APPENDIX B

GROUNDWATER IMPACT ANALYSIS MATERIALS

Appendix B-1
SONIR Model Users Guide

SONIR MODEL USER'S GUIDE

Simulation of Nitrogen in Recharge (SONIR)
Nelson, Pope & Voorhis, LLC Microcomputer Model

INTRODUCTION

SONIR is a microcomputer model developed by Charles J. Voorhis, CEP, AICP for use by Nelson, Pope & Voorhis, LLC in order to simulate the hydrologic water budget of a site and determine total nitrogen and nitrogen present in recharge in connection with land use projects. The model was developed on the Microsoft Excel Spreadsheet (trademark of Microsoft Products) for IBM (trademark of International Business Machines, Inc.) or compatible Personal Computers capable of running Excel.

Nitrogen has been identified as a source of contamination primarily from sanitary discharge and lawn fertilization. Nitrogen is of concern as a drinking water contaminant, and there is an established health limit of 10 milligrams per liter (mg/l) in drinking water. Nitrogen is also of concern in surface water, as it is a nutrient that when present in high concentrations can cause algal blooms, resulting in biological oxygen demand as algae is biologically decomposed. Depleted oxygen in surface waters causes conditions unfavorable to fish species and can result in extremely undesirable aesthetic impacts, primarily related to odors. Accordingly, it is necessary to understand the concentration of nitrogen recharge as related to a proposed site development.

Utilizing a mass-balance concept, and applying known hydrologic facts and basic assumptions, it is possible to predict the concentration of nitrogen in recharge to the shallow aquifer underlying a given site. This prediction can in turn be used to determine impacts and significance of impacts in consideration of hydrogeologic factors. Similar techniques have been used to simulate nitrogen in recharge as published by the New York State Water Resources Institute, Center for Environmental Research at Cornell University, Ithaca, New York (**Hughes and Pacenka, 1985**). SONIR is intended to provide a more versatile model based upon the BURBS Mass-Balance concept. SONIR allows for use of the model to predict nitrogen impact from many sources including sewage treatment plants, and further allows for determination of a wider variety site recharge components under the hydrologic water budget section. SONIR has more versatility in the input of information, and also provides a printout of each step performed by the model, in order for regulatory agencies and review entities to understand how values are derived.

This text describes in detail the definition of terms, supported by referenced information regarding input of data for the simulation. The concept of determining the concentration of nitrogen in recharge involves a predication of the weight of nitrogen introduced to the site, as compared to the quantity of recharge resulting from precipitation and wastewater water discharge. Losses due to evapotranspiration and runoff must be accounted for in the simulation. The values and relationship associated with these parameters determines the quantity of recharge that enters the site. The prediction is generally annualized due to the availability of average

annual hydrologic data; however, data input can be determined on a seasonal basis if information is available.

The model includes four (4) data sheets identified as follows:

* Data Input Field - Sheet 1
* Site Recharge Computations - Sheet 2
* Site Nitrogen Budget - Sheet 3
* Nitrogen in Recharge Output Field - Sheet 4

All information required by the model is input in Sheet 1 - Data Input Field. Sheets 2 and 3 utilize data from Sheet 1 to compute the Site Recharge and the Site Nitrogen Budget. Sheet 4 utilizes the total values from Sheets 2 and 3 to perform the final Nitrogen in Recharge computations. Sheet 4 also includes tabulations of all conversion factors utilized in the model.

It should be noted that the simulation is only as accurate as the data which is input into the model. An understanding of hydrologic principles is necessary to determine and justify much of the data inputs used for water budget parameters. Further principles of environmental science and engineering are applied in determining nitrogen sources, application and discharge rates, degradation and losses, and final recharge. Users must apply caution in arriving at assumptions in order to ensure justifiable results.

SITE RECHARGE COMPUTATIONS

Overview

SONIR utilizes the basic hydrologic equation for determining the quantity of recharge anticipated by subtracting recharge losses from total precipitation. The quantity of recharge resulting from a given site is determined using the hydrologic budget equation **(Koszalka, 1984; p. 19):**

$$R = P - (E + Q)$$

where:

R = recharge
P = precipitation
E = evapotranspiration
Q = overland runoff

The quantity of recharge must be determined for each type of land use existing on a site, in order to determine the resultant site recharge. Surfaces commonly considered include: impervious surfaces; turfed areas; and natural areas; however, SONIR allows for a variety of land cover types to be considered in the model. In addition, site recharge occurs as a result of irrigation and wastewater discharge. In cases where water is imported to a site via a public water system, this quantity of recharge must be considered as additional water recharged on site. SONIR allows for all of these recharge components to be included in the simulation. Many sites have fresh surface

water in the form of lakes and ponds. Precipitation falls upon these surfaces; however, such features generally act as a mechanism for water loss as a result of evaporation. SONIR includes a Water Area Loss component in determining the site Hydrologic Water Budget and in computing recharge nitrogen.

Data Input - Sheet 1

The following provides a discussion of data sources and assumptions associated with the hydrologic water budget, corresponding to the Data Input Field in Sheet 1 of SONIR:

1. *Area of Site* - The total area of the site (in acres) that is capable of recharging precipitation is entered in this data cell. For sites that include tidal wetlands, the area that is inundated by tidal waters should be excluded, as recharge from these areas should not be considered in the context of nitrogen simulation. For sites that include surface water, the area can be included, provided evaporative water loss from surface water is considered by entering the acreage of surface water in Data Cell 15 noted below.

2. *Precipitation Rate* - Precipitation in the form of rainfall and snowmelt is determined using long-term recorded values from local weather stations. Cornell University maintains the Northeast Regional Climate Center, from which long-term precipitation data for Long Island weather stations is available. Monthly precipitation averages are published for the period 1951-1980 in Thornthwaite and Mather's Climatic Water Budget Method **(Snowden and Pacenka, 1985).** A tabulation of monthly and annual precipitation averages excerpted from this reference is included in the table cited for Evapotranspiration values. Data entry is in inches.

3. *Acreage of Lawn* - The total area of lawn (in acres) is entered in this Data Cell. This area includes all lawn area whether it is irrigated, fertilized or unmaintained. If there is no lawn area, a value of zero (0) is entered.

4. *Fraction of Land in Lawn* - No entry need be made in this Data Cell. SONIR will compute the Fraction of Land in Lawn by dividing the lawn area by total area.

5. *Evapotranspiration from Lawn* - Evapotranspiration is the natural water loss attributed to evaporation and plant utilization. Rainwater that is evaporated and transpired by plants is returned to the atmosphere as vapor. There are various methods for determining evapotranspiration, including direct measure and calculation. A commonly recognized method is the Thornthwaite and Mather Climatic Water Budget Method. Evapotranspiration rates for various locations on Long Island have been determined by the U.S. Geological Survey, as documented in: "Ground-Water-Recharge Rates in Nassau and Suffolk Counties, New York" **(Peterson, 1987; p. 10).** The following general rates as a percent of total precipitation are excerpted from that reference:

Location	Soil Type	Vegetation	ET (in)	ET (%)
Bridgehampton	sandy loam	shallow root	21.2	46.6
	silt loam	shallow root	21.4	47.2
LaGuardia	sand	shallow root	24.2	52.9
	clay loam	shallow root	25.4	55.5
	sandy loam	moderate root	26.2	57.2
JFK Airport	sand	shallow root	22.5	53.8
	clay loam	shallow root	23.9	57.3
	sandy loam	moderate root	25.0	60.0
Mineola	sand	shallow root	22.4	47.8
	sand-silt	shallow root	23.8	51.0
	sandy loam	moderate root	25.1	53.7
	sandy loam	orchards	25.5	54.5
Patchogue	fine sand	mature forest	25.5	53.5
Riverhead	sandy loam	shallow root	22.4	49.3
		orchards	24.8	54.7
Setauket	sandy loam	mature forest	26.8	57.9
Upton	silt loam	deep root	23.9	48.4
	sandy loam	moderate root	23.0	46.5

6. *Runoff from Lawn* - Runoff is the quantity of water that travels overland during a precipitation event. Soil infiltration capacity is the critical factor in determining runoff; however, factors such as slope and vegetation also determine runoff characteristics to a lesser extent on Long Island because of soil conditions. Less urbanized areas of Long Island with characteristically dry soils with groundcover will have a low runoff percentage as a function of total precipitation, as compared to the more urbanized portions of western Long Island. Peterson **(1984; p. 14)** estimates runoff as a percent of total precipitation for Nassau County (2.1 percent); Suffolk County (0.7 percent), and Long Island in general (1.0 percent). If an average precipitation rate of 45 inches per year is assumed, runoff will vary from 0.31 to 0.94 inches. Lawn areas would be expected to be in the lower end of the range. Judgements of higher and lower runoff can be made on a site-specific basis depending upon slope and groundcover types.

7. *Acreage of Impervious* - The total area of impervious surface (in acres) is entered in this Data Cell. This area includes paved driveways, parking areas, roofs, roads, etc. If there are no impervious surfaces, a value of zero (0) is entered.

8. *Fraction of Land Impervious* - No entry need be made in this Data Cell. SONIR will compute the Fraction of Land in Impervious by dividing the impervious area by total area.

9. *Evaporation from Impervious* - Impervious surfaces will allow water to evaporate, particularly during summer months. There is no vegetation; therefore there is no transpiration by plants. Evaporation from Impervious is estimated to be approximately 10 percent of total precipitation **(Hughes and Porter, 1983; p. 10).** This value accounts

for evaporation from parking lots and other surfaces during summer months, averaged over the entire year. This indicates that recharge/runoff would comprise the remaining 90 percent of precipitation. This assumption coincides with most drainage computations required by Code Subdivision Regulations for determined leaching pool capacity.

10. *Runoff from Impervious* - The approximation of Evaporation from Impervious would indicate that recharge/runoff would comprise the remaining 90 percent of precipitation, as there are no other losses from impervious surfaces. In consideration of paved areas, runoff is not transported off the site or to surface water as a loss. Runoff is diverted to leaching pools and allowed to re-enter the hydrologic system beneath a given site. Therefore, in terms of site recharge computations, the value for Runoff from Impervious is zero (0).

11. *Acreage of Unvegetated* - The total acreage of unvegetated area is entered in this Data Cell. This area includes sand, barren soils, and porous drives and trails. If there is no unvegetated area, a value of zero (0) is used.

12. *Fraction of Land Unvegetated* - No entry need be made in this Data Cell. SONIR will compute the Fraction of Land Unvegetated by dividing the unvegetated area by total area.

13. *Evapotranspiration from Unvegetated* - Evapotranspiration from Unvegetated areas is determined in the same manner as described for Data Cell 5 above.

14. *Runoff from Unvegetated* - The runoff coefficients noted in the discussion for Data Cell 6 above, are applied to unvegetated areas on a site-specific basis. Runoff in the middle to the higher end of the range (0.7 to 2.1 percent of precipitation) is expected due to lack of groundcover vegetation.

15. *Acreage of Water* - SONIR considers evaporation from surface water in the computation of site recharge. Surface water, particularly groundwater fed lakes and ponds are a source of water loss in the water budget. The quantity of fresh surface water (in acres) is entered in this Data Cell.

16. *Fraction of Land in Water* - No entry need be made in this Data Cell. SONIR will compute the Fraction of Water on the site by dividing the water area by total area.

