# Appendix for Model 03130009

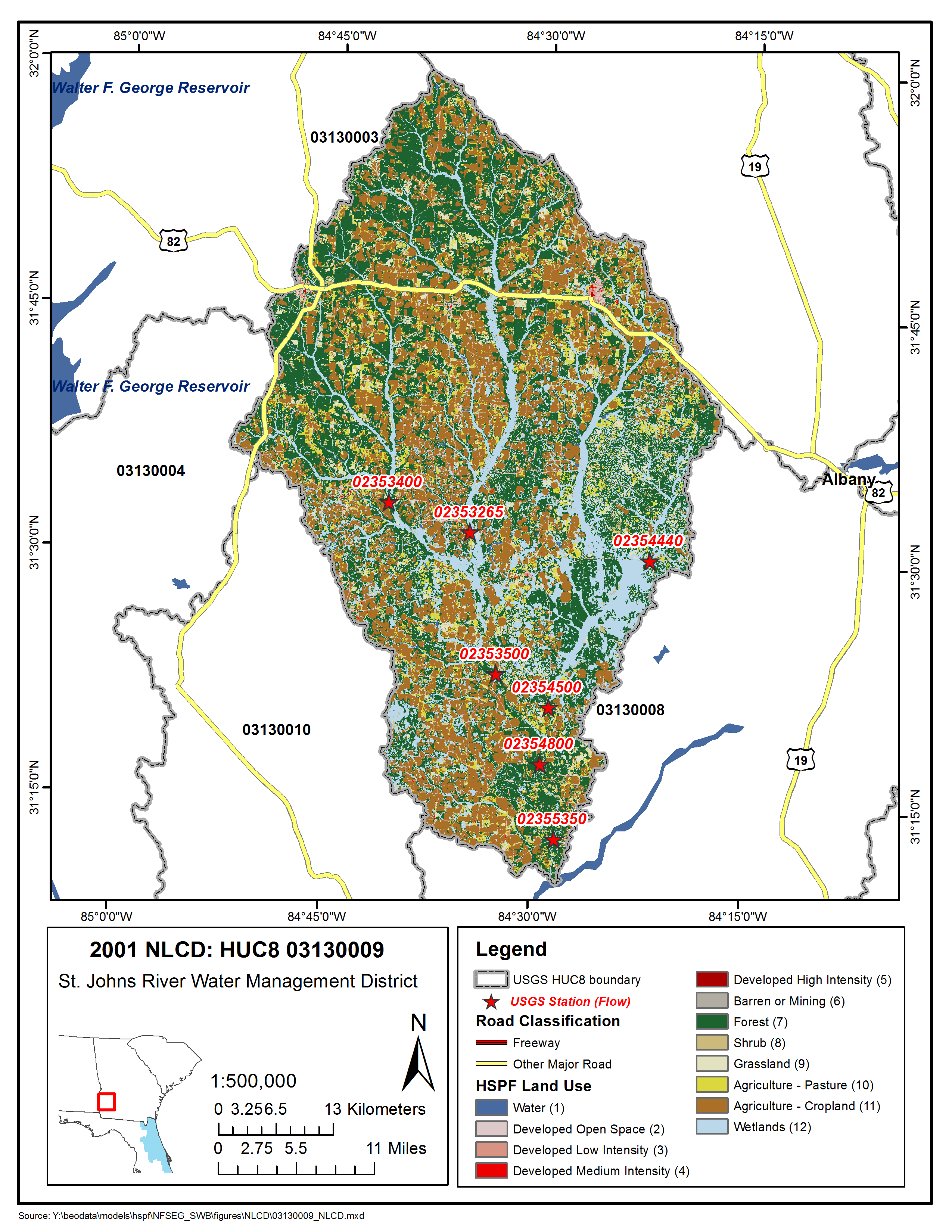


Figure 03130009-1: Land Cover from the National Land Cover Database.

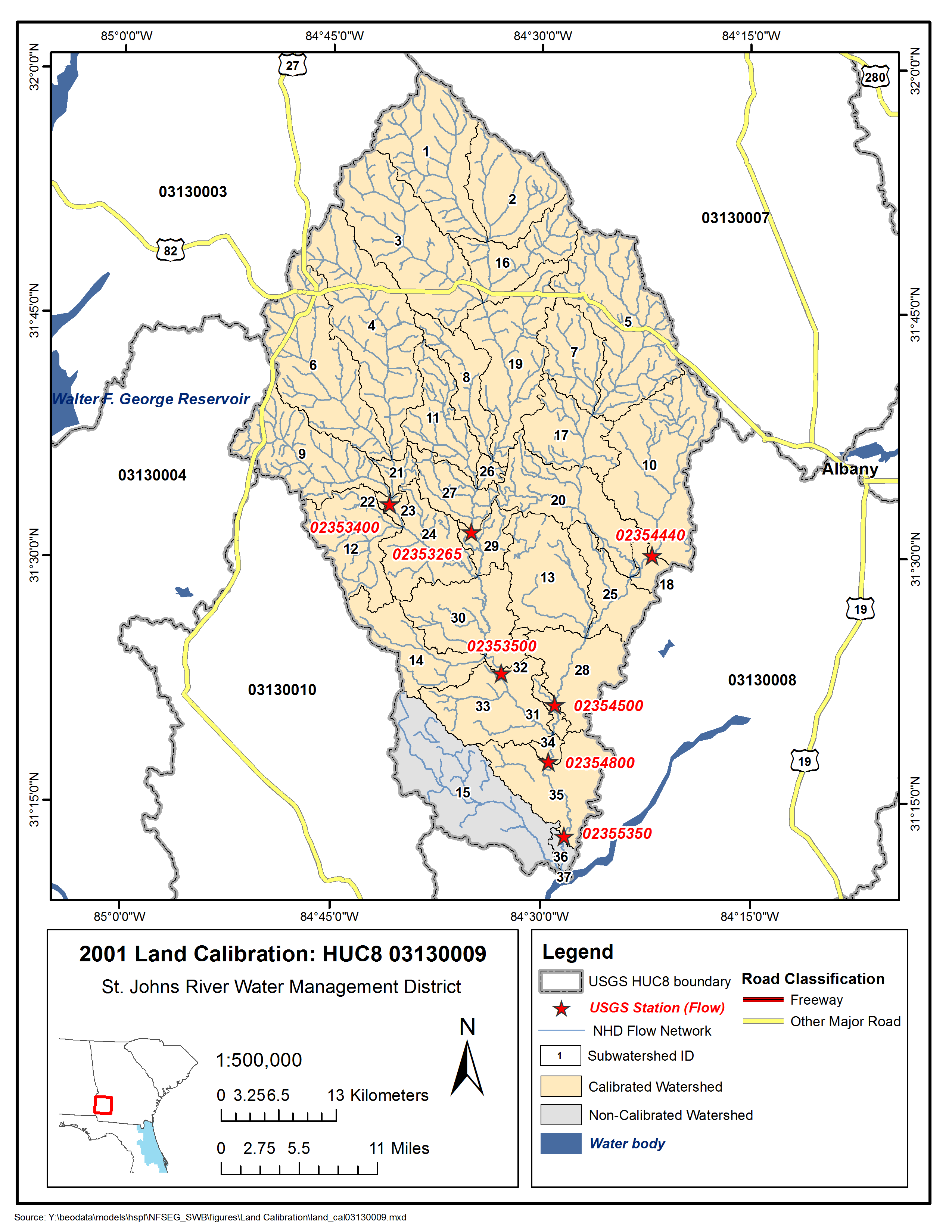


Figure 03130009-2: Calibrated sub-watersheds.

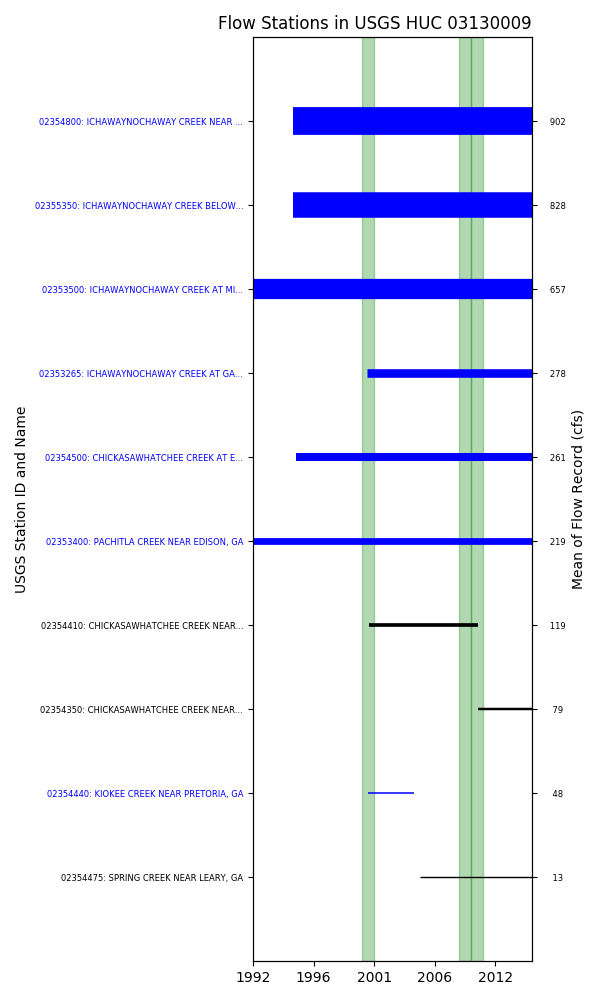


Figure 03130009-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 10, USGS Gauge 02354440

Table 03130009-1: Comparison Statistics Between HSPF Reach 10 and USGS Gauge 02354440.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 4.69 |
| Standard error | 62.28 |
| Relative bias | 0.07 |
| Relative standard error | 0.40 |
| Nash-Sutcliffe coefficient | 0.84 |
| Kling-Gupta coefficient | 0.64 |
| Coefficient of efficiency | 0.53 |
| Index of agreement | 0.72 |

