Remote Sensing and Modeling of Laguna de Santa Rosa Watershed

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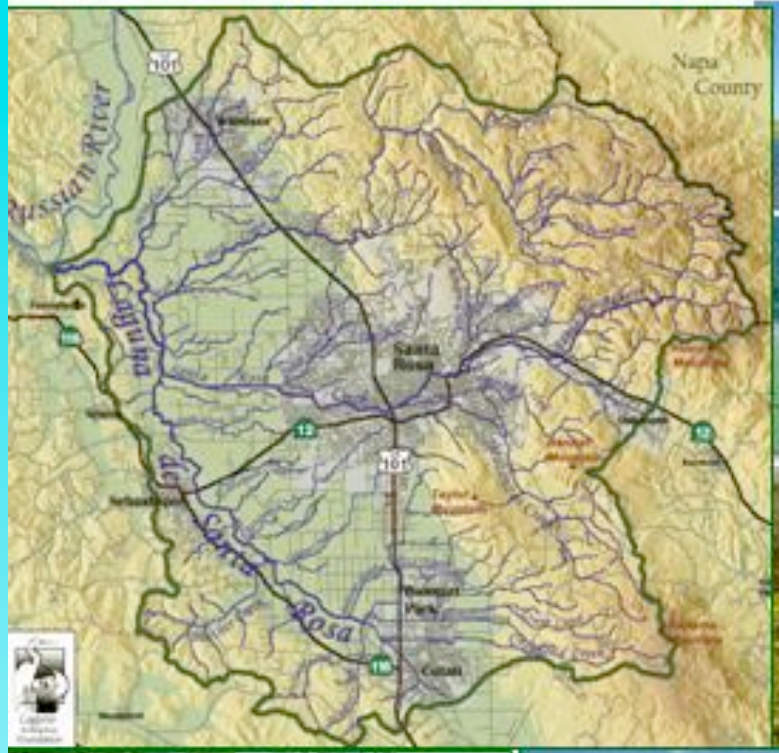
The Laguna de Santa Rosa, Russian River Basin



-250 sq. mile drainage (largest tributary of the Russian River

-90% private land: **75% Agricultural land**, Vineyards, Dairy farms

-2004 Sonoma County Agricultural production: $525,992,600

Wine Grape Production $309.9 Million

Dairy Production: $98.8 Million (> 75 million gallons milk)

Largest freshwater aquatic ecosystem complex in the northern California coastal region

Water Quality Issues in the Laguna Watershed

• Surface water quality in the Laguna watershed has been significantly impaired over recent years, as natural land cover has been urbanized and converted to agricultural uses.

• The Laguna de Santa Rosa is listed as impaired under the federal Clean Water Act for sediment, nitrogen, phosphorus, temperature, mercury, and dissolved oxygen, the most of any water body on the Northern Coastal region of California.

Water (re)Use Issues in the Laguna Watershed

- Tertiary municipal wastewater is reused for hay farm irrigation on City-owned property.