17. *Evaporation from Water* - Surface water features will cause evaporation of water in excess of normal evapotranspiration as documented by **Warren et al, 1968,** Hydrology of Brookhaven National Laboratory and Vicinity Suffolk County, New York. It is estimated that the upper limit of evaporation from a large free-water surface is approximately 30.00 inches per year **(Warren et al, 1968; p. 26).** This value is entered in Data Cell 17 as the most accurate approximation.

18. *Makeup Water* - SONIR allows for consideration of the impact of man-made lakes on site recharge. Lakes are generally lined with an impermeable material. Evaporation occurs

from the surface of the lake at a rate of 30.00 inches per year. In order to maintain a constant water level, an on-site well is generally installed to provide make-up water to the lake or pond. The quantity of make-up water is equivalent to the quantity of evaporation, given the fact that the function of the well is to replace water that is evaporated. Therefore, for cases where make-up water is used to maintain a constant water level, a value of 30.00 inches per year is entered in Data Cell 18.

19. *Acreage of Natural* - The total quantity of natural area (in acres) is entered in this Data Cell. This area includes naturally vegetated areas such as woodland, meadow, etc. If there is no natural area, a value of zero (0) is entered.

20. *Fraction of Land Natural* - No entry need be made in this Data Cell. SONIR will compute the Fraction of Land Natural by dividing the natural area by total area.

21. *Evapotranspiration from Natural* - Evapotranspiration from Natural areas is determined in the same manner as described for Data Cell 5 above.

22. *Runoff from Natural* - The runoff coefficients noted in the discussion for Data Cell 6 above, are applied to natural areas on a site specific basis. Generally lower values in the range of 0.7 percent of precipitation are expected due to groundcover and canopy vegetation.

23. *Acreage of Other Area* - This is a general category which can be used to include additional groundcover types in the simulation. Acreage of Other Area is entered (in acres). This Data Cell can be used to include site recharge considerations from a portion of the site that has different hydrologic properties, such as a moist hardwood forest or vegetated freshwater wetland, where evapotranspiration would be high and runoff would be extremely low.

24. *Fraction of Land in Other Area* - No entry need be made in this Data Cell. SONIR will compute the Fraction of Land in Other Area by dividing the land in other area by total area.

25. *Evapotranspiration from Other Area* - Evapotranspiration from Other areas is determined in the same manner as described for Data Cell 5 above. Value can be varied depending upon the hydrologic properties of the groundcover type.

26. *Runoff from Other Area* - The runoff coefficients noted in the discussion for Data Cell 6 above, are applied to Other Areas on a site-specific basis. Value can be varied depending upon the hydrologic properties of the groundcover type.

27. *Acreage of Land Irrigated* - Imported water for irrigation purposes is an additional site recharge component not considered in any of the Data Cells above. The quantity of land irrigated on a given site is entered in this Data Cell (in acres).

28. *Fraction of Land Irrigated* - No entry need be made in this Data Cell. SONIR will compute the Fraction of Land Irrigated by dividing the Land Irrigated area by total area.

29. *Irrigation Rate* - The rate of irrigation must be entered in this Data Cell (in inches). Hughes and Porter **(1983; p. 19)** have indicated that lawn irrigation is estimated to be about 5.5 inches per year. This value is entered in Data Cell 29 as the most accurate approximation.

30. *Number of Dwellings* - The number of dwellings is entered in this Data Cell in order to allow for computation of wastewater disposal from residential use. Wastewater imported to a site, or even withdrawn from on-site wells and recharged through sanitary effluent is an additional recharge component that must be considered. If the project is for a commercial use or utilizes a denitrification system, the number of dwellings should not be entered in the Data Entry Field, as the wastewater flow will include recharge and nitrogen components.

31. *Water Use per Dwelling* - The water use should correspond to the total site non-irrigation water use, divided by the number of units.

32. *Wastewater Design Flow* - No entry need be made in this Data Cell. SONIR will compute the Wastewater Design Flow by multiplying the Number of Dwellings by the Water Use per Dwelling.

33. *Commercial/STP Design Flow* - SONIR permits the consideration of recharge from commercial projects, denitrification systems and sewage treatment plants. The Commercial/STP Design Flow is entered in this Data Cell as per County Health Department or engineering design standards.

Site Recharge Computations - Sheet 2

Once data entry is complete for Site Recharge Parameters, SONIR will complete a series of detailed Water Budget computations for the overall site. The following describes the computations that are performed by the model:

A. *Lawn Area Recharge* - Lawn Area Recharge is determined by use of the basic Hydrologic Budget Equation [R = P - (E + Q)] as defined previously. The quantity of recharge determined by this method is then multiplied by that portion of the site occupied by Lawn Area to determine the component of Lawn Area Recharge in overall site recharge.

B. *Impervious Area Recharge* - Impervious area recharge is also determined using the Hydrologic Budget Equation; however, the value for runoff is zero (0) due to the fact that runoff is controlled by conveyance to on site leaching facilities or is allowed to runoff into depressions where runoff is recharged on site.

C. *Unvegetated Area Recharge* - Unvegetated Area Recharge is determined by use of the basic Hydrologic Budget Equation. The quantity of recharge determined by this method is then multiplied by that portion of the site occupied by Unvegetated Area to determine the component of Unvegetated Area Recharge in overall site recharge.

D. *Water Area Loss* - The Hydrologic Budget Equation is modified to consider Water Area Loss. This is particularly useful in water quantity stressed areas of Long Island. If runoff (Q) is considered be zero (0), then lake storage/recharge without make-up water would be Precipitation minus Evaporation (P - E). The resultant quantity of lake storage/recharge is then reduced by the amount of make-up water (M). The final quantity of loss is then multiplied by that portion of the site occupied by water to determine the component of water loss as related to the overall site water budget.

E. *Natural Area Recharge* - Natural Area Recharge is determined by use of the basic Hydrologic Budget Equation. The quantity of recharge determined by this method is then multiplied by that portion of the site occupied by Natural Area to determine the component of Natural Area Recharge in overall site recharge.

F. *Other Area Recharge* - Other Area Recharge is determined by use of the basic Hydrologic Budget Equation. The quantity of recharge determined by this method is then multiplied by that portion of the site occupied by Other Area to determine the component of Other Area Recharge in overall site recharge.

G. *Irrigation Recharge* - Irrigation recharge is an additional recharge component artificially added on sites where irrigation occurs. This quantity is determined in the same manner as the Hydrologic Water Budget except that the irrigation rate (in inches) is substituted for precipitation. The resultant recharge is multiplied by the area of the site that is irrigated, in order to determine the Irrigation Recharge in overall site recharge.

H. *Wastewater Recharge* - Wastewater is also a recharge component artificially added to a site. SONIR annualizes the wastewater design flow and assumes it is applied over the entire by multiplying Wastewater Design Flow by the Area of the Site, resulting in a per foot measure of wastewater over the site. This is converted to inches to be included in overall site recharge.

Once the eight (8) series of Site Recharge Computations are complete, SONIR totals each individual component to determine Total Site Recharge. The sum of these recharge contributions, is that quantity of water that is expected to enter the site on an annual basis due to precipitation, after the development is completed. This value is important in determining the concentration of nitrogen in recharge, and is important as a means of determining hydrologic impacts of a project in terms of changes to site recharge.

SITE NITROGEN BUDGET

Overview

The total nitrogen released on a given site must be determined in order to provide a means of simulating nitrogen in recharge. Nitrogen sources include: sanitary nitrogen; fertilizer nitrogen; pet waste nitrogen; precipitation nitrogen; and water supply nitrogen (wastewater and irrigation). The total of these quantities represents total site nitrogen.

Data Input - Sheet 1

The following provides a discussion of data sources and assumptions associated with the nitrogen budget, corresponding to the Data Input Field in Sheet 1 of SONIR:

1. *Persons per Dwelling* - The number of persons per dwelling is a demographic multiplier used in the determination of human population of a site. Based on multipliers listed in "The New Practitioner's Guide to Fiscal Impact Analysis", **(Rutgers, 1985)**, the average number of residents is calculated at 0.00/unit (Existing Conditions), and will be 4.1/unit (Proposed Conditions).

2. *Nitrogen per Person per Year* - Annual nitrogen per person is a function of nitrogen bearing waste in wastewater. For residential land use the population of the development is determined and the nitrogen generated is assumed to be 10 pounds per capita per year **(Hughes and Porter, 1983; p. 8).**

3. *Sanitary Nitrogen Leaching Rate* - For normal residential systems, Porter and Hughes report that 50 percent of the nitrogen entering the system is converted to gaseous nitrogen and the remainder leaches into the soil **(Porter and Hughes, 1983; p. 14).**

4. *Area of Land Fertilized 1* - The area of land fertilized is input in Data Cell 4. This value may correspond to the Acreage of Lawn and/or the Acreage of Land Irrigated, but is not necessarily the same value. This entry should be determined on a site-specific basis.

5. *Fertilizer Application Rate 1* - Fertilizer nitrogen is determined by a fertilizer application rate over a specified area of the site. The fertilizer application rates vary depending upon the type of use. The following table indicates the rate of fertilization as a function of use as excerpted from the Non-Point Source Management Handbook **(Koppelman, 1984; Chapter 5, p.6):**

Residential (contract)	1.5 lbs/1000 sq ft
Residential (unmanaged)	2.3 lbs/1000 sq ft
Commercial	3.5 lbs/1000 sq ft
Golf Course	3.5 lbs/1000 sq ft
Sod Farms	4.0 lbs/1000 sq ft
Recreational Lands	0.2 lbs/1000 sq ft

A commercial landscaping firm has been interviewed to determine trends in commercial fertilizer application. Various fertilizer formulations are used including 10-6-4, 16-4-8 and 20-10-5 (nitrogen-phosphate-potash) depending upon season. Heavier nitrogen application rates are generally used in the spring. Fertilizer used is 50 percent organic nitrogen. This is applied in a dry form approximately 2-3 times per year, and a 50-pound bag is applied over approximately 16,000 square feet. Based on this rate if 20- 10-5 nitrogen were applied in the spring, and 16-4-8 were applied during summer and fall, this would result in an application rate of 1.5-2.1 pounds per 1000 square feet. The high of this range is a conservative value based on three applications of relatively high nitrogen fertilizer, which will be used for nitrogen in recharge simulation.

In addition, it is noted that the Non-Point Source Management Handbook indicates that application rates as low as 1.0 lb/1000 sq ft can be achieved with proper fertilizer management control.

6. *Fertilizer Nitrogen Leaching Rate 1* - Nitrogen applied as fertilizer is subject to plant uptake (20 to 80%; 50% on average) and storage in thatch and soils (36 to 47%), thereby reducing the total amount of nitrogen leached. The percentage of plant uptake and storage are based on studies cited in the LIRPB's Special Groundwater Protection Area Plan. Based on those studies, a conservative nitrogen leaching rate of 14% has been applied in the model.

7. *Area of Land Fertilized 2* - More than one fertilizer nitrogen input is provided in order allow consideration of mixed use and/or golf course projects where land is fertilized at different rates.

8. *Fertilizer Application Rate 2* - Fertilizer Application Rates for this entry can be determined based upon Data Cell 5 above.

9. *Fertilizer Nitrogen Leaching Rate 2* - Fertilizer Nitrogen Leaching Rates can be determined based upon Data Cell 6 above.

