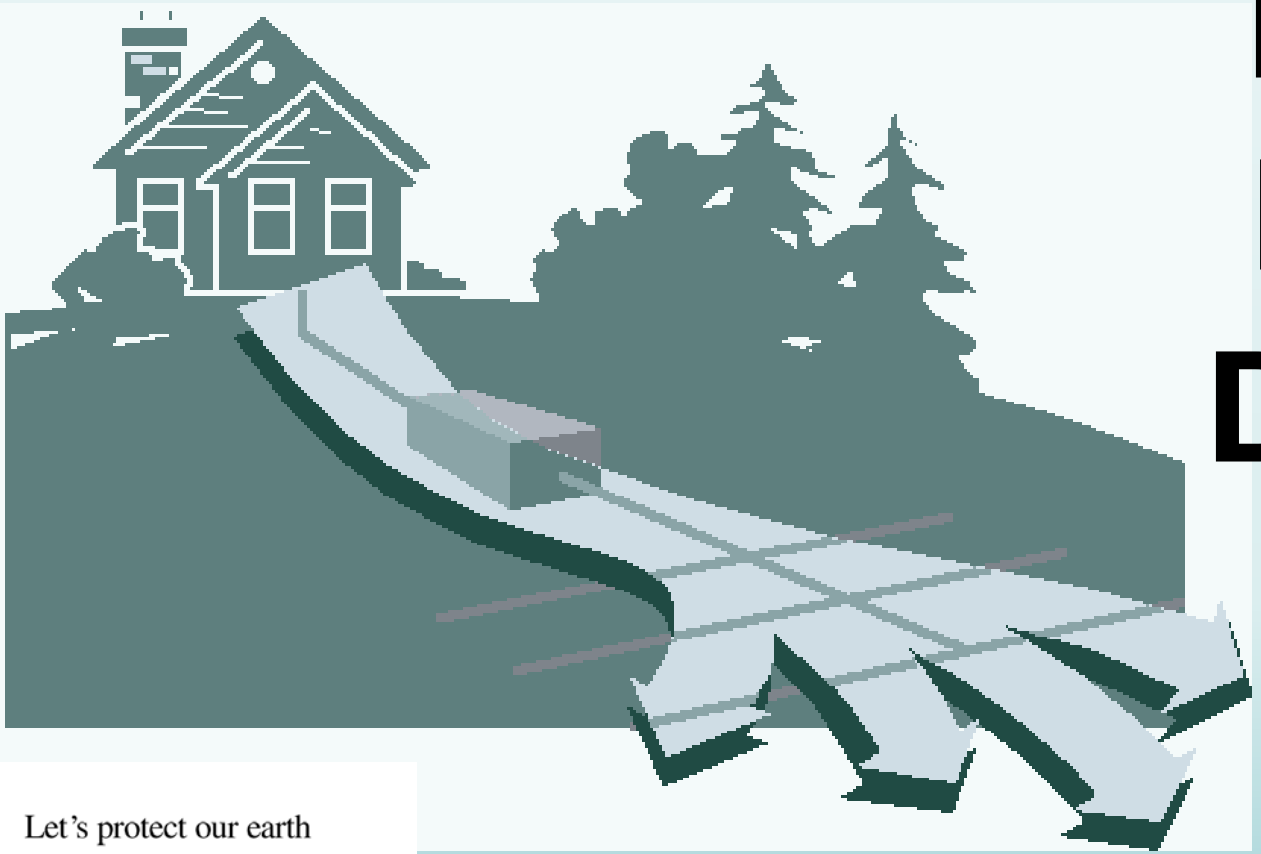


# HUC11 Nitrate Dilution Model


Jeffrey L. Hoffman

NJDEP

NJ Geological & Water Survey


October 2016

Let's protect our earth

NEW JERSEY DEPARTMENT
OF ENVIRONMENTAL PROTECTION

# Goals

- Estimate area that recharges sufficient water to dilute nitrate in effluent to a target concentration
- Reasonable input values
- Consistent methodology
- Defensible

# Model

*conservation of mass*

Nitrate In = Nitrate Out

# Nitrate In

- P: occupancy rate
  # of people per home

- N: nitrate loading rate
  pounds nitrate per person per year

# Nitrate Out

- R: recharge
  inches per year
- T: nitrate after dilution
  mg/l
- A: average lot size
  acres

