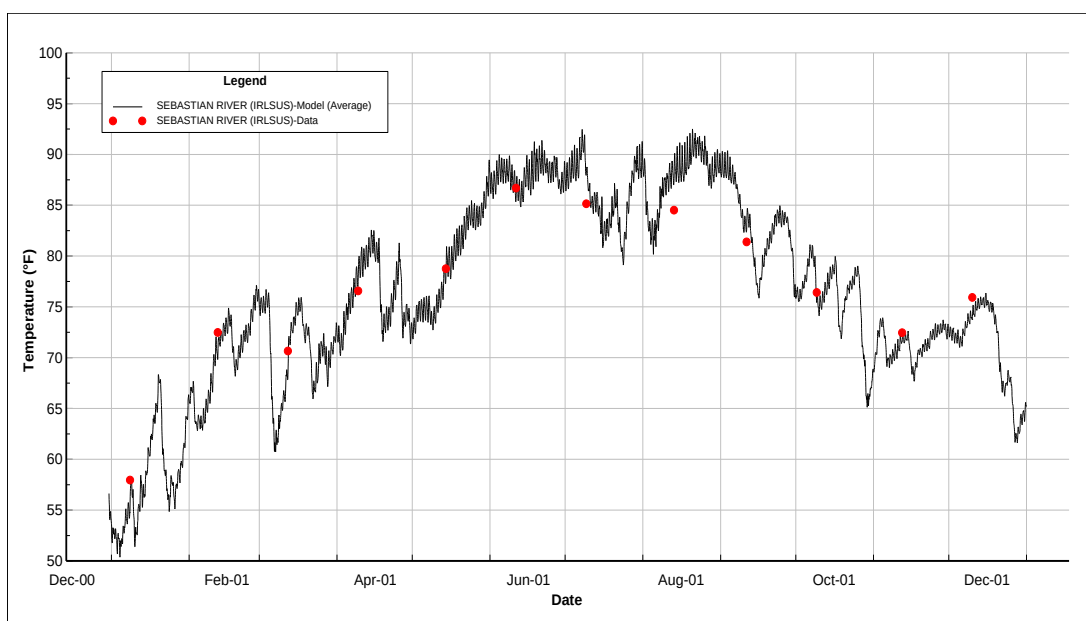


Figure F27-b. Sebastian River model temperature validation (Station: IRLSUS)

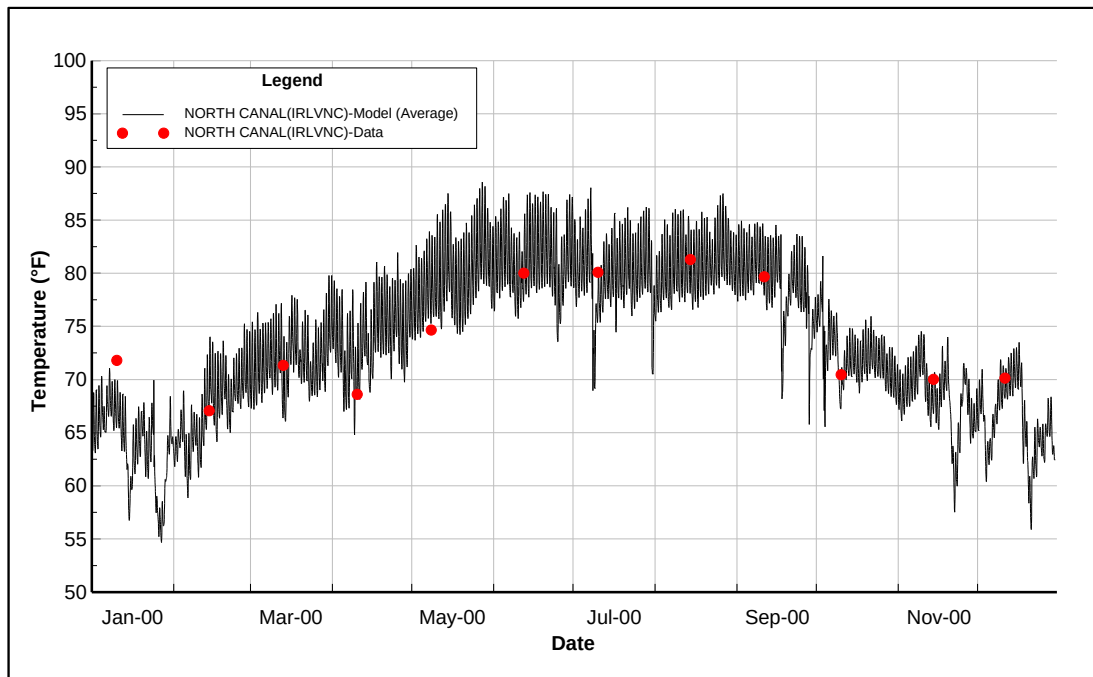


Figure F28-a. North Canal model temperature calibration (Station: IRLVNC)

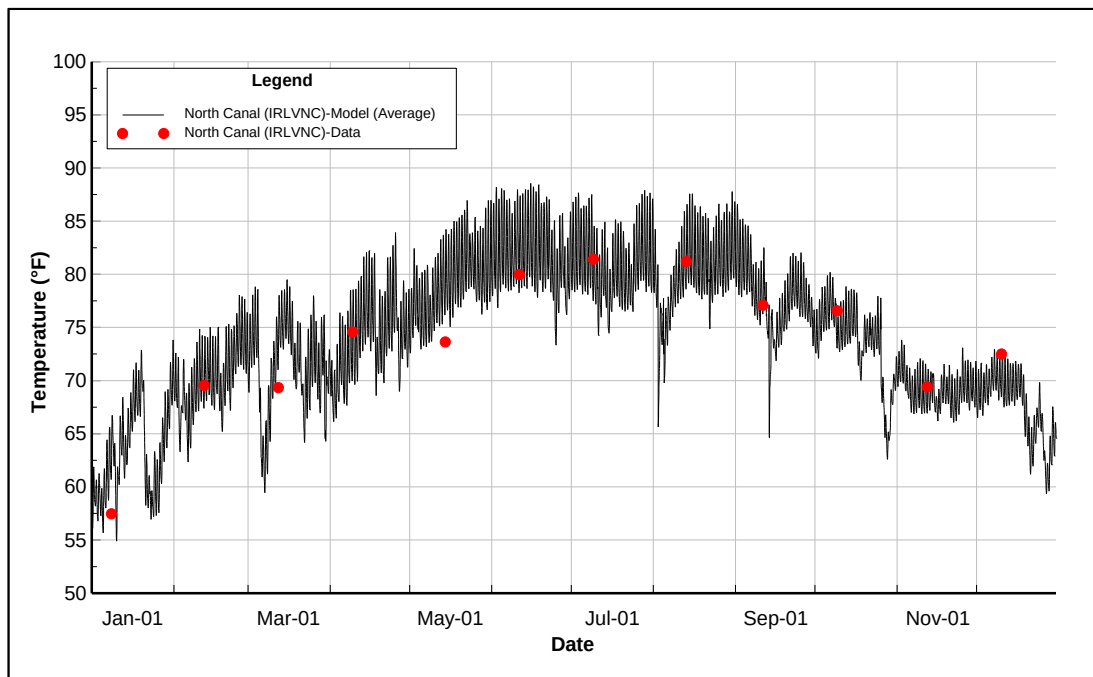


Figure F28-b. North Canal model temperature validation (Station: IRLVNC)

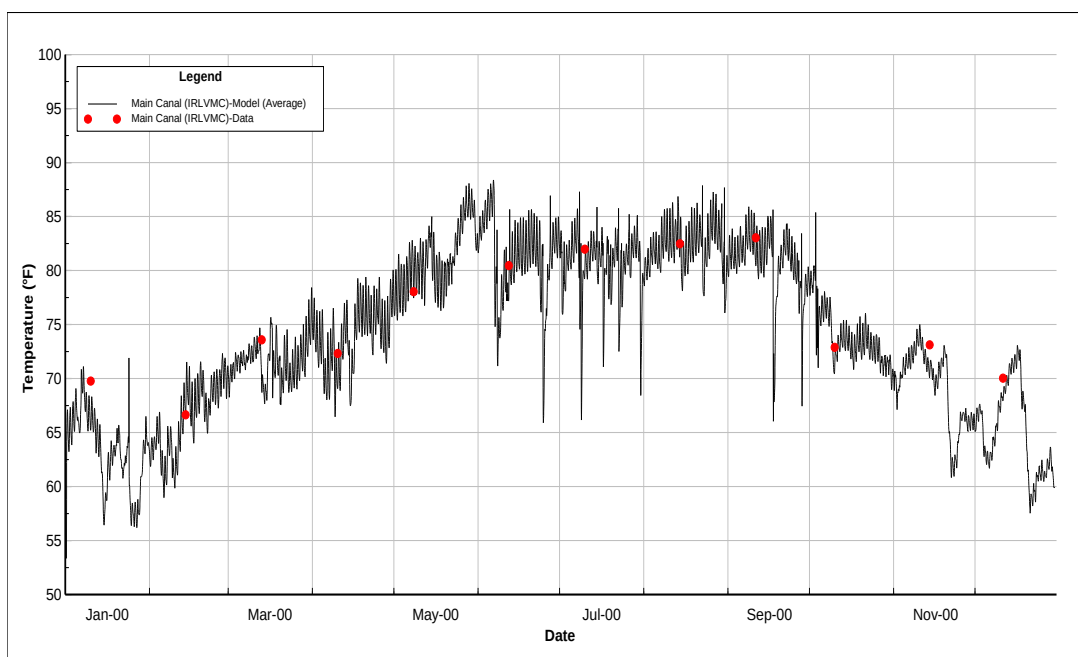


Figure F29-a. Main Canal model temperature calibration (Station: IRLVMC)

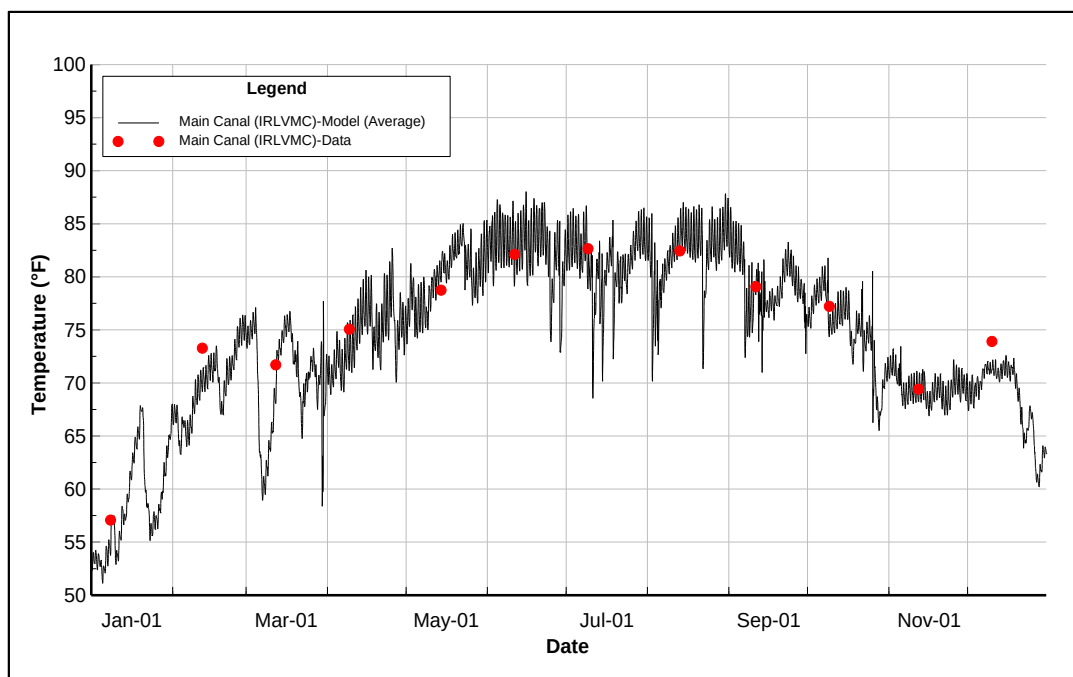


Figure F29-b. Main Canal model temperature validation (Station: IRLVMC)

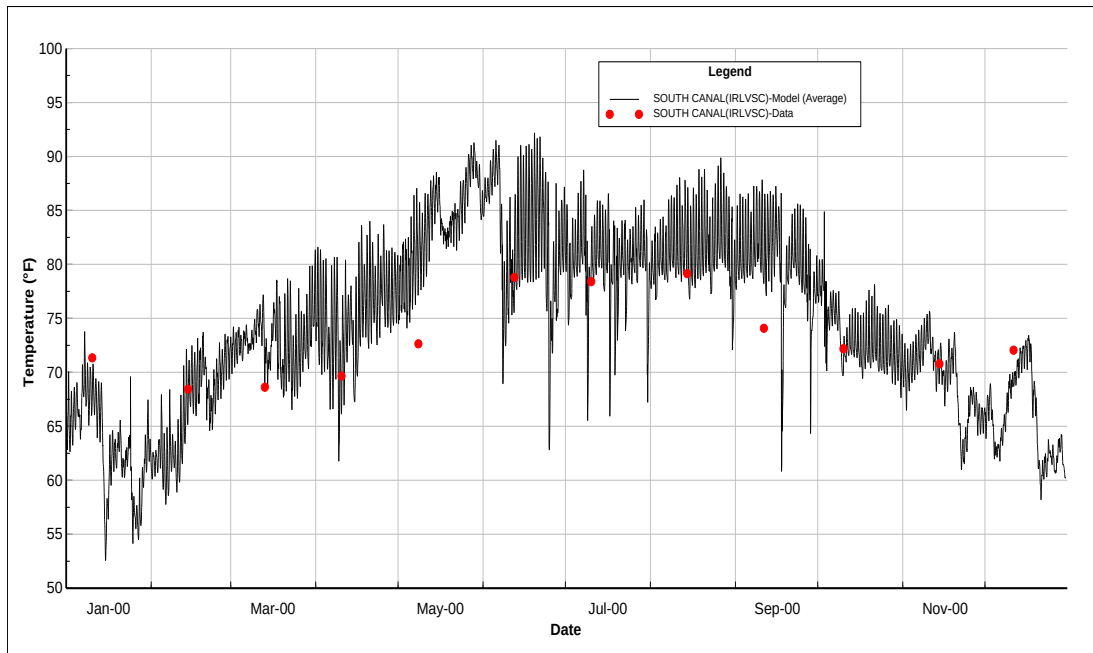


Figure F30-a. South Canal model temperature calibration (Station: IRLVSC)

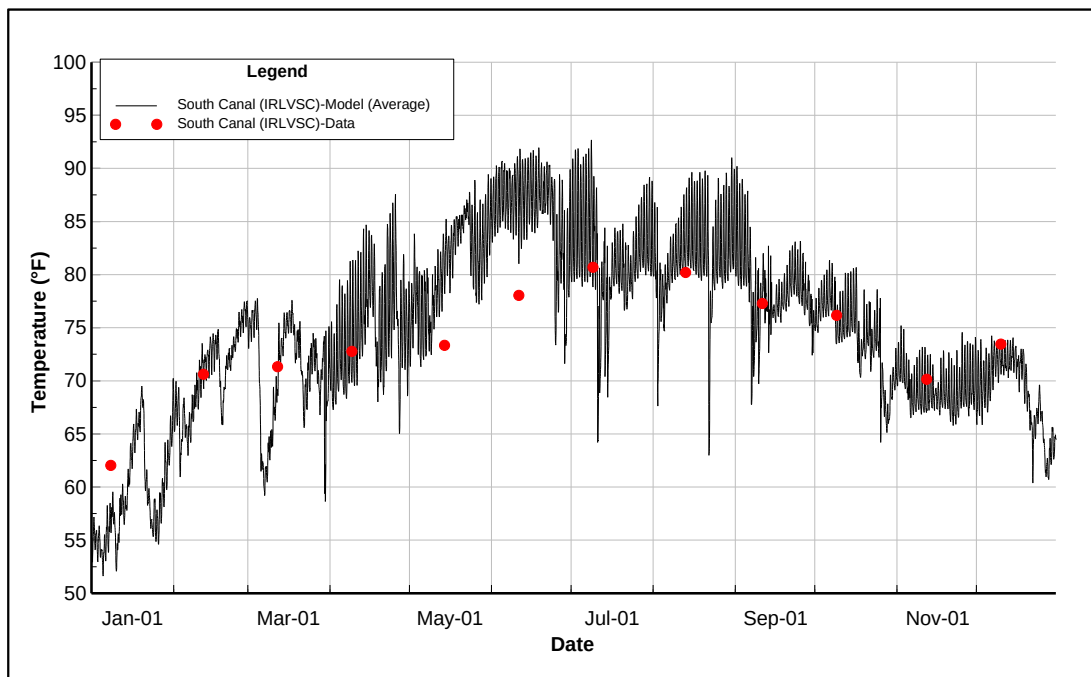


Figure F30-b. South Canal model temperature validation (Station: IRLVSC)

Appendix G: EFDC Model Water Quality Calibration and Validation

EFDC Water Quality Calibration and Validation for the Main Stem Model

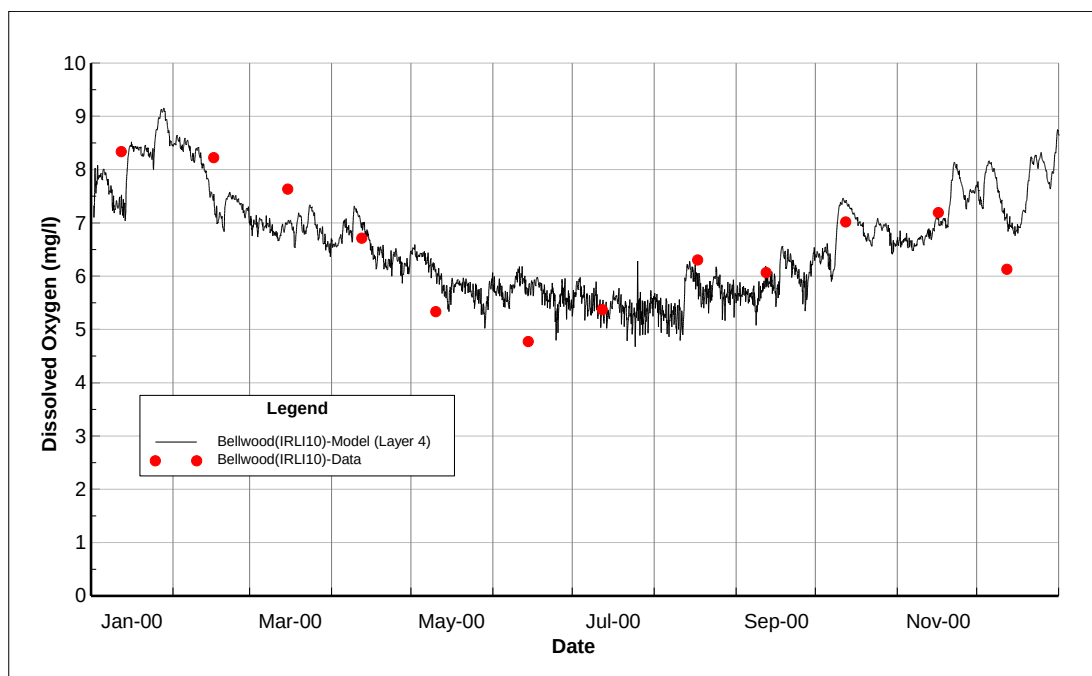


Figure G1-a. DO Calibration at Bellwood (Station: IRL110)

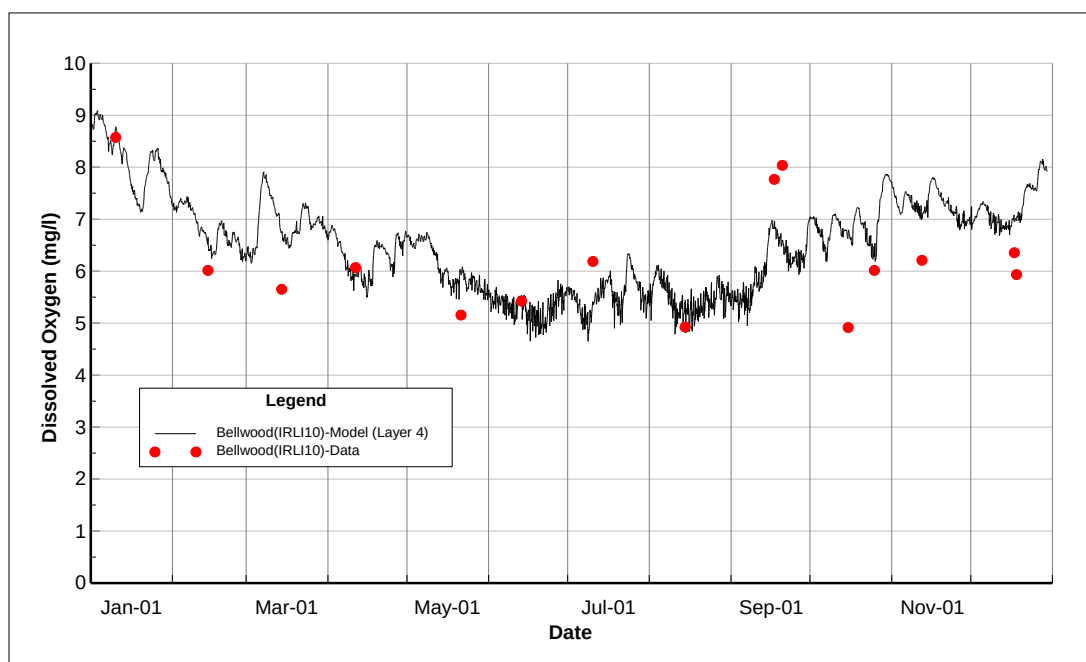


Figure G1-b. DO validation at Bellwood (Station: IRL110)

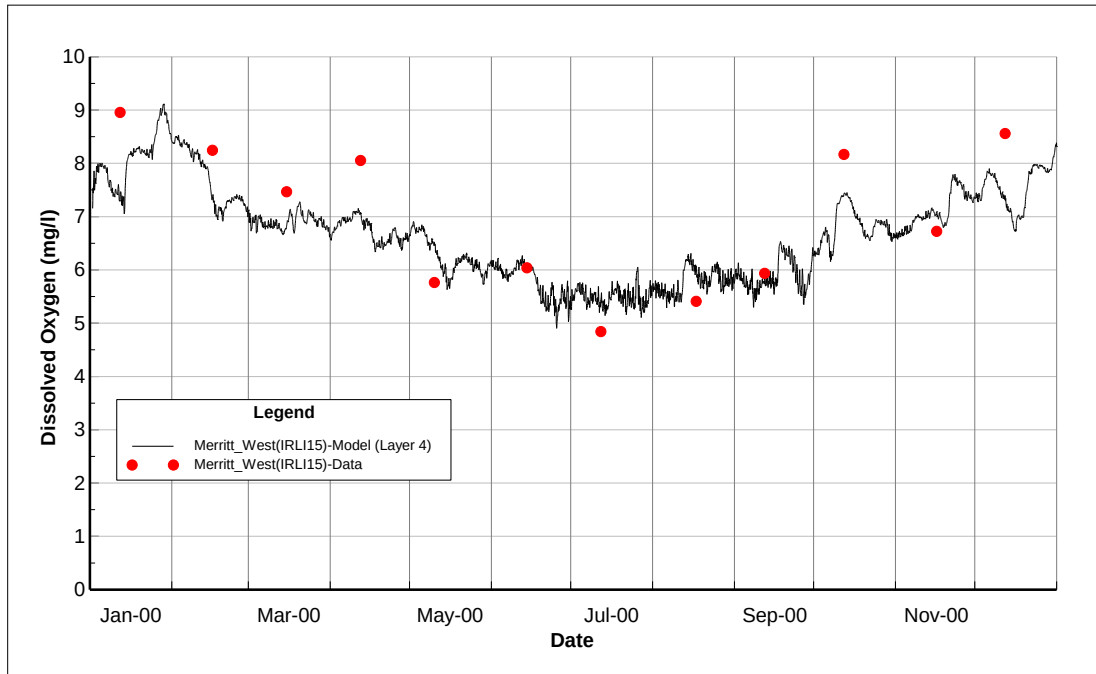


Figure G2-a. DO Calibration at Merritt West (Station: IRL15)

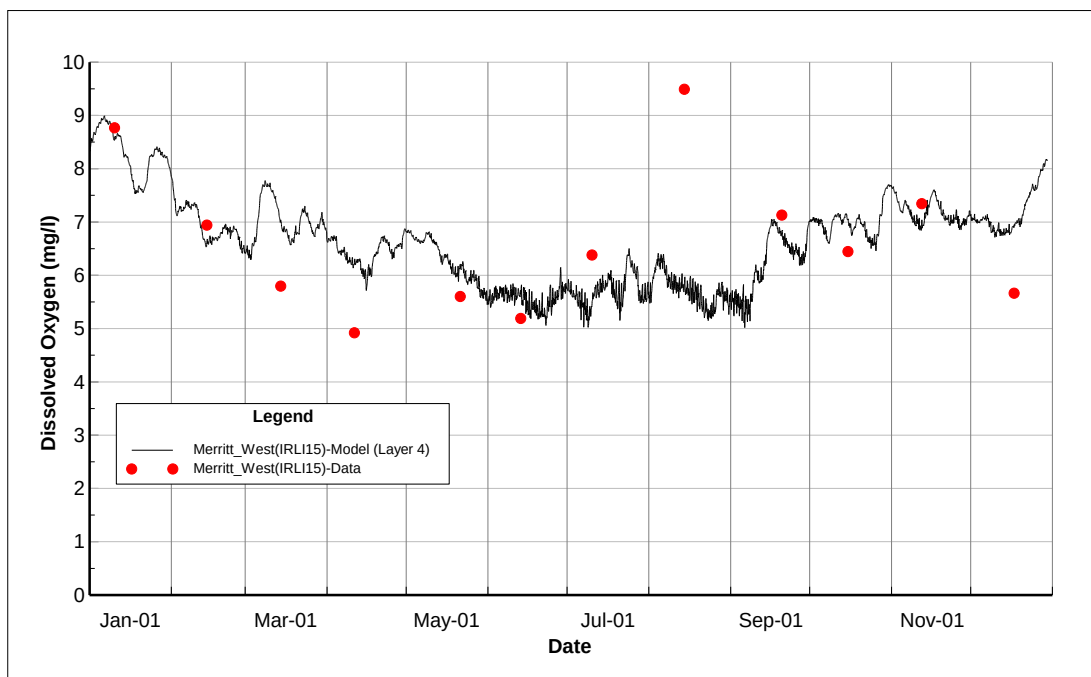


Figure G2-b. DO validation at Merritt West (Station: IRL15)

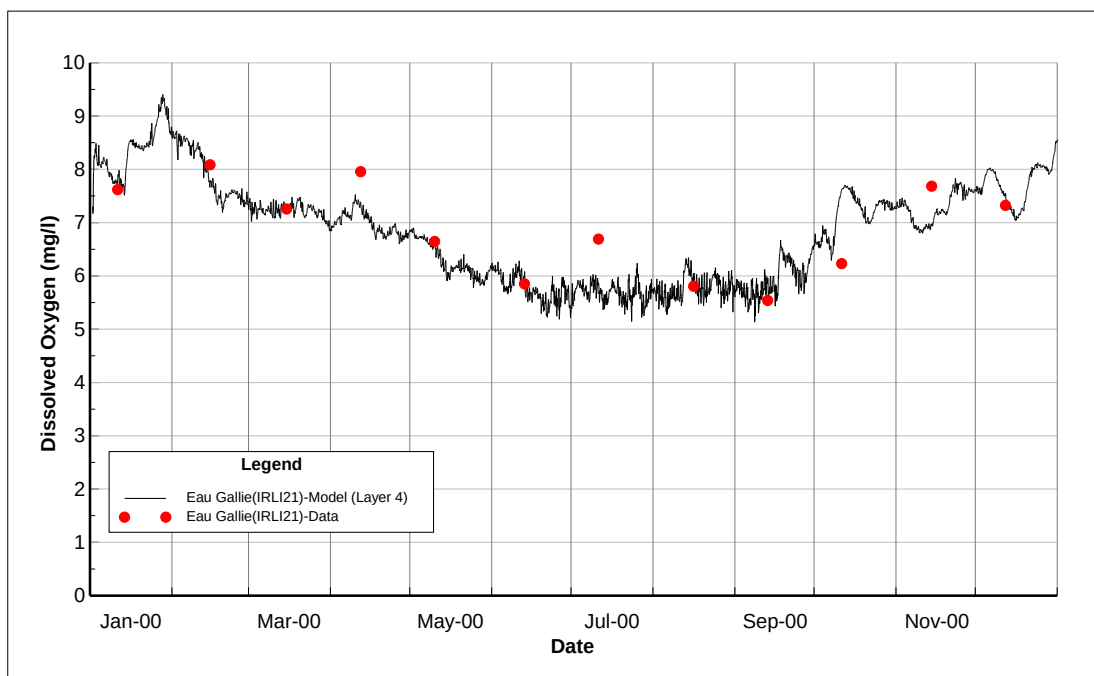


Figure G3-a. DO Calibration at Eau Gallie (Station: IRLI21)

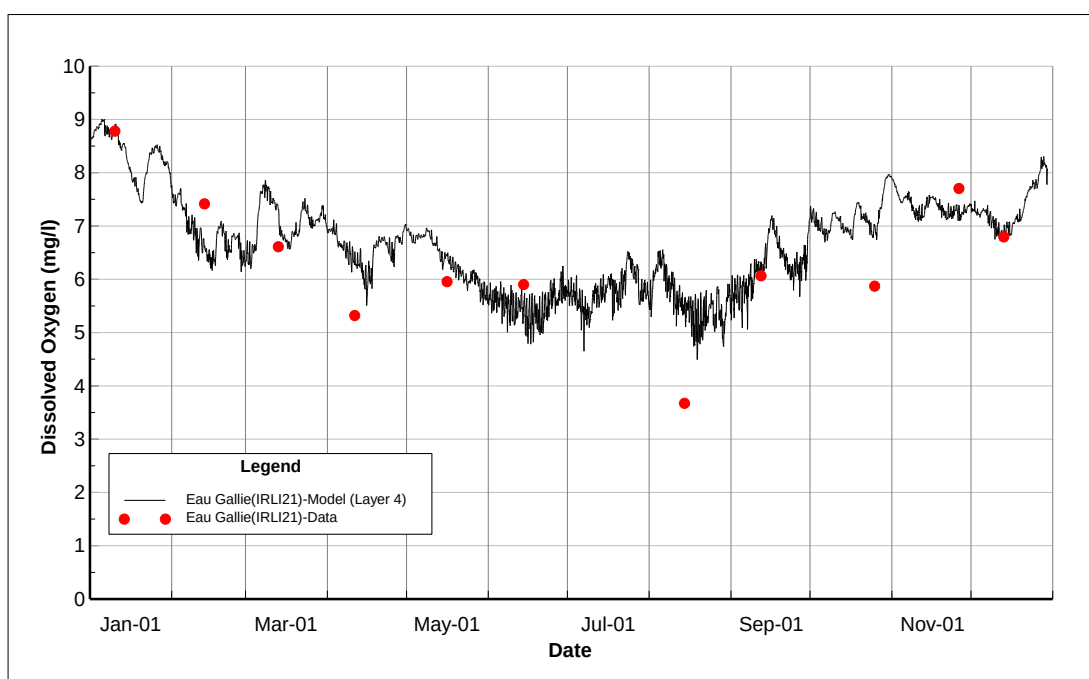


Figure G3-b. DO validation at Eau Gallie (Station: IRLI21)

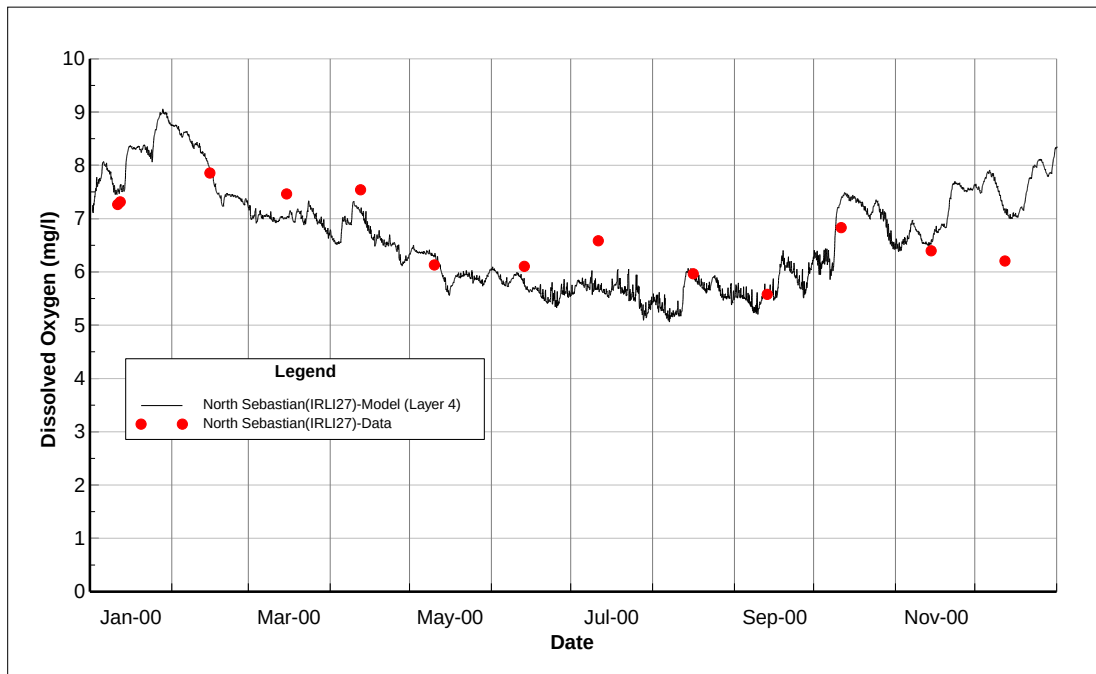


Figure G4-a. DO Calibration at North Sebastian (Station: IRLI27)

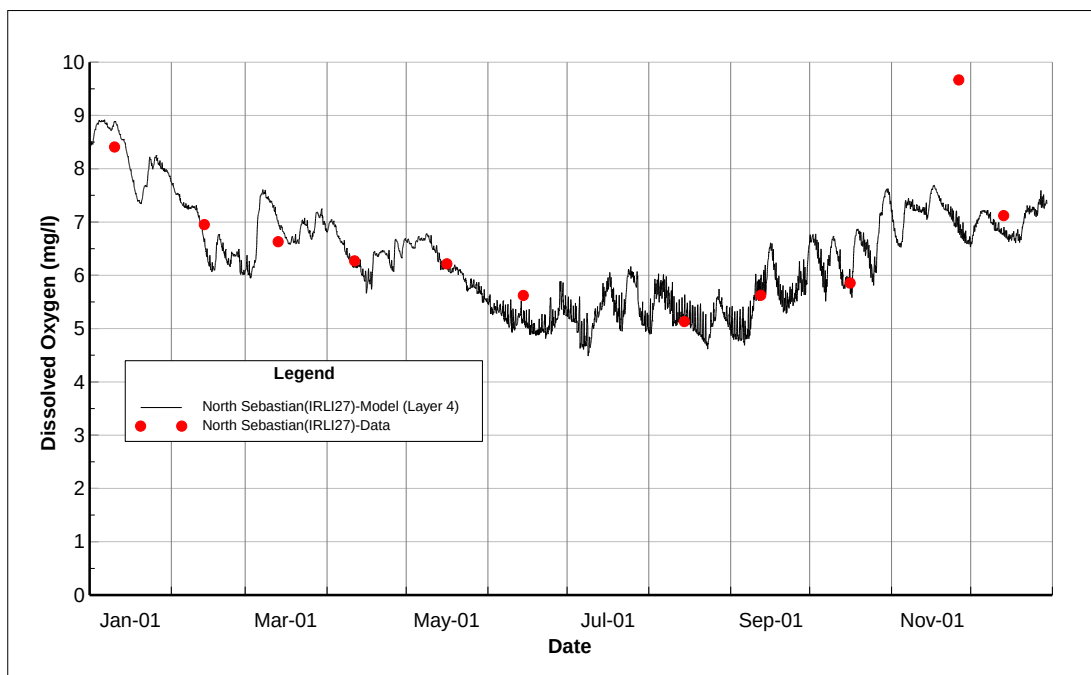


Figure G4-b. DO validation at North Sebastian (Station: IRLI27)

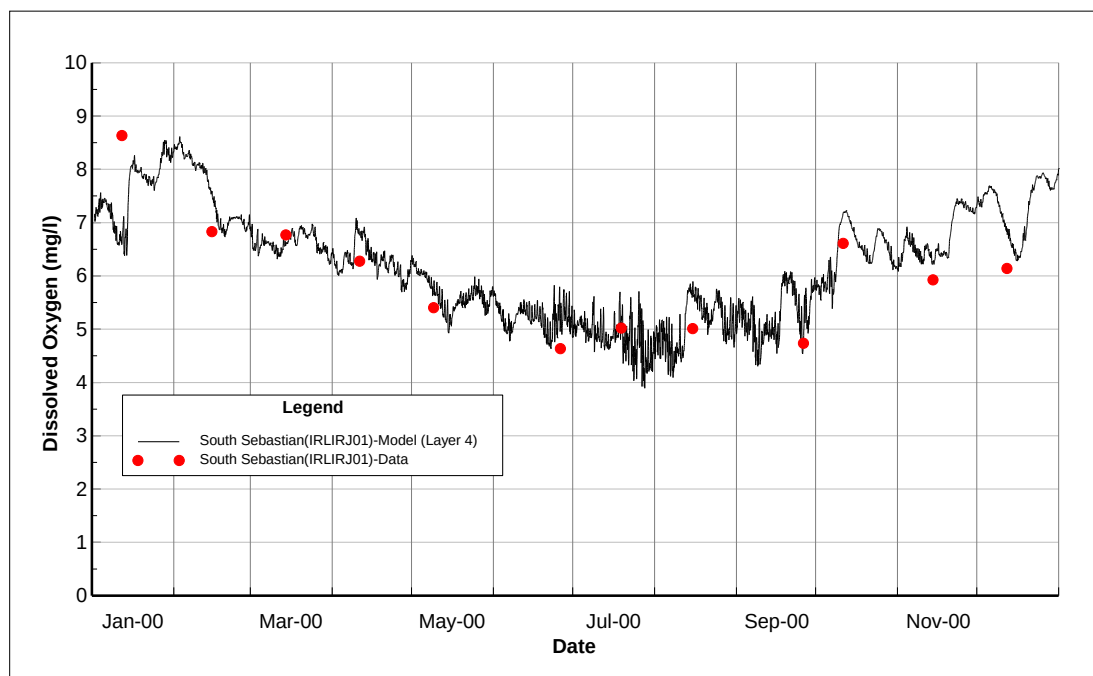


Figure G5-a. DO Calibration at South Sebastian (Station: IRLIRJ01)

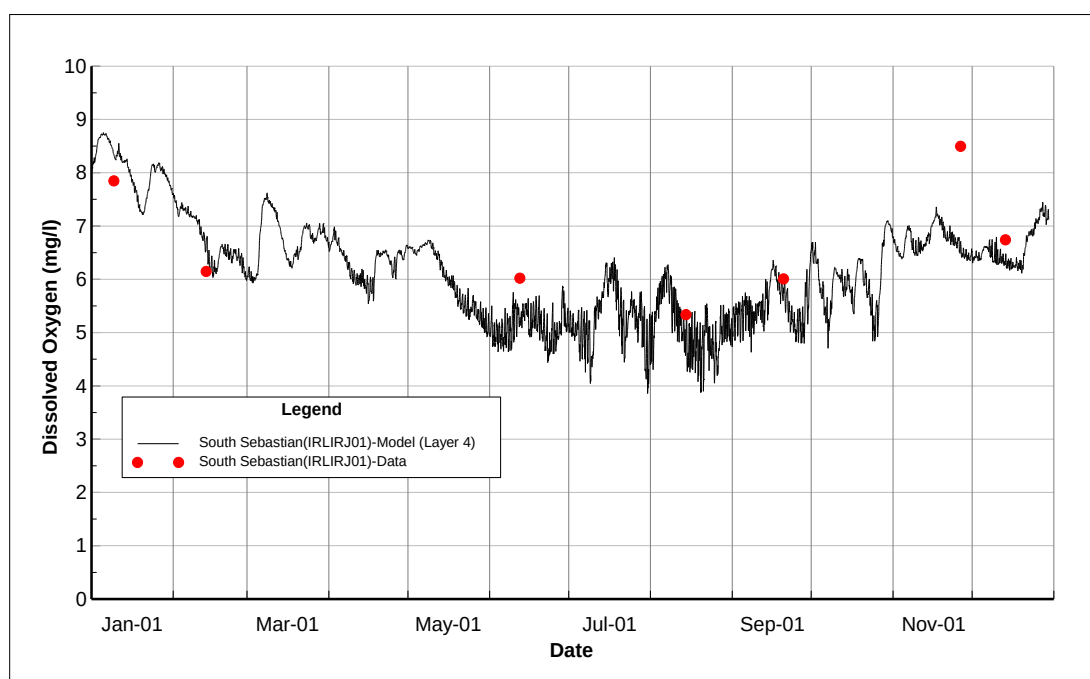


Figure G5-b. DO validation at South Sebastian (Station: IRLIRJ01)

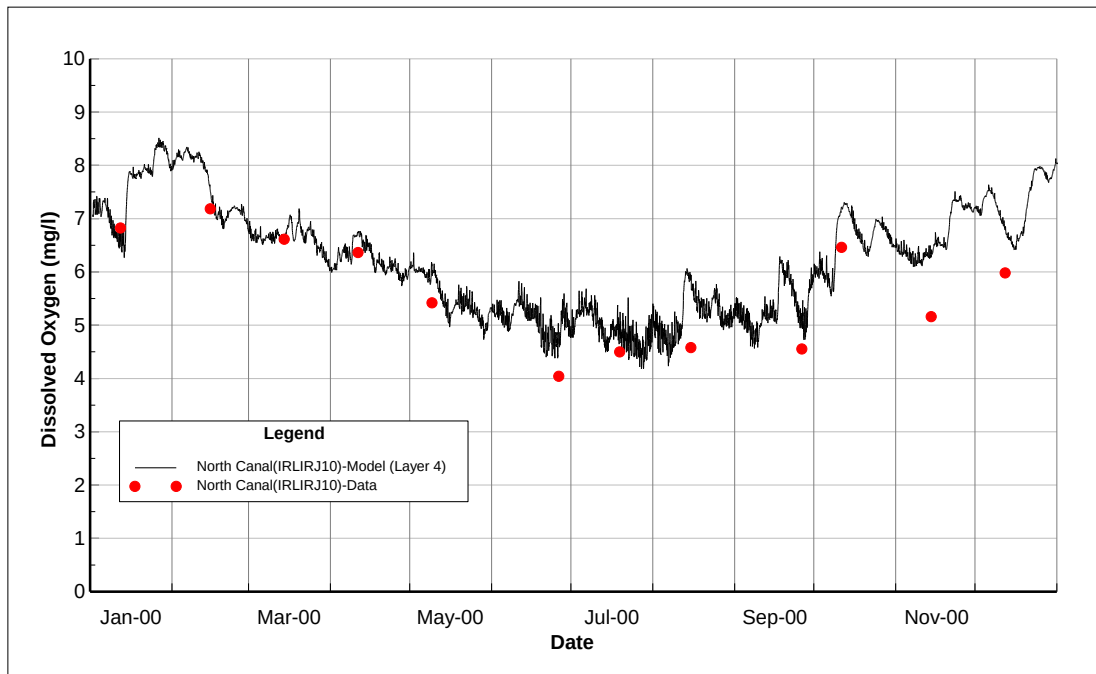


Figure G6-a. DO Calibration at North Canal (Station: IRLIRJ10)

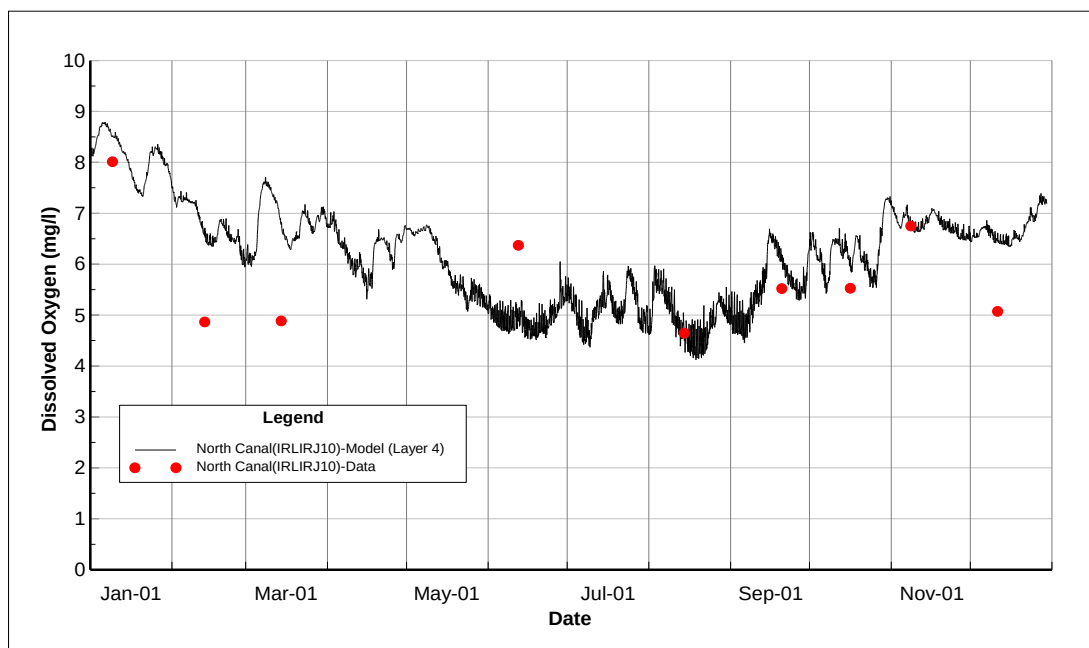


Figure G6-b. DO validation at North Canal (Station: IRLIRJ10)

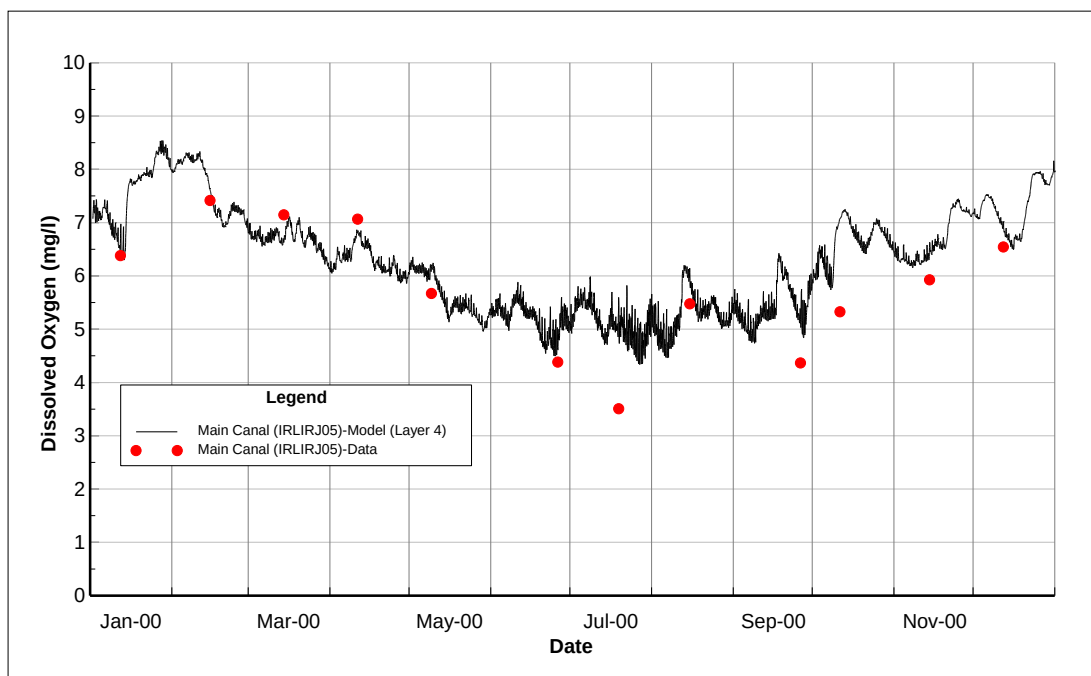


Figure G7-a. DO Calibration at Main Canal (Station: IRLIRJ05)

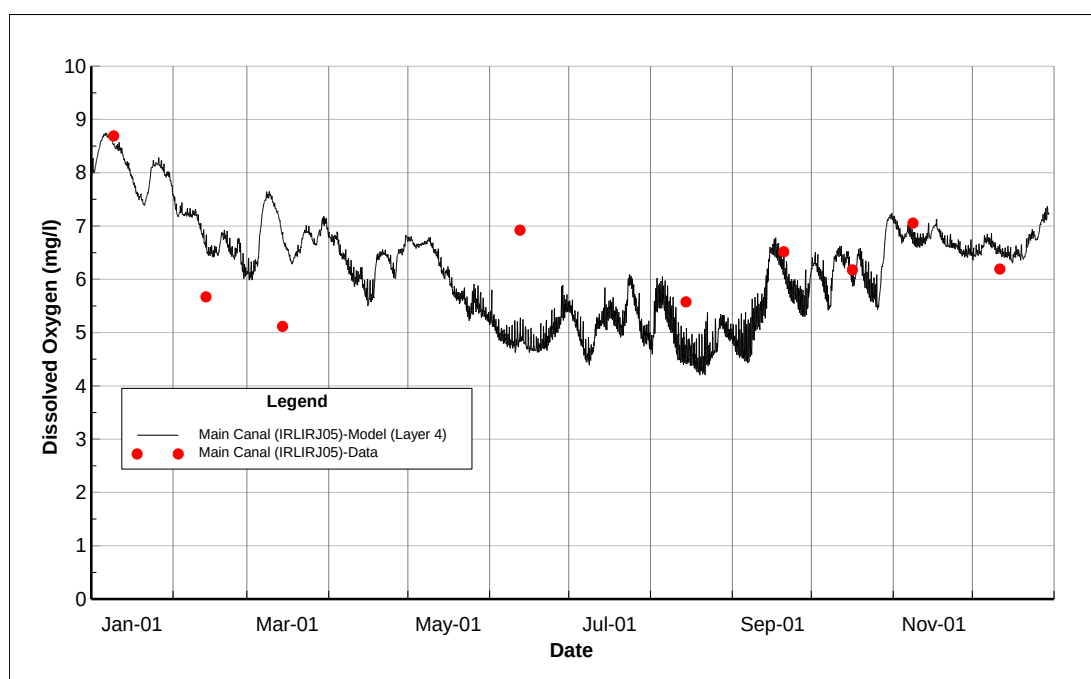


Figure G7-b. DO validation at Main Canal (Station: IRLIRJ05)

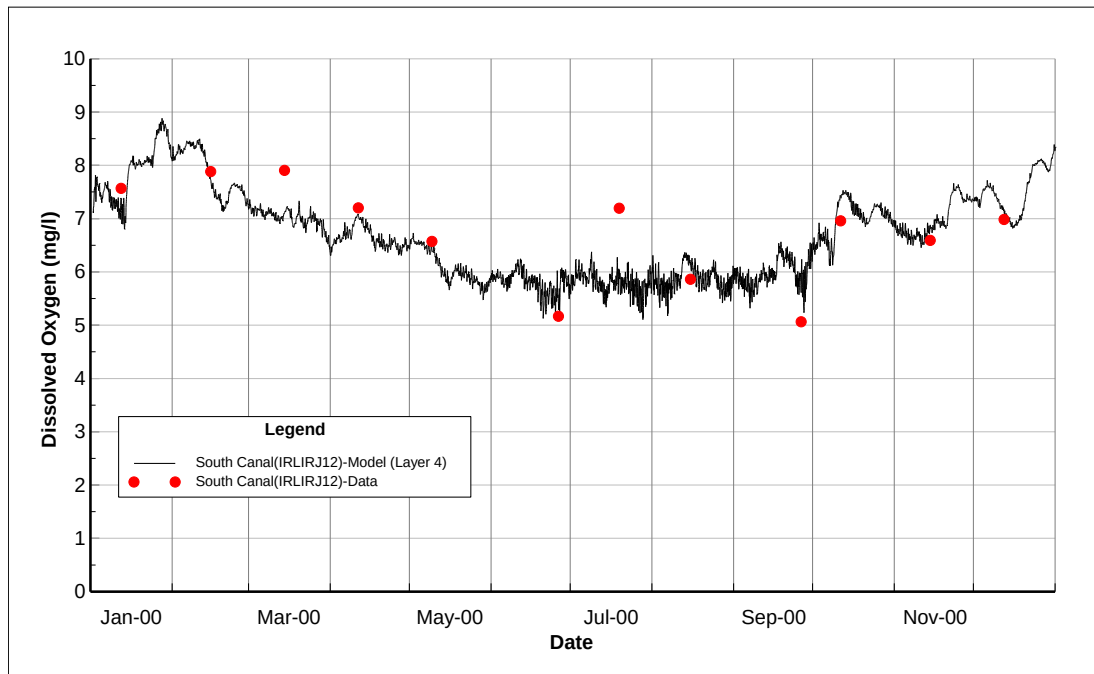


Figure G8-a. Calibration at South Canal (Station: IRLIRJ12)