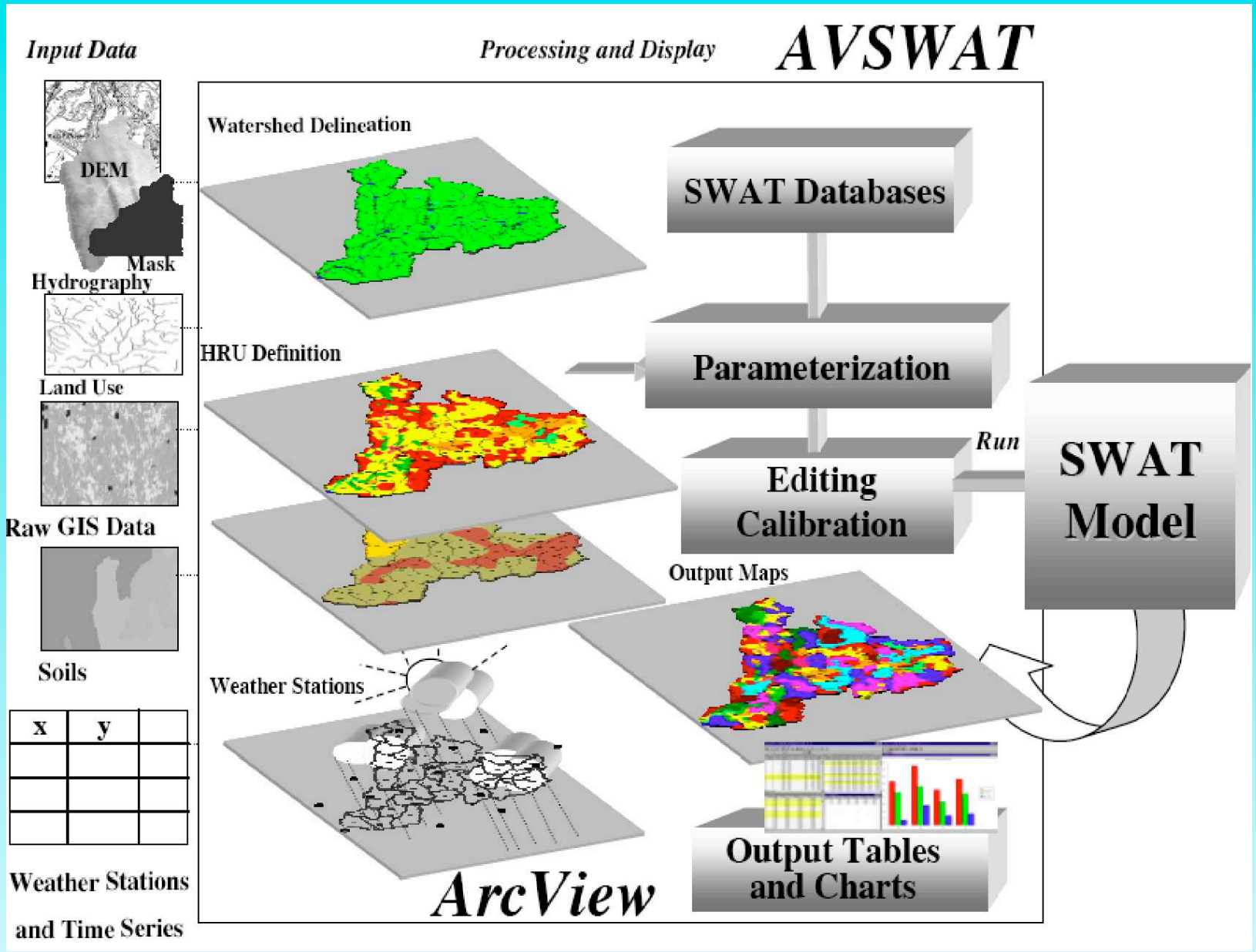
Concerns remain about the levels of pollution runoff into streams of pharmaceuticals, cosmetic, and household sources that are not removed by tertiary treatment.

- Demonstration wetlands have been constructed to study the benefits of tertiary-treated wastewater for wetland creation and restoration.

- The City of Santa Rosa reduces its wastewater discharges into the Laguna by pumping from its sewage treatment plant via a 40-mile pipeline to the The Geysers steam fields for power generation.

Since 2003, the city has pumped an average of 11 million gallons a day, or 4 billion gallons a year.