# Trela Douglas Model

$$4.42 \times P \times N = R \times T \times A$$

- In use in NJ since 1970's
- Wide application
  - ✓ Pinelands
  - ✓ Highlands
  - ✓ Municipalities
- SAB reviewed
- Solve for A

# Assumptions

- Septic tank only source of nitrate on lot
- No upgradient sources of nitrate
- All of area provides recharge, no runoff
- Complete mixing of leachate with recharge

# Nitrate In Variables

People per Home (P)

- 3
- Highlands uses 4

$NO_3$ loading rate (N)

- 10 lbs/person/home
- Never challanged

# Nitrate Out Variables

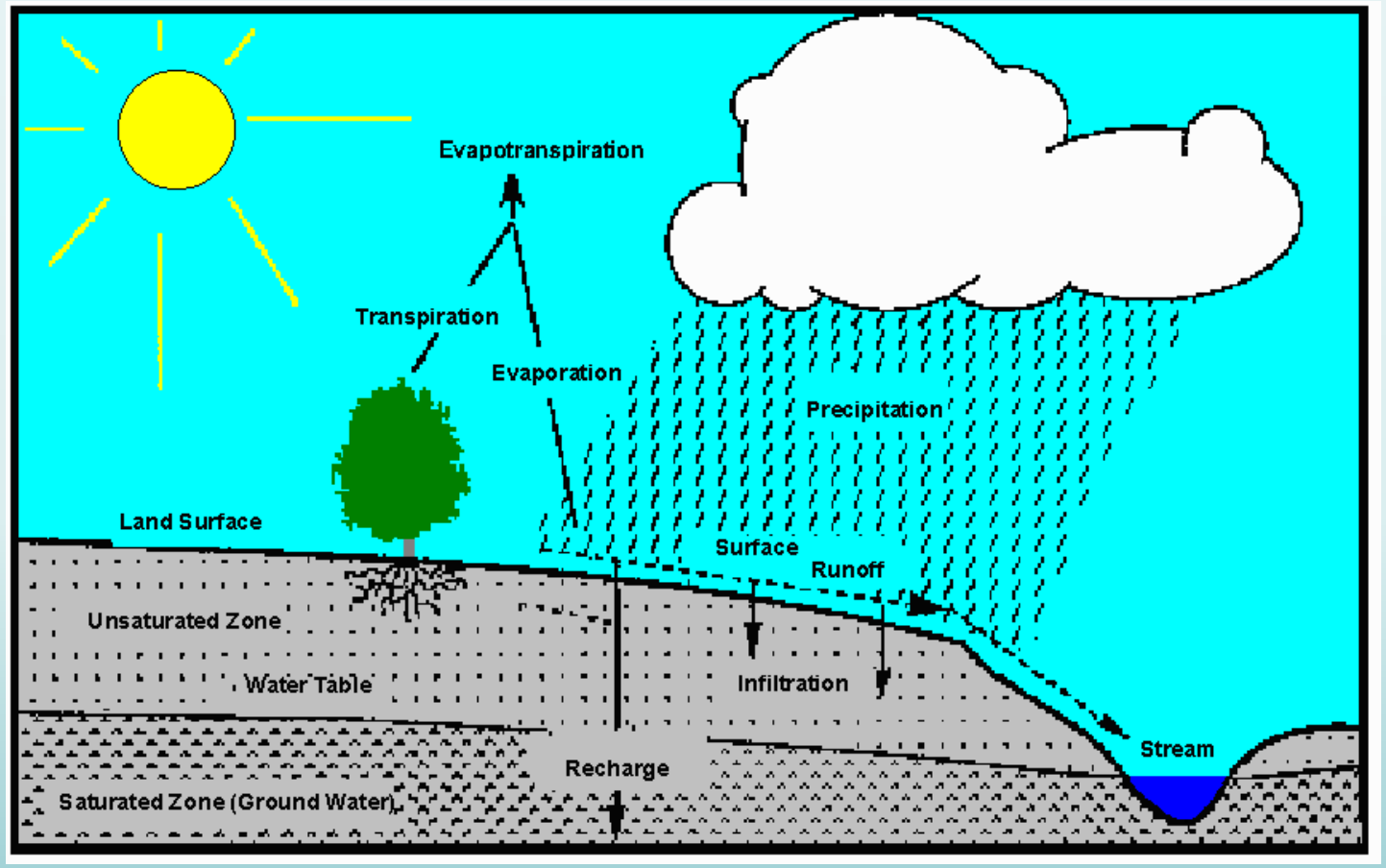
## Recharge (R)