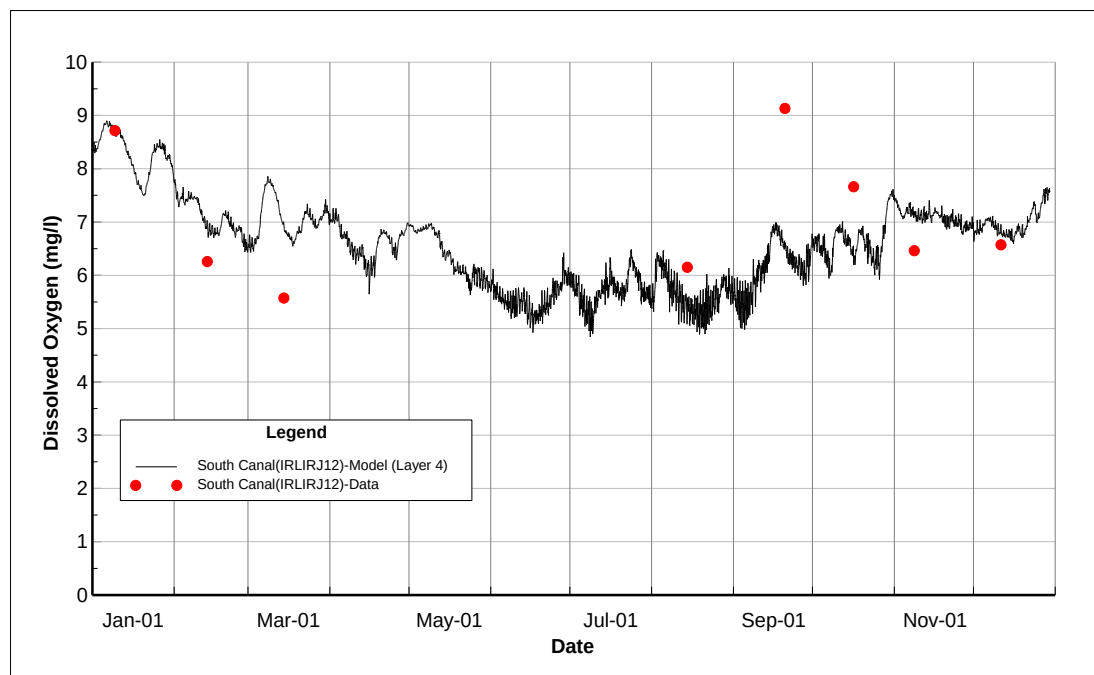


Figure G8-b. DO validation at South Canal (Station: IRLIRJ12)

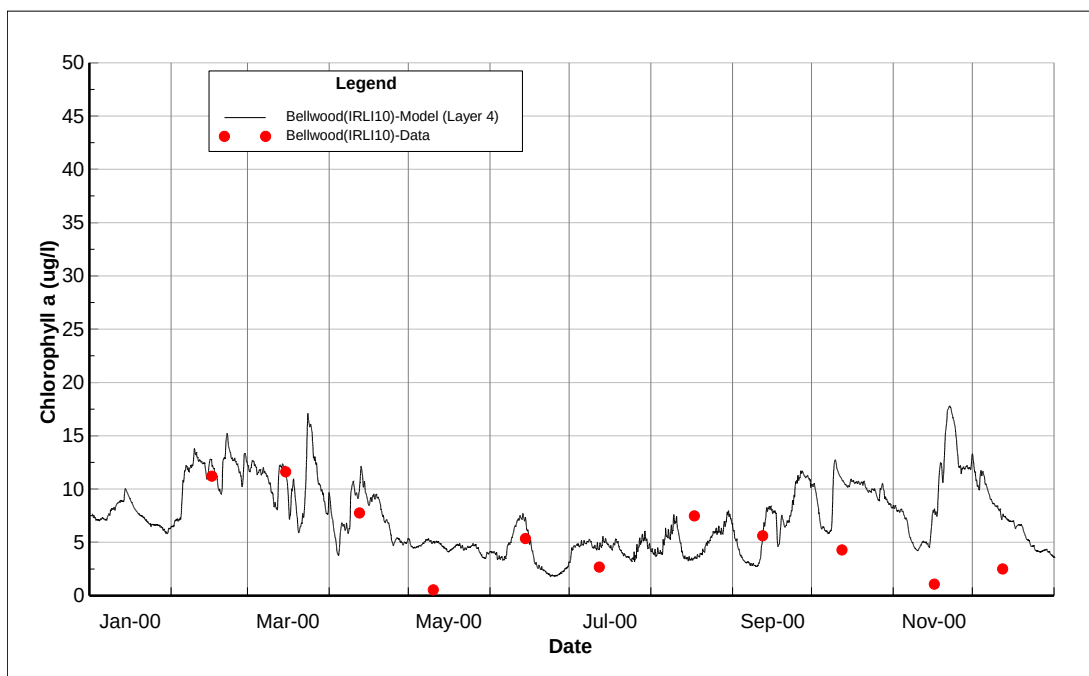


Figure G9-a. Chlorophyll-a Calibration at Bellwood (Station: IRL110)

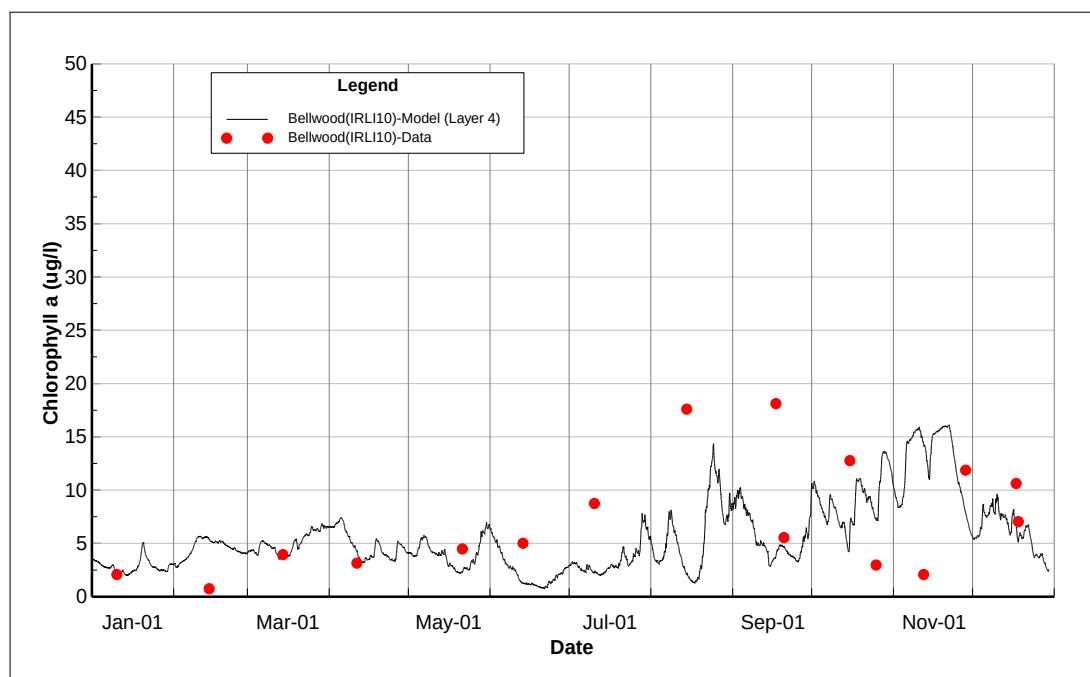


Figure G9-b. Chlorophyll-a validation at Bellwood (Station: IRL110)

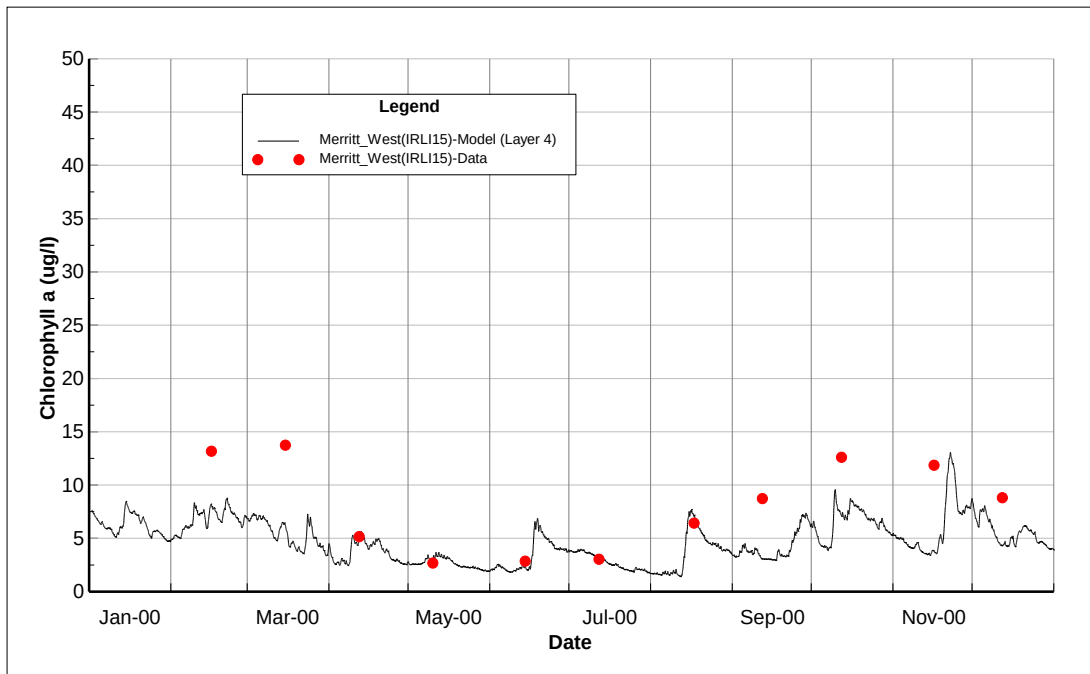


Figure G10-a. Chlorophyll-a Calibration at Merritt West (Station: IRL115)

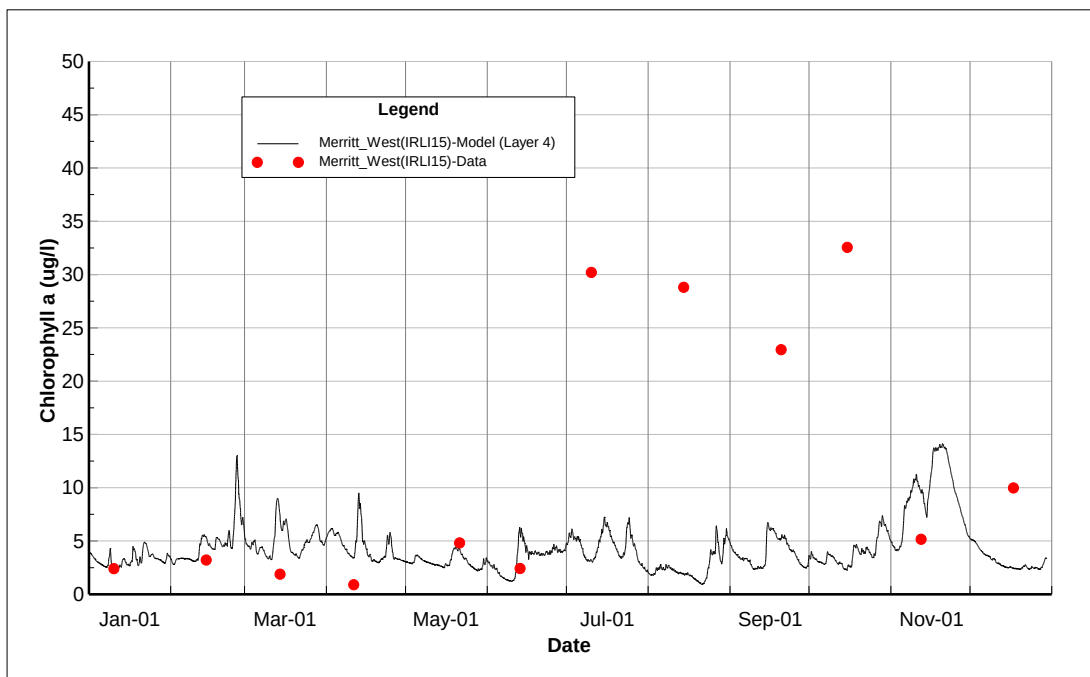


Figure G10-b. Chlorophyll-a validation at Merritt West (Station: IRL115)

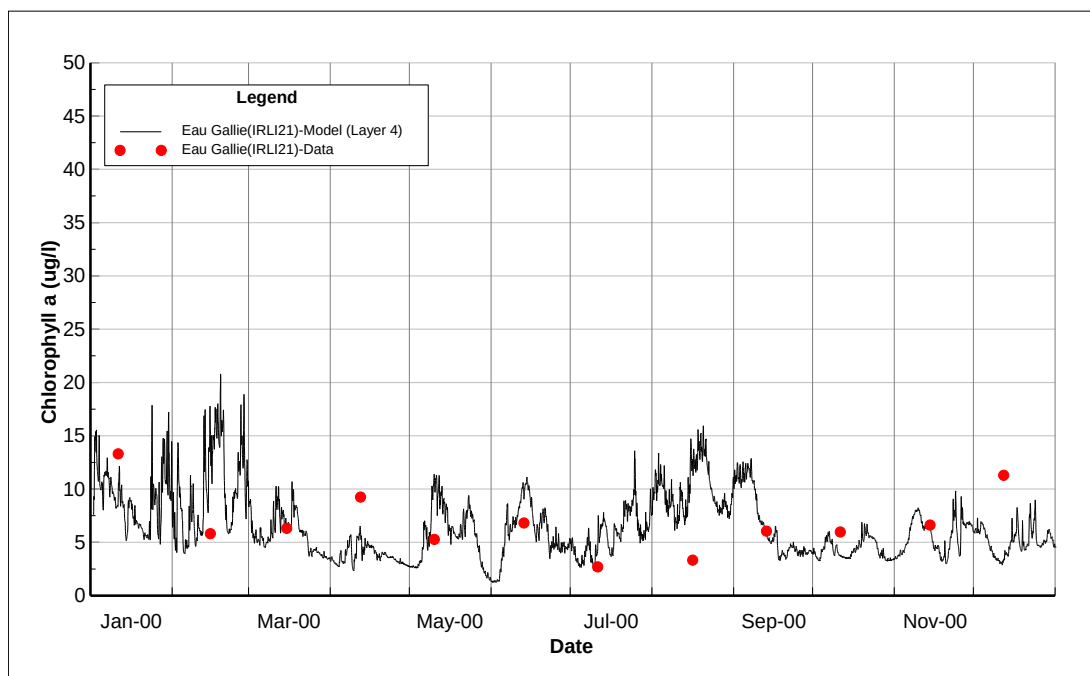


Figure G11-a. Chlorophyll-a Calibration at Eau Gallie (Station: IRLI21)

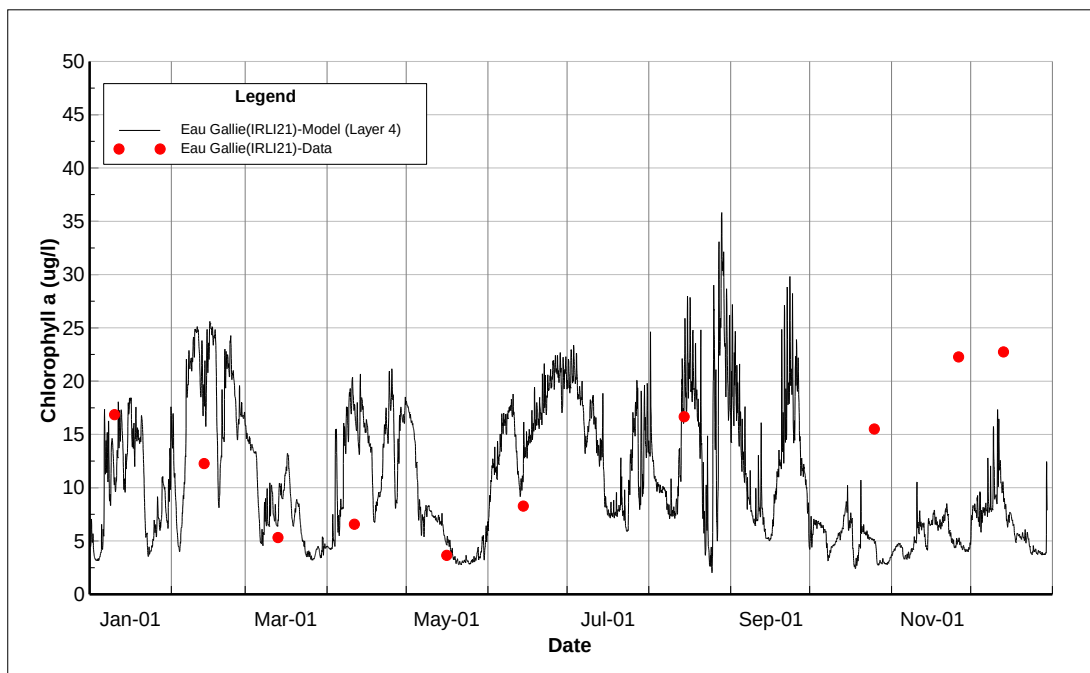


Figure G11-b. Chlorophyll-a validation at Eau Gallie (Station: IRLI21)

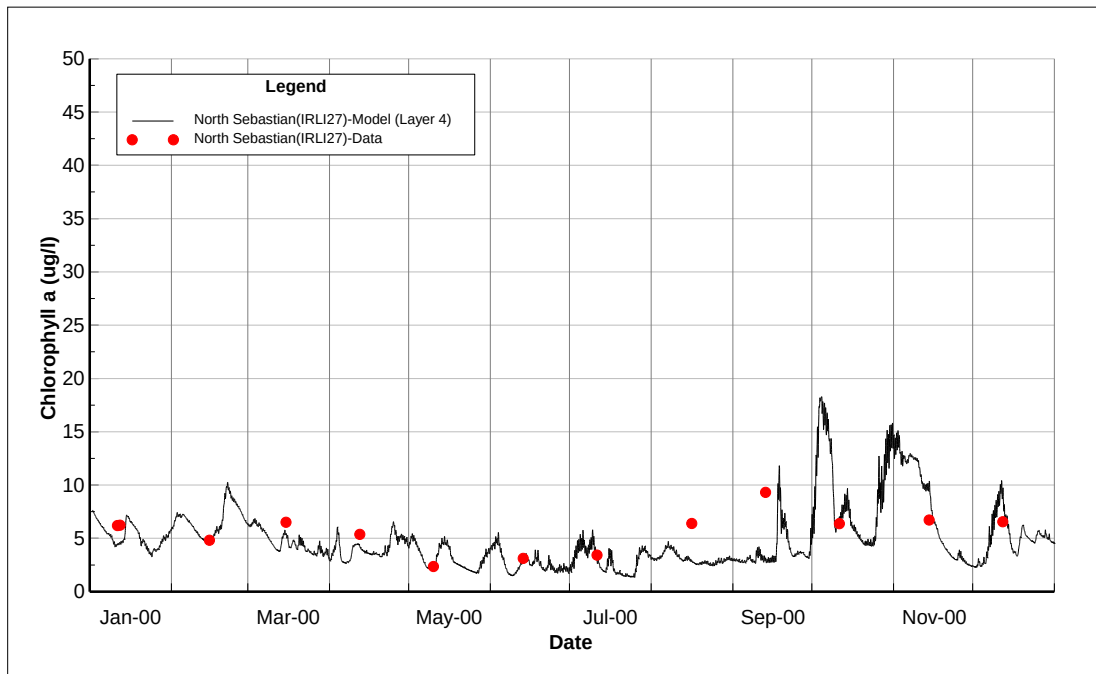


Figure G12-a. Chlorophyll-a Calibration at North Sebastian (Station: IRLI27)

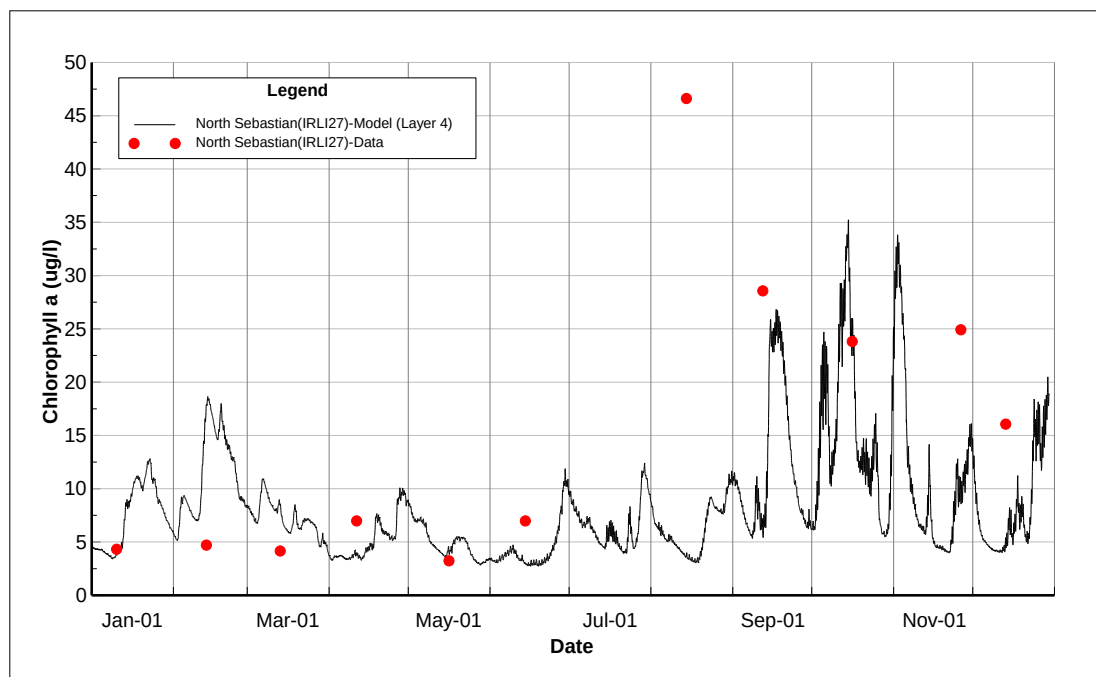


Figure G12-b. Chlorophyll-a validation at North Sebastian (Station: IRLI27)

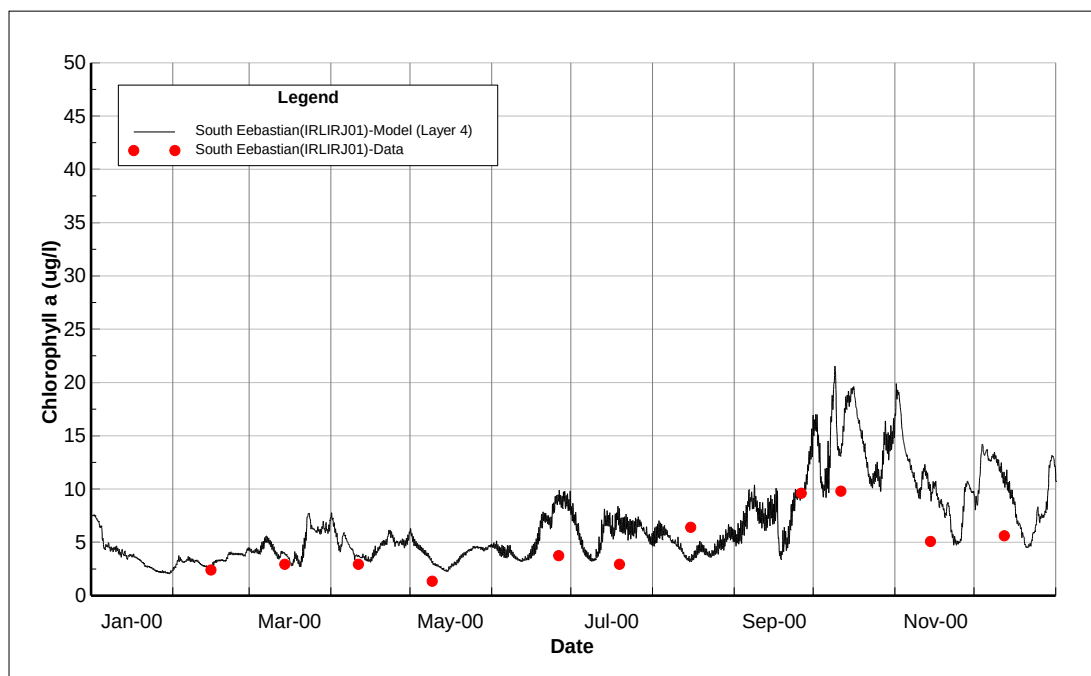


Figure G13-a. Chlorophyll-a Calibration at South Sebastian (Station: IRLIRJ01)

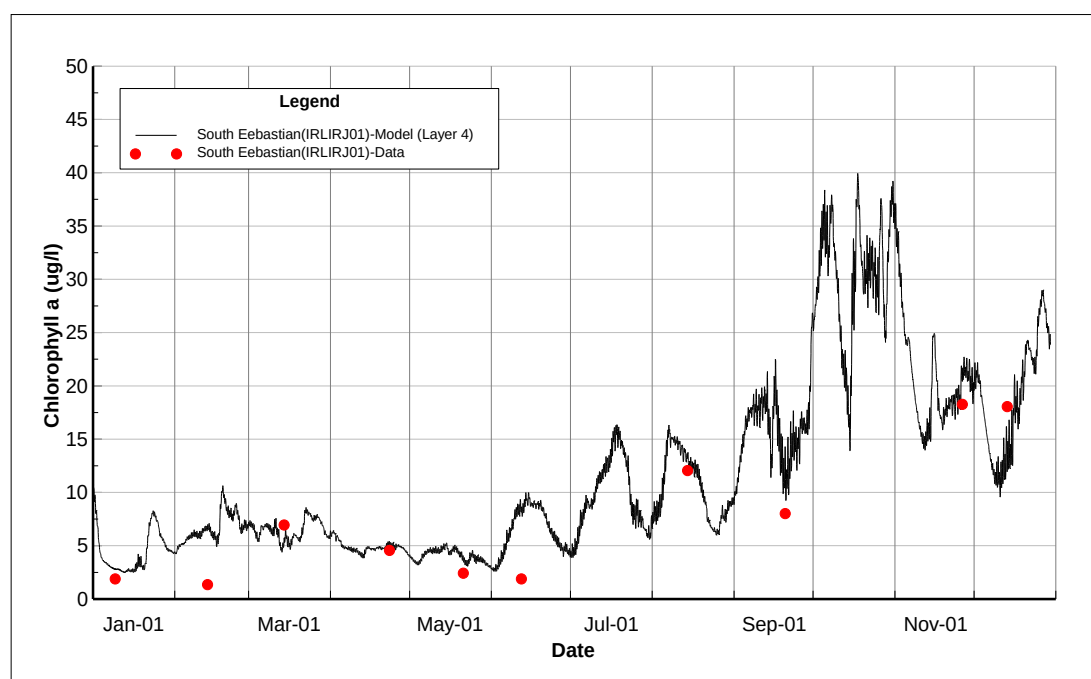


Figure G13-b. Chlorophyll-a validation at South Sebastian (Station: IRLIRJ01)

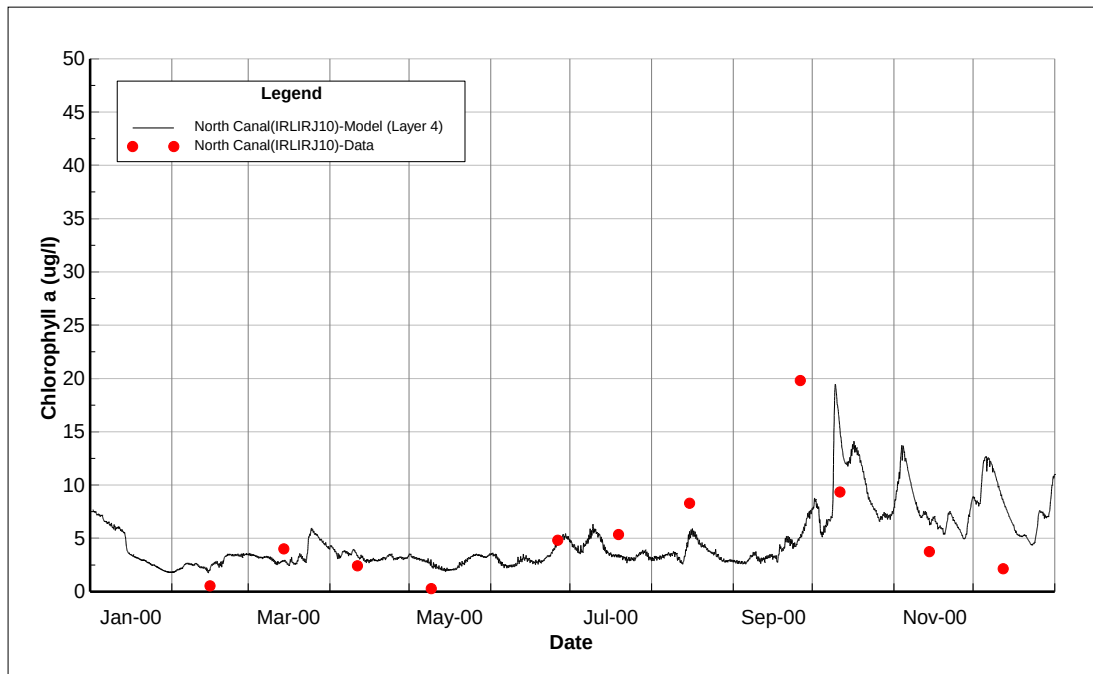


Figure G14-a. Chlorophyll-a Calibration at North Canal (Station: IRLIRJ10)

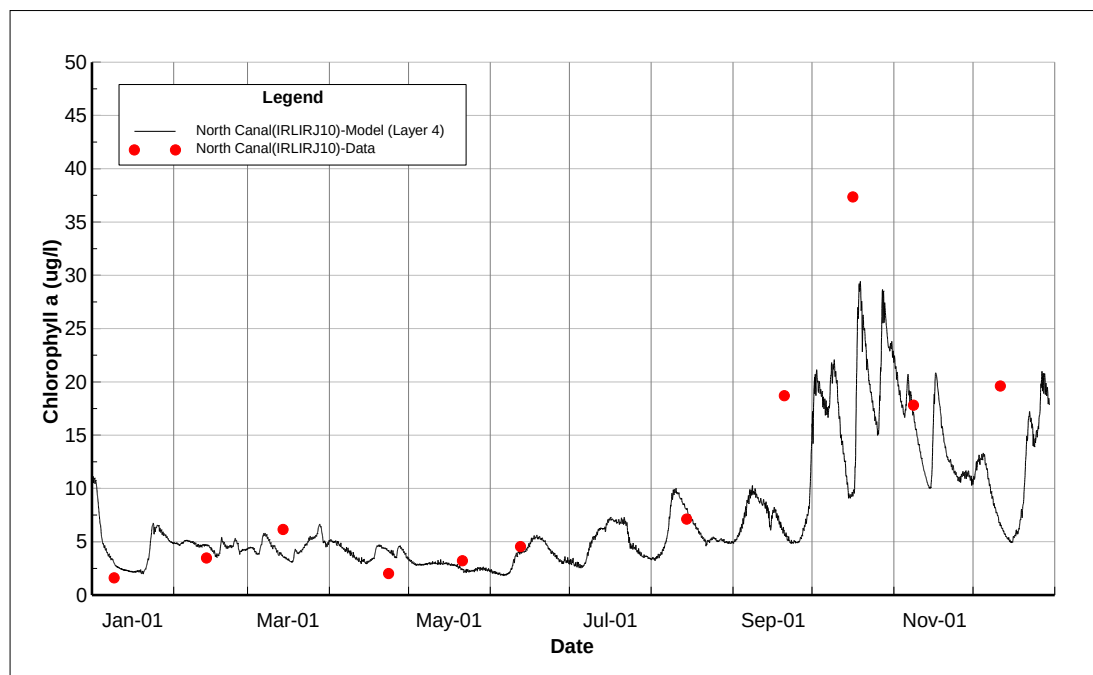


Figure G14-b. Chlorophyll-a validation at North Canal (Station: IRLIRJ10)

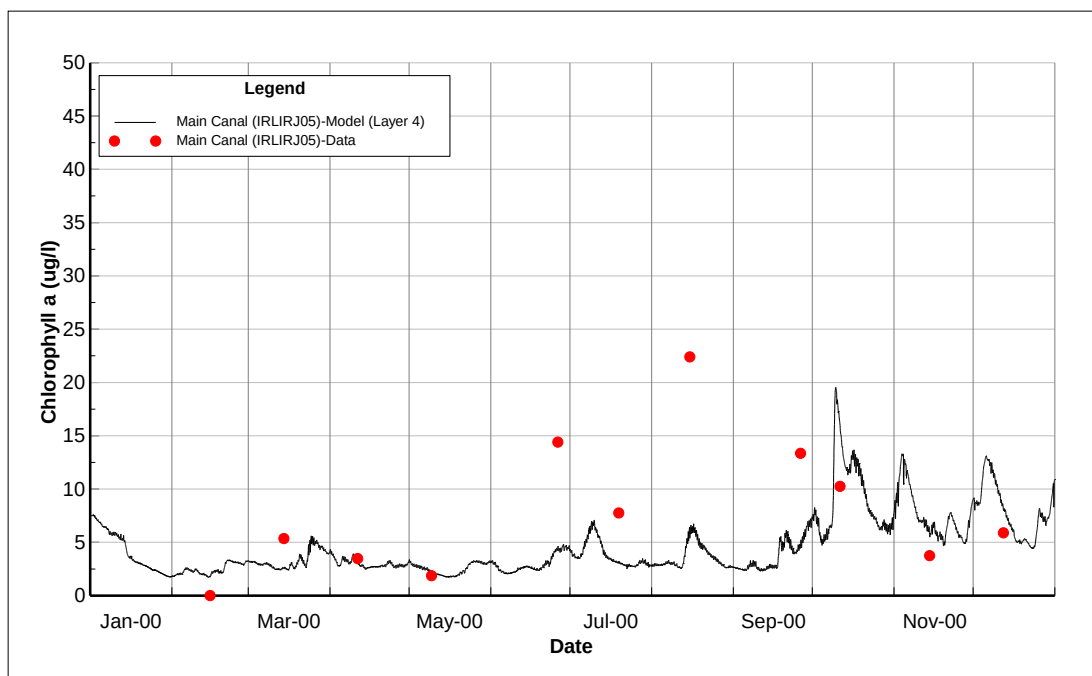


Figure G15-a. Chlorophyll-a Calibration at Main Canal (Station: IRLIRJ05)

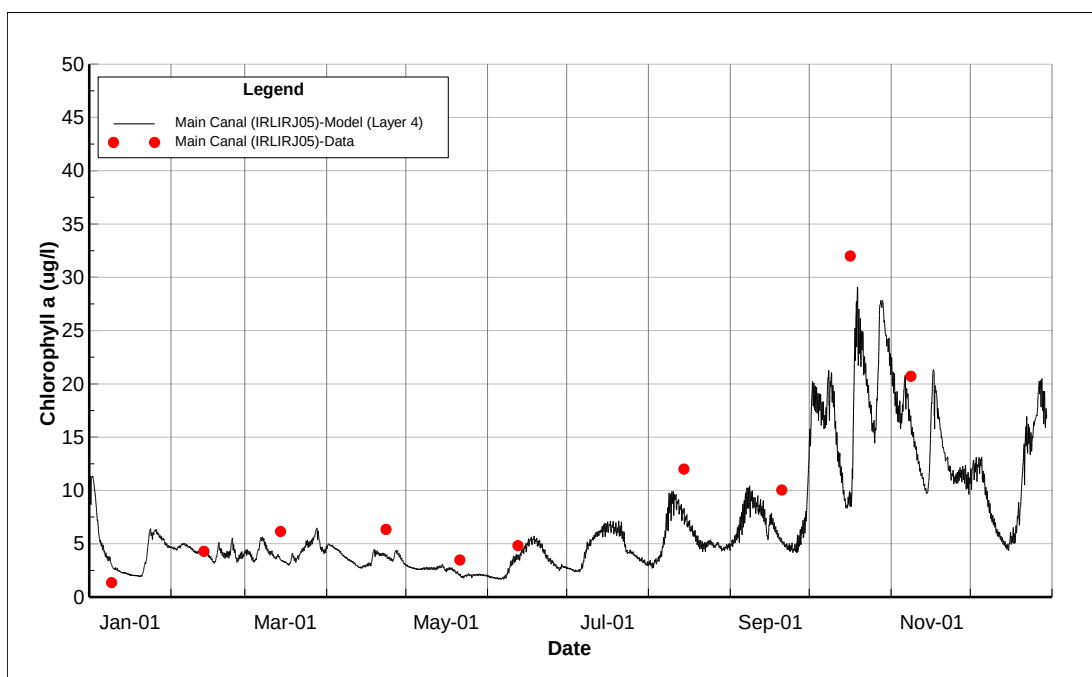


Figure G15-b. Chlorophyll-a validation at Main Canal (Station: IRLIRJ05)

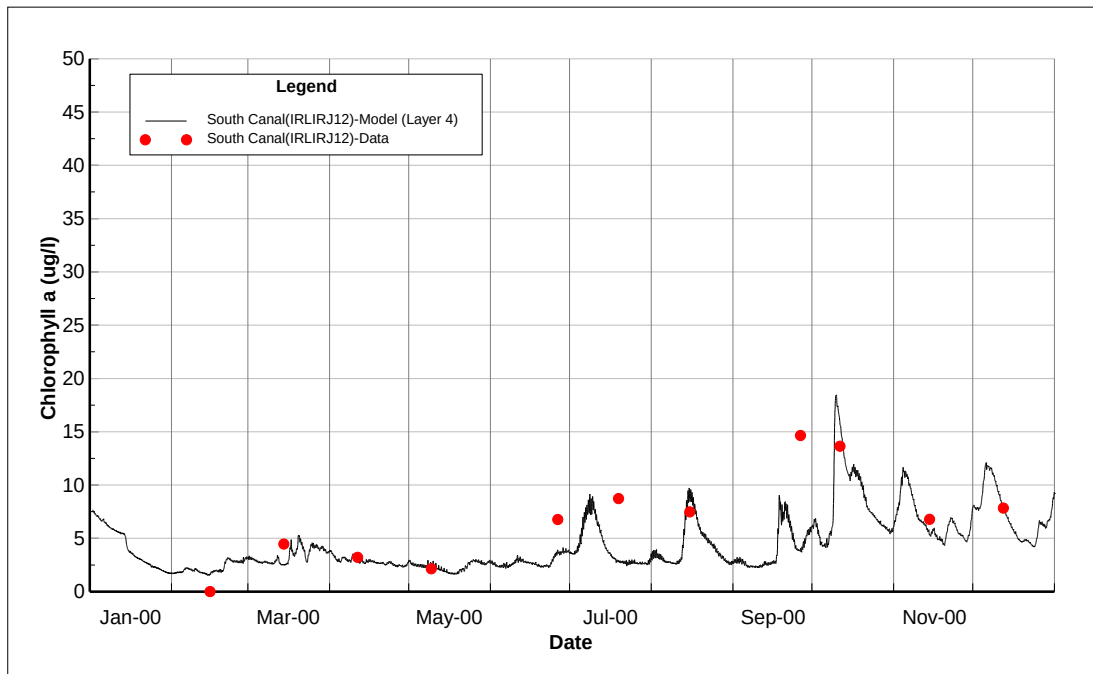


Figure G16-a. Chlorophyll-a Calibration at South Canal (Station: IRLJ12)

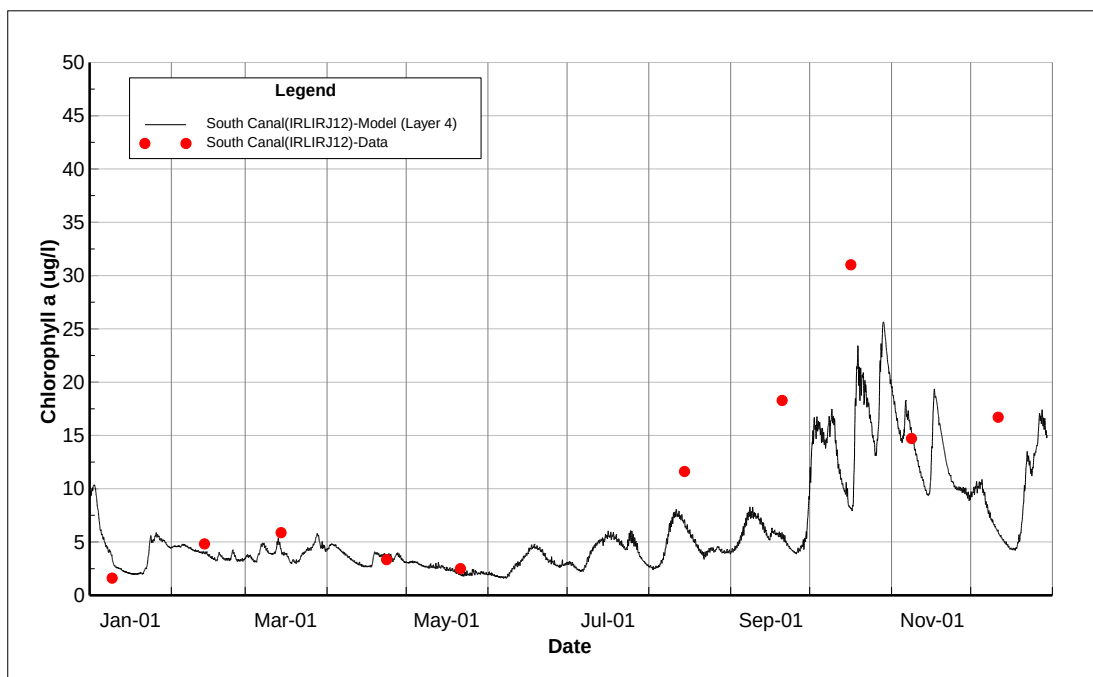


Figure G16-b. Chlorophyll-a validation at South Canal (Station: IRLIRJ12)

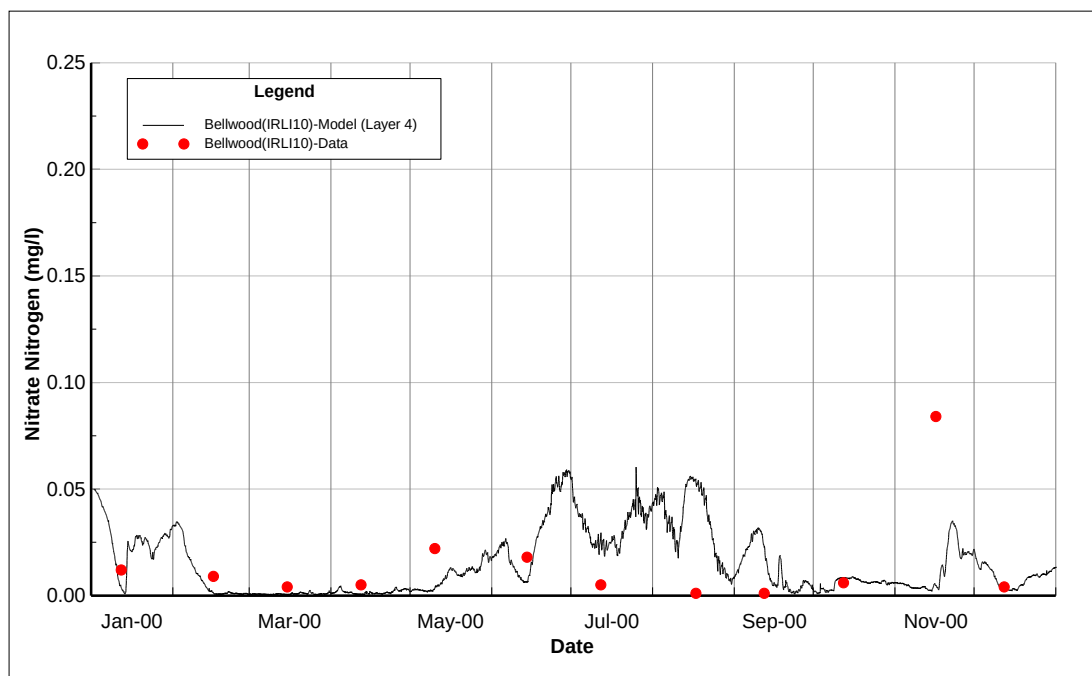


Figure G17-a. Nitrate Calibration at Bellwood (Station: IRL110)

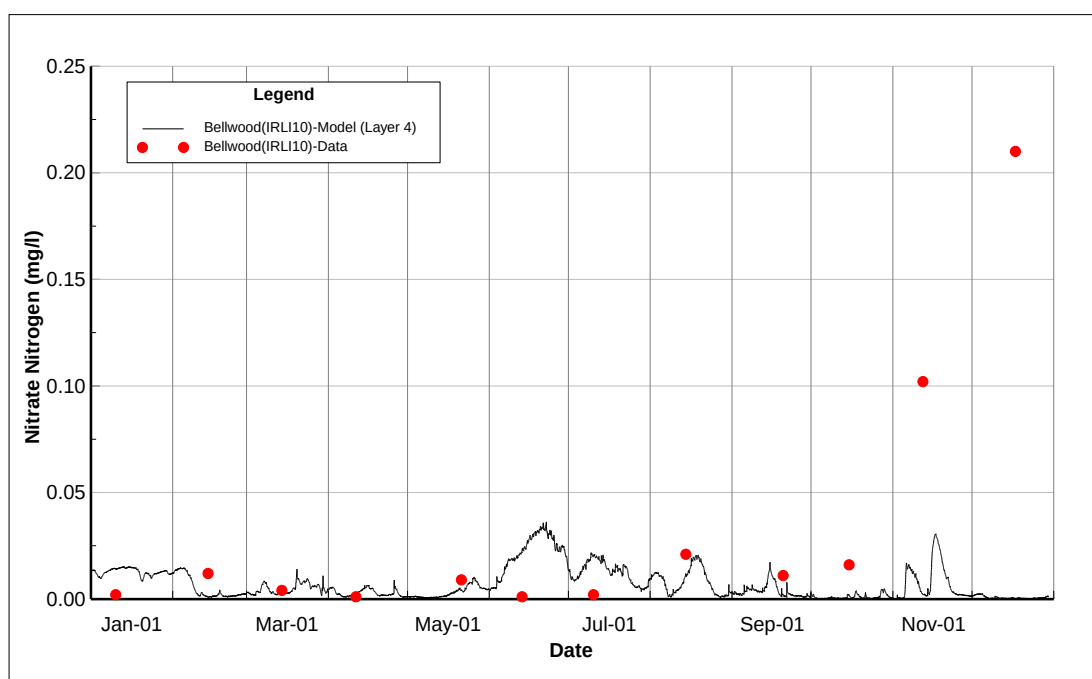


Figure G17-b. Nitrate validation at Bellwood (Station: IRL110)

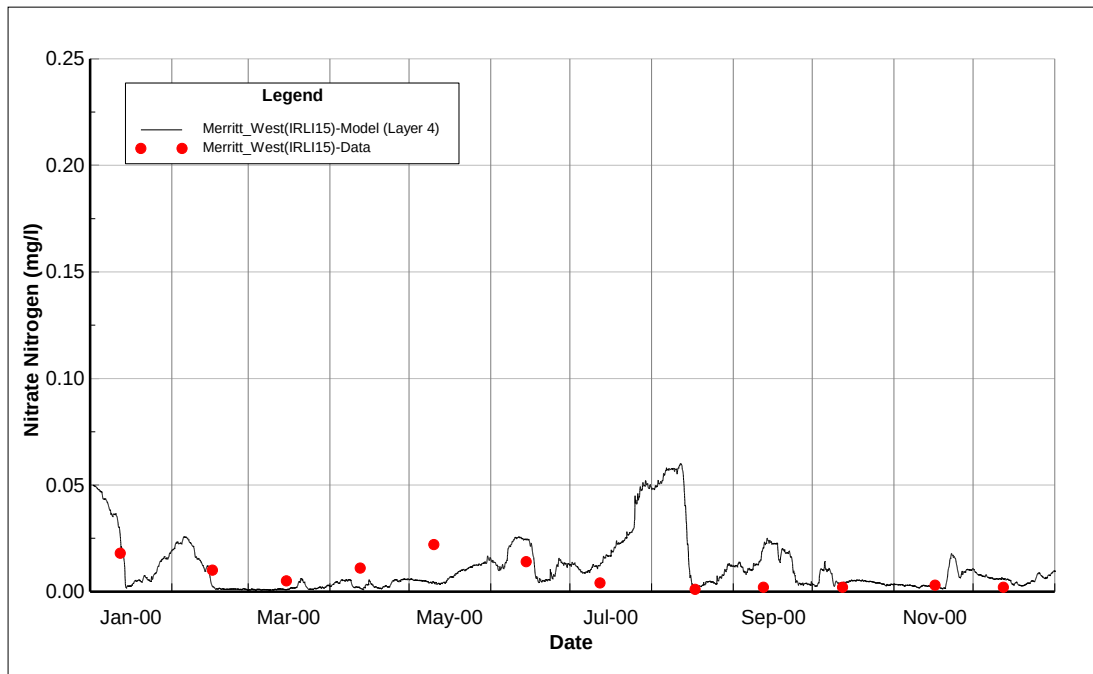


Figure G18-a. Nitrate Calibration at Merritt West (Station: IRLI15)

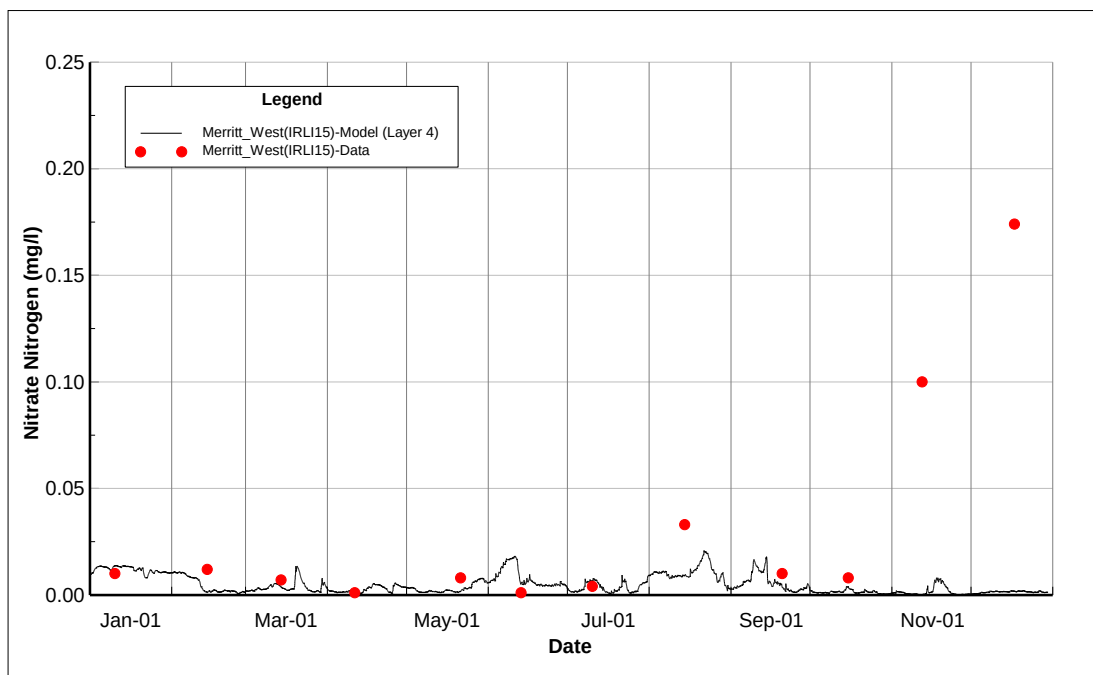


Figure G18-b. Nitrate validation at Merritt West (Station: IRLI15)