Watershed Modeling with USDA-SWAT Model



Major Features of the USDA-SWAT Model

- **Predicts the impact of land management practices on daily water, sediment, and agricultural chemical yields in large watersheds;**

- **ArcGIS-based and computationally efficient, readily accepts updated remotely sensed layers, land cover, climate and soil file inputs;**

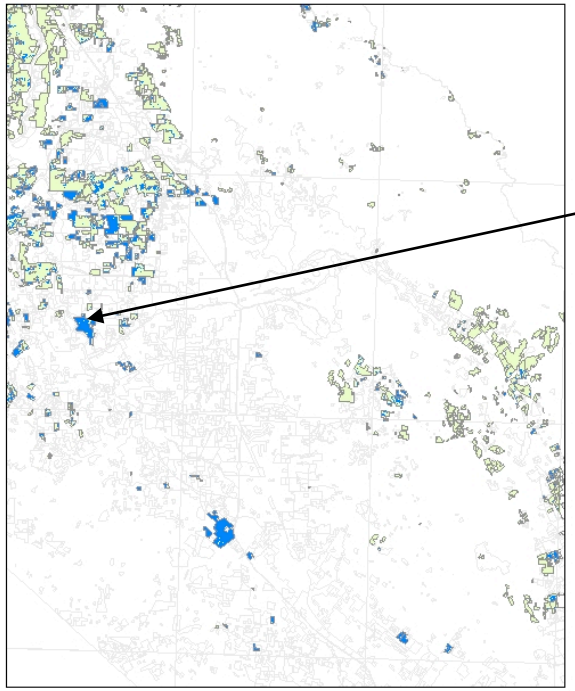
- **Defines hydrologic response units (HRUs) as portions of a sub-basin that possess unique combinations of land use, vegetation cover, and soil attributes. Land management settings can be customized for local practices;**