10. *Pet Waste Application Rate* - Pet Waste Nitrogen results from the excretion of domestic pets in the outside environment. There is relatively little definitive information concerning this nitrogen source; however, several references were located and are analyzed herein. The 208 Study provides a table of nitrogen concentration in manure for various animals, not including dogs or cats. Total nitrogen values in the range of 0.30-0.43 lbs/day/1000 lbs live weight are reported for cattle, sheep and horses **(Koppelman, 1978; Animal Waste report p. 3).** It is assumed that dogs constitute the major source of animal waste that would be present in the yards of residential developments. Cat waste would be significantly less due to the lesser live weight of cats and the fact that many cat owners dispose of cat waste in solid waste by using an indoor litter box. If an average of 0.35 lbs of nitrogen is assumed for dogs, and an average of 25 pounds live weight is assumed per dog, then the total annual nitrogen per pet would be 3.19 lbs/year. The only other reference located that approximates nitrogen in pet waste is Land Use and Ground-

Water Quality in the Pine Barrens of Southampton **(Hughes and Porter, 1983; p. 10).** This reference assumed an application rate of 6.5 lbs/acre of nitrogen. Pet waste was assumed to be deposited evenly over all turf. This assumption was not correlated to population density or pet density, but only to turfed acreage. In comparison of the two values, the per pet value corresponds to approximately 2 turfed acres. For the purpose of this model, the value of 3.19 lbs/pet/year is considered to be the most justifiable value for pet waste and is entered in this Data Cell.

11. *Pet Waste Nitrogen Leaching Rate* - Pet waste is also subject to a leaching rate factor whereby, 50 percent of the nitrogen applied to the ground is removed as a gas.

12. *Area of Land Irrigated* - No entry need be made in this Data Cell. This value is the same as Data Cell 27 of the Site Recharge Parameters and SONIR will transfer the data entry to this Cell.

13. *Irrigation Rate* - No entry need be made in this Data Cell. This value is the same as Data Cell 29 of the Site Recharge Parameters and SONIR will transfer the data entry to this Cell.

14. *Irrigation Nitrogen Leaching Rate* - Hughes and Porter **(1983; p. 10)** states "plant uptake and gaseous losses are assumed to remove 85% of the nitrogen entering in precipitation". Irrigation nitrogen would be expected to be subject to the same losses; therefore, a leaching rate of 15% is entered in this Data Cell.

15 *Nitrogen in Precipitation* - Groundwater nitrogen is partially derived from rainwater. Nitrate-nitrogen concentrations in precipitation have been reported to be on the order of 1-2 mg/l in Nassau and Suffolk Counties **(SCDHS, 1987; p. 6-4).**

16. *Precipitation Nitrogen Leaching Rate* - As indicated above, a nitrogen leaching rate of 15% is applied to precipitation nitrogen.

17. *Nitrogen in Water Supply* - The concentration of Nitrogen in Water Supply determines the quantity of nitrogen that enters the site as a result of irrigation nitrogen and wastewater flow. Local water supply data should be utilized if available, otherwise a value of between 1 and 2 mg/l could be utilized.

18. *Nitrogen in Commercial/STP Flow* - This data entry allows SONIR to compute the quantity of nitrogen resulting from commercial discharge, denitrification systems and/or sewage treatment plants. Total nitrogen in community wastewater is identified as having a total nitrogen concentration of 20 mg/l in weak effluent; 40 mg/l in medium strength effluent, and 85 mg/l in strong effluent **(Metcalf & Eddy, Inc, 1991).** It is recommended that a value of 40 mg/l be used for total nitrogen concentration in commercial sanitary systems. Properly functioning denitrification systems and sewage treatment plants are capable of reducing total nitrogen to less than 10 mg/l in accordance with discharge limitations. A value of 10 mg/l can be entered in this data cell for such systems. The

SONIR model computes the number of pounds of nitrogen in sanitary discharge as a function of concentration. The absolute nitrogen is utilized in the model; however, it must recognized that from the discharge point, nitrogen is nitrified through conversion of ammonia to nitrate in the leaching area beneath the discharge point. Further natural transformation in the form of denitrification occurs as a result of bacteria. This causes release of nitrogen gas and may account for further reduction of 50 percent or more subsequent to discharge **(Canter and Knox, 1979; pp. 77-78; Hughes and Porter, 1983; p. 14).** As a result SONIR is conservative in predicting the concentration of nitrogen in recharge, and when natural denitrification of sanitary effluent is considered, actual concentration would be less.

Site Nitrogen Budget - Sheet 2

Once data entry is complete for Nitrogen Budget Parameters, SONIR will complete a series of detailed computations to determine the individual component of nitrogen from each source and the total nitrogen for the overall site and use. The following describes the computations that are performed by the model:

A. *Sanitary Nitrogen - Residential* - SONIR establishes the site population using the number of units on the site, and the demographic multiplier. The nitrogen load factor is then applied and reduced by the leaching rate, resulting in the total residential nitrogen component. If the project is for a commercial use or utilizes a denitrification system, the number of dwellings should not be entered in the Data Entry Field, in which case the total nitrogen from this source will be zero (0).

B. *Pet Waste Nitrogen* - The pet waste nitrogen was determined on a per pet basis; however, the number of pets for a given residential project must be determined. In order to correlate the number of pets to human population, a ratio was determined using information contained in the 208 Study, wherein it was estimated that there is 1 dog per 5 residents in suburban areas and 1 dog per 7 residents in urban areas **(Koppelman, 1978; Animal Waste Report, pp. 6).** This results in an average number of dogs based upon of 17 percent of the human population. Accordingly, this multiplier is used based upon the population of a land use project in order to estimate the nitrogen waste from pets. The pet waste nitrogen is subject to reduction as a function of the leaching rate, leading to the total pet waste nitrogen in pounds.

C. *Sanitary Nitrogen (Commercial/STP)* - SONIR utilizes the Commercial/STP Flow that is converted to liters and multiplied by the nitrogen concentration in waste. This provides a weight of nitrogen in milligrams, which is converted to pounds for the total nitrogen from this component.

D. *Water Supply Nitrogen* - SONIR utilizes the residential wastewater design flow to compute the weight of nitrogen contributed from the water supply. The method

of calculation is the same as Sanitary Nitrogen (Commercial/STP). For commercial projects, this value is accounted for in the Commercial/STP Flow.

E. *Fertilizer Nitrogen 1* - This calculation utilizes data entry from the Area of Land Fertilized 1, in the Data Input Field, to determine the weight of fertilizer nitrogen applied to the area. The area is multiplied by the application rate and reduced by the leaching rate documented previously to arrive at total weight.

F. *Fertilizer Nitrogen 2* - If fertilization rates vary, the Area of Land Fertilized 2, is utilized to determine nitrogen from this source.

G. *Precipitation Nitrogen* - Nitrogen in precipitation is considered by determining the liters of Natural Recharge entering the site, multiplied by the concentration of nitrogen in precipitation. SONIR uses the sum of natural recharge components from the Site Recharge Computations to establish the natural recharge. A precipitation nitrogen leaching rate of 15% is utilized as referenced above.

H. *Irrigation Nitrogen* - Although a very small component, the Irrigation Nitrogen is determined using the Irrigation Recharge R(irr) computed in the Site Recharge Computations, over the irrigated area of the site to produce a volume of irrigation recharge. The Irrigation Recharge value is used in order to account for reduction of recharge due to evapotranspiration, since this component is only intended to determine nitrogen leaching into soil as a result of irrigation nitrogen in the water supply. This value is converted to liters and multiplied by the concentration of nitrogen in irrigation water supply. The Irrigation Nitrogen Leaching Rate (expected to the same as for precipitation) is applied to the weight to determine the total nitrogen from this source.

Once the eight (8) series of Site Nitrogen Budget computations are complete, SONIR totals each individual component to determine the Total Site Nitrogen. This value is used in determining the weight per volume ratio of nitrogen in recharge as computed in Sheet 4 of the SONIR model.

FINAL COMPUTATIONS AND SUMMARY

SONIR utilizes data generated in Sheets 2 and 3 of the model to compute a mass/volume ratio for nitrogen in recharge. Nitrogen in recharge is converted from pounds to milligrams in order to provide units compatible for mass/volume concentration. Likewise, the quantity of site recharge is applied over the site in order to determine an overall volume number for site recharge. This is then converted to liters. The final computation divides the total weight of nitrogen in milligrams, by the total volume of recharge in liters, to arrive at the Nitrogen in Recharge ratio in milligrams per liter (mg/l). This concentration represents the Final Concentration of Nitrogen in Recharge, which is highlighted on Sheet 4.

Sheet 4 also provides a site recharge summary in order to compare recharge between natural conditions, a proposed project and/or alternatives. Total Site Recharge is presented in both inches, and as a volume in cubic feet/year, gallons/year and million gallons/year (MGY).

The final field summarizes the Conversions Used in SONIR. Conversions are standard conversion multipliers as found in standard engineering references.

SONIR is a valuable tool allowing for versatile determination of site recharge as determined from many components of site recharge. SONIR determines the weight of nitrogen applied to a site from a variety of sources as well. SONIR is a fully referenced model utilizing basic hydrologic and engineering principals, in a simulation of nitrogen in recharge. Input data should be carefully justified in order to achieve best results. SONIR can be used effectively in comparing land use alternatives and relative impact upon groundwater due to nitrogen. By running the model for Existing Conditions, Proposed Project conditions and/or alternative land uses comparison of impacts can be made for consideration in land use decision-making. Questions, comments or suggestions concerning this model should be addressed to Nelson, Pope & Voorhis, LLC, 572 Walt Whitman Road, Melville, New York 11747.

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Appendix B-2
SONIR Model Results for Existing Conditions

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT Islandia Preserve

DATA INPUT FIELD Existing Conditions SHEET 1

A	*Site Recharge Parameters*	*Value*	*Units*
1	Area of Site	10.12	acres
2	Precipitation Rate	42.82	inches
3	Acreage of Lawn	1.44	acres
4	Fraction of Land in Lawn	0.142	fraction
5	Evapotranspiration from Lawn	24.20	inches
6	Runoff from Lawn	0.90	inches
7	Acreage of Impervious	0.81	acres
8	Fraction of Land Impervious	0.080	fraction
9	Evaporation from Impervious	4.28	inches
10	Runoff from Impervious	0.00	inches
11	Acreage of Unvegetated	6.55	acres
12	Fraction of Land Unvegetated	0.647	fraction
13	Evapotrans. from Unvegetated	24.20	inches
14	Runoff from Unvegetated	2.1	inches
15	Acreage of Water	0.00	acres
16	Fraction of Site in Water	0.000	fraction
17	Evaporation from Water	30.00	inches
18	Makeup Water (if applicable)	0.00	inches
19	Acreage of Natural Area	1.32	acres
20	Fraction of Land Natural	0.130	fraction
21	Evapotrans. from Natural Area	24.20	inches
22	Runoff from Natural Area	0.30	inches
23	Acreage of Other Area	0.00	acres
24	Fraction of Land Other Area	0.000	fraction
25	Evapotrans. from Other Area	0.00	inches
26	Runoff from Other Area	0.00	inches
27	Acreage of Land Irrigated	1.44	acres
28	Fraction of Land Irrigated	0.142	fraction
29	Irrigation Rate	5.50	inches
30	Number of Dwellings	0	units
31	Water Use per Dwelling	0	gal/day
32	Wastewater Design Flow		gal/day
33	Commercial /STP Design Flow	2,200	gal/day

B	*Nitrogen Budget Parameters*	*Value*	*Units*
1	Persons per Dwelling	0.00	persons
2	Nitrogen per Person per Year	0.0	lbs
3	Sanitary Nitrogen Leaching Rate	0	percent
4	Area of Land Fertilized 1	1.44	acres
5	Fertilizer Application Rate 1	2.30	lbs/1000 sq ft
6	Fertilizer Nitrogen Leaching Rate 1	14	percent
7	Area of Land Fertilized 2	0.00	acres
8	Fertilizer Application Rate 2	0.50	lbs/1000 sq ft
9	Fertilizer Nitrogen Leaching Rate 2	14	percent
10	Pet Waste Application Rate	157.00	lbs/pet
11	Pet Waste Nitrogen Leaching Rate	2	percent
12	Area of Land Irrigated	1.44	acres
13	Irrigation Rate	5.50	inches
14	Irrigation Nitrogen Leaching Rate	15	percent
15	Nitrogen in Precipitation	1.00	mg/l
16	Precipitation Nitrogen Leaching Rate	15	percent
17	Nitrogen in Water Supply	1.00	mg/l
18	Nitrogen in Commercial/STP Flow	40.00	mg/l

C	*Comments*
1)	Please refer to user manual for data input instructions.
2)	Estimated 0.43 lbs/day of nitrogen per horse.