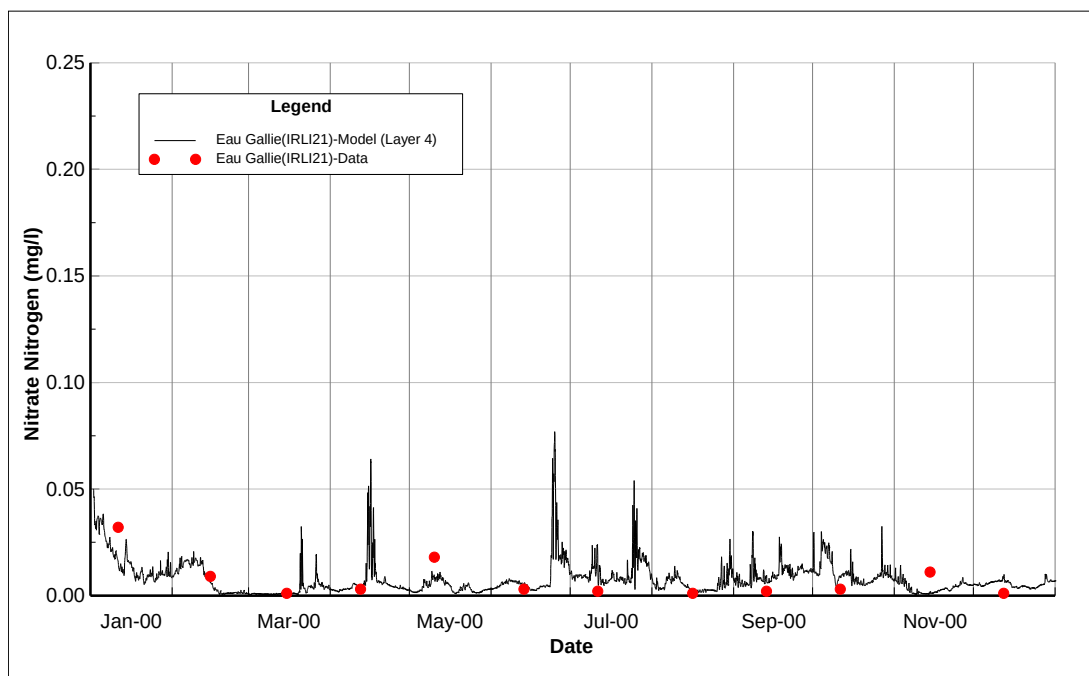


Figure G19-a. Nitrate Calibration at Eau Gallie (Station: IRLI21)

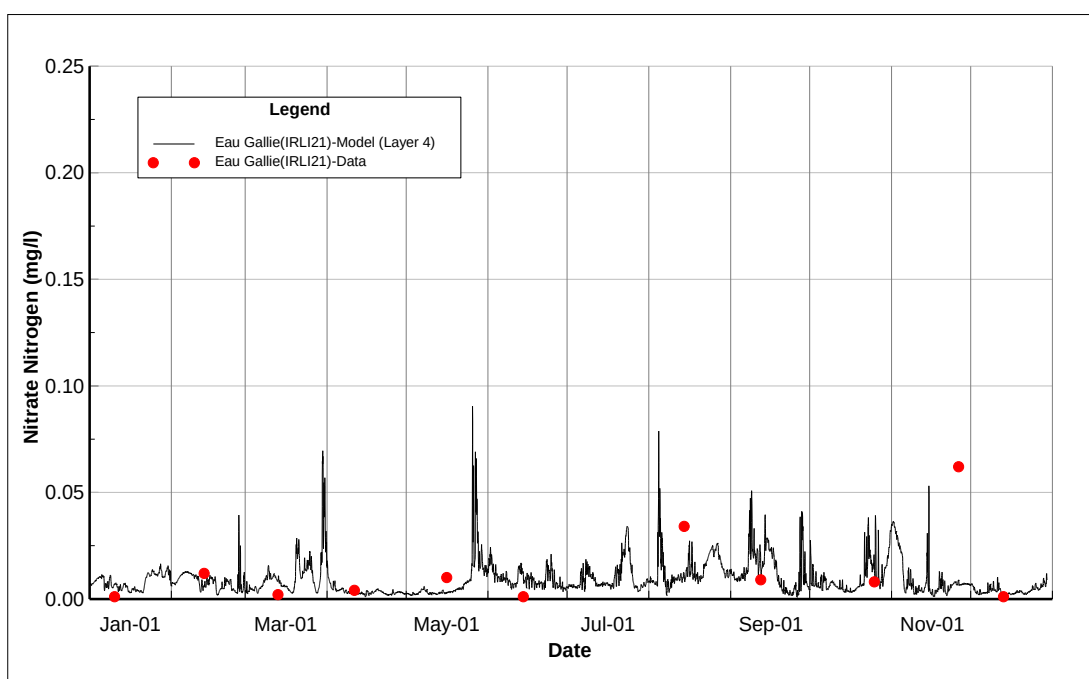


Figure G19-b. Nitrate validation at Eau Gallie (Station: IRLI21)

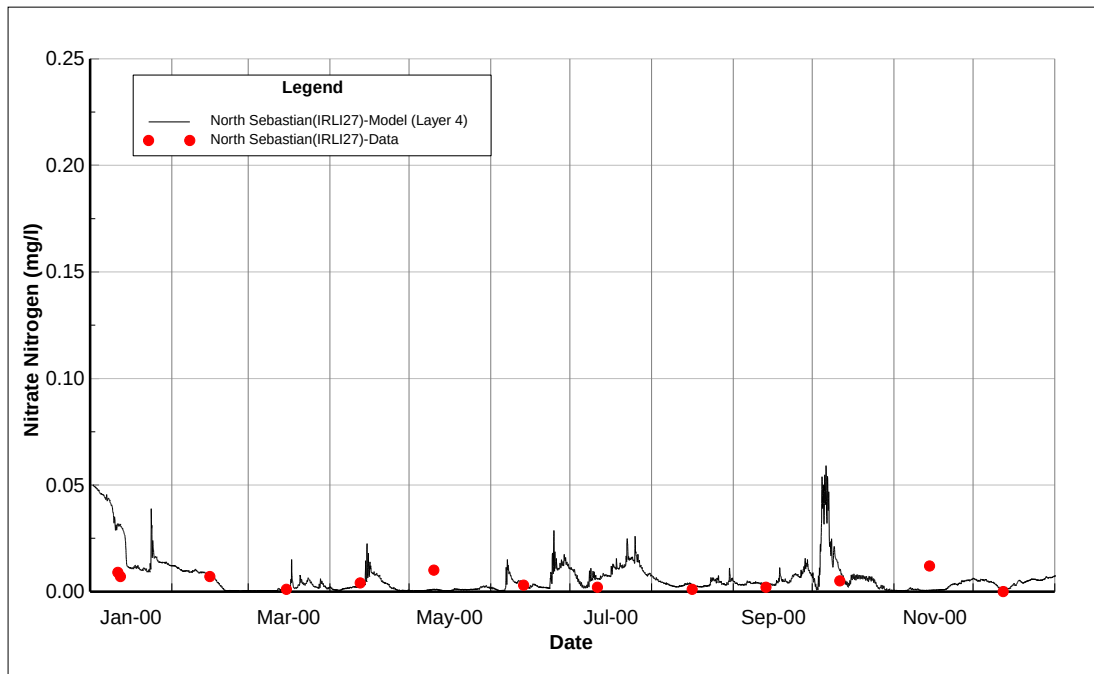


Figure G20-a. Nitrate Calibration at North Sebastian (Station: IRLI27)

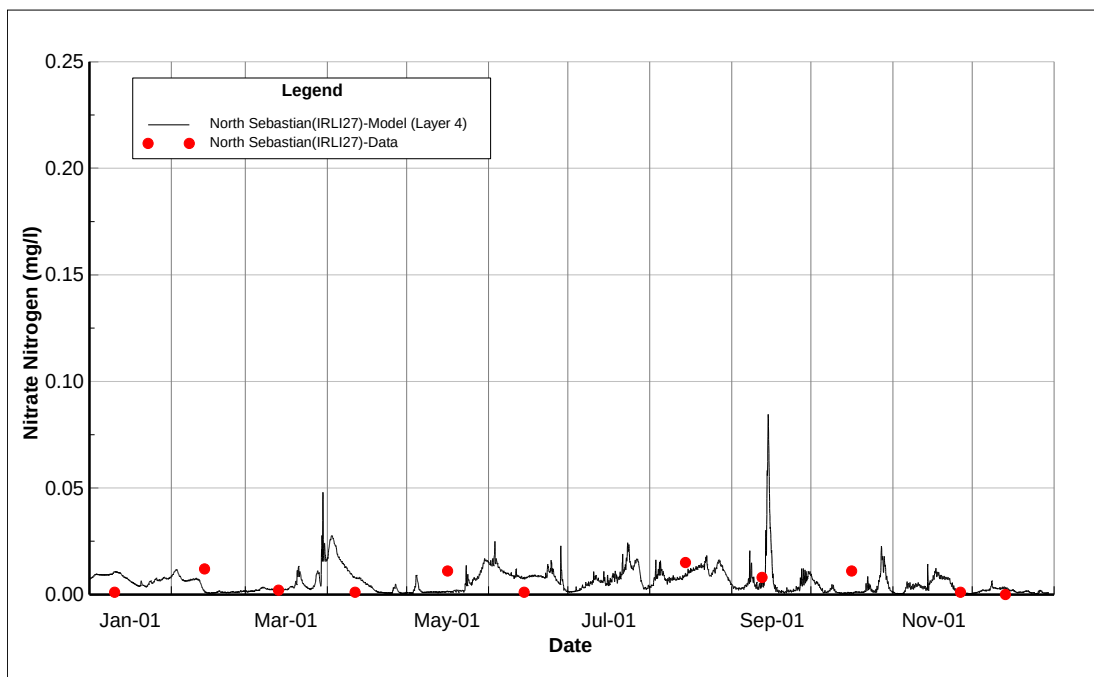


Figure G20-b. Nitrate validation at North Sebastian (Station: IRLI27)

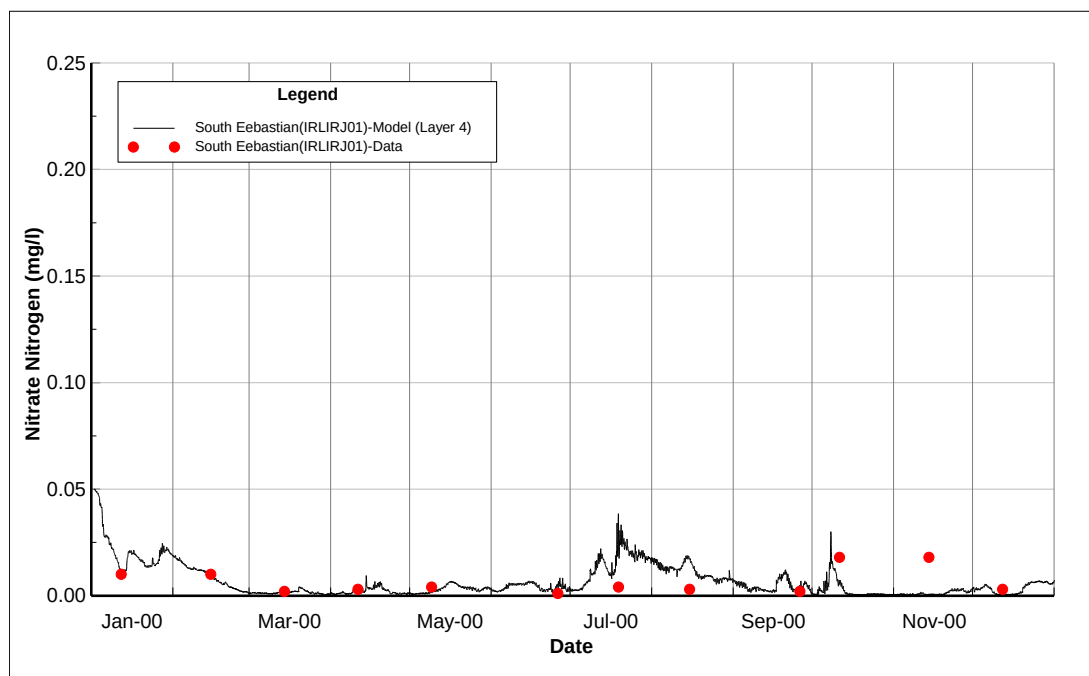


Figure G21-a. Nitrate Calibration at South Sebastian (Station: IRLIRJ01)

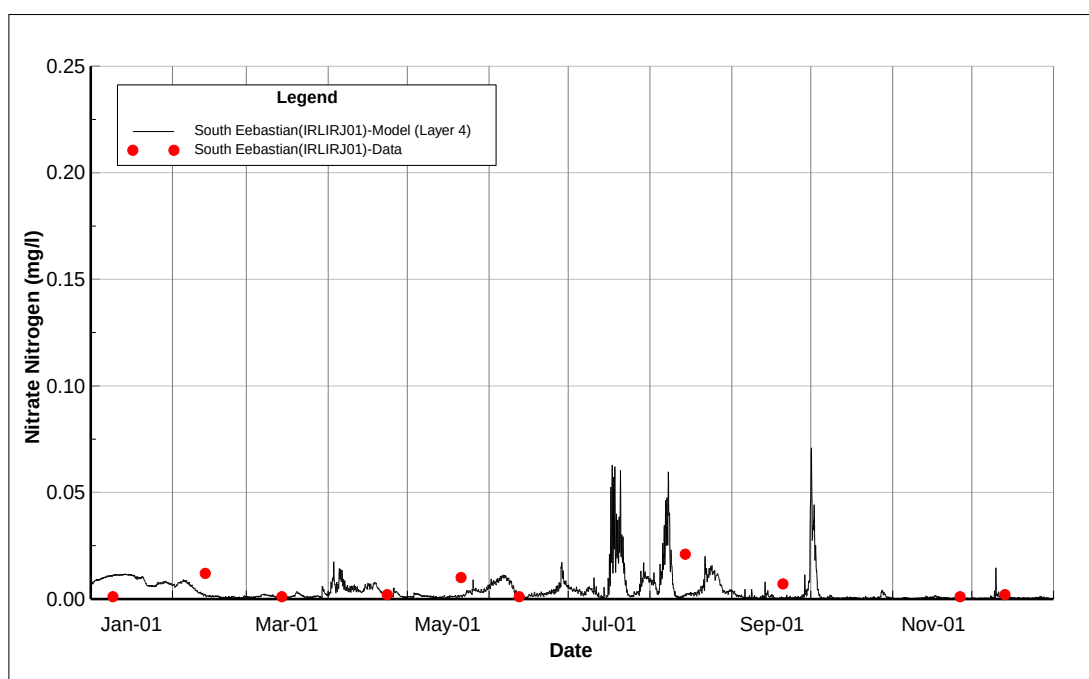


Figure G21-b. Nitrate validation at South Sebastian (Station: IRLIRJ01)

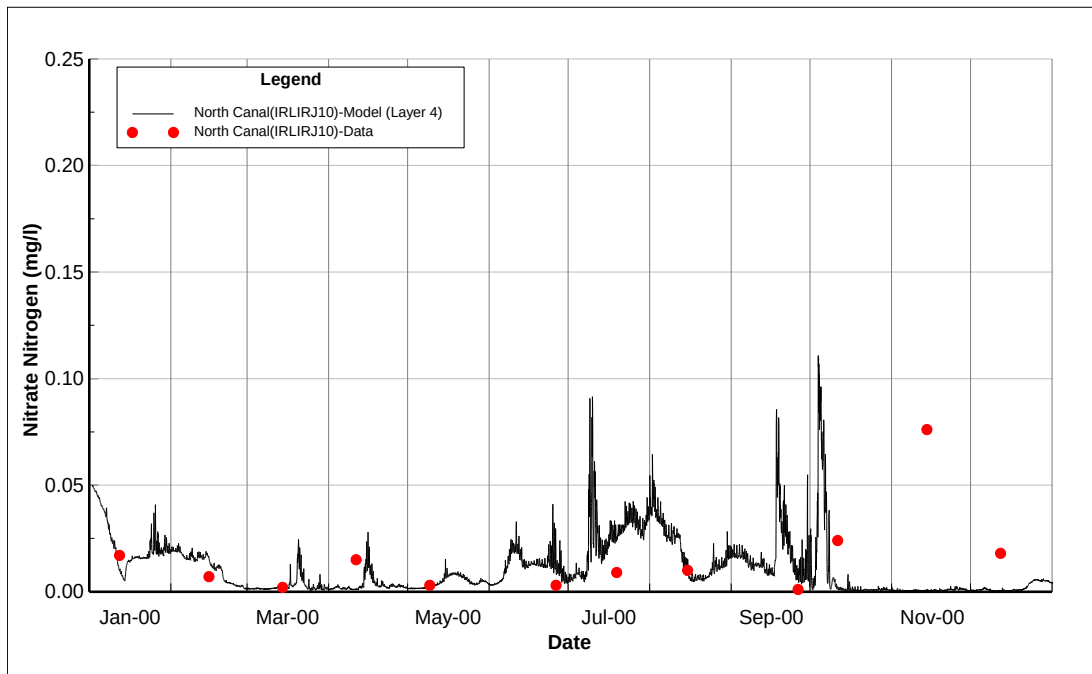


Figure G22-a. Nitrate Calibration at North Canal (Station: IRLIRJ10)

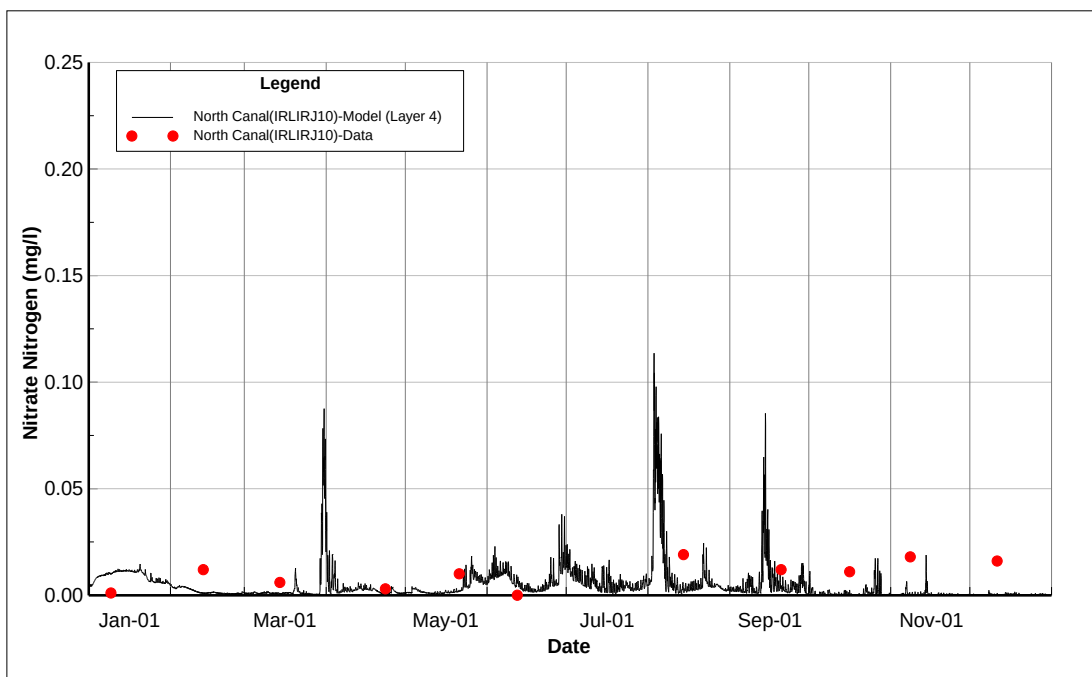


Figure G22-b. Nitrate validation at North Canal (Station: IRLIRJ10)

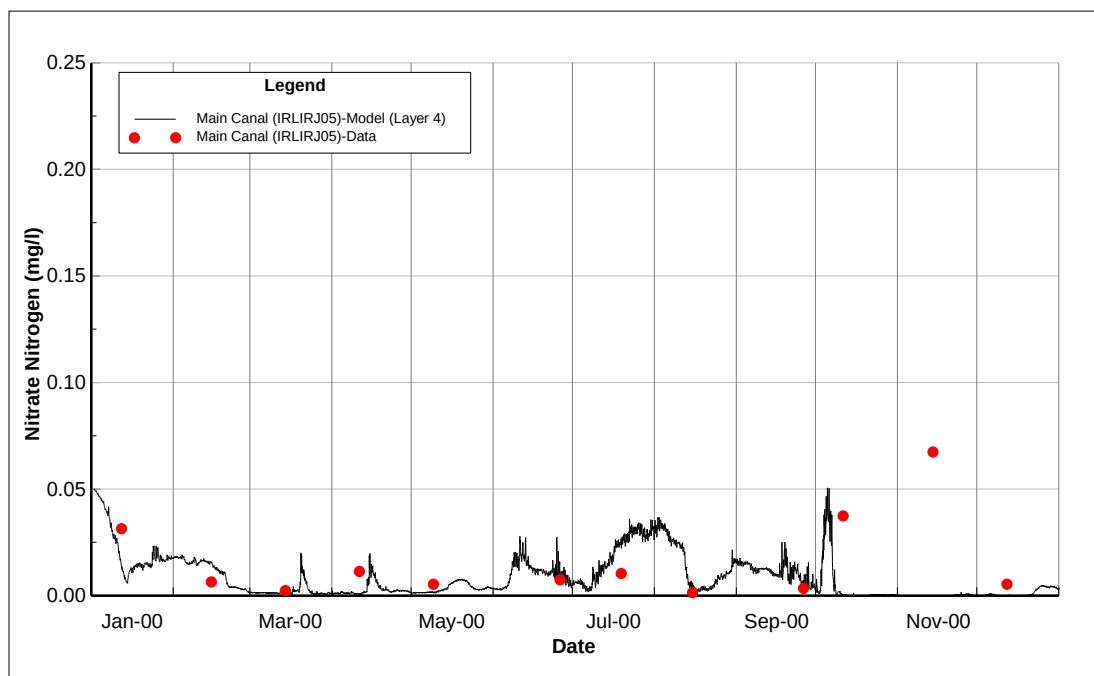


Figure G23-a. Nitrate Calibration at Main Canal (Station: IRLIRJ05)

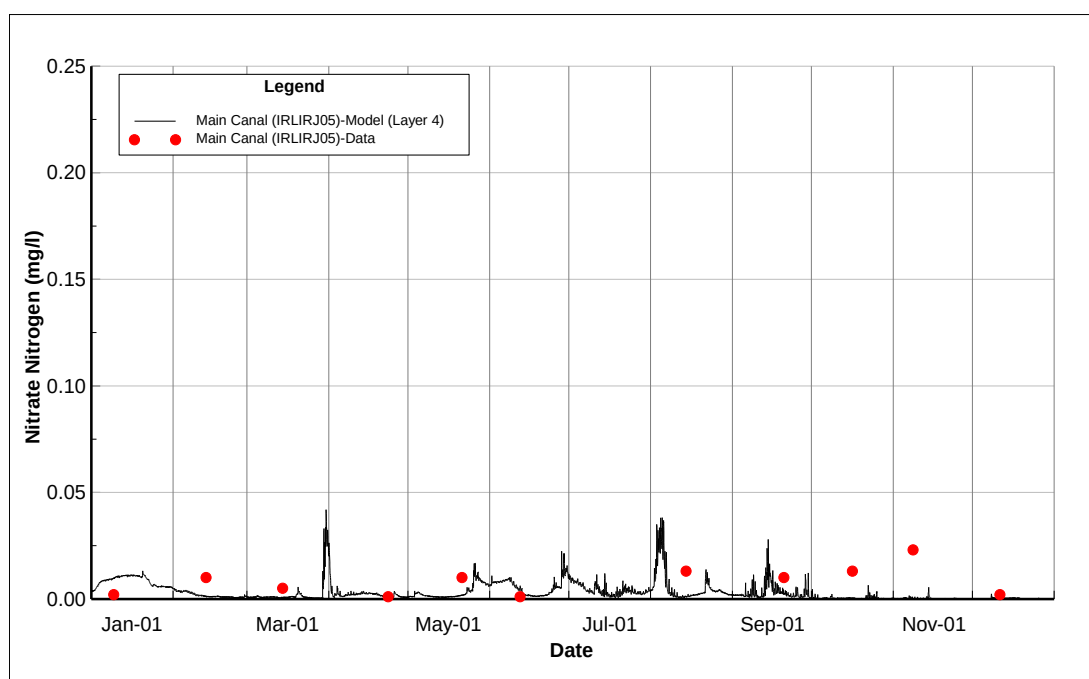


Figure G23-b. Nitrate validation at Main Canal (Station: IRLIRJ05)

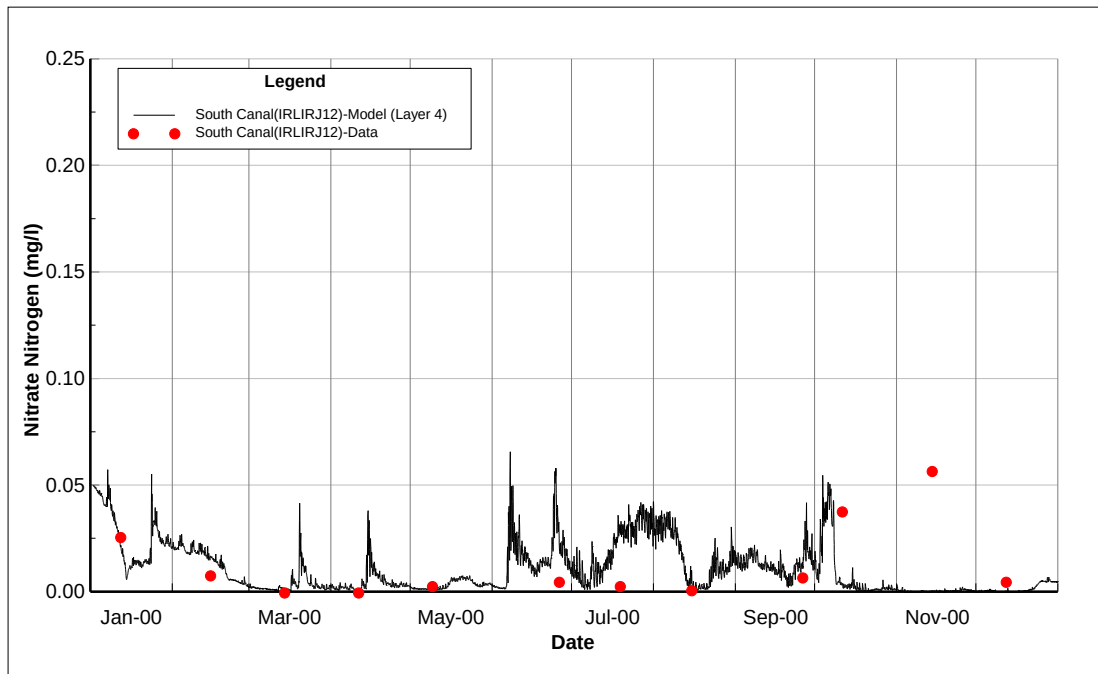


Figure G24-a. Nitrate Calibration at South Canal (Station: IRLIRJ12)

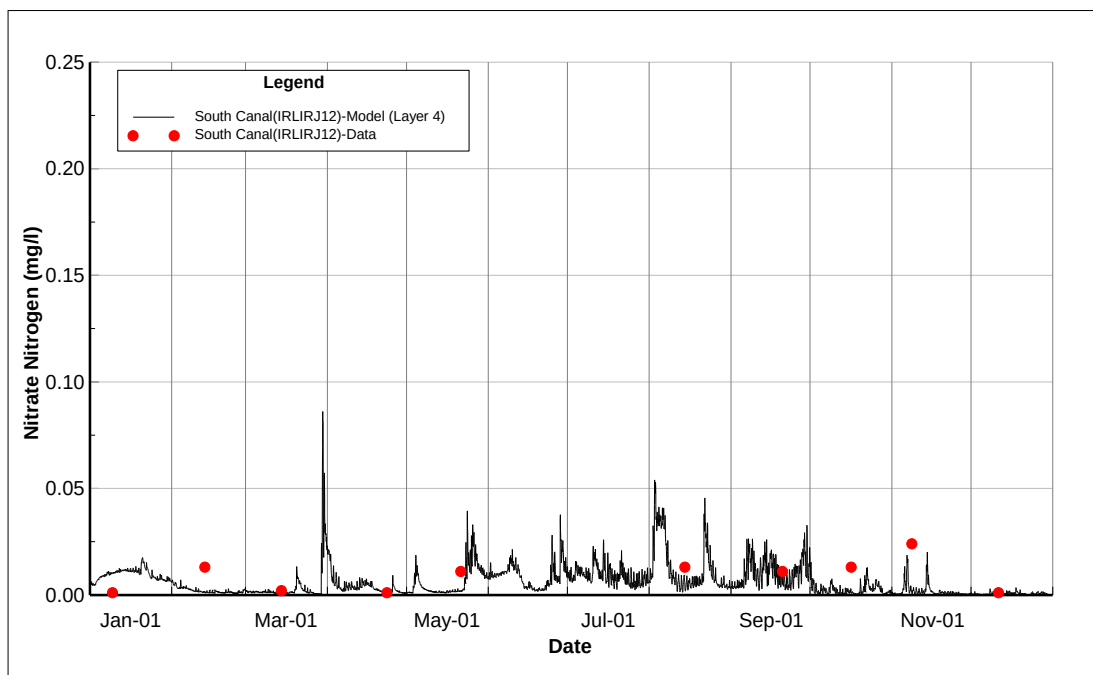


Figure G24-b. Nitrate validation at South Canal (Station: IRLIRJ12)

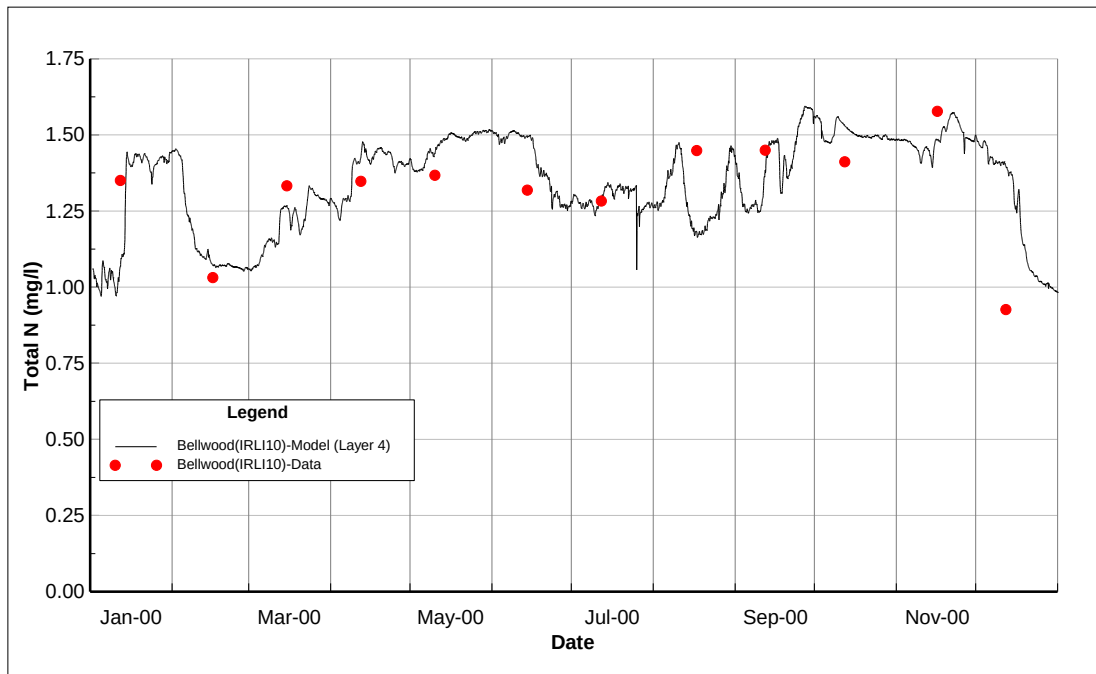


Figure G25-a. TN Calibration at Bellwood (Station: IRL110)

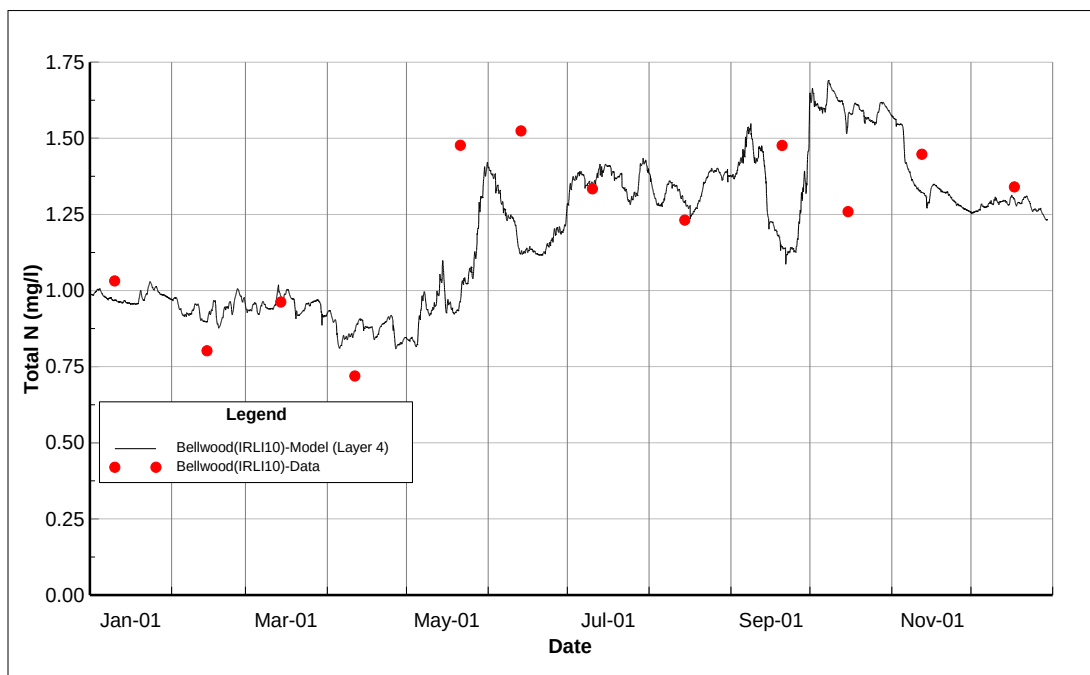


Figure G25-b. TN validation at Bellwood (Station: IRL110)

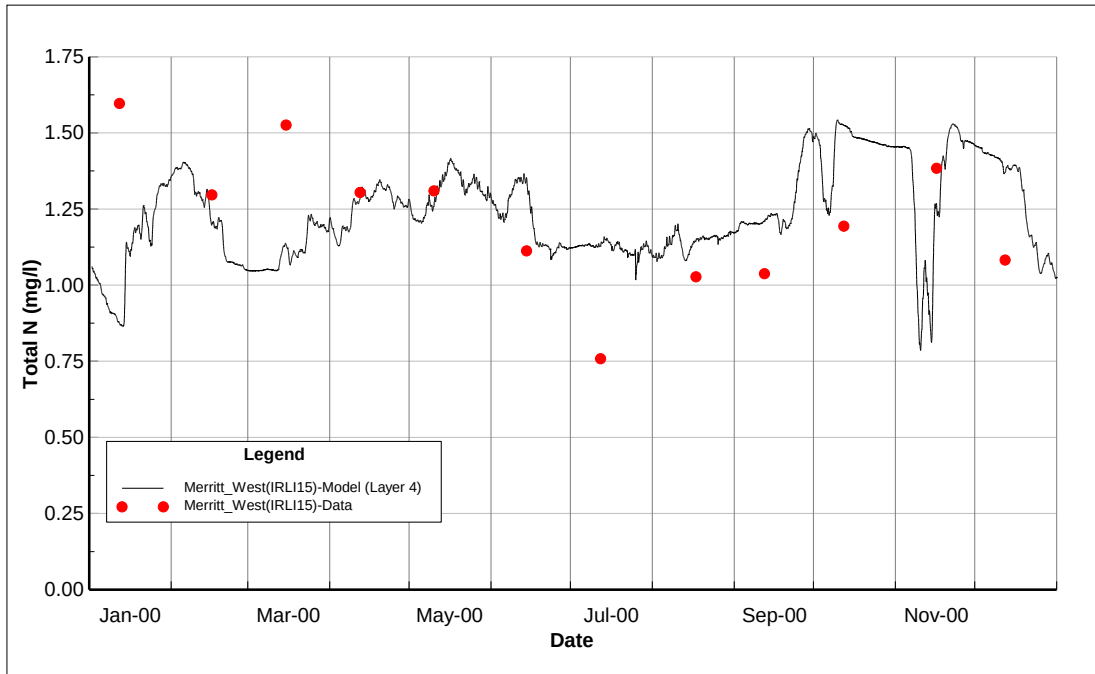


Figure G26-a. TN Calibration at Merritt West (Station: IRL15)

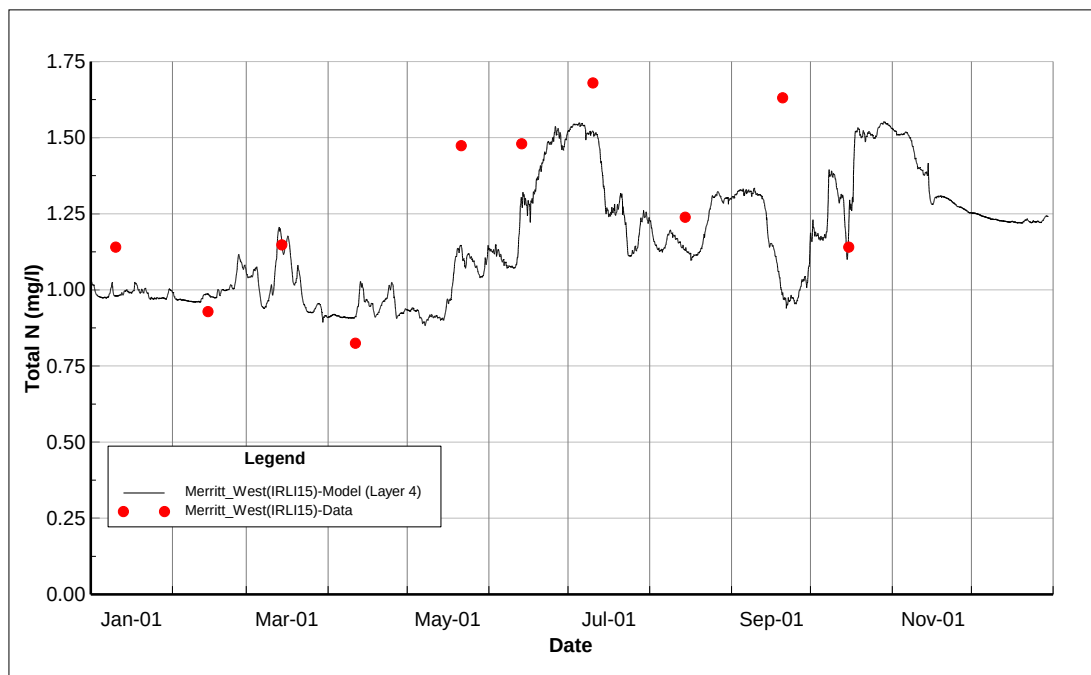


Figure G26-b. TN validation at Merritt West (Station: IRL15)

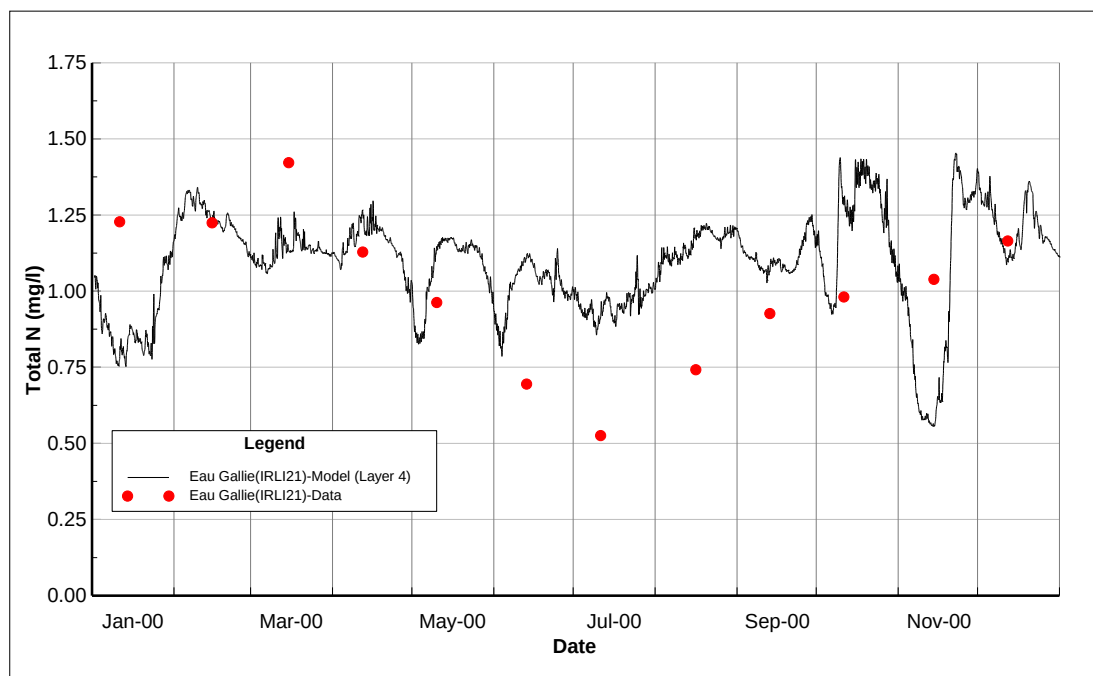


Figure G27-a. TN Calibration at Eau Gallie (Station: IRLI21)

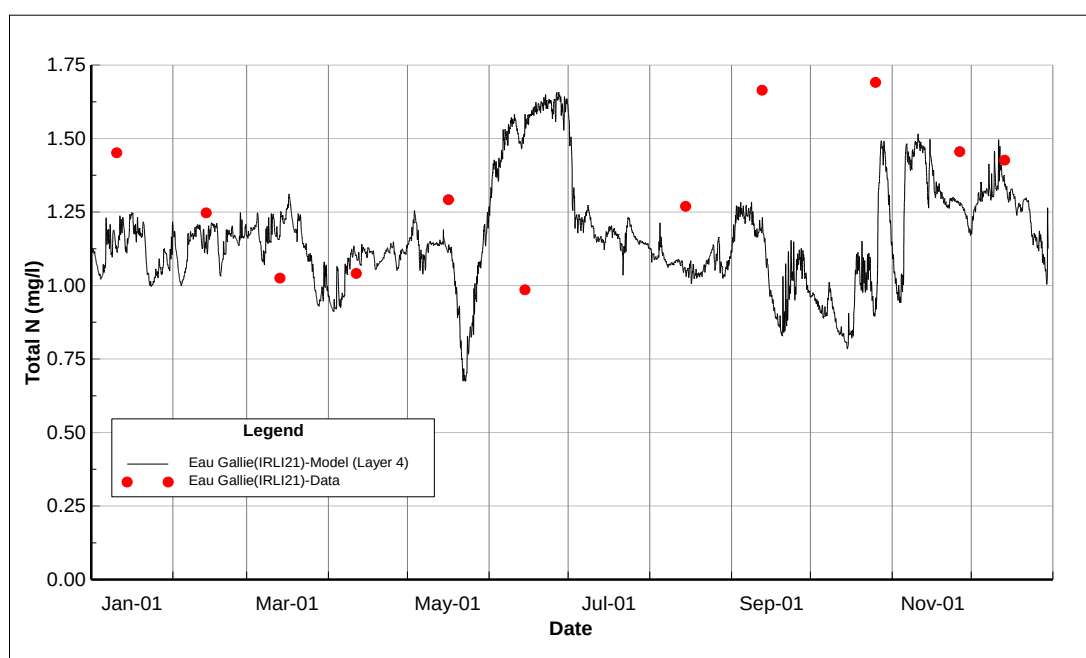


Figure G27-b. TN validation at Eau Gallie (Station: IRLI21)

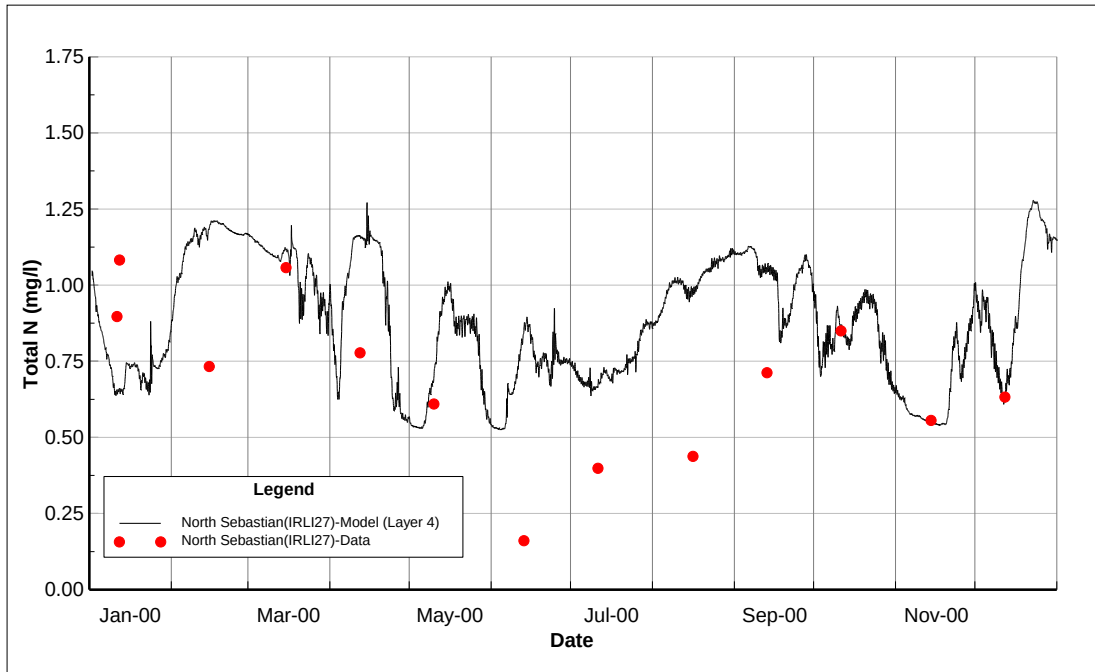


Figure G28-a. TN Calibration at North Sebastian (Station: IRLI27)

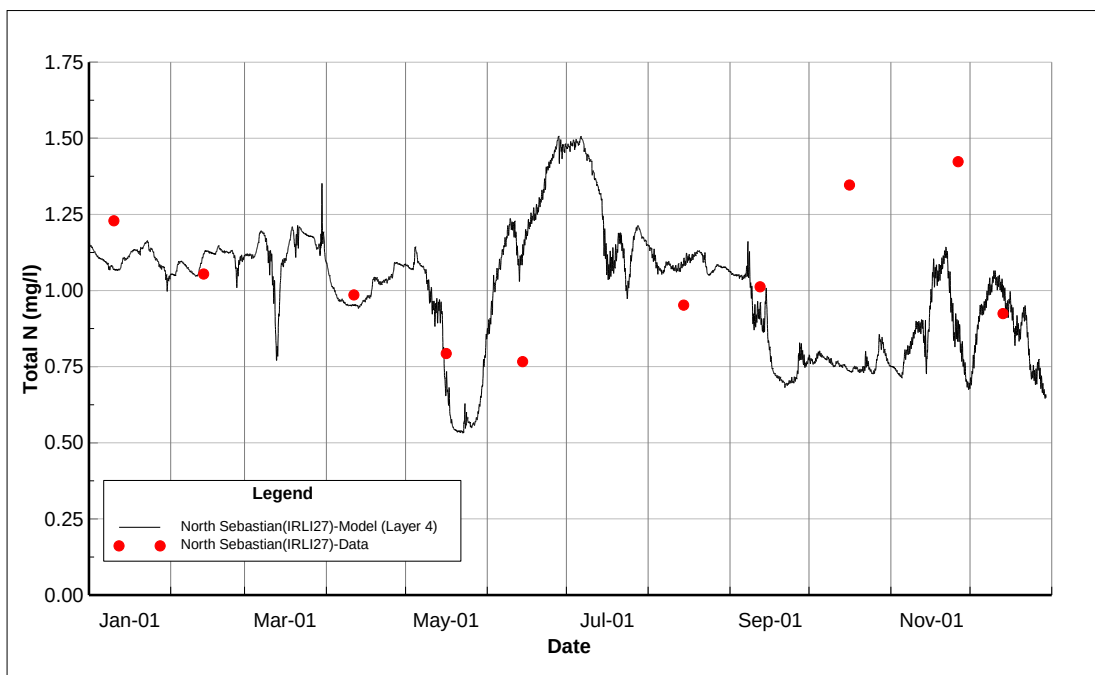


Figure G28-b. TN validation at North Sebastian (Station: IRLI27)

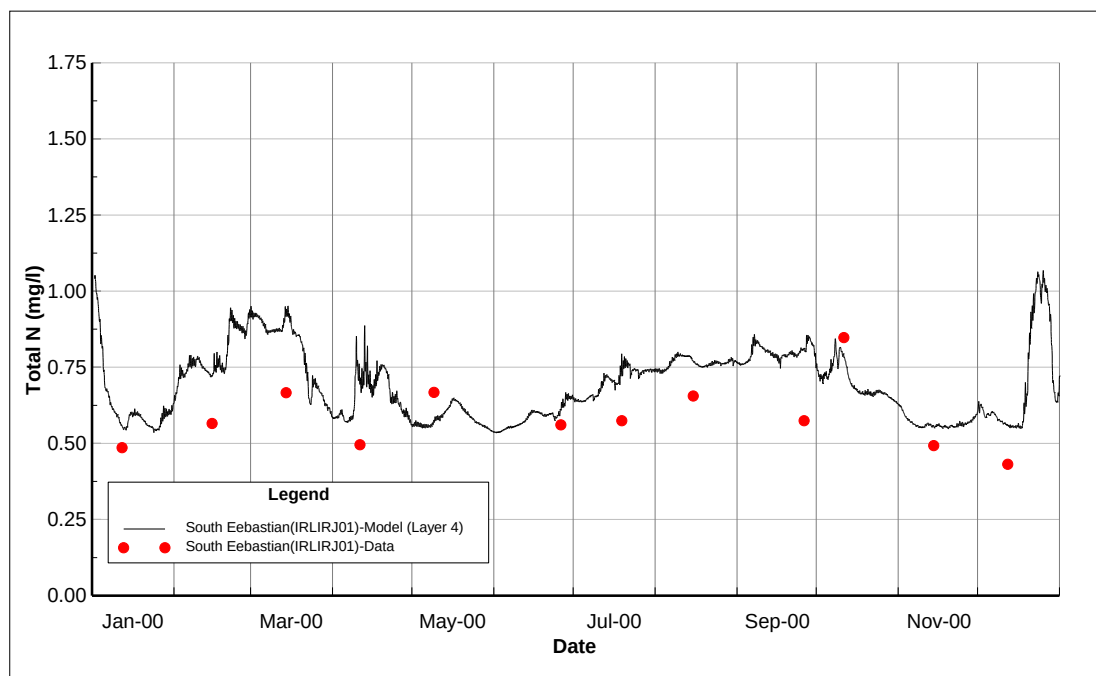


Figure G29-a. TN Calibration at South Sebastian (Station: IRLIRJ01)

