

Appendix G-3
SONIR Model Results, Proposed Project

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

SHEET 1

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

The Hills at Southampton
PDD 118 resort homes plus golf

DATA INPUT FIELD

<i>A</i>	<i>Site Recharge Parameters</i>	<i>Value</i>	<i>Units</i>	<i>B</i>	<i>Nitrogen Budget Parameters</i>	<i>Value</i>	<i>Units</i>																																																																				
1	Area of Site	591.00	acres	1	Persons per Dwelling	2.50	persons																																																																				
2	Precipitation Rate	49.90	inches	2	Nitrogen per Person per Year	10.0	lbs																																																																				
3	Acreeage of Rough/Res/Golf Landsc.	47.29	acres	3	a. Sanitary Nitrogen Leaching Rate	50%	percent																																																																				
4	Fraction of Land in above	0.080	fraction	3	b. Treated Sanitary Nitrogen Leaching Rate	90%	percent																																																																				
5	Evapotranspiration from above	23.00	inches	4	Fertilized Land (Golf Rough/Res/Golf Landsc.)	47.29	acres																																																																				
6	Runoff from above	1.05	inches	5	Fertilizer Application Rate (for above)	1.00	lbs/1000 sq ft																																																																				
7	Acreeage of Greens/Tees/Fairways	41.24	acres	6	Fertilizer Nitrogen Leaching Rate (for above)	10%	percent																																																																				
8	Fraction of above	0.070	fraction	7	Fertilized Land (Greens/Tees/Fairways)	41.24	acres																																																																				
9	Evapotranspiration from above	23.90	inches	8	Fertilizer Application Rate (for above)	2.50	lbs/1000 sq ft																																																																				
10	Runoff from above	1.05	inches	9	Fertilizer Nitrogen Leaching Rate (for above)	10%	percent																																																																				
11	Acreeage of Unvegetated/Dirt Roads	3.45	acres	10	Pet Waste Application Rate	3.19	lbs/pet																																																																				
12	Fraction of above	0.006	fraction	11	Pet Waste Nitrogen Leaching Rate	50%	percent																																																																				
13	Evapotranspiration from above	6.36	inches	12	Area of Land Irrigated	88.53	acres																																																																				
14	Runoff from above	1.05	inches	13	Irrigation Rate	21.40	inches																																																																				
15	Acreeage of Water/Ponds/Wetlands	7.25	acres	14	Irrigation Nitrogen Leaching Rate	10%	percent																																																																				
16	Fraction of Site in above	0.012	fraction	15	Nitrogen in Precipitation	0.75	mg/l																																																																				
17	Evaporation from above	30.00	inches	16	Precipitation Nitrogen Leaching Rate	15%	percent																																																																				
18	Makeup Water (if applicable)	0.00	inches	17	Nitrogen in Water Supply	2.00	mg/l																																																																				
19	Acreeage of Natural/Natural Reveg.	467.13	acres	18	Nitrogen in Sanitary Flow -1	50.00	mg/l																																																																				
20	Fraction of above	0.790	fraction	19	Nitrogen in Sanitary Flow -2	19.00	mg/l																																																																				
21	Evapotranspiration from above	23.00	inches	<table border="1"> <thead> <tr> <th><i>C</i></th> <th><i>Comments</i></th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>1)</td> <td>Please refer to user manual for data input instructions.</td> <td></td> <td></td> </tr> <tr> <td>2)</td> <td>Runoff for turfled areas increased/adjusted to 2.1% of ppt.</td> <td></td> <td></td> </tr> <tr> <td>3)</td> <td>Irrigation includes April-Oct.; based on 51,456,148 gpy; irrigation equals ET.</td> <td></td> <td></td> </tr> <tr> <td>4)</td> <td>Greens area equals 2.62 acres and does not include rain gardens.</td> <td></td> <td></td> </tr> <tr> <td>5)</td> <td>Bunkers and rain gardens are not fertilized or irrigated.</td> <td></td> <td></td> </tr> <tr> <td>6)</td> <td>Evapotranspiration from Unvegetated is 30% of ET for vegetated surfaces.</td> <td></td> <td></td> </tr> <tr> <td>7)</td> <td>Evapotranspiration from Rain Gardens is similar to other landscaping.</td> <td></td> <td></td> </tr> <tr> <td>8)</td> <td>Rain Garden runoff is adjusted to be similar to natural areas.</td> <td></td> <td></td> </tr> <tr> <td>9)</td> <td>Fertilizer nitrogen leaching rate is 10%; all landscaping maintained by GC</td> <td></td> <td></td> </tr> <tr> <td>10)</td> <td>Irrigation adjusted to increase runoff to 2.1% of ppt, and add leaching.</td> <td></td> <td></td> </tr> <tr> <td>11)</td> <td>Area of land irrigated includes all turf/landscaping, plus golf rough.</td> <td></td> <td></td> </tr> <tr> <td>12)</td> <td>Wastewater flow adjusted for maximum of 183 days/year; ensured by C&R.</td> <td></td> <td></td> </tr> <tr> <td>13)</td> <td>Rain Gardens adjusted for 70% Nitrogen removal efficiency (see Sheet 4).</td> <td></td> <td></td> </tr> <tr> <td></td> <td>Developed Area</td> <td>119.02</td> <td>20%</td> </tr> <tr> <td></td> <td>Natural/Unvegetated/Revegetated Area</td> <td>471.98</td> <td>80%</td> </tr> <tr> <td></td> <td>Total Acreage Check</td> <td>591.00</td> <td>100%</td> </tr> </tbody> </table>				<i>C</i>	<i>Comments</i>			1)	Please refer to user manual for data input instructions.			2)	Runoff for turfled areas increased/adjusted to 2.1% of ppt.			3)	Irrigation includes April-Oct.; based on 51,456,148 gpy; irrigation equals ET.			4)	Greens area equals 2.62 acres and does not include rain gardens.			5)	Bunkers and rain gardens are not fertilized or irrigated.			6)	Evapotranspiration from Unvegetated is 30% of ET for vegetated surfaces.			7)	Evapotranspiration from Rain Gardens is similar to other landscaping.			8)	Rain Garden runoff is adjusted to be similar to natural areas.			9)	Fertilizer nitrogen leaching rate is 10%; all landscaping maintained by GC			10)	Irrigation adjusted to increase runoff to 2.1% of ppt, and add leaching.			11)	Area of land irrigated includes all turf/landscaping, plus golf rough.			12)	Wastewater flow adjusted for maximum of 183 days/year; ensured by C&R.			13)	Rain Gardens adjusted for 70% Nitrogen removal efficiency (see Sheet 4).				Developed Area	119.02	20%		Natural/Unvegetated/Revegetated Area	471.98	80%		Total Acreage Check	591.00	100%
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24	Fraction of Land in above	0.039	fraction																																																																								
25	Evapotrans. from above	4.99	inches																																																																								
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28	Fraction of Land Irrigated	0.150	fraction																																																																								
29	Irrigation Rate	21.40	inches																																																																								
30	Number of Dwellings	118	units																																																																								
31	Water Use per Dwelling	300	gal/day																																																																								
32	Wastewater Design Flow (units)	0	gal/day																																																																								
33	Wastewater Design Flow (total)	41,814	gal/day																																																																								
34	Adjusted WW Design Flow (total)	20,964	gal/day																																																																								



SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

PDD 118 resort homes plus golf

SITE RECHARGE COMPUTATIONS

A Golf Rough/Res/Golf Landsc.			B Greens/Tees/Fairways				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.080	fraction	1	A = Fraction of Land in Cover Type	0.070	fraction
2	P = Precipitation Rate	49.90	inches	2	P = Precipitation Rate	49.90	inches
3	E = Evapotranspiration Rate	23.00	inches	3	E = Evapotranspiration Rate	23.90	inches
4	Q = Runoff Rate	1.05	inches	4	Q = Runoff Rate	1.05	inches
5	R(a) = P - (E + Q)	25.85	inches	5	R(b) = P - (E + Q)	24.95	inches
6	R(A) = R(a) x A	2.07	inches	6	R(B) = R(b) x A	1.74	inches

C Unvegetated/Dirt Roads			D Water/Ponds/Wetlands				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.006	fraction	1	A = Fraction of Site in Water	0.012	fraction
2	P = Precipitation Rate	49.90	inches	2	P = Precipitation Rate	49.90	inches
3	E = Evapotranspiration Rate	6.36	inches	3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	1.05	inches	4	Q = Runoff Rate	0.00	inches
5	R(c) = P - (E + Q)	42.49	inches	5	M = Makeup Water	0.00	inches
6	R(C) = R(c) x A	0.25	inches	6	R(d) = {P - (E+Q)} - M	19.90	inches
				7	R(D) = R(d) x A	0.24	inches

E Natural/Natural Revegetation			F Impervious/Paved/Roads				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.790	fraction	1	A = Fraction of Land in Cover Type	0.039	fraction
2	P = Precipitation Rate	49.90	inches	2	P = Precipitation Rate	49.90	inches
3	E = Evapotranspiration Rate	23.00	inches	3	E = Evapotranspiration Rate	4.99	inches
4	Q = Runoff Rate	0.35	inches	4	Q = Runoff Rate	0.00	inches
5	R(e) = P - (E + Q)	26.55	inches	5	R(f) = P - (E + Q)	44.91	inches
6	R(E) = R(e) x A	20.99	inches	6	R(F) = R(f) x A	1.77	inches