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE RECHARGE COMPUTATIONS Existing Conditions SHEET 2

A	*Lawn Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Lawn	0.142	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.90	inches
5	R(l) = P - (E + Q)	17.72	inches
6	R(L) = R(l) x A	2.52	inches

B	*Impervious Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Impervious	0.080	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	4.28	inches
4	Q = Runoff Rate	0.00	inches
5	R(i) = P - (E + Q)	38.54	inches
6	R(I) = R(i) x A	3.08	inches

C	*Unvegetated Area Recharge*		
1	A = Fraction of Land Unveg.	0.647	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	2.10	inches
5	R(u) = P - (E + Q)	16.52	inches
6	R(U) = R(u) x A	10.69	inches

D	*Water Area Loss*		
1	A = Fraction of Site in Water	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	0.00	inches
5	M = Makeup Water	0.00	inches
6	R(w) = {P - (E+Q)} - M	12.82	inches
7	R(W) = R(w) x A	0.00	inches

E	*Natural Area Recharge*		
1	A = Fraction of Land in Natural	0.130	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.30	inches
5	R(n) = P - (E + Q)	18.32	inches
6	R(N) = R(n) x A	2.39	inches

F	*Other Area Recharge*		
1	A = Fraction of Land in Other	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	0.00	inches
4	Q = Runoff Rate	0.00	inches
5	R(o) = P - (E + Q)	42.82	inches
6	R(O) = R(o) x A	0.00	inches

G	*Irrigation Recharge*		
1	A = Fraction of Land Irrigated	0.142	fraction
2	I = Irrigation Rate	5.50	inches
3	E = Evaptranspiration Rate	3.11	inches
4	Q = Runoff Rate	0.90	inches
5	R(irr) = I - (E + Q)	1.49	inches
6	R(IRR) = R(irr) x A	0.21	inches

H	*Wastewater Recharge*		
1	WDF = Wastewater Design Flow	2,200	gal/day
2	WDF = Wastewater Design Flow	107,361.10	cu ft/yr
3	A = Area of Site	440,827	sq ft
4	R(ww) = WDF/A	0.24	feet
5	R(WW) = Wastewater Recharge	2.92	inches

Total Site Recharge		
R(T) =	R(L) + R(I) + R(U) + R(W) + R(N) + R(O) + R(IRR) + R(WW)	
R(T) =	**21.82**	**inches**

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE NITROGEN BUDGET — Existing Conditions — SHEET 3

A	Sanitary Nitrogen-Residential	Value	Units
1	Number of Dwellings	0	units
2	Persons per Dwelling	0.00	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	0	lbs
5	LR = Leaching Rate	0	percent
6	N(S) = P x N x LR	0.00	lbs
7	N(S) = Sanitary Nitrogen	0.00	lbs

B	Pet Waste Nitrogen	Value	Units
1	AR = Application Rate	157.00	lbs/pet
2	Human Population	0	capita
3	Pets = 17 percent of capita	27	pets
4	N(p) = AR x pets	4239.00	lbs
5	LR = Leaching Rate	2	percent
6	N(P) = N(p) x LR	68.67	lbs
7	N(P) = Pet Waste Nitrogen	68.67	lbs

C	Sanitary Nitrogen (Commercial/STP)		
1	CF = Commercial/STP Flow	2,200	gal/day
2	CF = Commercial/STP Flow	3,039,355	liters/yr
3	N = Nitrogen in Commercial	40.00	mg/l
4	N(S) = CF x N	121,574,200	milligrams
5	N(S) = Sanitary Nitrogen	268.07	lbs

D	Water Supply Nitrogen		
1	WDF = Wastewater Design Flow	2,200	gal/day
2	WDF = Wastewater Design Flow	3,039,355	liters/yr
3	N = Nitrogen in Water Supply	1.00	mg/l
4	N(WW) = WDF x N	3,039,355	milligrams
5	N(WW) = Wastewater Nitrogen	6.70	lbs

E	Fertilizer Nitrogen 1		
1	A = Area of Land Fertilized 1	62,726	sq ft
2	AR = Application Rate	2.30	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F1) = A x AR x LR	20.20	lbs
5	N(F1) = Fertilizer Nitrogen	20.20	lbs

F	Fertilizer Nitrogen 2		
1	A = Area of Land Fertilized 2	0	sq ft
2	AR = Application Rate	0.50	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F2) = A x AR x LR	0.00	lbs
5	N(F2) = Fertilizer Nitrogen	0.00	lbs

G	Precipitation Nitrogen		
1	R(n) = Natural Recharge (feet)	1.56	feet
2	A = Area of Site (sq ft)	440,827	sq ft
3	R(N) = R(n) x A	686,515	cu ft
4	R(N) = Natural Recharge (liters)	19,442,106	liters
5	N = Nitrogen in Precipitation	1.00	mg/l
6	LR = Leaching Rate	15	percent
7	N(ppt) = P(S) x N x LR	194,421	milligrams
8	N(ppt) = Precipitation Nitrogen	0.43	lbs

H	Irrigation Nitrogen		
1	R = Irrigation Recharge (inches)	1.49	inches
2	R = Irrigation Rate (feet)	0.12	feet
3	A = Area of Land Irrigated	62,726	sq ft
4	R(I) = R(irr) x A	7,797	cu ft
5	R(I) = Site Precipitation (liters)	220,814	liters
6	N = Nitrogen in Water Supply	1.00	mg/l
7	LR = Leaching Rate	15	percent
8	N(irr) = R(I) x N x LR	33,122	milligrams
9	N(irr) = Irrigation Nitrogen	0.07	lbs

Total Site Nitrogen	
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)
N=	364.14 lbs

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

Islandia Preserve
Existing Conditions

FINAL COMPUTATIONS

SHEET 4

A	*Nitrogen in Recharge*	*Value*	*Units*
1	N = Total Nitrogen (lbs)	364.14	lbs
2	N = Total Nitrogen (milligrams)	165,321,522	milligrams
3	R(T) = Total Recharge (inches)	21.82	inches
4	R(T) = Total Recharge (feet)	1.82	feet
5	A = Area of Site	440,827	sq ft
6	R = R(T) x A	801,673	cu ft
7	R = Site Recharge Volume	22,703,386	liters
9	NR = N/R	7.28	mg/l

FINAL CONCENTRATION OF NITROGEN IN RECHARGE

7.28

B	*Site Recharge Summary*	*Value*	*Units*
1	R(T) = Total Site Recharge	21.82	inches/yr
2	R = Site Recharge Volume	801,673	cu ft/yr
3	R = Site Recharge Volume	5,996,933	gal/yr
4	R = Site Recharge Volume	6.00	MG/yr
5	R = Site Recharge Volume	16430	gal/day

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

Appendix B-3
SONIR Model Results for Proposed Project

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT: Islandia Preserve

DATA INPUT FIELD: Proposed Conditions SHEET 1

A	*Site Recharge Parameters*	*Value*	*Units*
1	Area of Site	10.17	acres
2	Precipitation Rate	42.82	inches
3	Acreage of Lawn	5.34	acres
4	Fraction of Land in Lawn	0.525	fraction
5	Evapotranspiration from Lawn	24.20	inches
6	Runoff from Lawn	0.90	inches
7	Acreage of Impervious	4.83	acres
8	Fraction of Land Impervious	0.475	fraction
9	Evaporation from Impervious	4.28	inches
10	Runoff from Impervious	0.00	inches
11	Acreage of Unvegetated	0.00	acres
12	Fraction of Land Unvegetated	0.000	fraction
13	Evapotrans. from Unvegetated	24.20	inches
14	Runoff from Unvegetated	2.1	inches
15	Acreage of Water	0.00	acres
16	Fraction of Site in Water	0.000	fraction
17	Evaporation from Water	30.00	inches
18	Makeup Water (if applicable)	0.00	inches
19	Acreage of Natural Area	0.00	acres
20	Fraction of Land Natural	0.000	fraction
21	Evapotrans. from Natural Area	24.20	inches
22	Runoff from Natural Area	0.30	inches
23	Acreage of Other Area	0.00	acres
24	Fraction of Land Other Area	0.000	fraction
25	Evapotrans. from Other Area	0.00	inches
26	Runoff from Other Area	0.00	inches
27	Acreage of Land Irrigated	5.34	acres
28	Fraction of Land Irrigated	0.525	fraction
29	Irrigation Rate	5.50	inches
30	Number of Dwellings	0	units
31	Water Use per Dwelling	0	gal/day
32	Wastewater Design Flow		gal/day
33	Commercial /STP Design Flow	14,925	gal/day

B	*Nitrogen Budget Parameters*	*Value*	*Units*
1	Persons per Dwelling	0.00	persons
2	Nitrogen per Person per Year	0.0	lbs
3	Sanitary Nitrogen Leaching Rate	0	percent
4	Area of Land Fertilized 1	3.24	acres
5	Fertilizer Application Rate 1	2.30	lbs/1000 sq ft
6	Fertilizer Nitrogen Leaching Rate 1	14	percent
7	Area of Land Fertilized 2	2.10	acres
8	Fertilizer Application Rate 2	0.50	lbs/1000 sq ft
9	Fertilizer Nitrogen Leaching Rate 2	14	percent
10	Pet Waste Application Rate	0.00	lbs/pet
11	Pet Waste Nitrogen Leaching Rate	2	percent
12	Area of Land Irrigated	5.34	acres
13	Irrigation Rate	5.50	inches
14	Irrigation Nitrogen Leaching Rate	15	percent
15	Nitrogen in Precipitation	1.00	mg/l
16	Precipitation Nitrogen Leaching Rate	15	percent
17	Nitrogen in Water Supply	1.00	mg/l
18	Nitrogen in Commercial/STP Flow	10.00	mg/l

C	*Comments*
1)	Please refer to user manual for data input instructions.