Table 03130009-2: Hydrologic Indices Between USGS Gauge 02354440 and HSPF Reach 10.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02354440 | Simulated Reach 10 | Percent Difference |
| MA1: Mean, all daily flows | 48.94 | 60.14 | 22.88 |
| MA2: Median, all daily flows | 10.50 | 38.71 | 268.65 |
| MA3: CV, all daily flows | 174.07 | 114.50 | -34.22 |
| MA4: CV, log of all daily flows | 146.87 | 77.91 | -46.95 |
| MA5: Mean daily flow / median daily flow | 4.66 | 1.55 | -66.67 |
| MA9: (Q10 - Q90) / median daily flow | 12.05 | 2.59 | -78.52 |
| MA10: (Q20 - Q80) / median daily flow | 7.81 | 1.48 | -81.09 |
| MA11: (Q25 - Q75) / median daily flow | 6.07 | 1.16 | -80.82 |
| MA12: Mean monthly flow, January | 38.88 | 35.12 | -9.67 |
| MA13: Mean monthly flow, February | 59.93 | 60.87 | 1.57 |
| MA14: Mean monthly flow, March | 116.45 | 96.38 | -17.24 |
| MA15: Mean monthly flow, April | 239.28 | 175.71 | -26.57 |
| MA16: Mean monthly flow, May | 15.81 | 33.56 | 112.31 |
| MA17: Mean monthly flow, June | 22.40 | 35.27 | 57.43 |
| MA18: Mean monthly flow, July | 21.73 | 30.33 | 39.58 |
| MA19: Mean monthly flow, August | 27.36 | 45.80 | 67.42 |
| MA20: Mean monthly flow, September | 37.86 | 55.51 | 46.63 |
| MA21: Mean monthly flow, October | 10.24 | 26.96 | 163.39 |
| MA22: Mean monthly flow, November | 9.75 | 36.02 | 269.29 |
| MA23: Mean monthly flow, December | 27.34 | 39.62 | 44.92 |
| ML1: Mean minimum monthly flow, January | 26.77 | 30.26 | 13.03 |
| ML2: Mean minimum monthly flow, February | 32.00 | 37.76 | 18.00 |
| ML3: Mean minimum monthly flow, March | 48.00 | 43.34 | -9.72 |
| ML4: Mean minimum monthly flow, April | 174.56 | 166.98 | -4.34 |
| ML5: Mean minimum monthly flow, May | 3.67 | 24.98 | 581.36 |
| ML6: Mean minimum monthly flow, June | 3.76 | 27.32 | 626.11 |
| ML7: Mean minimum monthly flow, July | 3.98 | 23.98 | 503.20 |
| ML8: Mean minimum monthly flow, August | 11.50 | 31.15 | 170.83 |
| ML9: Mean minimum monthly flow, September | 0.72 | 23.35 | 3121.14 |
| ML10: Mean minimum monthly flow, October | 5.75 | 27.48 | 377.76 |
| ML11: Mean minimum monthly flow, November | 2.80 | 28.11 | 903.94 |
| ML12: Mean minimum monthly flow, December | 14.43 | 32.04 | 122.10 |
| ML13: CV of minimum monthly flows | 336.69 | 191.43 | -43.14 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.02 | 0.45 | 1974.30 |
| ML15: Mean minimum annual flow / mean annual flow | 0.01 | 0.34 | 2398.94 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.35 |  |
| ML20: Ratio of baseflow volume to total flow volume | 0.47 | 0.59 | 25.91 |
| ML22: Mean annual minimum flow divided by catchment area | 0.02 | 0.17 | 845.24 |
| RA1: Mean of positive changes from one day to next (rise rate) | 36.87 | 17.83 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 264.79 | 434.91 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 15.08 | 7.14 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 464.15 | 333.75 |  |
| RA5: Ratio of days that are higher than previous day | 0.20 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.31 | 0.04 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.15 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 46.20 | 73.00 |  |
| RA9: CV, number of flow reversals from one day to the next | 80.83 | 47.91 |  |

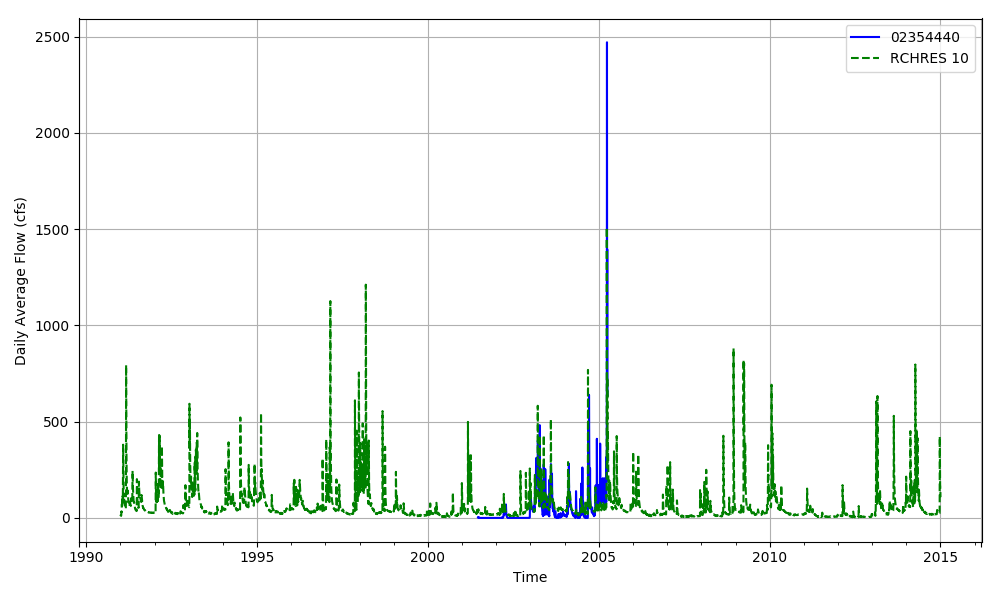


Figure 03130009-4: Daily flow for HSFP reach 10 and USGS station 02354440.

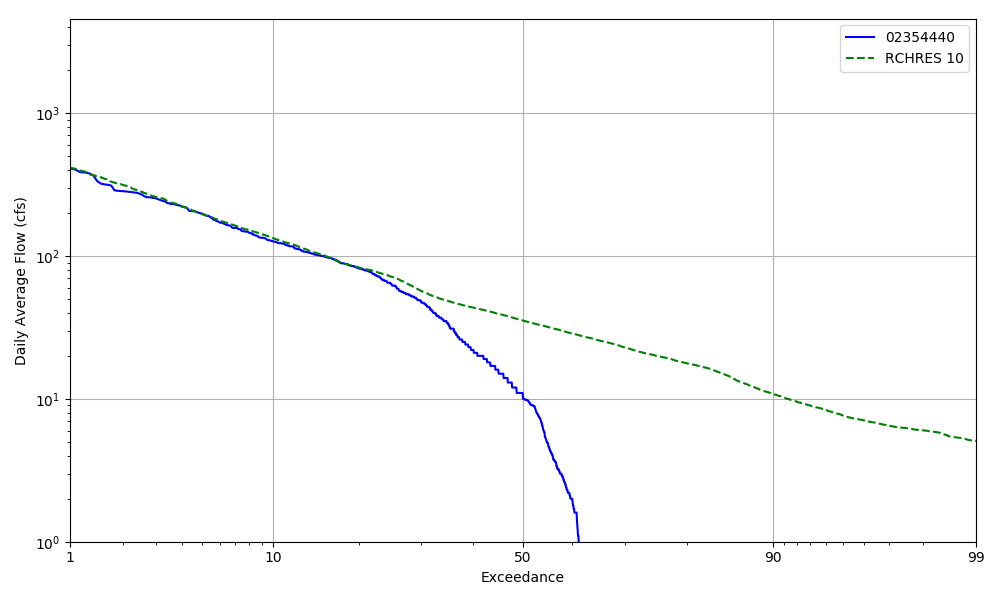


Figure 03130009-5: Daily exceedance for HSFP reach 10 and USGS station 02354440.

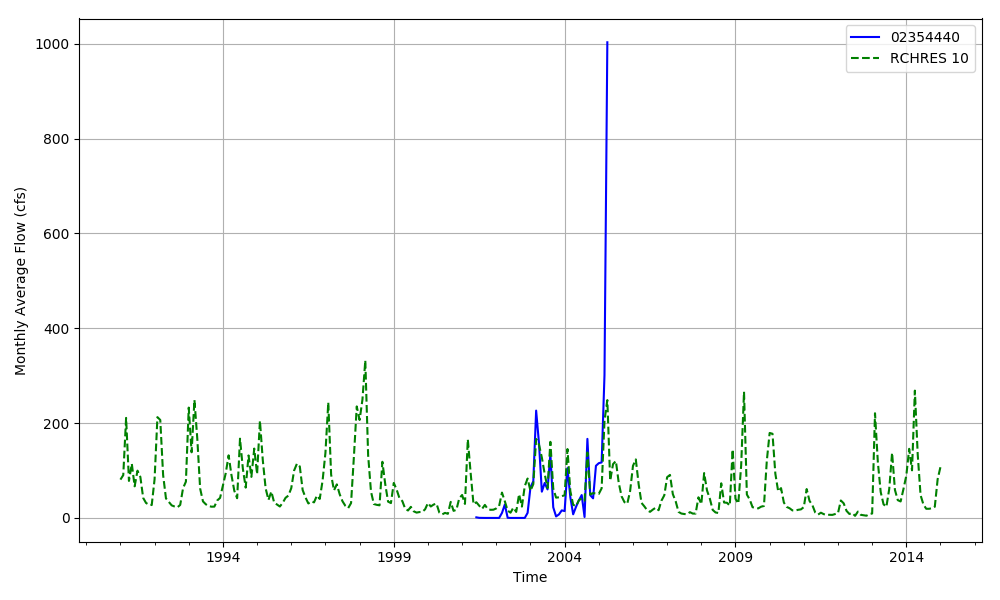


Figure 03130009-6: Monthly flow for HSFP reach 10 and USGS station 02354440.