- Based on average precipitation
- GSR-32 methodology
- What makes it below root zone
- No wetlands, hydric soils, water

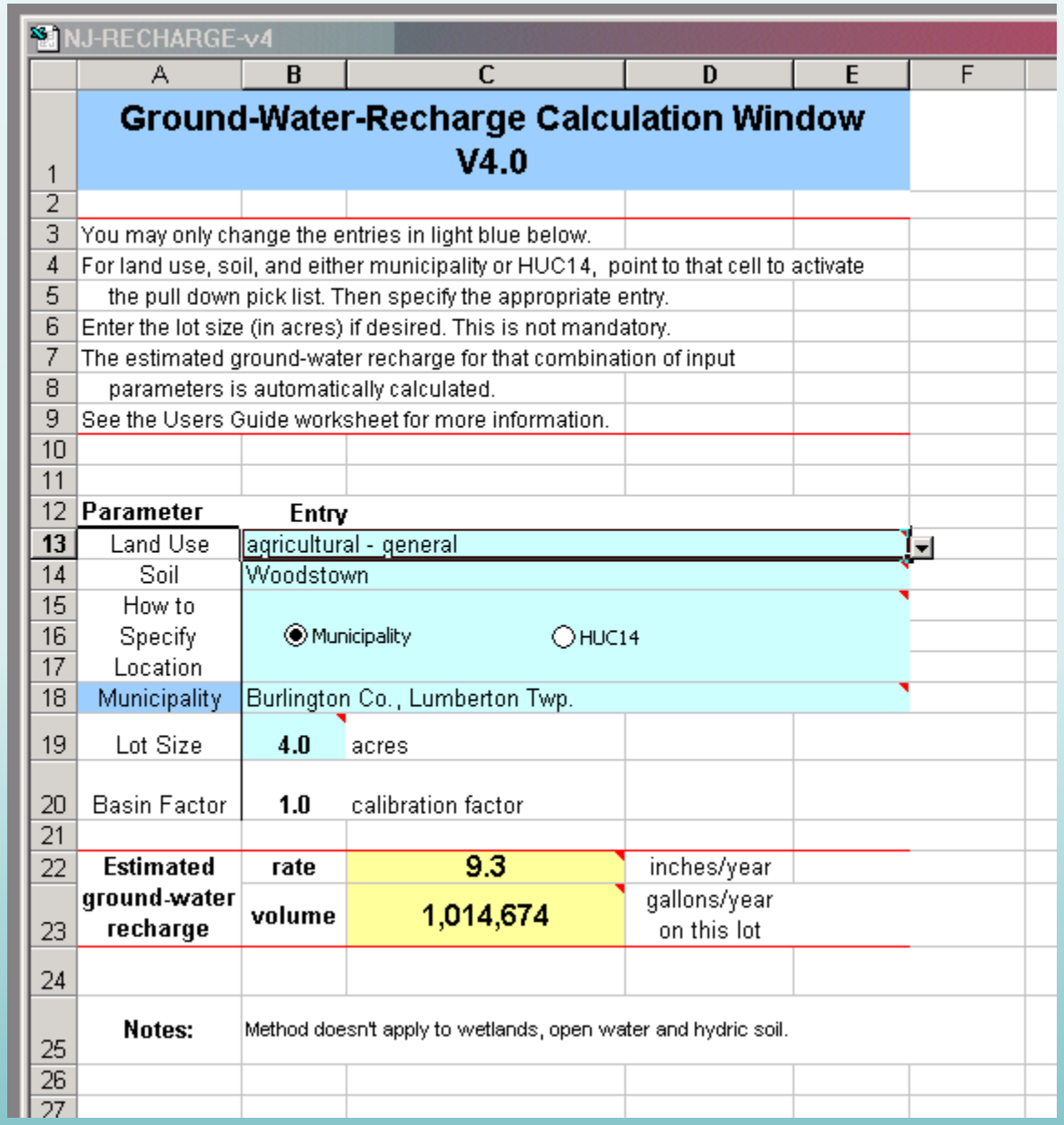
## Nitrate Target (T)