F Rain Gardens			H Irrigation Recharge				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.061	fraction	1	A = Fraction of Land Irrigated	0.150	fraction
2	P = Precipitation Rate	49.90	inches	2	I = Irrigation Rate	21.40	inches
3	E = Evapotranspiration Rate	23.90	inches	3	E = Evapotranspiration Rate	21.40	inches
4	Q = Runoff Rate	0.35	inches	4	Q = Runoff Rate	0.00	inches
5	R(g) = P - (E + Q)	25.65	inches	5	R(h) = I - (E + Q)	0.00	inches
6	R(G) = R(g) x A	1.56	inches	6	R(H) = R(h) x A	0.00	inches

I Wastewater Recharge			J Runoff Recharge				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	WDF = Wastewater Design Flow	20,964	gal/day	1	Q(A) = Runoff from Rough/Landscaped	0.084	inches
2	WDF = Wastewater Design Flow	1,023,067	cu ft/yr	2	Q(B) = Runoff from Tees/Fairways	0.073	inches
3	A = Area of Site	25,743,960	sq ft	3	Q(C) = Runoff from Unvegetated	0.006	inches
4	R(j) = WDF/A	0.04	feet	4	Q(E) = Runoff from Natural	0.276	inches
5	R(I) = Wastewater Recharge	0.48	inches	5	Q(H) = Runoff from Rain Gardens	0.021	inches
				6	Q(I) = Runoff from Irrigation	0.00	inches
				7	Q(tot) = Q(A)+Q(B)+Q(C)+Q(E)+Q(H)+Q(I)	0.46	inches

Total Site Recharge		
R(T) =	R(A)+R(B)+R(C)+R(D)+R(E)+R(F)+R(G)+R(H)+R(I)+R(J)+Q(tot)	
R(T) =	29.55	inches



SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

PDD 118 resort homes plus golf

SITE NITROGEN BUDGET

<i>A</i>	<i>Sanitary Nitrogen-Residential</i>	<i>Value</i>	<i>Units</i>
1	Number of Dwellings	0	units
2	Persons per Dwelling	2.50	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	10	lbs
6	N = (total: pre loss/removal)	0	lbs
7	LR = Leaching Rate	50%	percent
8	N(S) = P x N x LR	0.00	lbs
9	N = loss/removed	0.00	lbs

<i>B</i>	<i>Pet Waste Nitrogen</i>	<i>Value</i>	<i>Units</i>
1	AR = Application Rate	3.19	lbs/pet
2	Human Population	49	capita
3	Pets = 17 percent of capita	8	pets
4	N(p) = AR x pets	26.66	lbs
5	LR = Leaching Rate	50%	percent
6	N(P) = N(p) x LR	13.33	lbs
7	N = (loss/removed)	13.33	lbs

<i>C</i>	<i>Sanitary Nitrogen (Wastewater Design Flow)</i>	<i>Value</i>	<i>Units</i>
1	CF = Commercial/STP Flow	20,964	gal/day
2	CF = Commercial/STP Flow	28,962,676	liters/yr
3	N = Nitrogen (1)	50.00	mg/l
4	N = Nitrogen (1)	3193.14	lbs
5	N = Nitrogen (2)	50.00	mg/l
6	N = Nitrogen (2)	3193.14	lbs
7	LR = Leaching Rate	50%	percent
8	N(S) = CF x N x LR	724,066,904	milligrams
9	N(S) = Sanitary Nitrogen	1596.57	lbs
10	N = loss/removed	1596.57	lbs

<i>D</i>	<i>Water Supply Nitrogen (other than wastewater, if applicable)</i>	<i>Value</i>	<i>Units</i>
1	WDF = Wastewater Design Flow	0	gal/day
2	WDF = Wastewater Design Flow	0	liters/yr
3	N = Nitrogen in Water Supply	2.00	mg/l
4	N(WW) = WDF x N	0	milligrams
5	N(WW) = Wastewater Nitrogen	0.00	lbs

<i>E</i>	<i>Fertilized Land (Golf Rough/Res/Golf Landscaped)</i>	<i>Value</i>	<i>Units</i>
1	A = Area of Land Fertilized 1	2,059,952	sq ft
2	AR = Application Rate	1.00	lbs/1000 sf
3	N(T) = Nitrogen (total applied)	2059.95	lbs
4	LR = Leaching Rate	10%	percent
5	N(F1) = A x AR x LR	206.00	lbs
6	N = loss/removed	1853.96	lbs

<i>F</i>	<i>Fertilized Land (Greens/Tees/Fairways)</i>	<i>Value</i>	<i>Units</i>
1	A = Area of Land Fertilized 2	1,796,414	sq ft
2	AR = Application Rate	2.50	lbs/1000 sf
3	N(T) = Nitrogen (total applied)	4491.04	lbs
4	LR = Leaching Rate	10%	percent
5	N(F2) = A x AR x LR	449.10	lbs
6	N = loss/removed	4041.93	lbs