## HSPF Reach 22, USGS Gauge 02353400

Table 03130009-3: Comparison Statistics Between HSPF Reach 22 and USGS Gauge 02353400.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -39.95 |
| Standard error | 102.10 |
| Relative bias | -0.18 |
| Relative standard error | 0.58 |
| Nash-Sutcliffe coefficient | 0.67 |
| Kling-Gupta coefficient | 0.75 |
| Coefficient of efficiency | 0.51 |
| Index of agreement | 0.76 |

Table 03130009-4: Hydrologic Indices Between USGS Gauge 02353400 and HSPF Reach 22.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02353400 | Simulated Reach 22 | Percent Difference |
| MA1: Mean, all daily flows | 218.22 | 177.86 | -18.49 |
| MA2: Median, all daily flows | 145.00 | 110.87 | -23.54 |
| MA3: CV, all daily flows | 121.64 | 109.31 | -10.13 |
| MA4: CV, log of all daily flows | 78.43 | 86.03 | 9.69 |
| MA5: Mean daily flow / median daily flow | 1.50 | 1.60 | 6.60 |
| MA9: (Q10 - Q90) / median daily flow | 2.68 | 2.99 | 11.65 |
| MA10: (Q20 - Q80) / median daily flow | 1.52 | 1.66 | 8.98 |
| MA11: (Q25 - Q75) / median daily flow | 1.15 | 1.24 | 7.99 |
| MA12: Mean monthly flow, January | 301.83 | 251.72 | -16.60 |
| MA13: Mean monthly flow, February | 338.59 | 318.88 | -5.82 |
| MA14: Mean monthly flow, March | 345.65 | 318.15 | -7.96 |
| MA15: Mean monthly flow, April | 239.19 | 230.41 | -3.67 |
| MA16: Mean monthly flow, May | 125.71 | 115.02 | -8.51 |
| MA17: Mean monthly flow, June | 128.70 | 92.01 | -28.51 |
| MA18: Mean monthly flow, July | 217.10 | 116.82 | -46.19 |
| MA19: Mean monthly flow, August | 147.20 | 107.52 | -26.96 |
| MA20: Mean monthly flow, September | 127.91 | 104.73 | -18.13 |
| MA21: Mean monthly flow, October | 130.31 | 90.75 | -30.36 |
| MA22: Mean monthly flow, November | 169.65 | 113.03 | -33.38 |
| MA23: Mean monthly flow, December | 262.43 | 214.20 | -18.38 |
| ML1: Mean minimum monthly flow, January | 172.12 | 125.10 | -27.32 |
| ML2: Mean minimum monthly flow, February | 180.17 | 152.32 | -15.46 |
| ML3: Mean minimum monthly flow, March | 174.48 | 158.74 | -9.02 |
| ML4: Mean minimum monthly flow, April | 120.09 | 118.65 | -1.20 |
| ML5: Mean minimum monthly flow, May | 63.68 | 62.06 | -2.54 |
| ML6: Mean minimum monthly flow, June | 51.18 | 45.31 | -11.46 |
| ML7: Mean minimum monthly flow, July | 62.38 | 52.26 | -16.22 |
| ML8: Mean minimum monthly flow, August | 59.42 | 68.56 | 15.38 |
| ML9: Mean minimum monthly flow, September | 60.00 | 65.93 | 9.88 |
| ML10: Mean minimum monthly flow, October | 78.04 | 67.33 | -13.73 |
| ML11: Mean minimum monthly flow, November | 101.04 | 76.46 | -24.33 |
| ML12: Mean minimum monthly flow, December | 138.39 | 98.17 | -29.07 |
| ML13: CV of minimum monthly flows | 70.98 | 77.89 | 9.73 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.25 | 0.24 | -2.87 |
| ML15: Mean minimum annual flow / mean annual flow | 0.17 | 0.16 | -6.75 |
| ML16: Median minimum annual flow / median annual flow | 0.23 | 0.19 | -20.57 |
| ML20: Ratio of baseflow volume to total flow volume | 0.56 | 0.62 | 10.70 |
| ML22: Mean annual minimum flow divided by catchment area | 0.40 | 0.31 | -22.82 |
| RA1: Mean of positive changes from one day to next (rise rate) | 87.95 | 45.97 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 310.81 | 396.59 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 50.17 | 21.37 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 458.13 | 292.90 |  |
| RA5: Ratio of days that are higher than previous day | 0.35 | 0.32 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.16 | 0.06 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 101.50 | 100.62 |  |
| RA9: CV, number of flow reversals from one day to the next | 17.29 | 21.25 |  |

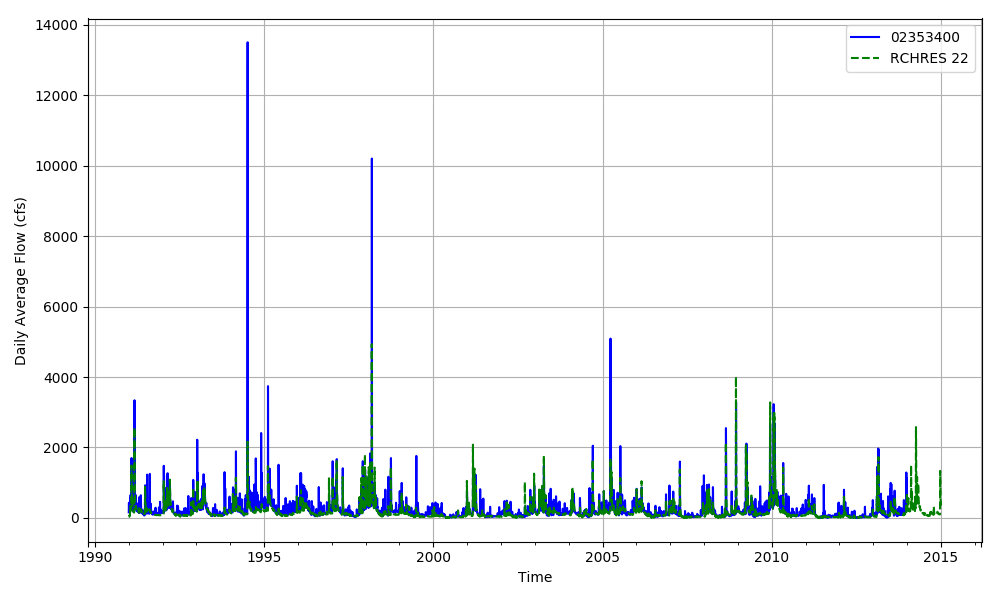


Figure 03130009-7: Daily flow for HSFP reach 22 and USGS station 02353400.

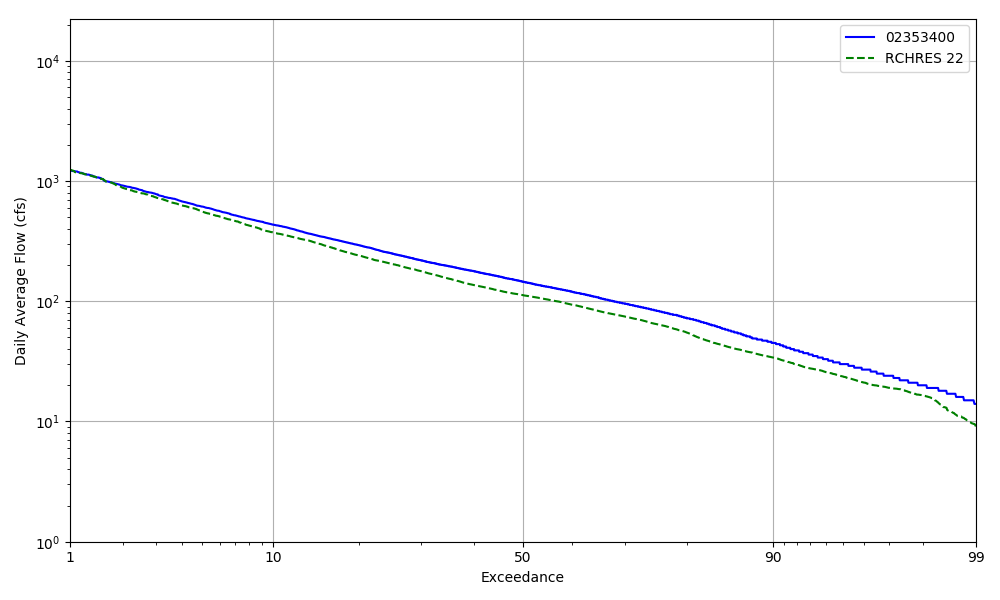


Figure 03130009-8: Daily exceedance for HSFP reach 22 and USGS station 02353400.

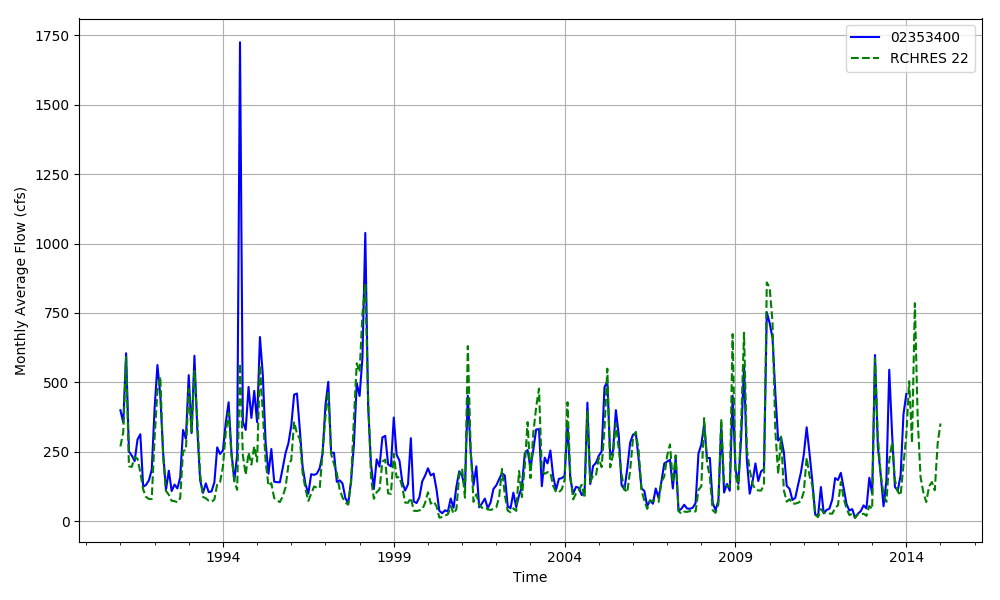


Figure 03130009-9: Monthly flow for HSFP reach 22 and USGS station 02353400.

