APPENDIX D

Wetlands Treatment Calculations

Table 1 - Root Zone Water Balance Working Model

Project Name: McMinnville — Designer: Emond
Project Number: WW irrigation:3.3MGD,May-Oct — Crop: grass

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Days/Month		31	28	31	30	31	30	31	31	30	31	30	31	365
Water Supply														
Average Precipitation	[in]	6.53	5.07	4.81	2.55	1.84	1.00	0.48	0.72	1.57	2.95	6.23	7.66	41.41
% Effective Precipitation	[%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Surface Runoff	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Effective Rainfall	[in]	6.53	5.07	4.81	2.55	1.84	1.00	0.48	0.72	1.57	2.95	6.23	7.66	41.41
Actual water Flow	[in]	0.00	0.00	0.00	0.00	3.65	3.53	3.65	3.65	3.53	3.65	0.00	0.00	21.68
	[MG]	0.00	0.00	0.00	0.00	102.30	99.00	102.30	102.30	99.00	102.30	0.00	0.00	607.20
	[mgd]	0.00	0.00	0.00	0.00	3.30	3.30	3.30	3.30	3.30	3.30	0.00	0.00	
	[ac-ft]	0.00	0.00	0.00	0.00	313.95	303.82	313.95	313.95	303.82	313.95	0.00	0.00	1863.43
Available water Flow to Irrigation/Storage?	(Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Irrigation Requirements and Management														
Potential Crop Evapotranspiration	[in]	0.28	0.67	1.61	3.27	4.96	5.35	6.06	4.69	1.89	1.50	0.47	0.16	30.91
Actual Crop Evapotranspiration	[in]	0.28	0.67	1.61	3.27	4.96	5.35	6.06	4.69	1.89	1.50	0.47	0.16	30.91
Net Irrigation Requirement	[in]	0.00	0.00	0.00	0.72	3.12	4.35	5.58	3.97	0.32	0.00	0.00	0.00	18.06
Gross Irrigation Requirement	[in]	0.00	0.00	0.00	0.90	3.90	5.44	6.98	4.96	0.40	0.00	0.00	0.00	22.58
	[MG]	0.00	0.00	0.00	25.21	109.25	152.33	195.40	139.02	11.21	0.00	0.00	0.00	632.41
	[ac-ft]	0.00	0.00	0.00	77.37	335.29	467.47	599.65	426.63	34.39	0.00	0.00	0.00	1940.80
Total Irrigation Applied	[in]	0.00	0.00	0.00	0.00	3.90	5.44	6.98	4.96	0.40	0.00	0.00	0.00	21.68
	[MG]	0.00	0.00	0.00	0.00	109.25	152.33	195.40	139.02	11.21	0.00	0.00	0.00	607.20
	[ac-ft]	0.00	0.00	0.00	0.00	335.29	467.47	599.65	426.63	34.39	0.00	0.00	0.00	1863.43
Irrigation Losses	[in]	0.00	0.00	0.00	0.00	0.78	1.09	1.40	0.99	0.08	0.00	0.00	0.00	4.34
Reservoir Storage Water Balance														
Peak Precipitation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reservoir Evaporation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peak Precipitation - Reservoir Evaporation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transfer of Available water to Reservoir	[MG]	0.00	0.00	0.00	0.00	102.30	99.00	102.30	102.30	99.00	102.30	0.00	0.00	607.20
Reservoir Storage for Variable Size Storage and Land Area Projects														
Change in Reservoir Storage	[MG]	0.00	0.00	0.00	0.00	-6.95	-53.33	-93.10	-36.72	87.79	102.30	0.00	0.00	0.00
Cumulative Active Storage	[MG]	0.00	0.00	0.00	0.00	-3.48	-33.62	-106.83	-171.74	-146.20	-51.15	0.00	0.00	
	[ac-ft]	0.00	0.00	0.00	0.00	-10.67	-103.17	-327.84	-527.04	-448.66	-156.97	0.00	0.00	

Reservoir Area = 0.00 acres

Reservoir Storage and Available water Discharge for Fixed Size Storage and Land Area Projects														
Change in Reservoir Storage	[MG]	0.00	0.00	0.00	0.00	-6.95	-53.33	-93.10	-36.72	87.79	102.30	0.00	0.00	
Cumulative Active Storage	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Non-irrigated Discharge of Available water	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	87.79	102.30	0.00	0.00	190.09
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	269.43	313.95	0.00	0.00	583.38
Soil Profile Water Balance														
Beginning Soil Moisture	[in]	11.2	11.2	11.2	11.2	10.4	10.4	10.4	10.4	10.4	10.4	11.2	11.2	
Ending Soil Moisture	[in]	11.2	11.2	11.2	10.4	10.4	10.4	10.4	10.4	10.4	11.2	11.2	11.2	
Deep Percolation	[in]	6.3	4.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.7	5.8	7.5	27.8
Soil Profile Salt Balance														
Beginning Soil Salinity, ECe	[dS/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ending Soil Salinity, ECe	[dS/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

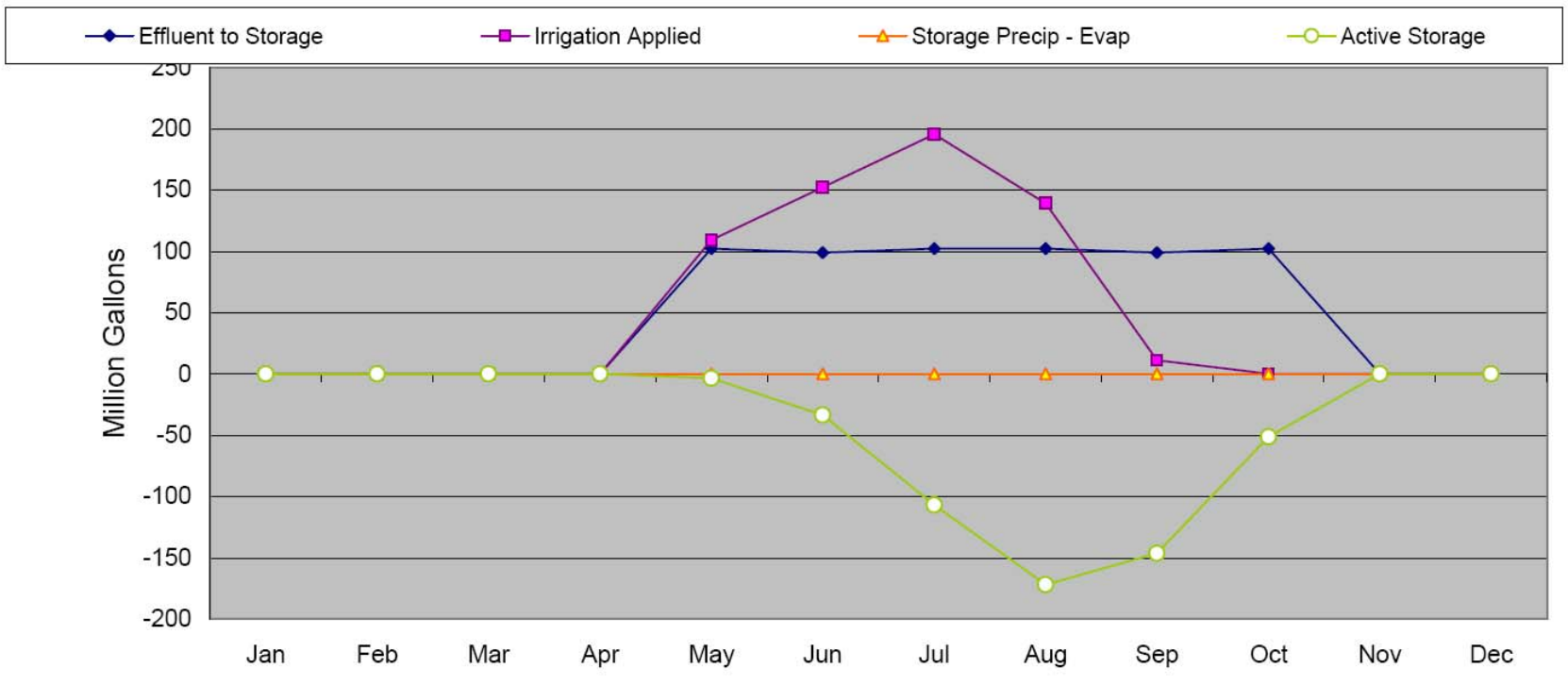
Irrigated Land = 1031.7 acres

Soil Water Storage at Field Capacity = 11.16 inches
Soil Water Storage at Permanent Wilting Point = 5.04 inches
Available Water Holding Capacity = 6.12 inches
Soil Water Storage at Minimum Management Allowed Soil Moisture = 5.04 inches

