Table 2 Aroostook River Model Hydraulic Coefficients

V = Velocity in fps
D = Depth in ft
Q = Flow in cfs

$V = A_1Q^{B_1}$ $D = A_2Q^{B_2}$

Model Reach #	Reach Description	River Miles	Velocity Coefficients		Depth Coefficients	
			A_1	B_1	A_2	B_2
1	Ashland	58.5 - 50.0	0.102	0.35	0.175	0.45
2	Pudding Rock	50 - 43.5	0.115	0.35	0.15	0.45
3	Donelly Island	43.5 - 40.0	0.129	0.35	0.125	0.45
4	Washburn	40 - 37.5	0.09	0.35	0.176	0.45
5	Crouseville	37.5 - 34.5	0.08	0.35	0.179	0.45
6	Presqus Isle above P I Str	34.5 - 29.5	0.071	0.35	0.182	0.45
7	Presque Isle Stream #1	1.5 - 1	0.0701	0.6	0.6476	0.3
8	Presque Isle Stream #2	1 - 0.5	0.0701	0.6	0.6476	0.3
9	Presque Isle Stream #3	0.5 - 0.0	0.0538	0.6	0.6263	0.3
10	Presque Isle below P I Str	29.5 - 27.0	0.111	0.35	0.102	0.45
11	Maysville	27.0 - 20.0	0.0867	0.35	0.126	0.45
12	Caribou Dam Impoundment Upper	20.0 - 19.0	0.000718	1	4.8	0
13	Caribou Dam Imp. McGraw	19.0 - 18.0	0.000407	1	6	0
14	Caribou Dam Imp. Middle	18.0 - 17.0	0.000255	1	8.64	0
15	Caribou Dam	17.0 - 15.5	0.000161	1	11.97	0
16	Caribou Dam to L Madawaska R	15.5 - 11.0	0.1013	0.35	0.11	0.45
17	Little Madawaska R #1	5.0 - 4.0	0.3971	0.26	0.221	0.45
18	Little Madawaska R #2	4.0 - 3.0	0.3971	0.26	0.221	0.45
19	Little Madawaska R #3	3.0 - 2.0	0.4844	0.18	0.1184	0.47
20	Little Madawaska R #4	2.0 - 1.0	0.3057	0.28	0.1803	0.48
21	Little Madawaska R #5	1.0 - 0.0	0.3326	0.28	0.1638	0.46
22	Below L Madawaska R	11.0 - 8.5	0.081	0.35	0.16	0.45
23	Goodwin	8.5 - 6.5	0.047	0.35	0.135	0.45
24	Stevensville	6.5 - 5.0	0.034	0.35	0.208	0.45
25	Tinker Dam Imp Upper	5.0-3.5	0.00314	0.6	1.166	0.3
26	USA / Canada Border	3.5 - 0.0	0.000162	1	10.16	0

Table 3 Flow Balance of Aroostook River

Reach	Description	Reach River Miles		Drainage Area (Mi^2)		Flow Inputs	Input DA (mi^2)	Flow (cfs) 8/02-16/01		Flow (cfs) 8/09-30/01	
		Begin	End	Begin	End			Incremental	Head of Rch	Incremental	Head of Rch
1	Ashland	58.5	50	1338	1459	L Machias R	63	8.6	180.2	5.1	116.1
						Incremental	58	7.9		4.7	
2	Pudding Rock	50	43.5	1459	1577	Beaver Br	103	14.0	196.7	8.3	125.8
						Incremental	15	2.0		1.2	
3	Donnelly Island	43.5	40	1577	1599	Incremental	22	3.0	212.8	1.8	135.4
4	Washburn	40	37.5	1599	1659	Salmon Br	55	7.5	215.8	4.4	137.2
						Incremental	5	0.7		0.4	
5	Crouseville	37.5	34.5	1659	1681	Incremental	22	3.0	224	1.8	142
6	Presque Isle	34.5	29.5	1681	1889	P I Stream	197	8.0	227.0	4.6	143.8
						Incremental	11	1.5		0.9	
10	Presque Isle	29.5	27	1889	1900	Incremental	11	1.5	236.5	0.9	149.3
11	Maysville	27	20	1900	1915	Incremental	15	2.0	238.0	1.2	150.2
12	Caribou Dam Upper	20	19	1915	1922	Incremental	7	1.0	240.0	0.6	151.4
13	McGraw	19	18	1922	1929	Incremental	7	1.0	241.0	0.6	151.9
14	Caribou Dam Middle	18	17	1929	1936	Incremental	7	1.0	242.0	0.6	152.5
15	Caribou Dam Lower	17	15.5	1936	1943	Incremental	7	1.0	242.9	0.6	153.1
16	Grimes Mill	15.5	11	1943	2253	Caribou Str	50	6.1	243.9	4.1	153.6
						L Madaw R	243	40.4		28.5	
						Incremental	17	2.3		1.4	
22	Below L Madaw R	11	8.5	2253	2271	Incremental	18	2.5	292.7	1.5	187.6
23	Goodwin	8.5	6.5	2271	2291	Incremental	20	2.7	295.1	1.6	189.1
24	Stevensville	6.5	5	2291	2296	Incremental	5	0.7	297.9	0.4	190.7
25	Tinker Dam Upper	5	3.5	2296	2301	Incremental	5	0.7	298.5	0.4	191.1
26	Tinker Dam Lower	3.5	0	2301	2328	Pattee Br	27	3.7	299.2	2.2	191.5
						Incremental	25	3.4		2.0	
						End			306.3		195.7
						USGS Masardis	892		116		78
						CFSM Masardis-Washburn			0.136		0.081