- 2 mg/l
- Highlands more restrictive

# Recharge



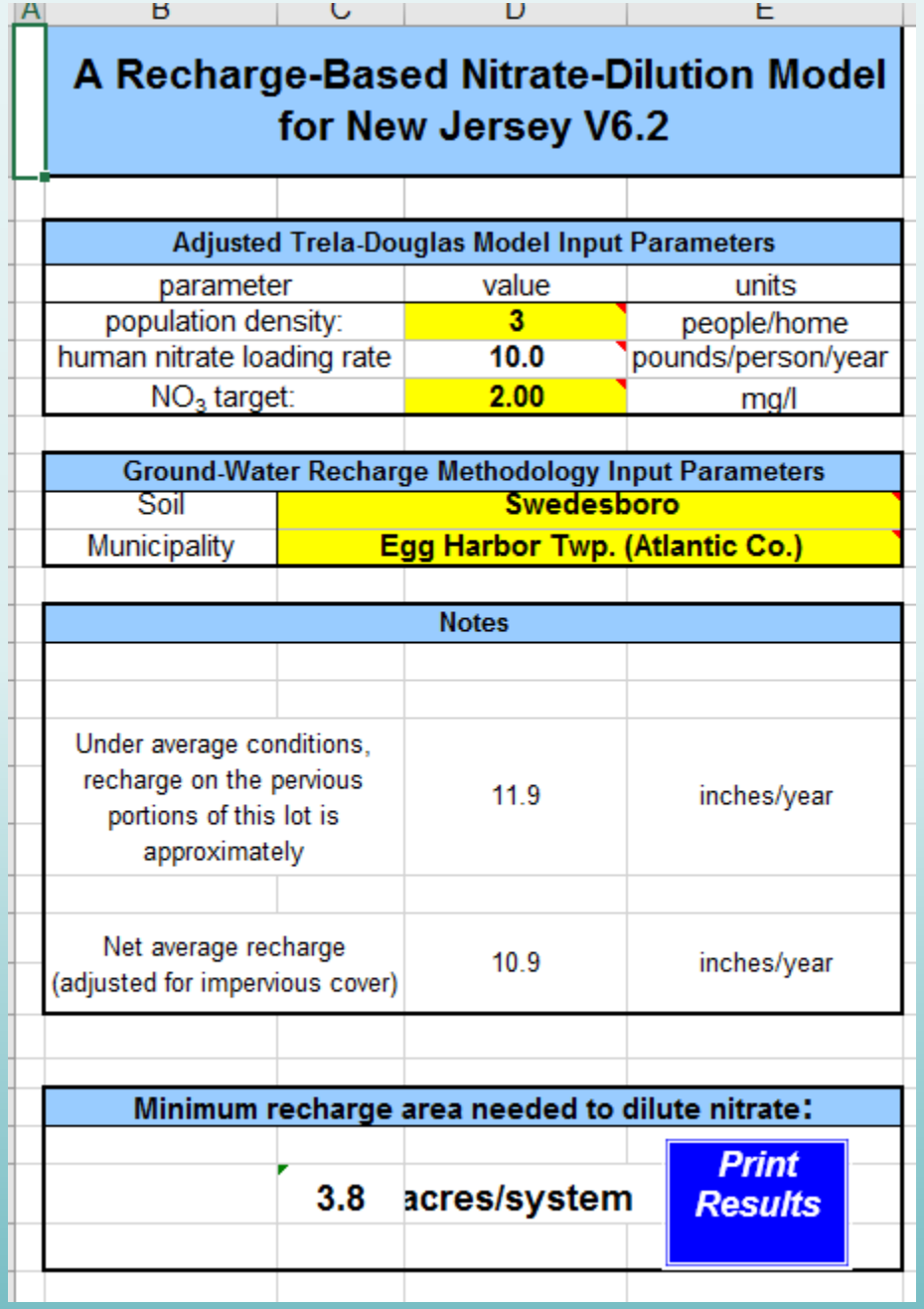

"A Method for Evaluating Ground-Water-Recharge Areas in New Jersey" by Charles and others, 1993, GSR-32


NJ-RECHARGE-v4
Ground-Water-Recharge Calculation Window
V4.0
You may only change the entries in light blue below.
For land use, soil, and either municipality or HUC14, point to that cell to activate
the pull down pick list. Then specify the appropriate entry.
Enter the lot size (in acres) if desired. This is not mandatory.
The estimated ground-water recharge for that combination of input
parameters is automatically calculated.
See the Users Guide worksheet for more information.
Parameter
Entry
Land Use
agricultural - general
Soil
Woodstown
How to Specify Location
Municipality
HUC14
Municipality
Burlington Co., Lumberton Twp.
Lot Size
4.0
acres
Basin Factor
1.0
calibration factor
Estimated ground-water recharge
rate
9.3
inches/year
volume
1,014,674
gallons/year on this lot
Notes:
Method doesn't apply to wetlands, open water and hydric soil.