## HSPF Reach 27, USGS Gauge 02353265

Table 03130009-5: Comparison Statistics Between HSPF Reach 27 and USGS Gauge 02353265.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 3.39 |
| Standard error | 80.43 |
| Relative bias | 0.01 |
| Relative standard error | 0.32 |
| Nash-Sutcliffe coefficient | 0.90 |
| Kling-Gupta coefficient | 0.92 |
| Coefficient of efficiency | 0.67 |
| Index of agreement | 0.84 |

Table 03130009-6: Hydrologic Indices Between USGS Gauge 02353265 and HSPF Reach 27.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02353265 | Simulated Reach 27 | Percent Difference |
| MA1: Mean, all daily flows | 271.05 | 276.47 | 2.00 |
| MA2: Median, all daily flows | 178.00 | 175.11 | -1.62 |
| MA3: CV, all daily flows | 113.74 | 108.58 | -4.54 |
| MA4: CV, log of all daily flows | 80.77 | 87.38 | 8.18 |
| MA5: Mean daily flow / median daily flow | 1.52 | 1.58 | 3.68 |
| MA9: (Q10 - Q90) / median daily flow | 2.56 | 2.97 | 16.13 |
| MA10: (Q20 - Q80) / median daily flow | 1.53 | 1.73 | 13.10 |
| MA11: (Q25 - Q75) / median daily flow | 1.16 | 1.36 | 16.39 |
| MA12: Mean monthly flow, January | 406.36 | 356.89 | -12.17 |
| MA13: Mean monthly flow, February | 391.19 | 452.66 | 15.71 |
| MA14: Mean monthly flow, March | 334.45 | 364.84 | 9.09 |
| MA15: Mean monthly flow, April | 321.94 | 337.58 | 4.86 |
| MA16: Mean monthly flow, May | 161.90 | 166.90 | 3.09 |
| MA17: Mean monthly flow, June | 155.44 | 141.70 | -8.84 |
| MA18: Mean monthly flow, July | 178.41 | 185.46 | 3.96 |
| MA19: Mean monthly flow, August | 204.93 | 214.02 | 4.44 |
| MA20: Mean monthly flow, September | 172.91 | 193.69 | 12.02 |
| MA21: Mean monthly flow, October | 132.28 | 133.55 | 0.96 |
| MA22: Mean monthly flow, November | 178.14 | 151.66 | -14.87 |
| MA23: Mean monthly flow, December | 396.26 | 372.28 | -6.05 |
| ML1: Mean minimum monthly flow, January | 287.23 | 209.97 | -26.90 |
| ML2: Mean minimum monthly flow, February | 227.83 | 217.43 | -4.57 |
| ML3: Mean minimum monthly flow, March | 202.75 | 218.96 | 8.00 |
| ML4: Mean minimum monthly flow, April | 152.75 | 148.16 | -3.00 |
| ML5: Mean minimum monthly flow, May | 73.00 | 67.15 | -8.01 |
| ML6: Mean minimum monthly flow, June | 50.87 | 44.65 | -12.24 |
| ML7: Mean minimum monthly flow, July | 64.32 | 71.62 | 11.36 |
| ML8: Mean minimum monthly flow, August | 65.21 | 115.61 | 77.29 |
| ML9: Mean minimum monthly flow, September | 69.78 | 113.09 | 62.08 |
| ML10: Mean minimum monthly flow, October | 92.85 | 107.72 | 16.02 |
| ML11: Mean minimum monthly flow, November | 121.85 | 116.61 | -4.30 |
| ML12: Mean minimum monthly flow, December | 176.38 | 144.27 | -18.21 |
| ML13: CV of minimum monthly flows | 101.07 | 95.98 | -5.04 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.18 | 0.17 | -6.42 |
| ML15: Mean minimum annual flow / mean annual flow | 0.12 | 0.12 | -3.94 |
| ML16: Median minimum annual flow / median annual flow | 0.11 | 0.08 | -31.02 |
| ML20: Ratio of baseflow volume to total flow volume | 0.55 | 0.57 | 3.53 |
| ML22: Mean annual minimum flow divided by catchment area | 0.36 | 0.36 | 0.78 |
| RA1: Mean of positive changes from one day to next (rise rate) | 74.68 | 69.72 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 306.70 | 394.40 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 46.44 | 34.52 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 320.63 | 265.37 |  |
| RA5: Ratio of days that are higher than previous day | 0.37 | 0.33 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.11 | 0.08 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.08 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 78.14 | 83.43 |  |
| RA9: CV, number of flow reversals from one day to the next | 29.28 | 31.83 |  |

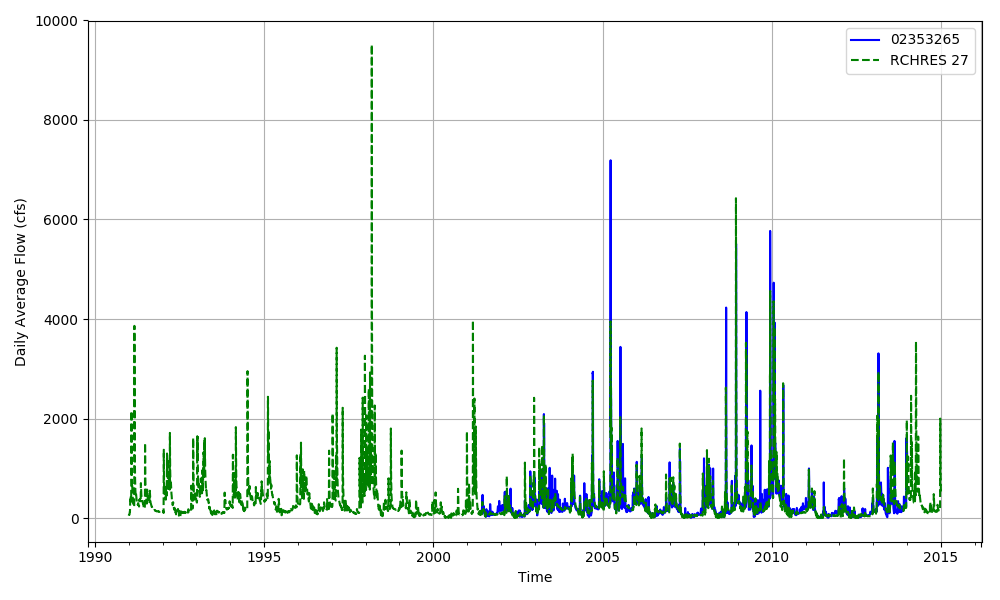


Figure 03130009-10: Daily flow for HSFP reach 27 and USGS station 02353265.

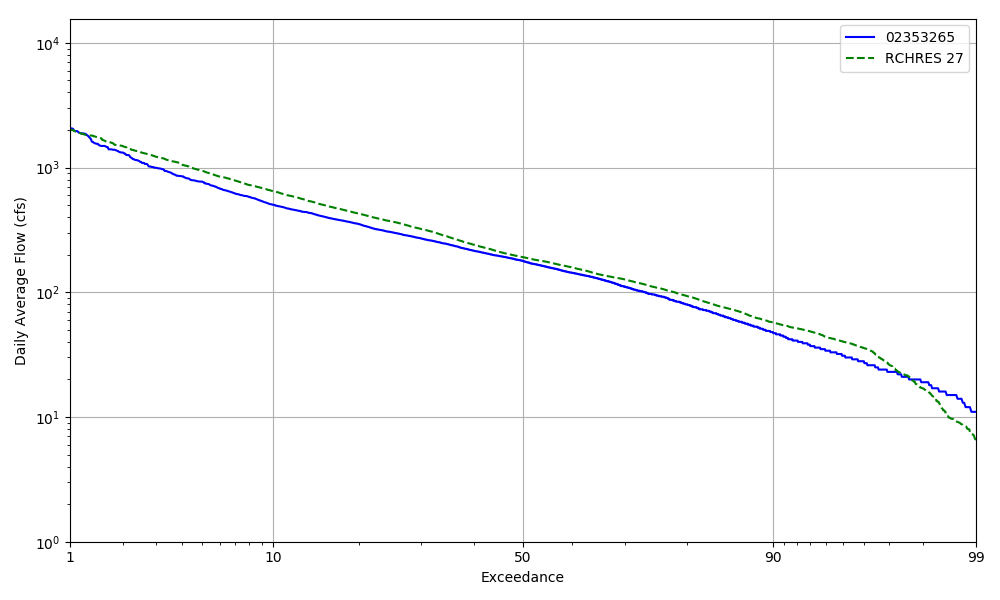


Figure 03130009-11: Daily exceedance for HSFP reach 27 and USGS station 02353265.

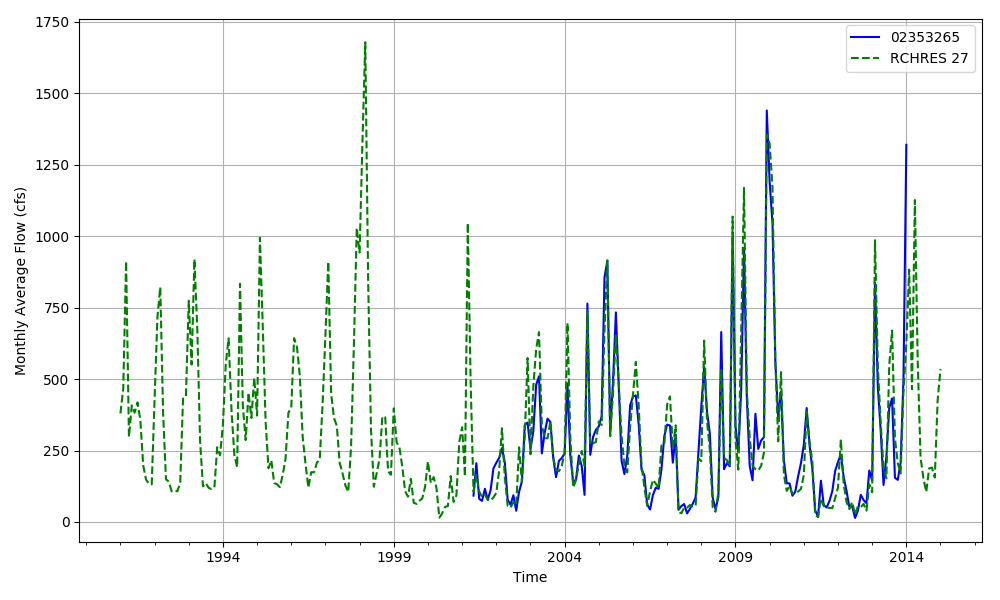


Figure 03130009-12: Monthly flow for HSFP reach 27 and USGS station 02353265.

