



# Critical Aquifer Recharge Areas Review

## Draft Final Report

CARA Review Committee Meeting 4  
May 14, 2013

Mike Murray HDR

Michael Kasch HDR

Michael Hermanson Spokane County Utilities

# Presentation Outline

- Draft Final CARA Review Report Overview
  - Report Structure
  - Technical Overview and Recommendations
  - CARA Spreadsheet
- Gather Comments
- Roundtable Discussion



# Report Structure

- **Executive Summary**
  - Overview of project and recommendations
- **Attachment A**
  - Guidance for analysis
- **Attachment B**
  - Summary of project technical review
- **Attachment C**
  - Summary of stakeholder involvement

# Review of Existing Code

- *Non-residential uses in moderate and high susceptibility areas shall have a disposal system that protects the aquifer, <90 gallons of wastewater per acre per day*
- County required to regularly review protection measures as effective, enforceable, and equitable
- Review concluded
  - Code protects aquifers for most situations
  - However a site specific approach is recommended to meet the goals of effective, enforceable, and equitable

# Evaluate Standard Revisions

- Examined the characteristics of non-residential wastewater
- Reviewed potential fate and transport of wastewater
  - Nitrate – high mobile and primary contaminant
  - Phosphorus – connectivity to surface water and Spokane River TMDL

# Recommended Approach

- Adopt a three level approach
  - Level 1 CARA spreadsheet (soil mixing) with a few project inputs
  - Level 2 CARA spreadsheet with a few project inputs and additional supporting information
  - Level 3 If Level 1 and 2 do not work, use WDOH Groundwater Mixing analysis or propose and have County approved alternative analytical approach

# Analysis Methods

- Level 1 and 2
  - CARA spreadsheet  
Soil nitrogen leachate mixing analysis
    - Checks hydraulic loading requirement
    - Checks nitrate concentration
- Level 3
  - WDOH LOSS spreadsheet  
Groundwater nitrogen mixing analysis
    - Checks groundwater nitrate values
- All Levels
  - Distance to surface water
    - Shoreline Master Program protects surface water

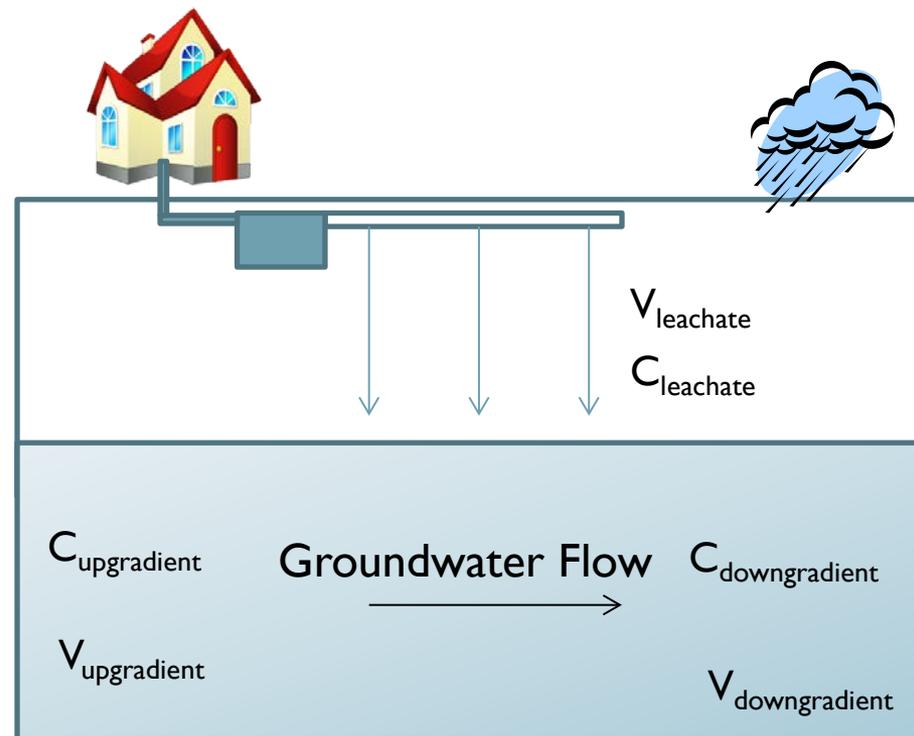
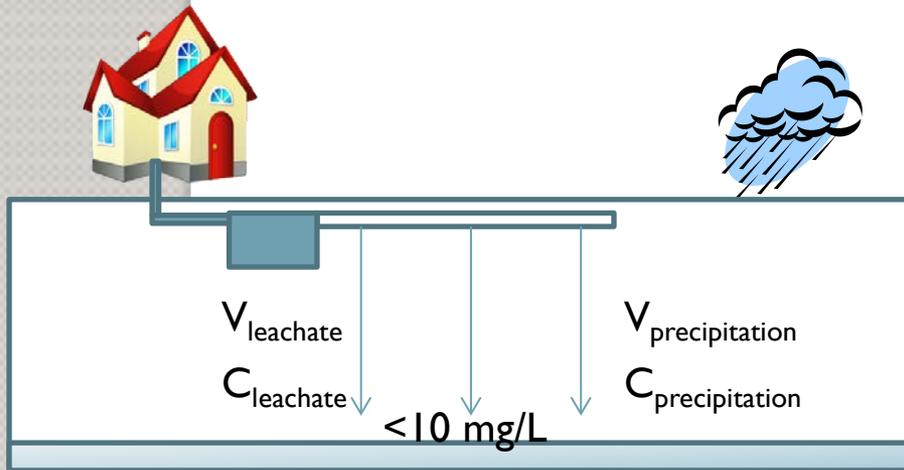
# Spreadsheet Inputs

