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Table 1. Construction and operation data relevant to Spring Hollow Reservoir.

Date	Event
August 1993	Complete construction of roller compacted concrete dam
November 1993	Begin filling of reservoir
June 1994	Complete initial filling of reservoir
January 1995	Begin post grouting of reservoir
September 1995	Complete post grouting of reservoir
December 1995	Begin operation of treatment facility
April 1996	Begin daily pump withdrawals
June 1996	Surface reaches normal pool elevation of 1410 feet, filling stops until April 1997
April 1997	Filling begins again on periodic basis

Table 2. Parameters measured in Spring Hollow Reservoir at 5-10 foot intervals.

Measurement Parameter	Units
Temperature	°C
Dissolved Oxygen	mg*L ⁻¹ and % saturation
Conductivity	mS*cm ⁻¹
Specific Conductivity	mS*cm ⁻¹
pH	
ORP	mV
Depth	feet

Table 3. Constituents measured in Spring Hollow Reservoir at the bottom, middle, and surface of the water column.

Constituent	Units
Orthophosphate	mg*L ⁻¹
Total phosphorus	mg*L ⁻¹
Total Kjeldahl nitrogen	mg*L ⁻¹
Ammonia nitrogen	mg*L ⁻¹
Oxidized nitrogen	mg*L ⁻¹
Total organic carbon	mg*L ⁻¹
Turbidity	NTU
Total suspended solids	mg*L ⁻¹
Chlorophyll <i>a</i> ^a	μg* L ⁻¹
Pheohpytin <i>a</i> ^a	μg* L ⁻¹
Plankton counts ^a	54 plankton genera

a – measured only in the epilimnion of the reservoir

Table 4. Roanoke River water quality parameters used for pump discharge and local runoff into Spring Hollow.

Parameter	Constant Value
DO	Saturation value at influent temperature
Algae	0.1 mg*L ⁻¹
Detritus	2.0 mg*L ⁻¹
Dissolved organics	2.0 mg*L ⁻¹
Ammonia	0.2 mg*L ⁻¹
Nitrate and nitrite	0.25 mg*L ⁻¹
Bioavailable phosphorus	0.005 mg*L ⁻¹

Table 5. Results of the temperature sensitivity analysis on Spring Hollow Reservoir using the BETTER model.

Daily Inputs	Change	Surface Temperature	Hypolimnion Temperature	Epilimnion Depth
Wind speed	base*2	decrease 4°C	increase 2°C during stratification & decrease 2°C during destratification	increase 8 ft
	base/2	increase 4°C	decrease 2°C during stratification & increase 2°C during destratification	no change
Solar radiation	base*1.5	increase 5°C	increase 2°C after day 375	increase 2 ft
	base/1.5	decrease 5°C	decrease 1°C after day 375	decrease 2 ft
Dew point and dry bulb temperature	base*2	increase 8°C	increase 0.5°C after day 375	no change
	base/2	decrease 4°C	decrease 0.5°C after day 300	no change
Constants	Change	Surface Temperature	Hypolimnion Temperature	Epilimnion Depth
Wind speed adjustment coefficient	base*1.5	decrease 2°C	increase 1°C during stratification & decrease 1°C during destratification	increase 1 ft
	base*0.5	increase 4°C	increase 2° during destratification	decrease 1 ft
Evaporation adjustment factor	base*2	decrease 2°C	decrease 2°C	no change
	base/2	increase 2°C	increase 2°C	no change
Light extinction coefficient	base*2	no change	decrease 0.5°C	decrease 5 ft
	base/2	no change	increase 0.5°C	increase 5 ft
Initial temperature	base*2	no change after day 100	increase 2°C until day 400 and then no change	no change
	base/2	no change after day 100	decrease 1°C until day 400 and then no change	no change

Table 6. Parameters used in application of BETTER model to Spring Hollow after sensitivity analysis and calibration were completed.

Parameter	Units	Suggested Range	Assigned Value
1. Sediment Oxygen Demand column 1 and 2 ^{a, b}	$\text{g-O}_2 \cdot \text{m}^{-2} \cdot \text{day}^{-1}$	none	2.0
2. Sediment Oxygen Demand column 3 ^a	$\text{g-O}_2 \cdot \text{m}^{-2} \cdot \text{day}^{-1}$	none	1.0
3. Sediment Oxygen Demand column 4 ^a	$\text{g-O}_2 \cdot \text{m}^{-2} \cdot \text{day}^{-1}$	none	0.5
4. Fraction of local drainage area for each column	fraction	none	0.25

a – the temporal variation in sediment oxygen demand is explained in the section entitled “Discussion.”

b – column 1 is the column closest to the dam.