## HSPF Reach 28, USGS Gauge 02354500

Table 03130009-7: Comparison Statistics Between HSPF Reach 28 and USGS Gauge 02354500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 36.63 |
| Standard error | 143.55 |
| Relative bias | 0.14 |
| Relative standard error | 0.38 |
| Nash-Sutcliffe coefficient | 0.85 |
| Kling-Gupta coefficient | 0.73 |
| Coefficient of efficiency | 0.59 |
| Index of agreement | 0.77 |

Table 03130009-8: Hydrologic Indices Between USGS Gauge 02354500 and HSPF Reach 28.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02354500 | Simulated Reach 28 | Percent Difference |
| MA1: Mean, all daily flows | 251.01 | 286.39 | 14.10 |
| MA2: Median, all daily flows | 90.00 | 168.22 | 86.92 |
| MA3: CV, all daily flows | 133.05 | 107.48 | -19.22 |
| MA4: CV, log of all daily flows | 139.38 | 91.71 | -34.20 |
| MA5: Mean daily flow / median daily flow | 2.79 | 1.70 | -38.96 |
| MA9: (Q10 - Q90) / median daily flow | 7.03 | 3.24 | -54.00 |
| MA10: (Q20 - Q80) / median daily flow | 3.97 | 1.64 | -58.67 |
| MA11: (Q25 - Q75) / median daily flow | 3.15 | 1.23 | -60.77 |
| MA12: Mean monthly flow, January | 373.17 | 375.60 | 0.65 |
| MA13: Mean monthly flow, February | 448.64 | 498.73 | 11.16 |
| MA14: Mean monthly flow, March | 539.95 | 478.86 | -11.31 |
| MA15: Mean monthly flow, April | 418.61 | 384.45 | -8.16 |
| MA16: Mean monthly flow, May | 133.16 | 166.93 | 25.36 |
| MA17: Mean monthly flow, June | 116.08 | 147.50 | 27.07 |
| MA18: Mean monthly flow, July | 116.54 | 166.10 | 42.53 |
| MA19: Mean monthly flow, August | 127.21 | 193.87 | 52.40 |
| MA20: Mean monthly flow, September | 105.24 | 186.67 | 77.38 |
| MA21: Mean monthly flow, October | 74.02 | 145.38 | 96.41 |
| MA22: Mean monthly flow, November | 87.22 | 170.90 | 95.94 |
| MA23: Mean monthly flow, December | 291.56 | 324.84 | 11.41 |
| ML1: Mean minimum monthly flow, January | 221.94 | 228.49 | 2.95 |
| ML2: Mean minimum monthly flow, February | 260.85 | 236.53 | -9.32 |
| ML3: Mean minimum monthly flow, March | 236.56 | 226.74 | -4.15 |
| ML4: Mean minimum monthly flow, April | 137.89 | 169.63 | 23.02 |
| ML5: Mean minimum monthly flow, May | 31.54 | 86.51 | 174.28 |
| ML6: Mean minimum monthly flow, June | 27.45 | 75.84 | 176.31 |
| ML7: Mean minimum monthly flow, July | 30.01 | 82.55 | 175.10 |
| ML8: Mean minimum monthly flow, August | 31.04 | 99.42 | 220.33 |
| ML9: Mean minimum monthly flow, September | 15.45 | 96.36 | 523.82 |
| ML10: Mean minimum monthly flow, October | 26.80 | 100.91 | 276.59 |
| ML11: Mean minimum monthly flow, November | 43.57 | 113.98 | 161.59 |
| ML12: Mean minimum monthly flow, December | 124.80 | 145.30 | 16.43 |
| ML13: CV of minimum monthly flows | 169.64 | 92.03 | -45.75 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.10 | 0.29 | 187.91 |
| ML15: Mean minimum annual flow / mean annual flow | 0.04 | 0.21 | 379.02 |
| ML16: Median minimum annual flow / median annual flow | 0.06 | 0.24 | 344.38 |
| ML20: Ratio of baseflow volume to total flow volume | 0.52 | 0.57 | 10.58 |
| ML22: Mean annual minimum flow divided by catchment area | 0.07 | 0.56 | 699.89 |
| RA1: Mean of positive changes from one day to next (rise rate) | 51.38 | 70.57 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 326.14 | 420.32 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 26.37 | 36.10 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 304.82 | 291.34 |  |
| RA5: Ratio of days that are higher than previous day | 0.31 | 0.34 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.11 | 0.07 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.08 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 68.40 | 77.10 |  |
| RA9: CV, number of flow reversals from one day to the next | 26.90 | 27.70 |  |

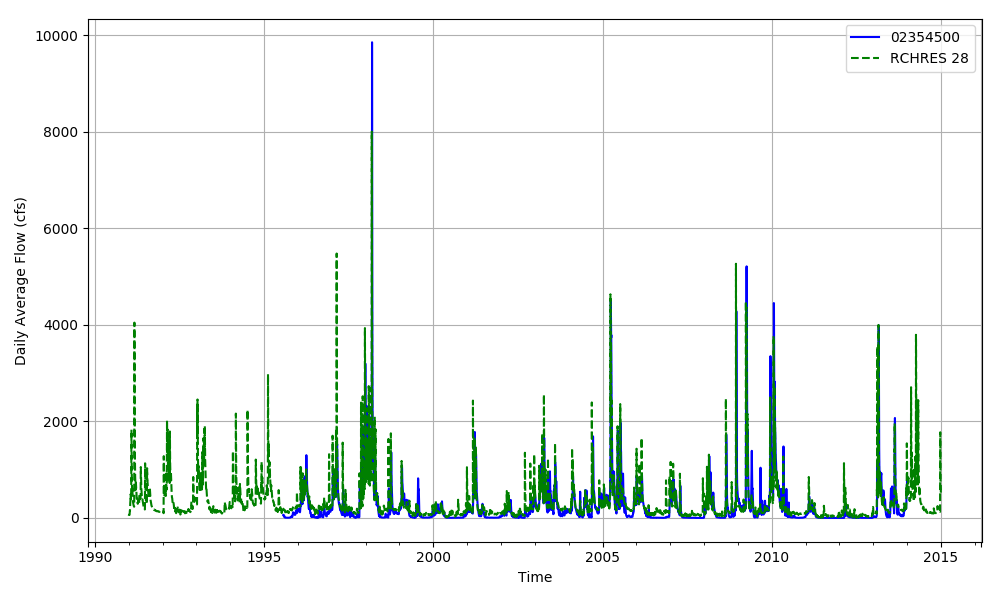


Figure 03130009-13: Daily flow for HSFP reach 28 and USGS station 02354500.

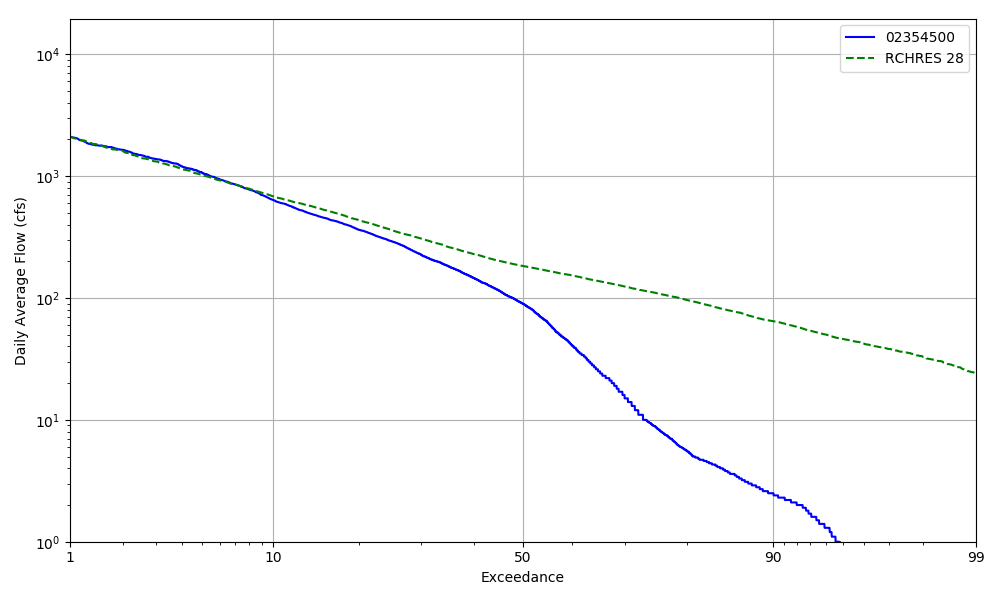


Figure 03130009-14: Daily exceedance for HSFP reach 28 and USGS station 02354500.

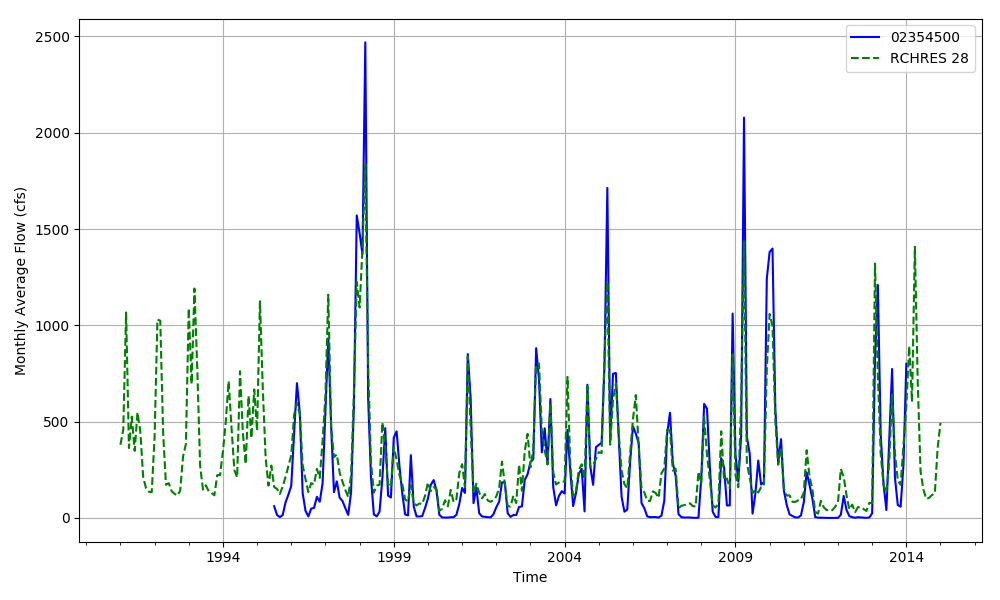


Figure 03130009-15: Monthly flow for HSFP reach 28 and USGS station 02354500.