<i>G</i>	<i>Precipitation Nitrogen (existing condition)</i>	<i>Value</i>	<i>Units</i>
1	R(n) = Natural Recharge (feet)	2.00	feet
2	A = Area of Site (sq ft)	25,743,960	sq ft
3	R(N) = R(n) x A	51,407,339	cu ft
4	R(N) = Natural Recharge (liters)	1,455,855,846	liters
5	N = Nitrogen in Precipitation	0.75	mg/l
6	N(T) = Nitrogen (total)	2,408	lbs
7	LR = Leaching Rate	15%	percent
8	N(ppt) = R(N) x N x LR	163,783,782.67	milligrams
10	N(irr) = Irrigation Nitrogen	361.14	lbs
9	N = loss/removed	2046.48	lbs

<i>H</i>	<i>Irrigation Nitrogen</i>	<i>Value</i>	<i>Units</i>
1	R = Irrigation Recharge (inches)	0.00	inches
2	R = Irrigation Rate (feet)	0.0001	feet
3	A = Area of Land Irrigated	3,856,367	sq ft
4	R(I) = R(irr) x A	212	cu ft
5	R(I) = Site Irrigation (liters)	5,999	liters
6	N = Nitrogen in Water Supply	2.00	mg/l
7	N(T) = Nitrogen (total applied)	0.03	lbs
8	LR = Leaching Rate	10%	percent
9	N(irr) = R(I) x N x LR	1,200	milligrams
10	N(irr) = Irrigation Nitrogen	0.00	lbs
11	N = loss/removed	0.02	lbs

Total Site Nitrogen	
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)
N=	2,626.14 lbs



SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

The Hills at Southampton
PDD 118 resort homes plus golf

FINAL COMPUTATIONS

A	Nitrogen in Recharge	Value	Units
1	N = Total Nitrogen (lbs)	2,626.14	lbs
2	N = Total Nitrogen (milligrams)	1,192,269,281	milligrams
3	R(T) = Total Recharge (inches)	29.55	inches
4	R(T) = Total Recharge (feet)	2.46	feet
5	A = Area of Site	25,743,960	sq ft
6	R = R(T) x A	63,401,153	cu ft
7	R = Site Recharge Volume	1,795,520,656	liters
9	NR = N/R	0.66	mg/l

CONCENTRATION OF NITROGEN IN RECHARGE	
Pre-Mitigation	0.66

A	Nitrogen in Recharge	Value	Units
1	N = Total Nitrogen (lbs)	2,329.59	lbs
2	N = Total Nitrogen (milligrams)	1,057,635,722	milligrams
3	R(T) = Total Recharge (inches)	29.55	inches
4	R(T) = Total Recharge (feet)	2.46	feet
5	A = Area of Site	25,743,960	sq ft
6	R = R(T) x A	63,401,153	cu ft
7	R = Site Recharge Volume	1,795,520,656	liters
9	NR = N/R	0.59	mg/l

CONCENTRATION OF NITROGEN IN RECHARGE	
With Mitigation (not including well pumping)	0.59

B	Site Recharge Summary	Value	Units
1	R(T) = Total Site Recharge	0.00	inches/yr
2	R = Site Recharge Volume	63,401,153	cu ft/yr
3	R = Site Recharge Volume	474,273,594	gal/yr
4	R = Site Recharge Volume	474.27	MG/yr

MITIGATION COMPUTATIONS

M1	Reuse of Irrigation Water	Value	Units
1	IW = Reused Irrigation Water	54,795	gal/day
2	IW = Reused Irrigation Water	75,700,000	liters/yr
3	N = Nitrogen in Aquifer	15.00	mg/l
4	AF = Additional Factor (n/a)	100%	percent
5	N(IW) = IW x N x AF	1,135,500,000	milligrams
6	N(IW) = Irrigation N Reduction	2503.78	lbs

Conversions used in SONIR	
Acres x 43,560 =	Square Feet
Cubic Feet x 7.48052 =	Gallons
Cubic Feet x 28.32 =	Liters
Days x 365 =	Years
Feet x 12 =	Inches
Gallons x 0.1337 =	Cubic Feet
Gallons x 3.785 =	Liters
Grams / 1,000 =	Milligrams
Grams x 0.002205 =	Pounds
Milligrams / 1,000 =	Grams

M2	Lined Greens	Value	Units
1	A = Area of Land Fertilized 2	114,127	sq ft
2	AR = Application Rate	2.50	lbs/1000 sf
4	N(LG) = A x AR x LR	285.32	lbs
5	N(LG) = Potential Lined Greens N Reduction	285.32	lbs
6	N(LGeff) = Effective Lined Greens N Reduction	199.72	lbs (70% eff)

