

SITE NUMBER—07144100

SITE NAME—Little Arkansas River near Sedgwick

DATE CREATED—4/10/2013

MODEL DEVELOPMENT DATA PERIOD—7/27/2004 – 9/22/2011

MODEL-CALIBRATION DATASET—All data were collected using U.S. Geological Survey (USGS) protocols and are stored in National Water Information System (NWIS) database. The regression model is based on 65 concurrent measurements of total organic nitrogen and turbidity samples collected from 07-27-2004 through 09-22-2011. Samples were collected throughout the range of continuously observed hydrologic conditions. Summary statistics and complete model-calibration dataset are provided. No total organic nitrogen values were deemed outliers.

MODEL DEVELOPMENT— Regression analysis was done using S-PLUS, R, and a spreadsheet macro that examined specific conductance as an explanatory variable for estimating total organic nitrogen. Different combinations of untransformed and \log_{10} -transformed data were evaluated. Turbidity was selected as the best model based on residual plots, model standard percentage error (*MSPE*), adjusted R^2 , prediction error sum of squares (*PRESS*), and Mallow's C_p . Model spreadsheet is archived and can be found at <http://nrtwq.usgs.gov/ks> for review, and contains all relevant sample data and more in-depth statistical information.

MODEL SUMMARY—Summary of final regression analysis for total organic nitrogen at site number 07144100.

Turbidity and water temperature-based model:

$$\log_{10}(TON) = 0.371 \times \log_{10}(Turb) - 0.513 ,$$

where

TON = total organic nitrogen, in milligrams per liter as nitrogen; and

Turb = turbidity, in formazin nephelometric units.

The use of turbidity as an explanatory variable makes sense both physically and statistically. It makes physical sense because nutrients, such as total organic nitrogen, tend to adhere to particles associated with turbidity. Therefore, total organic nitrogen is mobilized by the same hydrologic forces that mobilize sediment particles associated with turbidity. Also, total organic nitrogen is a nutrient that affects organisms in water that reduce penetration of light. There is a clear correlation between turbidity and total organic nitrogen. Turbidity makes statistical sense as an explanatory variable because they resulted in a model with low Mallow's C_p and *PRESS* values, and high adjusted R^2 values.

TOTAL ORGANIC NITROGEN RECORD— The record is computed using the regression model in the National Real-Time Water Quality (NRTWQ) website. Data are computed at hourly intervals. The record is complete for the year except as noted. A more in-depth description of the water quality record can be found at –

<http://nrtwq.usgs.gov/ks>

REMARKS—

- Site location, equipment, and other stream-gaging station information can be found in the Site Information Management System (SIMS).

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Reviewed: Patrick Rasmussen

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Model Form

$$\log(\text{TON}) = 0.371 * \log(\text{Turb}) - 0.513$$

Explanatory variable summary statistics

	log(Turb)	Turb
Minimum	0.5185	3.30
1st Quartile	1.362	23.0
Median	2.146	140
Mean	1.883	186
3rd Quartile	2.380	240
Maximum	3.025	1060

Notes:

Dependent variable summary statistics

	log(TON)	TON
Minimum	-0.3872	0.410
1st Quartile	-0.04576	0.900
Median	0.2788	1.90
Mean	0.1846	1.82
3rd Quartile	0.3802	2.40
Maximum	0.7076	5.10

Notes:

Model Calibration

Basic Data

Number of Measurements:	65
Standard Error:	0.0829
MSPE (Upper)	+21.03
MSPE (Lower)	-17.38
R ²	0.91
Adj R ²	0.91
Duan BCF:	1.02

Explanatory Variables

Variable	Value	Standard Error
Intercept	-0.513	0.0300
log(Turb)	0.371	0.0150

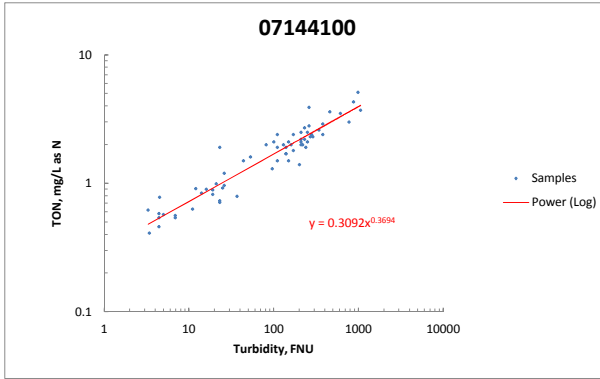
Notes:

Covariance Matrix

	Intercept	log(Turb)
Intercept	1	-0.94
log(Turb)	-0.94	1

Test Criteria

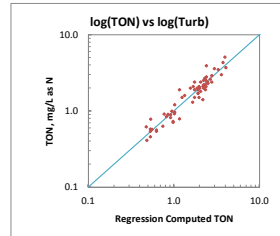
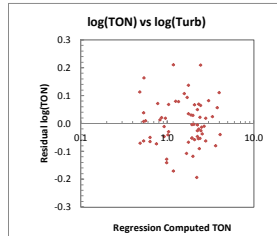
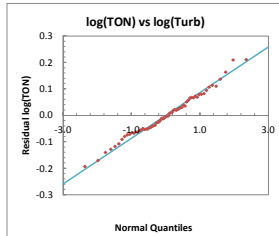
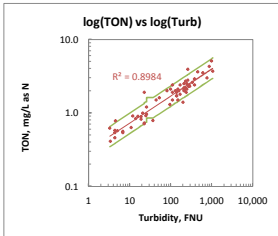
	Leverage	Cook's D	DFITS
	0.0923	0.797	0.351



Observations exceeding at least one test criterion

Observation	Observed log(TON)	Predicted log(TON)	Residuals	Standardized Residuals	Studentized Residuals	Leverage	Cook's D	DFITS
1	0.146	0.339	-0.193	-2.35	-2.45	0.0211	0.0597	-0.359
3	0.591	0.383	0.208	2.54	2.66	0.0248	0.0818	0.424
10	0.279	0.0684	0.211	2.57	2.69	0.0186	0.0624	0.370
35	-0.208	-0.321	0.113	1.42	1.43	0.0762	0.0833	0.412
36	-0.108	-0.271	0.163	2.04	2.09	0.0649	0.144	0.552

Notes:



Date	Turbidity		TON, mg/L as N	log(TON)	Regression		Residual log(TON)	90% P.I.		90% P.I. Upper
	FNU	ft ² /sec			Computed TON	Normal Quantiles		Lower		
7/27/2004	200	5855	1.40	0.146	2.30	2.19	-0.194	-2.36	1.59	3.01
1/27/2005	81.0	172	2.00	0.301	1.91	1.56	0.107	1.28	1.14	2.15
3/23/2005	260	5855	3.90	0.591	2.42	2.41	0.209	1.97	1.75	3.31
5/10/2005	170	203	2.40	0.380	2.23	2.06	0.067	0.811	1.50	2.83
5/27/2005	1060	743	3.70	0.568	3.03	4.06	-0.040	-0.353	2.95	5.58
6/6/2005	290	1957	2.30	0.362	2.46	2.51	-0.038	-0.313	1.82	3.45
6/9/2005	380	11797	2.40	0.380	2.58	2.77	-0.063	-0.811	2.02	3.81
8/31/2005	96.0	112	1.30	0.114	1.98	1.67	-0.108	-1.37	1.21	2.29
1/10/2007	6.90	13.8	0.540	-0.268	0.839	0.628	-0.065	-0.984	0.46	0.86
3/12/2007	23.0	19.1	1.90	0.279	1.57	1.17	0.211	2.36	0.85	1.61
3/21/2007	26.0	51.0	1.20	0.079	1.42	1.03	0.068	0.759	0.75	1.41
3/27/2007	250	164	2.50	0.398	2.40	2.38	0.022	0.353	1.73	3.27
4/2/2007	380	2886	2.90	0.462	2.58	2.77	0.019	0.313	2.02	3.81
7/11/2007	210	1927	2.20	0.342	2.32	2.23	-0.005	0.154	1.62	3.06
8/16/2007	26.0	59.3	0.960	-0.018	1.42	1.03	-0.029	-0.272	0.75	1.41
9/6/2007	23.0	25.5	0.730	-0.137	1.36	0.981	-0.128	-1.60	0.71	1.35
11/26/2007	4.40	28.9	0.580	-0.237	0.644	0.531	0.038	0.523	0.39	0.73
12/6/2007	5.00	29.5	0.570	-0.244	0.699	0.557	0.010	0.154	0.40	0.77
12/13/2007	260	2740	2.80	0.447	2.42	2.41	0.065	0.709	1.75	3.31
3/6/2008	610	979	3.50	0.544	2.79	3.31	0.025	0.394	2.40	4.55
4/14/2008	230	484	2.70	0.431	2.36	2.30	0.069	0.923	1.67	3.17
5/29/2008	230	2895	2.20	0.342	2.36	2.30	-0.020	-0.154	1.67	3.17
6/30/2008	210	877	2.50	0.398	2.32	2.23	0.050	0.613	1.62	3.06
9/16/2008	170	1716	1.80	0.255	2.23	2.06	-0.058	-0.759	1.50	2.83
4/6/2009	53.0	187	1.60	0.204	1.72	1.34	0.078	0.984	0.97	1.84
4/28/2009	280	9190	2.40	0.380	2.45	2.48	-0.014	-0.077	1.80	3.41
6/16/2009	870	661	4.30	0.634	2.94	3.77	0.057	0.660	2.74	5.18
7/30/2009	210	523	2.10	0.322	2.32	2.23	-0.025	-0.193	1.62	3.06
9/9/2009	210	3141	2.00	0.301	2.32	2.23	-0.046	-0.436	1.62	3.06
9/24/2009	770	333	3.00	0.477	2.89	3.60	-0.080	-1.19	2.62	4.96
11/3/2009	140	328	1.70	0.230	2.15	1.92	-0.052	-0.567	1.39	2.63
11/19/2009	6.90	65.0	0.560	-0.252	0.839	0.628	-0.049	-0.660	0.46	0.86
12/1/2009	4.40	54.7	0.460	-0.337	0.644	0.531	-0.062	-0.866	0.39	0.73
12/17/2009	3.40	58.7	0.410	-0.387	0.532	0.483	-0.071	-1.05	0.35	0.66
1/6/2010	3.30	94.5	0.620	-0.208	0.519	0.477	0.114	1.37	0.35	0.66
1/19/2010	4.50	79.7	0.780	-0.108	0.653	0.536	0.163	1.75	0.39	0.74
2/4/2010	4.40	63.9	0.540	-0.268	0.644	0.531	0.007	0.116	0.39	0.73
2/23/2010	11.0	69.3	0.630	-0.201	1.04	0.746	-0.073	-1.12	0.54	1.03
3/10/2010	150	547	2.10	0.322	2.18	1.97	0.029	0.436	1.43	2.70
3/11/2010	100	11111	2.10	0.322	2.00	1.69	0.094	1.19	1.23	2.33