## HSPF Reach 32, USGS Gauge 02353500

Table 03130009-9: Comparison Statistics Between HSPF Reach 32 and USGS Gauge 02353500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -17.48 |
| Standard error | 226.96 |
| Relative bias | -0.03 |
| Relative standard error | 0.39 |
| Nash-Sutcliffe coefficient | 0.85 |
| Kling-Gupta coefficient | 0.92 |
| Coefficient of efficiency | 0.71 |
| Index of agreement | 0.85 |

Table 03130009-10: Hydrologic Indices Between USGS Gauge 02353500 and HSPF Reach 32.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02353500 | Simulated Reach 32 | Percent Difference |
| MA1: Mean, all daily flows | 655.90 | 638.82 | -2.60 |
| MA2: Median, all daily flows | 431.00 | 396.47 | -8.01 |
| MA3: CV, all daily flows | 112.23 | 106.44 | -5.16 |
| MA4: CV, log of all daily flows | 79.31 | 84.85 | 6.98 |
| MA5: Mean daily flow / median daily flow | 1.52 | 1.61 | 5.88 |
| MA9: (Q10 - Q90) / median daily flow | 2.80 | 3.00 | 7.04 |
| MA10: (Q20 - Q80) / median daily flow | 1.61 | 1.70 | 5.75 |
| MA11: (Q25 - Q75) / median daily flow | 1.25 | 1.31 | 4.71 |
| MA12: Mean monthly flow, January | 943.09 | 893.27 | -5.28 |
| MA13: Mean monthly flow, February | 1090.29 | 1145.61 | 5.07 |
| MA14: Mean monthly flow, March | 1134.98 | 1157.42 | 1.98 |
| MA15: Mean monthly flow, April | 799.82 | 816.42 | 2.08 |
| MA16: Mean monthly flow, May | 402.09 | 396.11 | -1.49 |
| MA17: Mean monthly flow, June | 365.08 | 326.78 | -10.49 |
| MA18: Mean monthly flow, July | 561.75 | 426.12 | -24.14 |
| MA19: Mean monthly flow, August | 405.61 | 419.89 | 3.52 |
| MA20: Mean monthly flow, September | 361.46 | 382.96 | 5.95 |
| MA21: Mean monthly flow, October | 370.74 | 337.21 | -9.04 |
| MA22: Mean monthly flow, November | 442.61 | 404.30 | -8.66 |
| MA23: Mean monthly flow, December | 783.54 | 753.20 | -3.87 |
| ML1: Mean minimum monthly flow, January | 569.42 | 443.60 | -22.10 |
| ML2: Mean minimum monthly flow, February | 594.04 | 552.29 | -7.03 |
| ML3: Mean minimum monthly flow, March | 571.70 | 572.33 | 0.11 |
| ML4: Mean minimum monthly flow, April | 410.91 | 406.55 | -1.06 |
| ML5: Mean minimum monthly flow, May | 206.09 | 182.19 | -11.60 |
| ML6: Mean minimum monthly flow, June | 149.77 | 136.39 | -8.93 |
| ML7: Mean minimum monthly flow, July | 171.47 | 172.29 | 0.47 |
| ML8: Mean minimum monthly flow, August | 164.68 | 253.82 | 54.13 |
| ML9: Mean minimum monthly flow, September | 164.77 | 244.02 | 48.10 |
| ML10: Mean minimum monthly flow, October | 240.26 | 242.79 | 1.05 |
| ML11: Mean minimum monthly flow, November | 296.35 | 275.15 | -7.15 |
| ML12: Mean minimum monthly flow, December | 427.22 | 359.97 | -15.74 |
| ML13: CV of minimum monthly flows | 80.86 | 84.28 | 4.23 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.19 | 0.18 | -5.43 |
| ML15: Mean minimum annual flow / mean annual flow | 0.14 | 0.12 | -8.70 |
| ML16: Median minimum annual flow / median annual flow | 0.16 | 0.14 | -8.83 |
| ML20: Ratio of baseflow volume to total flow volume | 0.59 | 0.62 | 4.41 |
| ML22: Mean annual minimum flow divided by catchment area | 0.99 | 0.87 | -11.43 |
| RA1: Mean of positive changes from one day to next (rise rate) | 151.94 | 151.95 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 373.31 | 389.58 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 92.99 | 73.89 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 353.58 | 279.23 |  |
| RA5: Ratio of days that are higher than previous day | 0.37 | 0.33 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.11 | 0.06 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.07 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 78.12 | 83.71 |  |
| RA9: CV, number of flow reversals from one day to the next | 19.98 | 22.88 |  |

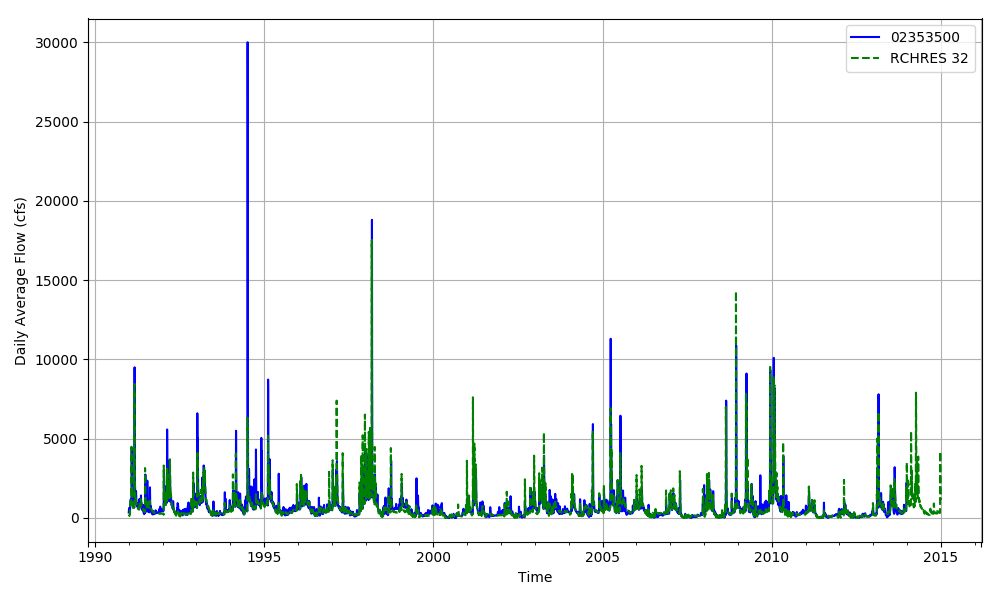


Figure 03130009-16: Daily flow for HSFP reach 32 and USGS station 02353500.

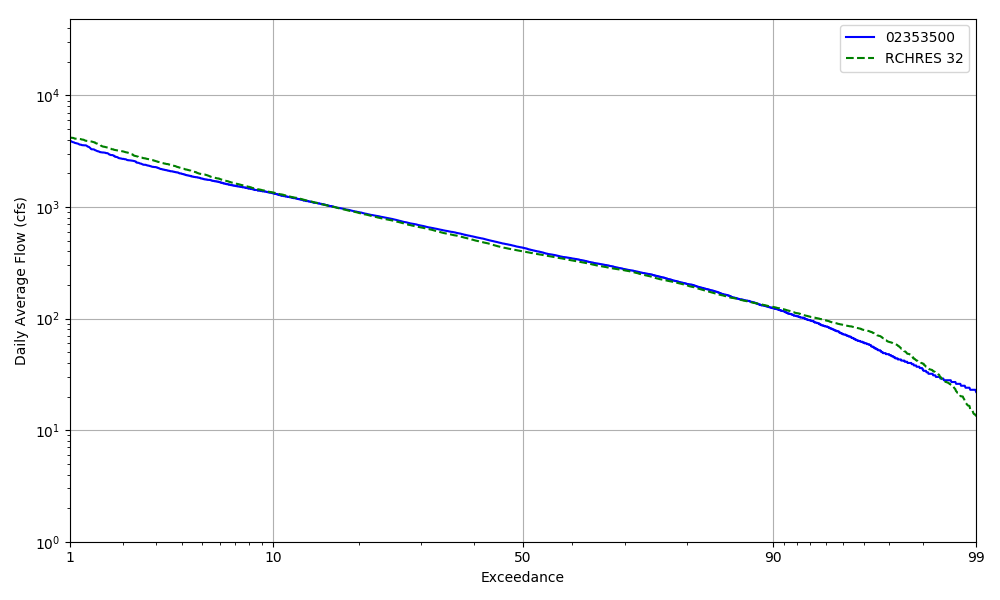


Figure 03130009-17: Daily exceedance for HSFP reach 32 and USGS station 02353500.

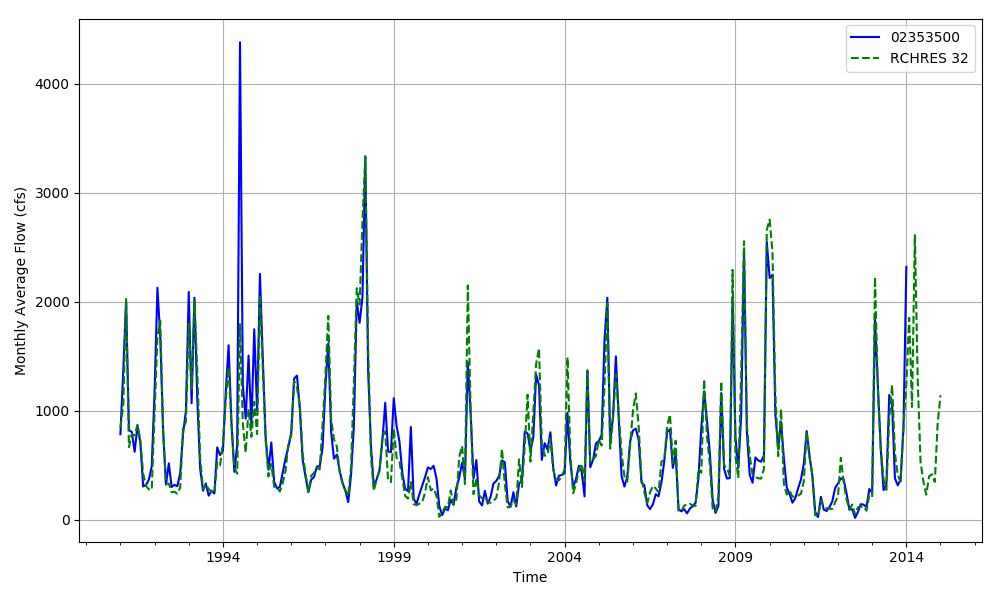


Figure 03130009-18: Monthly flow for HSFP reach 32 and USGS station 02353500.