- CARA Spreadsheet
  - Level 1
    - Parcel lot size
    - Recharge
    - Wastewater volume
    - Drainfield area
    - Soil type
    - Surface water information
  - Level 2
    - Effluent nitrate concentration
    - Soil denitrification
    - Precipitation nitrate concentration
- LOSS Spreadsheet
  - Level 3
    - Level 1 and 2 information
    - Groundwater hydraulic conductivity
    - Groundwater gradient
    - Upgradient groundwater nitrate concentration

# Nitrogen Assessment

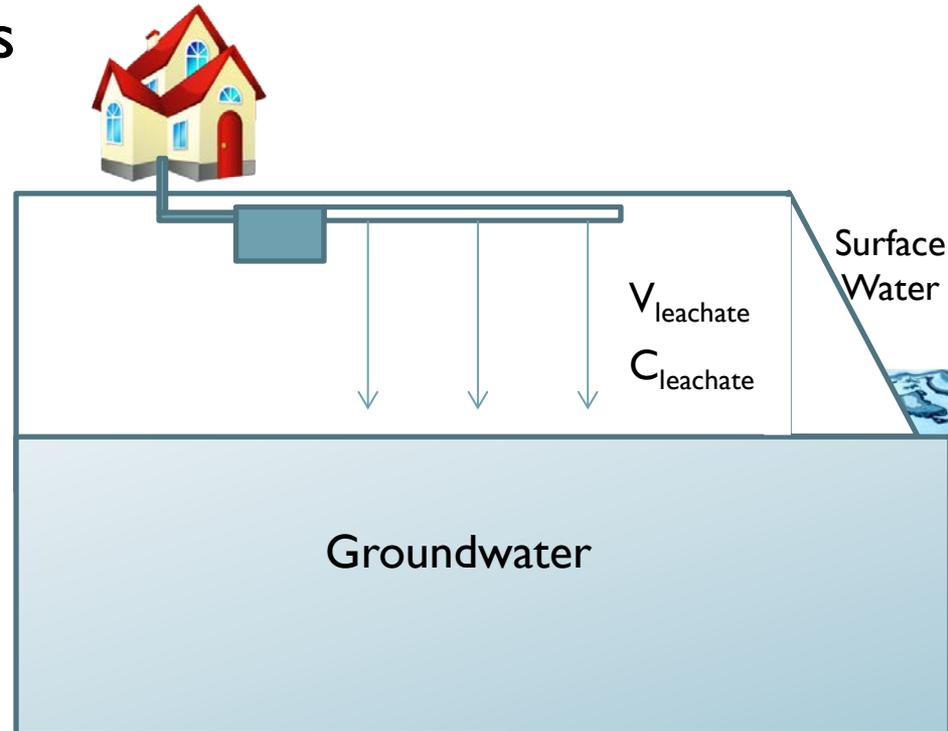
- Levels 1 and 2
- Soil groundwater interface nitrogen concentration  $< 10$  mg/L

- Level 3
- Groundwater nitrogen concentration  $< 5$  mg/L



# Phosphorus Assessment

- Distance of drain field to surface water, soil-groundwater-surface water pathway
  - Shoreline Master Plan provides general protection
  - Restricts commercial/industrial uses
  - 200-foot buffer
    - Checked using Montana breakthrough analysis, >20 years
- Spreadsheet requires information on surface water and a map
  - Spokane County can require further evaluation



# CARA Spreadsheet

ON-SITE SEPTIC SYSTEM ANALYSIS					
<b>Instructions:</b>	Enter information into areas shaded green. Red values must be updated.				
<b>Project name:</b>	ABC Church				
<b>Completed by and Date:</b>	John Doe, May 4, 2013				
<b>Facility type, size and description:</b>	Church, 5 acre parcel, 10,000 square foot building.				
<b>Address:</b>	####, Spokane County				
<b>Name of nearest waterbody:</b>	Spokane River				
<b>Distance to shoreline:</b>	2 miles				
<b>Depth to groundwater:</b>	75 feet, based on driller well logs within 1/4 mile				
<b>Include a map of the parcel.</b>	Attached				
Input Values		Sign	Values	Units	Instructions
Parcel lot size		A <sub>P</sub>	5	acre	Site specific 1 acre = 43,560 ft <sup>2</sup>
Recharge		R	4	in/yr	Use recharge Map
Wastewater volume		V <sub>W</sub>	300	gpd	Use table or provide basis
Drainfield area		A <sub>D</sub>	900	ft <sup>2</sup>	Primary drainfield area
Soil Type	Type 4 - Fine sands, loamy fine			unitless	Use Drop Menu and WAC 246-272A-0220
County Values		Sign	Values	Units	Notes
Total nitrogen concentration in wastewater		N <sub>W</sub>	45.0	mg/l	Default
Soil denitrification		d	0.1	unitless	Default
Nitrate concentration in precipitation		N <sub>R</sub>	0.24	mg/l as N	Default
Hydraulic Output Values		Sign	Values	Units	Notes
Hydraulic loading		D <sub>H</sub>	0.6	gal/ft <sup>2</sup> /day	
Minimum drainfield area		A <sub>D</sub>	500	ft <sup>2</sup>	
Nitrate Output Values		Sign	Values	Units	Notes
Volume of recharge over parcel		V <sub>P</sub>	1,488	gpd	A <sub>P</sub> * R * conversion
Total infiltration (drainfield & parcel)		V <sub>PT</sub>	1,788	gpd	V <sub>W</sub> + V <sub>P</sub>
Total Nitrogen concentration from drainfield & parcel		N <sub>JP</sub>	7.0	mg/l as N	$((V_P * N_R + V_W * N_W) * (1 - d)) / (V_P + V_W)$
Assessment			Values	Units	Instructions
Hydraulic loading			Okay	unitless	If Revise, review input values
Nitrate			Okay	unitless	If Revise, review input values