Presque Isle Stream

7	Downtown Presque Isle	1.5	1
8	WWTP to Bypass Bridge	1	0.5
9	Bypass Bridge to Confluence	0.5	0

Little Madawaska River

17	Bowles Rd	5	4
18	Rte 89	4	3
19	Island #1 to Island #2	3	2
20	Island #2 - S Curve	2	1
21	S Curve - Confluence	1	0

Table 4 Environmental Constants and Parameter Rates Used in Aroostook River Model Constant by Model Reach

Literature Source - Help and Limit Screens for Eutrophication Preprocessor for EPA WASP4/Eutro4 Model, Tetra Tech, 8/8/1991.

-Computer Program Documentation for the Enhanced Stream Water Quality Model QUAL2E , USEPA, 8 / 1985.

Constants — Cannot be Varied by Reach in Qual2e

	Literature				
Algae as Phytoplankton	Range	Default	Aroostook Model	Units	Considerations and Logic Used
Maximum Growth Rate	1 - 4	1.8	1.8	1 / day	Calibration of chlorophyll a.
Algal Respiration Rate	.05 - .5	0.15	0.3	1 / day	Calibration of chlorophyll a, DO
Algal Death Rate	0 - .25	0.05	See settling rate Table 6	1 / day	Assigned as settling rate. Qual2e has no input for algae death.
Oxygen Uptake by Algae	1.6 - 2.3	2	2	mg-O / mg-A	Default
Oxy. Production by Algae	1.4 - 1.8	1.6	20		High rate needed to calibrate DO.
Nitrogen Content of Algae	.07 - .09	0.085	0.085	mg-N / mg-A	Default range.
Phosphorus Content of Algae	.01 - .02	0.014	0.01	mg-P / mg-A	
N-Half Saturation Constant	.001 - .15	0.025	0.025	mg/l	Default
P-Half Saturation Constant	.001 - .05	0.001	0.001	mg/l	
Light Saturation Coef	.02 - .10	0.06	0.06	BTU / ft^2-min	Default
Algae as Periphyton					
Maximum Growth Rate	.3 - 2.25		1.5	1 / day	Calibration of model phosphorus, dissolved oxygen
Periphyton Respiration Rate	.01 - .8		0.01		
Periphyton Death Rate	0 - .8		0.001		
Oxygen Uptake by Periphyton	1.6 - 2.3	2	2	mg-O / mg-AP	Default
Oxy. Production by Periphyton	1.4 - 1.8	1.6	6		High rate needed to calibrate DO.
Nitrogen Content of Periphyton	.07 - .09	0.08	0.08	mg-N / mg-AP	Default
Phosph. Content of Periphyton	.01 - .02	0.01	0.01	mg-P / mg-AP	
Chl-a Content of Algae	5 - 10	7.5	10		Calibration of model phosphorus, dissolved oxygen
N Half- Sat. Constant Periphy.	.01 - .766		0.02	mg/l	
P Half -Sat. Constant Periphy.	.001 - .08		0.006	mg/l	
Light Saturation Coef Periphy.	.01 - .10	0.05	0.1	BTU / ft^2-min	
Periphyton Density Satur. Coef	3 - 6	4.5	4.5	mg-chl-a / ft^2	Default

Parameter Rates — Varied by model reach in Aroostook model. See Table 5 for reach specific rates.