## HSPF Reach 34, USGS Gauge 02354800

Table 03130009-11: Comparison Statistics Between HSPF Reach 34 and USGS Gauge 02354800.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 52.16 |
| Standard error | 269.42 |
| Relative bias | 0.06 |
| Relative standard error | 0.28 |
| Nash-Sutcliffe coefficient | 0.92 |
| Kling-Gupta coefficient | 0.91 |
| Coefficient of efficiency | 0.72 |
| Index of agreement | 0.86 |

Table 03130009-12: Hydrologic Indices Between USGS Gauge 02354800 and HSPF Reach 34.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02354800 | Simulated Reach 34 | Percent Difference |
| MA1: Mean, all daily flows | 876.95 | 927.86 | 5.80 |
| MA2: Median, all daily flows | 499.00 | 568.63 | 13.95 |
| MA3: CV, all daily flows | 109.26 | 106.96 | -2.10 |
| MA4: CV, log of all daily flows | 93.69 | 87.73 | -6.36 |
| MA5: Mean daily flow / median daily flow | 1.76 | 1.63 | -7.15 |
| MA9: (Q10 - Q90) / median daily flow | 3.56 | 3.09 | -13.31 |
| MA10: (Q20 - Q80) / median daily flow | 2.07 | 1.64 | -20.71 |
| MA11: (Q25 - Q75) / median daily flow | 1.53 | 1.20 | -21.36 |
| MA12: Mean monthly flow, January | 1254.60 | 1252.68 | -0.15 |
| MA13: Mean monthly flow, February | 1411.52 | 1597.29 | 13.16 |
| MA14: Mean monthly flow, March | 1581.30 | 1517.34 | -4.05 |
| MA15: Mean monthly flow, April | 1321.14 | 1253.99 | -5.08 |
| MA16: Mean monthly flow, May | 547.65 | 573.52 | 4.72 |
| MA17: Mean monthly flow, June | 482.30 | 488.97 | 1.38 |
| MA18: Mean monthly flow, July | 520.67 | 540.91 | 3.89 |
| MA19: Mean monthly flow, August | 516.48 | 627.92 | 21.58 |
| MA20: Mean monthly flow, September | 467.54 | 601.17 | 28.58 |
| MA21: Mean monthly flow, October | 408.18 | 483.04 | 18.34 |
| MA22: Mean monthly flow, November | 480.07 | 565.59 | 17.81 |
| MA23: Mean monthly flow, December | 1061.12 | 1139.58 | 7.39 |
| ML1: Mean minimum monthly flow, January | 839.16 | 727.40 | -13.32 |
| ML2: Mean minimum monthly flow, February | 864.28 | 779.01 | -9.87 |
| ML3: Mean minimum monthly flow, March | 821.33 | 749.22 | -8.78 |
| ML4: Mean minimum monthly flow, April | 583.47 | 576.92 | -1.12 |
| ML5: Mean minimum monthly flow, May | 244.32 | 265.51 | 8.67 |
| ML6: Mean minimum monthly flow, June | 194.21 | 218.62 | 12.57 |
| ML7: Mean minimum monthly flow, July | 206.16 | 242.25 | 17.51 |
| ML8: Mean minimum monthly flow, August | 199.32 | 349.79 | 75.49 |
| ML9: Mean minimum monthly flow, September | 184.74 | 348.87 | 88.85 |
| ML10: Mean minimum monthly flow, October | 261.37 | 352.62 | 34.91 |
| ML11: Mean minimum monthly flow, November | 328.84 | 394.51 | 19.97 |
| ML12: Mean minimum monthly flow, December | 522.42 | 500.79 | -4.14 |
| ML13: CV of minimum monthly flows | 101.61 | 87.73 | -13.66 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.21 | 0.24 | 16.05 |
| ML15: Mean minimum annual flow / mean annual flow | 0.14 | 0.17 | 15.38 |
| ML16: Median minimum annual flow / median annual flow | 0.18 | 0.20 | 10.20 |
| ML20: Ratio of baseflow volume to total flow volume | 0.59 | 0.60 | 1.90 |
| ML22: Mean annual minimum flow divided by catchment area | 1.21 | 1.58 | 31.29 |
| RA1: Mean of positive changes from one day to next (rise rate) | 165.90 | 224.79 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 323.51 | 413.51 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 95.40 | 113.09 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 285.00 | 288.55 |  |
| RA5: Ratio of days that are higher than previous day | 0.36 | 0.34 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.10 | 0.06 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.07 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 69.05 | 75.10 |  |
| RA9: CV, number of flow reversals from one day to the next | 22.35 | 24.52 |  |

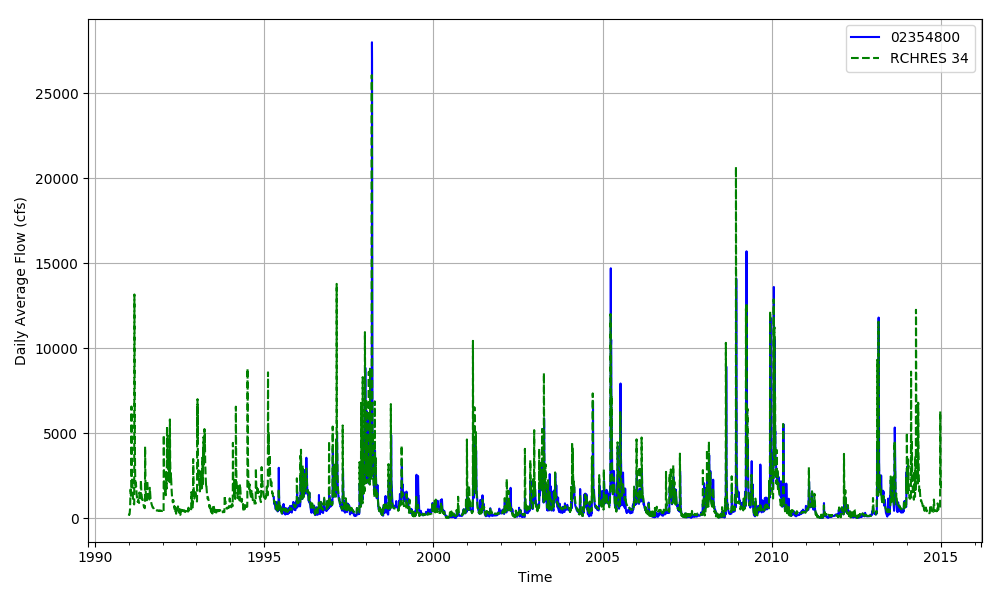


Figure 03130009-19: Daily flow for HSFP reach 34 and USGS station 02354800.

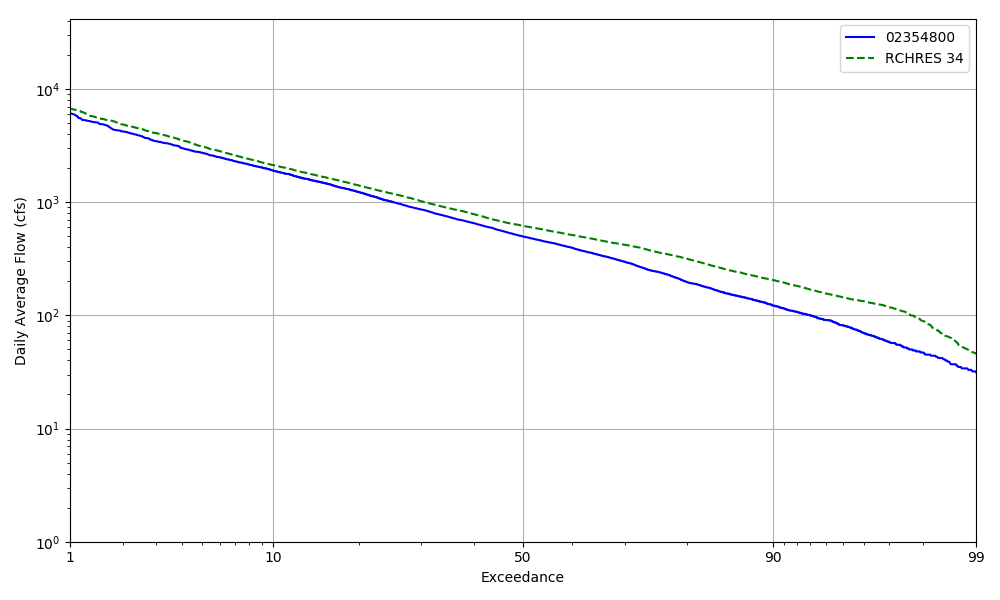


Figure 03130009-20: Daily exceedance for HSFP reach 34 and USGS station 02354800.

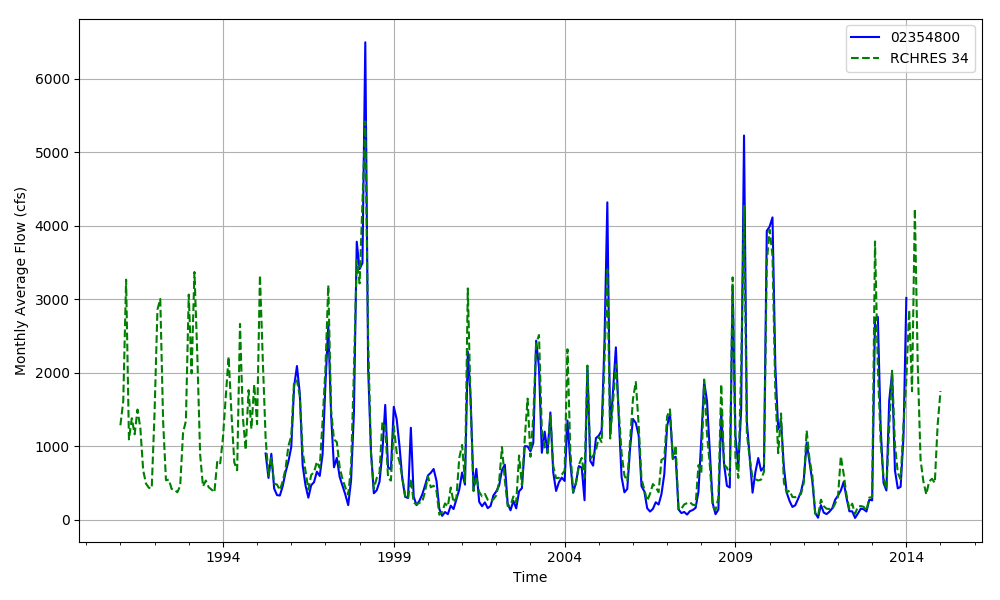


Figure 03130009-21: Monthly flow for HSFP reach 34 and USGS station 02354800.