Mitigation Summary

M1 Reuse of Irrigation Water	2,503.78
M2 Lined Greens	199.72
M3 Rain Gardens	7.86
Total	2,711.36
Total Nitrogen	
Site Nitrogen (No Mitigation)	2,626.14
Mitigation Nitrogen	2,711.36
Adjusted Total Site Nitrogen	-85.22
Total Anthropogenic Nitrogen	
Site Nitrogen (No Mitigation)	2,265.00
Mitigation Nitrogen	2,711.36
Adjusted Total Site Nitrogen	-446.36

M3	Rain Gardens	Value	Units
1	RG = RG Recharge (inches)	0.46	inches
2	RG = RG Recharge (feet)	0.04	feet
3	A = Area of Golf Runoff (SF)	1,796,414	SF
4	RG = RG Recharge Volume (CF)	68,928	CF
5	RG = RG Recharge (Gallons/year)	515,620	gal/yr
6	RG = RG Recharge (Liters/year)	1,951,623	liters/yr
8	N = Nitrogen in Runoff (mg/l)	2.61	mg/l
9	N = Nitrogen Load (milligrams)	5,093,737	milligrams
10	N(IW) = IW x N x AF	11.23	lbs
12	N(RG) = Potential Rain Garden N Reduction	11.23	lbs
13	N(RGeff) = Effective Rain Garden N Reduction	7.86	lbs

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

The Hills at Southampton

PDD 118 resort homes plus golf

DATA INPUT FIELD

A	Site Recharge Parameters	Value	Units	B	Nitrogen Budget Parameters	Value	Units
1	Area of Site	591.00	acres	1	Persons per Dwelling	2.50	persons
2	Precipitation Rate	49.90	inches	2	Nitrogen per Person per Year	10.0	lbs
3	Acreage of Rough/Res/Golf Landsc.	47.29	acres	3	a. Sanitary Nitrogen Leaching Rate	50%	percent
4	Fraction of Land in above	0.080	fraction	3	b. Treated Sanitary Nitrogen Leaching Rate	90%	percent
5	Evapotranspiration from above	23.00	inches	4	Fertilized Land (Golf Rough/Res/Golf Landsc.)	47.29	acres
6	Runoff from above	1.05	inches	5	Fertilizer Application Rate (for above)	1.00	lbs/1000 sq ft
7	Acreage of Greens/Tees/Fairways	41.24	acres	6	Fertilizer Nitrogen Leaching Rate (for above)	10%	percent
8	Fraction of above	0.070	fraction	7	Fertilized Land (Greens/Tees/Fairways)	41.24	acres
9	Evapotranspiration from above	23.90	inches	8	Fertilizer Application Rate (for above)	2.50	lbs/1000 sq ft
10	Runoff from above	1.05	inches	9	Fertilizer Nitrogen Leaching Rate (for above)	10%	percent
11	Acreage of Unvegetated/Dirt Roads	3.45	acres	10	Pet Waste Application Rate	3.19	lbs/pet
12	Fraction of above	0.006	fraction	11	Pet Waste Nitrogen Leaching Rate	50%	percent
13	Evapotranspiration from above	6.36	inches	12	Area of Land Irrigated	88.53	acres
14	Runoff from above	1.05	inches	13	Irrigation Rate	21.40	inches
15	Acreage of Water/Ponds/Wetlands	7.25	acres	14	Irrigation Nitrogen Leaching Rate	10%	percent
16	Fraction of Site in above	0.012	fraction	15	Nitrogen in Precipitation	0.75	mg/l
17	Evaporation from above	30.00	inches	16	Precipitation Nitrogen Leaching Rate	15%	percent
18	Makeup Water (if applicable)	0.00	inches	17	Nitrogen in Water Supply	2.00	mg/l
19	Acreage of Natural/Natural Reveg.	467.13	acres	18	Nitrogen in Sanitary Flow -1	50.00	mg/l
20	Fraction of above	0.790	fraction	19	Nitrogen in Sanitary Flow -2	19.00	mg/l
21	Evapotranspiration from above	23.00	inches	C Comments 1) Please refer to user manual for data input instructions. 2) Runoff for turfed areas increased/adjusted to 2.1% of ppt. 3) Irrigation includes April-Oct.; based on 51,456,148 gpy; irrigation equals ET. 4) Greens area equals 2.62 acres and does not include rain gardens. 5) Bunkers and rain gardens are not fertilized or irrigated. 6) Evapotranspiration from Unvegetated is 30% of ET for vegetated surfaces. 7) Evapotranspiration from Rain Gardens is similar to other landscaping. 8) Rain Garden runoff is adjusted to be similar to natural areas. 9) Fertilizer nitrogen leaching rate is 10%; all landscaping maintained by GC 10) Irrigation adjusted to increase runoff to 2.1% of ppt, and add leaching. 11) Area of land irrigated includes all turf/landscaping, plus golf rough. 12) Wastewater flow adjusted for maximum of 183 days/year; ensured by C&R. 13) Rain Gardens adjusted for 70% Nitrogen removal efficiency (see Sheet 4).			
22	Runoff from above	0.35	inches				
23	Acreage of Impervious/Paved/Bldgs	23.24	acres				
24	Fraction of Land in above	0.039	fraction				
25	Evapotrans. from above	4.99	inches				
26	Runoff from Impervious	0.00	inches				
23	Acreage of Other (Rain Gardens)	1.40	acres				
24	Fraction of Land in above	0.061	fraction				
25	Evapotrans. from above	23.90	inches				
26	Runoff from above	0.35	inches				
27	Acreage of Land Irrigated	88.53	acres				
28	Fraction of Land Irrigated	0.150	fraction				
29	Irrigation Rate	21.40	inches				
30	Number of Dwellings	118	units	Developed Area	119.02	20%	
31	Water Use per Dwelling	300	gal/day	Natural/Unvegetated/Revegetated Area	471.98	80%	
32	Wastewater Design Flow (units)	0	gal/day	Total Acreage Check	591.00	100%	
33	Wastewater Design Flow (total)	41,814	gal/day				
34	Adjusted WW Design Flow (total)	20,964	gal/day				



SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

PDD 118 resort homes plus golf

SITE RECHARGE COMPUTATIONS

<i>A Golf Rough/Res/Golf Landsc.</i>			<i>B Greens/Tees/Fairways</i>				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.080	fraction	1	A = Fraction of Land in Cover Type	0.070	fraction
2	P = Precipitation Rate	49.90	inches	2	P = Precipitation Rate	49.90	inches
3	E = Evapotranspiration Rate	23.00	inches	3	E = Evapotranspiration Rate	23.90	inches
4	Q = Runoff Rate	1.05	inches	4	Q = Runoff Rate	1.05	inches
5	R(a) = P - (E + Q)	25.85	inches	5	R(b) = P - (E + Q)	24.95	inches
6	R(A) = R(a) x A	2.07	inches	6	R(B) = R(b) x A	1.74	inches

<i>C Unvegetated/Dirt Roads</i>			<i>D Water/Ponds/Wetlands</i>				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.006	fraction	1	A = Fraction of Site in Water	0.012	fraction
2	P = Precipitation Rate	49.90	inches	2	P = Precipitation Rate	49.90	inches
3	E = Evapotranspiration Rate	6.36	inches	3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	1.05	inches	4	Q = Runoff Rate	0.00	inches
5	R(c) = P - (E + Q)	42.49	inches	5	M = Makeup Water	0.00	inches
6	R(C) = R(c) x A	0.25	inches	6	R(d) = {P - (E+Q)} - M	19.90	inches
				7	R(D) = R(d) x A	0.24	inches

<i>E Natural/Natural Revegetation</i>			<i>F Impervious/Paved/Roads</i>				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.790	fraction	1	A = Fraction of Land in Cover Type	0.039	fraction
2	P = Precipitation Rate	49.90	inches	2	P = Precipitation Rate	49.90	inches
3	E = Evapotranspiration Rate	23.00	inches	3	E = Evapotranspiration Rate	4.99	inches
4	Q = Runoff Rate	0.35	inches	4	Q = Runoff Rate	0.00	inches
5	R(e) = P - (E + Q)	26.55	inches	5	R(f) = P - (E + Q)	44.91	inches
6	R(E) = R(e) x A	20.99	inches	6	R(F) = R(f) x A	1.77	inches

<i>F Rain Gardens</i>			<i>H Irrigation Recharge</i>				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	A = Fraction of Land in Cover Type	0.061	fraction	1	A = Fraction of Land Irrigated	0.150	fraction
2	P = Precipitation Rate	49.90	inches	2	I = Irrigation Rate	21.40	inches
3	E = Evapotranspiration Rate	23.90	inches	3	E = Evapotranspiration Rate	21.40	inches
4	Q = Runoff Rate	0.35	inches	4	Q = Runoff Rate	0.00	inches
5	R(g) = P - (E + Q)	25.65	inches	5	R(h) = I - (E + Q)	0.00	inches
6	R(G) = R(g) x A	1.56	inches	6	R(H) = R(h) x A	0.00	inches

<i>I Wastewater Recharge</i>			<i>J Runoff Recharge</i>				
	<i>Value</i>	<i>Units</i>		<i>Value</i>	<i>Units</i>		
1	WDF = Wastewater Design Flow	20,964	gal/day	1	Q(A) = Runoff from Rough/Landscaped	0.084	inches
2	WDF = Wastewater Design Flow	1,023,067	cu ft/yr	2	Q(B) = Runoff from Tees/Fairways	0.073	inches
3	A = Area of Site	25,743,960	sq ft	3	Q(C) = Runoff from Unvegetated	0.006	inches
4	R(j) = WDF/A	0.04	feet	4	Q(E) = Runoff from Natural	0.276	inches
5	R(I) = Wastewater Recharge	0.48	inches	5	Q(H) = Runoff from Rain Gardens	0.021	inches
				6	Q(I) = Runoff from Irrigation	0.00	inches
				7	Q(tot) = Q(A)+Q(B)+Q(C)+Q(E)+Q(H)+Q(I)	0.46	inches