# WDOH LOSS Spreadsheet

WASHINGTON DEPARTMENT OF HEALTH

LEVEL 1 NITRATE BALANCE FOR LARGE ON-SITE SEWAGE SYSTEM

Project name:

Address, city and county:

Completed by (name and title):

Date:

Input Values	Factor	Units	Values	Instructions	Information Source
Nitrate concentration in precipitation	$N_R$	mg/l as N	0.24	Default	
Total nitrogen concentration in wastewater	$N_W$	mg/l	60	Default - residential strength	
Soil denitrification	d	unitless	0.1	Default	
Aquifer thickness	b	ft	20	Default or aquifer thickness if known	
Drainfield area	$A_D$	ft <sup>2</sup>		Primary drainfield area	
Distance from drainfield to property boundary	$D_{pb}$	ft	0	Measure in direction of GW flow	
Aquifer width	$W_A$	ft		Perpendicular to GW flow	
Aquifer hydraulic conductivity	K	ft/day		Measured or literature value	
Hydraulic gradient	i	ft/ft		If unknown, use 0.010	
Recharge	R	in/yr		Recharge will be a % of ppt	
Nitrate concentration of upgradient ground water	$N_B$	mg/l		Prefer sampling data	
Wastewater volume	$V_W$	gpd		Design flows or measured volume	

## Output Values

Groundwater nitrate value  $N_{GW}$  mg/l as N  Point of Compliance (POC)

Groundwater nitrate value  $N_{GW\_ALT}$  mg/l as N  Alternative POC

# Spokane County Groundwater Recharge Analysis

CARA Committee Meeting  
May 14, 2013



# Groundwater Recharge & CARA

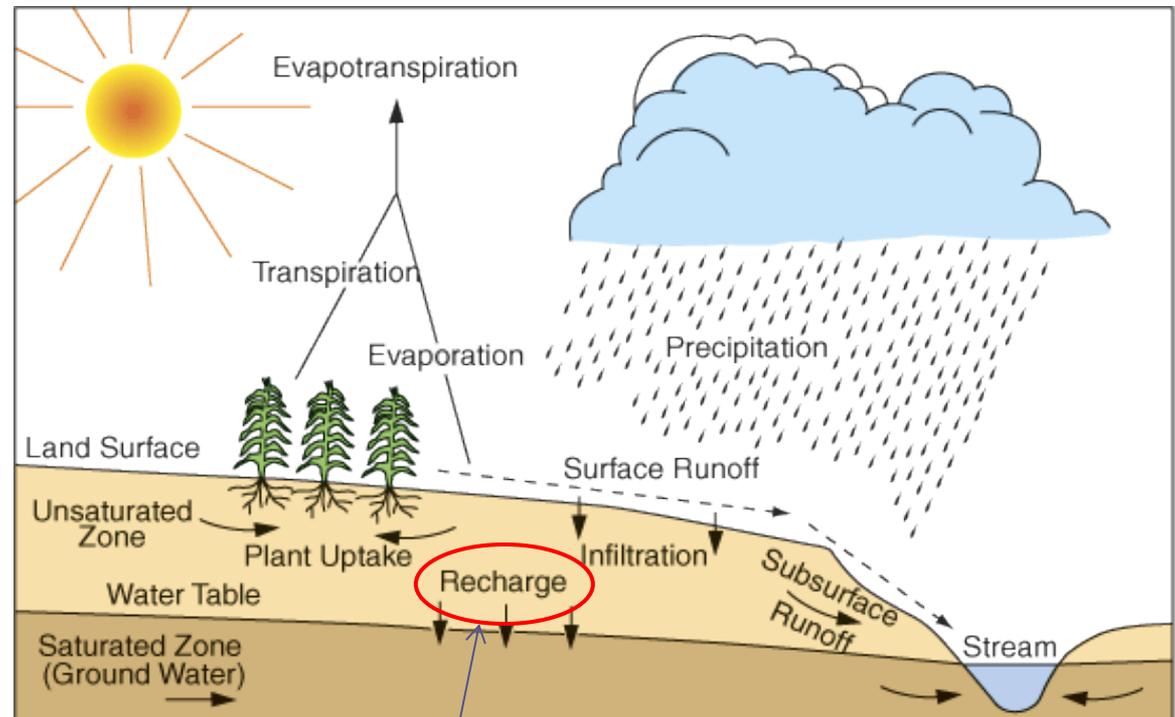
- Groundwater Recharge is an important variable in the proposed CARA Level 1 & 2 analysis

Input Values		Sign	Values	Units	Instructions
Parcel lot size		A <sub>P</sub>	5	acre	Site specific 1 acre = 43,560 ft <sup>2</sup>
Recharge		R	4	in/yr	Use recharge Map
Wastewater volume		V <sub>w</sub>	300	gpd	Use table or provide basis
Drainfield area		A <sub>D</sub>	900	ft <sup>2</sup>	Primary drainfield area
Soil Type	Type 4 - Fine sands, loamy fine			unitless	Use Drop Menu and WAC 246-272A-0220
County Values		Sign	Values	Units	Notes

