Determine the nitrate contributions to Wakulla Springs during the reverse flow scenario where Spring Creek flows to Wakulla Springs

The calculations below by Mr. John Folks (FAMU) were developed to calculate an estimate in terms of nitrogen to the above question. They are based on the flows provided in the Lombardo Report for two scenarios: Scenario 1 (More frequent situation where flows to Wakulla Springs do not contain contributions from Spring Creek flows) and Scenario 2 (Less frequent situation, where reversal in flows from Spring Creek causes northerly ground water flows towards Wakulla Springs, and contribute nitrogen contributions to the normal Wakulla Springs flows).

Wakulla Springs N loading:

Base flow of 300cfs - Scenario 1 (Lombardo report)

Additional 500cfs added in a Scenario 2 (Lombardo report)

Max. flow both scenarios = 800cfs

What would be the concentration of the 500cfs necessary to produce a concentration of .5mg/l at 800 cfs, when you have an initial flow of 300cfs with an N concentration at .7mg/l?

N1 = .7 N conc. at 300 cfs

N2 =? Unknown N conc. of the extra 500 cfs

N3 = .5 N conc. of the combined 800 cfs

Q1 = 300 cfs Initial Flow - scenario 1

Q2 = 500 cfs Extra Flow due to Scenario 2

Q3 = 800 cfs Net Flow

Governing equation

Q3 x N3 = Q1 x N1 + Q2 x N2

Solve for N2

N2 = (Q3 x N3 – Q1 x N1) / Q2 = (800 x .5 - 300 x .7) / 500 = 0.38 mg/l

N2 = 0.38 mg/l

What would be the load for both the initial event-Scenario 1 and the extra flow-Scenario 2?

For the stated problem, you can only get a loading rate, i.e. load per unit time, where Loading rate = Conc. x Flow, since we didn't have a time interval.

Now, let's get the units correct with flow in cfs and concentration in mg/l. It's easy to go directly to (lbs / unit time) because mg/l is the same as ppm:

Loading Rate (lbs/sec) = Conc. (mg/l or ppm) x Flow (cfs) x 62.4 lbs/cf x (1 lbs /1,000,000 lbs)

For Q1 Loading Rate = .7 x 300 x 62.4 x (1/ 1,000,000) = 0.0131 lbs/sec or 1,132 lbs/day (0.031 lbs/sec x 86400 sec/day)

For Q2 Loading Rate = .38 x 500x62.4 x (1/1, 000,000) = 0.0118 lbs/sec or 1,025 lbs/day

For Q3 Loading Rate = .5 x 800 x 62.4 x (1/ 1,000,000) = 0.025 lbs/sec or 2,157 lbs/day

Metric is a little trickier,

Loading Rate (kg/sec) = Conc. (mg/l) x Flow (cfs) x 0.0283 (cubic meters/cf) x 1000 (liters/cubic meter) / 1000000 (mg/kg)

For Q1 Loading Rate = .7 x 300 x 0.0283 / 1000 = 0.0059 kg/sec or 510 kg/day (0.0059 kg/sec x 86400 sec/day)

For Q2 Loading rate = .38 x 500 x 0.0283/1000 = 0.0054 kg/sec or 468 kg/day

For Q3 Loading Rate = .5 x 800 x 0.0283 / 1000 = 0.0113 kg/sec or 978 kg/day

Please contact Steve Cioccia for questions on the above.