- **Predicts transport of constituents into and out of all sub-basins and river channels: sediment (metric tons), organic nitrogen, nitrate, and ammonium (kg N), organic and mineral phosphorus (kg P), chlorophyll-a, algal biomass, carbonaceous biochemical oxygen demand, dissolved oxygen, soluble and sorbed pesticide, and number of persistent bacteria.**

- **Determines sediment yield used for in-stream transport from the Modified Universal Soil Loss Equation (MUSLE). For sediment routing, deposition calculation is based on fall velocities of various sediment sizes.**

Land Cover in the Laguna de Santa Rosa

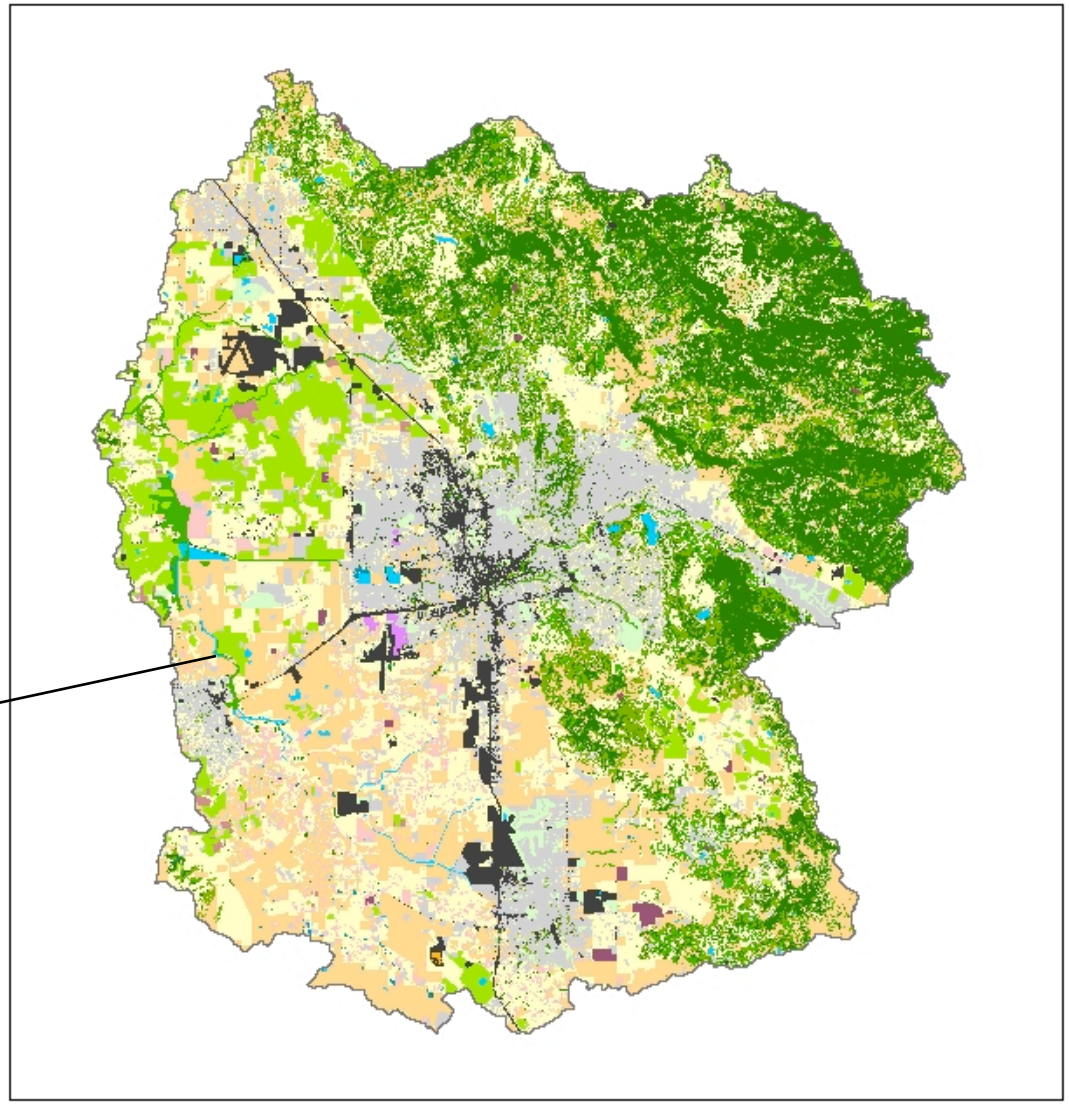
NLCD 1992
DWR 1999
Parcel Map 2004
NAIP 2005