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE RECHARGE COMPUTATIONS — Proposed Conditions — SHEET 2

A	*Lawn Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Lawn	0.525	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.90	inches
5	R(l) = P - (E + Q)	17.72	inches
6	R(L) = R(l) x A	9.30	inches

B	*Impervious Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Impervious	0.475	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	4.28	inches
4	Q = Runoff Rate	0.00	inches
5	R(i) = P - (E + Q)	38.54	inches
6	R(I) = R(i) x A	18.30	inches

C	*Unvegetated Area Recharge*		
1	A = Fraction of Land Unveg.	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	2.10	inches
5	R(u) = P - (E + Q)	16.52	inches
6	R(U) = R(u) x A	0.00	inches

D	*Water Area Loss*		
1	A = Fraction of Site in Water	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	0.00	inches
5	M = Makeup Water	0.00	inches
6	R(w) = {P - (E+Q)} - M	12.82	inches
7	R(W) = R(w) x A	0.00	inches

E	*Natural Area Recharge*		
1	A = Fraction of Land in Natural	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.30	inches
5	R(n) = P - (E + Q)	18.32	inches
6	R(N) = R(n) x A	0.00	inches

F	*Other Area Recharge*		
1	A = Fraction of Land in Other	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	0.00	inches
4	Q = Runoff Rate	0.00	inches
5	R(o) = P - (E + Q)	42.82	inches
6	R(O) = R(o) x A	0.00	inches

G	*Irrigation Recharge*		
1	A = Fraction of Land Irrigated	0.525	fraction
2	I = Irrigation Rate	5.50	inches
3	E = Evaptranspiration Rate	3.11	inches
4	Q = Runoff Rate	0.90	inches
5	R(irr) = I - (E + Q)	1.49	inches
6	R(IRR) = R(irr) x A	0.78	inches

H	*Wastewater Recharge*		
1	WDF = Wastewater Design Flow	14,925	gal/day
2	WDF = Wastewater Design Flow	728,347.46	cu ft/yr
3	A = Area of Site	443,005	sq ft
4	R(ww) = WDF/A	1.64	feet
5	R(WW) = Wastewater Recharge	19.73	inches

Total Site Recharge		
R(T) =	R(L) + R(I) + R(U) + R(W) + R(N) + R(O) + R(IRR) + R(WW)	
R(T) =	48.12 inches	

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE NITROGEN BUDGET — Proposed Conditions — SHEET 3

A	*Sanitary Nitrogen-Residential*	*Value*	*Units*
1	Number of Dwellings	0	units
2	Persons per Dwelling	0.00	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	0	lbs
5	LR = Leaching Rate	0	percent
6	N(S) = P x N x LR	0.00	lbs
7	N(S) = Sanitary Nitrogen	0.00	lbs

B	*Pet Waste Nitrogen*	*Value*	*Units*
1	AR = Application Rate	0.00	lbs/pet
2	Human Population	0	capita
3	Pets = 17 percent of capita	0	pets
4	N(p) = AR x pets	0.00	lbs
5	LR = Leaching Rate	2	percent
6	N(P) = N(p) x LR	0.00	lbs
7	N(P) = Pet Waste Nitrogen	0.00	lbs

C	*Sanitary Nitrogen (Commercial/STP)*		
1	CF = Commercial/STP Flow	14,925	gal/day
2	CF = Commercial/STP Flow	20,619,261	liters/yr
3	N = Nitrogen in Commercial	10.00	mg/l
4	N(S) = CF x N	206,192,606	milligrams
5	N(S) = Sanitary Nitrogen	454.65	lbs

D	*Water Supply Nitrogen*		
1	WDF = Wastewater Design Flow	14,925	gal/day
2	WDF = Wastewater Design Flow	20,619,261	liters/yr
3	N = Nitrogen in Water Supply	1.00	mg/l
4	N(WW) = WDF x N	20,619,261	milligrams
5	N(WW) = Wastewater Nitrogen	45.47	lbs

E	*Fertilizer Nitrogen 1*		
1	A = Area of Land Fertilized 1	141,134	sq ft
2	AR = Application Rate	2.30	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F1) = A x AR x LR	45.45	lbs
5	N(F1) = Fertilizer Nitrogen	45.45	lbs

F	*Fertilizer Nitrogen 2*		
1	A = Area of Land Fertilized 2	91,476	sq ft
2	AR = Application Rate	0.50	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F2) = A x AR x LR	6.40	lbs
5	N(F2) = Fertilizer Nitrogen	6.40	lbs

G	*Precipitation Nitrogen*		
1	R(n) = Natural Recharge (feet)	2.30	feet
2	A = Area of Site (sq ft)	443,005	sq ft
3	R(N) = R(n) x A	1,019,206	cu ft
4	R(N) = Natural Recharge (liters)	28,863,914	liters
5	N = Nitrogen in Precipitation	1.00	mg/l
6	LR = Leaching Rate	15	percent
7	N(ppt) = P(S) x N x LR	288,639	milligrams
8	N(ppt) = Precipitation Nitrogen	0.64	lbs

H	*Irrigation Nitrogen*		
1	R = Irrigation Recharge (inches)	1.49	inches
2	R = Irrigation Rate (feet)	0.12	feet
3	A = Area of Land Irrigated	232,610	sq ft
4	R(I) = R(irr) x A	28,914	cu ft
5	R(I) = Site Precipitation (liters)	818,851	liters
6	N = Nitrogen in Water Supply	1.00	mg/l
7	LR = Leaching Rate	15	percent
8	N(irr) = R(I) x N x LR	122,828	milligrams
9	N(irr) = Irrigation Nitrogen	0.27	lbs

Total Site Nitrogen	
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)
N=	552.88 lbs

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

Islandia Preserve
Proposed Conditions

FINAL COMPUTATIONS

SHEET 4

A	*Nitrogen in Recharge*	*Value*	*Units*
1	N = Total Nitrogen (lbs)	552.88	lbs
2	N = Total Nitrogen (milligrams)	251,005,726	milligrams
3	R(T) = Total Recharge (inches)	48.12	inches
4	R(T) = Total Recharge (feet)	4.01	feet
5	A = Area of Site	443,005	sq ft
6	R = R(T) x A	1,776,468	cu ft
7	R = Site Recharge Volume	50,309,565	liters
9	NR = N/R	4.99	mg/l

FINAL CONCENTRATION OF NITROGEN IN RECHARGE

4.99

B	*Site Recharge Summary*	*Value*	*Units*
1	R(T) = Total Site Recharge	48.12	inches/yr
2	R = Site Recharge Volume	1,776,468	cu ft/yr
3	R = Site Recharge Volume	13,288,902	gal/yr
4	R = Site Recharge Volume	13.29	MG/yr
5	R = Site Recharge Volume	36408	gal/day

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

Appendix B-4
SONIR Model Results for Alternatives

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT: Islandia Preserve

DATA INPUT FIELD: Alternative 1 SHEET 1

A	Site Recharge Parameters	Value	Units
1	Area of Site	10.12	acres
2	Precipitation Rate	42.82	inches
3	Acreage of Lawn	1.44	acres
4	Fraction of Land in Lawn	0.142	fraction
5	Evapotranspiration from Lawn	24.20	inches
6	Runoff from Lawn	0.90	inches
7	Acreage of Impervious	0.81	acres
8	Fraction of Land Impervious	0.080	fraction
9	Evaporation from Impervious	4.28	inches
10	Runoff from Impervious	0.00	inches
11	Acreage of Unvegetated	6.55	acres
12	Fraction of Land Unvegetated	0.647	fraction
13	Evapotrans. from Unvegetated	24.20	inches
14	Runoff from Unvegetated	2.1	inches
15	Acreage of Water	0.00	acres
16	Fraction of Site in Water	0.000	fraction
17	Evaporation from Water	30.00	inches
18	Makeup Water (if applicable)	0.00	inches
19	Acreage of Natural Area	1.32	acres
20	Fraction of Land Natural	0.130	fraction
21	Evapotrans. from Natural Area	24.20	inches
22	Runoff from Natural Area	0.30	inches
23	Acreage of Other Area	0.00	acres
24	Fraction of Land Other Area	0.000	fraction
25	Evapotrans. from Other Area	0.00	inches
26	Runoff from Other Area	0.00	inches
27	Acreage of Land Irrigated	1.44	acres
28	Fraction of Land Irrigated	0.142	fraction
29	Irrigation Rate	5.50	inches
30	Number of Dwellings	0	units
31	Water Use per Dwelling	0	gal/day
32	Wastewater Design Flow		gal/day
33	Commercial /STP Design Flow	2,200	gal/day

B	Nitrogen Budget Parameters	Value	Units
1	Persons per Dwelling	0.00	persons
2	Nitrogen per Person per Year	0.0	lbs
3	Sanitary Nitrogen Leaching Rate	0	percent
4	Area of Land Fertilized 1	1.44	acres
5	Fertilizer Application Rate 1	2.30	lbs/1000 sq ft
6	Fertilizer Nitrogen Leaching Rate 1	14	percent
7	Area of Land Fertilized 2	0.00	acres
8	Fertilizer Application Rate 2	0.50	lbs/1000 sq ft
9	Fertilizer Nitrogen Leaching Rate 2	14	percent
10	Pet Waste Application Rate	157.00	lbs/pet
11	Pet Waste Nitrogen Leaching Rate	2	percent
12	Area of Land Irrigated	1.44	acres
13	Irrigation Rate	5.50	inches
14	Irrigation Nitrogen Leaching Rate	15	percent
15	Nitrogen in Precipitation	1.00	mg/l
16	Precipitation Nitrogen Leaching Rate	15	percent
17	Nitrogen in Water Supply	1.00	mg/l
18	Nitrogen in Commercial/STP Flow	40.00	mg/l

C	Comments
1)	Please refer to user manual for data input instructions.
2)	Estimated 0.43 lbs/day of nitrogen per horse.

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE RECHARGE COMPUTATIONS — Alternative 1 — SHEET 2

A	*Lawn Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Lawn	0.142	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.90	inches
5	R(l) = P - (E + Q)	17.72	inches
6	R(L) = R(l) x A	2.52	inches

B	*Impervious Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Impervious	0.080	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	4.28	inches
4	Q = Runoff Rate	0.00	inches
5	R(i) = P - (E + Q)	38.54	inches
6	R(I) = R(i) x A	3.08	inches

C	*Unvegetated Area Recharge*		
1	A = Fraction of Land Unveg.	0.647	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	2.10	inches
5	R(u) = P - (E + Q)	16.52	inches
6	R(U) = R(u) x A	10.69	inches

D	*Water Area Loss*		
1	A = Fraction of Site in Water	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	0.00	inches
5	M = Makeup Water	0.00	inches
6	R(w) = {P - (E+Q)} - M	12.82	inches
7	R(W) = R(w) x A	0.00	inches

E	*Natural Area Recharge*		
1	A = Fraction of Land in Natural	0.130	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.30	inches
5	R(n) = P - (E + Q)	18.32	inches
6	R(N) = R(n) x A	2.39	inches

F	*Other Area Recharge*		
1	A = Fraction of Land in Other	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	0.00	inches
4	Q = Runoff Rate	0.00	inches
5	R(o) = P - (E + Q)	42.82	inches
6	R(O) = R(o) x A	0.00	inches

G	*Irrigation Recharge*		
1	A = Fraction of Land Irrigated	0.142	fraction
2	I = Irrigation Rate	5.50	inches
3	E = Evaptranspiration Rate	3.11	inches
4	Q = Runoff Rate	0.90	inches
5	R(irr) = I - (E + Q)	1.49	inches
6	R(IRR) = R(irr) x A	0.21	inches

H	*Wastewater Recharge*		
1	WDF = Wastewater Design Flow	2,200	gal/day
2	WDF = Wastewater Design Flow	107,361.10	cu ft/yr
3	A = Area of Site	440,827	sq ft
4	R(ww) = WDF/A	0.24	feet
5	R(WW) = Wastewater Recharge	2.92	inches

Total Site Recharge		
R(T) =	R(L) + R(I) + R(U) + R(W) + R(N) + R(O) + R(IRR) + R(WW)	
R(T) =	**21.82**	**inches**