# Lot-Specific Nitrate Dilution Excel File

Time intensive
Different lot size
for every soil &
municipality

OFR 04-1



**A Recharge-Based Nitrate-Dilution Model for New Jersey V6.2**

| Adjusted Trela-Douglas Model Input Parameters | | |
|---|---|---|
| parameter | value | units |
| population density: | 3 | people/home |
| human nitrate loading rate | 10.0 | pounds/person/year |
| $NO_3$ target: | 2.00 | mg/l |

| Ground-Water Recharge Methodology Input Parameters | |
|---|---|
| Soil | Swedesboro |
| Municipality | Egg Harbor Twp. (Atlantic Co.) |

| Notes | | |
|---|---|---|
| Under average conditions, recharge on the pervious portions of this lot is approximately | 11.9 | inches/year |
| Net average recharge (adjusted for impervious cover) | 10.9 | inches/year |

**Minimum recharge area needed to dilute nitrate:**

3.8 acres/system

Print Results

# HUC11 NO3 Model

**A Recharge-Based HUC11-Scale Nitrate-Carrying-Capacity Planning Exercise for New Jersey, MS Excel Workbook, version 3.0**

| County & Municipality | population density | $NO_3$ target | human nitrate loading rate |
|---|---|---|---|
| Salem_Pennsville Township | 3 | 2 | 10 |
| | people/home | mg/l | pounds/person/year |

| HUC11s in this Municipality | | Carrying Capacity of Recharging Land in each HUC11 | |
|---|---|---|---|
| # | *name* | Septic Density (acres/home) | Average Recharge (inches/yr) |
| 02040206020 | Pennsville / Penns Grove tribs | **11.6** | 5.7 |
| 02040206030 | Salem R(above 39d40m14s dam)/Salem Canal | **7.2** | 9.2 |
| 02040206040 | Salem River (below 39d40m14s dam) | **7.6** | 8.7 |

**Limitations**

- This tool is intended for unsewered areas.
- This tool is not for use in Hudson and Essex Counties.
- No estimates of recharge on hydric soils or wetlands.

**Instructions**

1) In the County & Municipality box click on the green box. Use the drop down menu to specify the county and municipality.

2) The Average Recharge column updates automatically.

3) Input the popluation density and nitrate target in the appropriate green boxes. **Note that N.J.A.C. 7:15 requires a maximum nitrate target of 2 mg/L and a minimum population density of 3 persons per household, except in the Highlands. Differing standards apply in the Highlands.**

4) The Septic Density column shows the area (assumed to supply recharge at the Average Recharge rate) needed to dilute the input loading of nitrate to the target concentration. This automatically updates based on the data entered in the green boxes.

See the Users Guide worksheet for more information.