Initial concentration values in all reservoir elements

Parameter	Units	Suggested Range	Assigned Value
1. Temperature	°C	none	5.0
2. Suspended solids	$\text{mg} \cdot \text{L}^{-1}$	none	2.0
3. Dissolved oxygen	$\text{mg} \cdot \text{L}^{-1}$	none	12.8
4. pH		none	7.83
5. Alkalinity	$\text{mg} \cdot \text{L}^{-1}$	none	120.0
6. Algae	$\text{mg} \cdot \text{L}^{-1}$	none	0.1
7. Detritus	$\text{mg} \cdot \text{L}^{-1}$	none	0.8
8. Dissolved Organics	$\text{mg} \cdot \text{L}^{-1}$	none	0.8
9. Ammonia	$\text{mg} \cdot \text{L}^{-1}$	none	0.03
10. Nitrite and nitrate	$\text{mg} \cdot \text{L}^{-1}$	none	0.22
11. Bioavailable phosphorus	$\text{mg} \cdot \text{L}^{-1}$	none	0.005

Thermal structure rates and coefficients

Parameter	Units	Suggested Range	Assigned Value
1. Initial pool elevation	ft	none	1391.7
2. Fraction of wind energy available for mixing	none	0.02 – 0.1	0.05
3. Turbidity extinction coefficient	$\text{m}^{-1} \cdot (\text{mg} \cdot \text{L}^{-1})^{-1}$	0.05 – 0.2	0.05
4. Density deflection adjustment factor	none	0.1 – 10	1.0
5. Withdrawal zone thickness for Gaussian outflow distribution	none	10 – 30	1.e05
6. Light extinction coefficient	m^{-1}	0.2 – 1	0.8
7. Evaporation adjustment factor	none	0.8 – 1.2	1.2
8. Wind speed adjustment coefficient	none	0.5 – 2	1.1
9. Fraction of solar radiation that is photosynthetically active	none	0.3 – 0.7	0.3
10. Algal biomass extinction coefficient	$\text{m}^{-1} \cdot (\text{mg} \cdot \text{L}^{-1})^{-1}$	0.1 – 0.2	0.1

11. Adjustment for vertical mixing	none	0.1 – 10	0.1
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Water quality rates, biological and chemical data

Algae coefficients

Parameter	Units	Suggested Range	Assigned Value
1. Maximum growth rate	day ⁻¹	1.0 – 1.5	1.0
2. Maximum respiration rate	day ⁻¹	0.1 – 0.3	0.1
3. Maximum phytoplankton mortality rate	day ⁻¹	0.0 – 0.2	0.1
4. Algae settling rate	m*day ⁻¹	0.0 – 0.2	0.1
5. Light half-saturation	kcal*m ⁻² *hr ⁻¹	10 – 30	15
6. Carbon half-saturation	mg*L ⁻¹	0.01 – 0.05	0.03
7. Algae phosphorus content	fraction	0.003 – 0.01	0.004
8. Algae nitrogen content	fraction	0.03 – 0.07	0.04
9. Algae carbon content	fraction	0.3 – 0.7	0.4
10. Growth range temperatures	°C	10, 20, 30, 40	10, 15, 25, 30
11. Growth rate multipliers for temperatures	none	0.1, 0.98, 0.98, 0.01	0.1, 0.98, 0.98, 0.01

Detritus coefficients

Parameter	Units	Suggested Range	Assigned Value
1. Detritus phosphorus content	fraction	0.003 – 0.01	0.004
2. Detritus nitrogen content	fraction	0.03 – 0.07	0.04
3. Detritus carbon content	fraction	0.3 – 0.7	0.4
4. Detritus settling rate	m*day ⁻¹	0.05 – 0.2	0.2
5. Suspended solids settling rate	day ⁻¹	0.1 – 0.5	0.5
6. Temperature for 0.1 maximum detritus decay	°C	1 – 5	5
7. Temperature for 0.98 maximum detritus decay	°C	15 – 40	15

Decay rates

Parameter	Units	Suggested Range	Assigned Value
1. Maximum dissolved organics (DOR) decay rate	day ⁻¹	0.1 – 0.3	0.3
2. Maximum nitrification rate	day ⁻¹	0.05 – 0.2	0.1
3. Maximum detritus decay rate	day ⁻¹	0.05 – 0.2	0.2
4. Temperature for 0.1 maximum DOR decay	°C	1 – 10	5
5. Temperature for 0.98 maximum DOR decay	°C	15 – 35	15

6. Temperature for 0.1 maximum nitrification and SOD	°C	1 – 10	5
7. Temperature for 0.98 maximum nitrification and SOD	°C	15 – 35	20

Oxygen rates

Parameter	Units	Suggested Range	Assigned Value
1. Oxygen consumed in nitrification	mg-O ₂ *mg-N ⁻¹	4.33 – 4.7	4.7
2. Oxygen consumed in detritus decay	mg-O ₂ *mg-DET ⁻¹	1.0 – 1.15	1.07
3. Oxygen required in algae respiration	mg-O ₂ *mg-ALG ⁻¹	1.4 – 1.8	1.6
4. Oxygen produced by photosynthesis	mg-O ₂ *mg-ALG ⁻¹	1.4 – 1.8	1.8
5. Carbon produced by DOR decay	mg-O ₂ *mg-DOR ⁻¹	0.4	0.3

Anaerobic rates

Parameter	Units	Suggested Range	Assigned Value
1. Anaerobic release of ammonia from sediment	g-N*m ⁻² *day ⁻¹	0.05 – 0.15	0.01
2. Anaerobic release of PO ₄ from sediment	g-P*m ⁻² *day ⁻¹	0.01 – 0.1	0.001
3. Anaerobic denitrification rate	day ⁻¹	0.05 – 0.25	0.1
4. Anaerobic release of DOR from sediment	g-DOR*m ⁻² *day ⁻¹	none	0.01