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE NITROGEN BUDGET Alternative 1 **SHEET 3**

A	*Sanitary Nitrogen-Residential*	*Value*	*Units*
1	Number of Dwellings	0	units
2	Persons per Dwelling	0.00	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	0	lbs
5	LR = Leaching Rate	0	percent
6	N(S) = P x N x LR	0.00	lbs
7	N(S) = Sanitary Nitrogen	0.00	lbs

B	*Pet Waste Nitrogen*	*Value*	*Units*
1	AR = Application Rate	157.00	lbs/pet
2	Human Population	0	capita
3	Pets = 17 percent of capita	27	pets
4	N(p) = AR x pets	4239.00	lbs
5	LR = Leaching Rate	2	percent
6	N(P) = N(p) x LR	68.67	lbs
7	N(P) = Pet Waste Nitrogen	68.67	lbs

C	*Sanitary Nitrogen (Commercial/STP)*		
1	CF = Commercial/STP Flow	2,200	gal/day
2	CF = Commercial/STP Flow	3,039,355	liters/yr
3	N = Nitrogen in Commercial	40.00	mg/l
4	N(S) = CF x N	121,574,200	milligrams
5	N(S) = Sanitary Nitrogen	268.07	lbs

D	*Water Supply Nitrogen*		
1	WDF = Wastewater Design Flow	2,200	gal/day
2	WDF = Wastewater Design Flow	3,039,355	liters/yr
3	N = Nitrogen in Water Supply	1.00	mg/l
4	N(WW) = WDF x N	3,039,355	milligrams
5	N(WW) = Wastewater Nitrogen	6.70	lbs

E	*Fertilizer Nitrogen 1*		
1	A = Area of Land Fertilized 1	62,726	sq ft
2	AR = Application Rate	2.30	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F1) = A x AR x LR	20.20	lbs
5	N(F1) = Fertilizer Nitrogen	20.20	lbs

F	*Fertilizer Nitrogen 2*		
1	A = Area of Land Fertilized 2	0	sq ft
2	AR = Application Rate	0.50	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F2) = A x AR x LR	0.00	lbs
5	N(F2) = Fertilizer Nitrogen	0.00	lbs

G	*Precipitation Nitrogen*		
1	R(n) = Natural Recharge (feet)	1.56	feet
2	A = Area of Site (sq ft)	440,827	sq ft
3	R(N) = R(n) x A	686,515	cu ft
4	R(N) = Natural Recharge (liters)	19,442,106	liters
5	N = Nitrogen in Precipitation	1.00	mg/l
6	LR = Leaching Rate	15	percent
7	N(ppt) = P(S) x N x LR	194,421	milligrams
8	N(ppt) = Precipitation Nitrogen	0.43	lbs

H	*Irrigation Nitrogen*		
1	R = Irrigation Recharge (inches)	1.49	inches
2	R = Irrigation Rate (feet)	0.12	feet
3	A = Area of Land Irrigated	62,726	sq ft
4	R(I) = R(irr) x A	7,797	cu ft
5	R(I) = Site Precipitation (liters)	220,814	liters
6	N = Nitrogen in Water Supply	1.00	mg/l
7	LR = Leaching Rate	15	percent
8	N(irr) = R(I) x N x LR	33,122	milligrams
9	N(irr) = Irrigation Nitrogen	0.07	lbs

Total Site Nitrogen	
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)
N=	364.14 lbs

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

Islandia Preserve
Alternative 1

FINAL COMPUTATIONS

SHEET 4

A	*Nitrogen in Recharge*	*Value*	*Units*
1	N = Total Nitrogen (lbs)	364.14	lbs
2	N = Total Nitrogen (milligrams)	165,321,522	milligrams
3	R(T) = Total Recharge (inches)	21.82	inches
4	R(T) = Total Recharge (feet)	1.82	feet
5	A = Area of Site	440,827	sq ft
6	R = R(T) x A	801,673	cu ft
7	R = Site Recharge Volume	22,703,386	liters
9	NR = N/R	7.28	mg/l

FINAL CONCENTRATION OF NITROGEN IN RECHARGE

7.28

B	*Site Recharge Summary*	*Value*	*Units*
1	R(T) = Total Site Recharge	21.82	inches/yr
2	R = Site Recharge Volume	801,673	cu ft/yr
3	R = Site Recharge Volume	5,996,933	gal/yr
4	R = Site Recharge Volume	6.00	MG/yr
5	R = Site Recharge Volume	16430	gal/day

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

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT Islandia Preserve

DATA INPUT FIELD Alternative 2 **SHEET 1**

A	*Site Recharge Parameters*	*Value*	*Units*
1	Area of Site	9.87	acres
2	Precipitation Rate	42.82	inches
3	Acreage of Lawn	0.00	acres
4	Fraction of Land in Lawn	0.000	fraction
5	Evapotranspiration from Lawn	24.20	inches
6	Runoff from Lawn	0.90	inches
7	Acreage of Impervious	0.37	acres
8	Fraction of Land Impervious	0.037	fraction
9	Evaporation from Impervious	4.28	inches
10	Runoff from Impervious	0.00	inches
11	Acreage of Unvegetated	0.50	acres
12	Fraction of Land Unvegetated	0.051	fraction
13	Evapotrans. from Unvegetated	24.20	inches
14	Runoff from Unvegetated	2.1	inches
15	Acreage of Water	0.00	acres
16	Fraction of Site in Water	0.000	fraction
17	Evaporation from Water	30.00	inches
18	Makeup Water (if applicable)	0.00	inches
19	Acreage of Natural Area	0.00	acres
20	Fraction of Land Natural	0.000	fraction
21	Evapotrans. from Natural Area	24.20	inches
22	Runoff from Natural Area	0.30	inches
23	Acreage of Other Area	9.00	acres
24	Fraction of Land Other Area	0.912	fraction
25	Evapotrans. from Other Area	24.20	inches
26	Runoff from Other Area	0.31	inches
27	Acreage of Land Irrigated	0.00	acres
28	Fraction of Land Irrigated	0.000	fraction
29	Irrigation Rate	5.50	inches
30	Number of Dwellings	0	units
31	Water Use per Dwelling	0	gal/day
32	Wastewater Design Flow		gal/day
33	Commercial /STP Design Flow	7,766	gal/day

B	*Nitrogen Budget Parameters*	*Value*	*Units*
1	Persons per Dwelling	0.00	persons
2	Nitrogen per Person per Year	0.0	lbs
3	Sanitary Nitrogen Leaching Rate	0	percent
4	Area of Land Fertilized 1	9.00	acres
5	Fertilizer Application Rate 1	4.00	lbs/1000 sq ft
6	Fertilizer Nitrogen Leaching Rate 1	14	percent
7	Area of Land Fertilized 2	0.00	acres
8	Fertilizer Application Rate 2	0.50	lbs/1000 sq ft
9	Fertilizer Nitrogen Leaching Rate 2	14	percent
10	Pet Waste Application Rate	0.00	lbs/pet
11	Pet Waste Nitrogen Leaching Rate	2	percent
12	Area of Land Irrigated	9.00	acres
13	Irrigation Rate	5.50	inches
14	Irrigation Nitrogen Leaching Rate	15	percent
15	Nitrogen in Precipitation	1.00	mg/l
16	Precipitation Nitrogen Leaching Rate	15	percent
17	Nitrogen in Water Supply	1.00	mg/l
18	Nitrogen in Commercial/STP Flow	40.00	mg/l

C	*Comments*
1)	Please refer to user manual for data input instructions.

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE RECHARGE COMPUTATIONS Alternative 2 **SHEET 2**

A	*Lawn Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Lawn	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.90	inches
5	R(l) = P - (E + Q)	17.72	inches
6	R(L) = R(l) x A	0.00	inches

B	*Impervious Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Impervious	0.037	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	4.28	inches
4	Q = Runoff Rate	0.00	inches
5	R(i) = P - (E + Q)	38.54	inches
6	R(I) = R(i) x A	1.44	inches

C	*Unvegetated Area Recharge*		
1	A = Fraction of Land Unveg.	0.051	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	2.10	inches
5	R(u) = P - (E + Q)	16.52	inches
6	R(U) = R(u) x A	0.84	inches

D	*Water Area Loss*		
1	A = Fraction of Site in Water	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	0.00	inches
5	M = Makeup Water	0.00	inches
6	R(w) = {P - (E+Q)} - M	12.82	inches
7	R(W) = R(w) x A	0.00	inches

E	*Natural Area Recharge*		
1	A = Fraction of Land in Natural	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.30	inches
5	R(n) = P - (E + Q)	18.32	inches
6	R(N) = R(n) x A	0.00	inches

F	*Other Area Recharge*		
1	A = Fraction of Land in Other	0.912	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.31	inches
5	R(o) = P - (E + Q)	18.31	inches
6	R(O) = R(o) x A	16.70	inches

G	*Irrigation Recharge*		
1	A = Fraction of Land Irrigated	0.000	fraction
2	I = Irrigation Rate	5.50	inches
3	E = Evaptranspiration Rate	3.11	inches
4	Q = Runoff Rate	0.90	inches
5	R(irr) = I - (E + Q)	1.49	inches
6	R(IRR) = R(irr) x A	0.00	inches

H	*Wastewater Recharge*		
1	WDF = Wastewater Design Flow	7,766	gal/day
2	WDF = Wastewater Design Flow	378,984.68	cu ft/yr
3	A = Area of Site	429,937	sq ft
4	R(ww) = WDF/A	0.88	feet
5	R(WW) = Wastewater Recharge	10.58	inches

Total Site Recharge		
R(T) =	R(L) + R(I) + R(U) + R(W) + R(N) + R(O) + R(IRR) + R(WW)	
R(T) =	**29.56**	**inches**

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE NITROGEN BUDGET Alternative 2 **SHEET 3**

A	*Sanitary Nitrogen-Residential*	*Value*	*Units*
1	Number of Dwellings	0	units
2	Persons per Dwelling	0.00	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	0	lbs
5	LR = Leaching Rate	0	percent
6	N(S) = P x N x LR	0.00	lbs
7	N(S) = Sanitary Nitrogen	0.00	lbs

B	*Pet Waste Nitrogen*	*Value*	*Units*
1	AR = Application Rate	0.00	lbs/pet
2	Human Population	0	capita
3	Pets = 17 percent of capita	0	pets
4	N(p) = AR x pets	0.00	lbs
5	LR = Leaching Rate	2	percent
6	N(P) = N(p) x LR	0.00	lbs
7	N(P) = Pet Waste Nitrogen	0.00	lbs

C	*Sanitary Nitrogen (Commercial/STP)*		
1	CF = Commercial/STP Flow	7,766	gal/day
2	CF = Commercial/STP Flow	10,728,923	liters/yr
3	N = Nitrogen in Commercial	40.00	mg/l
4	N(S) = CF x N	429,156,926	milligrams
5	N(S) = Sanitary Nitrogen	946.29	lbs

D	*Water Supply Nitrogen*		
1	WDF = Wastewater Design Flow	7,766	gal/day
2	WDF = Wastewater Design Flow	10,728,923	liters/yr
3	N = Nitrogen in Water Supply	1.00	mg/l
4	N(WW) = WDF x N	10,728,923	milligrams
5	N(WW) = Wastewater Nitrogen	23.66	lbs