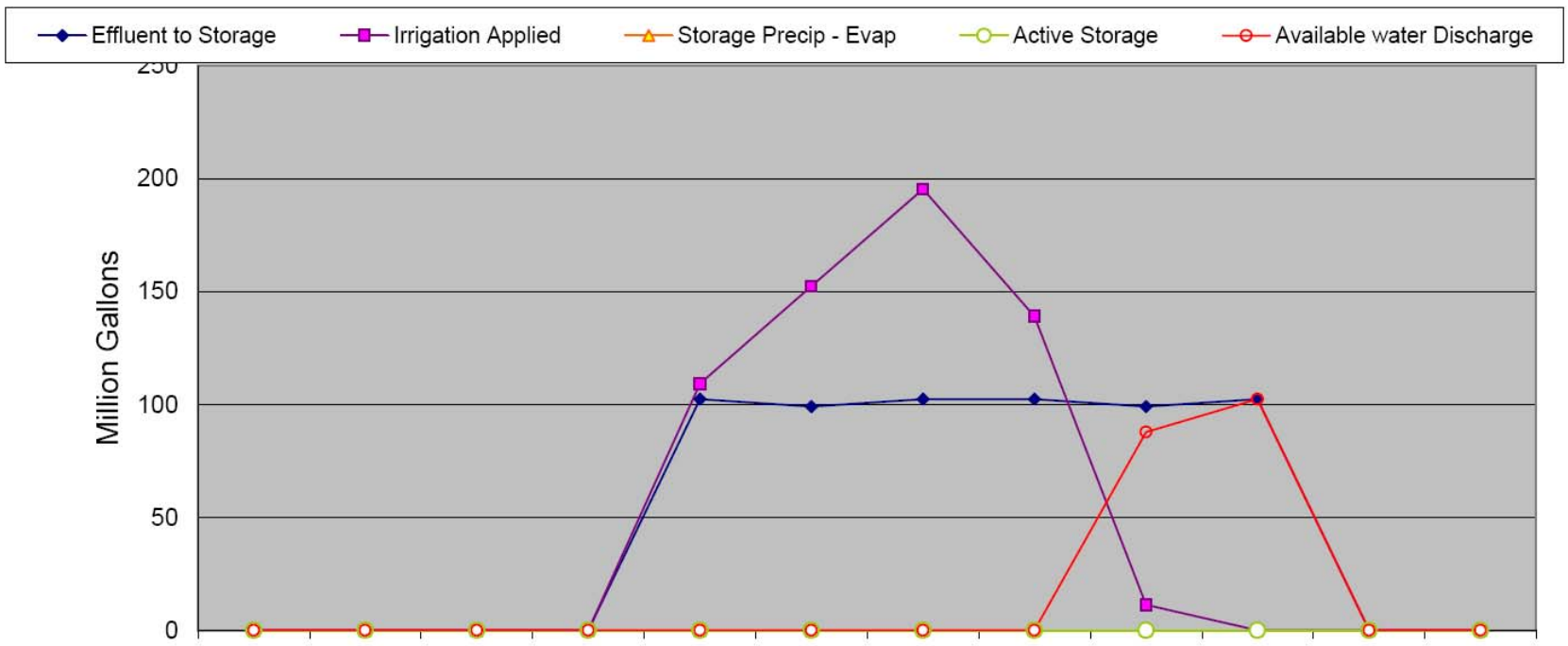
General Design Parameters

Crop Parameters			**Notes:**
Depletion Fraction	[-]	1.00	*Depletion Fraction - Average fraction of total available soil water that can be depleted from the root zone before moisture stress resulting in ET reduction occurs. Yield Response Factor - A slope factor describing the reduction in relative yield according to the reduction in ETc caused by soil water shortage. Salinity Induced Yield Reduction - A slope factor describing the reduction in relative yield according to an incremental increase in ECe for values above the threshold ECe. Threshold ECe - Electrical conductivity of the saturation extract at the threshold of ECe when crop yield first reduces below the maximum yield potential. See " Ref-Yield Response Factors" for typical values of this parameter. See "Ref-Crop Water Parameters" for typical values of the depletion fraction and maximum rooting depth. See "Ref-Crop Salt Tolerance for typical values of the salinity induced yield reduction factor and the threshold ECe.*
Rooting Depth	[ft]	3.0	
Yield Response Factor	[-]	1.00	
Salinity Induced Yield Reduction	[%/(dS/m)]	7.6	
Threshold ECe	[dS/m]	5.6	
Soil Parameters			
Field Capacity	[in/in]	0.31	*Field Capacity - Defined as the water held at a tension of 0.33 Bar. Permanent Wilting Point - Defined as the water held at a tension of 15 Bar. All water content measurements expressed in inches of water per inch of rooting depth. See " Ref-Soil Properties" for typical values of field capacity and permanent wilting point for USDA soil textures.*
Permanent Wilting Point	[in/in]	0.14	
Irrigation System Parameters			
Combined Irrigation Application Efficiency	[-]	0.80	*Combined Irrigation Application Efficiency* - (average depth of water infiltrated and retained in the root zone following irrigation) / (average depth of water applied). *See "Calc-Irrig Applic Efficiency" for guidelines on estimating.*
Storage Constraints			
Limiting Reservoir Depth	[ft]	0.00	*Limiting Reservoir Depth* - Maximum allowable depth for reservoir facilties.