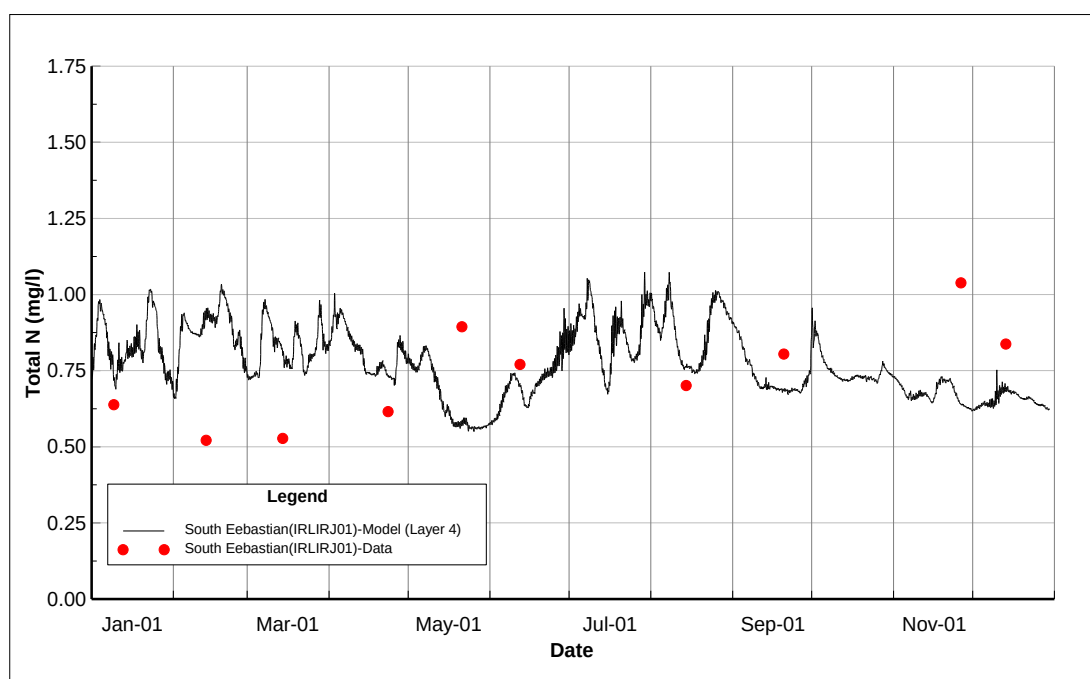


Figure G29-b. TN validation at South Sebastian (Station: IRLIRJ01)

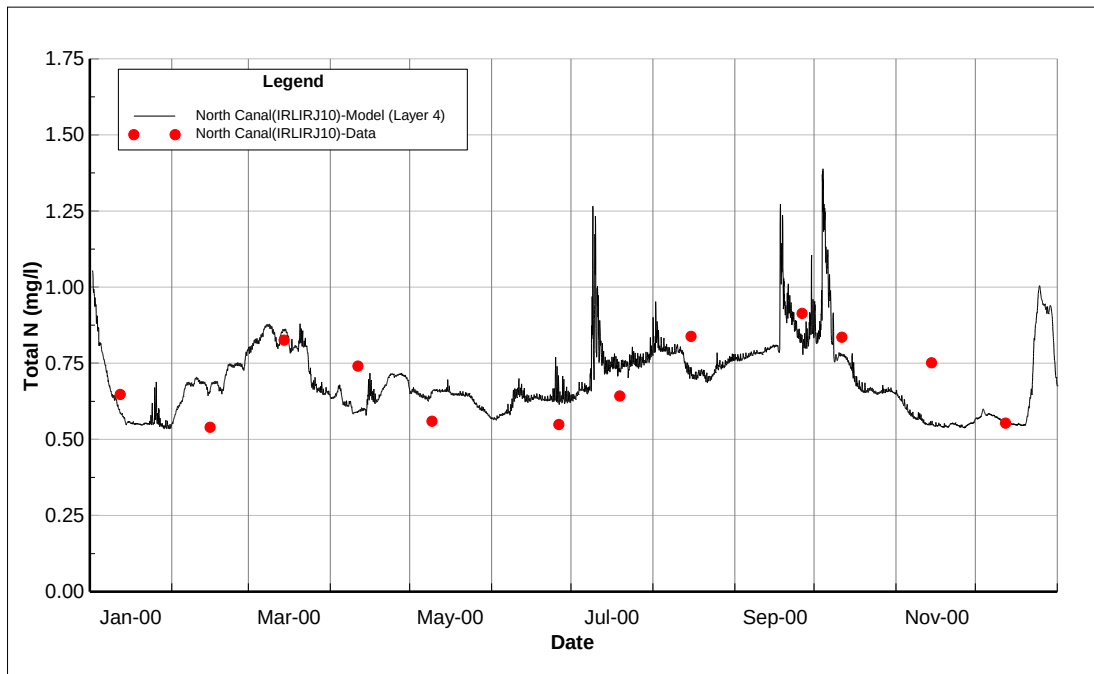


Figure G30-a. TN Calibration at North Canal (Station: IRLIRJ10)

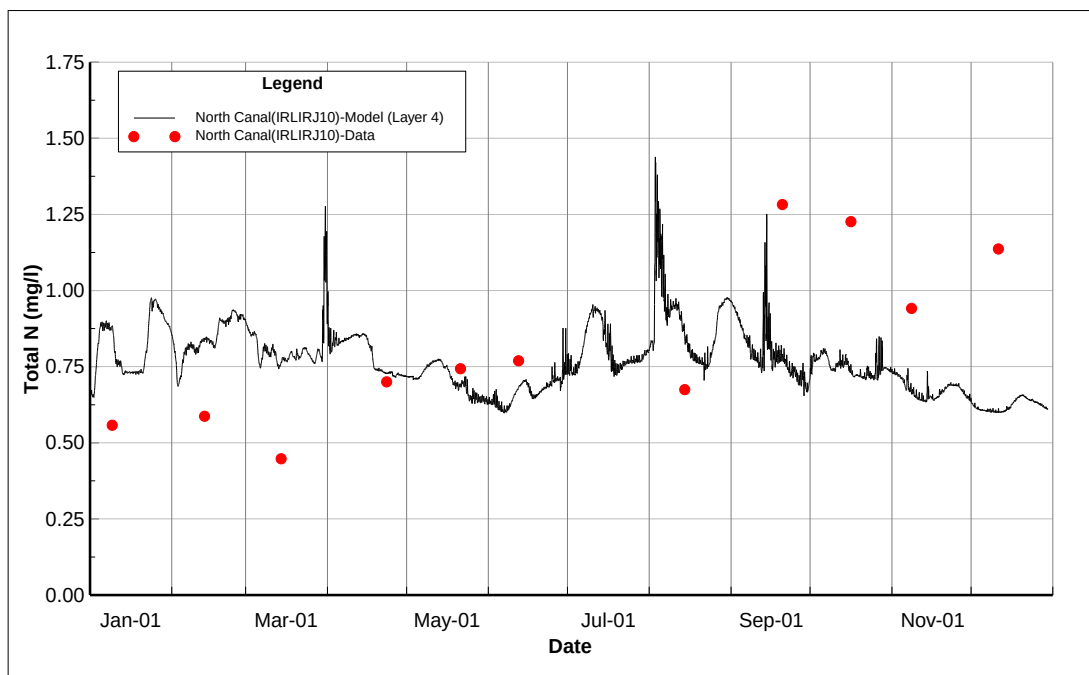


Figure G30-b. TN validation at North Canal (Station: IRLIRJ10)

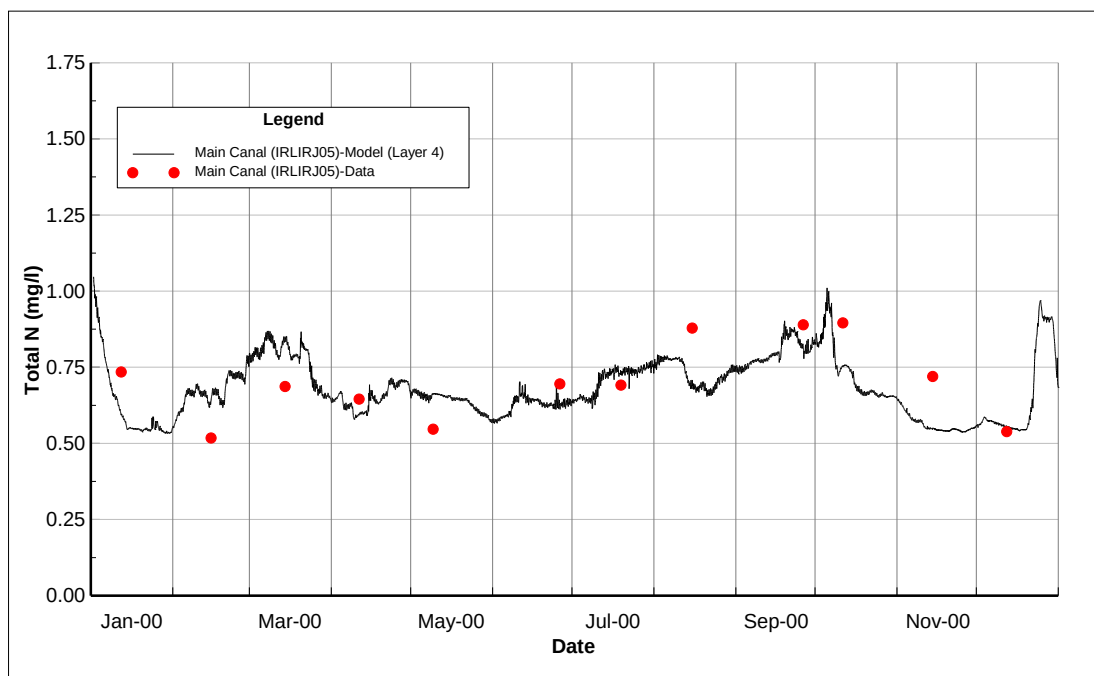


Figure G31-a. TN Calibration at Main Canal (Station: IRLIRJ05)

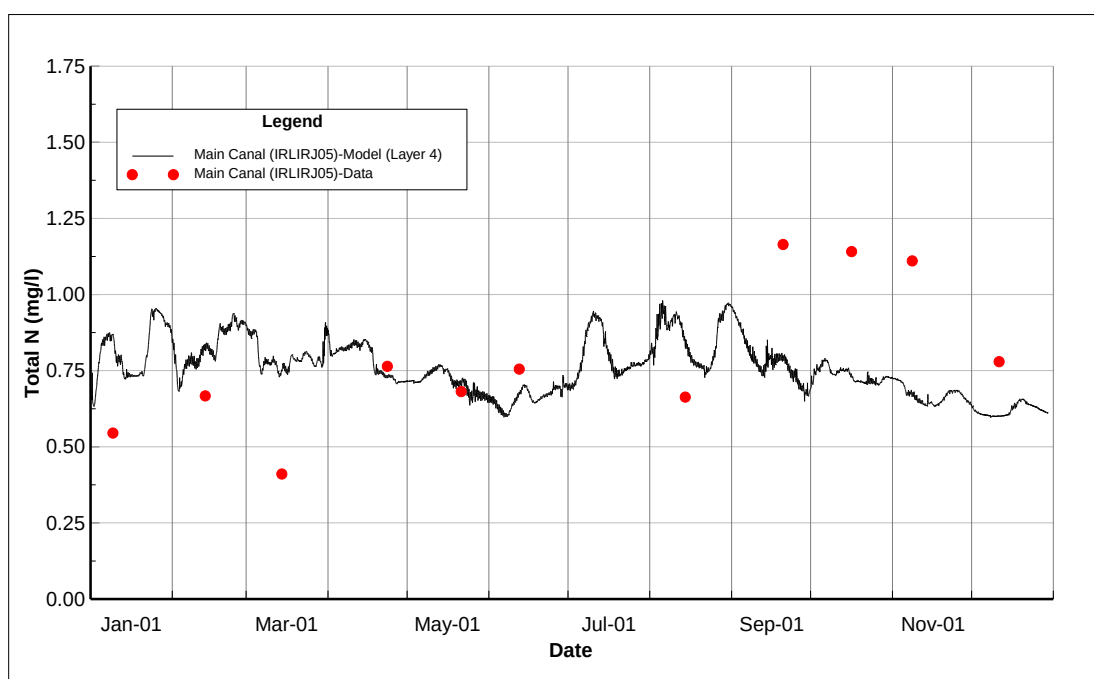


Figure G31-b. TN validation at Main Canal (Station: IRLIRJ05)

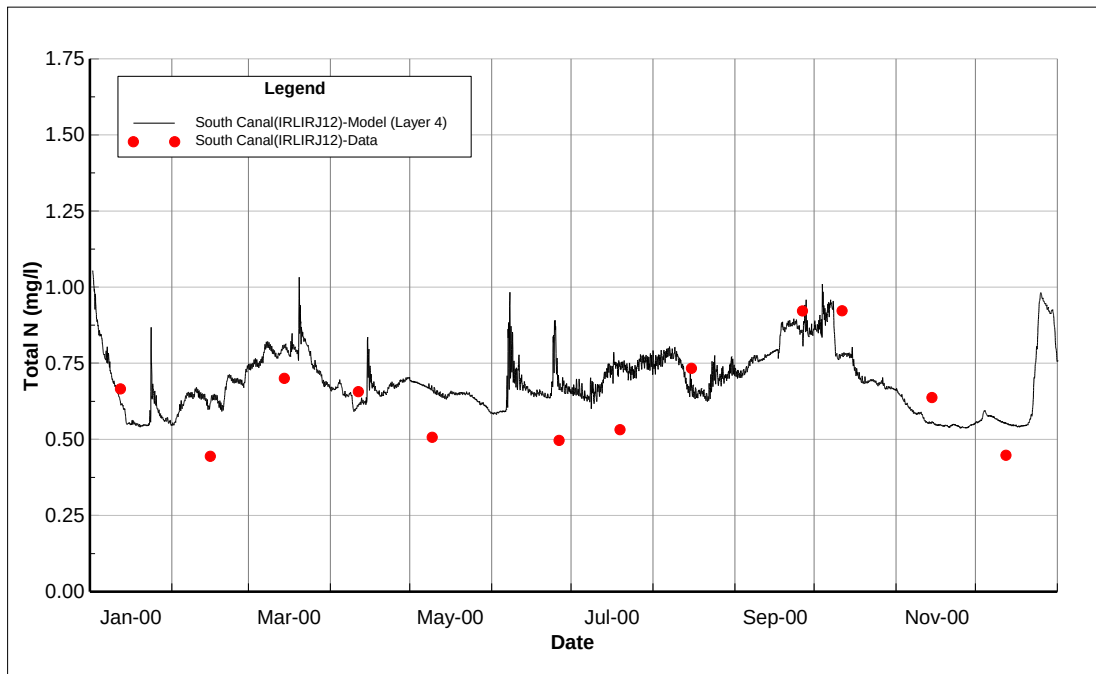


Figure G32-a. TN Calibration at South Canal (Station: IRLIRJ12)

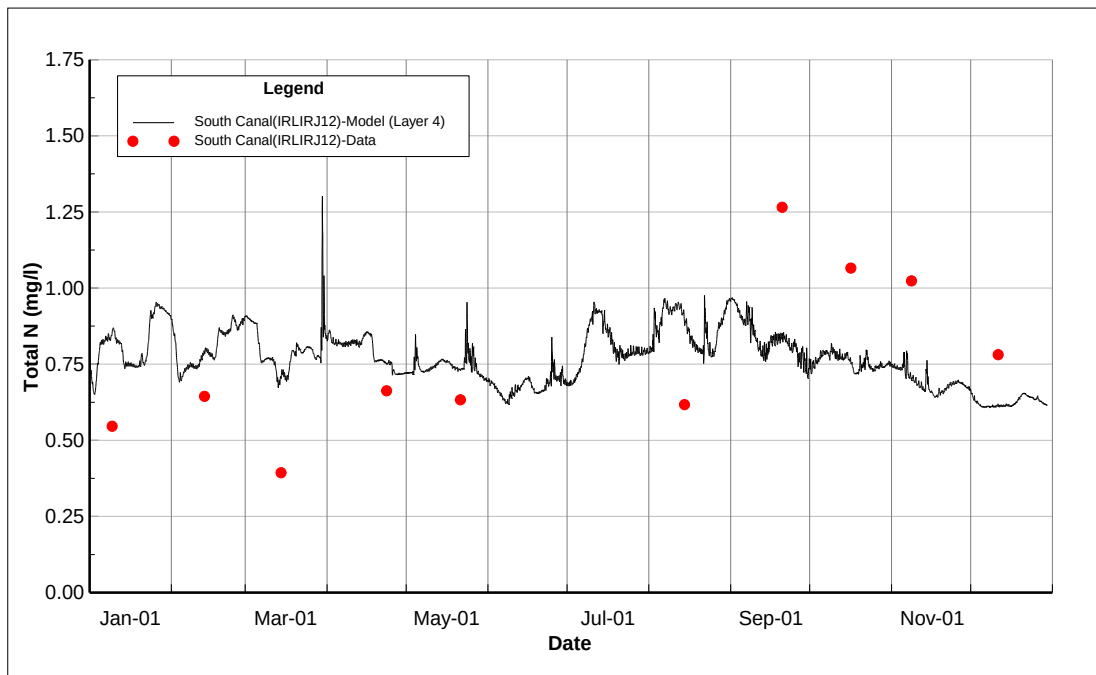


Figure G32-b. TN Validation at South Canal (Station: IRLIRJ12)

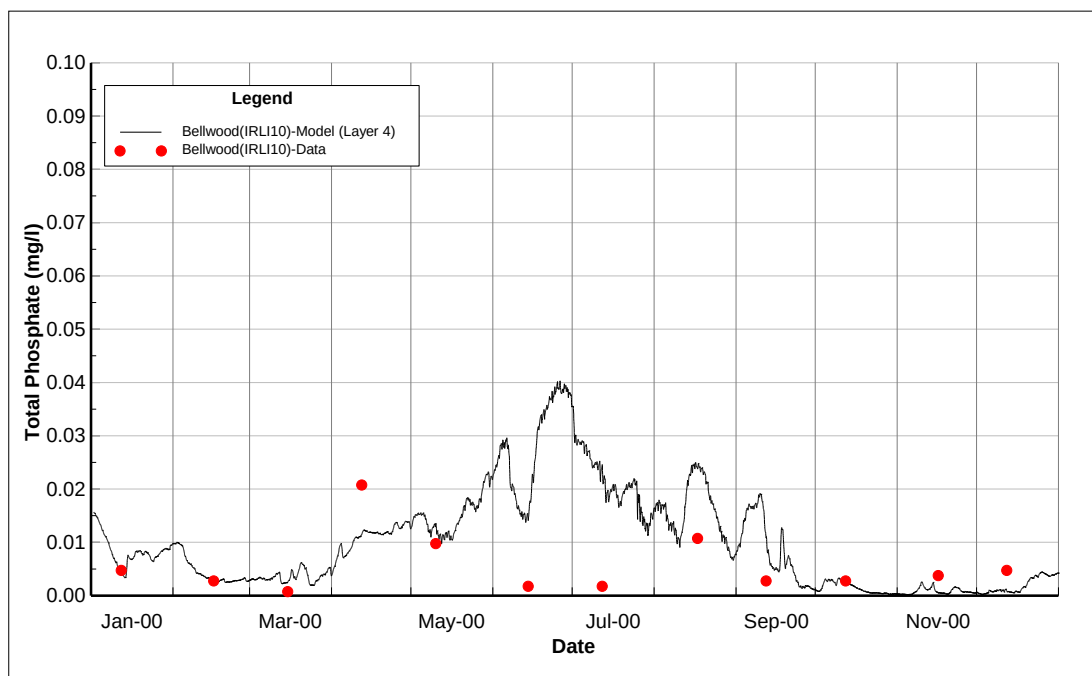


Figure G33-a. Phosphate Calibration at Bellwood (Station: IRL110)

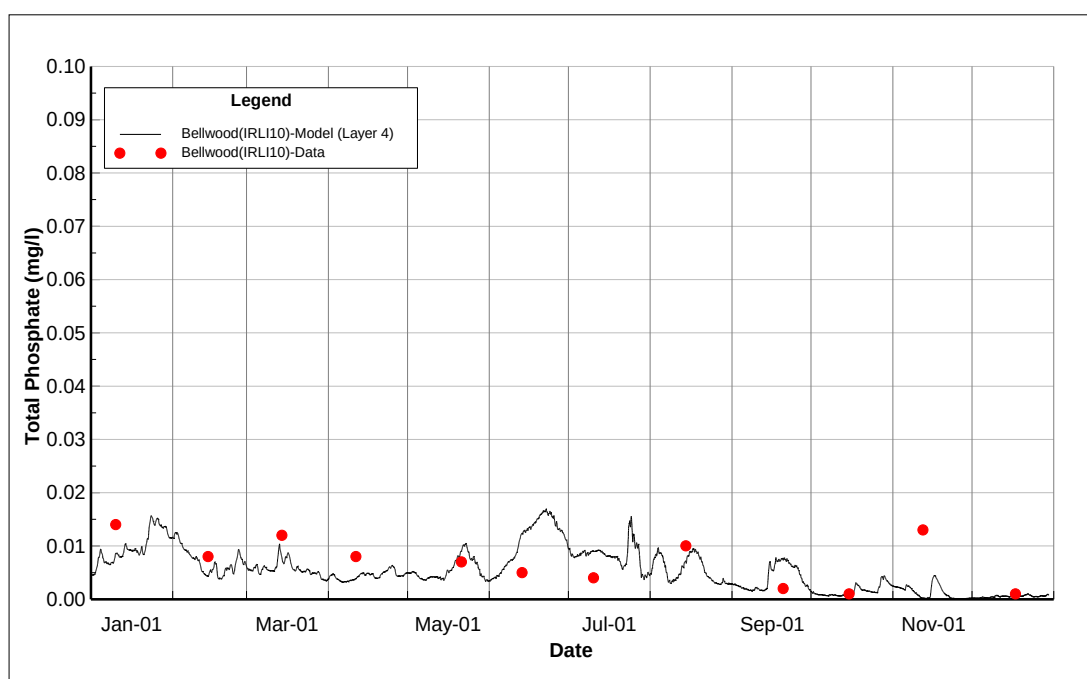


Figure G33-b. Phosphate validation at Bellwood (Station: IRL110)

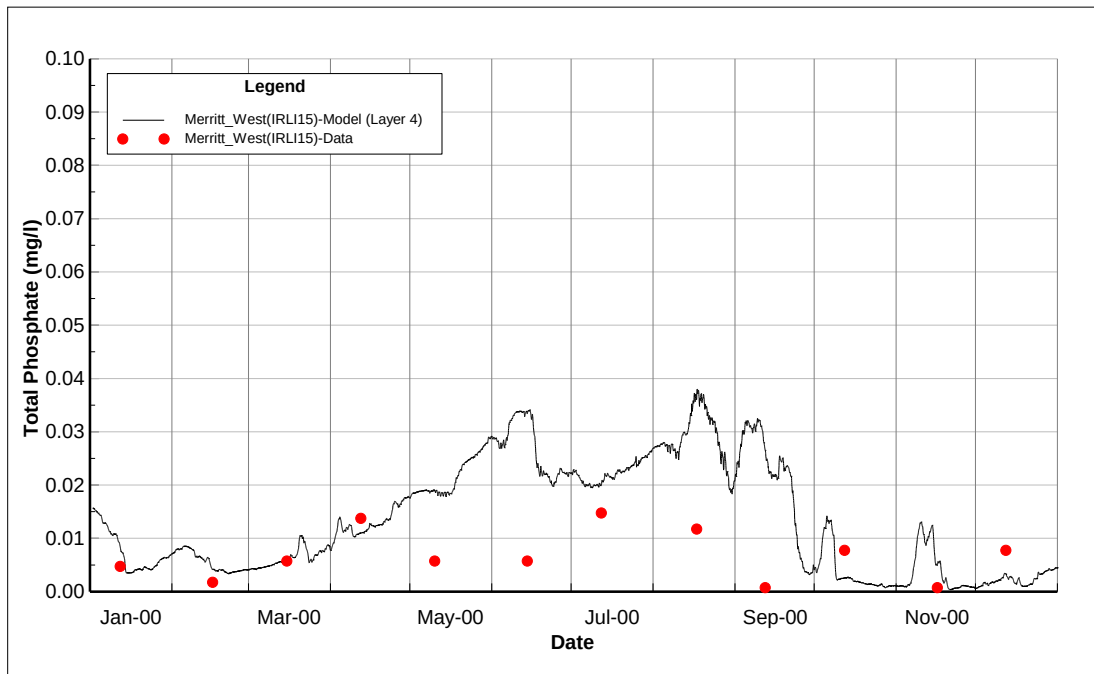


Figure G34-a. Phosphate Calibration at Merritt West (Station: IRL15)

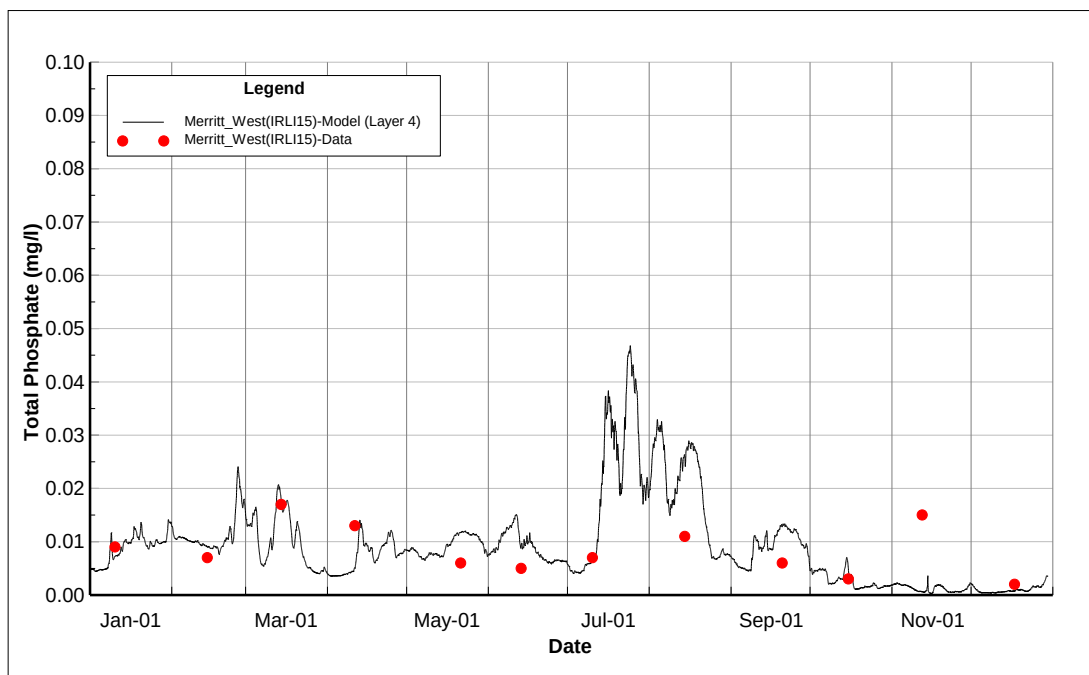


Figure G34-b. Phosphate validation at Merritt West (Station: IRL15)

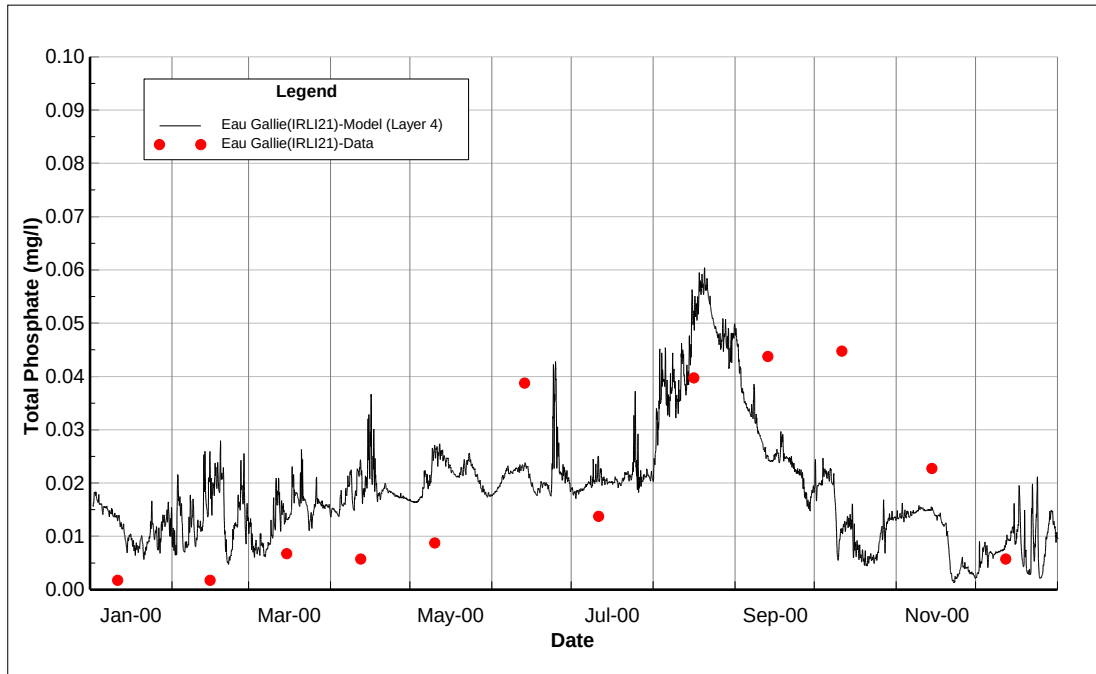


Figure G35-a. Phosphate Calibration at Eau Gallie (Station: IRL121)

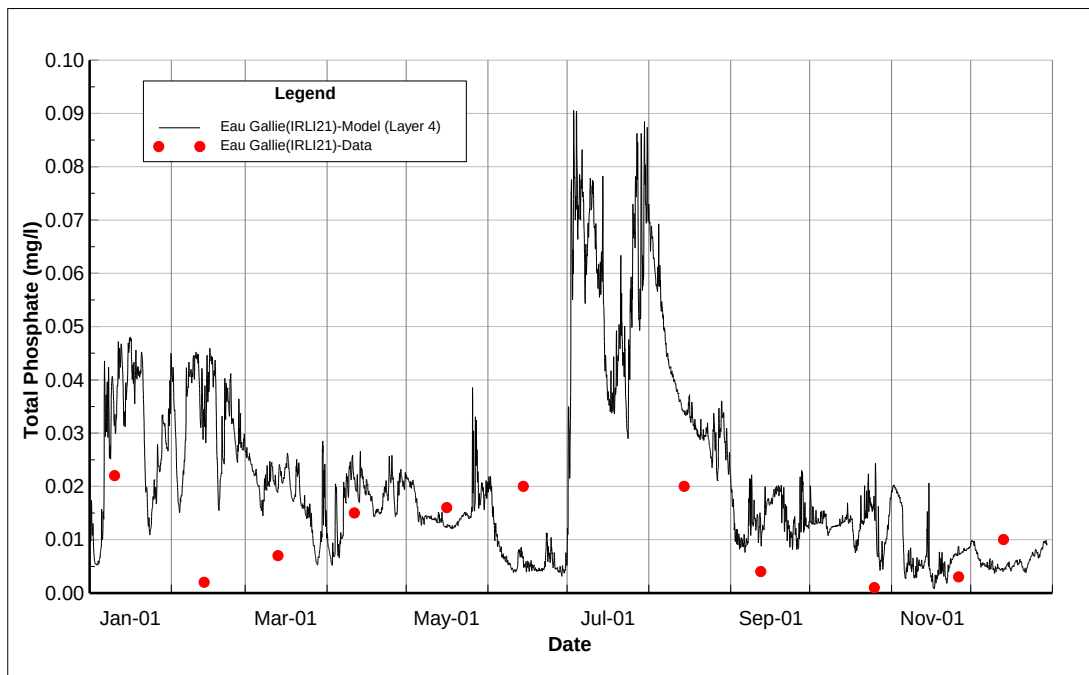


Figure G35-b. Phosphate validation at Eau Gallie (Station: IRL121)

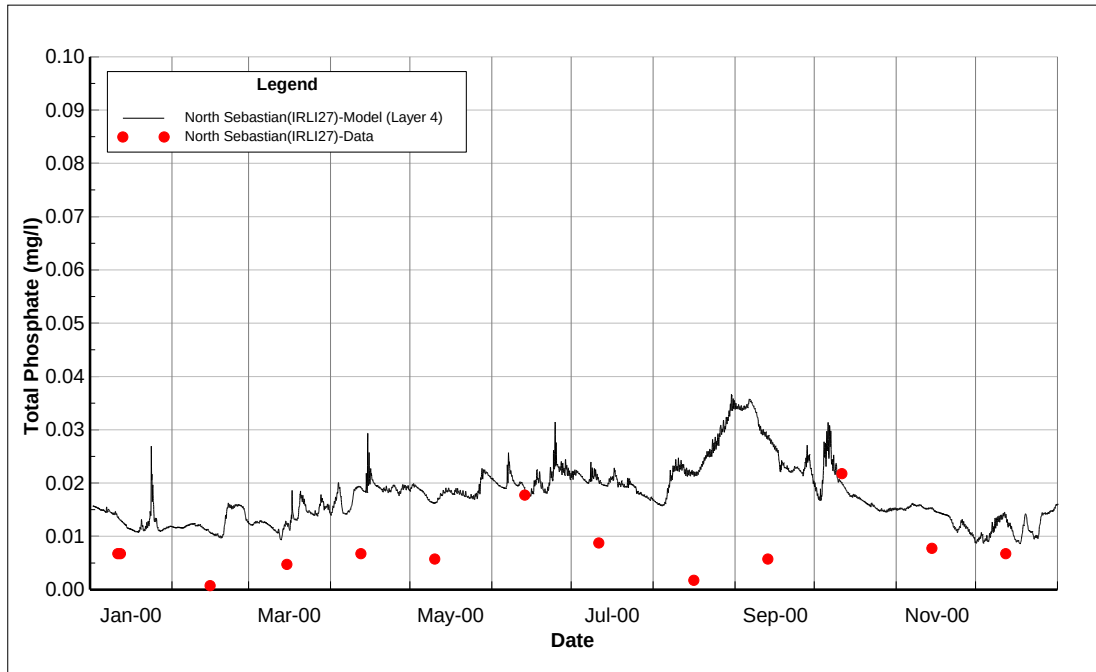


Figure G36-a. Phosphate Calibration at North Sebastian (Station: IRLI27)

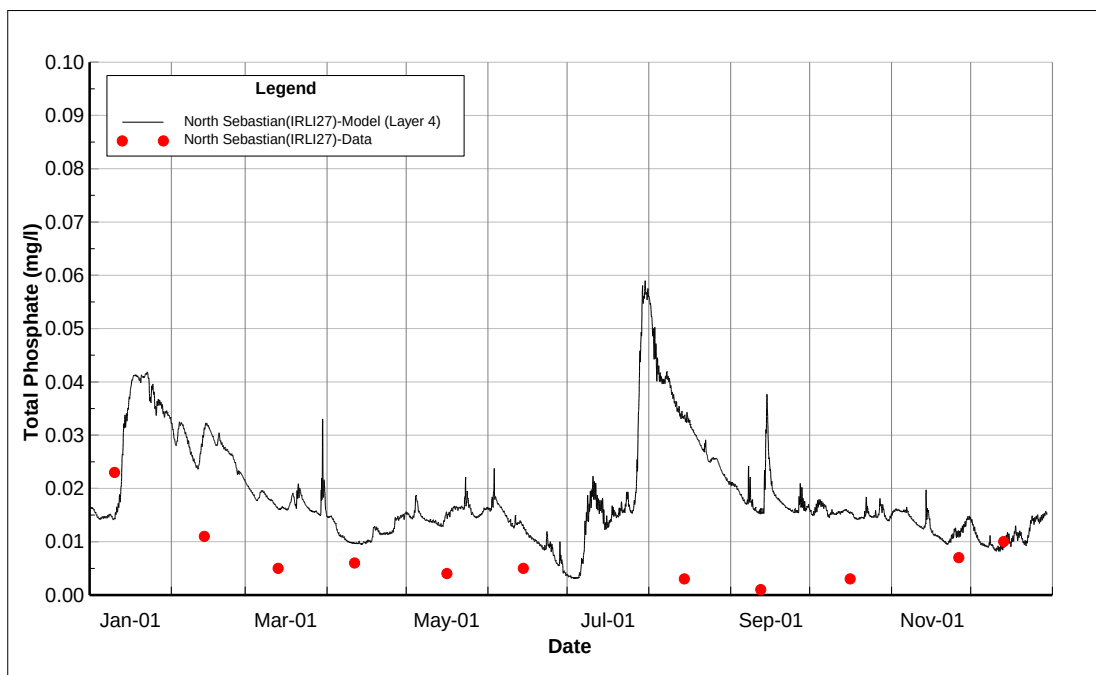


Figure G36-b. Phosphate validation at North Sebastian (Station: IRLI27)

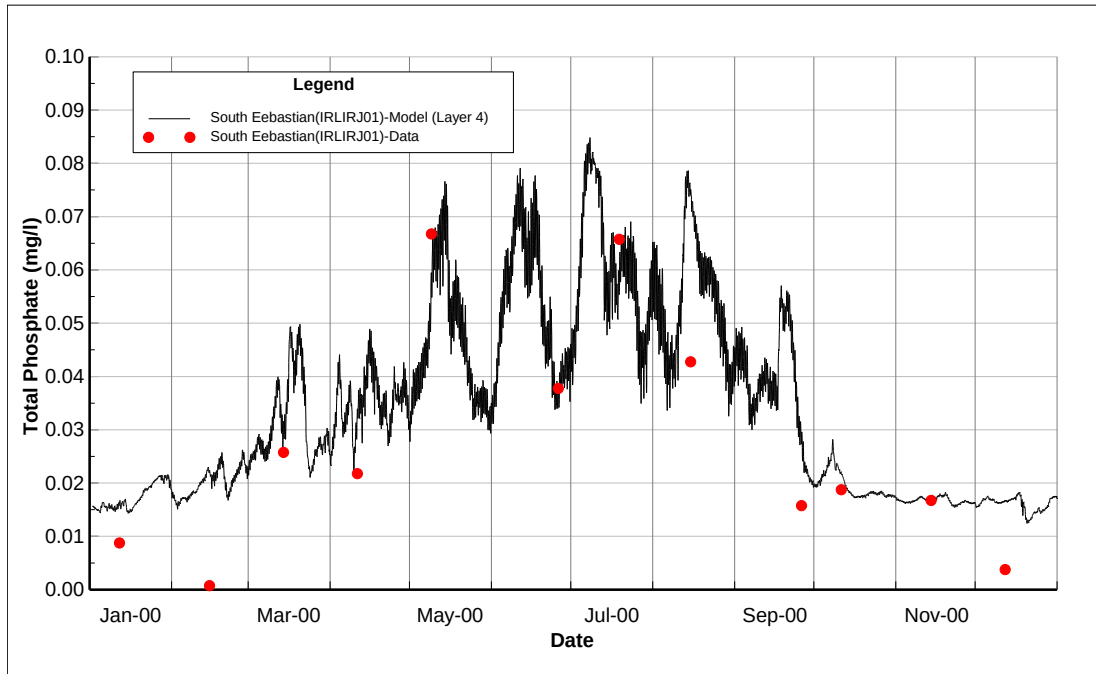


Figure G37-a. Phosphate Calibration at South Sebastian (Station: IRLIRJ01)

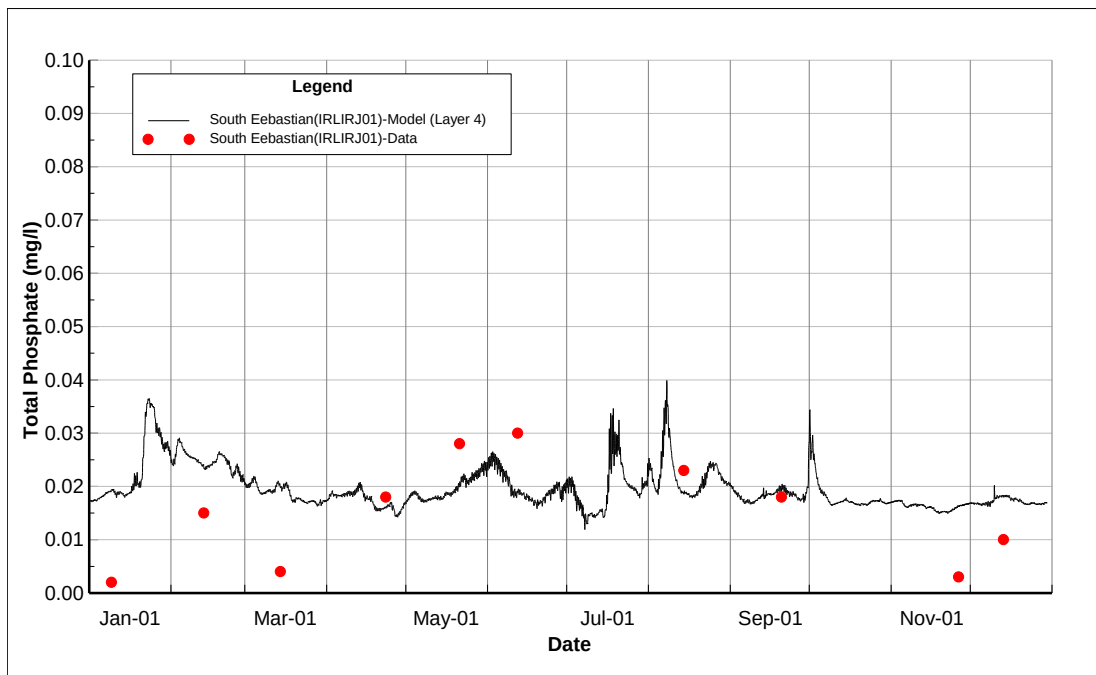


Figure G37-b. Phosphate validation at South Sebastian (Station: IRLIRJ01)

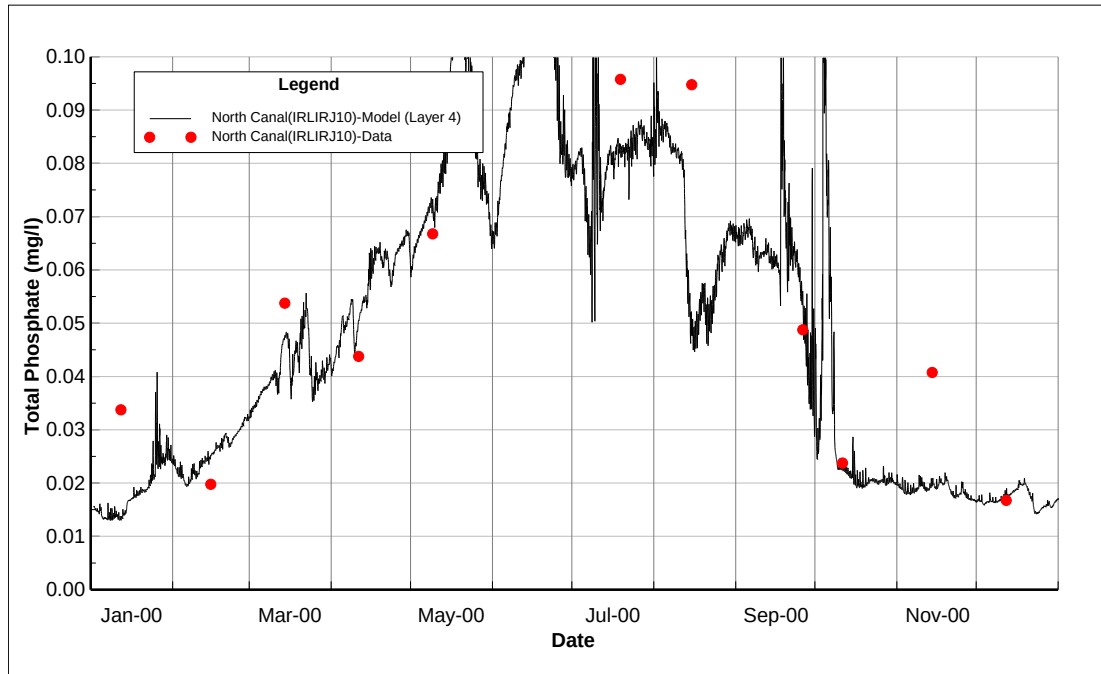


Figure G38-a. Phosphate Calibration at North Canal (Station: IRLIRJ10)

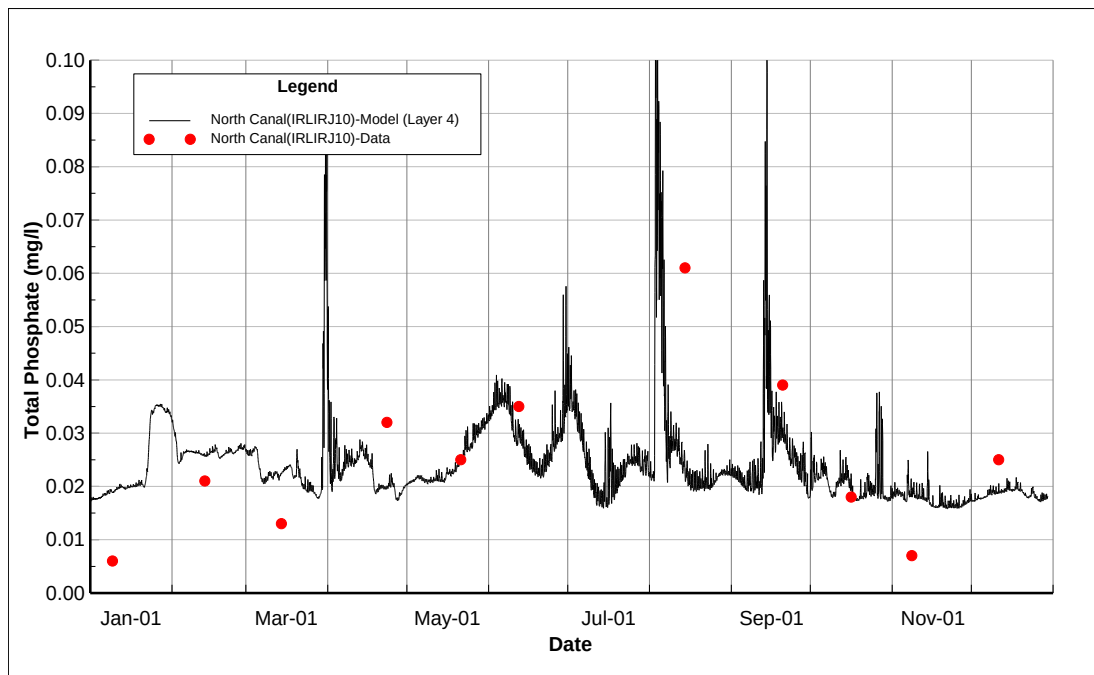


Figure G38-b. Phosphate validation at North Canal (Station: IRLIRJ10)

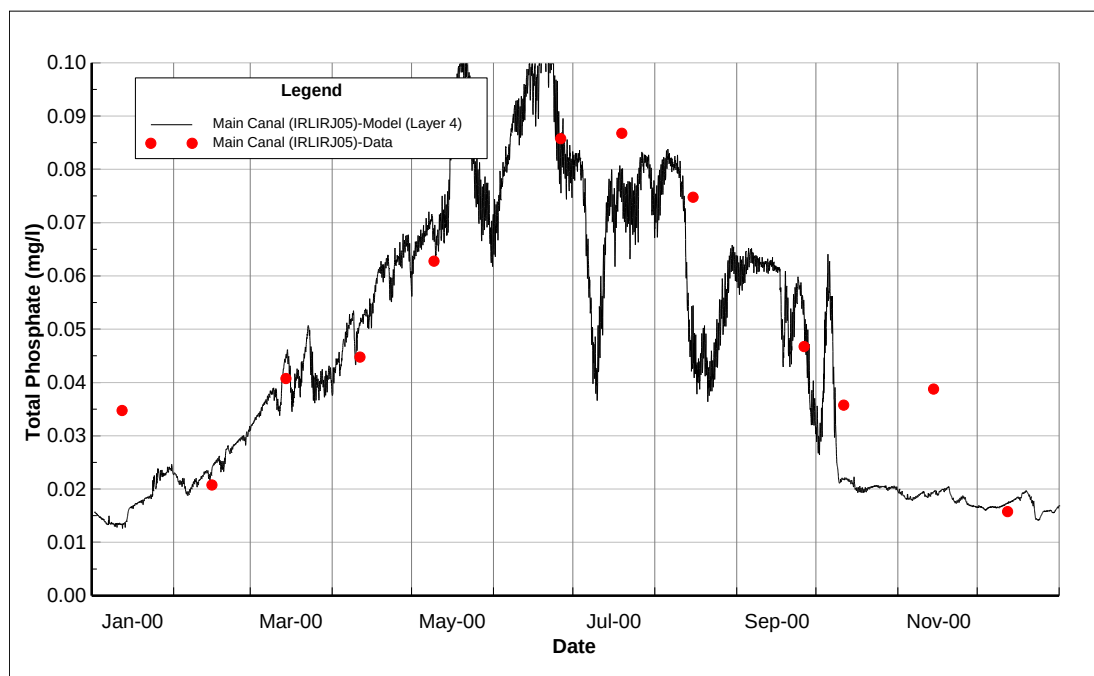


Figure G39-a. Phosphate Calibration at Main Canal (Station: IRLIRJ05)

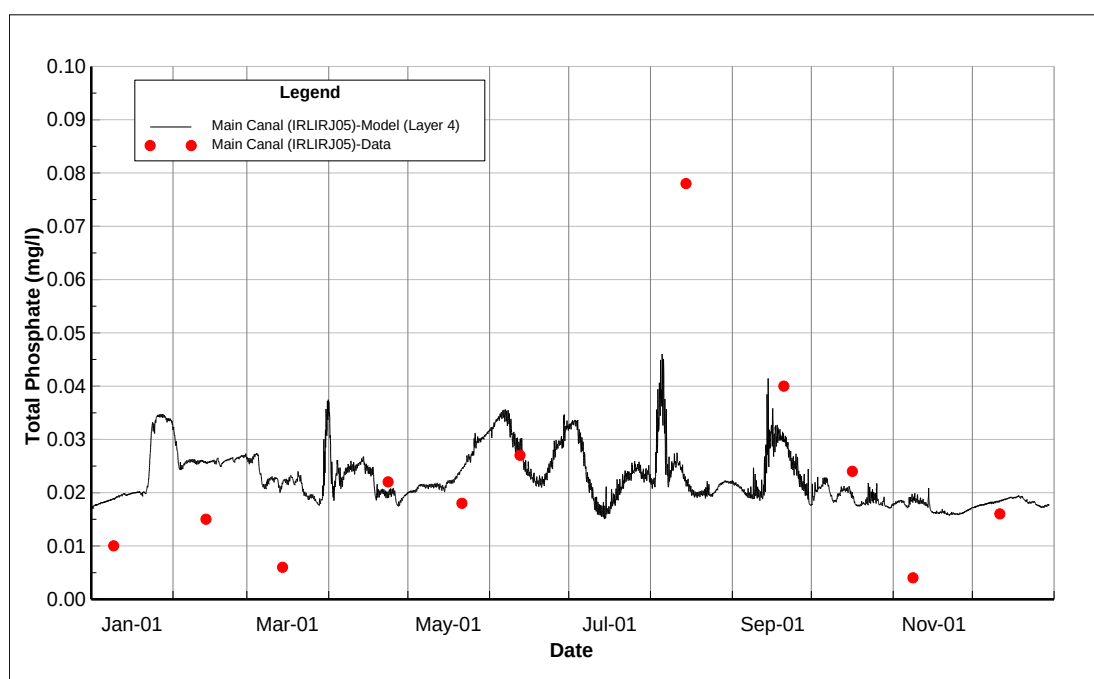


Figure G39-b. Phosphate validation at Main Canal (Station: IRLIRJ05)

