APPENDIX E

SRT CALCULATION, NITRIFICATION AND DENITRIFICATION CALCULATION

OBJECTIVE	SRT Calculation, Nitrification and Denitrification Calculation
PROJECT	Village of Toas Ski Valley WWTF Improvements
CALCULATED BY	KV
CHECKED BY	MAD
DATE	1/20/16

References

Ref 1 Wastewater Engineering Treatment and Reuse, Metcalf and Eddy: 4th Edition

Ref 2 Biological Wastewater Treatment, Grady,Daigger, Lim:2nd Edition

Ref3 Phosphorus and Nitrogen Removal from Municipal Wastewaterm Principles and practice, 2nd edition, Richard Sedlak

Calculations

SECTION 1 - A-BASIN DESIGN CRITERIA

DESIGN CRITERIA

A-Basin Temp, Deg C		8
pH		7.2
DO, mg/l		2
NH3 Discharge Limit, mg/L		1
A-Basin NH3, mg/L	set equal to discharge limit	1

SECTION 2 - CALCULATE SRT and REQUIRED AEROBIC BIOMASS for COMPLETE NITRIFICATION

2.A	**Calc SRT**		
	Temp Term, T	e^(0.098*(T-15))	0.50
	DO Term, DO	DO/Ko+DO), Ko=1.3	0.61
	pH term, pH	1 - 0.833*(7.2 - pH)	1.00
	Ammonia Term, NH3	NH3-N/(Kn+NH3-N)	0.85
		Kn=10^(0.051*T - 1.158)	
	Nitrifier Growth Rate, (days)^-1	.50*(T)(pH)(DO)(NH3)	0.130
	Minimum Solids Age, days	(Nitrifier Growth Rate)^-1	7.72
	Safety Factor (typ range 1.5 - 2.5x)	2	
	Design Aerobic SRT, Days	Min. Solids Age * Safety Factor	15.44
		(at optimum pH = 7.2)	
	Adopted SRT		18.00

2.B Calc Mass Aerobic Biomass

Flow, MGD Design flow/Basin		0.31
Influent BOD Conc, mg/L (no primary treatment)		350
Effluent BOD conc, mg/L		5
Influent NH3, mg/L		45
Influent TKN, mg/L- Assume99% hydrolysis to NH3		66
Effluent NH3, mg/L		1
Effluent NO3. mg/L		1
Yield TSS, lb/lb		0.6
BOD Load, lb/day /Basin	AVG BOD*Qm	905
WAS Produced, lb/day/Basin	AVG	543
Required Aerobic Mass, lb	Mass=SRT*WAS	9773

SECTION 3 - DETERMINE REQUIRED MLSS FOR COMPLETE NITRIFICATION AND A-BASIN SIZING

3.A CALC REQUIRED MLSS

Total Volume of A-Basin (aeration + MBR), MG =		0.141
Volume of Pre- anoxic. MG		0.036
Volume of Post- anoxic, MG		0.057

3.A CALC ACTIVATED SLUDGE DESIGN VARIABLES - MINIMUM REQUIREMENTS

MLSS Required for Complete Nitrif. (to Permit Limit), mg/l =		8313
BOD Space Loading @ nominal loading, lb/day - ft3 =		48.0
Hydraulic Retention Time (HRT) @ Qm , hrs =		10.9
Volatiles Fraction, fv =		0.75
F/M =		0.12
Amount of NO3 to denitrify	Nitrogen converted - Nitrogen lost in sludge	
Nitrogen lost in sludge, lb/d	7 % in VSS as nitrogen, WAS NOT destroyed = 75%, Effluent BOD 5 mg/L Ref 3	19.7
Amount of NO3 to denitrify, lb/d	Nitrogen converted-lost in sludge-	144
Amount of NO3 to denitrify, mg/L	Nitrate in effluent(1 mg/L)	56

SECTION 4 - DETERMINE AMOUNT OF NO3 DENITRIFIED

F/Mb ratio	(Q*inf. BOD)/(Vax*MLVSS)	0.482881924
Q*BOD		108500000
V*ax* *MLVSS		224692610.5

Specific Denite raate @ 20 C, from figure 8-23, Ref 1 based on F/Mb ratio	SDNR 20	0.12
Specific Denite rate@ 8 C, mg NO3/mg MLVSS	SDNR20 * (1.026)^(8-20)	0.088

Volume of Reactor, MG		0.036
Volume of reactor, L		136403.83
VSS in reactor	mg VSS	850461530.8
AX HRT	hr/day	4.54

Amount of NO3 denitrified in MLSS	mg NO3 denitrified/day	14187707
	lb NO3/day	**31**

Ref 1- Table 8-20

	10 C
y	0.17
kd	0.04
um	0.52
K	3.1
ks	12.6

Assume post-Ax SRT, d	5
Residual methanol concentration, S	=Ks(1+kd*SRT)/SRT(YK-kd)-1
	10.53658537
Ks(1+kd*SRT)	15.12
SRT(YK-kd)-1	1.435

Nitrate to be reduced, mg/l	44

bCOD/NO3-N	=2.86/(1-1.42Yn)
	3.580
Yn	=Y/(1+kd*SRT)
	0.141666667

Methanol Dose, mg/L or g/m3 as COD	166.7588568
Methanol Dose, g/L as CH3OH	111.1725712

Daily Methanol Consumption, lb/day	287.4255655