RESERVOIR WATER BALANCE CHART FOR VARIABLE SIZE STORAGE FACILITIES



RESERVOIR WATER BALANCE CHART FOR FIXED SIZE STORAGE FACILITIES



ROOT ZONE WATER BALANCE CHART

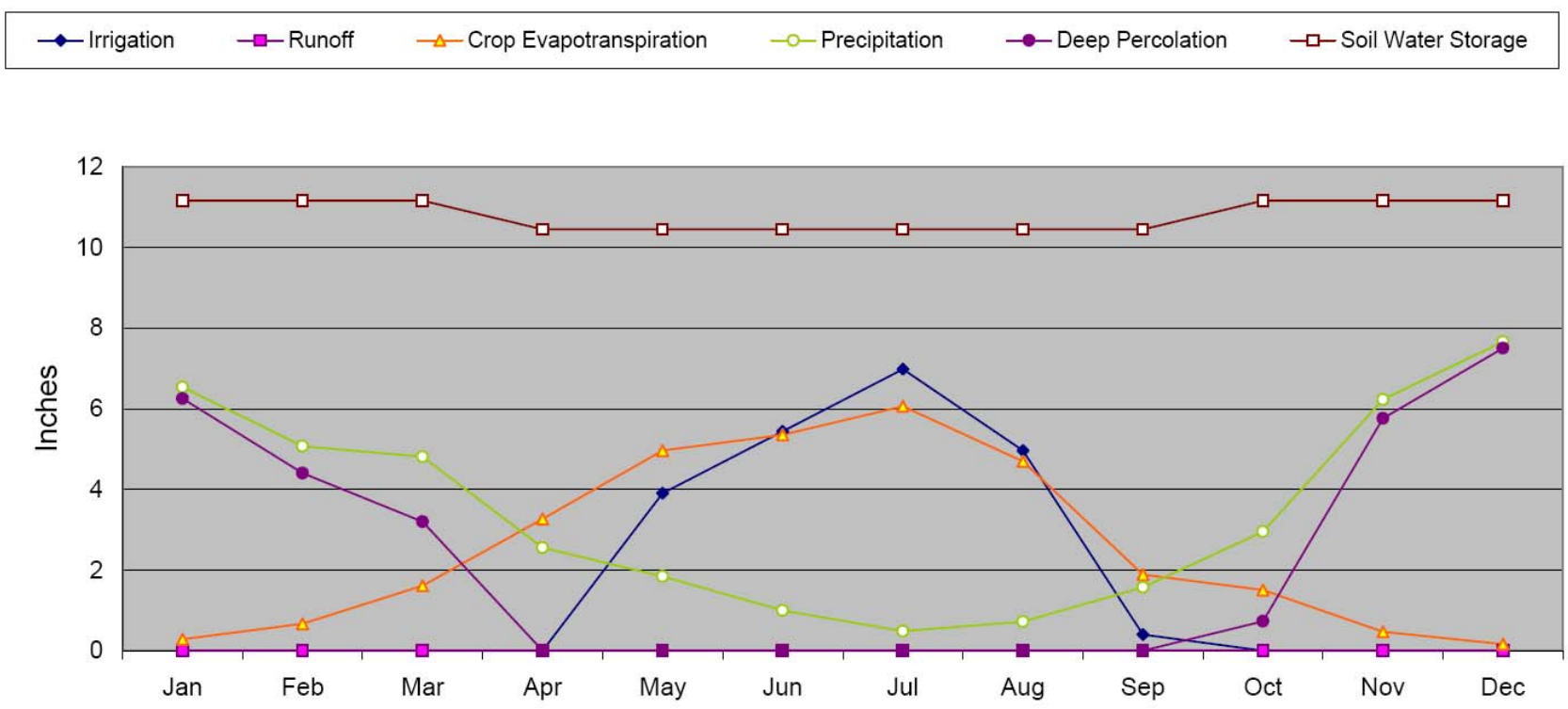


Table 1 - Root Zone Water Balance Working Model

Project Name: McMinnville
Project Number: WW irrigation:3.3 MGD,Jun-Aug

Designer: Emond
Crop: grass

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Days/Month	31	28	31	30	31	30	31	31	30	31	30	31	365
Water Supply														
Average Precipitation	[in]	6.53	5.07	4.81	2.55	1.84	1.00	0.48	0.72	1.57	2.95	6.23	7.66	41.41
% Effective Precipitation	[%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Surface Runoff	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Effective Rainfall	[in]	6.53	5.07	4.81	2.55	1.84	1.00	0.48	0.72	1.57	2.95	6.23	7.66	41.41
Actual water Flow	[in]	0.00	0.00	0.00	0.00	0.00	5.67	5.85	5.85	0.00	0.00	0.00	0.00	17.38
	[MG]	0.00	0.00	0.00	0.00	0.00	99.00	102.30	102.30	0.00	0.00	0.00	0.00	303.60
	[mgd]	0.00	0.00	0.00	0.00	0.00	3.30	3.30	3.30	0.00	0.00	0.00	0.00	
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	303.82	313.95	313.95	0.00	0.00	0.00	0.00	931.72
Available water Flow to Irrigation/Storage?	(Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Irrigation Requirements and Management														
Potential Crop Evapotranspiration	[in]	0.28	0.67	1.61	3.27	4.96	5.35	6.06	4.69	1.89	1.50	0.47	0.16	30.91
Actual Crop Evapotranspiration	[in]	0.28	0.67	1.61	3.27	4.96	4.55	5.45	4.22	1.70	1.46	0.47	0.16	28.81
Net Irrigation Requirement	[in]	0.00	0.00	0.00	0.72	3.12	4.35	5.58	3.97	0.32	0.00	0.00	0.00	18.06
Gross Irrigation Requirement	[in]	0.00	0.00	0.00	0.90	3.90	5.44	6.98	4.96	0.40	0.00	0.00	0.00	22.58
	[MG]	0.00	0.00	0.00	15.73	68.15	95.01	121.88	86.71	6.99	0.00	0.00	0.00	394.46
	[ac-ft]	0.00	0.00	0.00	48.26	209.13	291.58	374.03	266.11	21.45	0.00	0.00	0.00	1210.56
Total Irrigation Applied	[in]	0.00	0.00	0.00	0.00	0.00	5.44	6.98	4.96	0.00	0.00	0.00	0.00	17.38
	[MG]	0.00	0.00	0.00	0.00	0.00	95.01	121.88	86.71	0.00	0.00	0.00	0.00	303.60
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	291.58	374.03	266.11	0.00	0.00	0.00	0.00	931.72
Irrigation Losses	[in]	0.00	0.00	0.00	0.00	0.00	1.09	1.40	0.99	0.00	0.00	0.00	0.00	3.48
Reservoir Storage Water Balance														
Peak Precipitation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reservoir Evaporation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peak Precipitation - Reservoir Evaporation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transfer of Available water to Reservoir	[MG]	0.00	0.00	0.00	0.00	0.00	99.00	102.30	102.30	0.00	0.00	0.00	0.00	303.60
Reservoir Storage for Variable Size Storage and Land Area Projects														
Change in Reservoir Storage	[MG]	0.00	0.00	0.00	0.00	0.00	3.99	-19.58	15.59	0.00	0.00	0.00	0.00	0.00
Cumulative Active Storage	[MG]	15.59	15.59	15.59	15.59	15.59	17.58	9.79	7.79	15.59	15.59	15.59	15.59	
	[ac-ft]	47.84	47.84	47.84	47.84	47.84	53.96	30.04	23.92	47.84	47.84	47.84	47.84	

Reservoir Area = 60079.15 acres

Reservoir Storage and Available water Discharge for Fixed Size Storage and Land Area Projects														
Change in Reservoir Storage	[MG]	0.00	0.00	0.00	0.00	0.00	3.99	-19.58	15.59	0.00	0.00	0.00	0.00	
Cumulative Active Storage	[MG]	0.00	0.00	0.00	0.00	0.00	1.99	0.00	7.79	15.59	15.59	15.59	15.59	
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	6.12	0.00	23.92	47.84	47.84	47.84	47.84	
Non-irrigated Discharge of Available water	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Soil Profile Water Balance														
Beginning Soil Moisture	[in]	11.2	11.2	11.2	11.2	10.4	7.3	8.2	9.0	9.5	9.3	10.8	11.2	
Ending Soil Moisture	[in]	11.2	11.2	11.2	10.4	7.3	8.2	9.0	9.5	9.3	10.8	11.2	11.2	
Deep Percolation	[in]	6.3	4.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	7.5	26.8
Soil Profile Salt Balance														
Beginning Soil Salinity, ECe	[dS/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ending Soil Salinity, ECe	[dS/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