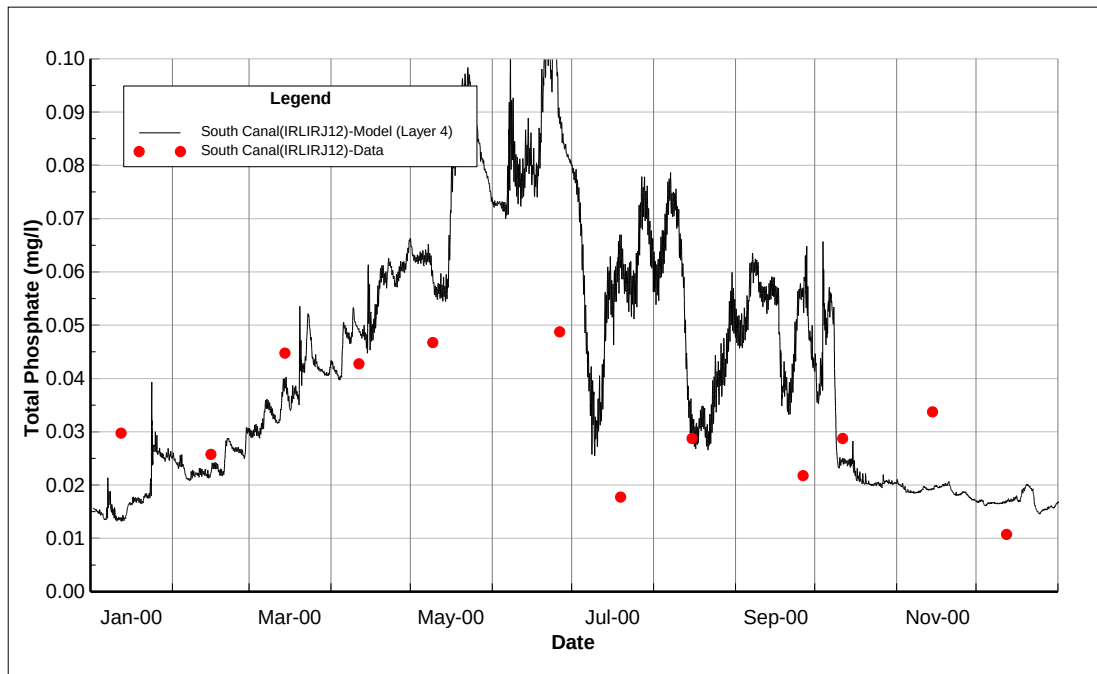


Figure G40-a. Phosphate Calibration at South Canal (Station: IRLIRJ12)

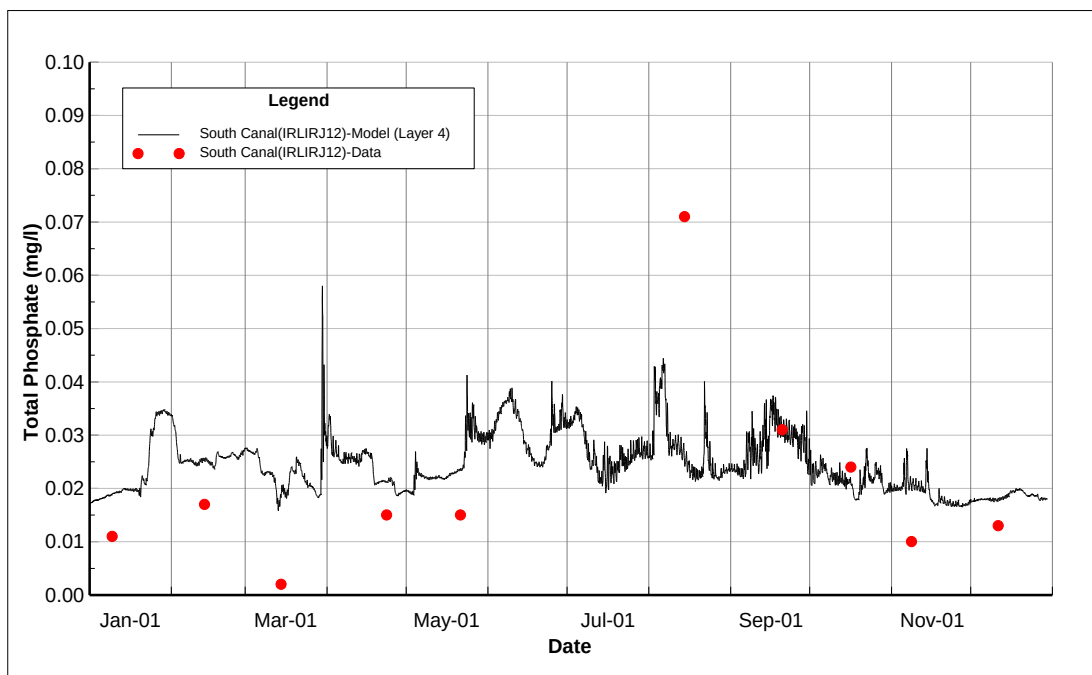


Figure G40-b. Phosphate Validation at South Canal (Station: IRLIRJ12)

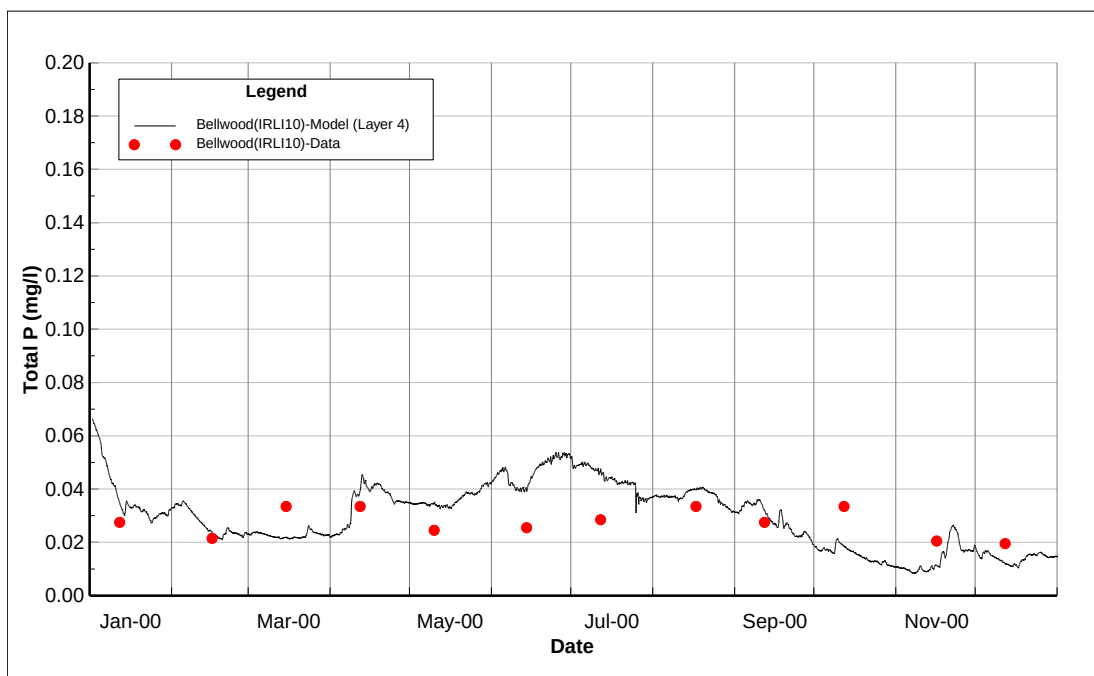


Figure G41-a. TP Calibration at Bellwood (Station: IRLI10)

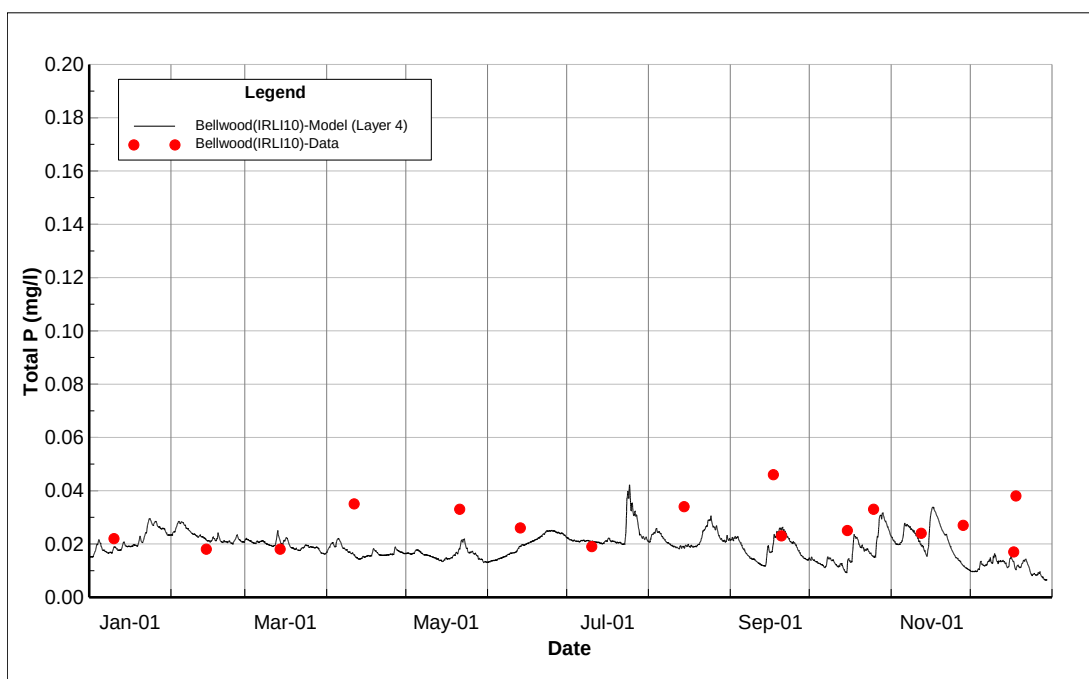


Figure G41-b. TP validation at Bellwood (Station: IRLI10)

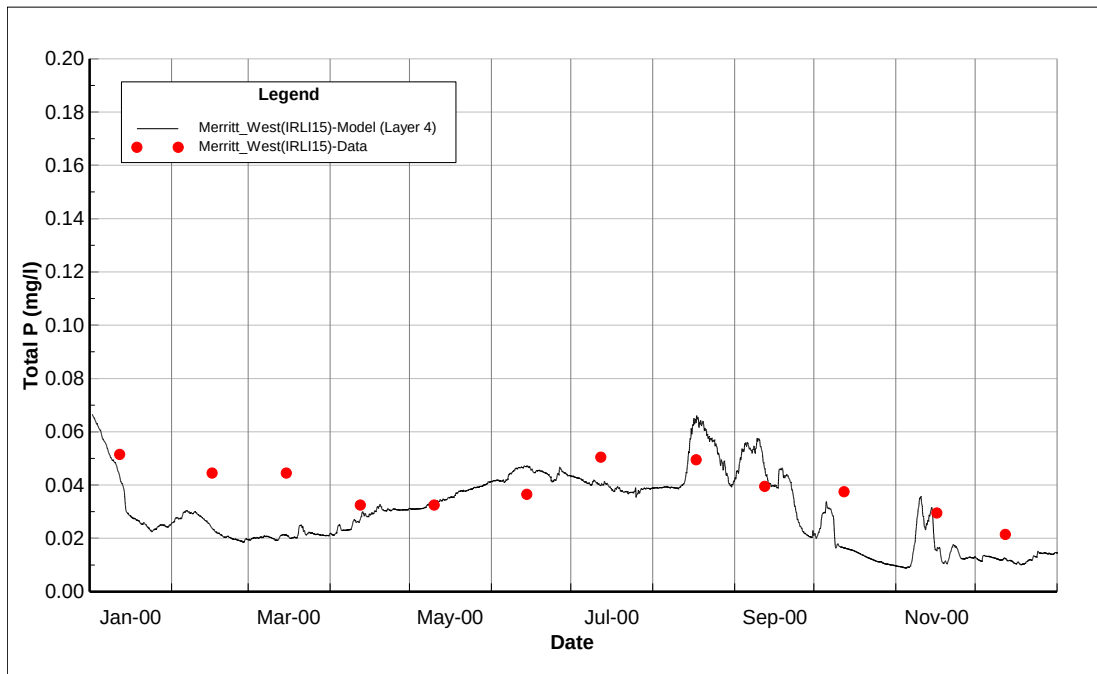


Figure G42-a. TP Calibration at Merritt West (Station: IRLI15)

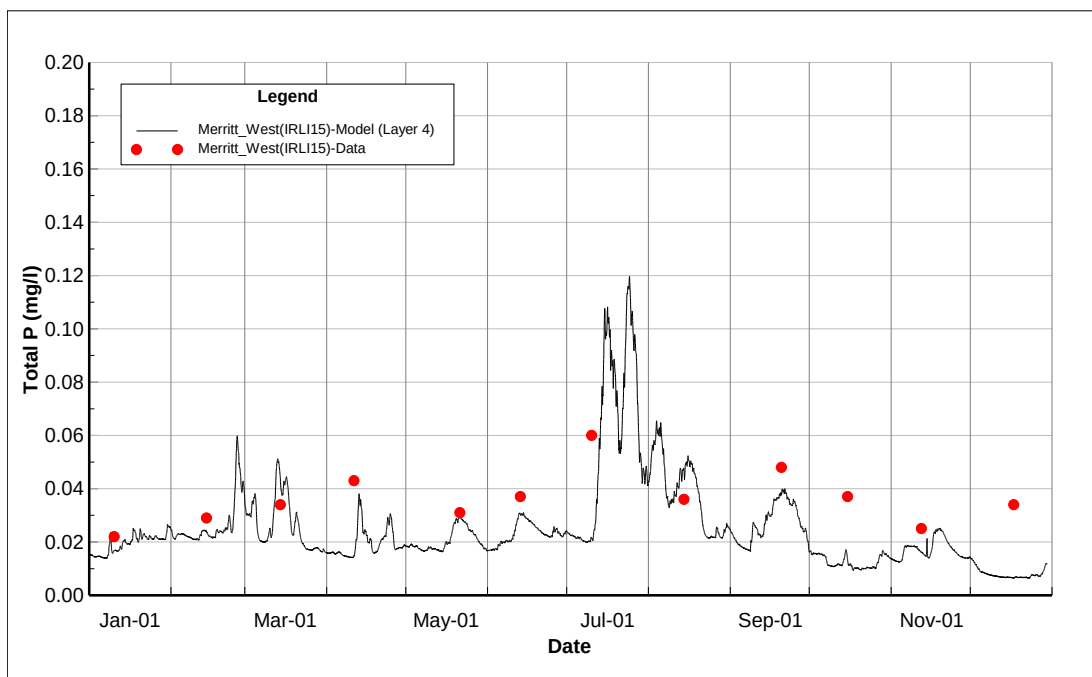


Figure G-42-b. TP validation at Merritt West (Station: IRLI15)

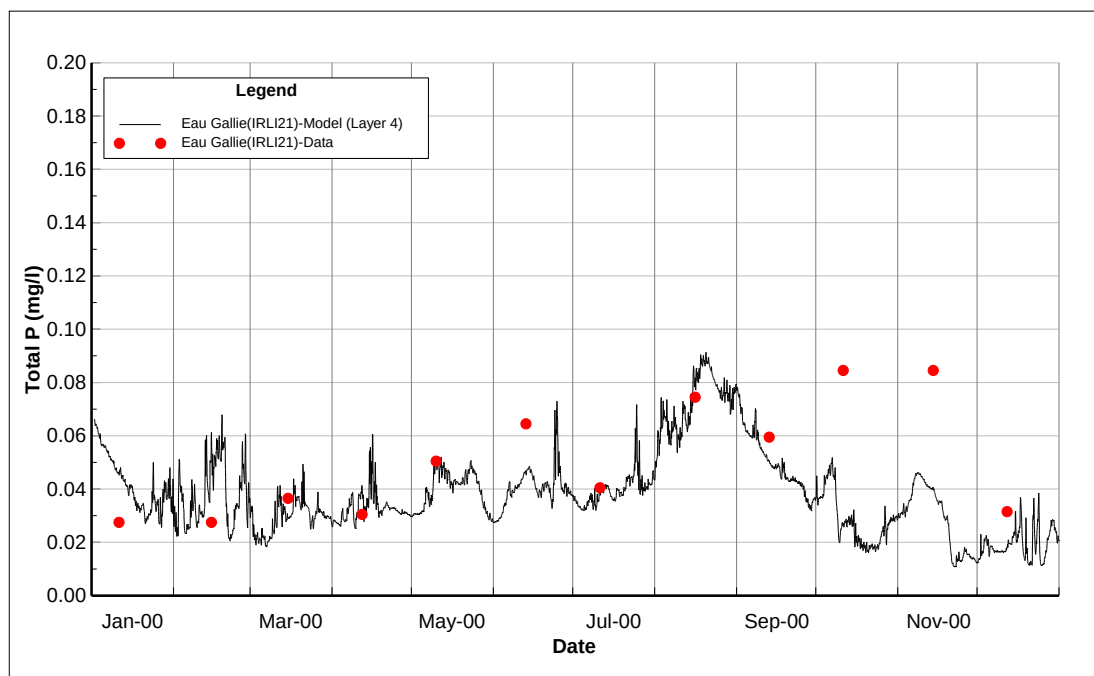


Figure G43-a. TP Calibration at Eau Gallie (Station: IRLI21)

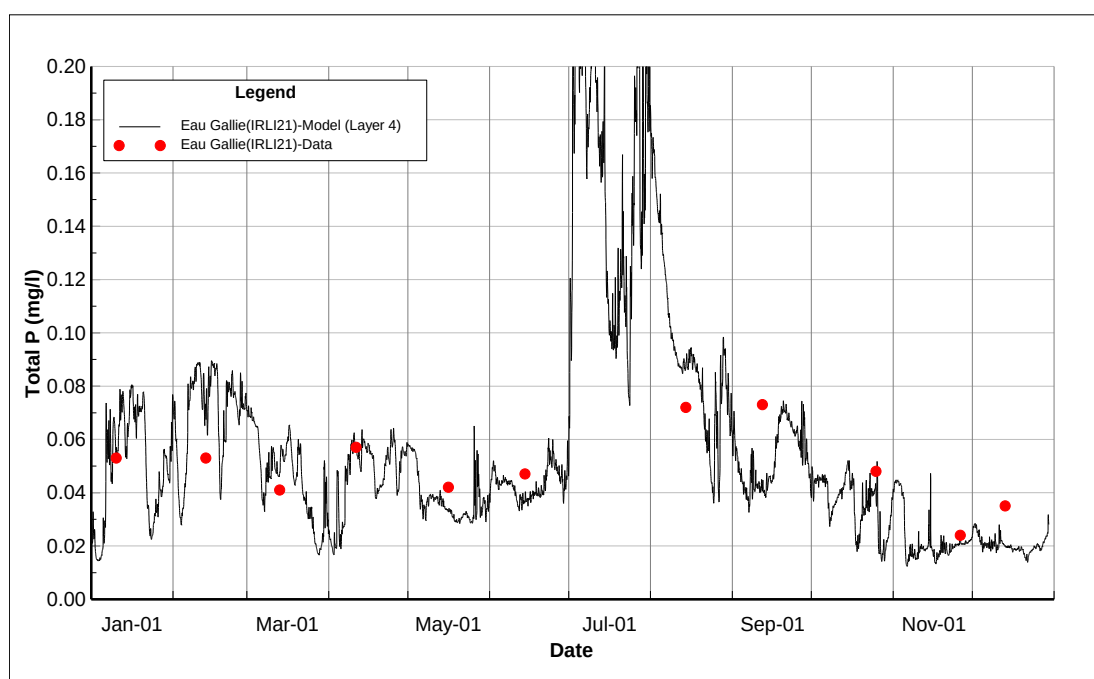


Figure G43-b. TP validation at Eau Gallie (Station: IRLI21)

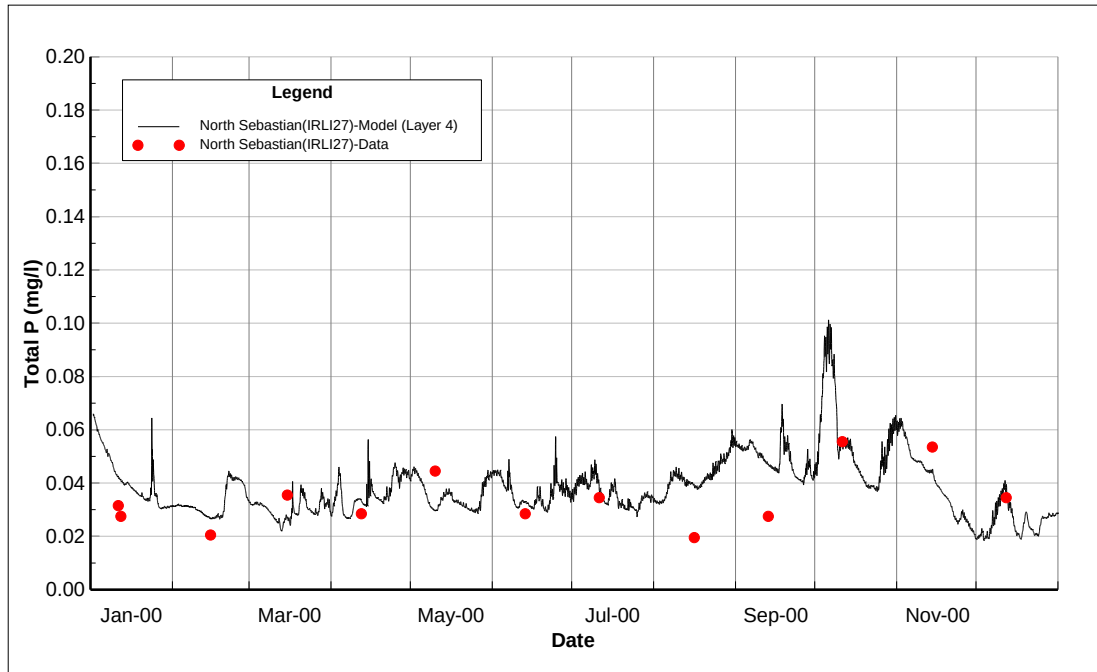


Figure G44-a. TP Calibration at North Sebastian (Station: IRLI27)

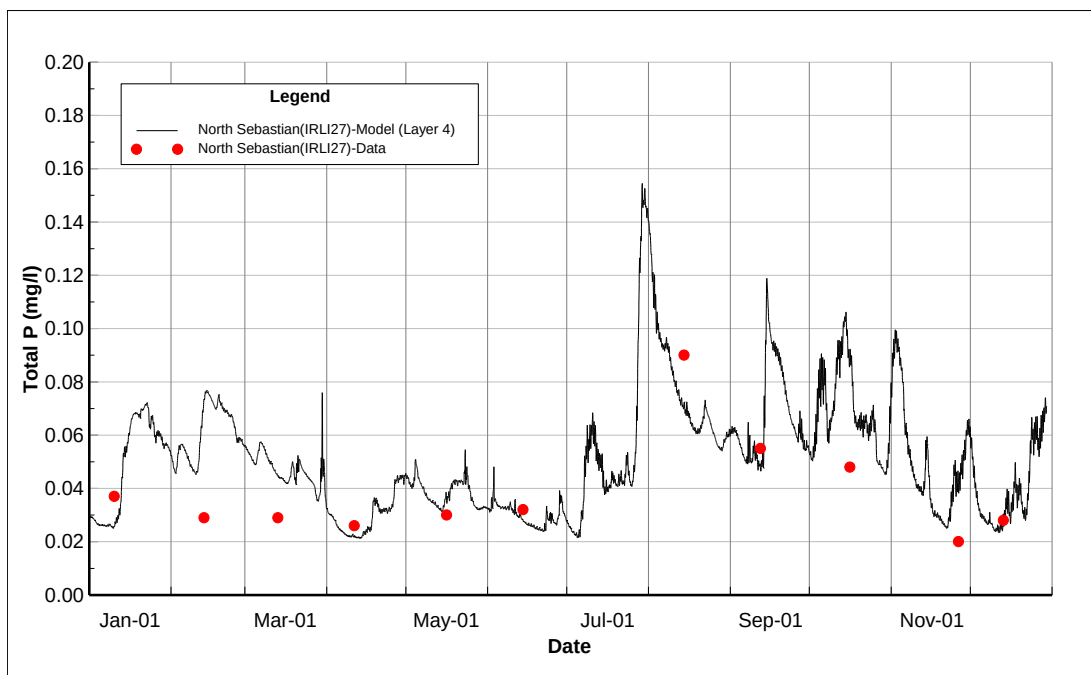


Figure G44-b. TP validation at North Sebastian (Station: IRLI27)

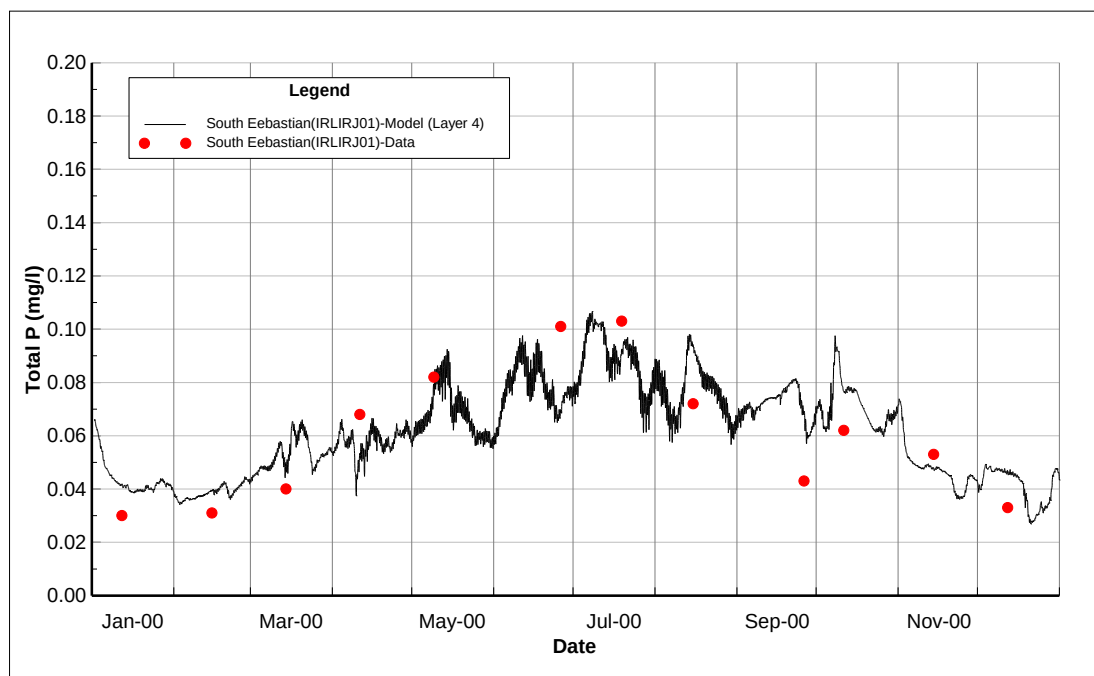


Figure G45-a. TP Calibration at South Sebastian (Station: IRLIRJ01)

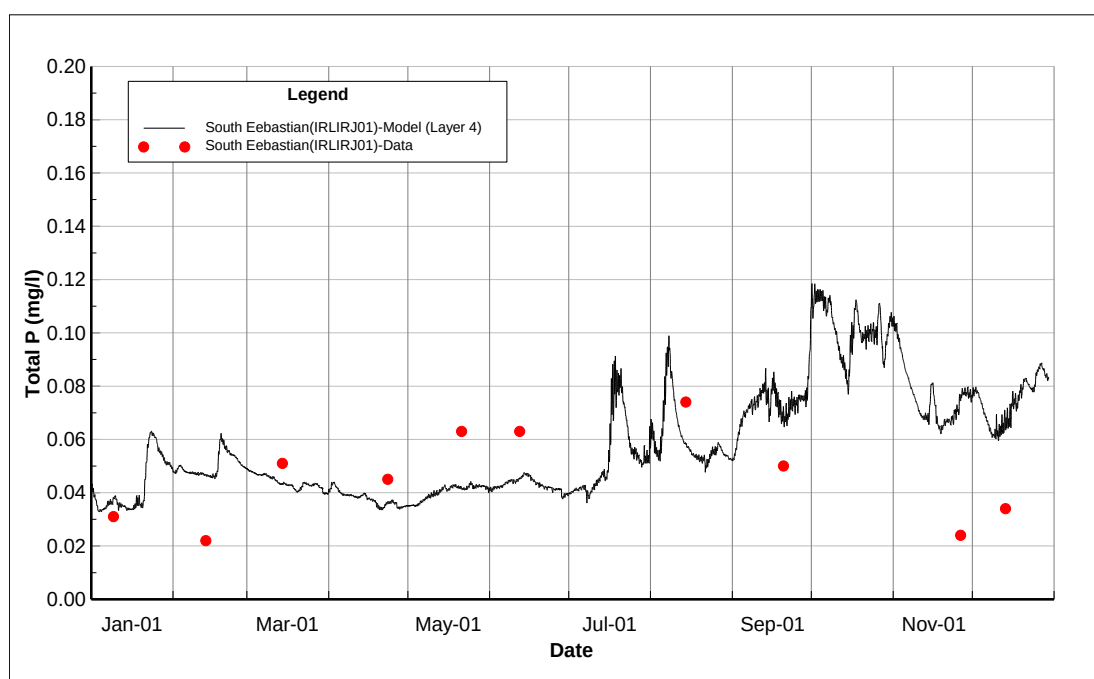


Figure G45-b. TP validation at South Sebastian (Station: IRLIRJ01)

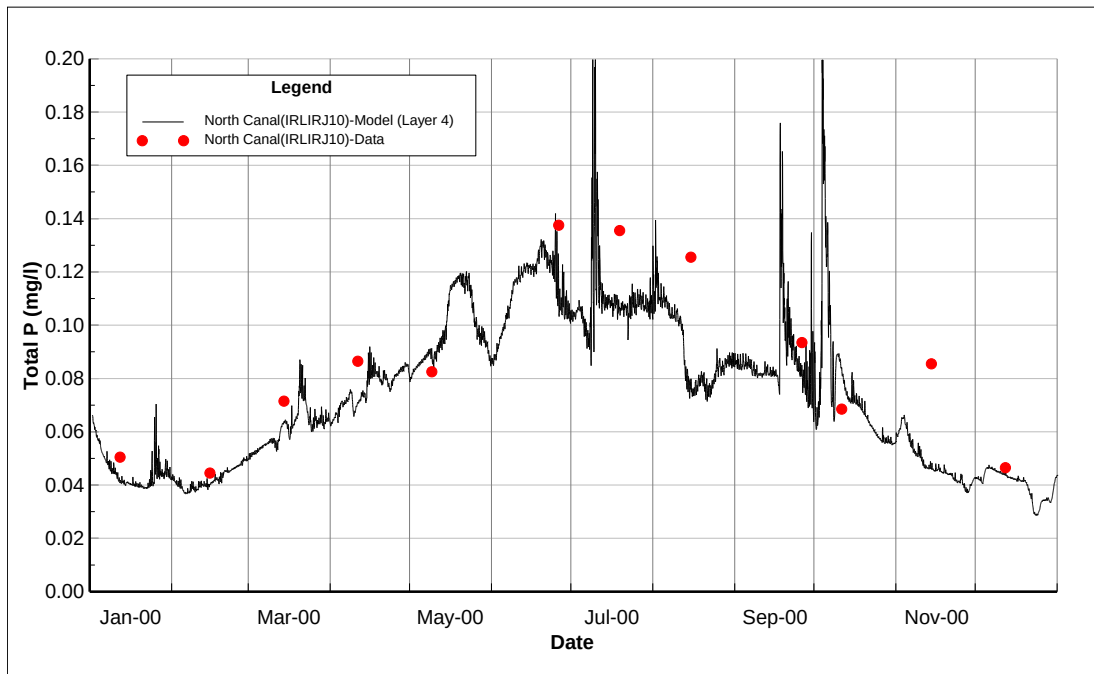


Figure G46-a. TP Calibration at North Canal (Station: IRLIRJ10)

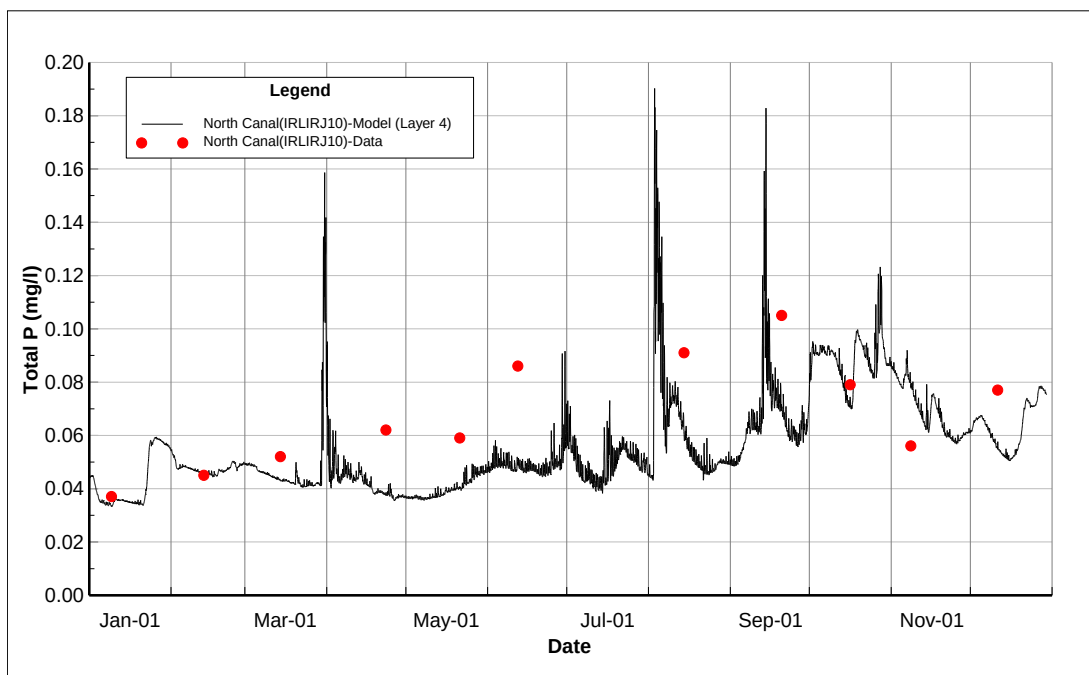


Figure G46-b. TP validation at North Canal (Station: IRLIRJ10)

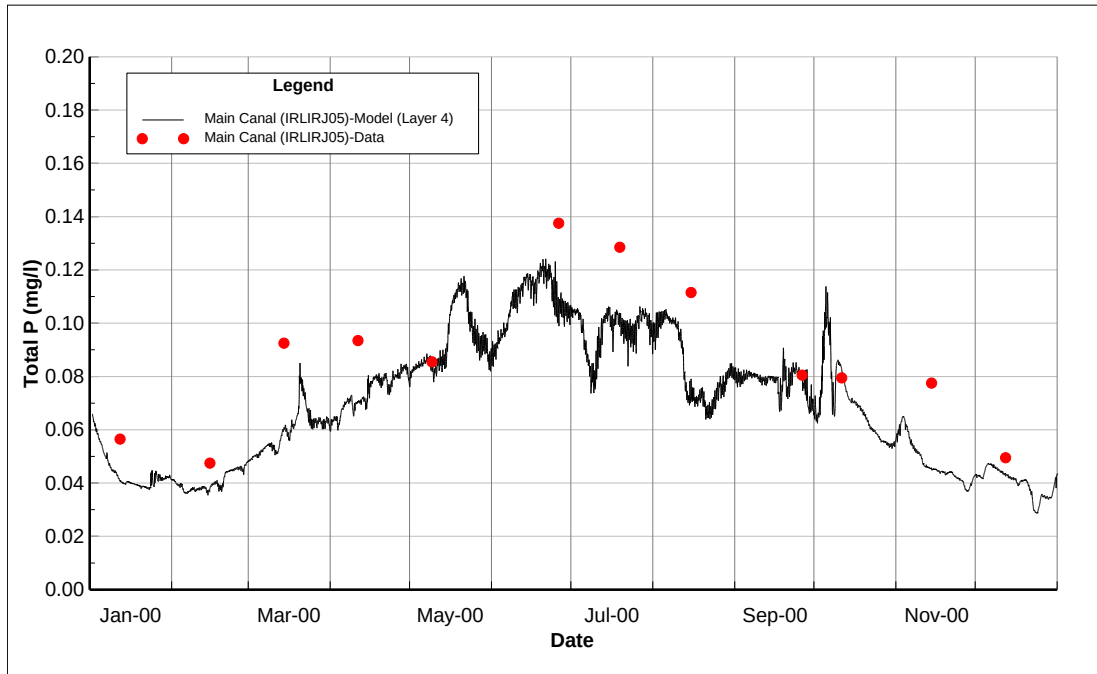


Figure G47-a. TP Calibration at Main Canal (Station: IRLIRJ05)

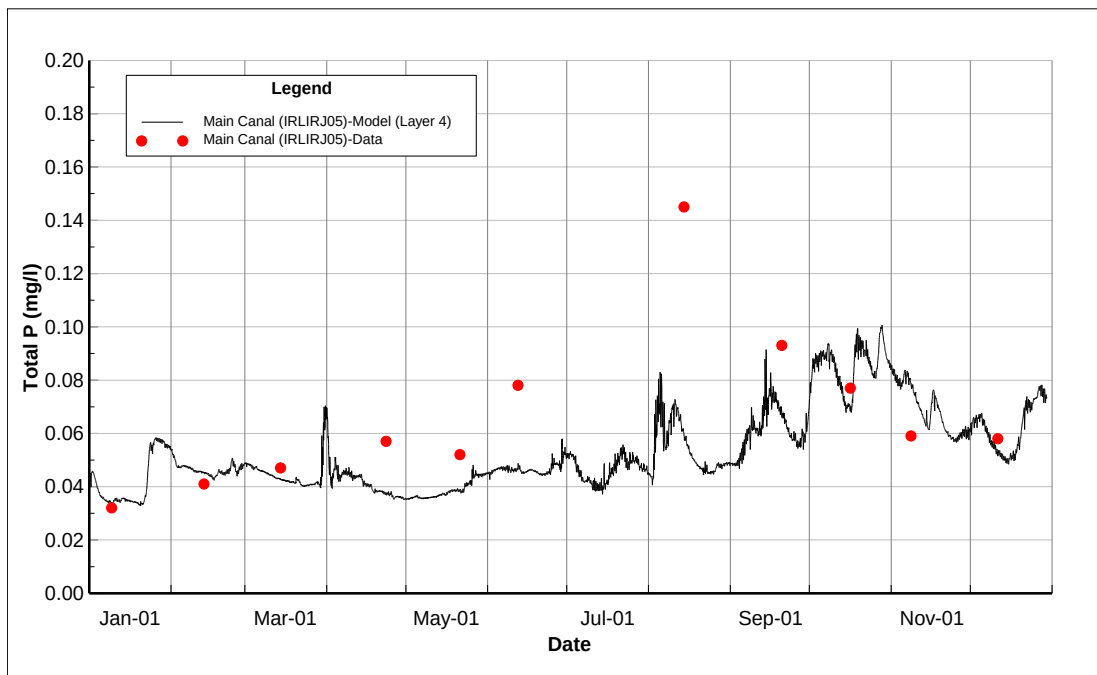


Figure G47-b. TP validation at Main Canal (Station: IRLIRJ05)

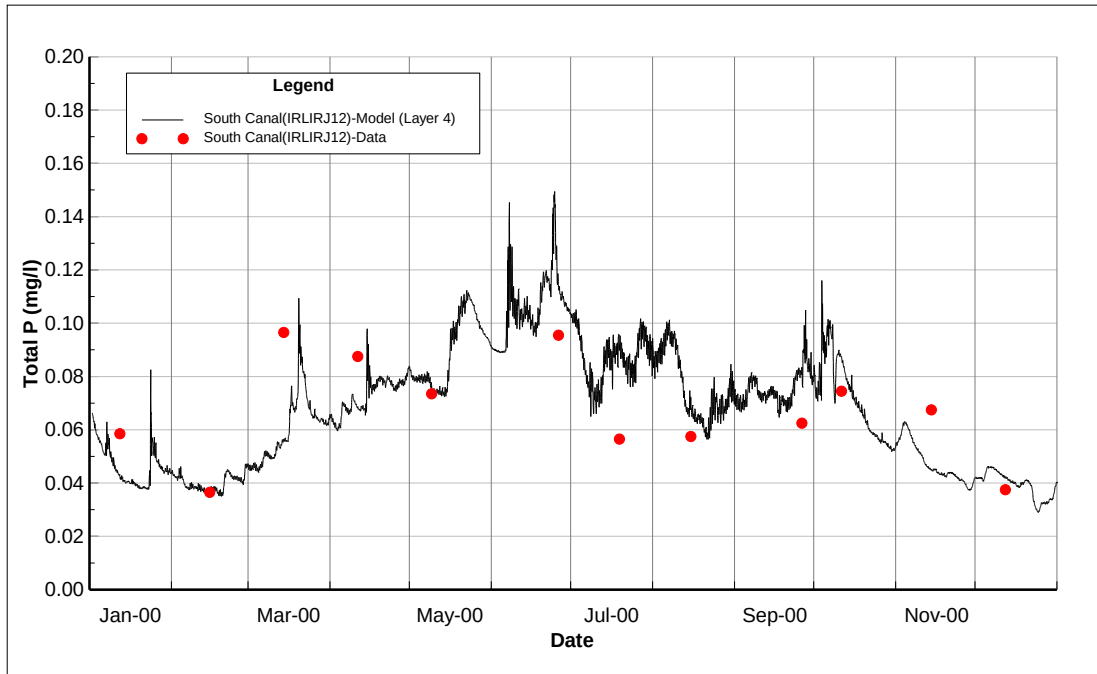


Figure G48-a. TP Calibration at South Canal (Station: IRLIRJ12)

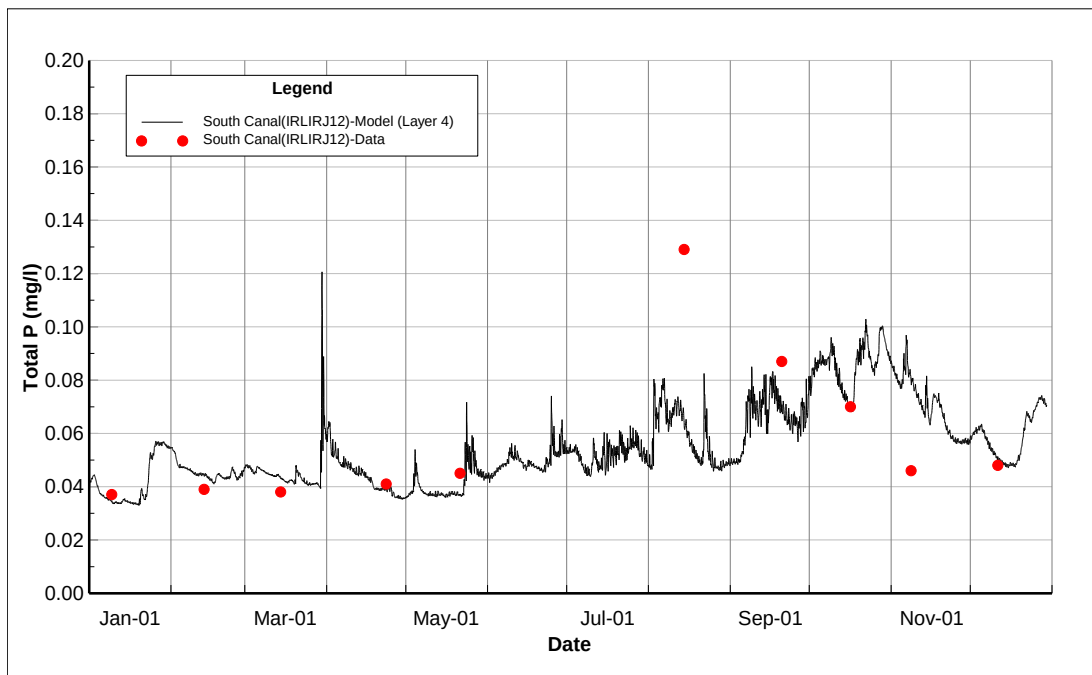


Figure G48-b. TP validation at South Canal (Station: IRLIRJ12)

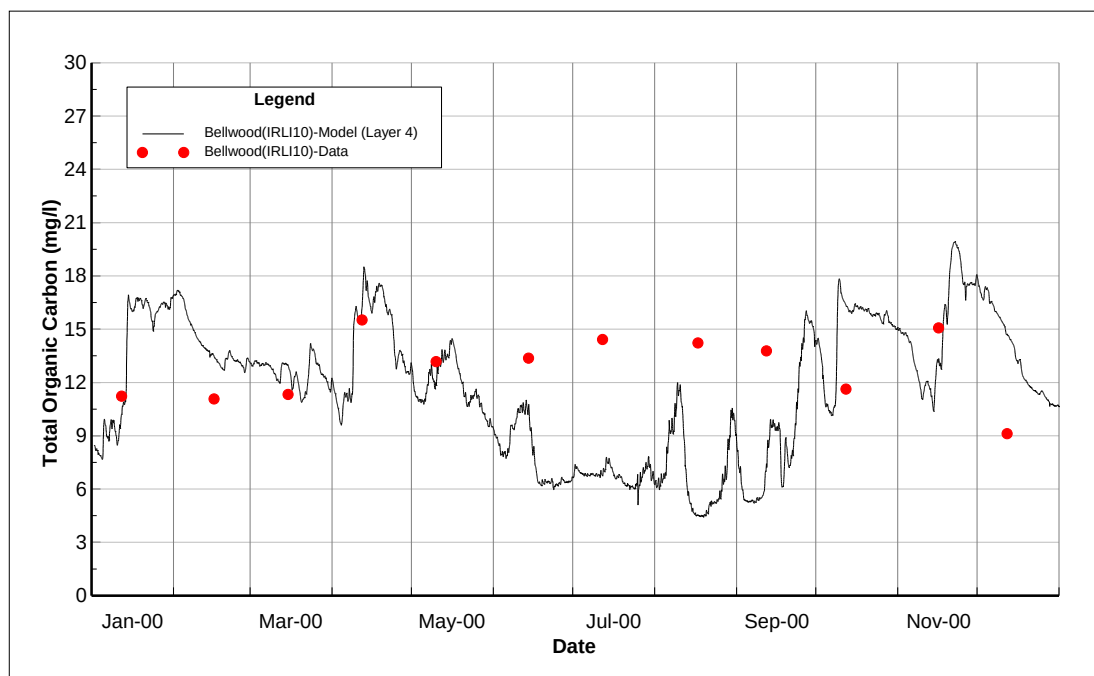


Figure G49-a. TOC Calibration at Bellwood (Station: IRLI10)

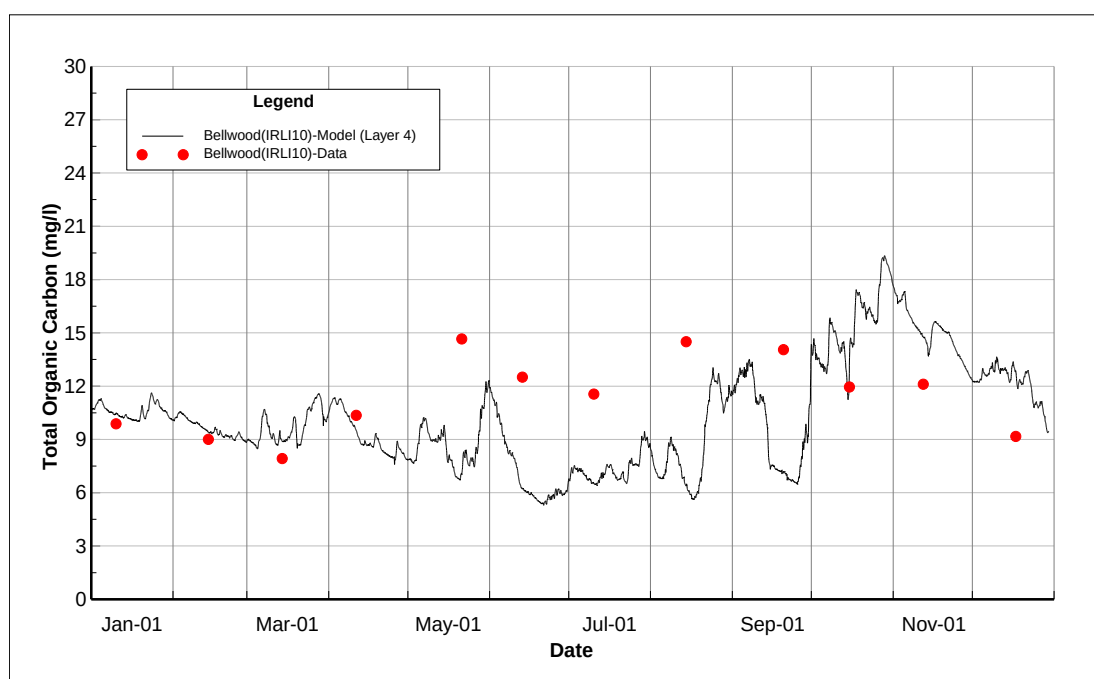


Figure G49-b. TOC validation at Bellwood (Station: IRLI10)

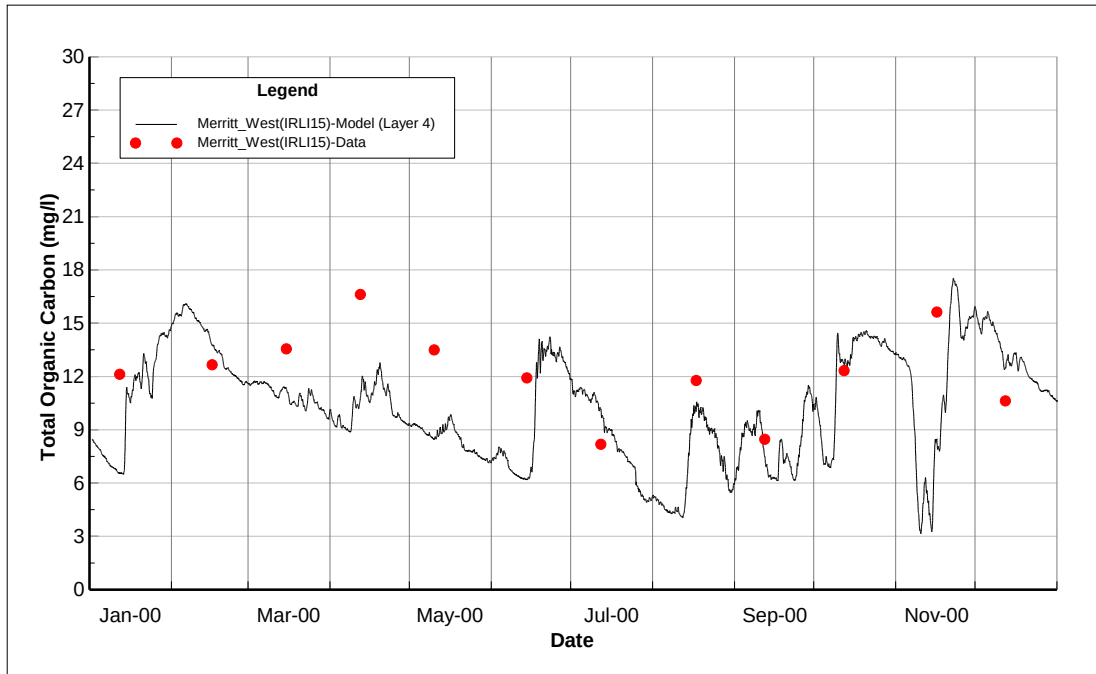


Figure G50-a. TOC Calibration at Merritt West (Station: IRL15)