Total Site Recharge		
R(T) =	R(A)+R(B)+R(C)+R(D)+R(E)+R(F)+R(G)+R(H)+R(I)+R(J)+Q(tot)	
R(T) =	29.55	inches



SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

PDD 118 resort homes plus golf

SITE NITROGEN BUDGET

<i>A</i>	<i>Sanitary Nitrogen-Residential</i>	<i>Value</i>	<i>Units</i>
1	Number of Dwellings	0	units
2	Persons per Dwelling	2.50	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	10	lbs
6	N = (total: pre loss/removal)	0	lbs
7	LR = Leaching Rate	50%	percent
8	N(S) = P x N x LR	0.00	lbs
9	N = loss/removed	0.00	lbs

<i>B</i>	<i>Pet Waste Nitrogen</i>	<i>Value</i>	<i>Units</i>
1	AR = Application Rate	3.19	lbs/pet
2	Human Population	49	capita
3	Pets = 17 percent of capita	8	pets
4	N(p) = AR x pets	26.66	lbs
5	LR = Leaching Rate	50%	percent
6	N(P) = N(p) x LR	13.33	lbs
7	N = (loss/removed)	13.33	lbs

<i>C</i>	<i>Sanitary Nitrogen (Wastewater Design Flow)</i>		
1	CF = Commercial/STP Flow	20,964	gal/day
2	CF = Commercial/STP Flow	28,962,676	liters/yr
3	N = Nitrogen (1)	19.00	mg/l
4	N = Nitrogen (1)	1213.39	lbs
5	N = Nitrogen (2)	19.00	mg/l
6	N = Nitrogen (2)	1213.39	lbs
7	LR = Leaching Rate	50%	percent
8	N(S) = CF x N x LR	275,145,424	milligrams
9	N(S) = Sanitary Nitrogen	606.70	lbs
10	N = loss/removed	606.70	lbs

<i>D</i>	<i>Water Supply Nitrogen (other than wastewater, if applicable)</i>		
1	WDF = Wastewater Design Flow	0	gal/day
2	WDF = Wastewater Design Flow	0	liters/yr
3	N = Nitrogen in Water Supply	2.00	mg/l
4	N(WW) = WDF x N	0	milligrams
5	N(WW) = Wastewater Nitrogen	0.00	lbs

<i>E</i>	<i>Fertilized Land (Golf Rough/Res/Golf Landscaped)</i>		
1	A = Area of Land Fertilized 1	2,059,952	sq ft
2	AR = Application Rate	1.00	lbs/1000 sf
3	N(T) = Nitrogen (total applied)	2059.95	lbs
4	LR = Leaching Rate	10%	percent
5	N(F1) = A x AR x LR	206.00	lbs
6	N = loss/removed	1853.96	lbs

<i>F</i>	<i>Fertilized Land (Greens/Tees/Fairways)</i>		
1	A = Area of Land Fertilized 2	1,796,414	sq ft
2	AR = Application Rate	2.50	lbs/1000 sf
3	N(T) = Nitrogen (total applied)	4491.04	lbs
4	LR = Leaching Rate	10%	percent
5	N(F2) = A x AR x LR	449.10	lbs
6	N = loss/removed	4041.93	lbs

<i>G</i>	<i>Precipitation Nitrogen (existing condition)</i>		
1	R(n) = Natural Recharge (feet)	2.00	feet
2	A = Area of Site (sq ft)	25,743,960	sq ft
3	R(N) = R(n) x A	51,407,339	cu ft
4	R(N) = Natural Recharge (liters)	1,455,855,846	liters
5	N = Nitrogen in Precipitation	0.75	mg/l
6	N(T) = Nitrogen (total)	2,408	lbs
7	LR = Leaching Rate	15%	percent
8	N(ppt) = R(N) x N x LR	163,783,782.67	milligrams
10	N(irr) = Irrigation Nitrogen	361.14	lbs
9	N = loss/removed	2046.48	lbs

<i>H</i>	<i>Irrigation Nitrogen</i>		
1	R = Irrigation Recharge (inches)	0.00	inches
2	R = Irrigation Rate (feet)	0.0001	feet
3	A = Area of Land Irrigated	3,856,367	sq ft
4	R(I) = R(irr) x A	212	cu ft
5	R(I) = Site Irrigation (liters)	5,999	liters
6	N = Nitrogen in Water Supply	2.00	mg/l
7	N(T) = Nitrogen (total applied)	0.03	lbs
8	LR = Leaching Rate	10%	percent
9	N(irr) = R(I) x N x LR	1,200	milligrams
10	N(irr) = Irrigation Nitrogen	0.00	lbs
11	N = loss/removed	0.02	lbs