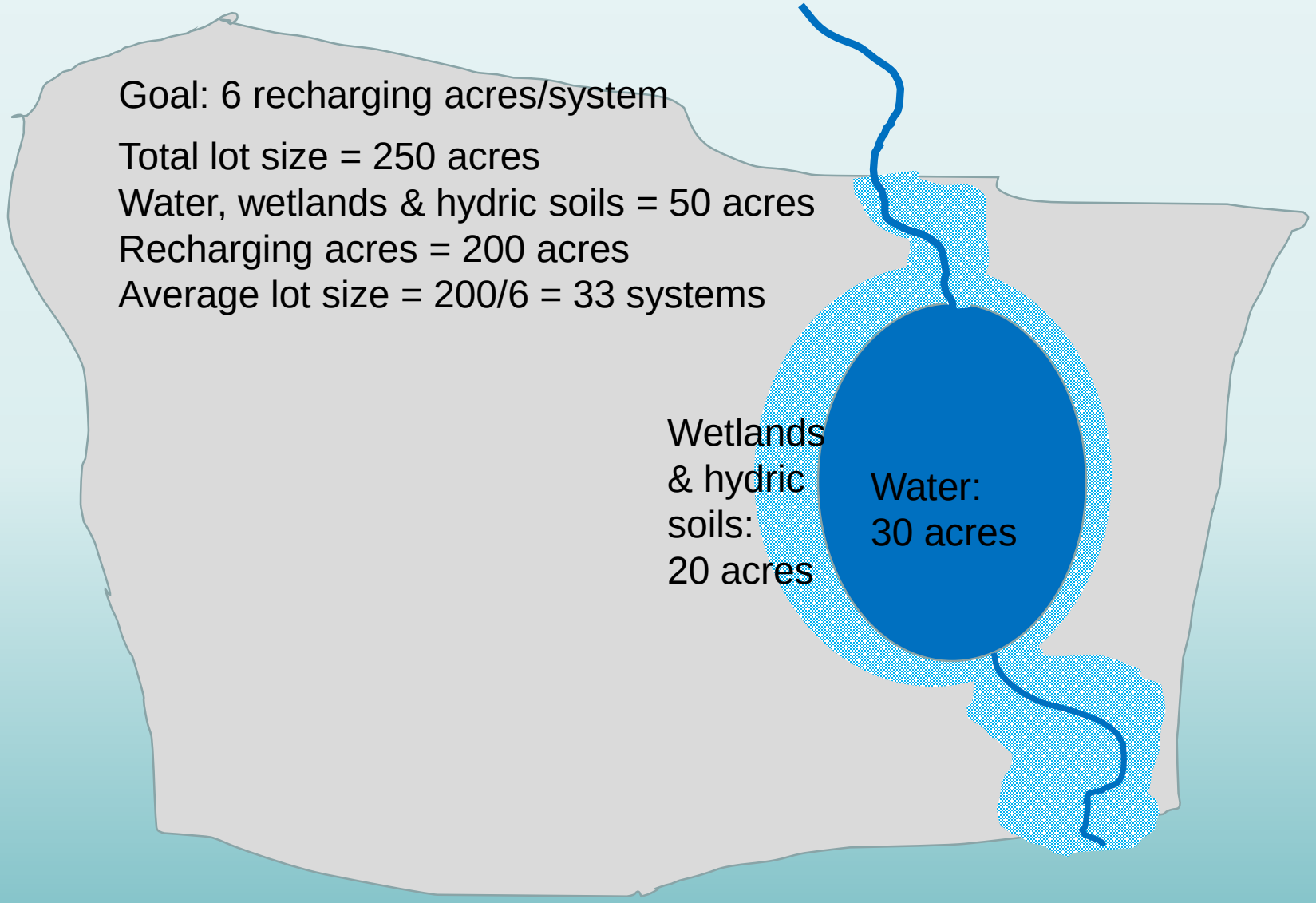
# Limitations/Features

- Average lot sizes per HUC11
  - ✓ Multiple zonings per municipality, maybe
  - ✓ Need to determine HUC11s
- No credit for $NO_3$ treatment technology
- Required recharging land per septic system
  - ✓ Eliminate water, wetlands, hydric soils
- Only $NO_3$ from lot
  - ✓ No credit for nearby areas of clean recharge
  - ✓ No penalty for nearby $NO_3$ loading