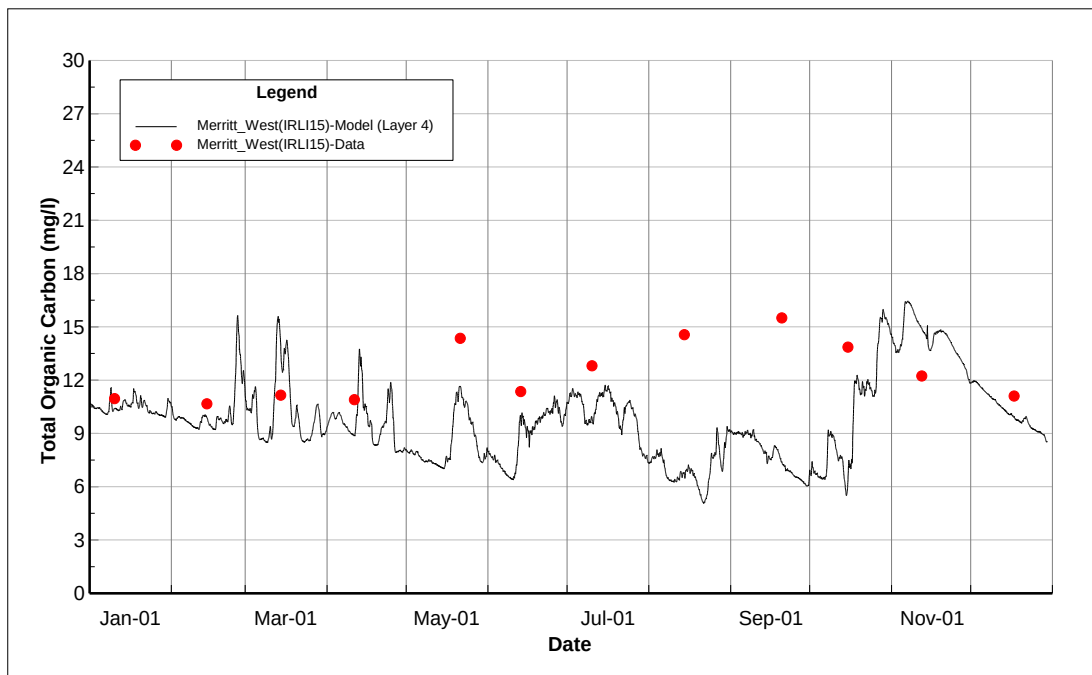


Figure G50-b. TOC validation at Merritt West (Station: IRL15)

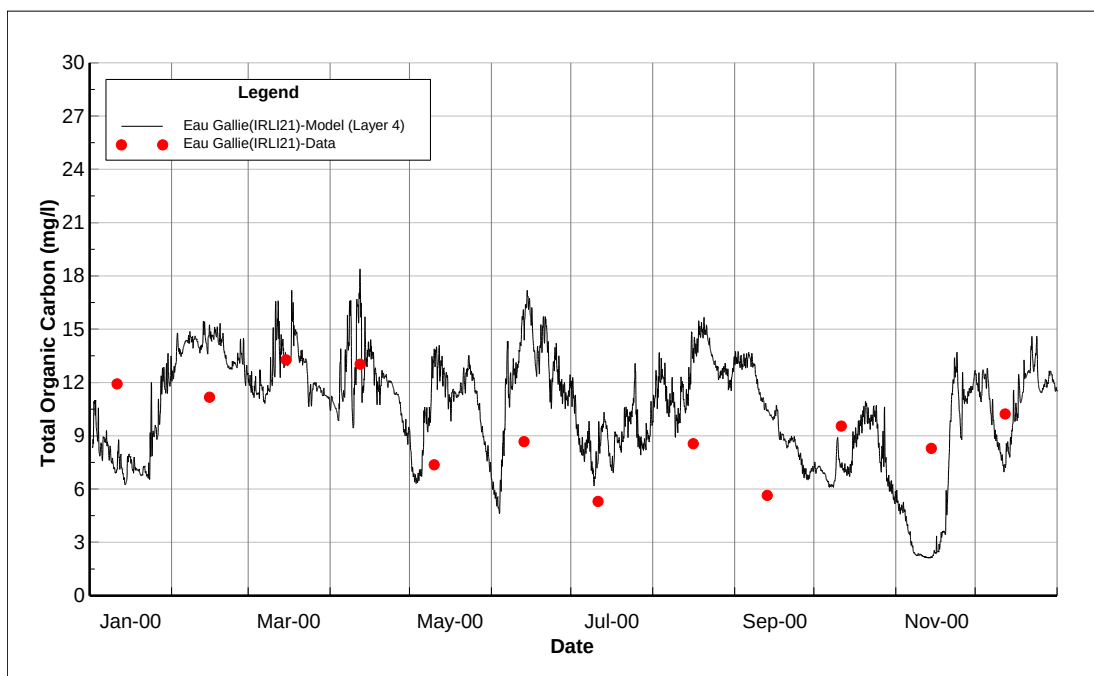


Figure G51-a. TOC Calibration at Eau Gallie (Station: IRLI21)

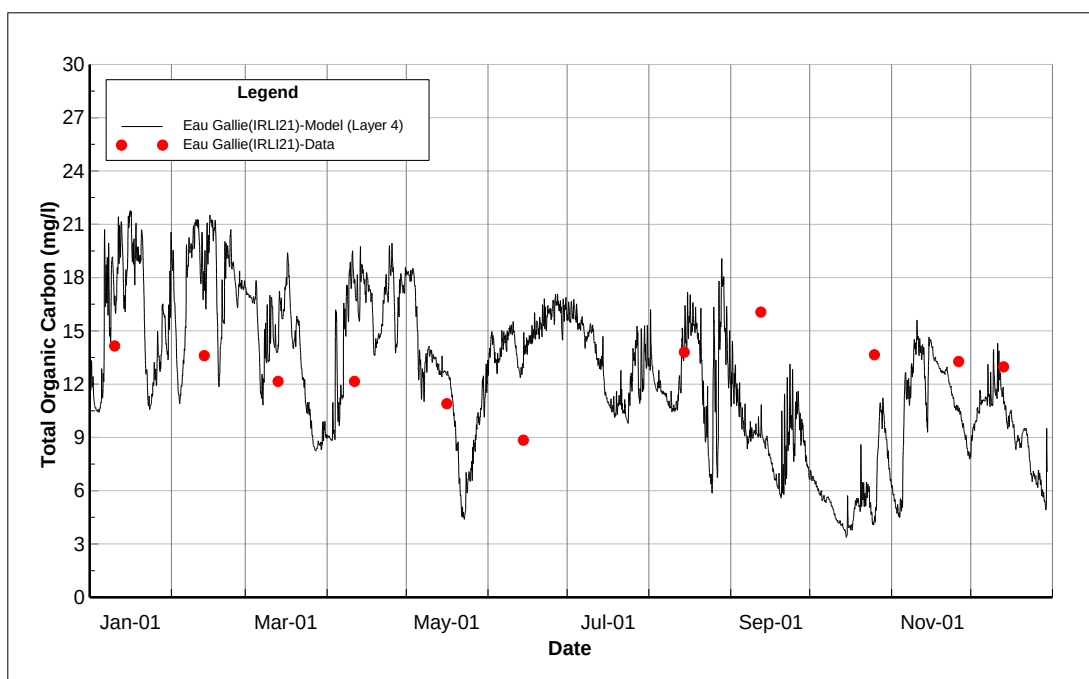


Figure G51-b. TOC validation at Eau Gallie (Station: IRLI21)

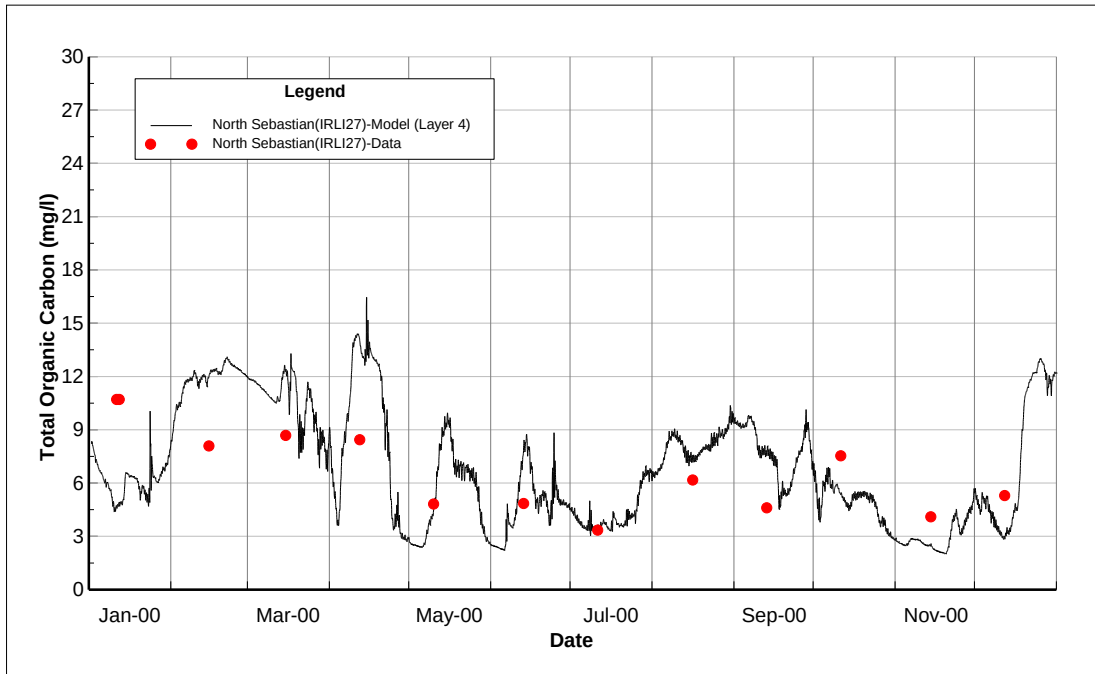


Figure G52-a. TOC Calibration at North Sebastian (Station: IRLI27)

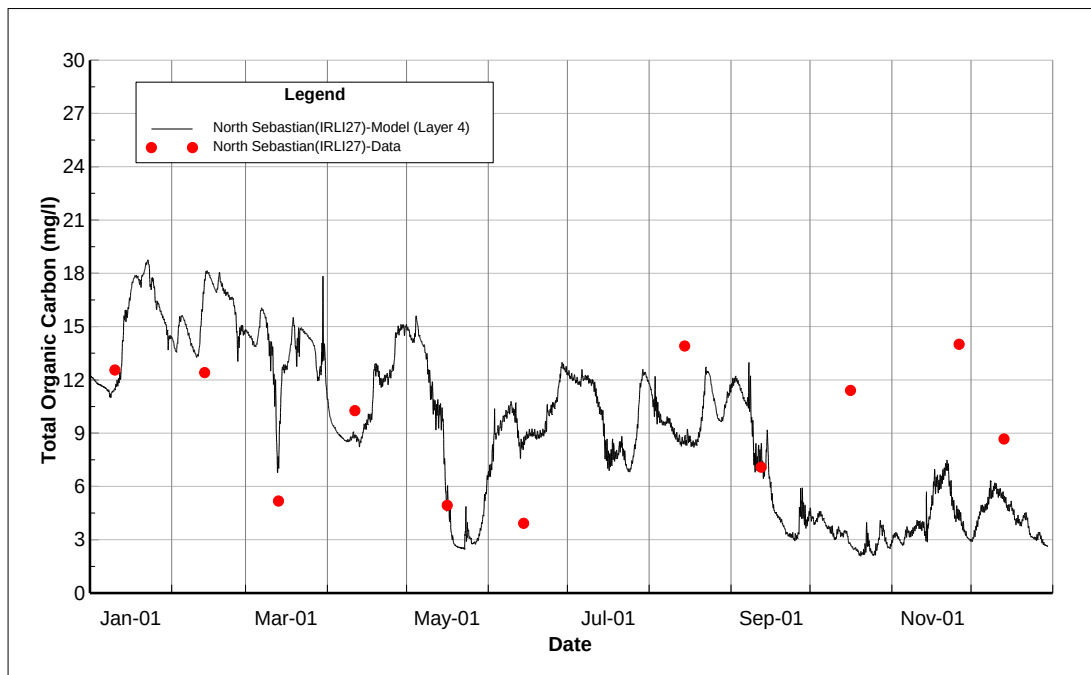


Figure G52-b. TOC validation at North Sebastian (Station: IRLI27)

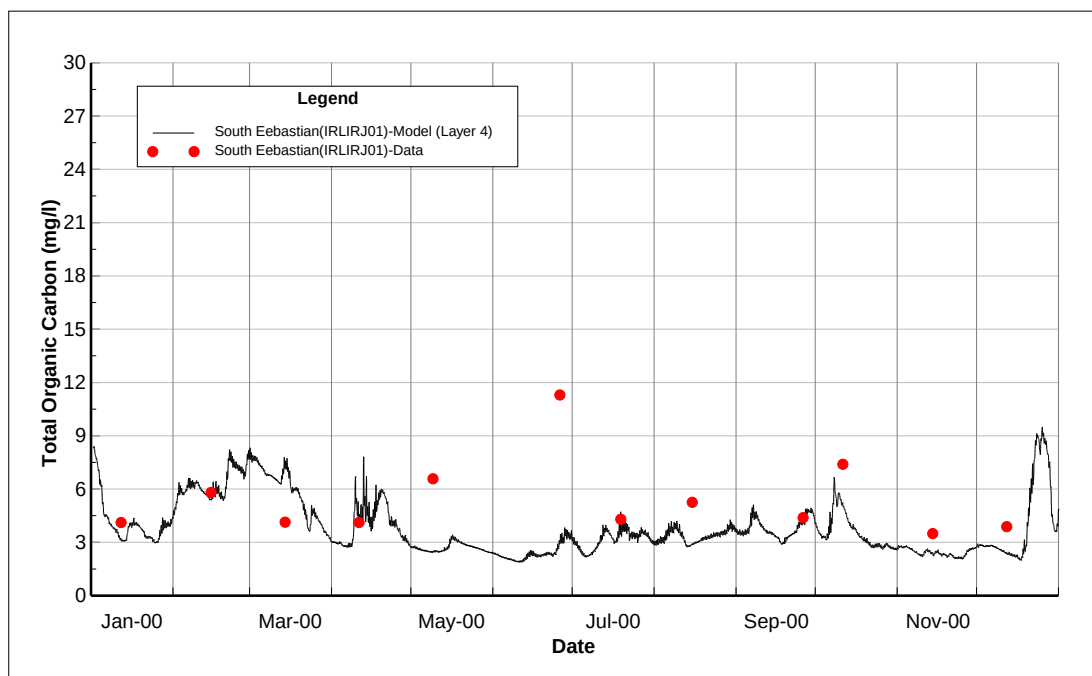


Figure G53-a. TOC Calibration at South Sebastian (Station: IRLIRJ01)

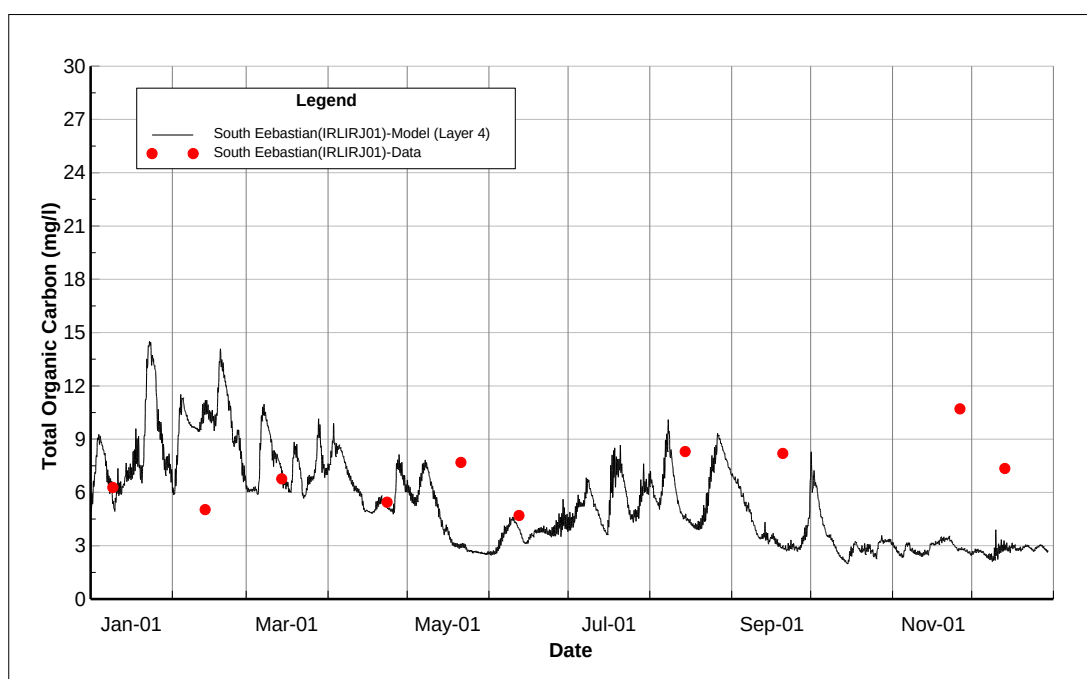


Figure G53-b. TOC validation at South Sebastian (Station: IRLIRJ01)

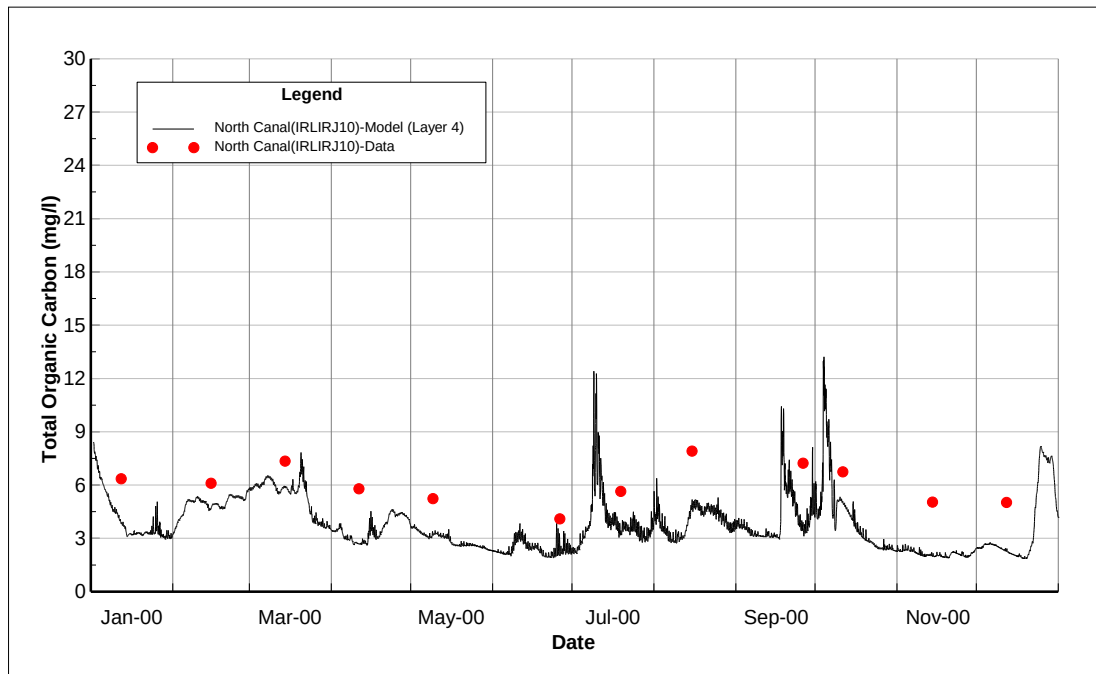


Figure G54-a. TOC Calibration at North Canal (Station: IRLIRJ10)

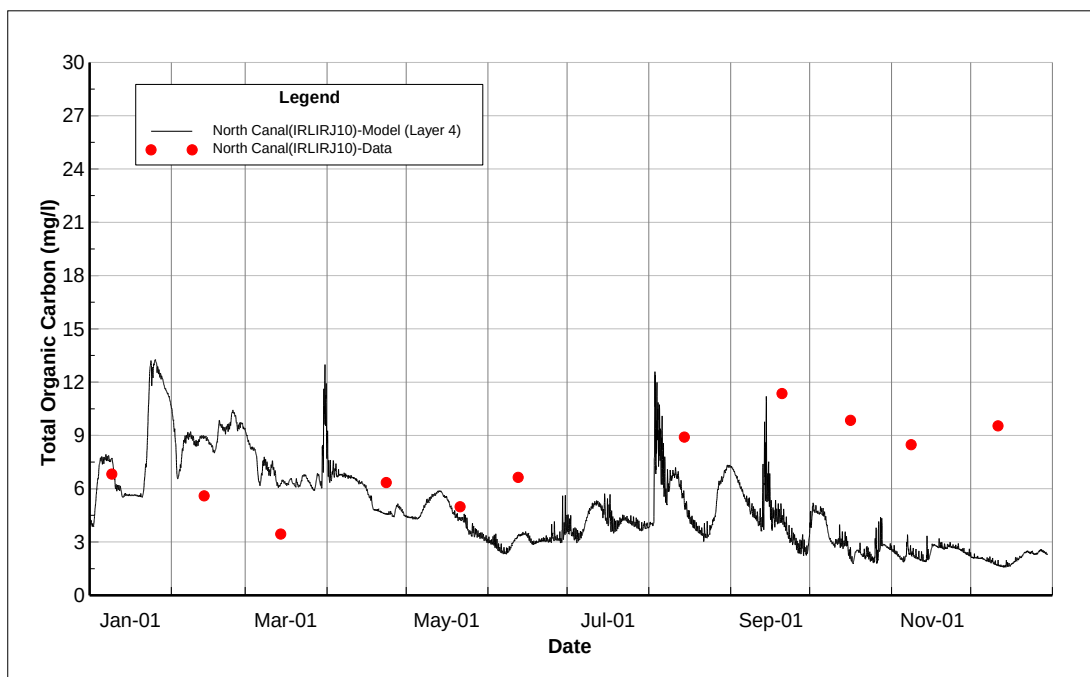


Figure G54-b. TOC validation at North Canal (Station: IRLIRJ10)

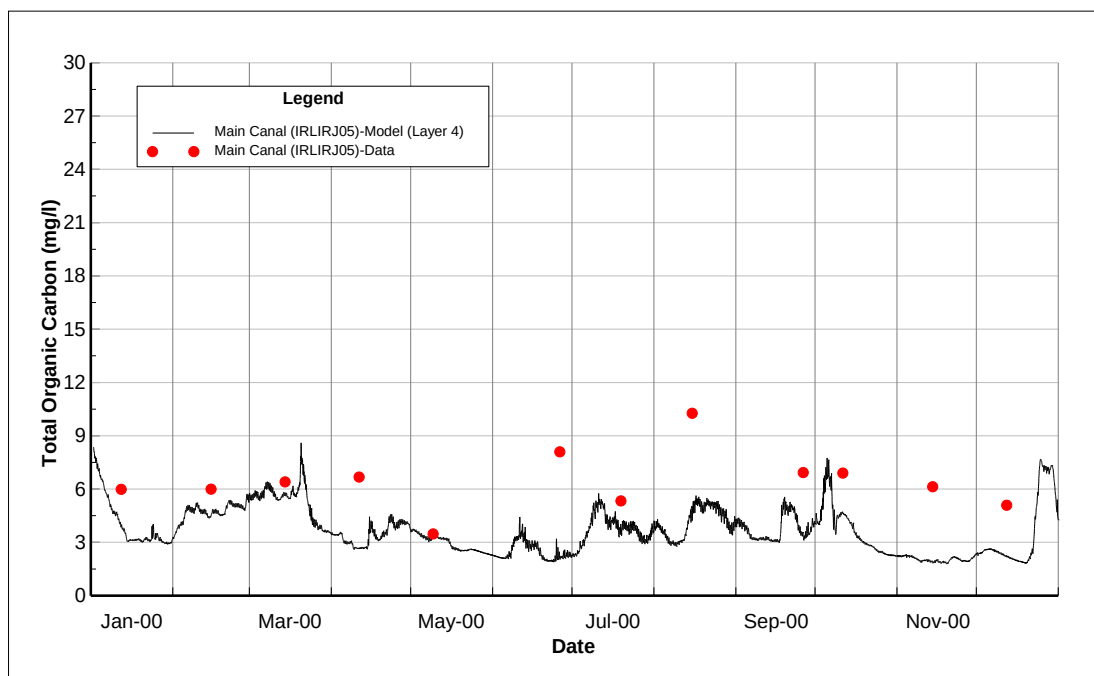


Figure G55-a. TOC Calibration at Main Canal (Station: IRLIRJ05)

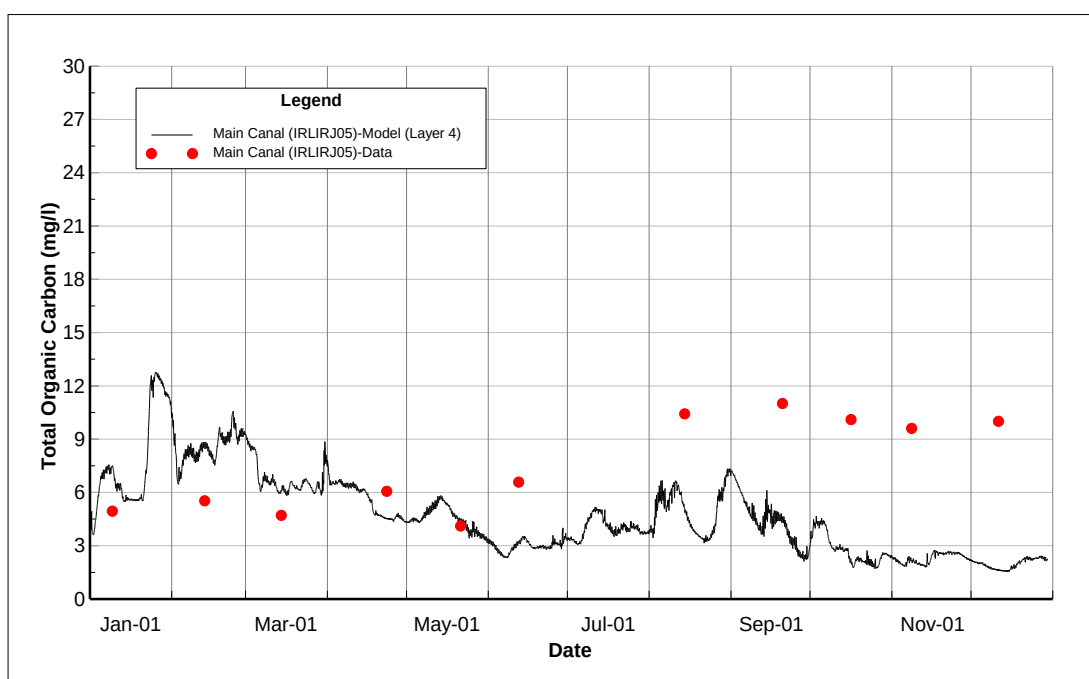


Figure G55-b. TOC validation at Main Canal (Station: IRLIRJ05)

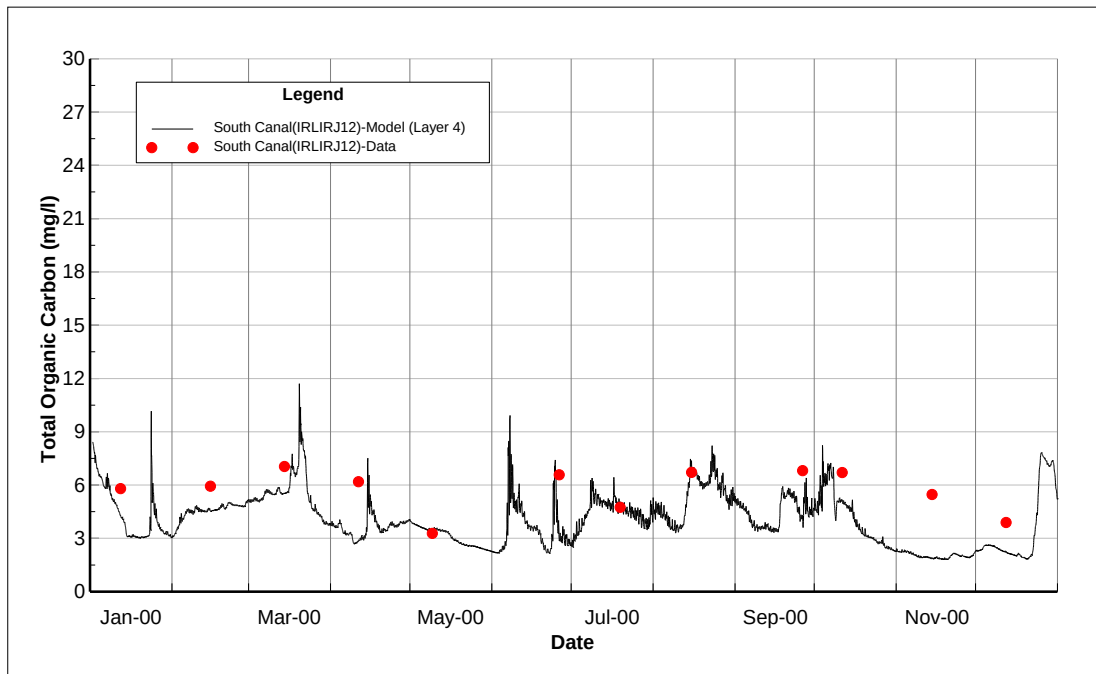


Figure G56-a. TOC Calibration at South Canal (Station: IRLIRJ12)

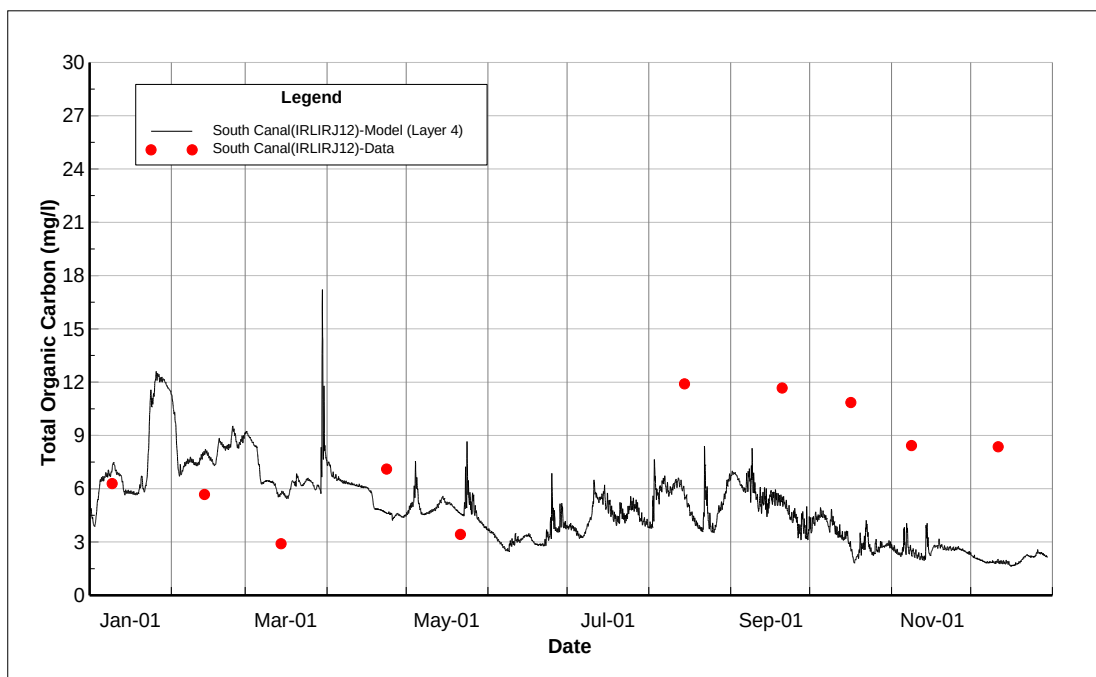


Figure G56-b. TOC validation at South Canal (Station: IRLIRJ12)

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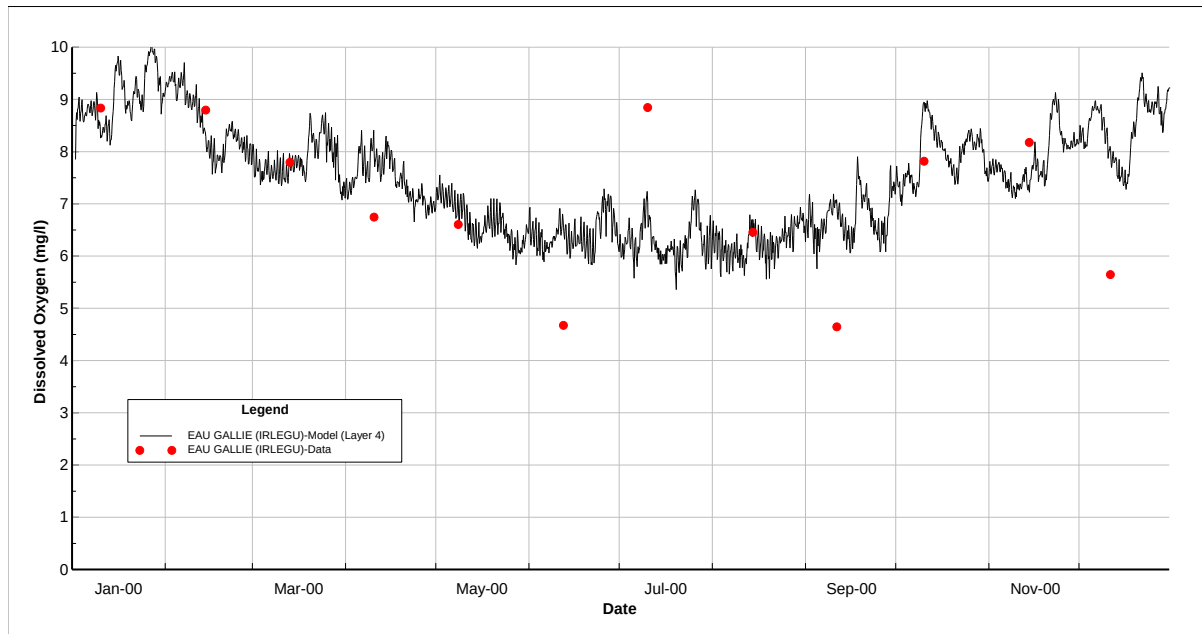


Figure G57-a. Eau Gallie Model DO Calibration (Station: IRLEGU)

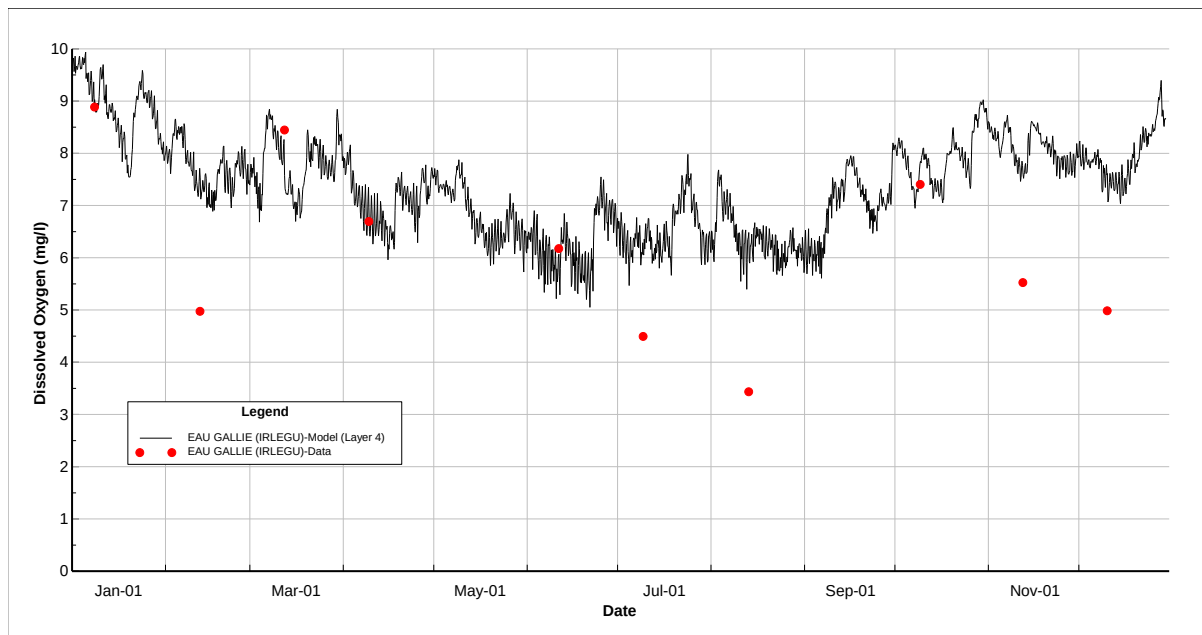


Figure G57-b. Eau Gallie model DO validation (Station: IRLEGU)

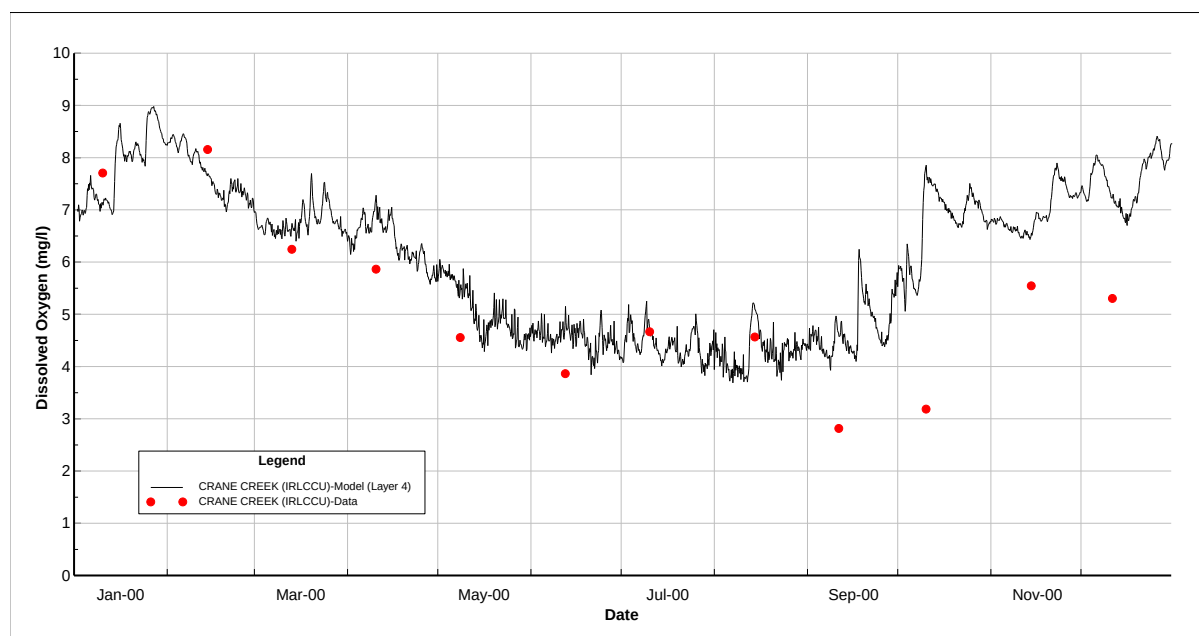


Figure G58-a. Crane Creek Model DO Calibration (Station: IRLCCU)

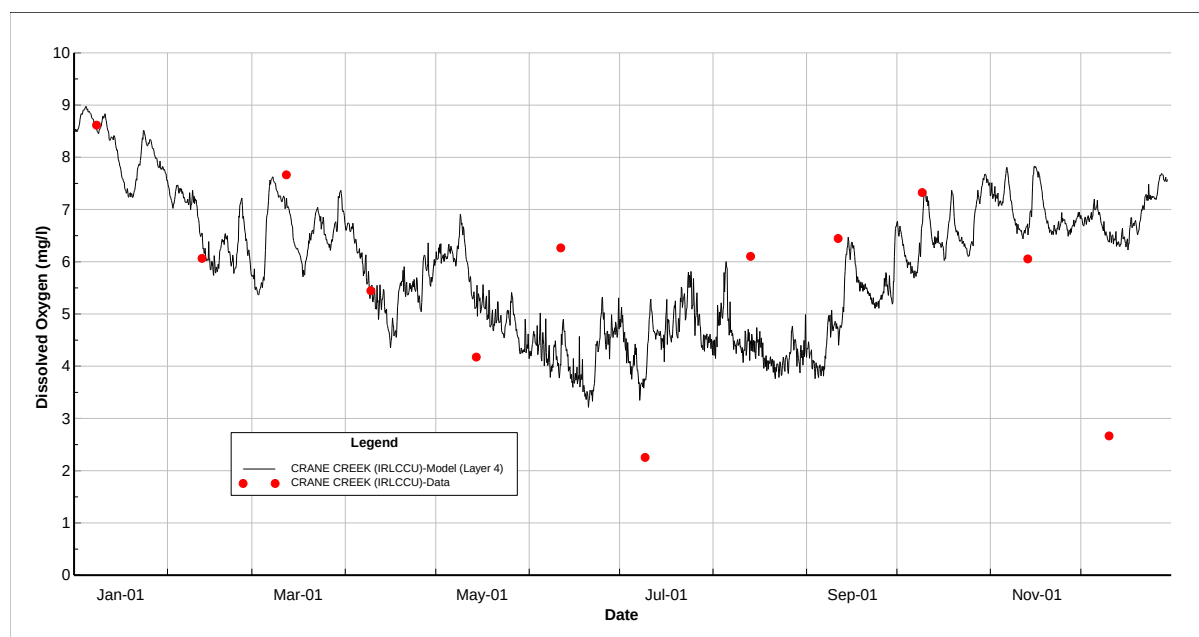


Figure G58-b. Crane Creek model DO validation (Station: IRLCCU)

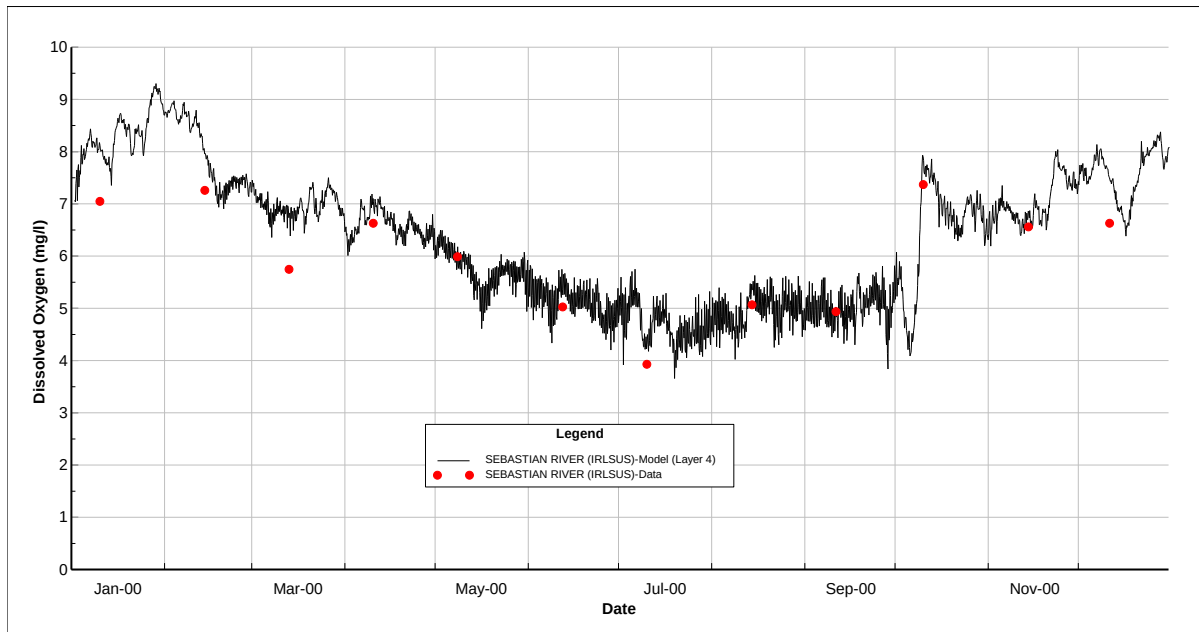


Figure G59-a. Sebastian River model DO calibration (Station: IRLSUS)

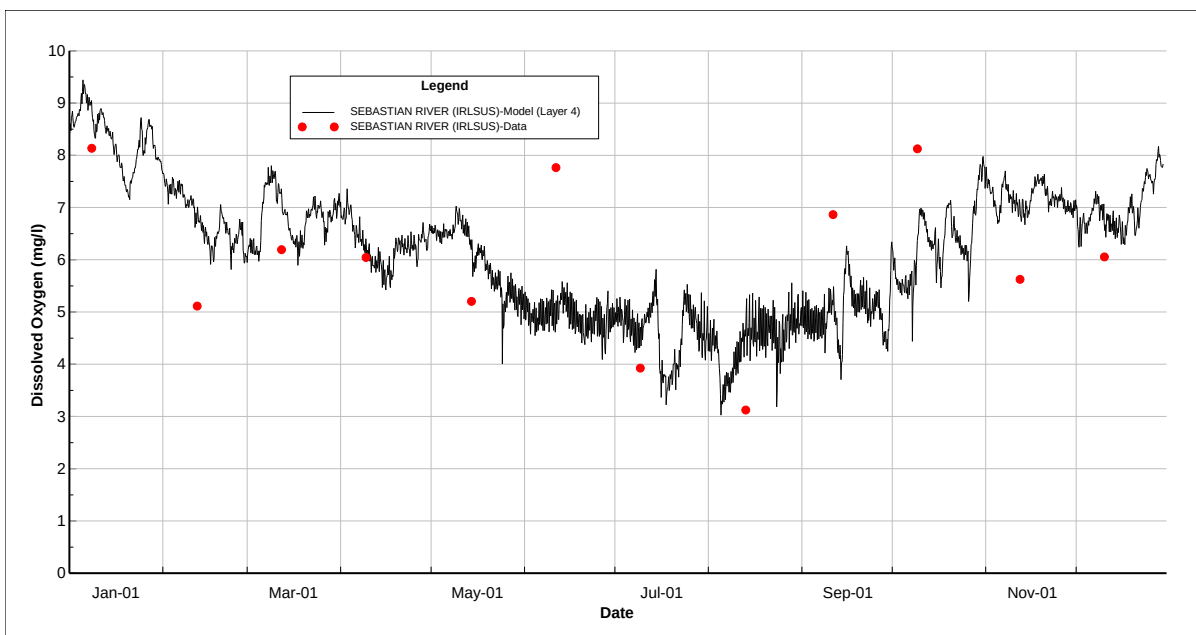


Figure G59-b. Sebastian River model DO validation (Station: IRLSUS)

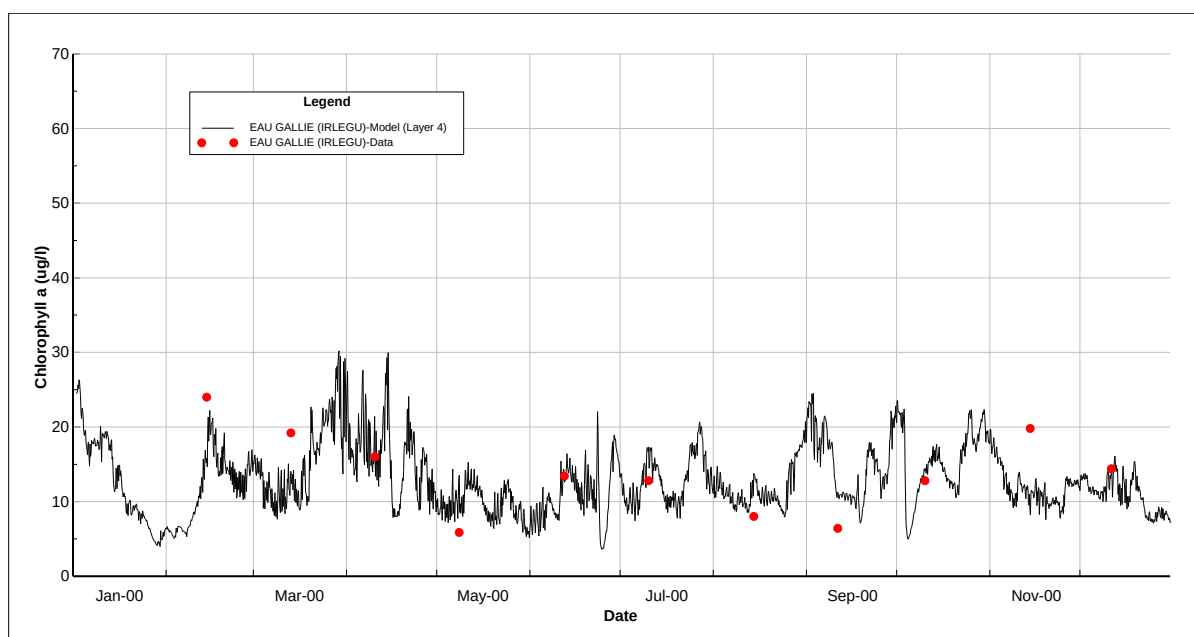


Figure G60-a. Eau Gallie Model Chlorophyll-a Calibration (Station: IRLEGU)

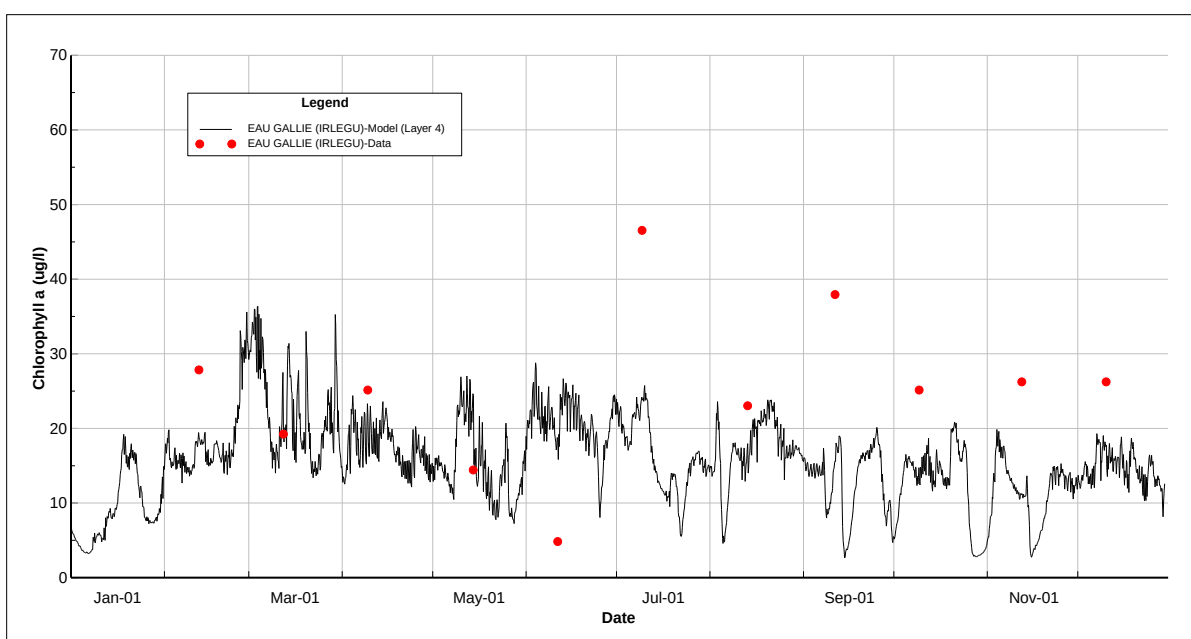


Figure G60-b. Eau Gallie model Chlorophyll-a validation (Station: IRLEGU)

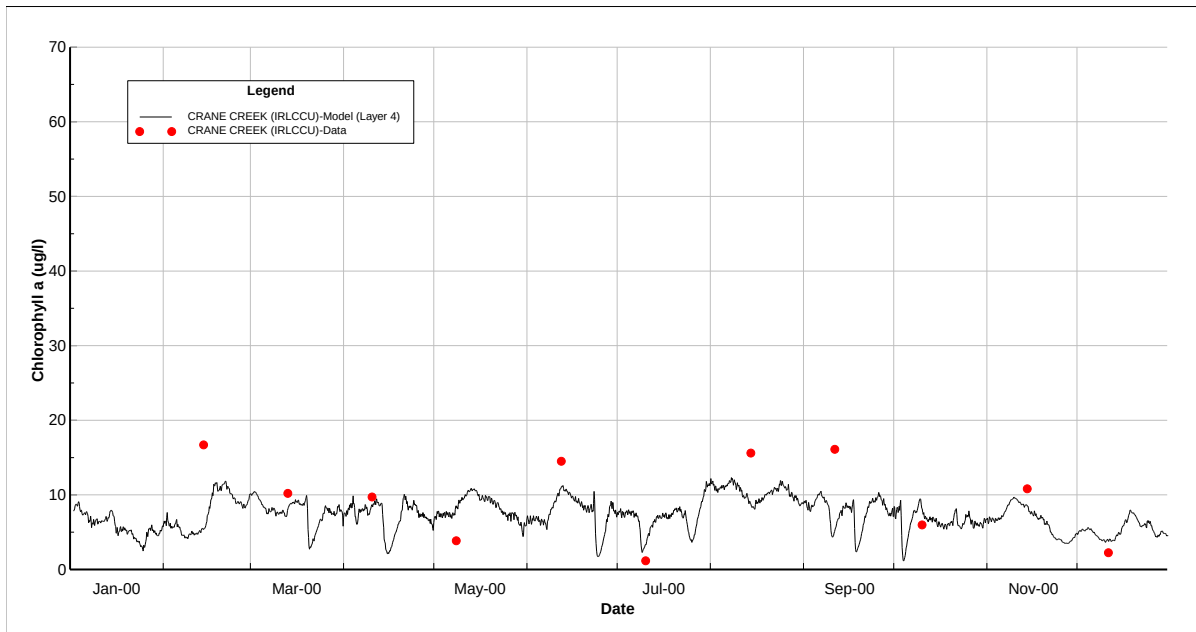


Figure G61-a. Crane Creek Model Chlorophyll-a Calibration (Station: IRLCCU)