- At a concentration of 45 mg/l:
  - 2 inches of recharge – 47 gallons per day per acre
  - 6 inches of recharge – 144 gallons per day per acre
- No Existing countywide groundwater recharge data set

# Groundwater Recharge

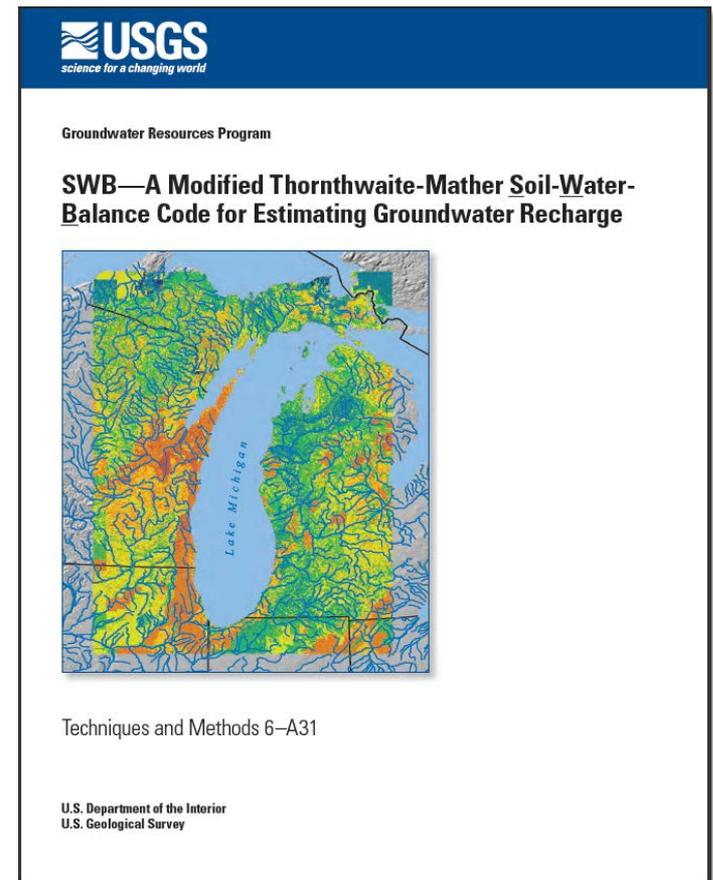
- Groundwater recharge is a dynamic process that is temporally and spatially variable
- Dependent on many factors
  - Climate
  - Soil
  - Land use
  - Landscape (slope)