E	*Fertilizer Nitrogen 1*		
1	A = Area of Land Fertilized 1	392,040	sq ft
2	AR = Application Rate	4.00	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F1) = A x AR x LR	219.54	lbs
5	N(F1) = Fertilizer Nitrogen	219.54	lbs

F	*Fertilizer Nitrogen 2*		
1	A = Area of Land Fertilized 2	0	sq ft
2	AR = Application Rate	0.50	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F2) = A x AR x LR	0.00	lbs
5	N(F2) = Fertilizer Nitrogen	0.00	lbs

G	*Precipitation Nitrogen*		
1	R(n) = Natural Recharge (feet)	1.58	feet
2	A = Area of Site (sq ft)	429,937	sq ft
3	R(N) = R(n) x A	679,935	cu ft
4	R(N) = Natural Recharge (liters)	19,255,747	liters
5	N = Nitrogen in Precipitation	1.00	mg/l
6	LR = Leaching Rate	15	percent
7	N(ppt) = P(S) x N x LR	192,557	milligrams
8	N(ppt) = Precipitation Nitrogen	0.42	lbs

H	*Irrigation Nitrogen*		
1	R = Irrigation Recharge (inches)	1.49	inches
2	R = Irrigation Rate (feet)	0.12	feet
3	A = Area of Land Irrigated	392,040	sq ft
4	R(I) = R(irr) x A	48,732	cu ft
5	R(I) = Site Precipitation (liters)	1,380,086	liters
6	N = Nitrogen in Water Supply	1.00	mg/l
7	LR = Leaching Rate	15	percent
8	N(irr) = R(I) x N x LR	207,013	milligrams
9	N(irr) = Irrigation Nitrogen	0.46	lbs

Total Site Nitrogen	
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)
N=	1190.37 lbs

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

Islandia Preserve
Alternative 2

FINAL COMPUTATIONS

SHEET 4

A	*Nitrogen in Recharge*	*Value*	*Units*
1	N = Total Nitrogen (lbs)	1190.37	lbs
2	N = Total Nitrogen (milligrams)	540,428,775	milligrams
3	R(T) = Total Recharge (inches)	29.56	inches
4	R(T) = Total Recharge (feet)	2.46	feet
5	A = Area of Site	429,937	sq ft
6	R = R(T) x A	1,058,919	cu ft
7	R = Site Recharge Volume	29,988,593	liters
9	NR = N/R	18.02	mg/l

FINAL CONCENTRATION OF NITROGEN IN RECHARGE

18.02

B	*Site Recharge Summary*	*Value*	*Units*
1	R(T) = Total Site Recharge	29.56	inches/yr
2	R = Site Recharge Volume	1,058,919	cu ft/yr
3	R = Site Recharge Volume	7,921,267	gal/yr
4	R = Site Recharge Volume	7.92	MG/yr
5	R = Site Recharge Volume	21702	gal/day

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

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT Islandia Preserve

DATA INPUT FIELD Alternative 3 **SHEET 1**

A	*Site Recharge Parameters*	*Value*	*Units*
1	Area of Site	10.12	acres
2	Precipitation Rate	42.82	inches
3	Acreage of Lawn	5.53	acres
4	Fraction of Land in Lawn	0.546	fraction
5	Evapotranspiration from Lawn	24.20	inches
6	Runoff from Lawn	0.90	inches
7	Acreage of Impervious	4.65	acres
8	Fraction of Land Impervious	0.459	fraction
9	Evaporation from Impervious	4.83	inches
10	Runoff from Impervious	0.00	inches
11	Acreage of Unvegetated	0.00	acres
12	Fraction of Land Unvegetated	0.000	fraction
13	Evapotrans. from Unvegetated	24.20	inches
14	Runoff from Unvegetated	2.1	inches
15	Acreage of Water	0.00	acres
16	Fraction of Site in Water	0.000	fraction
17	Evaporation from Water	30.00	inches
18	Makeup Water (if applicable)	0.00	inches
19	Acreage of Natural Area	0.00	acres
20	Fraction of Land Natural	0.000	fraction
21	Evapotrans. from Natural Area	24.20	inches
22	Runoff from Natural Area	0.30	inches
23	Acreage of Other Area	0.00	acres
24	Fraction of Land Other Area	0.000	fraction
25	Evapotrans. from Other Area	0.00	inches
26	Runoff from Other Area	0.00	inches
27	Acreage of Land Irrigated	5.47	acres
28	Fraction of Land Irrigated	0.541	fraction
29	Irrigation Rate	5.50	inches
30	Number of Dwellings	0	units
31	Water Use per Dwelling	0	gal/day
32	Wastewater Design Flow		gal/day
33	Commercial /STP Design Flow	14,925	gal/day

B	*Nitrogen Budget Parameters*	*Value*	*Units*
1	Persons per Dwelling	0.00	persons
2	Nitrogen per Person per Year	0.0	lbs
3	Sanitary Nitrogen Leaching Rate	0	percent
4	Area of Land Fertilized 1	5.53	acres
5	Fertilizer Application Rate 1	2.30	lbs/1000 sq ft
6	Fertilizer Nitrogen Leaching Rate 1	14	percent
7	Area of Land Fertilized 2	0.00	acres
8	Fertilizer Application Rate 2	0.50	lbs/1000 sq ft
9	Fertilizer Nitrogen Leaching Rate 2	14	percent
10	Pet Waste Application Rate	0.00	lbs/pet
11	Pet Waste Nitrogen Leaching Rate	2	percent
12	Area of Land Irrigated	5.53	acres
13	Irrigation Rate	5.50	inches
14	Irrigation Nitrogen Leaching Rate	15	percent
15	Nitrogen in Precipitation	1.00	mg/l
16	Precipitation Nitrogen Leaching Rate	15	percent
17	Nitrogen in Water Supply	1.00	mg/l
18	Nitrogen in Commercial/STP Flow	10.00	mg/l

C	*Comments*
1)	Please refer to user manual for data input instructions.

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE RECHARGE COMPUTATIONS Alternative 3 **SHEET 2**

A	*Lawn Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Lawn	0.546	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.90	inches
5	R(l) = P - (E + Q)	17.72	inches
6	R(L) = R(l) x A	9.68	inches

B	*Impervious Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Impervious	0.459	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	4.83	inches
4	Q = Runoff Rate	0.00	inches
5	R(i) = P - (E + Q)	37.99	inches
6	R(I) = R(i) x A	17.46	inches

C	*Unvegetated Area Recharge*		
1	A = Fraction of Land Unveg.	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	2.10	inches
5	R(u) = P - (E + Q)	16.52	inches
6	R(U) = R(u) x A	0.00	inches

D	*Water Area Loss*		
1	A = Fraction of Site in Water	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	0.00	inches
5	M = Makeup Water	0.00	inches
6	R(w) = {P - (E+Q)} - M	12.82	inches
7	R(W) = R(w) x A	0.00	inches

E	*Natural Area Recharge*		
1	A = Fraction of Land in Natural	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.30	inches
5	R(n) = P - (E + Q)	18.32	inches
6	R(N) = R(n) x A	0.00	inches

F	*Other Area Recharge*		
1	A = Fraction of Land in Other	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	0.00	inches
4	Q = Runoff Rate	0.00	inches
5	R(o) = P - (E + Q)	42.82	inches
6	R(O) = R(o) x A	0.00	inches

G	*Irrigation Recharge*		
1	A = Fraction of Land Irrigated	0.541	fraction
2	I = Irrigation Rate	5.50	inches
3	E = Evaptranspiration Rate	3.11	inches
4	Q = Runoff Rate	0.90	inches
5	R(irr) = I - (E + Q)	1.49	inches
6	R(IRR) = R(irr) x A	0.81	inches

H	*Wastewater Recharge*		
1	WDF = Wastewater Design Flow	14,925	gal/day
2	WDF = Wastewater Design Flow	728,347.46	cu ft/yr
3	A = Area of Site	440,827	sq ft
4	R(ww) = WDF/A	1.65	feet
5	R(WW) = Wastewater Recharge	19.83	inches

Total Site Recharge		
R(T) =	R(L) + R(I) + R(U) + R(W) + R(N) + R(O) + R(IRR) + R(WW)	
R(T) =	47.77	inches

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE NITROGEN BUDGET — Alternative 3 — SHEET 3

A	*Sanitary Nitrogen-Residential*	*Value*	*Units*
1	Number of Dwellings	0	units
2	Persons per Dwelling	0.00	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	0	lbs
5	LR = Leaching Rate	0	percent
6	N(S) = P x N x LR	0.00	lbs
7	N(S) = Sanitary Nitrogen	0.00	lbs

B	*Pet Waste Nitrogen*	*Value*	*Units*
1	AR = Application Rate	0.00	lbs/pet
2	Human Population	0	capita
3	Pets = 17 percent of capita	27	pets
4	N(p) = AR x pets	0.00	lbs
5	LR = Leaching Rate	2	percent
6	N(P) = N(p) x LR	0.00	lbs
7	N(P) = Pet Waste Nitrogen	0.00	lbs

C	*Sanitary Nitrogen (Commercial/STP)*		
1	CF = Commercial/STP Flow	14,925	gal/day
2	CF = Commercial/STP Flow	20,619,261	liters/yr
3	N = Nitrogen in Commercial	10.00	mg/l
4	N(S) = CF x N	206,192,606	milligrams
5	N(S) = Sanitary Nitrogen	454.65	lbs

D	*Water Supply Nitrogen*		
1	WDF = Wastewater Design Flow	14,925	gal/day
2	WDF = Wastewater Design Flow	20,619,261	liters/yr
3	N = Nitrogen in Water Supply	1.00	mg/l
4	N(WW) = WDF x N	20,619,261	milligrams
5	N(WW) = Wastewater Nitrogen	45.47	lbs

E	*Fertilizer Nitrogen 1*		
1	A = Area of Land Fertilized 1	240,887	sq ft
2	AR = Application Rate	2.30	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F1) = A x AR x LR	77.57	lbs
5	N(F1) = Fertilizer Nitrogen	77.57	lbs

F	*Fertilizer Nitrogen 2*		
1	A = Area of Land Fertilized 2	0	sq ft
2	AR = Application Rate	0.50	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F2) = A x AR x LR	0.00	lbs
5	N(F2) = Fertilizer Nitrogen	0.00	lbs

G	*Precipitation Nitrogen*		
1	R(n) = Natural Recharge (feet)	2.26	feet
2	A = Area of Site (sq ft)	440,827	sq ft
3	R(N) = R(n) x A	996,962	cu ft
4	R(N) = Natural Recharge (liters)	28,233,956	liters
5	N = Nitrogen in Precipitation	1.00	mg/l
6	LR = Leaching Rate	15	percent
7	N(ppt) = P(S) x N x LR	282,340	milligrams
8	N(ppt) = Precipitation Nitrogen	0.62	lbs

H	*Irrigation Nitrogen*		
1	R = Irrigation Recharge (inches)	1.49	inches
2	R = Irrigation Rate (feet)	0.12	feet
3	A = Area of Land Irrigated	240,887	sq ft
4	R(I) = R(irr) x A	29,943	cu ft
5	R(I) = Site Precipitation (liters)	847,986	liters
6	N = Nitrogen in Water Supply	1.00	mg/l
7	LR = Leaching Rate	15	percent
8	N(irr) = R(I) x N x LR	127,198	milligrams
9	N(irr) = Irrigation Nitrogen	0.28	lbs

Total Site Nitrogen	
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)
N=	578.59 lbs