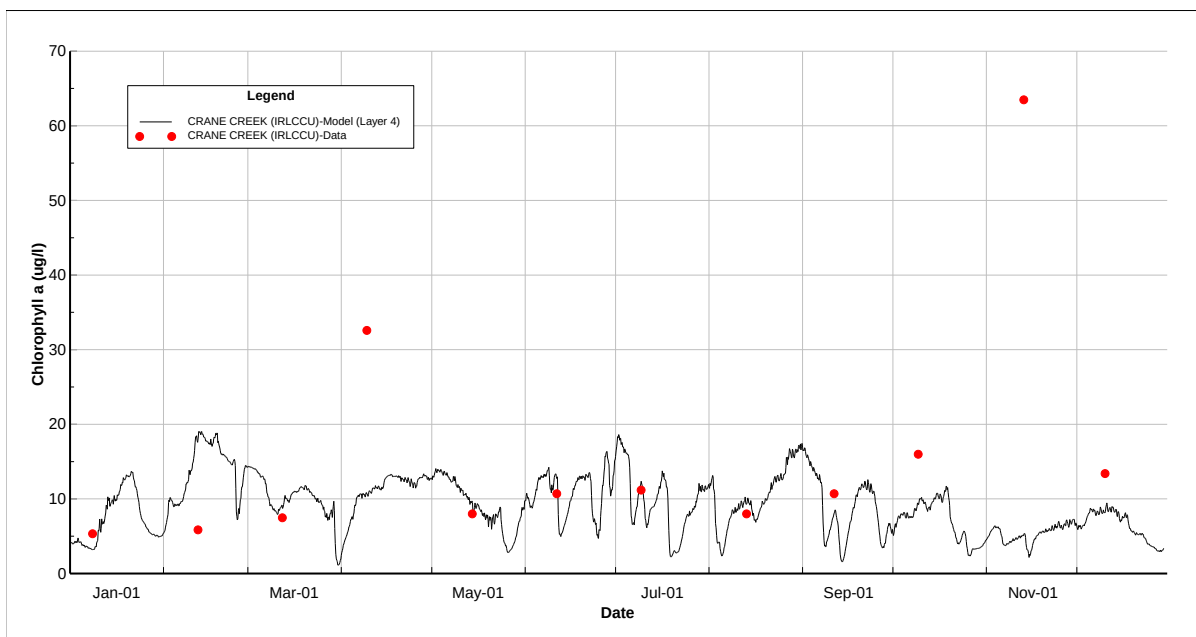


Figure G61-b. Crane Creek model Chlorophyll-a validation (Station: IRLCCU)

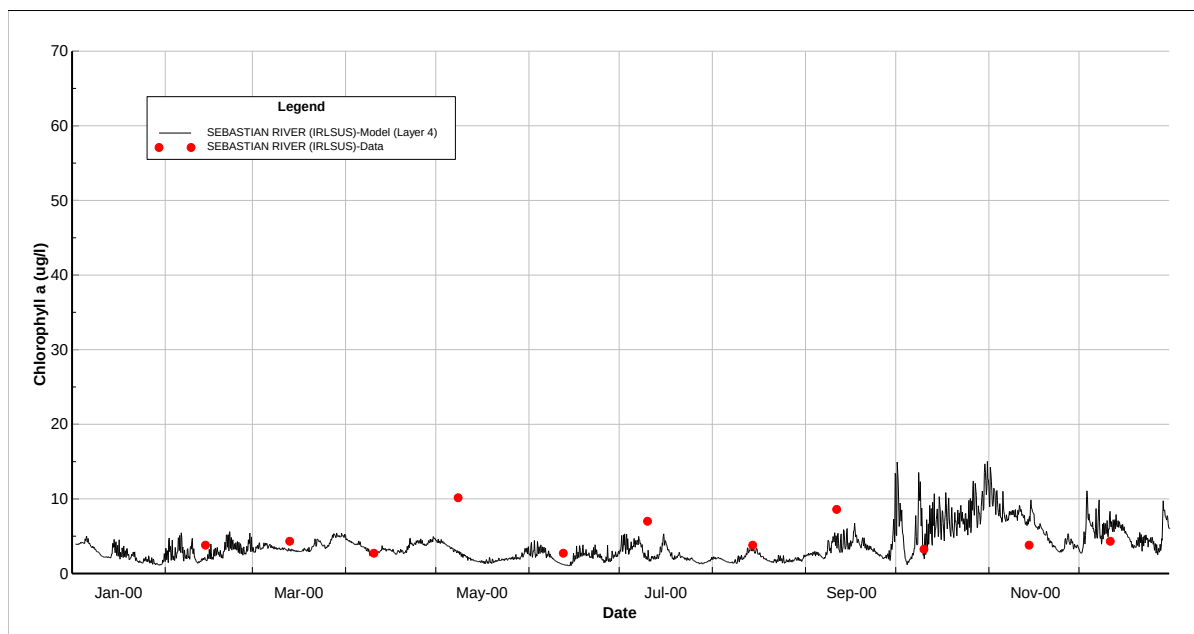


Figure G62-a. Sebastian River model Chlorophyll-a calibration (Station: IRLSUS)

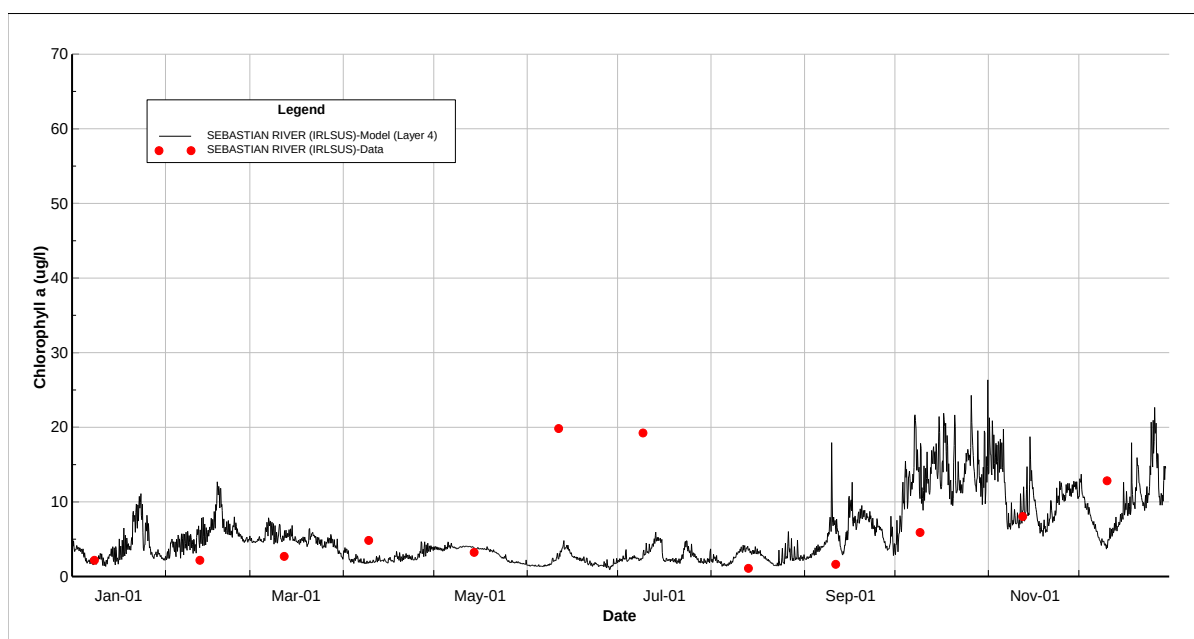


Figure G62-b. Sebastian River model Chlorophyll-a validation (Station: IRLSUS)

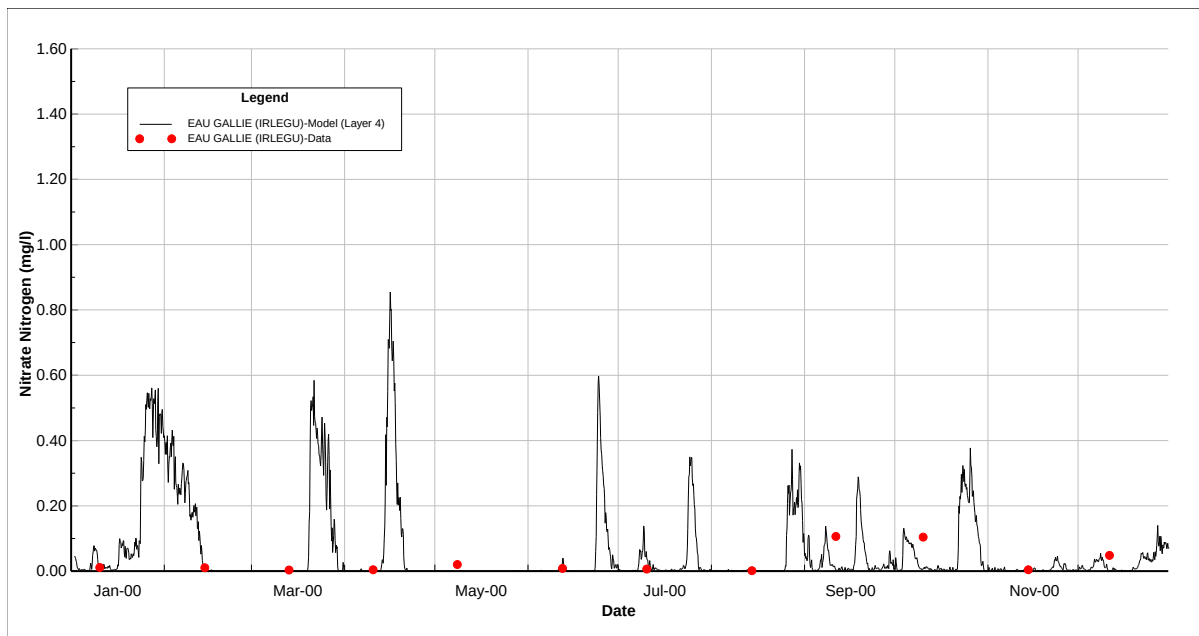


Figure G63-a. Eau Gallie Model Nitrate Calibration (Station: IRLEGU)

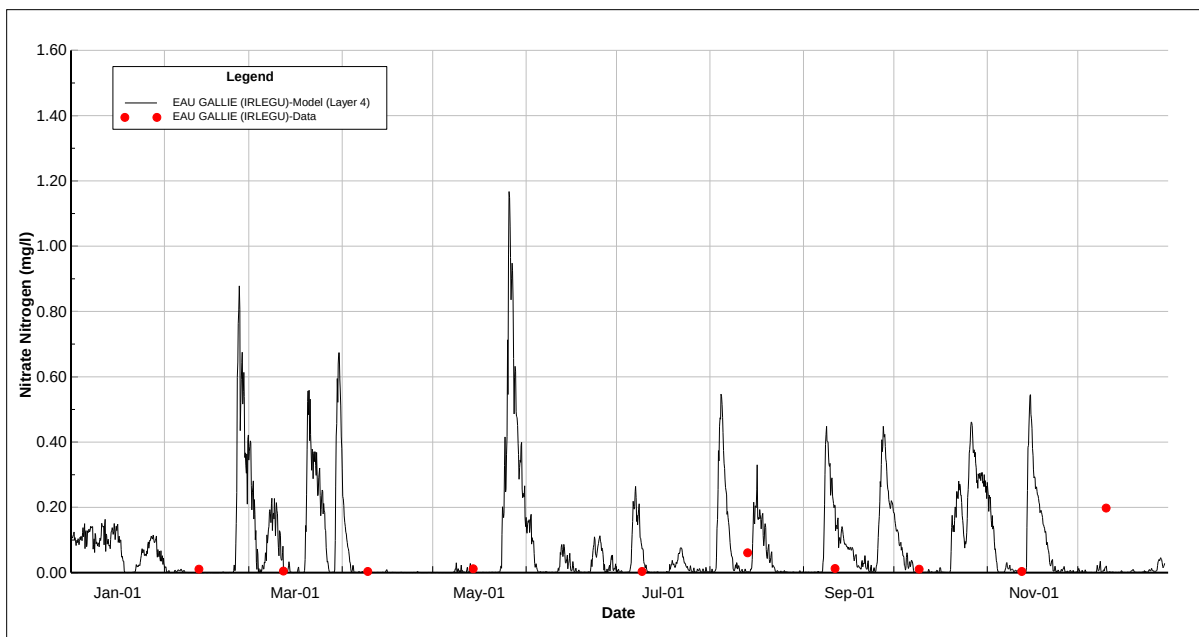


Figure G63-b. Eau Gallie model nitrate validation (Station: IRLEGU)

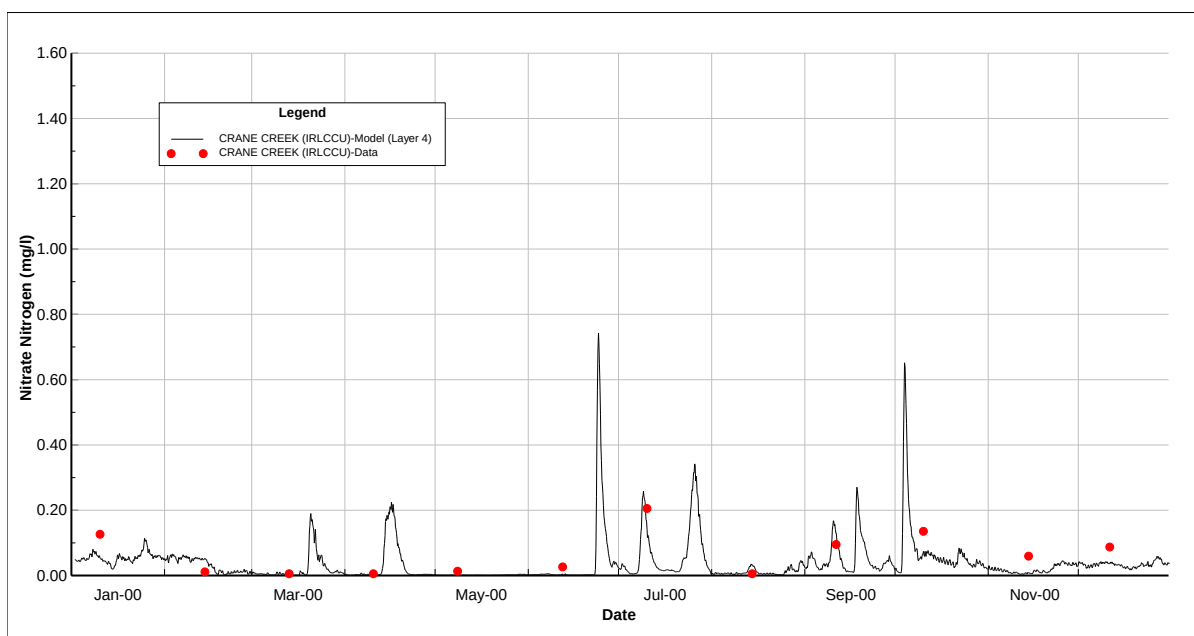


Figure G64-a. Crane Creek Model Nitrate Calibration (Station: IRLCCU)

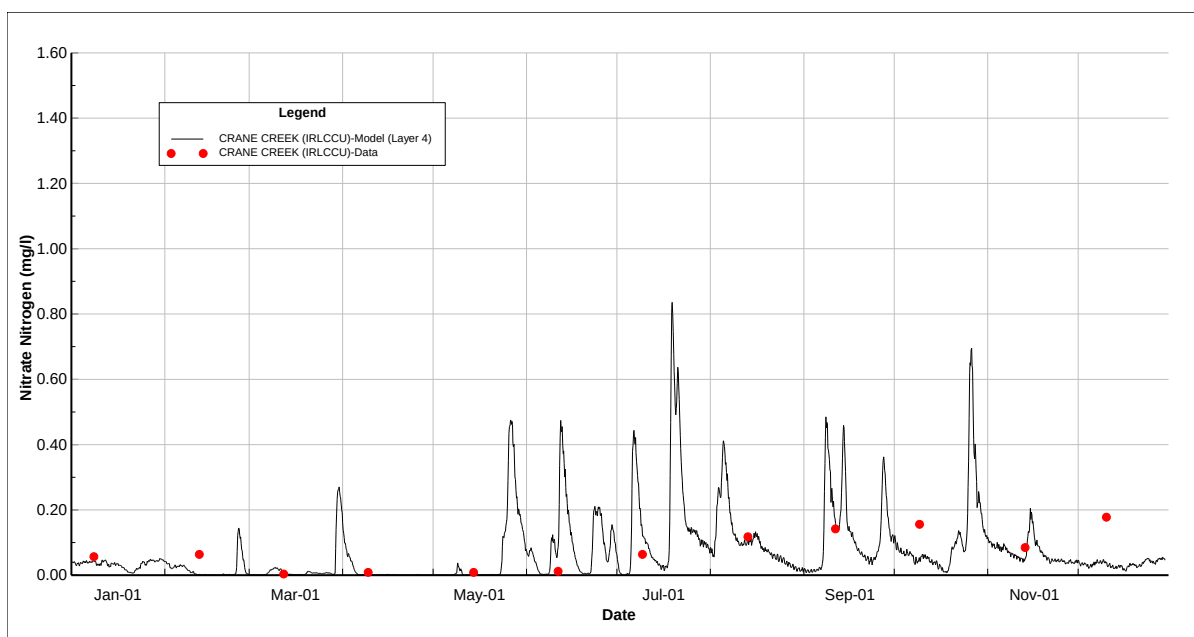


Figure G64-b. Crane Creek model nitrate validation (Station: IRLCCU)

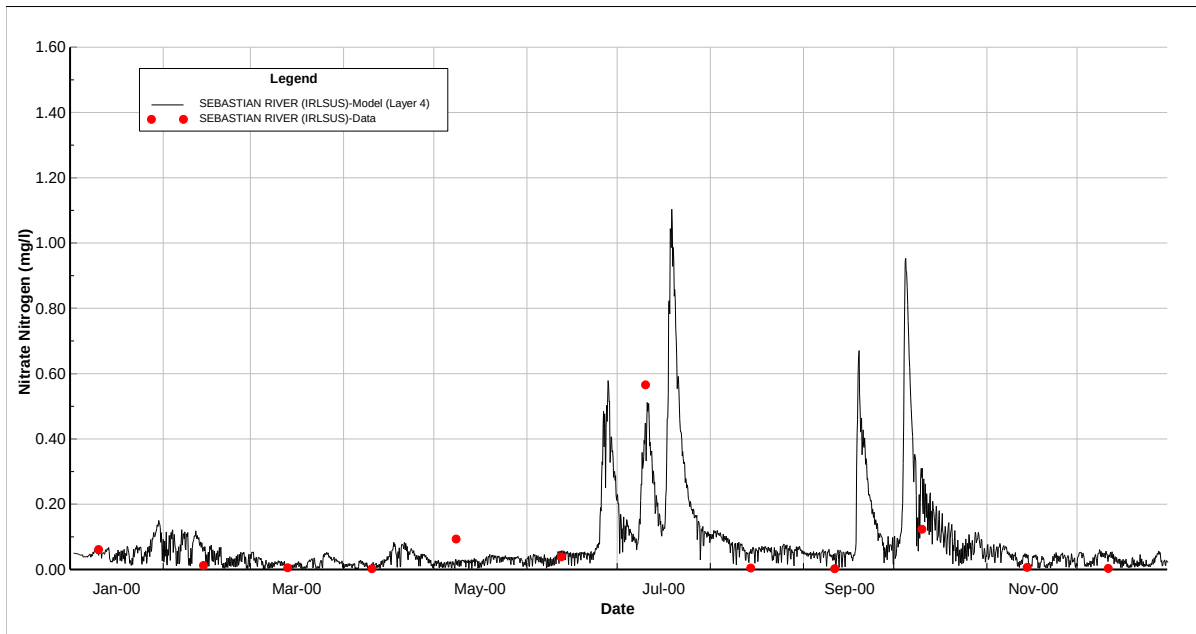


Figure G65-a. Sebastian River model nitrate calibration (Station: IRLSUS)

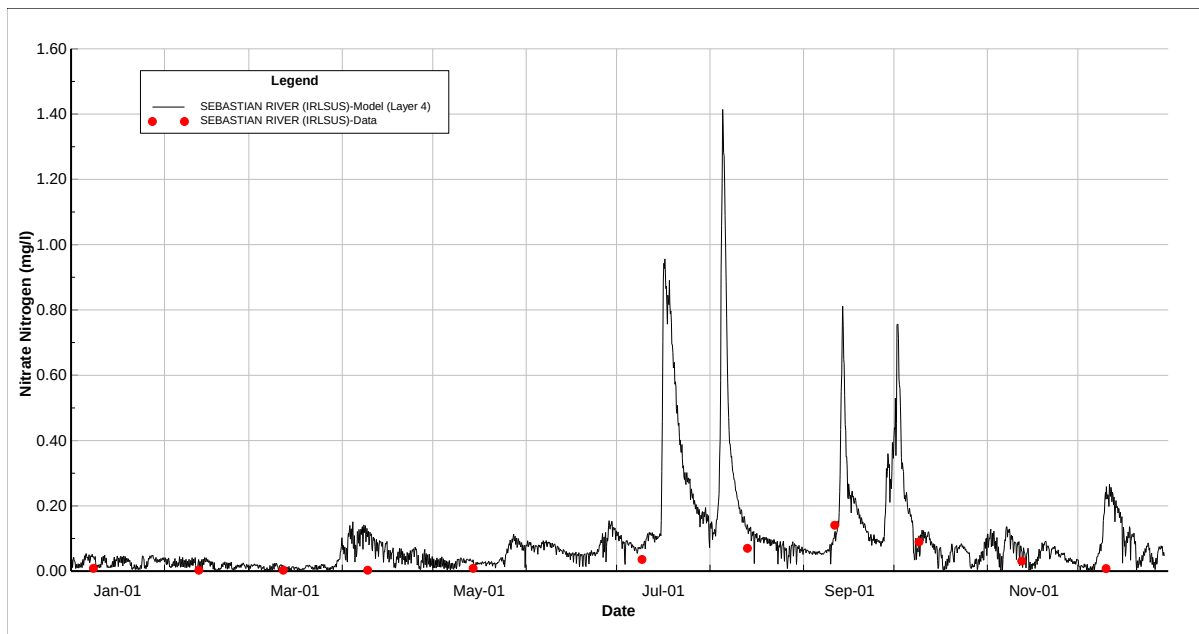


Figure G65-b. Sebastian River model nitrate validation (Station: IRLSUS)

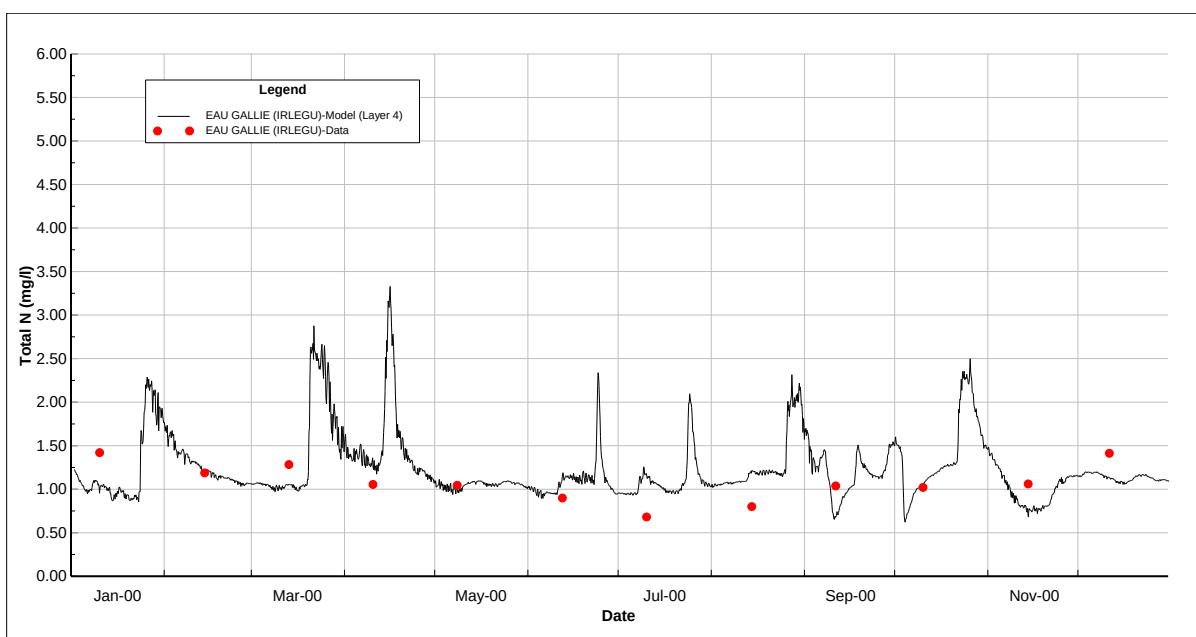


Figure G66-a. Eau Gallie Model TN Calibration (Station: IRLEGU)

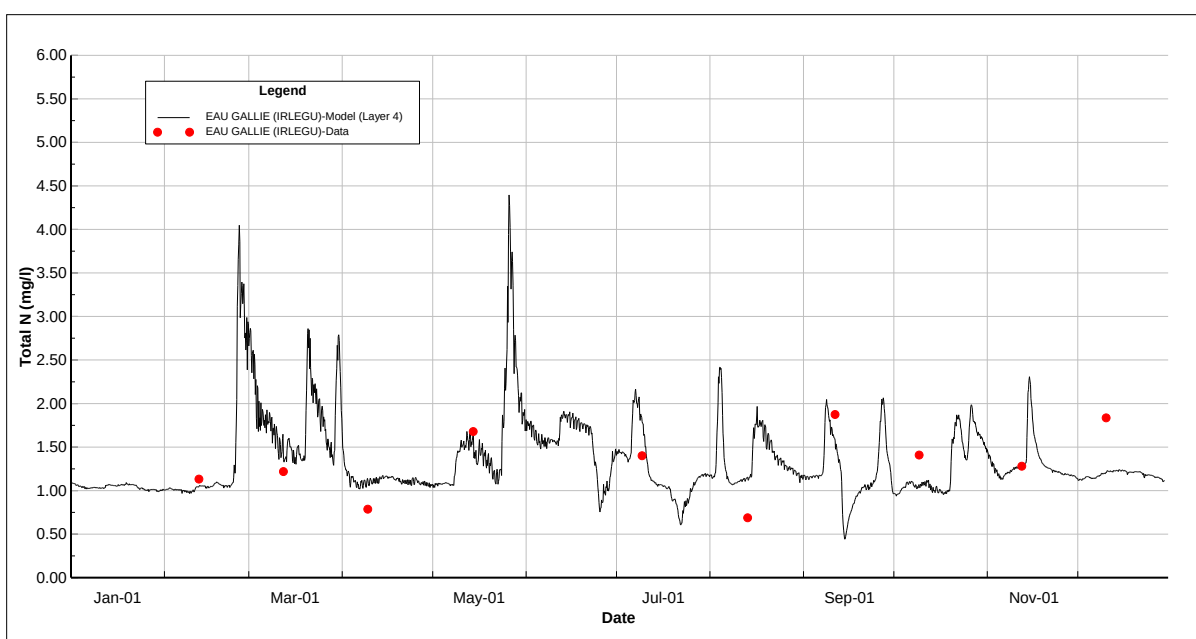


Figure G66-b. Eau Gallie model TN validation (Station: IRLEGU)

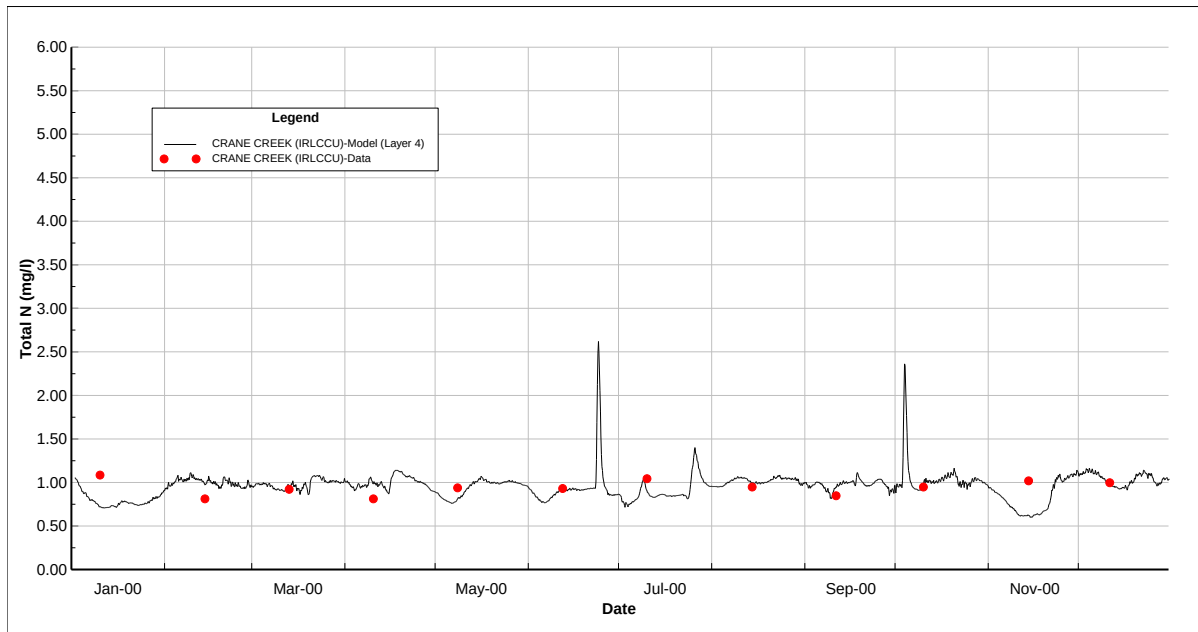


Figure G67-a. Crane Creek Model TN Calibration (Station: IRLCCU)

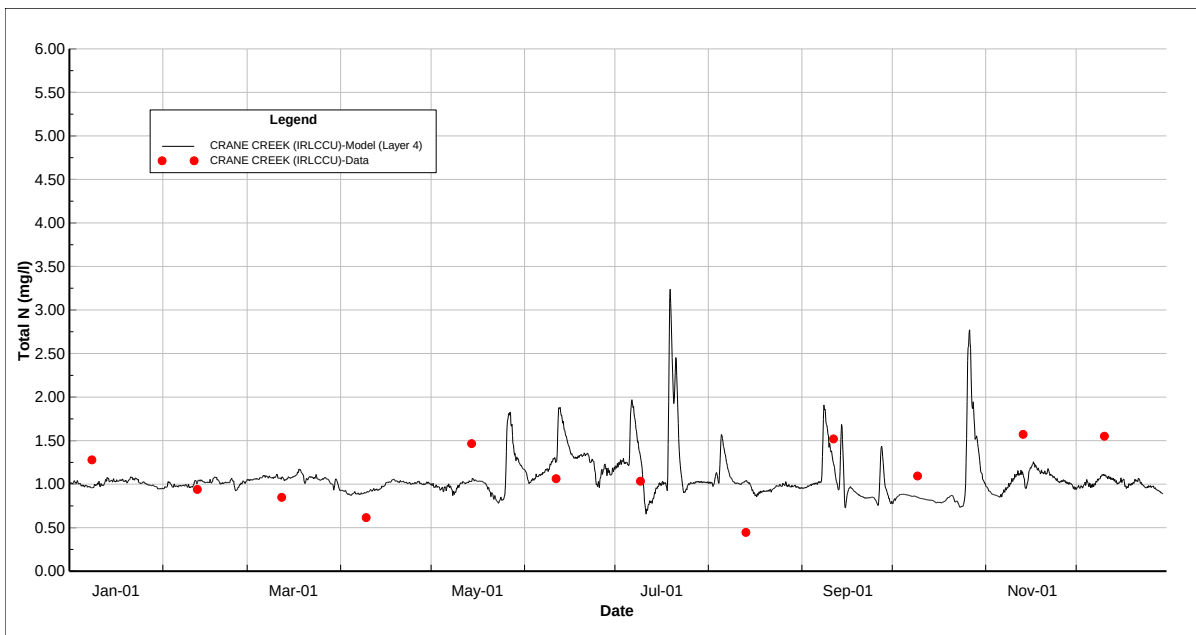


Figure G67-b. Crane Creek model TN validation (Station: IRLCCU)

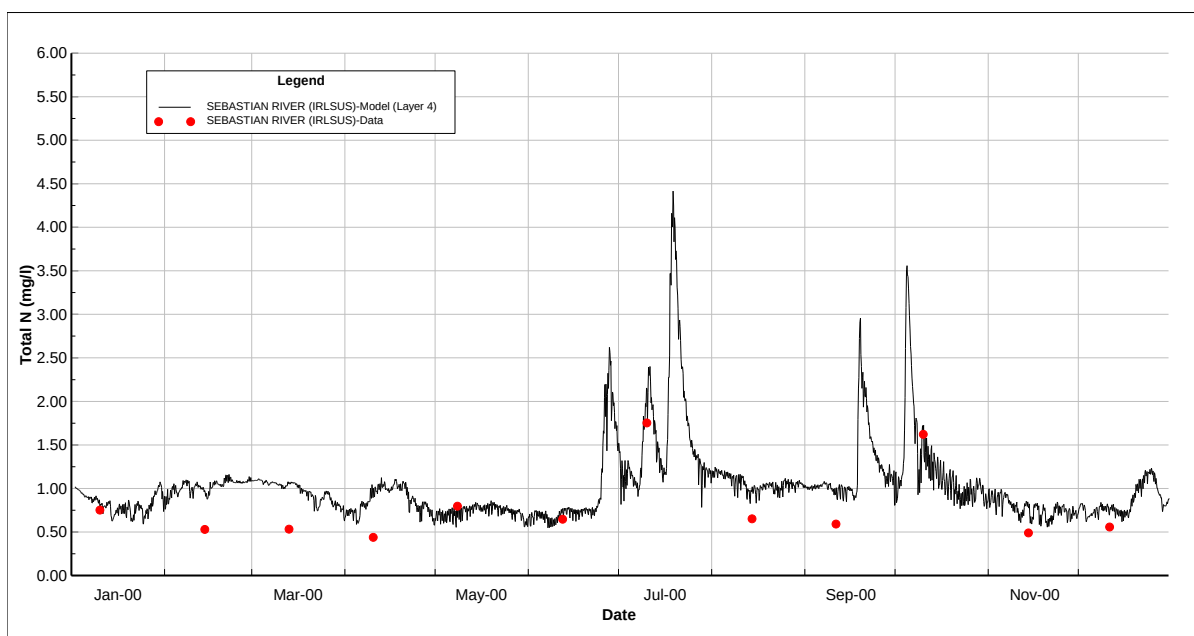


Figure G68-a. Sebastian River model TN calibration (Station: IRLSUS)

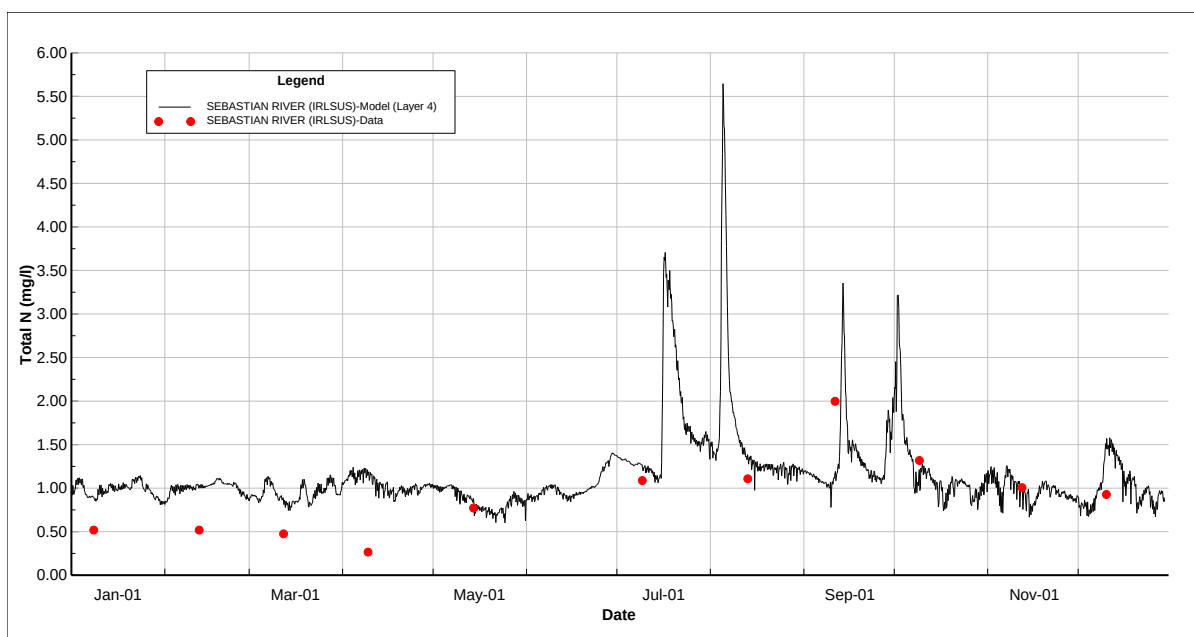


Figure G68-b. Sebastian River model TN validation (Station: IRLSUS)

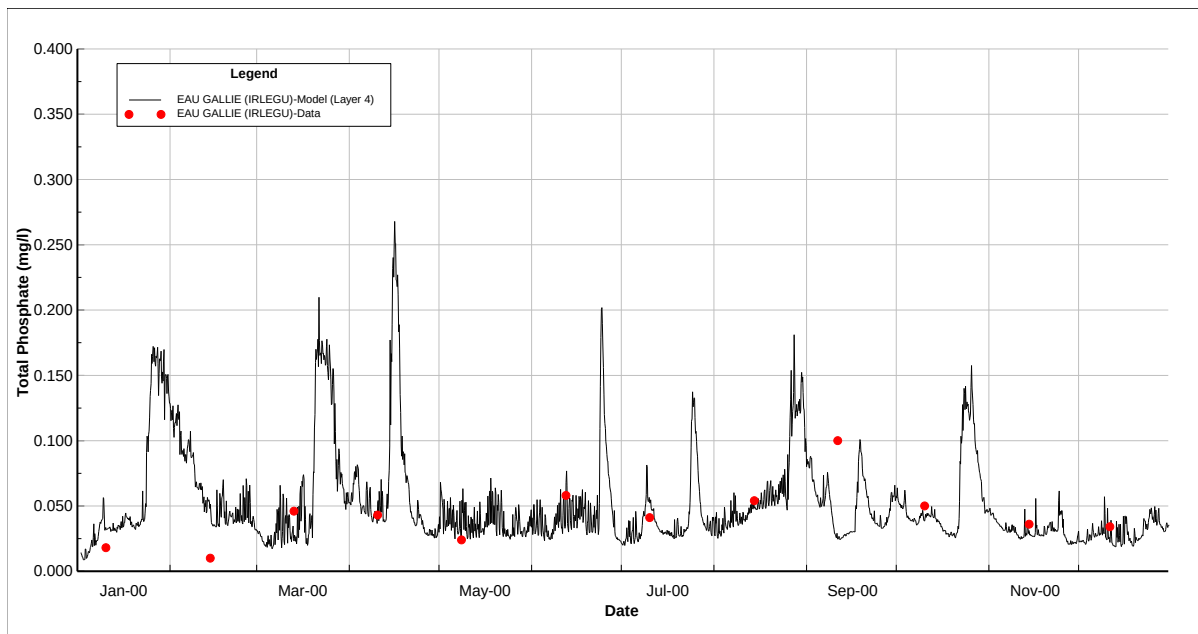


Figure G69-a. Eau Gallie Model Phosphate Calibration (Station: IRLEGU)

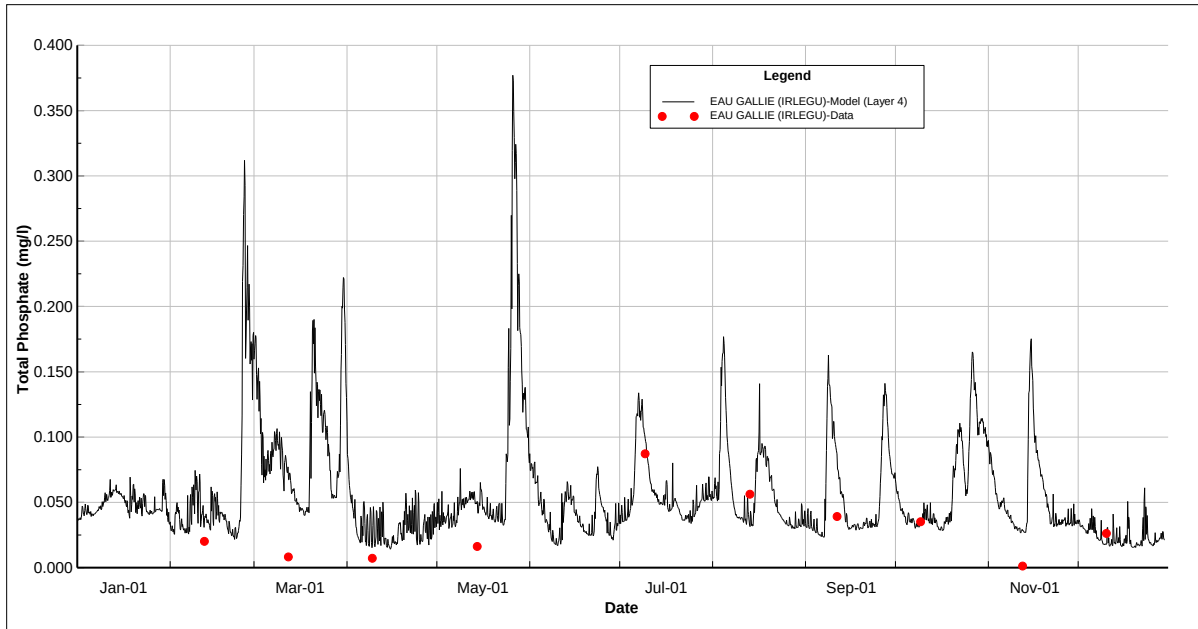


Figure G69-b. Eau Gallie model phosphate validation (Station: IRLEGU)

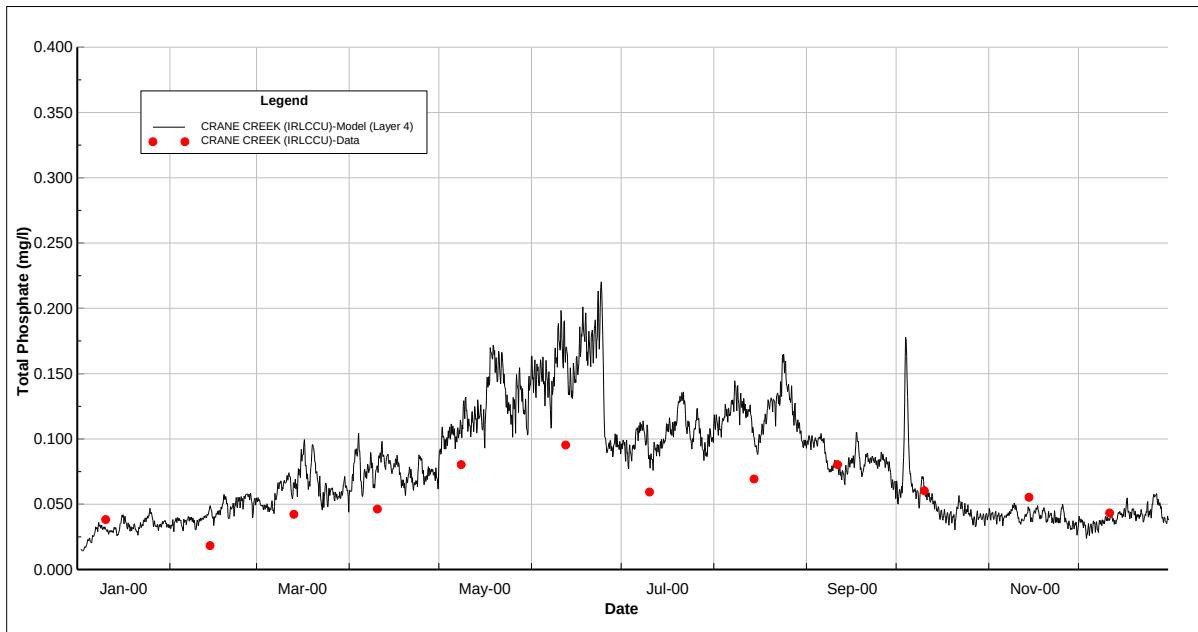


Figure G70-a. Crane Creek Model Phosphate Calibration (Station: IRLCCU)

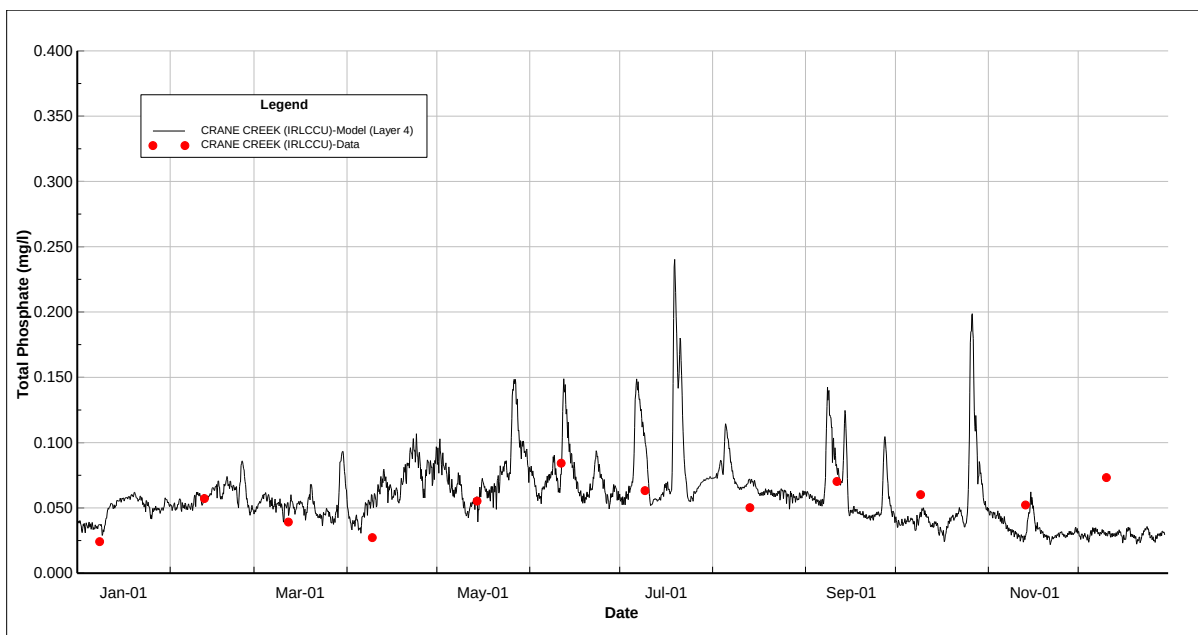


Figure G70-b. Crane Creek model phosphate validation (Station: IRLCCU)

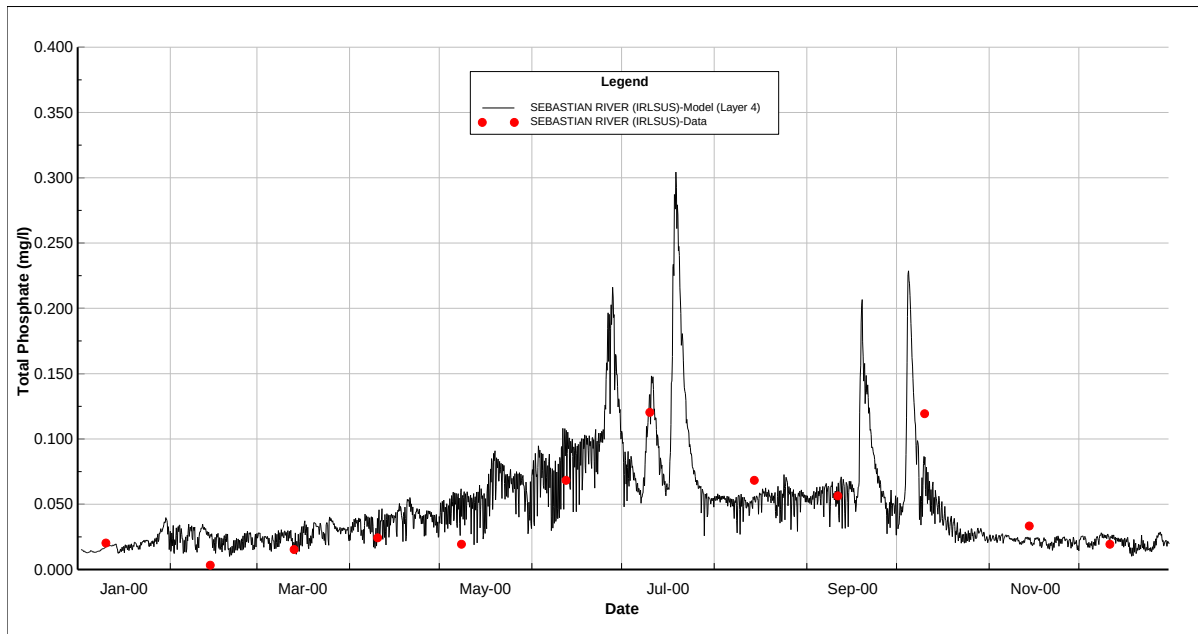


Figure G71-a. Sebastian River model phosphate calibration (Station: IRLSUS)

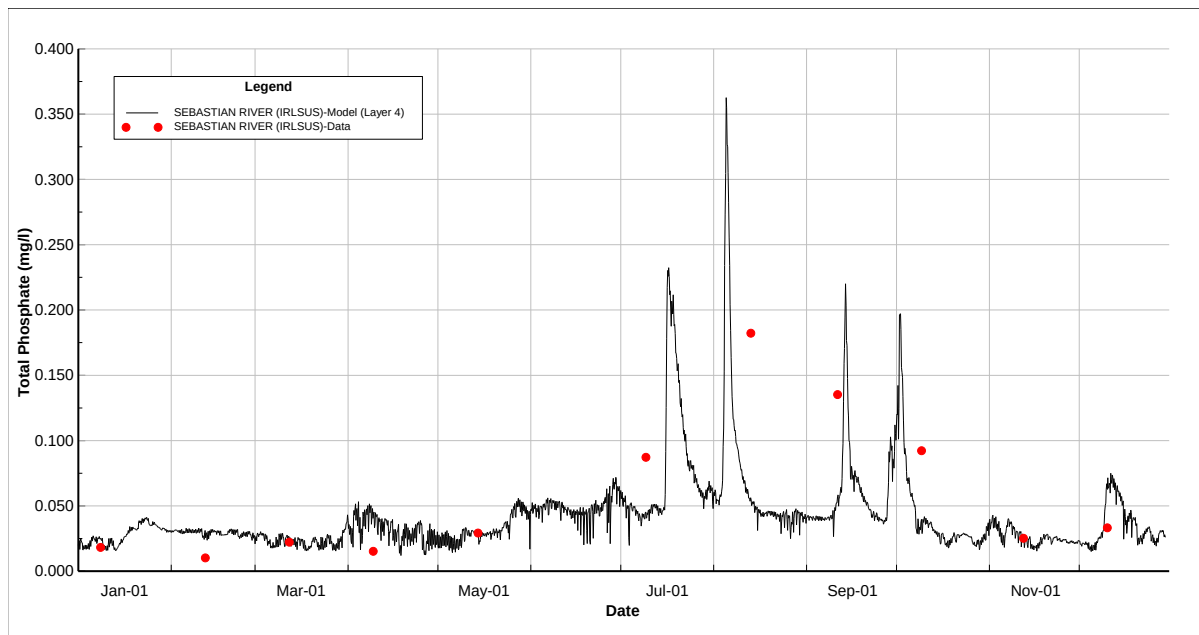


Figure G70-b. Sebastian River model phosphate validation (Station: IRLSUS)