## HSPF Reach 35, USGS Gauge 02355350

Table 03130009-13: Comparison Statistics Between HSPF Reach 35 and USGS Gauge 02355350.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 42.52 |
| Standard error | 303.46 |
| Relative bias | 0.05 |
| Relative standard error | 0.35 |
| Nash-Sutcliffe coefficient | 0.88 |
| Kling-Gupta coefficient | 0.88 |
| Coefficient of efficiency | 0.67 |
| Index of agreement | 0.83 |

Table 03130009-14: Hydrologic Indices Between USGS Gauge 02355350 and HSPF Reach 35.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02355350 | Simulated Reach 35 | Percent Difference |
| MA1: Mean, all daily flows | 820.82 | 861.81 | 4.99 |
| MA2: Median, all daily flows | 558.50 | 581.25 | 4.07 |
| MA3: CV, all daily flows | 85.74 | 95.15 | 10.98 |
| MA4: CV, log of all daily flows | 81.52 | 78.61 | -3.57 |
| MA5: Mean daily flow / median daily flow | 1.47 | 1.48 | 0.88 |
| MA9: (Q10 - Q90) / median daily flow | 2.82 | 2.73 | -3.03 |
| MA10: (Q20 - Q80) / median daily flow | 1.70 | 1.52 | -10.48 |
| MA11: (Q25 - Q75) / median daily flow | 1.33 | 1.16 | -12.64 |
| MA12: Mean monthly flow, January | 1263.79 | 1184.07 | -6.31 |
| MA13: Mean monthly flow, February | 1323.17 | 1507.13 | 13.90 |
| MA14: Mean monthly flow, March | 1595.60 | 1447.86 | -9.26 |
| MA15: Mean monthly flow, April | 1080.15 | 1039.82 | -3.73 |
| MA16: Mean monthly flow, May | 595.71 | 590.23 | -0.92 |
| MA17: Mean monthly flow, June | 509.62 | 499.17 | -2.05 |
| MA18: Mean monthly flow, July | 498.37 | 530.30 | 6.41 |
| MA19: Mean monthly flow, August | 456.59 | 600.62 | 31.54 |
| MA20: Mean monthly flow, September | 474.79 | 614.25 | 29.37 |
| MA21: Mean monthly flow, October | 447.34 | 505.21 | 12.94 |
| MA22: Mean monthly flow, November | 517.78 | 589.81 | 13.91 |
| MA23: Mean monthly flow, December | 909.72 | 1044.59 | 14.83 |
| ML1: Mean minimum monthly flow, January | 944.95 | 763.40 | -19.21 |
| ML2: Mean minimum monthly flow, February | 942.44 | 815.90 | -13.43 |
| ML3: Mean minimum monthly flow, March | 907.94 | 785.23 | -13.52 |
| ML4: Mean minimum monthly flow, April | 679.95 | 619.69 | -8.86 |
| ML5: Mean minimum monthly flow, May | 316.00 | 291.45 | -7.77 |
| ML6: Mean minimum monthly flow, June | 254.42 | 244.98 | -3.71 |
| ML7: Mean minimum monthly flow, July | 257.63 | 265.84 | 3.19 |
| ML8: Mean minimum monthly flow, August | 250.74 | 369.98 | 47.56 |
| ML9: Mean minimum monthly flow, September | 228.11 | 366.24 | 60.56 |
| ML10: Mean minimum monthly flow, October | 303.11 | 370.83 | 22.34 |
| ML11: Mean minimum monthly flow, November | 372.47 | 413.06 | 10.90 |
| ML12: Mean minimum monthly flow, December | 582.53 | 524.24 | -10.01 |
| ML13: CV of minimum monthly flows | 96.90 | 85.97 | -11.28 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.26 | 0.26 | 0.14 |
| ML15: Mean minimum annual flow / mean annual flow | 0.20 | 0.19 | -3.25 |
| ML16: Median minimum annual flow / median annual flow | 0.22 | 0.22 | -0.50 |
| ML20: Ratio of baseflow volume to total flow volume | 0.69 | 0.65 | -6.03 |
| ML22: Mean annual minimum flow divided by catchment area | 1.61 | 1.77 | 10.04 |
| RA1: Mean of positive changes from one day to next (rise rate) | 127.38 | 199.50 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 346.42 | 435.22 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 70.64 | 102.44 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 283.15 | 433.96 |  |
| RA5: Ratio of days that are higher than previous day | 0.35 | 0.34 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.08 | 0.06 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.06 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 66.55 | 69.60 |  |
| RA9: CV, number of flow reversals from one day to the next | 23.93 | 25.05 |  |

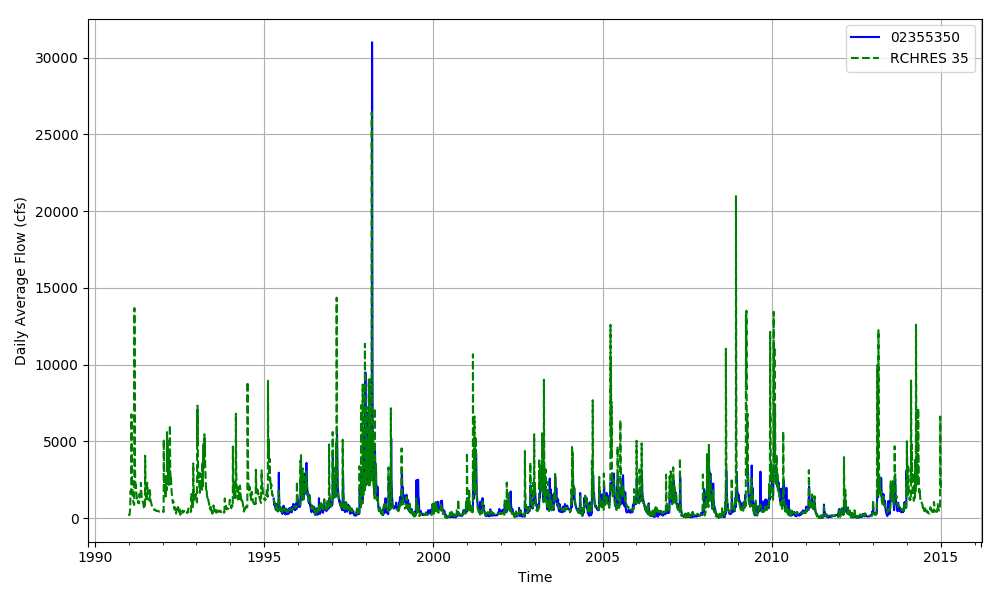


Figure 03130009-22: Daily flow for HSFP reach 35 and USGS station 02355350.

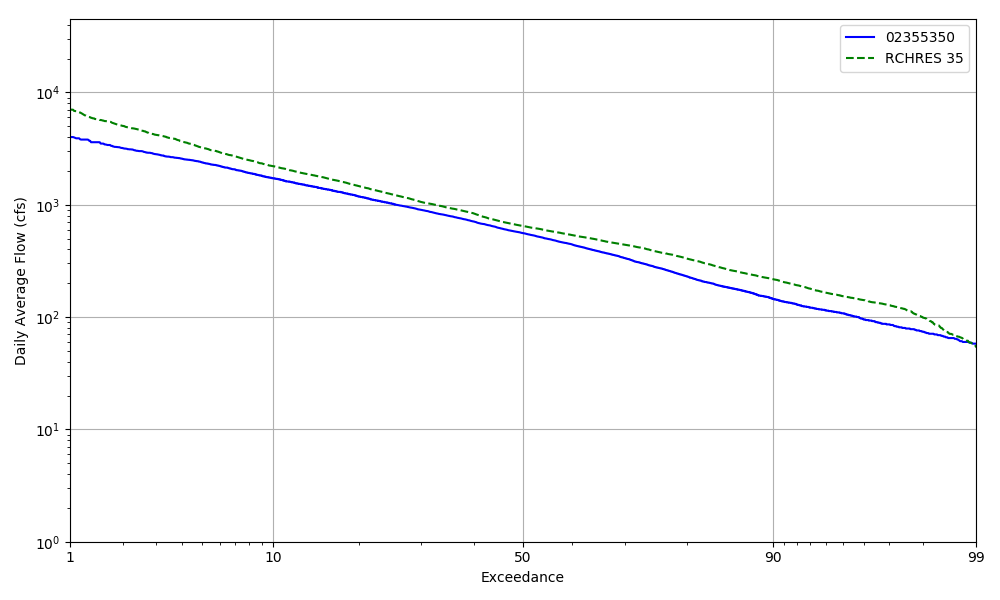


Figure 03130009-23: Daily exceedance for HSFP reach 35 and USGS station 02355350.

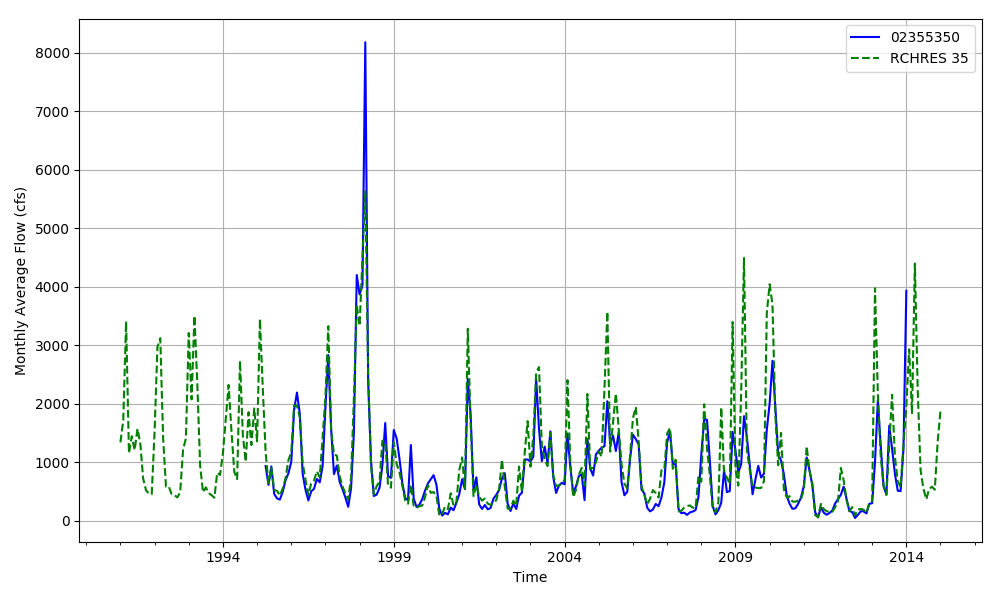


Figure 03130009-24: Monthly flow for HSFP reach 35 and USGS station 02355350.