*We are interested in the amount that percolates to groundwater*

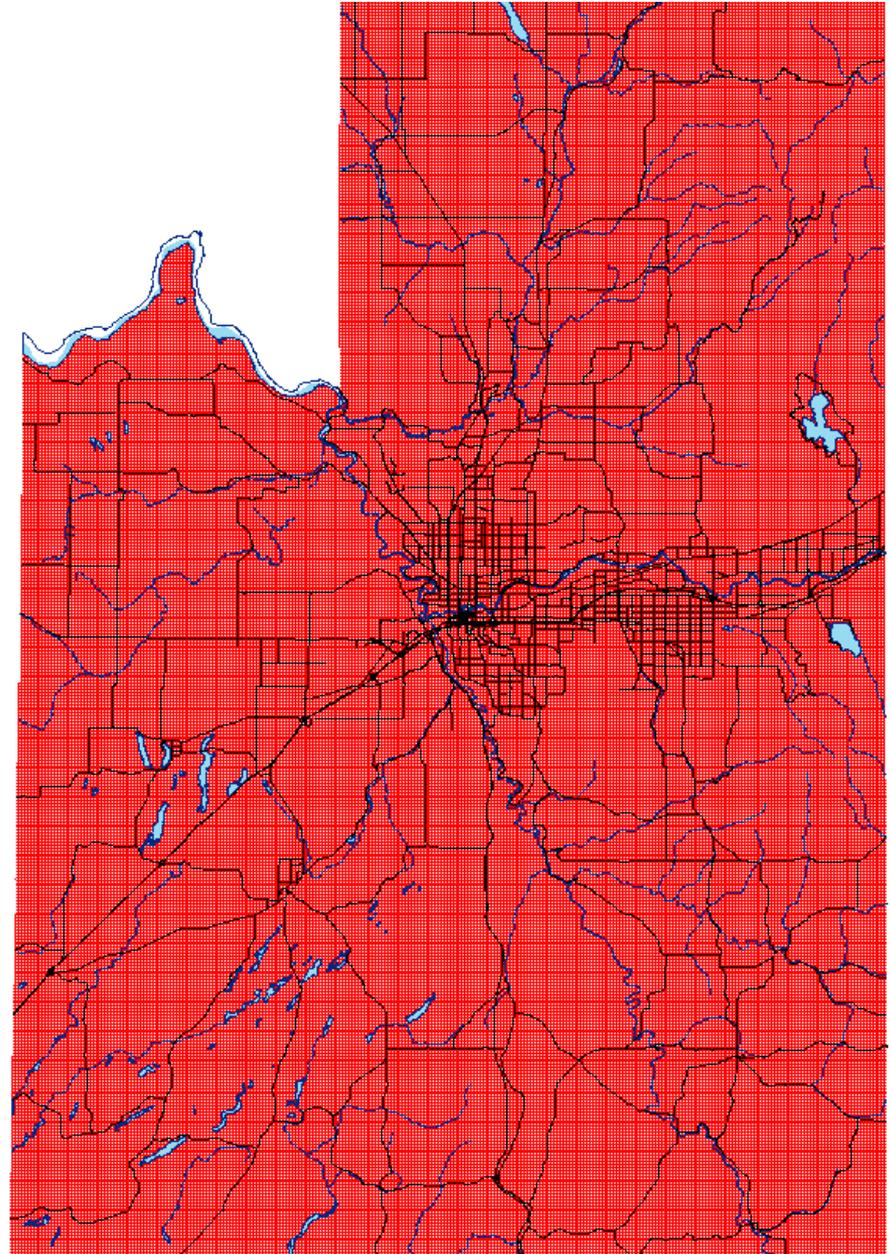
# New Groundwater Recharge Analysis

- Spokane County conducted a recharge analysis using a USGS Groundwater Recharge Model.
- This model was chosen because:
  - Developed by USGS
  - Uses well established data sets that are available for the entire county.
  - Uses well established soil water balance calculation methods
  - Can account for wide variation of climate and land use found in Spokane County



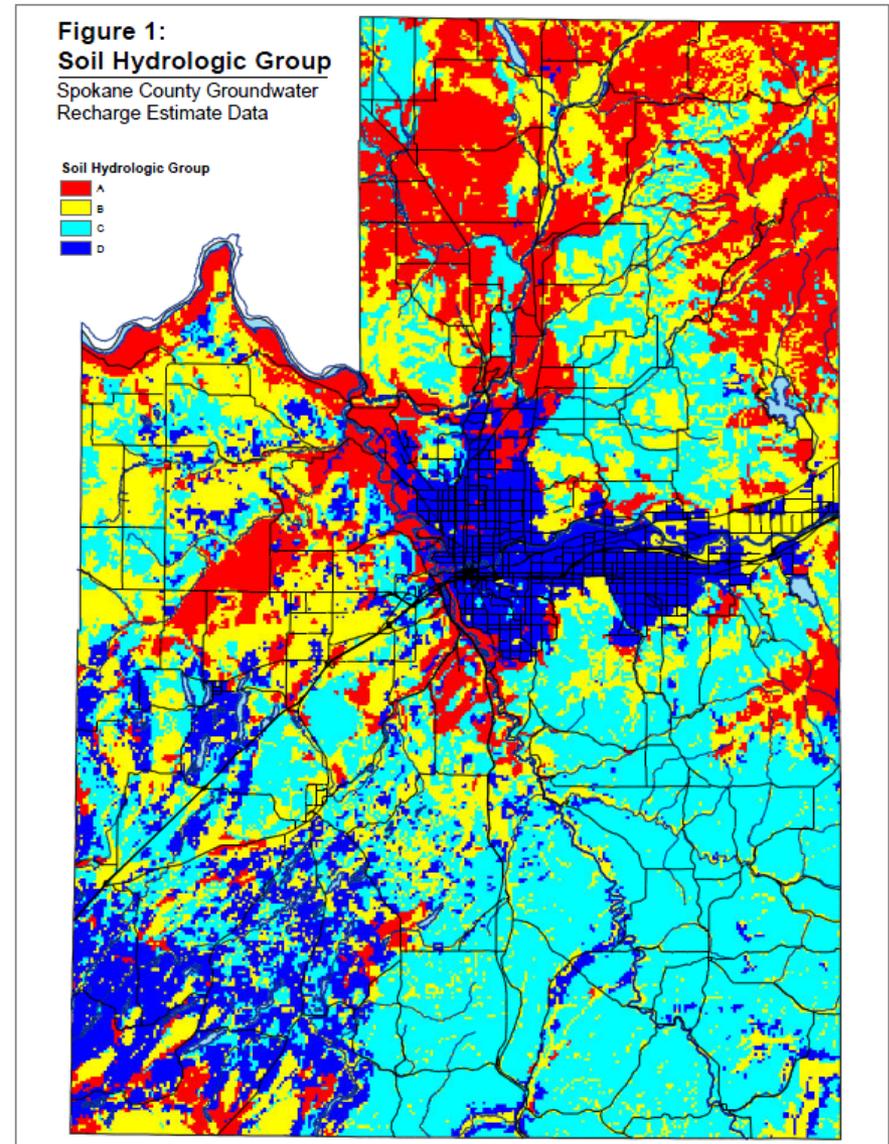
# Spokane County Recharge Model

- 114,000 model cells
- 660 ft by 660 ft
- 10 acres each



# Data Inputs

- Soil Hydrologic Group
  - NRCS USDA Soil Survey Geographic Database (SSURGO)
  - Measure of runoff potential



# Data Inputs

- Available Water Capacity
  - NRCS USDA Soil Survey Geographic Database (SSURGO)
  - Maximum amount of plant available water a soil can provide. Indicator of soil's ability to retain water.