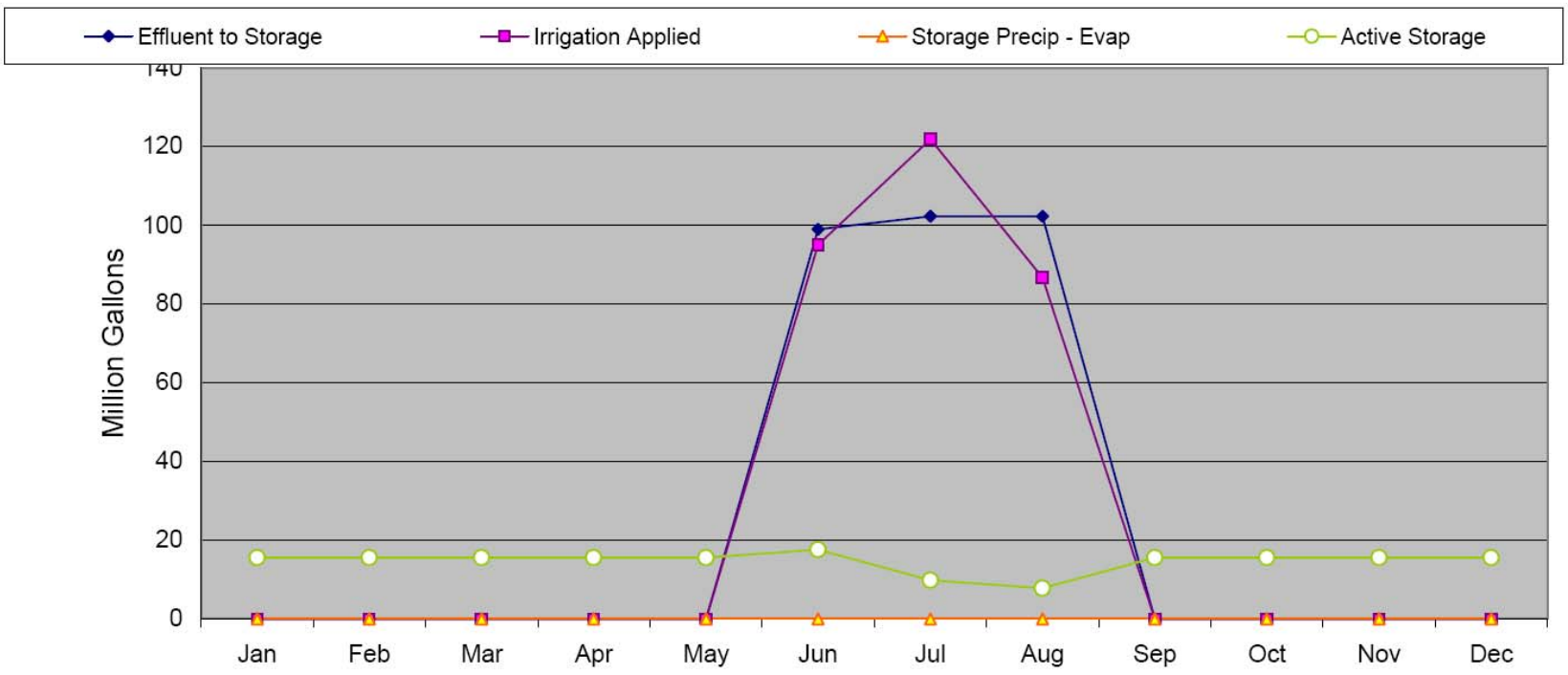
Irrigated Land = 643.5 acres

Soil Water Storage at Field Capacity = 11.16 inches
Soil Water Storage at Permanent Wilting Point = 5.04 inches
Available Water Holding Capacity = 6.12 inches
Soil Water Storage at Minimum Management Allowed Soil Moisture = 5.04 inches

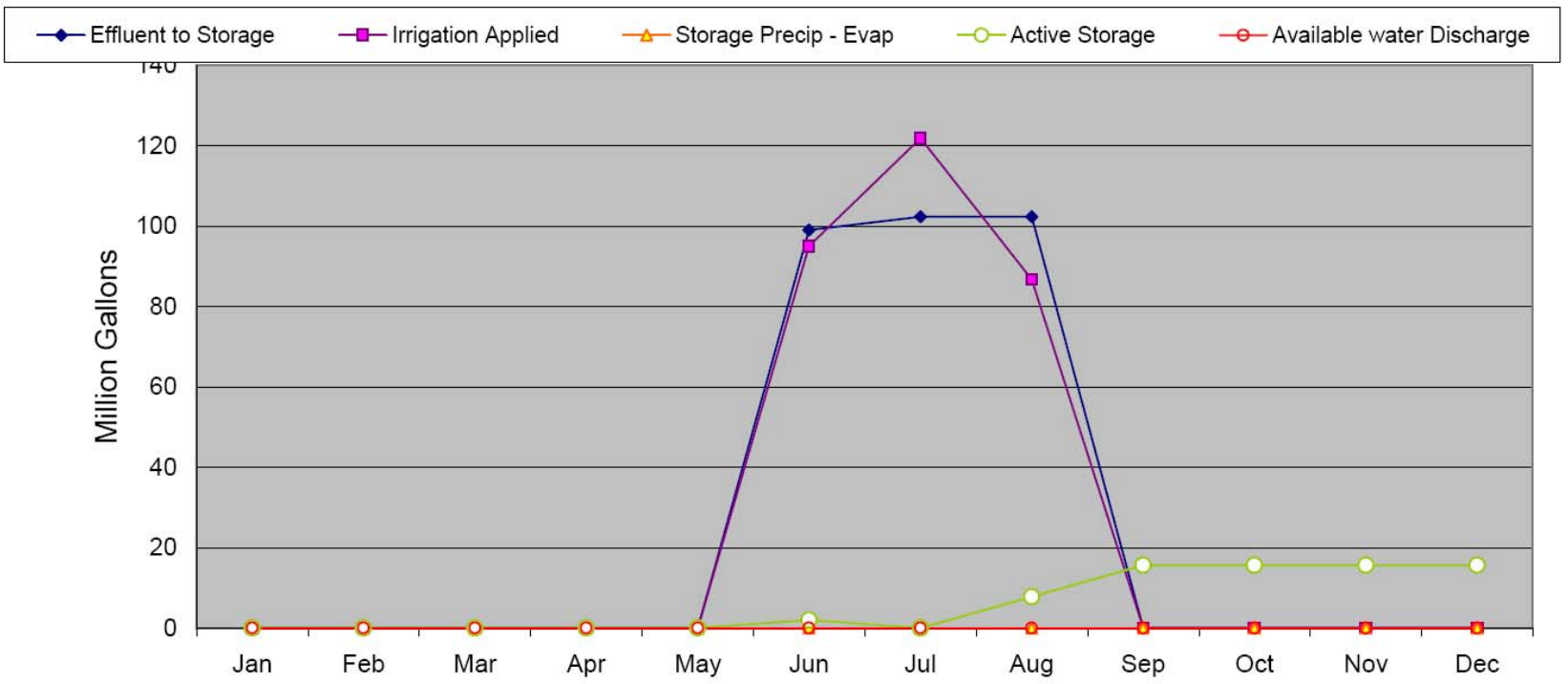
General Design Parameters

Crop Parameters			**Notes:**
Depletion Fraction	[-]	1.00	*Depletion Fraction - Average fraction of total available soil water that can be depleted from the root zone before moisture stress resulting in ET reduction occurs. Yield Response Factor - A slope factor describing the reduction in relative yield according to the reduction in ETc caused by soil water shortage. Salinity Induced Yield Reduction - A slope factor describing the reduction in relative yield according to an incremental increase in ECe for values above the threshold ECe. Threshold ECe - Electrical conductivity of the saturation extract at the threshold of ECe when crop yield first reduces below the maximum yield potential. See " Ref-Yield Response Factors" for typical values of this parameter. See "Ref-Crop Water Parameters" for typical values of the depletion fraction and maximum rooting depth. See "Ref-Crop Salt Tolerance for typical values of the salinity induced yield reduction factor and the threshold ECe.*
Rooting Depth	[ft]	3.0	
Yield Response Factor	[-]	1.00	
Salinity Induced Yield Reduction	[%/(dS/m)]	7.6	
Threshold ECe	[dS/m]	5.6	
Soil Parameters			
Field Capacity	[in/in]	0.31	*Field Capacity - Defined as the water held at a tension of 0.33 Bar. Permanent Wilting Point - Defined as the water held at a tension of 15 Bar. All water content measurements expressed in inches of water per inch of rooting depth. See " Ref-Soil Properties" for typical values of field capacity and permanent wilting point for USDA soil textures.*
Permanent Wilting Point	[in/in]	0.14	
Irrigation System Parameters			
Combined Irrigation Application Efficiency	[-]	0.80	*Combined Irrigation Application Efficiency* - (average depth of water infiltrated and retained in the root zone following irrigation) / (average depth of water applied). *See "Calc-Irrig Applic Efficiency" for guidelines on estimating.*
Storage Constraints			
Limiting Reservoir Depth	[ft]	0.00	*Limiting Reservoir Depth* - Maximum allowable depth for reservoir facilties.