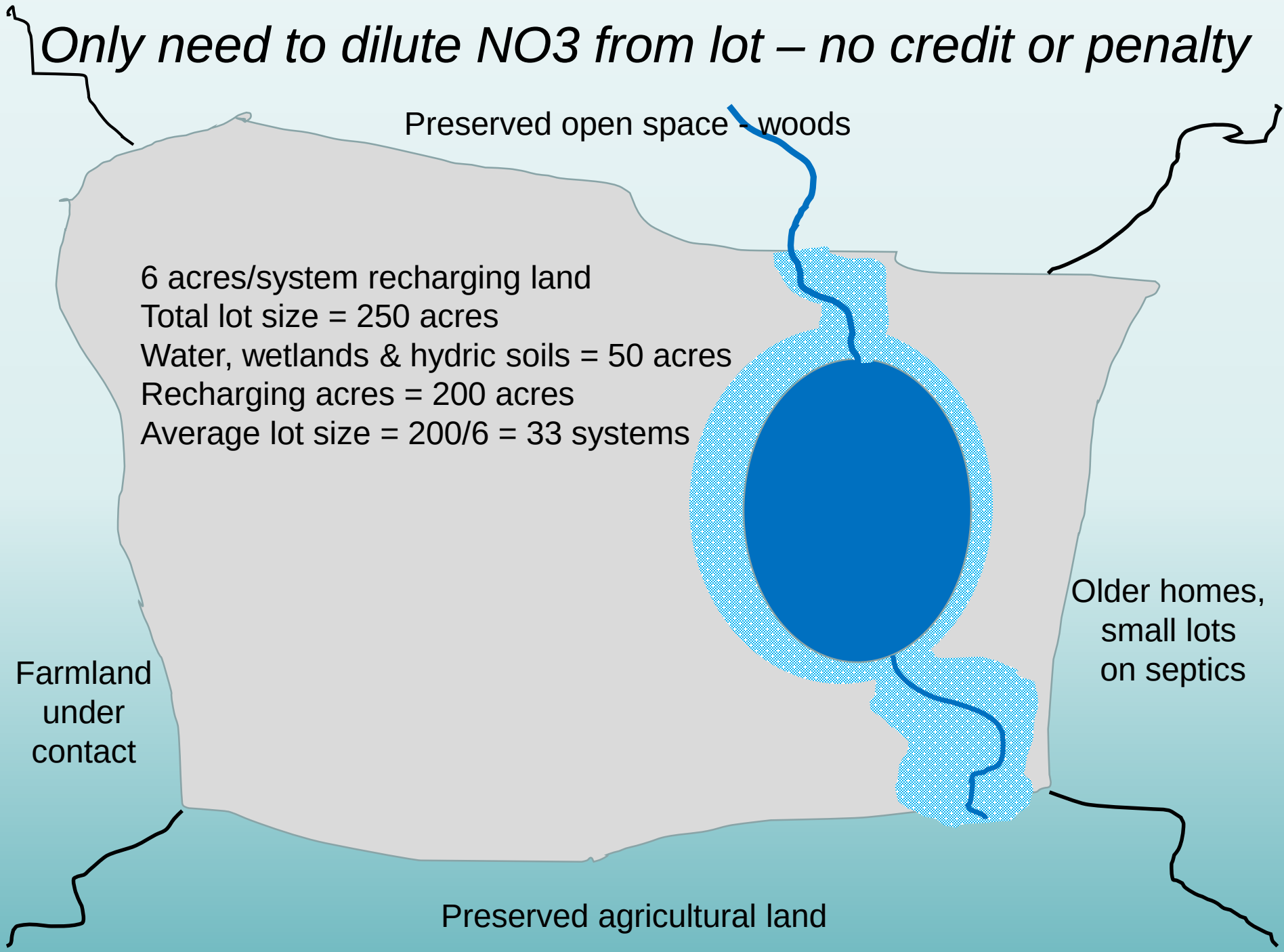
# Eliminate water, wetlands, hydric soils