Sediment Oxygen Demand	9 - 900	Variable	10 - 150	mg / ft2-day	Consistent with measured reates in impoundments
Reaeration Rate	.01 - 100	Variable	.25 - 20.4	1 / day	Modified method of Covar
PO4-P Uptake Rate	Variable		.01 - 3.0	mg / ft^{2-}day	Assigned as negative flux rate to calibrate PO4-P.
Algae Settling Coefficient	0.3 - 59	1.6	.1 - 1.5	ft / day	Includes algae death. Qual2e has no direct input for algae depth.
Benthal CBOD Source	Variable		10-80	mg / ft2-day	BOD calibration / See text for details
OP decay	.01 - .7	0.22	.05 - .25	1 / day	OP calibration
ON Settling	0.001 - 0.10	0.05	.01 - .50	1 / day	ON, OP calibration. Very high loss rate in Aroostook
OP Settling			.01 - 20		

Parameter Rates — Can be varied by model reach in Qual2e but were assigned as constants in Aroostook model

NH3-N Benthal Source	Variable		0.05	mg / ft2-day	Nitrogen, phosphorus calibration
ON hydrolysis	.02 - .4	0.075	0.001	1 / day	Turned off, insignificant in Aroostook
Chl-a to Algae Ratio	10 - 100	50	80	ug-chl-a / mgA	Chl-a calibration
Non-Algal light extinction coef.	Variable		0.2	1 / ft	
Fraction of bottom area available for periphy. growth	0 - 1	Variable	0.7	unitless	Dissolved Oxygen / Phosphorus Calibration
Carbonaceous BOD Decay	.01 - 5.6	≥ Bottle rate	0.05	1 / day	Laboratory bottle decay rates used
Ammonia Decay	.1 - 1.0	Variable	0.2	1 / day	NH3-N calibration

Table 5 Environmental Parameter Rates Used in Aroostook River Model Variable by Model Reach

Model Reach #	Reach Description	River Miles	Benthal BOD Source mg / ft^2-day		Sediment Oxygen Demand mg/ft^2-day	Reaeration Rate Option	Reaeration Rate at 20° C (/day)	ON Settling (/day)	OP Settling (/day)		PO4-P Uptake Rate (mg/ft^2-day)		OP Decay (/day)	*Algae Loss Coef. (/day)	
	Data Set		8/14-16	8/28-30	Both	Both	Both	Both	8/14-16	8/28-30	8/14-16	8/28-30	Both	8/14-16	8/28-30
1	Ashland	58.5 - 50.0	10		150	O-D	5.29	0.1	0.1		0.01		0.05	0.2	0.1
2	Pudding Rock	50.0 - 43.5					6.61								
3	Donelly Island	43.5 - 40.0					9.07								
4	Washburn	40.0 - 37.5					4.47								
5	Crouseville	37.5 - 34.5					4.08								
6	Presqus Isle above P I Str	34.5 - 29.5					3.75								
7	Presque Isle Stream #1	1.5 - 1.0			50		5.69		5		1.5				
8	Presque Isle Stream #2	1 - 0.5					5.47								
9	Presque Isle Stream #3	0.5 - 0.0					5.09								
10	Presque Isle below P I Str	29.5 - 27	80	40			10.92	0.5	0.1	0.1	0.01		0.25		
11	Maysville	27.0 - 20.0					6.98			2	1.5	2.2	0.05		
12	Caribou Dam Impoundment Upper	20.0 - 19.0					0.41			0.1	0.01				
13	Caribou Dam Imp. McGraw	19.0 - 18.0				ID	0.51								
14	Caribou Dam Imp. Middle	18.0 - 17.0					0.36								
15	Caribou Dam	17.0 - 15.5					0.25								
16	Caribou Dam to L Madawaska R	15.5 - 11.0	40		10	O-D	9.05						0.25	1.0	
17	Little Madawaska R #1	5.0 - 4.0	10				12.95	0.01					0.05	0.2	0.1
18	Little Madawaska R #2	4.0 - 3.0					12.81								
19	Little Madawaska R #3	3.0 - 2.0					20.38		10	20	2	2.8			
20	Little Madawaska R #4	2.0 - 1.0					13.28		0.1		0.01				
21	Little Madawaska R #5	1.0 - 0.0					17.65								
22	Below L Madawaska R	11.0 - 8.5	40				4.20	0.5	0.5	3	2	3			0.2
23	Goodwin	8.5 - 6.5			85		4.13		0.1		1				
24	Stevensville	6.5 - 5.0					1.83							1.5	
25	Tinker Dam Imp Upper	5.0 - 3.5					0.26								
26	USA / Canada Border	3.5 - 0.0				ID	0.30		0.01		1	1.5			

O-D = Oconnor Dobbins

ID = Impoundment Default

* In Qual 2e, Algae losses from settling, death, and predation are all assigned in the settling rate.