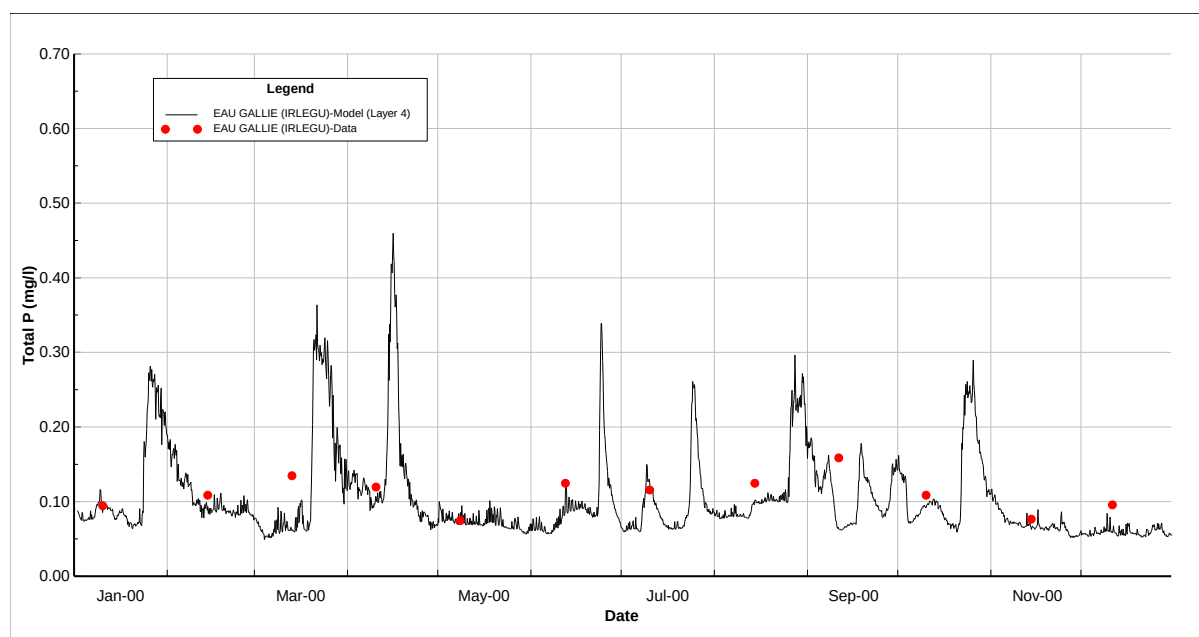


Figure G71-a. Eau Gallie Model TP Calibration (Station: IRLEGU)

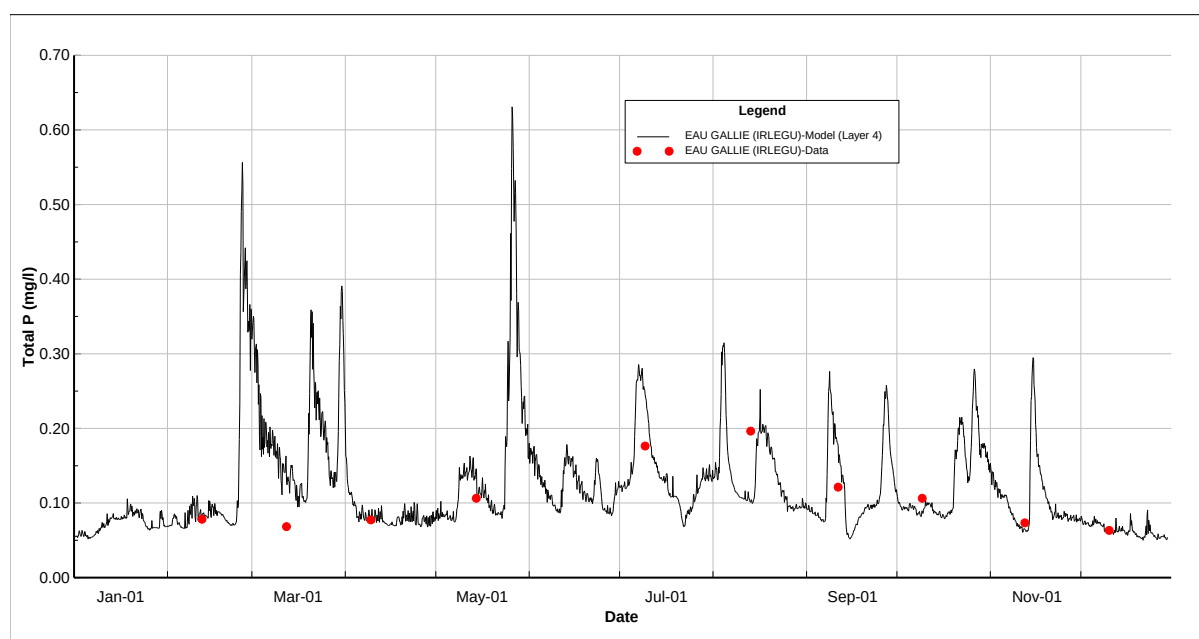


Figure G71-b. Eau Gallie model TP validation (Station: IRLEGU)

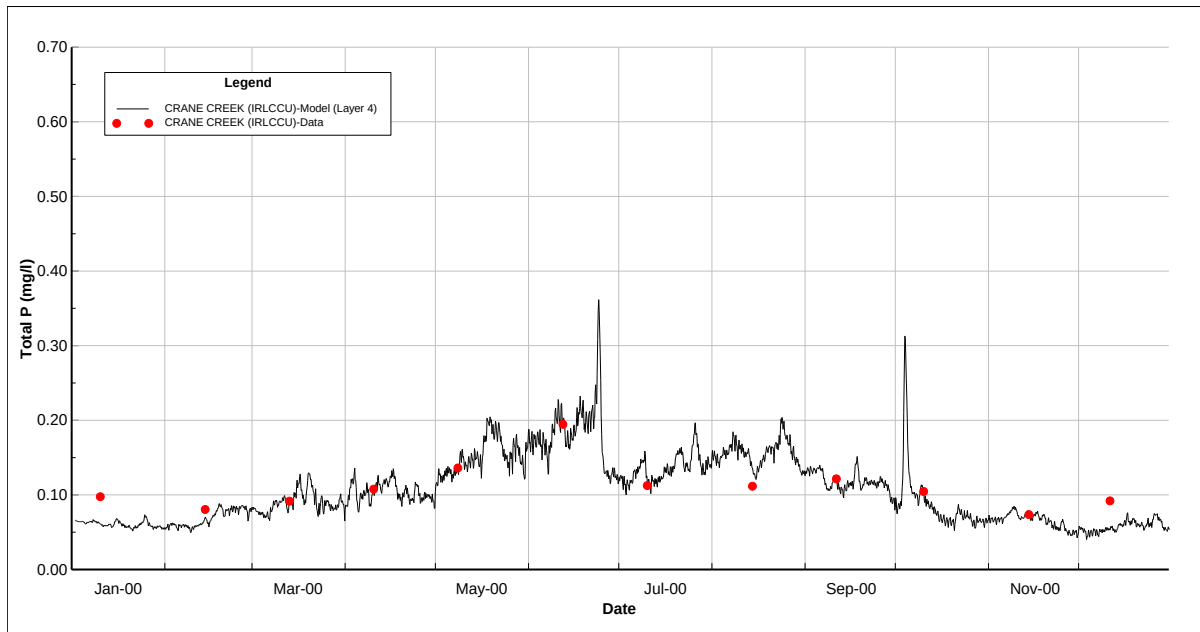


Figure G72-a. Crane Creek Model TP Calibration (Station: IRLCCU)

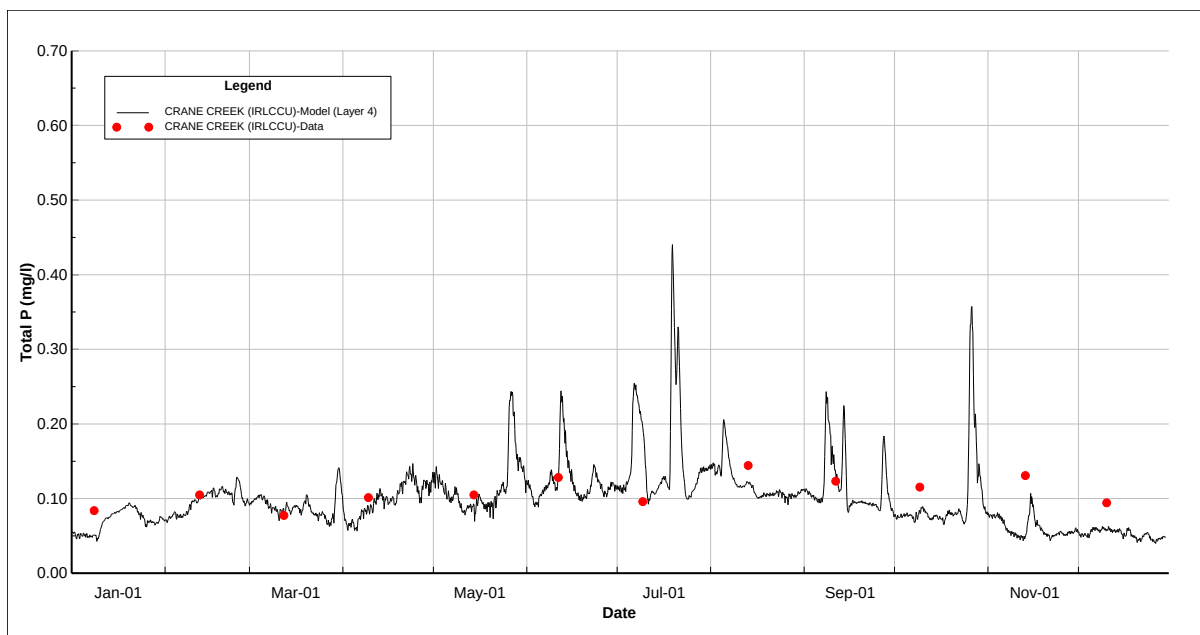


Figure G72-b. Crane Creek model TP validation (Station: IRLCCU)

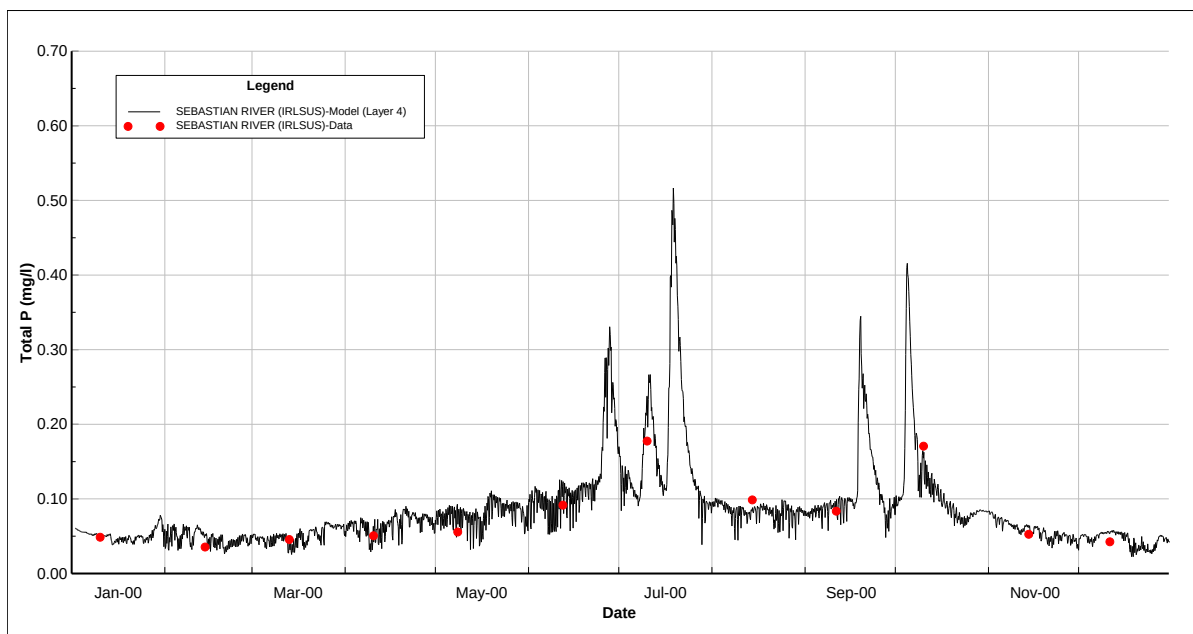


Figure G73-a. Sebastian River model TP calibration (Station: IRLSUS)

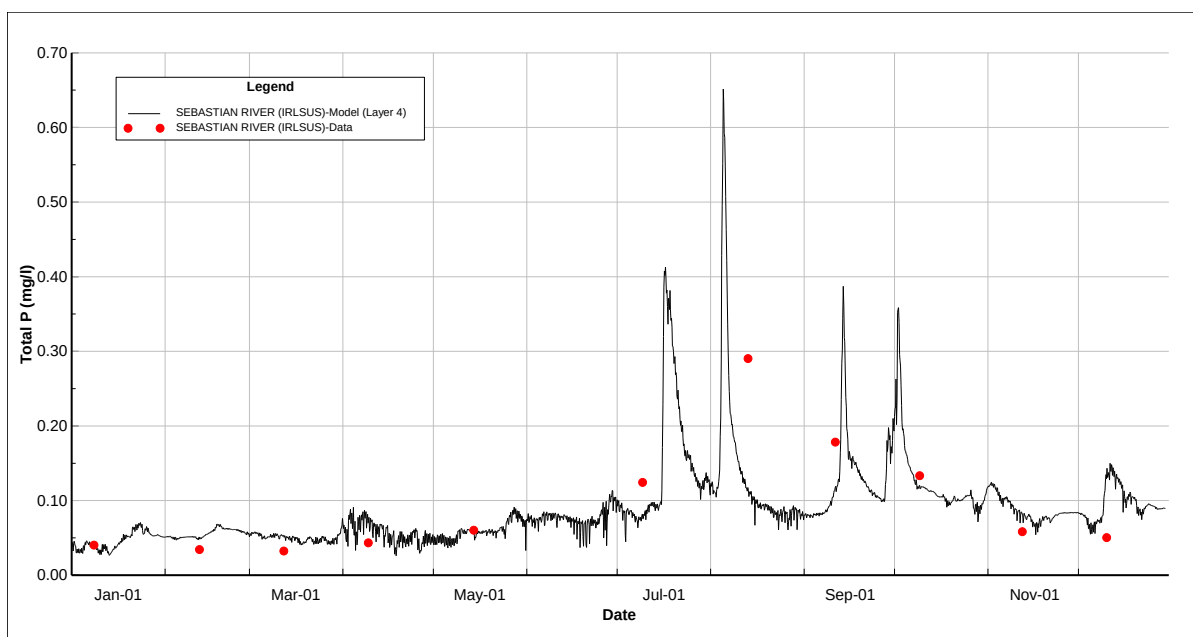


Figure G73-b. Sebastian River model TP validation (Station: IRLSUS)

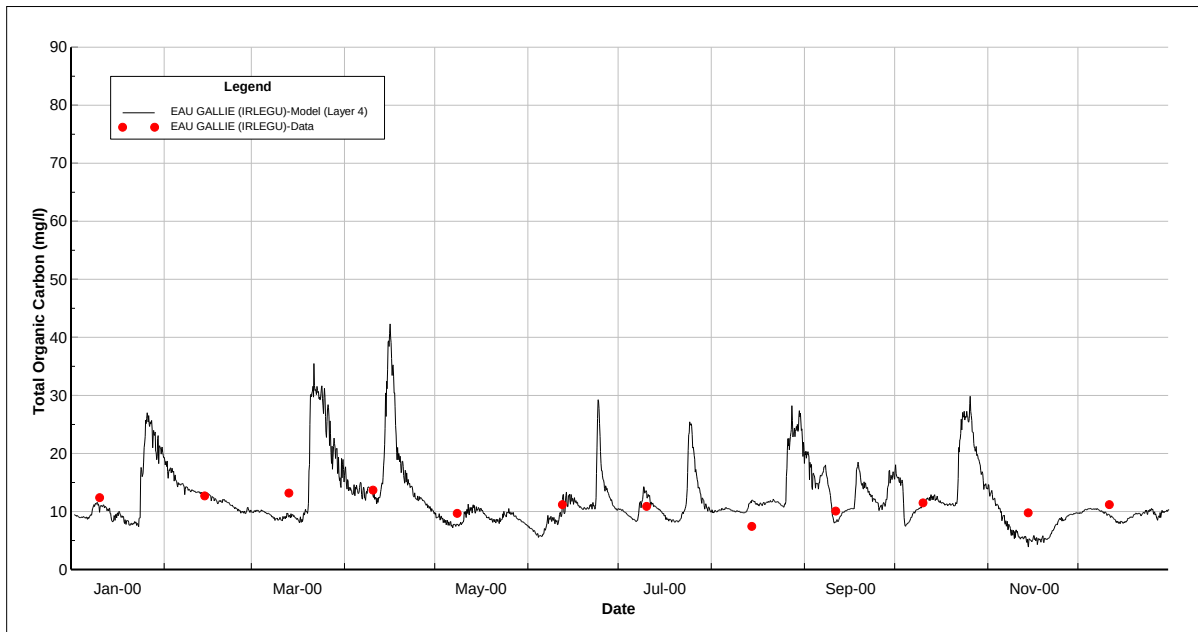


Figure G74-a. Eau Gallie Model TOC Calibration (Station: IRLEGU)

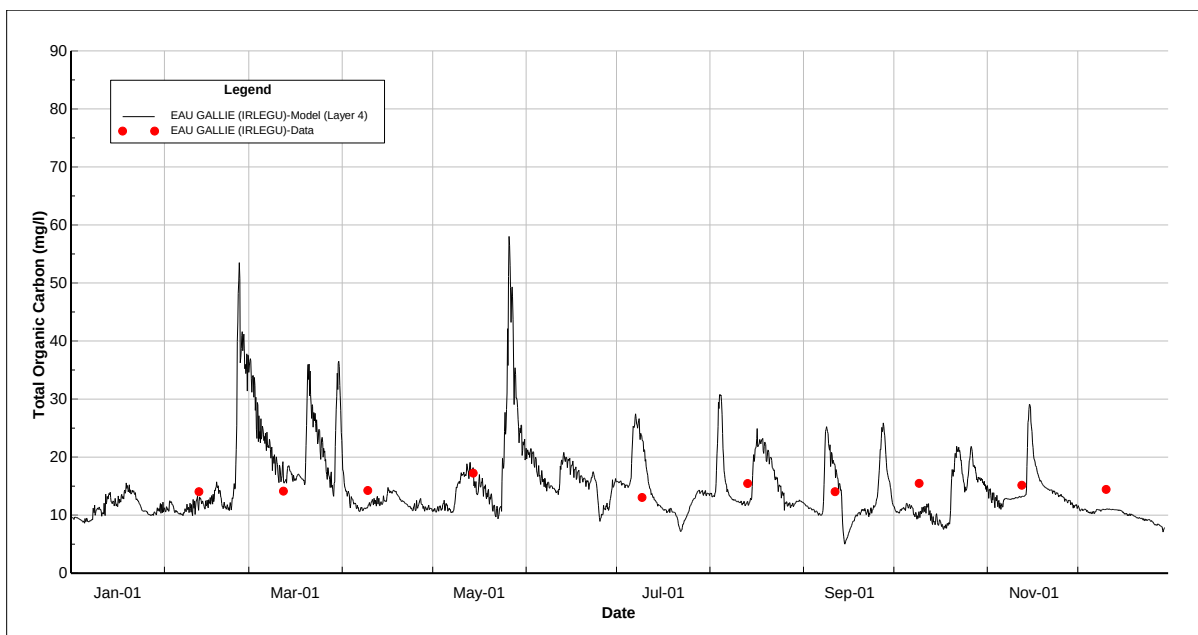


Figure G74-b. Eau Gallie model TOC validation (Station: IRLEGU)

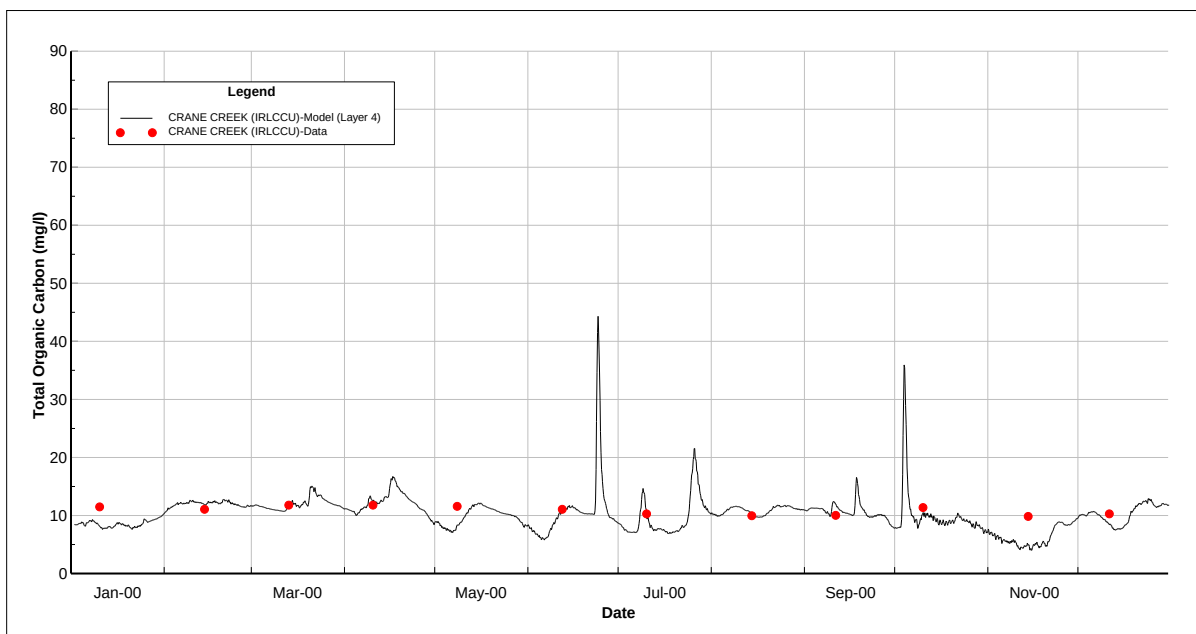


Figure G75-a. Crane Creek Model TOC Calibration (Station: IRLCCU)

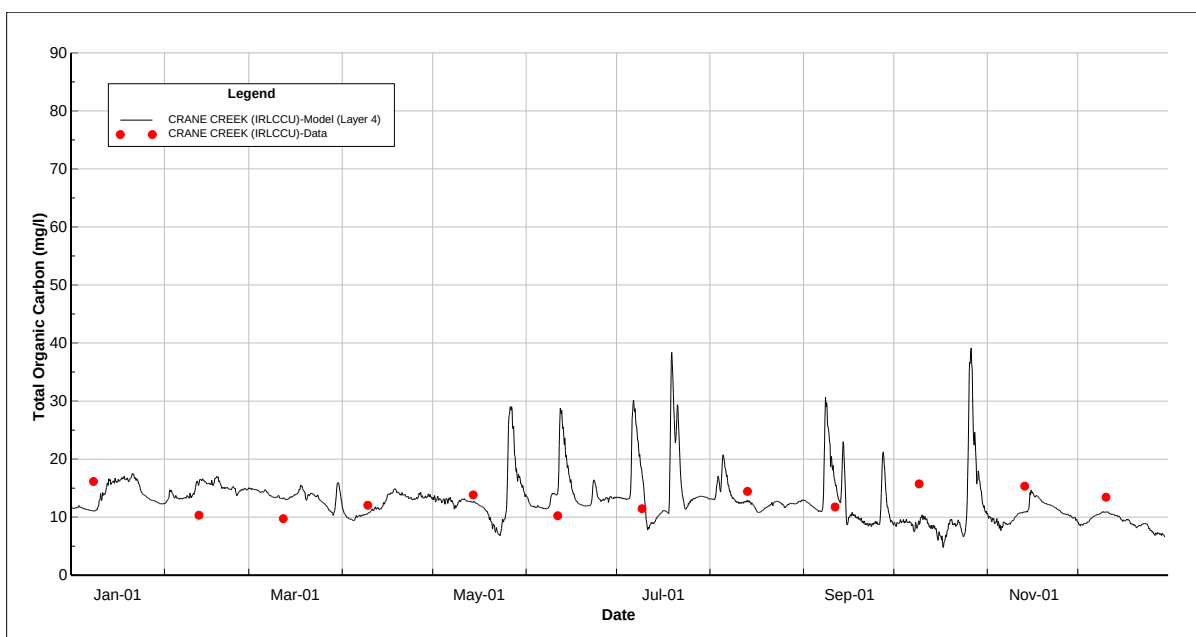


Figure G75-b. Crane Creek model TOC validation (Station: IRLCCU)

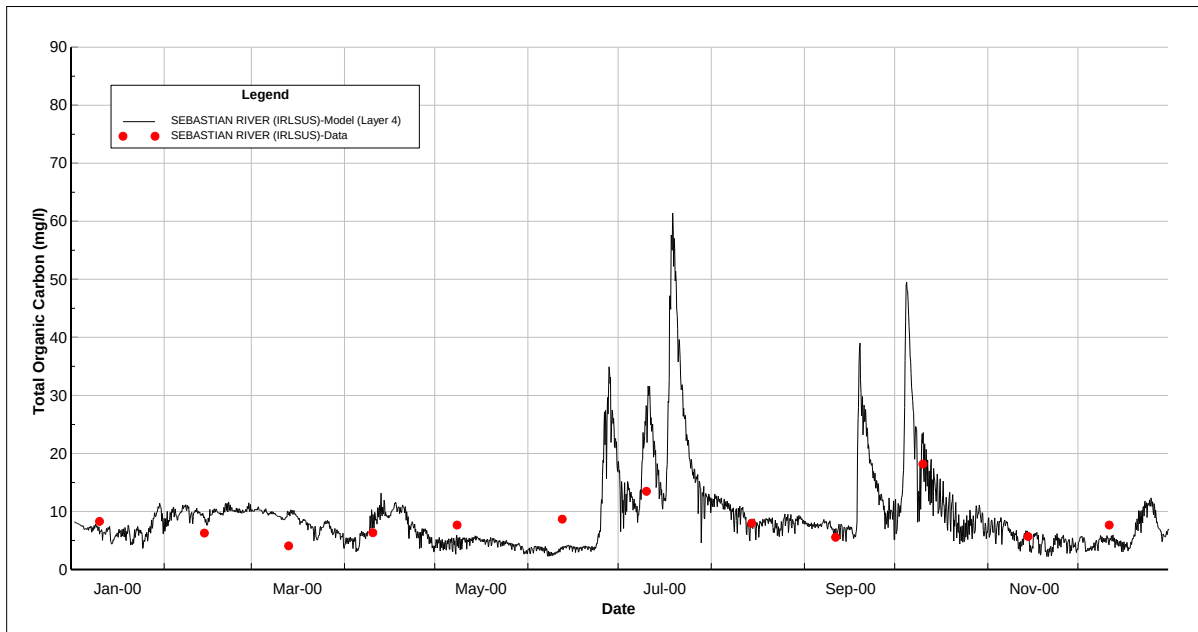


Figure G76-a. Sebastian River model TOC calibration (Station: IRLSUS)

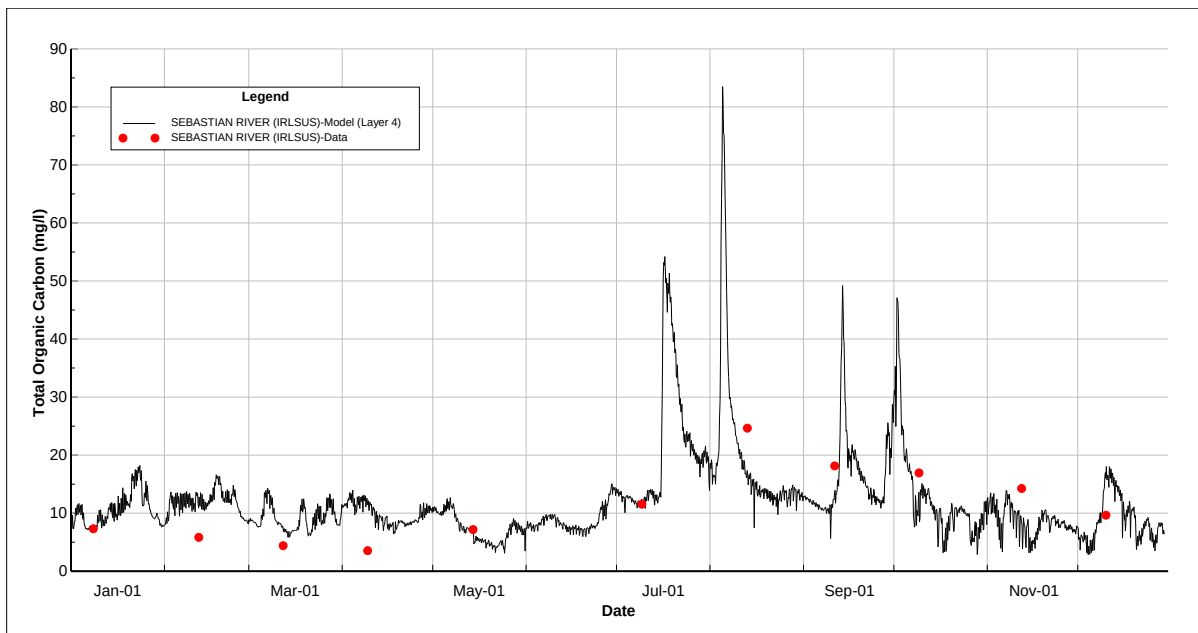


Figure G76-b. Sebastian River model TOC validation (Station: IRLSUS)

Appendix H: Public Comments and FDEP Responses

FDEP Response to City of Melbourne Comments

, February 12, 2013

Ms. Jenni Lamb
Engineering Department
City of Melbourne
900 E. Strawbridge Avenue
Melbourne, FL 32901

Dear Ms. Lamb:

Thank you very much for your comments dated at December 21, 2012, regarding the Indian River Lagoon (IRL) tributary TMDLs presented at the public workshop on December 4th, 2012! Your comments are very valuable in helping us refine these TMDLs. We appreciate your thoughtful input and are looking forward to continuously working with you and other local stakeholders to protect the valuable water resources in the Indian River Lagoon basin.

The following are responses to your comments:

Comment 1 from the City of Melbourne:

The City of Melbourne's Mullins Potable Water Plant discharges into the Eau Gallie River tributary. This treatment facility has an Industrial Wastewater Facility Permit (05-FL0043443-002-IW5A) that authorizes a discharge of demineralization concentrate at 1.25 MGD maximum daily flow to the Eau Gallie River at the US Highway 1 Bridge. The FDEP should include this facility so that its permitted discharge is recognized in the TMDL Report.

FDEP Response:

FDEP has added this facility into the revised report. Because of the low total nitrogen (TN) and total phosphorus (TP) concentrations in the facility's effluent, and as the facility only discharges a small percentage of the total TN and TP loads received by the Eau Gallie River, FDEP decided that the facility should be allowed to discharge at the 95th percentile of its existing discharge capacity. This is a reduction of nutrients identified in the IRL mainstem seagrass TMDLs that the FDEP adopted in 2009. Therefore, the Eau Gallie River DO and nutrient TMDLs will not require any added nutrient reductions from this facility.

We did not identify any biochemical oxygen demand (BOD) measurements in the EPA permit compliance system (PCS) database for the facility. According to staff members from the FDEP's industrial wastewater permitting program, the BOD measurement included in the facility's permit application was at an undetectable level. Therefore, at this point, the FDEP does not consider the facility as a major contributor of BOD to the Eau Gallie River system. Therefore, no BOD wasteload allocation is assigned to the facility.

Comment 2 from the City of Melbourne:

This TMDL report states that ground water input from the Floridan aquifer does not represent a significant portion of the total water budget for the IRL system. However, recent studies conducted by Brevard County have concluded that groundwater represents a substantial portion of the input. What additional measures will be taken by FDEP to address the additional nutrient loading through groundwater?

FDEP Response:

Even though ground water input may be a significant part of the total nutrient load going into the receiving waters in the Indian River Lagoon, as it was identified by the Brevard County's IRL mainstem TMDL refinement studies, most of these ground water contribution results from the rain falling into the drainage basins feeding to the Indian River Lagoon, not from regional aquifers like the Floridan Aquifer. Therefore, the statement that the *Floridan aquifer does not represent a significant portion of the total water budget for the IRL system* is not contradictory to the statement that a significant portion of the nutrient loads may enter impaired IRL waters through the ground water pathway. In fact, in developing these tributary TMDLs, the FDEP used the HSPF models, which took into consideration of the nutrient loads entering impaired water segments through the ground water pathways (interflow and baseflow pathways).

Comment 3 from the City of Melbourne:

During the TMDL evaluation of the Eau Gallie River nutrient impairment, several different models were used with substantial differences in simulated loading of nutrients. It is also noted that the 2001 annual average chlorophyll concentrations for background conditions exceeded the 11 IJg/L limit. Additionally, the modeling forecasts TN and TP reductions below background conditions to achieve chlorophyll values for several years in Table 5.23. This appears to suggest a potentially unachievable approach or one that may lead to a higher nutrient reduction requirement than necessary for this waterbody.

FDEP Response:

The reason why multiple models were used for the Eau Gallie River nutrient TMDLs was because the FDEP tried to ensure that pollutant load allocations in the upcoming BMAP process for the Eau Gallie River TMDL will rely on the same sets of models and use the same modeling time domain as those used for the mainstem TMDL models, which, for the North Indian River Lagoon basin where the Eau Gallie River is located, include PLSM model for the TN loading simulation and St. Johns River Water Management District (SJRWMD)'s HSPF model for the TP loading simulation. Loading numbers in Table 5.23 were simulated using the CDM HSPF model and were used only to calculate the needed percent reductions of TN and TP loads. These needed percent reductions were then

applied to the PLSM model and SJRWMD's HSPF model to estimate the actual target loads.

It should be noted that the so-called "background nutrient loads," which are characterized by a land use pattern that includes only natural lands, will vary depending on the hydrology of the years used for the modeling. For example, the background nutrient loads from a year that has 36 inches of rainfall will be very different from the background nutrient loads from a year that has 61 inches of rainfall, even though the watershed land uses do not show any changes at all. The same can be said of loading simulation from models that use different modeling time frames that have different rainfall conditions. The SJRWMD's PLSM model used a 30-year (1975 through 2005) long-term annual average rainfall to calculate the target nutrient load, while CDM's HSPF model used a timeframe from 1996 through 2005. Just because the background target loads calculated using SJRWMD's PLSM model is slightly lower than the background loading simulated using the CDM's HSPF model does not necessarily mean that we are trying to reduce the nutrient loads below the background condition. These models simply used different time domains. In fact, that was exactly why the FDEP tried to use the same set of models and the same modeling time frame as those used by the mainstem seagrass nutrient TMDLs.

Comment 4 from the City of Melbourne:

In July 2012, FDEP released a draft technical analysis for the derivation of dissolved oxygen criteria. This proposed criterion, which is based on a more modern scientific approach, could change the impaired designation in these water bodies. If the new criteria is approved after the TMDLs are adopted and if these waterbodies satisfy the new criteria, will FDEP delist the waterbodies without having to wait for the next cycle of assessments?

FDEP Response:

If the new dissolved oxygen (DO) criteria are adopted and assessment results show that the DO condition in the Eau Gallie River meets the new criteria, we will re-considered the TMDLs that we adopted for the Eau Gallie River. The re-consideration process may include delaying the implementation of the proposed TMDLs to allow for more data collection and analyses or even withdrawing the TMDL. Delisting the waterbody for DO impairment outside the normal assessment cycle can certainly be considered.

Comment 5 from the City of Melbourne:

Does FDEP propose to implement the IRL TMDL through a BMAP process?

FDEP Response:

The FDEP does not have a plan to include the implementation of the tributary TMDLs into the current effort developing Basin Management Action Plans (BMAPs) to implement the

mainstem nutrient TMDLs. The FDEP is open-minded regarding the planning process to implement these tributary TMDLs. For example, if future analyses indicates that many stormwater treatment structures in the IRL basin designed to remove nutrients can also remove BOD at similar or even higher removal efficiency, or sediment dredging designed to address the mainstem nutrient TMDLs also addresses appropriately the DO conditions in these tributaries, a full and separate BMAP may not be needed for these tributary TMDLs. The implementation of these tributary TMDLs can become part of the process when the current mainstem BMAPs are re-evaluated.

Comment 6 from the City of Melbourne:

There are several places within the Draft TMDL that shows not only the Eau Gallie River WBID 3082 but the Elbow Creek WBID 3087 is shown. Can you please clarify if both WBIDs are impaired?

FDEP Response:

Elbow Creek (WBID 3087) is not on the verified list for nutrients or DO impairment. However, because Elbow Creek is a tributary to the Eau Gallie River, the watershed of Elbow Creek is also part of the watershed of the Eau Gallie River. Therefore, the nutrient and BOD loading targets established through the Eau Gallie River nutrient and DO TMDLs also apply to the watershed of Elbow Creek. However, within the Eau Gallie River watershed, local stakeholders have the flexibility to decide where in the Eau Gallie River watershed the proposed TMDLs should be implemented in order to most effectively address the nutrient and DO conditions in the Eau Gallie River.

Once again, thank you very much for your insightful comments on these tributary TMDLs! If you have any further questions regarding these TMDLs, please feel free to contact me at Jan. Mandrup-Poulsen@dep.state.fl.us.

Sincerely,

Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section
Florida Department of Environmental Protection

O'HAIRE, QUINN, CANDLER & CASALINO - Attorneys
CARTER ASSOCIATES - Surveyors & Engineers

INDIAN RIVER FARMS WATER CONTROL DISTRICT

7305 4th Street
VERO BEACH, FLORIDA 32968
Phone: (772) 562-2141
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DAVID E. GUNTER
Secretary-Treasurer

Board of Supervisors
W. C. GRAVES, IV
SCOTT W. LAMBETH
MARK TRIPSON

INDIAN RIVER FARMS WATER CONTROL DISTRICT (IRFWCD)

RESPONSES TO FDEP DRAFT (11/20/12) TMDL REPORT for DISSOLVED OXYGEN AND NUTRIENT TMDLS FOR ELEVEN TRIBUTARY SEGMENTS OF THE INDIAN RIVER LAGOON

To: Mr. Jan Mandrup-Poulsen
Environmental Administrator
Watershed Evaluation and TMDL Section
Florida Department of Environmental Protection
jan.mandrup-poulsen@dep.state.fl.us.

IRFWCD AFFECTED TRIBUTARIES

North Relief Canal – WBID No. 3147
Main Relief Canal – WBID No. 3153A
South Relief Canal – WBID No. 3158

We appreciate the opportunity to make comments on the FDEP's draft DO and Nutrient TMDL Report. Although the Report may have been published on-line November 21st, the Department's public presentation of the draft TMDL Report occurred on December 4, 2012 at a public workshop at which the Department requested scientific based comments by December 21, 2012. The 17 day period is an insufficient period of time to analyze the data that was presented at the meeting much less have staff or a consultant draft a scientifically based comment.

The hydrodynamic model calibration and validation dates of 2000 through 2001 are not reflective of the hydrodynamic conditions that currently exist in IRFWCD. In 2002 the Indian River Farms Water Control District installed one tilting weir gate at each of our four water control structures. The use of these gates has changed the way that the District manages the discharge of water through the three outfall canals. Now we can spill the water out through the structure at a lower rate and discharge over a longer period of time. Prior to the installation of the tilting weir gates, the minimum discharge through an open gate was in the 500 to 700 C.F.S. range. Now the discharge rate can more closely match the storm event and the water can stage behind the structure and bleed out over a longer period of time. Additionally, the District instituted a 2-inch discharge rate rule in 1994 which has limited developments discharge to 2 acre inches per 24 hours in all storm events, up to and including the 25 year 24 hour storm event. We are uncertain that the

effects of the discharge rule or the reduced discharge over the tilting weir gates has been incorporated into the runoff modeling conducted by the EFDC Main Stream analyses.

The IRFWCD is a single purpose Drainage District operating under the Florida Statutes, Chapter 298. The single purpose as currently identified in the "Water Control Plan" is for maintenance and control of drainage works. We do not believe the "Plan" or taxing authority for environmental control or water quality control currently exists for the IRFWCD "Plan". We believe there will need to be legislative and/or judicial and/or public hearings to amend the current "Plan" for environmental and water quality management.

The Hyperlink below is to the Department's "Final Verified Lists for Impaired Waters in Group 5 Basins" as executed by DEP Secretary Herschel Vinyard, Jr. on February 7, 2012. The North and South Relief Canals are not included in the list. Why are they now included in the TMDL Report as impaired waters?

<http://www.dep.state.fl.us/water/watersheds/assessment/docs/303d/group5/adopted/cycle2/irl-verified-c2.xls>

The public access DEP STORET system is and has been "temporarily unavailable" to obtain data for the sample location, sample collector and data results used to determine the "impaired water" classification. Perhaps you can direct us to an alternate method of obtaining or provide us with to data used in Tables 2.14, 2.15 and 2.16.

COMMENTS ON REPORT:

1. The "Threshold Values for Nutrient Parameters" for Streams is listed in Table 2.1 of the publication. These values are footnoted to indicate they are the 70th percentile of the concentration in all Florida waters of the same waterbody type. Did this Florida-wide Stream Parameter "Index" also include an equally weighted number of Parameter values from the "Lake Worth and Southeast Coastal" WBIDS?
2. Tables 2.14, 2.15 and 2.16 show the number of exceedances blow the DO criteria of 5.0 mg/l for predominantly fresh waters. The report does not provide the specific STORET stations or information needed to confirm the results in the above mentioned Tables. We wish to confirm them before agreeing to the data summary in the Tables.
3. It appears from paragraph 5.3.1.1 that the hydrodynamic calibration for tributary EFDC modeling is based on salinity and temperature. We question the seemingly high existing calculated wasteloads for Nutrients and BOD in the above mentioned WBIDS that appear in Table 5-21. Since flow rate is a significant multiplier in determining the TOC We wish to compare your calculated tributary flows during the calibration and validation period to those as actually recorded by the USGS. Please guide us to, or provide us, the simulated model results for calibrated and validated flows from the requested WBIDS.
4. Not to disagree with the HSPF modeling results, but it appears in the Report that the presence and DO depletion caused by SOD is based on narrative and simulated modeling. Has there been any field sediment sampling and SOD measurements conducted in the IRFWCD Canals to substantiate the effects of SOD.

5. It appears there may be missing verbage regarding DO summary information from the bottom of the paragraph on page 186 to the next paragraph on page 191. We believe this entire paragraph 5.4.2 of the Report to be critical to the analyses of the IRFWCD Canals.
6. Section 5.4.2 sums up the concern we have regarding the Report conclusions for the WBIDS found to be impaired by BOD concentrations. Summarizing the sensitivity analyses for the IRFWCD, the Report states "reducing nutrient loadings from watersheds do not appear to be effective in improving the water column DO concentration. One major reason is that algal biomass in these systems does not contribute significantly to the water column DO consumption, and it does not contribute significantly to the SOD either... Therefore, the watershed BOD loading targets to these impaired waterbodies should not be lower than the natural background condition (i.e., under which these watershed are covered by upland forests, waters, and wetlands)". The first paragraph in Section 6.1 also states "In order to address the low DO condition in these tributaries, controlling BOD loads from the watershed should be the focus of future pollutant loading controls because results from sensitivity analyses clearly indicate that nutrient loadings into these tributary segments do not significantly impact the DO dynamics in the water column".

In summary, we are of the opinion that the WBIDS impaired with low DO caused by BOD which may be at or near background concentrations be separated from the nutrient impaired TMDL WBIDS and further study be conducted on the potential DO increase versus BOD removal.

Sincerely,



David E. Gunter
Superintendent

FDEP Responses to Indian River Farms Water Control Districts Comments

May 28, 2013

Mr. David E. Gunter
Indian River Farms Water Control District
7305 4th Street
Vero Beach, FL 32968

Dear Mr. Gunter,

Thank you very much for your letter dated December 21, 2012, regarding the dissolved oxygen (DO) and nutrient total maximum daily loads (TMDLs) for several tributaries discharging into the Indian River Lagoon, including the North, Main, and South Relief Canals, that the Florida Department of Environmental Protection (FDEP) presented at the December 4th, 2012 public workshop. Your letter includes many thoughtful comments and questions. We sincerely appreciate the time and effort that you took to help us refine these TMDLs.

Based on the sensitivity analyses, it appears that, in the North, Main, and South Relief Canals, the low DO ground water input had more significant impacts on DO than nutrient, biochemical oxygen demand (BOD), and sediment oxygen demand (SOD). Subsequent internal discussions have led us to the conclusion that more studies need to be done to better define the impacts from ground water in these three canals. For now, the Department will withhold proposing these TMDLs as rules.

The following are responses to your comments:

Indian River Farm Water Control District (IRFWCD) Comment 1:

The IRFWCD is a single purpose Drainage District operating under the Florida Statutes, Chapter 298. The single purpose as currently identified in the "Water Control Plan" is for maintenance and control of drainage works. We do not believe the "Plan" or taxing authority for environmental control or water quality control currently exists for the IRFWCD "Plan". We believe there will need to be legislative and/or judicial and/or public hearings to amend the current "Plan" for environmental and water quality management.

FDEP Response:

Chapters 298, 189, and 373 provide mechanisms that imply a responsibility for water quality. Specifically, Chapter 298 requires the WCDA Plan to include a description of a water quality program.

IRFWCD Comment 2:

The Hyperlink below is to the Department's "Final Verified Lists for Impaired Waters in Group 5 Basins" as executed by DEP Secretary Herschel Vinyard, Jr. on February 7, 2012. The North and South Relief Canals are not included in the list. Why are they now included in the TMDL Report as impaired waters?

<http://www.dep.state.fl.us/water/watersheds/assessment/docs/303d/group5/adopted/cycle2/irlverified-c2.xls>

FDEP Response:

The DO impairment in the North (3147), Main (3153), and South (3158) Relief Canals were verified in the FDEP Cycle 1 water quality assessment. The Cycle 1 Verified List was signed by the Secretary on December 12, 2007 and was revised and signed by the Secretary on May 19, 2009. You can find the final Cycle 1 Verified List at

http://www.dep.state.fl.us/water/watersheds/assessment/adopted_gp5.htm

Normally, if a given waterbody-parameter was listed on the Cycle 1 Verified List, it will not be listed on the Cycle 2 Verified List again. That was why you could not find the DO impairment listed on the Cycle 2 Verified List. Until a waterbody-parameter is delisted due to either meeting the delisting threshold or a TMDL for the waterbody-parameter is developed, the waterbody-parameter will stay on the Verified List.

IRFWCD Comment 3:

The public access DEP STORET system is and has been "temporarily unavailable" to obtain data for the sample location, sample collector and data results used to determine the "impaired water" classification. Perhaps you can direct us to an alternate method of obtaining or provide us with to data used in Tables 2.14, 2.15 and 2.16.

FDEP Response:

The Florida STORET system allows user to store and retrieve water quality data. However, the database does not provide the information regarding what water quality data were used for the water quality assessment. The water quality assessment has been conducted by the FDEP's Watershed Assessment Section. For access to or for information regarding which water quality data were used for listing, please contact Ms. Julie Espy. She can be reached at Julie.Espy@dep.state.fl.us or (850)-245-8416.

IRFWCD Comment 4:

The "Threshold Values for Nutrient Parameters" for Streams is listed in Table 2.1 of the publication. These values are footnoted to indicate they are the 70th percentile of the concentration in all Florida waters of the same waterbody type. Did this Florida-wide Stream Parameter "Index" also include an equally weighted number of Parameter values from the "Lake Worth and Southeast Coastal" WBIDS?

FDEP Response:

Yes, these threshold values were calculated based on the TN, TP, and BOD values collected from waterbodies of the same type across the entire Florida. Here, springs, streams, and black waters are considered similar types of freshwater flow-through systems. Data from springs, streams, and black waters were combined for making the 70th percentile calculation. Canals are also treated as streams. TN, TP, and BOD data collected from canals are also treated as freshwater flow-through system data and, therefore, combined with the data collected from springs, streams, and black waters for the 70th percentile calculation. As the 70th percentile value was drawn from a distribution of all available data, no weighting system was applied. No data from the Lake Worth and Southeast Coastal WBIDs were excluded from this analysis.

IRFWCD Comment 5:

Tables 2.14, 2.15 and 2.16 show the number of exceedances blow the DO criteria of 5.0 mg/l for predominantly fresh waters. The report does not provide the specific STORET stations or information needed to confirm the results in the above mentioned Tables. We wish to confirm them before agreeing to the data summary in the Tables.

FDEP Response:

Please see the response to **IRFWCD Comment 3**.

IRFWCD Comment 6:

It appears from paragraph 5.3.1.1 that the hydrodynamic calibration for tributary EFDC modeling is based on salinity and temperature. We question the seemingly high existing calculated wasteloads for Nutrients and BOD in the above mentioned WBIDS that appear in Table 5-21. Since flow rate is a significant multiplier in determining the TOC, we wish to compare your calculated tributary flows during the calibration and validation

period to those as actually recorded by the USGS. Please guide us to, or provide us, the simulated model results for calibrated and validated flows from the requested WBIDS.

FDEP Response:

The hydrodynamic calibration for tributary EFDC modeling was primarily used to address the receiving water processes taking place in the tidal portion of these canals. The flow and watershed nutrients and BOD loads were simulated using the Hydrologic Simulation Program – Fortran (HSPF) model. The HSPF flow calibrations were conducted using the flow data measured at 02252500 (North Canal), 02253000 (Main Canal), and 02253500 (South Canal). The results of flow calibration and validation can be found from Appendix C: Flow Calibration and Validation for HSPF Models Developed by the CDM in the [“Dissolved Oxygen and Nutrient TMDLs for Eleven Tributary Segments of the Indian River Lagoon – Appendices”](http://www.dep.state.fl.us/water/tmdl/docs/tmdls/draft/gp5/irl-trib-donut-tmdl-appdx.pdf) posted at <http://www.dep.state.fl.us/water/tmdl/docs/tmdls/draft/gp5/irl-trib-donut-tmdl-appdx.pdf>.

IRFWCD Comment 7:

Not to disagree with the HSPF modeling results, but it appears in the Report that the presence and DO depletion caused by SOD is based on narrative and simulated modeling. Has there been any field sediment sampling and SOD measurements conducted in the IRFWCD Canals to substantiate the effects of SOD.

FDEP Response:

Yes, in developing this set of TMDLs, the FDEP hired DB Environmental, Inc. in the period from 2008 through 2009 to conducted SOD and sediment nutrient studies in some of the Indian River Lagoon tributaries. The SOD numbers used in the HSPF model were produced through DB Environmental's sediment studies and adjusted through model calibration and validation.

IRFWCD Comment 8:

It appears there may be missing verb age regarding DO summary information from the bottom of the paragraph on page 186 to the next paragraph on page 191. We believe this entire paragraph 5.4.2 of the Report to be critical to the analyses of the IRFWCD Canals.

FDEP Response:

Yes, this is a good catch. We also found that part of the following paragraph (underlined portion were accidentally deleted when the report was edited. Thanks for pointing this one out. We have replaced the missing text the revised report.

This suggests that, in order to improve the DO condition in these systems, BOD, instead of nutrients, should be the focus of pollutant loading control. However, it is important to remember that, natural land use areas, including upland forests and wetlands can also create BOD loads. Therefore, the watershed BOD loading targets to these impaired waterbodies should not be lower than the natural background condition, under which these watersheds are covered by upland forests, waters, and wetlands. In addition, other natural processes, such as low DO interflow and baseflow discharges entering these systems also influence DO dynamics in these system. Even when watershed BOD loads are reduced to the natural background condition, DO concentration may not achieve the 5.0 mg/L all the time for freshwater systems, and 4.0 mg/L all the time for marine systems.

Once again, we sincerely appreciate the effort from you to help us improve the quality of our work. We are looking forward to continuously working with you to improve the water quality conditions of the valuable water resources in the Indian River Lagoon basin.

Sincerely,

Jan Mandrup-Poulsen, Environmental Administrator
Watershed Evaluation and TMDL Section
Florida Department of Environmental Protection



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