RESERVOIR WATER BALANCE CHART FOR VARIABLE SIZE STORAGE FACILITIES



RESERVOIR WATER BALANCE CHART FOR FIXED SIZE STORAGE FACILITIES



ROOT ZONE WATER BALANCE CHART

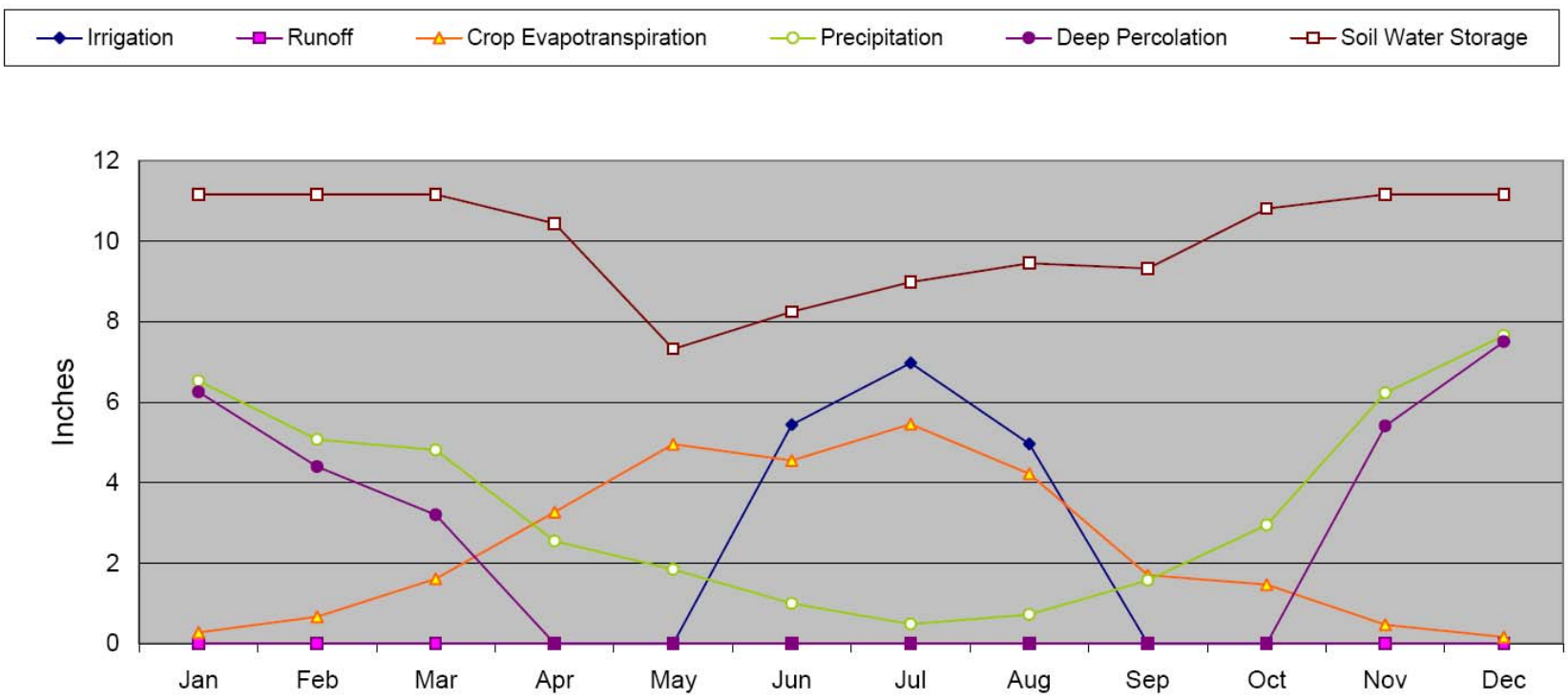


Table 1 - Root Zone Water Balance Working Model

Project Name: McMinnville — Designer: Emond
Project Number: WW irrigation:6.1MGD,May-Oct — Crop: grass

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Days/Month	31	28	31	30	31	30	31	31	30	31	30	31	365
Water Supply														
Average Precipitation	[in]	6.53	5.07	4.81	2.55	1.84	1.00	0.48	0.72	1.57	2.95	6.23	7.66	41.41
% Effective Precipitation	[%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Surface Runoff	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Effective Rainfall	[in]	6.53	5.07	4.81	2.55	1.84	1.00	0.48	0.72	1.57	2.95	6.23	7.66	41.41
Actual water Flow	[in]	0.00	0.00	0.00	0.00	3.65	3.53	3.65	3.65	3.53	3.65	0.00	0.00	21.68
	[MG]	0.00	0.00	0.00	0.00	189.10	183.00	189.10	189.10	183.00	189.10	0.00	0.00	1122.40
	[mgd]	0.00	0.00	0.00	0.00	6.10	6.10	6.10	6.10	6.10	6.10	0.00	0.00	
	[ac-ft]	0.00	0.00	0.00	0.00	580.33	561.61	580.33	580.33	561.61	580.33	0.00	0.00	3444.52
Available water Flow to Irrigation/Storage?	(Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Irrigation Requirements and Management														
Potential Crop Evapotranspiration	[in]	0.28	0.67	1.61	3.27	4.96	5.35	6.06	4.69	1.89	1.50	0.47	0.16	30.91
Actual Crop Evapotranspiration	[in]	0.28	0.67	1.61	3.27	4.96	5.35	6.06	4.69	1.89	1.50	0.47	0.16	30.91
Net Irrigation Requirement	[in]	0.00	0.00	0.00	0.72	3.12	4.35	5.58	3.97	0.32	0.00	0.00	0.00	18.06
Gross Irrigation Requirement	[in]	0.00	0.00	0.00	0.90	3.90	5.44	6.98	4.96	0.40	0.00	0.00	0.00	22.58
	[MG]	0.00	0.00	0.00	46.60	201.95	281.57	361.19	256.97	20.71	0.00	0.00	0.00	1169.00
	[ac-ft]	0.00	0.00	0.00	143.03	619.78	864.11	1108.44	788.62	63.57	0.00	0.00	0.00	3587.55
Total Irrigation Applied	[in]	0.00	0.00	0.00	0.00	3.90	5.44	6.98	4.96	0.40	0.00	0.00	0.00	21.68
	[MG]	0.00	0.00	0.00	0.00	201.95	281.57	361.19	256.97	20.71	0.00	0.00	0.00	1122.40
	[ac-ft]	0.00	0.00	0.00	0.00	619.78	864.11	1108.44	788.62	63.57	0.00	0.00	0.00	3444.52
Irrigation Losses	[in]	0.00	0.00	0.00	0.00	0.78	1.09	1.40	0.99	0.08	0.00	0.00	0.00	4.34
Reservoir Storage Water Balance														
Peak Precipitation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Reservoir Evaporation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peak Precipitation - Reservoir Evaporation	[in]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transfer of Available water to Reservoir	[MG]	0.00	0.00	0.00	0.00	189.10	183.00	189.10	189.10	183.00	189.10	0.00	0.00	1122.40
Reservoir Storage for Variable Size Storage and Land Area Projects														
Change in Reservoir Storage	[MG]	0.00	0.00	0.00	0.00	-12.85	-98.57	-172.09	-67.87	162.29	189.10	0.00	0.00	0.00
Cumulative Active Storage	[MG]	0.00	0.00	0.00	0.00	-6.43	-62.14	-197.47	-317.45	-270.24	-94.55	0.00	0.00	
	[ac-ft]	0.00	0.00	0.00	0.00	-19.72	-190.70	-606.01	-974.22	-829.35	-290.16	0.00	0.00	
Reservoir Area =	0.00 acres													
Reservoir Storage and Available water Discharge for Fixed Size Storage and Land Area Projects														
Change in Reservoir Storage	[MG]	0.00	0.00	0.00	0.00	-12.85	-98.57	-172.09	-67.87	162.29	189.10	0.00	0.00	
Cumulative Active Storage	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Non-irrigated Discharge of Available water	[MG]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	162.29	189.10	0.00	0.00	351.39
	[ac-ft]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	498.04	580.33	0.00	0.00	1078.37
Soil Profile Water Balance														
Beginning Soil Moisture	[in]	11.2	11.2	11.2	11.2	10.4	10.4	10.4	10.4	10.4	10.4	11.2	11.2	
Ending Soil Moisture	[in]	11.2	11.2	11.2	10.4	10.4	10.4	10.4	10.4	10.4	11.2	11.2	11.2	
Deep Percolation	[in]	6.3	4.4	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.7	5.8	7.5	27.8
Soil Profile Salt Balance														
Beginning Soil Salinity, ECe	[dS/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ending Soil Salinity, ECe	[dS/m]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