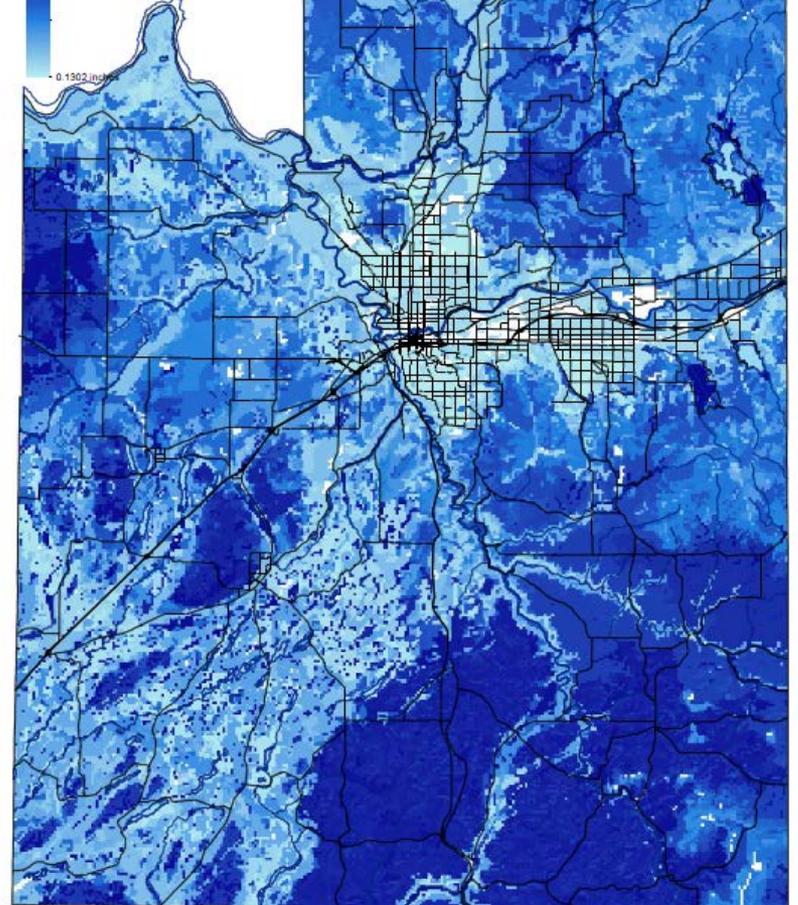
**Figure 2:**  
**Soil Available**  
**Water Capacity**

Spokane County Groundwater  
Recharge Estimate Data

Inches per foot of thickness

5.4 inches

0.1902 inches



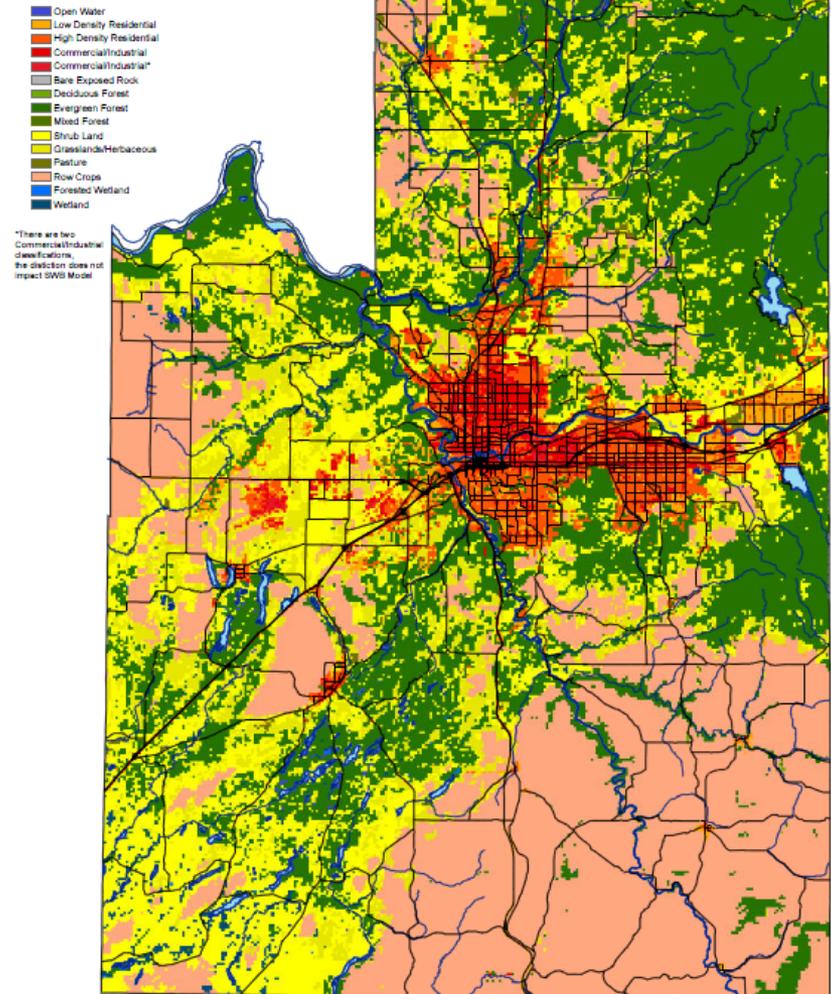
# Data Inputs

- Land Use

- USGS National Land Cover Database
- Impacts variables such as:
  - Interception of precip from canopy
  - Root zone depth
  - Growing season