Total Site Nitrogen		
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)	
N=	1,636.27	lbs



SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

The Hills at Southampton
PDD 118 resort homes plus golf

FINAL COMPUTATIONS

A	Nitrogen in Recharge	Value	Units
1	N = Total Nitrogen (lbs)	1,636.27	lbs
2	N = Total Nitrogen (milligrams)	742,867,455	milligrams
3	R(T) = Total Recharge (inches)	29.55	inches
4	R(T) = Total Recharge (feet)	2.46	feet
5	A = Area of Site	25,743,960	sq ft
6	R = R(T) x A	63,401,153	cu ft
7	R = Site Recharge Volume	1,795,520,656	liters
9	NR = N/R	0.41	mg/l

CONCENTRATION OF NITROGEN IN RECHARGE	
Pre-Mitigation	0.41

A	Nitrogen in Recharge	Value	Units
1	N = Total Nitrogen (lbs)	1,339.72	lbs
2	N = Total Nitrogen (milligrams)	608,233,896	milligrams
3	R(T) = Total Recharge (inches)	29.55	inches
4	R(T) = Total Recharge (feet)	2.46	feet
5	A = Area of Site	25,743,960	sq ft
6	R = R(T) x A	63,401,153	cu ft
7	R = Site Recharge Volume	1,795,520,656	liters
9	NR = N/R	0.34	mg/l

CONCENTRATION OF NITROGEN IN RECHARGE	
With Mitigation (not including well pumping)	0.34

B	Site Recharge Summary	Value	Units
1	R(T) = Total Site Recharge	0.00	inches/yr
2	R = Site Recharge Volume	63,401,153	cu ft/yr
3	R = Site Recharge Volume	474,273,594	gal/yr
4	R = Site Recharge Volume	474.27	MG/yr

MITIGATION COMPUTATIONS

M1	Reuse of Irrigation Water	Value	Units
1	IW = Reused Irrigation Water	54,795	gal/day
2	IW = Reused Irrigation Water	75,700,000	liters/yr
3	N = Nitrogen in Aquifer	15.00	mg/l
4	AF = Additional Factor (n/a)	100%	percent
5	N(IW) = IW x N x AF	1,135,500,000	milligrams
6	N(IW) = Irrigation N Reduction	2503.78	lbs

Conversions used in SONIR	
Acres x 43,560 =	Square Feet
Cubic Feet x 7.48052 =	Gallons
Cubic Feet x 28.32 =	Liters
Days x 365 =	Years
Feet x 12 =	Inches
Gallons x 0.1337 =	Cubic Feet
Gallons x 3.785 =	Liters
Grams / 1,000 =	Milligrams
Grams x 0.002205 =	Pounds
Milligrams / 1,000 =	Grams

M2	Lined Greens	Value	Units
1	A = Area of Land Fertilized 2	114,127	sq ft
2	AR = Application Rate	2.50	lbs/1000 sf
4	N(LG) = A x AR x LR	285.32	lbs
5	N(LG) = Potential Lined Greens N Reduction	285.32	lbs
6	N(LGeff) = Effective Lined Greens N Reduction	199.72	lbs (70% eff)

Mitigation Summary

M1 Reuse of Irrigation Water	2,503.78
M2 Lined Greens	199.72
M3 Rain Gardens	7.86
Total	2,711.36
Total Nitrogen	
Site Nitrogen (No Mitigation)	1,636.27
Mitigation Nitrogen	2,711.36
Adjusted Total Site Nitrogen	-1,075.09
Total Anthropogenic Nitrogen	
Site Nitrogen (No Mitigation)	1,275.13
Mitigation Nitrogen	2,711.36
Adjusted Total Site Nitrogen	-1,436.23

M3	Rain Gardens	Value	Units
1	RG = RG Recharge (inches)	0.46	inches
2	RG = RG Recharge (feet)	0.04	feet
3	A = Area of Golf Runoff (SF)	1,796,414	SF
4	RG = RG Recharge Volume (CF)	68,928	CF
5	RG = RG Recharge (Gallons/year)	515,620	gal/yr
6	RG = RG Recharge (Liters/year)	1,951,623	liters/yr
8	N = Nitrogen in Runoff (mg/l)	2.61	mg/l
9	N = Nitrogen Load (milligrams)	5,093,737	milligrams
10	N(IW) = IW x N x AF	11.23	lbs
12	N(RG) = Potential Rain Garden N Reduction	11.23	lbs
13	N(RGeff) = Effective Rain Garden N Reduction	7.86	lbs (70% eff)