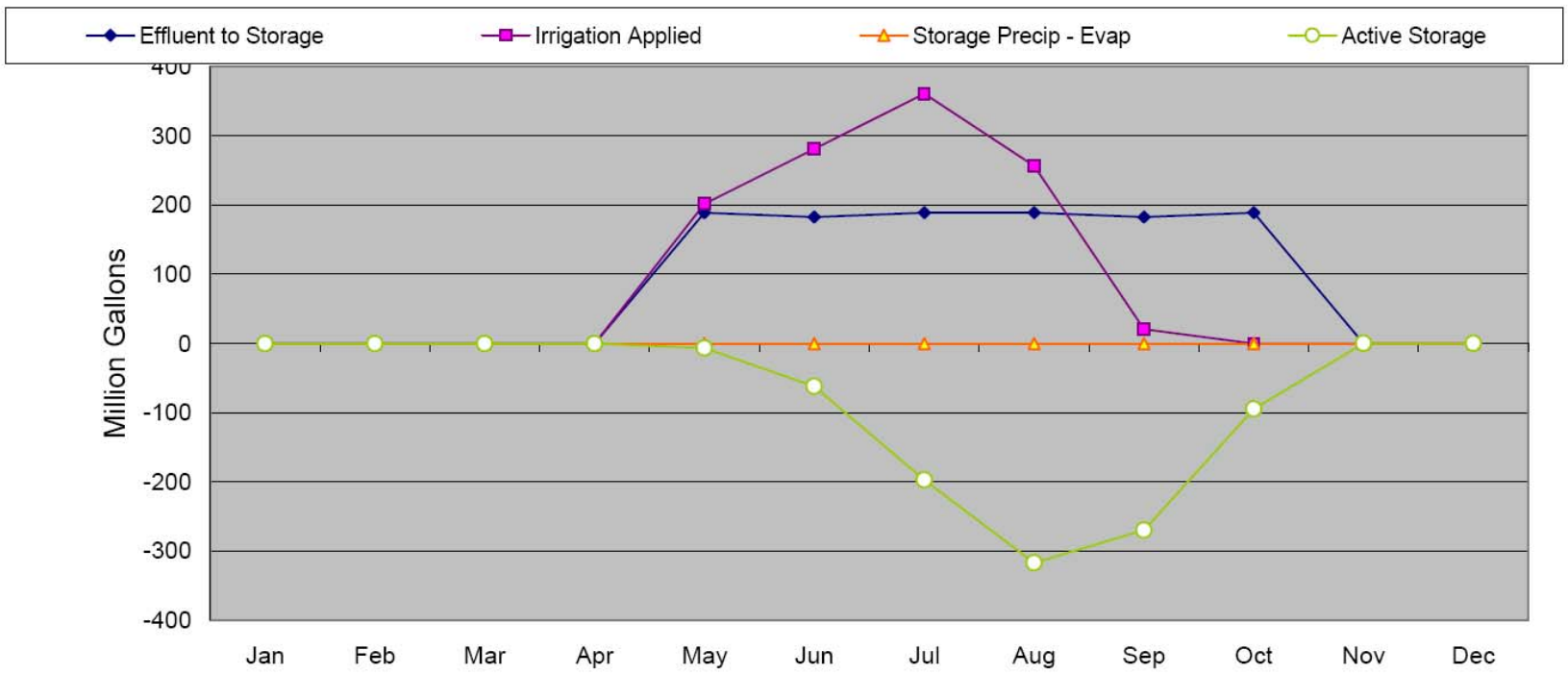
Irrigated Land = 1907.0 acres

Soil Water Storage at Field Capacity = 11.16 inches
Soil Water Storage at Permanent Wilting Point = 5.04 inches
Available Water Holding Capacity = 6.12 inches
Soil Water Storage at Minimum Management Allowed Soil Moisture = 5.04 inches

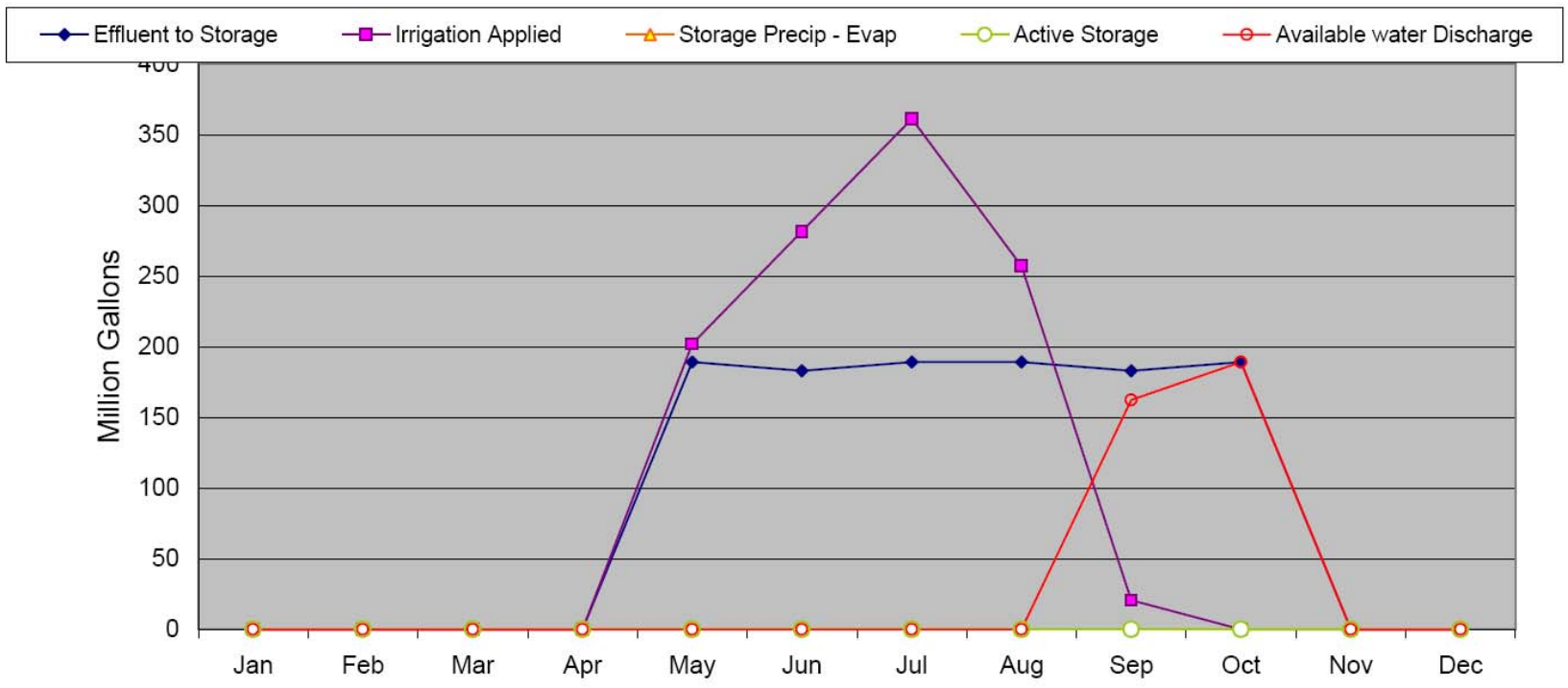
General Design Parameters

Crop Parameters			**Notes:**
Depletion Fraction	[-]	1.00	*Depletion Fraction - Average fraction of total available soil water that can be depleted from the root zone before moisture stress resulting in ET reduction occurs. Yield Response Factor - A slope factor describing the reduction in relative yield according to the reduction in ETc caused by soil water shortage. Salinity Induced Yield Reduction - A slope factor describing the reduction in relative yield according to an incremental increase in ECe for values above the threshold ECe. Threshold ECe - Electrical conductivity of the saturation extract at the threshold of ECe when crop yield first reduces below the maximum yield potential. See " Ref-Yield Response Factors" for typical values of this parameter. See "Ref-Crop Water Parameters" for typical values of the depletion fraction and maximum rooting depth. See "Ref-Crop Salt Tolerance for typical values of the salinity induced yield reduction factor and the threshold ECe.*
Rooting Depth	[ft]	3.0	
Yield Response Factor	[-]	1.00	
Salinity Induced Yield Reduction	[%/(dS/m)]	7.6	
Threshold ECe	[dS/m]	5.6	
Soil Parameters			
Field Capacity	[in/in]	0.31	*Field Capacity - Defined as the water held at a tension of 0.33 Bar. Permanent Wilting Point - Defined as the water held at a tension of 15 Bar. All water content measurements expressed in inches of water per inch of rooting depth. See " Ref-Soil Properties" for typical values of field capacity and permanent wilting point for USDA soil textures.*
Permanent Wilting Point	[in/in]	0.14	
Irrigation System Parameters			
Combined Irrigation Application Efficiency	[-]	0.80	*Combined Irrigation Application Efficiency* - (average depth of water infiltrated and retained in the root zone following irrigation) / (average depth of water applied). *See "Calc-Irrig Applic Efficiency" for guidelines on estimating.*
Storage Constraints			
Limiting Reservoir Depth	[ft]	0.00	*Limiting Reservoir Depth* - Maximum allowable depth for reservoir facilties.