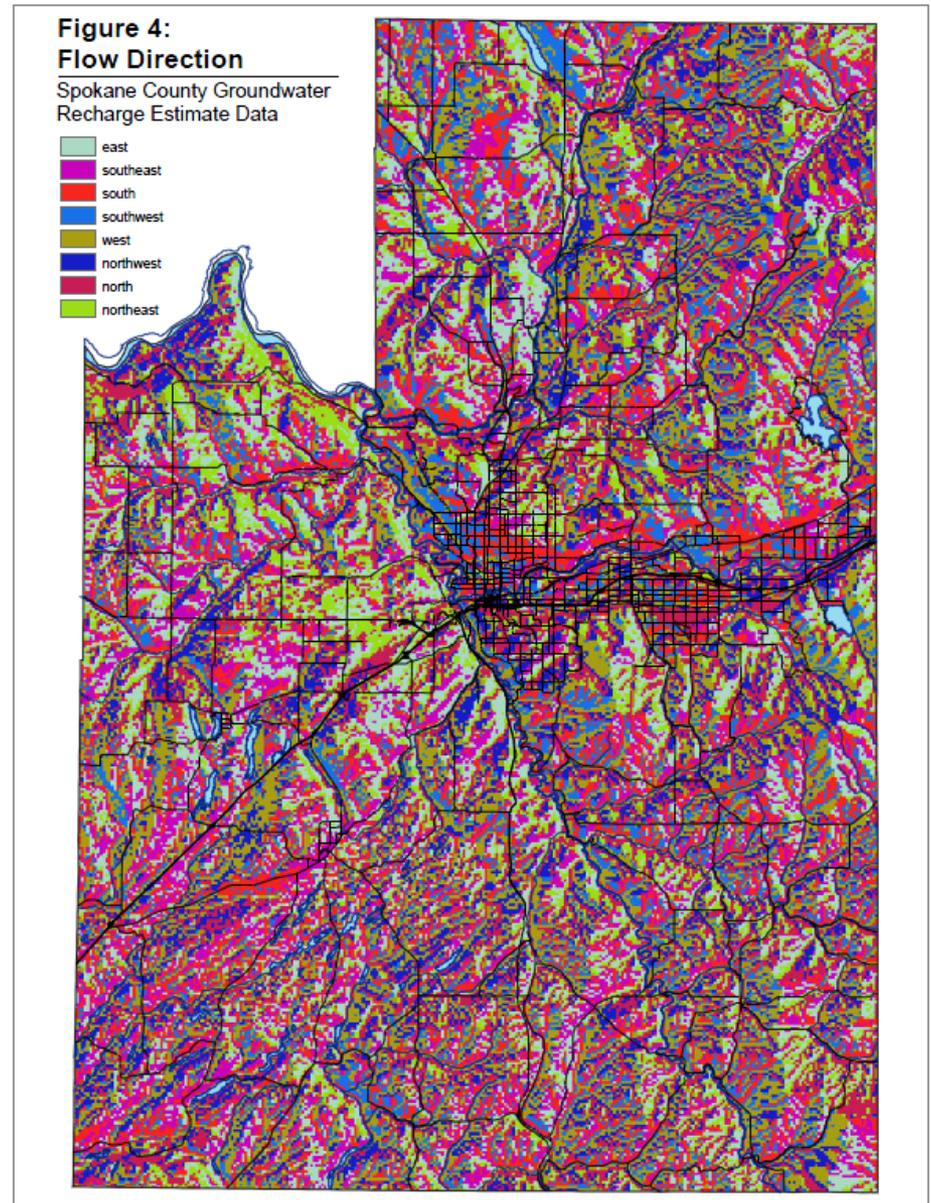
- Open water
- Low density residential
- High density residential
- Commercial/industrial
- Bare exposed rock
- Deciduous forest
- Evergreen forest
- Mixed forest
- Shrubland
- Grassland/herbaceous
- Pasture
- Row crops
- Forested wetland
- Wetland
- Shrubland

**Figure 3:**  
**Land Cover Designation**  
Spokane County Groundwater  
Recharge Estimate Data



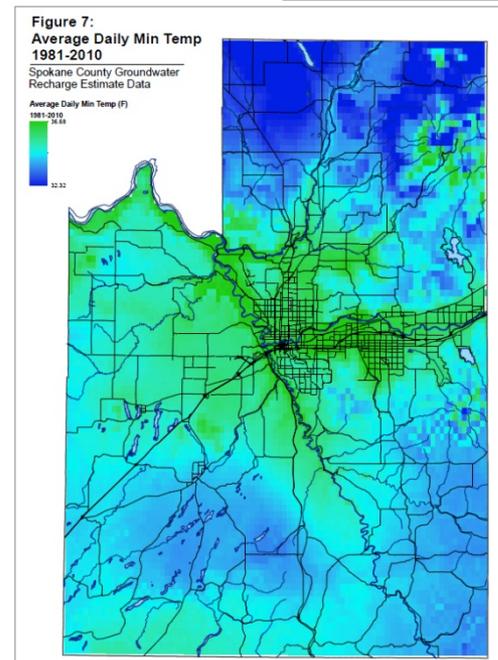
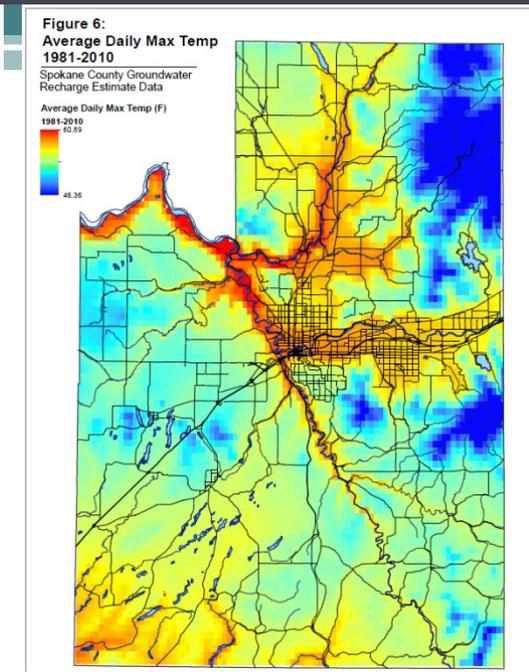
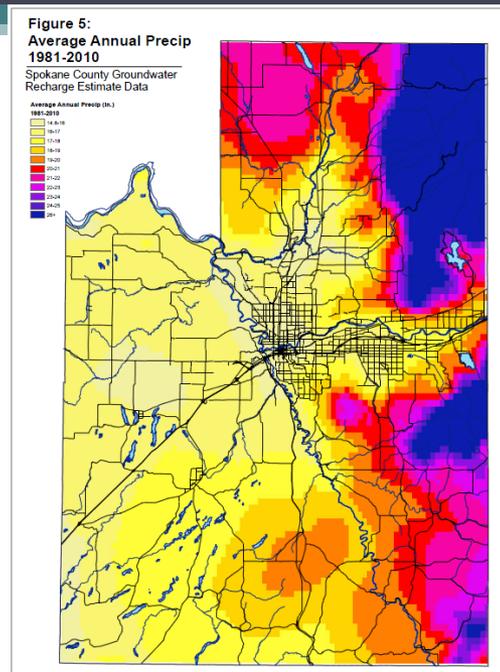
# Data Inputs