Goal: 6 recharging acres/system

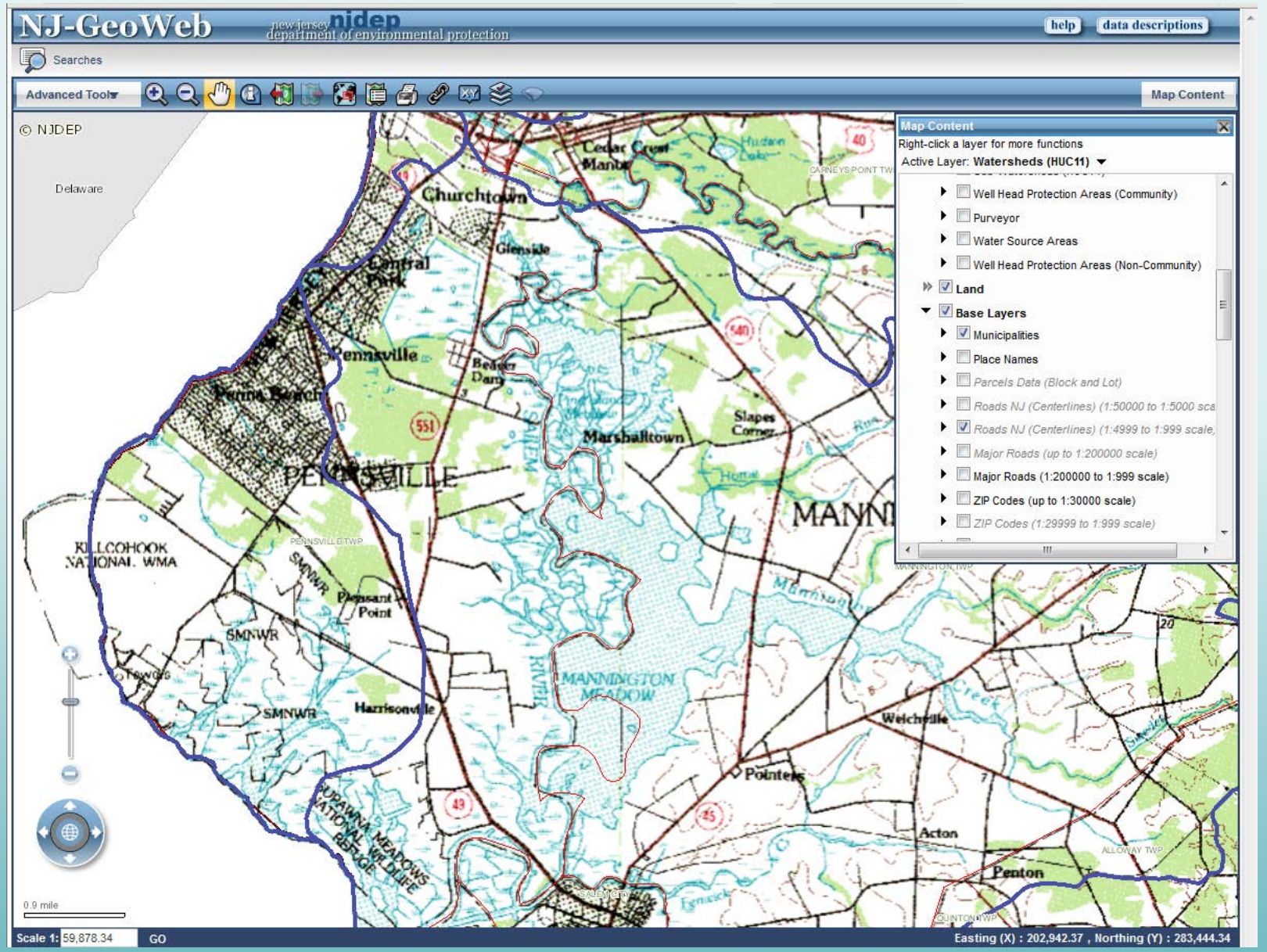
Total lot size = 250 acres
Water, wetlands & hydric soils = 50 acres
Recharging acres = 200 acres
Average lot size = 200/6 = 33 systems



# *Only need to dilute NO3 from lot – no credit or penalty*



# Use DEP's GEOWEB for HUC11s



# References

www.nj.gov/dep/wrm/index.html

http://www.nj.gov/dep/wqmp/guidance.html

**Nitrate Dilution Model Related Information**

- Nitrate as a Surrogate for Assessing Impact of Development Using Individual Subsurface Sewage Disposal Systems on Ground Water Quality
  May 21, 2007
- A Recharge-Based Nitrate-Dilution Model for New Jersey, v7 for Excel 2010 (MS Excel)
- A Recharge-Based HUC 11-Scale Nitrate-Carrying-Capacity Planning Exercise for New Jersey, MS Excel Workbook version 3.0 (MS Excel Workbook)
- A Recharge-Based Nitrate-Dilution Model for Small Commercial Establishments in New Jersey, v2.2 (MS Excel)
- Map of New Jersey Septic Densities Based on Regional HUC 11 Analysis - this map depicts statewide variations in HUC 11 septic densities
- Septic Density per HUC 11 (MS Excel) - average acres per individual subsurfacesewage disposal system, HUC 11s by County and HUC 11s by Municipality

# References

www.njgeology.org

| Reference | Link |
|---|---|
| Recharge report GSR 32 | http://www.njgeology.org/pricelst/gsreport/gsr32.pdf |
| Recharge Excel | http://www.state.nj.us/dep/njgs/geodata/dgs99-2.htm |
| Nitrate Dilution Report | http://www.state.nj.us/dep/njgs/pricelst/ofreport/ofr04-1.pdf |
| Nitrate Dilution Excel | http://www.state.nj.us/dep/njgs/geodata/dgs02-6.htm |
| Nitrate Dilution IC | http://www.state.nj.us/dep/njgs/enviroed/infocirc/nitratedilutionFAQ.pdf |

Thank You

Questions?