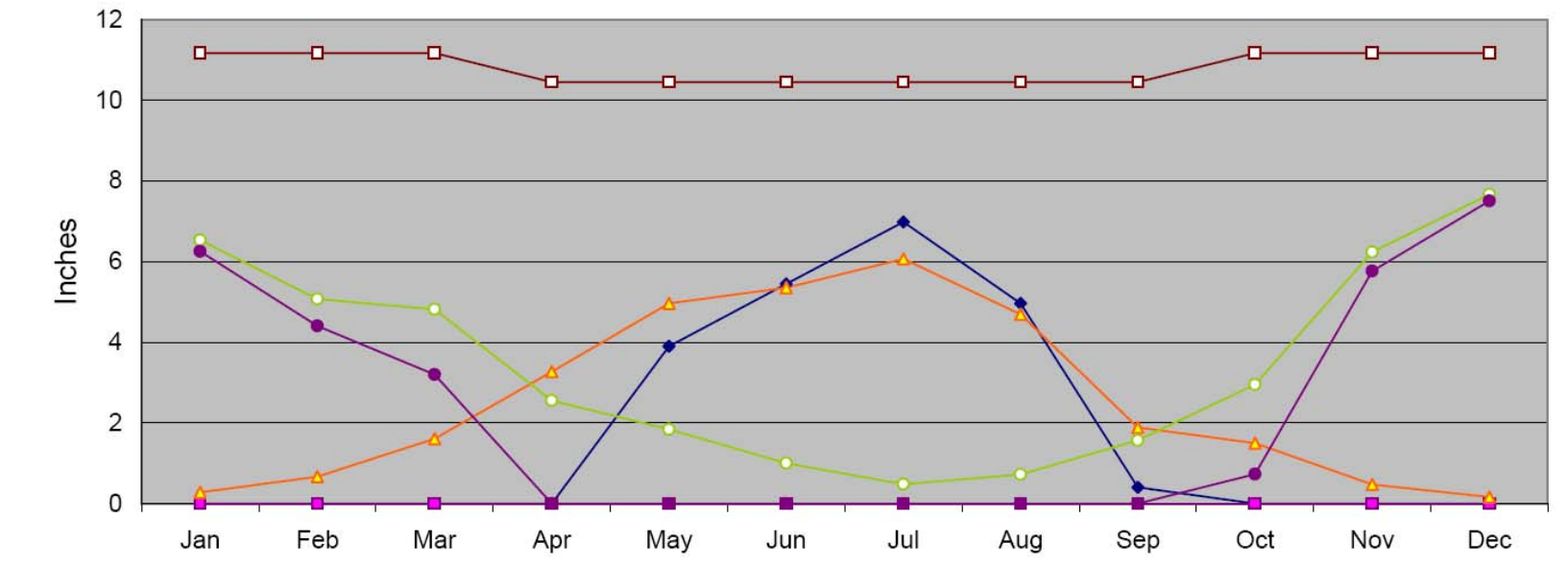
RESERVOIR WATER BALANCE CHART FOR VARIABLE SIZE STORAGE FACILITIES



RESERVOIR WATER BALANCE CHART FOR FIXED SIZE STORAGE FACILITIES



ROOT ZONE WATER BALANCE CHART



Tanks-in-Series Design Model (Wastewater Parameters)

Project Name: McMinnville reuse/wetlands
Project Number: existing avg dry weather flow & avg 2(

User inputs indicated by white boxes.
Pop-up notes indicated by red triangles.
Reference: Kadlec, R.H., and R.L. Knight. 1996. Treatment Wetlands. Boca Raton: CRC Press, Inc.

General Inflow Data

Parameter	Value	Units		
Annual Average Daily Flow	3.30	mgd	2.5	Number of representative tanks in series
Converted Flow	12,491	m^3/d		
Wastewater Temperature	20	°C		

Water Quality Characteristics

Parameter		BOD	TSS	Organic N	NH_4-N	$NO_{2/3}$-N	TN	TP	FC
Influent Concentration, mg/l	C_i =	2.00	1.86	0.72	0.18	11.68	12.58	5.00	
Average Target Effluent Conc., mg/l	C_e =	5.00	5.00		0.50	10.00		0.07	126.00
Max Month/Annual Factor		1.7	1.9	1.8	2.5	2.5	1.6	1.8	3.0
Design Target Conc., mg/L	C_d =	2.9	2.6		0.2	4.0		0.04	42.0
Wetland Background Limit, mg/l	C* =	3.61	5.40	1.5	0	0	1.5	0.02	300
Reduction fraction to target	$F_e = 1 - C_e/C_i$=	No Value	No Value	1.000	No Value	0.144	1.000	0.986	No Value
Reduction fraction to background	$F_b = 1 - C^*/C_i$ =	-0.803	-1.902	-1.083	1.000	1.000	0.881	0.996	
Areal Rate Constant, 20°C, m/y	k_{20} =	34	1000	17	18	35	22	12	75
Temperature Factor	θ =	1.00	1.065	1.05	1.04	1.09	1.05	1.00	1.00
Areal Rate Constant, m/y	k_T =	34	1000	17.0	18.0	35.0	22.0	12	75
Area required for each parameter, ac		35.0	0.3	C*>Cd	C*>Cd	43.1	C*>Cd	1947.6	2.3

Required Treatment Wetland Area

Required Treatment Wetland Area	A_{max} =	**1947.6**	acres	Displays minimum wetland area to treat all pollutants down to desired targets
		788.5	ha	
User Defined Area	A_{user} =	**18.0**	acres	User specified wetland area; leave blank if you wish to use A_{max} (above) for effluent calculations below.
		7.3	ha	

Final Effluent Concentrations and Percent Removal

Area (ha) used for Calculations = **7.3**

		BOD	TSS	Organic N	NH_4-N	$NO_{2/3}$-N	TN	TP	FC
Design Target Conc., mg/L	C_d =	2.9	2.6		0.2	4.0		0.04	42.0
Influent concentrations, mg/l	C_i =	2.0	1.9	0.7	0.2	11.7	12.6	5.00	
Effluent concentrations, mg/l	C_e =	3.6	5.4	1.5	0.0	7.1	9.5	4.16	
Percent Reduction (by concentration)		-80%	-190%	-108%	105%	40%	25%	17%	
Mass Loading (lb/day)		55	51	20	5	322	346	138	
Mass Loading (kg/ha/d)		3.4	3.2	1.2	0.3	20.0	21.6	8.6	
Mass Out (lb/day)		99	149	41	0	194	261	114	
Mass Out (kg/ha/d)		6.2	9.3	2.6	(0.0)	12.1	16.2	7.1	
Percent Reduction (by mass)		-80%	-190%	-108%	105%	40%	25%	17%	

Hydraulic Properties Based on Area and Flow

Percent Open Water	10%
Marsh Zone Depth (m)	0.3
Deep Zone Depth (m)	1.5
Volume (m3)	30607

Hydraulic Loading Rate, q	HLR =	17.1	cm/d
Nominal Hydraulic Residence Time, da	HRT =	2.5	days

Nitrogen Species Calculations

Nitrogen Models
per K&K Eqns 13-28. 13-29, 13-39:
Adapted for TIS model

DO NOT CHANGE		
$(1+k_{ON}/Nq)^{-N}$	$(1+k_{AN}/Nq)^{-N}$	$(1+k_{NN}/Nq)^{-N}$
0.773	0.762	0.604
$k_{ON}/(k_{NH3}-k_{ON})$	kAN/(kNN-kAN)	kA/(kN-kO)
17.0	1.059	1.000

Organic Nitrogen (ON)

$$C_{ON_{OUT}} = C^*_{ON} + (C_{ON_{IN}} - C^*_{ON})\left[1+\frac{k_{ON}A}{NQ}\right]^{-N}$$