NLCD Natural Vegetation/Pasture to DWR Vinyard/Orchard

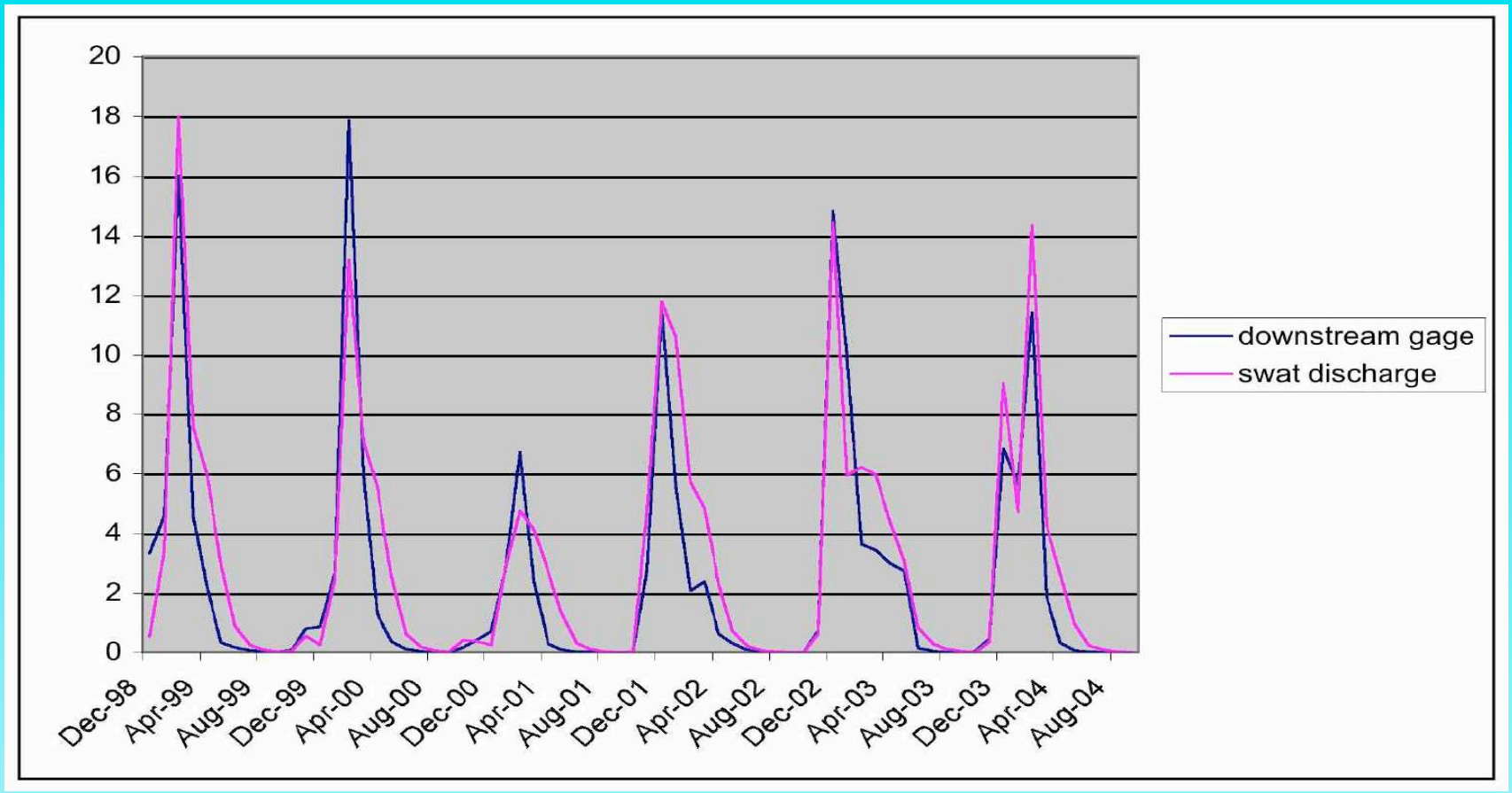
Vinyard

Change to Vinyard



Orchard
Water
Low Density Residential
High Density Residential
Comm/Indust/Transport
Rock/Sand/Clay
Quarries/Mines
Transitional
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrubland
Vinyard
Grassland
Pasture
Row Crops
Small Grains
Fallow
Urban Grasses
Woody Wetland
Emergent Herbaceous Wetland

Laguna de Santa Rosa Discharge Rate Predictions



Performance of the SWAT model before and after groundwater extraction (GWE).

Gauge	*Location*	E_{NS}	R^2	E_{NS} (GWE)	R^2 (GWE)
11465680	LSR Stony Point	0.71	0.81	0.84	0.92
11465700	Colgan Creek	0.83	0.84	0.86	0.87
11465750	LSR Sebastopol	0.75	0.84	0.83	0.91
11466320	SRC Willowside	0.91	0.92	0.94	0.93
11465800	SRC upstream	0.85	0.90	0.84	0.89
11466800	MWC at Trenton	0.84	0.86	0.84	0.86