- **Surface Flow Direction**
  - Derived from USGS DEM
  - Which way water would flow on the surface.



# Data Inputs

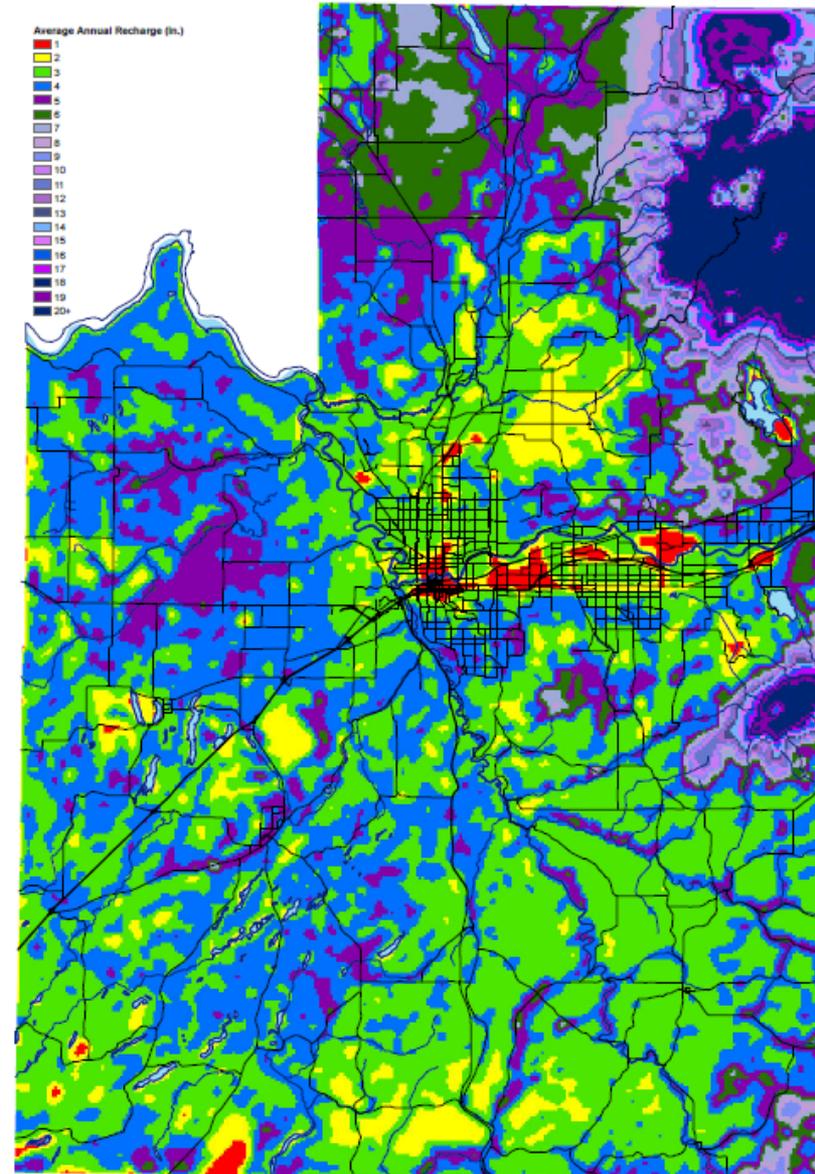
- **Climate Data**
  - Precipitation
  - Maximum Temperature
  - Minimum Temperature
  - Oregon State University PRISM Climate Group
  - 1981-2010



# Recharge Estimate Map

- Average Recharge is 4.9 inches
- Median model cell value is 3.57
- Recharge varies from 0 – 27 inches per year.

Figure 8:  
Modeled Average Annual Recharge  
Spokane County Groundwater  
Recharge Estimate



- **If a recharge value of 4 (median cell value of 3.57 rounded to nearest inch) is used in the CARA Level 1 spreadsheet with a nitrate concentration of 45 mg/l the allowable gallons per day per acres is **95.****

# Summary

- Application package with CARA spreadsheet\*,
  - Based on scientific data and analyses
  - Protective of sensitive groundwater and surface water
  - Provides a consistent review method for Spokane County
  - Provides a straightforward submittal for the applicant
  - Includes an adaptable approach for site specific conditions and/or specific project proposals

\* For Level 3, LOSS spreadsheet, or alternatively approved analysis

# Questions?