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

Islandia Preserve
Alternative 3

FINAL COMPUTATIONS

SHEET 4

A	*Nitrogen in Recharge*	*Value*	*Units*
1	N = Total Nitrogen (lbs)	578.59	lbs
2	N = Total Nitrogen (milligrams)	262,679,291	milligrams
3	R(T) = Total Recharge (inches)	47.77	inches
4	R(T) = Total Recharge (feet)	3.98	feet
5	A = Area of Site	440,827	sq ft
6	R = R(T) x A	1,754,927	cu ft
7	R = Site Recharge Volume	49,699,542	liters
9	NR = N/R	5.29	mg/l

FINAL CONCENTRATION OF NITROGEN IN RECHARGE

5.29

B	*Site Recharge Summary*	*Value*	*Units*
1	R(T) = Total Site Recharge	47.77	inches/yr
2	R = Site Recharge Volume	1,754,927	cu ft/yr
3	R = Site Recharge Volume	13,127,769	gal/yr
4	R = Site Recharge Volume	13.13	MG/yr
5	R = Site Recharge Volume	35966	gal/day

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

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT Islandia Preserve

DATA INPUT FIELD Alternative 4 **SHEET 1**

A	*Site Recharge Parameters*	*Value*	*Units*
1	Area of Site	10.41	acres
2	Precipitation Rate	42.82	inches
3	Acreage of Lawn	5.58	acres
4	Fraction of Land in Lawn	0.536	fraction
5	Evapotranspiration from Lawn	24.20	inches
6	Runoff from Lawn	0.90	inches
7	Acreage of Impervious	4.83	acres
8	Fraction of Land Impervious	0.464	fraction
9	Evaporation from Impervious	4.28	inches
10	Runoff from Impervious	0.00	inches
11	Acreage of Unvegetated	0.00	acres
12	Fraction of Land Unvegetated	0.000	fraction
13	Evapotrans. from Unvegetated	24.20	inches
14	Runoff from Unvegetated	2.1	inches
15	Acreage of Water	0.00	acres
16	Fraction of Site in Water	0.000	fraction
17	Evaporation from Water	30.00	inches
18	Makeup Water (if applicable)	0.00	inches
19	Acreage of Natural Area	0.00	acres
20	Fraction of Land Natural	0.000	fraction
21	Evapotrans. from Natural Area	24.20	inches
22	Runoff from Natural Area	0.30	inches
23	Acreage of Other Area	0.00	acres
24	Fraction of Land Other Area	0.000	fraction
25	Evapotrans. from Other Area	0.00	inches
26	Runoff from Other Area	0.00	inches
27	Acreage of Land Irrigated	5.58	acres
28	Fraction of Land Irrigated	0.536	fraction
29	Irrigation Rate	5.50	inches
30	Number of Dwellings	0	units
31	Water Use per Dwelling	0	gal/day
32	Wastewater Design Flow		gal/day
33	Commercial /STP Design Flow	14,925	gal/day

B	*Nitrogen Budget Parameters*	*Value*	*Units*
1	Persons per Dwelling	0.00	persons
2	Nitrogen per Person per Year	0.0	lbs
3	Sanitary Nitrogen Leaching Rate	0	percent
4	Area of Land Fertilized 1	3.24	acres
5	Fertilizer Application Rate 1	2.30	lbs/1000 sq ft
6	Fertilizer Nitrogen Leaching Rate 1	14	percent
7	Area of Land Fertilized 2	2.34	acres
8	Fertilizer Application Rate 2	0.50	lbs/1000 sq ft
9	Fertilizer Nitrogen Leaching Rate 2	14	percent
10	Pet Waste Application Rate	0.00	lbs/pet
11	Pet Waste Nitrogen Leaching Rate	2	percent
12	Area of Land Irrigated	5.58	acres
13	Irrigation Rate	5.50	inches
14	Irrigation Nitrogen Leaching Rate	15	percent
15	Nitrogen in Precipitation	1.00	mg/l
16	Precipitation Nitrogen Leaching Rate	15	percent
17	Nitrogen in Water Supply	1.00	mg/l
18	Nitrogen in Commercial/STP Flow	10.00	mg/l

C	*Comments*
1)	Please refer to user manual for data input instructions.

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE RECHARGE COMPUTATIONS Alternative 4 **SHEET 2**

A	*Lawn Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Lawn	0.536	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.90	inches
5	R(l) = P - (E + Q)	17.72	inches
6	R(L) = R(l) x A	9.50	inches

B	*Impervious Area Recharge*	*Value*	*Units*
1	A = Fraction of Land in Impervious	0.464	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	4.28	inches
4	Q = Runoff Rate	0.00	inches
5	R(i) = P - (E + Q)	38.54	inches
6	R(I) = R(i) x A	17.88	inches

C	*Unvegetated Area Recharge*		
1	A = Fraction of Land Unveg.	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	2.10	inches
5	R(u) = P - (E + Q)	16.52	inches
6	R(U) = R(u) x A	0.00	inches

D	*Water Area Loss*		
1	A = Fraction of Site in Water	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evaporation Rate	30.00	inches
4	Q = Runoff Rate	0.00	inches
5	M = Makeup Water	0.00	inches
6	R(w) = {P - (E+Q)} - M	12.82	inches
7	R(W) = R(w) x A	0.00	inches

E	*Natural Area Recharge*		
1	A = Fraction of Land in Natural	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	24.20	inches
4	Q = Runoff Rate	0.30	inches
5	R(n) = P - (E + Q)	18.32	inches
6	R(N) = R(n) x A	0.00	inches

F	*Other Area Recharge*		
1	A = Fraction of Land in Other	0.000	fraction
2	P = Precipitation Rate	42.82	inches
3	E = Evapotranspiration Rate	0.00	inches
4	Q = Runoff Rate	0.00	inches
5	R(o) = P - (E + Q)	42.82	inches
6	R(O) = R(o) x A	0.00	inches

G	*Irrigation Recharge*		
1	A = Fraction of Land Irrigated	0.536	fraction
2	I = Irrigation Rate	5.50	inches
3	E = Evaptranspiration Rate	3.11	inches
4	Q = Runoff Rate	0.90	inches
5	R(irr) = I - (E + Q)	1.49	inches
6	R(IRR) = R(irr) x A	0.80	inches

H	*Wastewater Recharge*		
1	WDF = Wastewater Design Flow	14,925	gal/day
2	WDF = Wastewater Design Flow	728,347.46	cu ft/yr
3	A = Area of Site	453,460	sq ft
4	R(ww) = WDF/A	1.61	feet
5	R(WW) = Wastewater Recharge	19.27	inches

Total Site Recharge		
R(T) =	R(L) + R(I) + R(U) + R(W) + R(N) + R(O) + R(IRR) + R(WW)	
R(T) =	**47.45**	**inches**

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

SITE NITROGEN BUDGET

Alternative 4 SHEET 3

A	*Sanitary Nitrogen-Residential*	*Value*	*Units*
1	Number of Dwellings	0	units
2	Persons per Dwelling	0.00	capita
3	P = Population	0.00	capita
4	N = Nitrogen per person	0	lbs
5	LR = Leaching Rate	0	percent
6	N(S) = P x N x LR	0.00	lbs
7	N(S) = Sanitary Nitrogen	0.00	lbs

B	*Pet Waste Nitrogen*	*Value*	*Units*
1	AR = Application Rate	0.00	lbs/pet
2	Human Population	0	capita
3	Pets = 17 percent of capita	0	pets
4	N(p) = AR x pets	0.00	lbs
5	LR = Leaching Rate	2	percent
6	N(P) = N(p) x LR	0.00	lbs
7	N(P) = Pet Waste Nitrogen	0.00	lbs

C	*Sanitary Nitrogen (Commercial/STP)*		
1	CF = Commercial/STP Flow	14,925	gal/day
2	CF = Commercial/STP Flow	20,619,261	liters/yr
3	N = Nitrogen in Commercial	10.00	mg/l
4	N(S) = CF x N	206,192,606	milligrams
5	N(S) = Sanitary Nitrogen	454.65	lbs

D	*Water Supply Nitrogen*		
1	WDF = Wastewater Design Flow	14,925	gal/day
2	WDF = Wastewater Design Flow	20,619,261	liters/yr
3	N = Nitrogen in Water Supply	1.00	mg/l
4	N(WW) = WDF x N	20,619,261	milligrams
5	N(WW) = Wastewater Nitrogen	45.47	lbs

E	*Fertilizer Nitrogen 1*		
1	A = Area of Land Fertilized 1	141,134	sq ft
2	AR = Application Rate	2.30	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F1) = A x AR x LR	45.45	lbs
5	N(F1) = Fertilizer Nitrogen	45.45	lbs

F	*Fertilizer Nitrogen 2*		
1	A = Area of Land Fertilized 2	101,930	sq ft
2	AR = Application Rate	0.50	lbs/1000 sf
3	LR = Leaching Rate	14	percent
4	N(F2) = A x AR x LR	7.14	lbs
5	N(F2) = Fertilizer Nitrogen	7.14	lbs

G	*Precipitation Nitrogen*		
1	R(n) = Natural Recharge (feet)	2.28	feet
2	A = Area of Site (sq ft)	453,460	sq ft
3	R(N) = R(n) x A	1,034,644	cu ft
4	R(N) = Natural Recharge (liters)	29,301,108	liters
5	N = Nitrogen in Precipitation	1.00	mg/l
6	LR = Leaching Rate	15	percent
7	N(ppt) = P(S) x N x LR	293,011	milligrams
8	N(ppt) = Precipitation Nitrogen	0.65	lbs

H	*Irrigation Nitrogen*		
1	R = Irrigation Recharge (inches)	1.49	inches
2	R = Irrigation Rate (feet)	0.12	feet
3	A = Area of Land Irrigated	243,065	sq ft
4	R(I) = R(irr) x A	30,214	cu ft
5	R(I) = Site Precipitation (liters)	855,653	liters
6	N = Nitrogen in Water Supply	1.00	mg/l
7	LR = Leaching Rate	15	percent
8	N(irr) = R(I) x N x LR	128,348	milligrams
9	N(irr) = Irrigation Nitrogen	0.28	lbs

Total Site Nitrogen	
N=	N(S) + N(P) + N(WW) + N(F1) + N(F2) + N(ppt) + N(irr)
N=	553.63 lbs

SIMULATION OF NITROGEN IN RECHARGE (SONIR)

NELSON, POPE & VOORHIS, LLC MICROCOMPUTER MODEL

NAME OF PROJECT

Islandia Preserve
Alternative 4

FINAL COMPUTATIONS

SHEET 4

A	*Nitrogen in Recharge*	*Value*	*Units*
1	N = Total Nitrogen (lbs)	553.63	lbs
2	N = Total Nitrogen (milligrams)	251,347,869	milligrams
3	R(T) = Total Recharge (inches)	47.45	inches
4	R(T) = Total Recharge (feet)	3.95	feet
5	A = Area of Site	453,460	sq ft
6	R = R(T) x A	1,793,205	cu ft
7	R = Site Recharge Volume	50,783,562	liters
9	NR = N/R	4.95	mg/l

FINAL CONCENTRATION OF NITROGEN IN RECHARGE

4.95

B	*Site Recharge Summary*	*Value*	*Units*
1	R(T) = Total Site Recharge	47.45	inches/yr
2	R = Site Recharge Volume	1,793,205	cu ft/yr
3	R = Site Recharge Volume	13,414,105	gal/yr
4	R = Site Recharge Volume	13.41	MG/yr
5	R = Site Recharge Volume	36751	gal/day

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