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4/14/2010	12.0	52.7	0.910	-0.041	1.08	0.770	0.072	0.866	0.56	1.06
4/23/2010	110	228	2.40	0.380	2.04	1.75	0.137	1.60	1.27	2.41
5/13/2010	460	544	3.60	0.556	2.66	2.98	0.083	1.12	2.16	4.09
6/9/2010	990	2448	5.10	0.708	3.00	3.96	0.110	1.47	2.88	5.44
6/10/2010	160	3345	2.00	0.301	2.20	2.01	-0.003	0.077	1.46	2.77
6/13/2010	340	7905	2.60	0.415	2.53	2.66	-0.010	-0.038	1.93	3.66
6/14/2010	150	15162	1.50	0.176	2.18	1.97	-0.117	-1.47	1.43	2.70
6/15/2010	250	6480	2.10	0.322	2.40	2.38	-0.053	-0.613	1.73	3.27
6/16/2010	220	4806	2.00	0.301	2.34	2.27	-0.054	-0.709	1.65	3.12
7/6/2010	140	13387	1.70	0.230	2.15	1.92	-0.052	-0.523	1.39	2.63
8/19/2010	37.0	60.8	0.790	-0.102	1.57	1.17	-0.170	-1.97	0.85	1.61
8/25/2010	240	770	1.90	0.279	2.38	2.34	-0.090	-1.28	1.70	3.22
11/16/2010	140	262	1.90	0.279	2.15	1.92	-0.003	0.038	1.39	2.63
1/19/2011	21.0	83.3	0.990	-0.004	1.32	0.948	0.019	0.233	0.69	1.30
3/7/2011	14.0	50.8	0.840	-0.076	1.15	0.816	0.013	0.193	0.59	1.12
3/16/2011	19.0	48.0	0.820	-0.086	1.28	0.913	-0.047	-0.479	0.66	1.26
4/6/2011	16.0	37.6	0.900	-0.046	1.20	0.857	0.021	0.272	0.62	1.18
4/18/2011	19.0	32.8	0.890	-0.051	1.28	0.913	-0.011	-0.116	0.66	1.26
5/2/2011	25.0	28.8	0.920	-0.036	1.40	1.01	-0.041	-0.394	0.74	1.39
5/16/2011	23.0	26.8	0.710	-0.149	1.36	0.981	-0.140	-1.75	0.71	1.35
6/7/2011	44.0	21.9	1.50	0.176	1.64	1.25	0.080	1.05	0.91	1.71
6/21/2011	110	110	1.90	0.279	2.04	1.75	0.035	0.567	1.27	2.41
6/22/2011	130	46.2	2.00	0.301	2.11	1.86	0.031	0.479	1.35	2.56
8/15/2011	270	25.5	2.30	0.362	2.43	2.44	-0.026	-0.233	1.78	3.36
9/22/2011	110	42.9	1.50	0.176	2.04	1.75	-0.067	-0.923	1.27	2.41