Ammonia Nitrogen (AN)

$$C_{AN_{OUT}} = C^*_{AN} + (C_{AN_{IN}} - C^*_{AN})\left[1+\frac{k_{AN}A}{NQ}\right]^{-N} + \left(\frac{k_{ON}}{k_{AN}-k_{ON}}\right)(C_{ON_{IN}} - C^*_{ON})\left(\left[1+\frac{k_{ON}A}{NQ}\right]^{-N} - \left[1+\frac{k_{AN}A}{NQ}\right]^{-N}\right)$$

Nitrate Nitrogen (NN)

$$C_{NN\ OUT} = C_{NN\ IN}\left[1+\frac{k_{NN}\ A}{NQ}\right]^{-N} + \Psi\left[\begin{array}{l}\left(\frac{k_{AN}}{k_{NN}-k_{AN}}\right)C_{AN\ IN}\left(\left[1+\frac{k_{AN}\ A}{NQ}\right]^{-N} - \left[1+\frac{k_{NN}\ A}{NQ}\right]^{-N}\right) \\ +\left(\frac{k_{ON}}{k_{AN}-k_{ON}}\right)\left(\frac{k_{AN}}{k_{NN}-k_{ON}}\right)(C_{ON\ IN} - C^*_{ON})\left(\left[1+\frac{k_{ON}\ A}{NQ}\right]^{-N} - \left[1+\frac{k_{NN}\ A}{NQ}\right]^{-N}\right) \\ -\left(\frac{k_{ON}}{k_{AN}-k_{ON}}\right)\left(\frac{k_{AN}}{k_{NN}-k_{AN}}\right)(C_{ON\ IN} - C^*_{ON})\left(\left[1+\frac{k_{AN}\ A}{NQ}\right]^{-N} - \left[1+\frac{k_{NN}\ A}{NQ}\right]^{-N}\right)\end{array}\right]$$

where Ψ = fraction of ammonium nitrified, assumed to be 100% = 100%

Tanks-in-Series Design Model (Wastewater Parameters)

Project Name: McMinnville reuse/wetlands
Project Number: existing avg dry weather flow & avg 2(

User inputs indicated by white boxes.
Pop-up notes indicated by red triangles.
Reference: Kadlec, R.H., and R.L. Knight. 1996. Treatment Wetlands. Boca Raton: CRC Press, Inc.

General Inflow Data

Parameter	Value	Units		
Annual Average Daily Flow	6.10	mgd	2.5	Number of representative tanks in series
Converted Flow	23,089	m^3/d		
Wastewater Temperature	20	°C		

Water Quality Characteristics

Parameter		BOD	TSS	Organic N	NH_4-N	$NO_{2/3}$-N	TN	TP	FC
Influent Concentration, mg/l	C_i =	2.00	1.86	0.72	0.18	11.68	12.58	5.00	
Average Target Effluent Conc., mg/l	C_e =	5.00	5.00		0.50	10.00		0.07	126.00
Max Month/Annual Factor		1.7	1.9	1.8	2.5	2.5	1.6	1.8	3.0
Design Target Conc., mg/L	C_d =	2.9	2.6		0.2	4.0		0.04	42.0
Wetland Background Limit, mg/l	C* =	3.61	5.40	1.5	0	0	1.5	0.02	300
Reduction fraction to target	$F_e = 1 - C_e/C_i$=	No Value	No Value	1.000	No Value	0.144	1.000	0.986	No Value
Reduction fraction to background	$F_b = 1 - C^*/C_i$ =	-0.803	-1.902	-1.083	1.000	1.000	0.881	0.996	
Areal Rate Constant, 20°C, m/y	k_{20} =	34	1000	17	18	35	22	12	75
Temperature Factor	θ =	1.00	1.065	1.05	1.04	1.09	1.05	1.00	1.00
Areal Rate Constant, m/y	k_T =	34	1000	17.0	18.0	35.0	22.0	12	75
Area required for each parameter, ac		64.8	0.5	C*>Cd	C*>Cd	79.6	C*>Cd	3600.1	4.3

Required Treatment Wetland Area

Required Treatment Wetland Area	A_{max} =	**3600.1**	acres	Displays minimum wetland area to treat all pollutants down to desired targets
		1457.5	ha	
User Defined Area	A_{user} =	**35.0**	acres	User specified wetland area; leave blank if you wish to use A_{max} (above) for effluent calculations below.
		14.2	ha	

Final Effluent Concentrations and Percent Removal

Area (ha) used for Calculations = **14.2**

		BOD	TSS	Organic N	NH_4-N	$NO_{2/3}$-N	TN	TP	FC
Design Target Conc., mg/L	C_d =	2.9	2.6		0.2	4.0		0.04	42.0
Influent concentrations, mg/l	C_i =	2.0	1.9	0.7	0.2	11.7	12.6	5.00	
Effluent concentrations, mg/l	C_e =	3.6	5.4	1.5	0.0	6.9	9.3	4.12	
Percent Reduction (by concentration)		-80%	-190%	-108%	109%	41%	26%	18%	
Mass Loading (lb/day)		102	95	37	9	594	640	254	
Mass Loading (kg/ha/d)		3.3	3.0	1.2	0.3	19.0	20.5	8.1	
Mass Out (lb/day)		183	275	76	-1	351	476	210	
Mass Out (kg/ha/d)		5.9	8.8	2.4	(0.0)	11.2	15.2	6.7	
Percent Reduction (by mass)		-80%	-190%	-108%	109%	41%	26%	18%	

Hydraulic Properties Based on Area and Flow

Percent Open Water	10%
Marsh Zone Depth (m)	0.3
Deep Zone Depth (m)	1.5
Volume (m3)	59514

Hydraulic Loading Rate, q	HLR =	16.3	cm/d
Nominal Hydraulic Residence Time, da	HRT =	2.6	days

Nitrogen Species Calculations

DO NOT CHANGE		
$(1+k_{ON}/Nq)^{-N}$	$(1+k_{AN}/Nq)^{-N}$	$(1+k_{NN}/Nq)^{-N}$
0.763	0.751	0.589
$k_{ON}/(k_{NH3}-k_{ON})$	kAN/(kNN-kAN)	kA/(kN-kO)
17.0	1.059	1.000

Nitrogen Models
per K&K Eqns 13-28. 13-29, 13-39:
Adapted for TIS model

Organic Nitrogen (ON)

$$C_{ON_{OUT}} = C^*_{ON} + (C_{ON_{IN}} - C^*_{ON})\left[1 + \frac{k_{ON}A}{NQ}\right]^{-N}$$

Ammonia Nitrogen (AN)

$$C_{AN_{OUT}} = C^*_{AN} + (C_{AN_{IN}} - C^*_{AN})\left[1 + \frac{k_{AN}A}{NQ}\right]^{-N} + \left(\frac{k_{ON}}{k_{AN} - k_{ON}}\right)(C_{ON_{IN}} - C^*_{ON})\left(\left[1 + \frac{k_{ON}A}{NQ}\right]^{-N} - \left[1 + \frac{k_{AN}A}{NQ}\right]^{-N}\right)$$

Nitrate Nitrogen (NN)

$$C_{NN_{OUT}} = C_{NN_{IN}}\left[1 + \frac{k_{NN}A}{NQ}\right]^{-N} + \Psi\left[\begin{array}{l}\left(\frac{k_{AN}}{k_{NN} - k_{AN}}\right)C_{AN_{IN}}\left(\left[1 + \frac{k_{AN}A}{NQ}\right]^{-N} - \left[1 + \frac{k_{NN}A}{NQ}\right]^{-N}\right) \\ + \left(\frac{k_{ON}}{k_{AN} - k_{ON}}\right)\left(\frac{k_{AN}}{k_{NN} - k_{ON}}\right)(C_{ON_{IN}} - C^*_{ON})\left(\left[1 + \frac{k_{ON}A}{NQ}\right]^{-N} - \left[1 + \frac{k_{NN}A}{NQ}\right]^{-N}\right) \\ - \left(\frac{k_{ON}}{k_{AN} - k_{ON}}\right)\left(\frac{k_{AN}}{k_{NN} - k_{AN}}\right)(C_{ON_{IN}} - C^*_{ON})\left(\left[1 + \frac{k_{AN}A}{NQ}\right]^{-N} - \left[1 + \frac{k_{NN}A}{NQ}\right]^{-N}\right)\end{array}\right]$$

where Ψ = fraction of ammonium nitrified, assumed to be 100% = 100%