Land Cover Contributions to Pollutant Runoff Rates

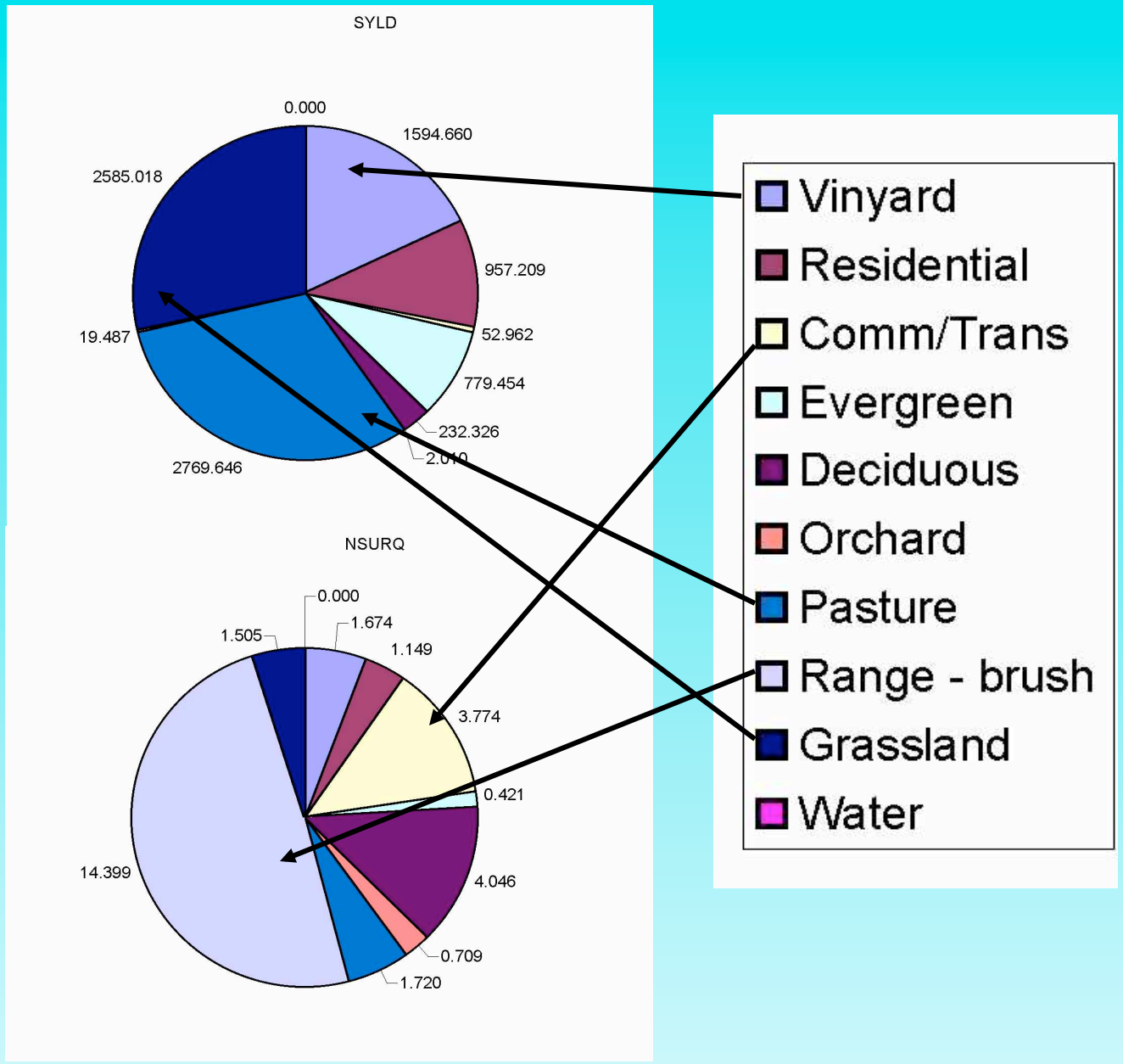
Sediment and nutrients contributions from SWAT land cover classes, ranked by sediment yield rates.

Land Use/Cover	Soil Yield T/ha	Organic N kg/ha	Organic P kg/ha	NO_3 released kg/ha
Pasture	19.6	15.3	2.0	0.7
Vineyard	19.1	10.8	1.4	0.9
Grassland	15.0	14.3	1.7	0.8
Brushland	9.6	8.6	1.0	0.4
Urban	8.8	7.3	1.1	1.0
Forest (mixed)	4.8	6.2	0.8	0.4
Forest (evergreen)	1.3	2.3	0.3	0.3
Forest (deciduous)	0.8	1.3	0.2	0.5
Irrigated Pasture	0.2	0.6	0.1	2.0
Orchards	0.0	0.0	0.0	0.3

Predicted Contributions to Annual Loadings

Sediment Yield (NO_3 Lateral)

NO_3 Surface



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