Isotopic and Hydrochemical Analysis of Riverine Flows in Malibu Creek Watershed, CA

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Anchorage, AK

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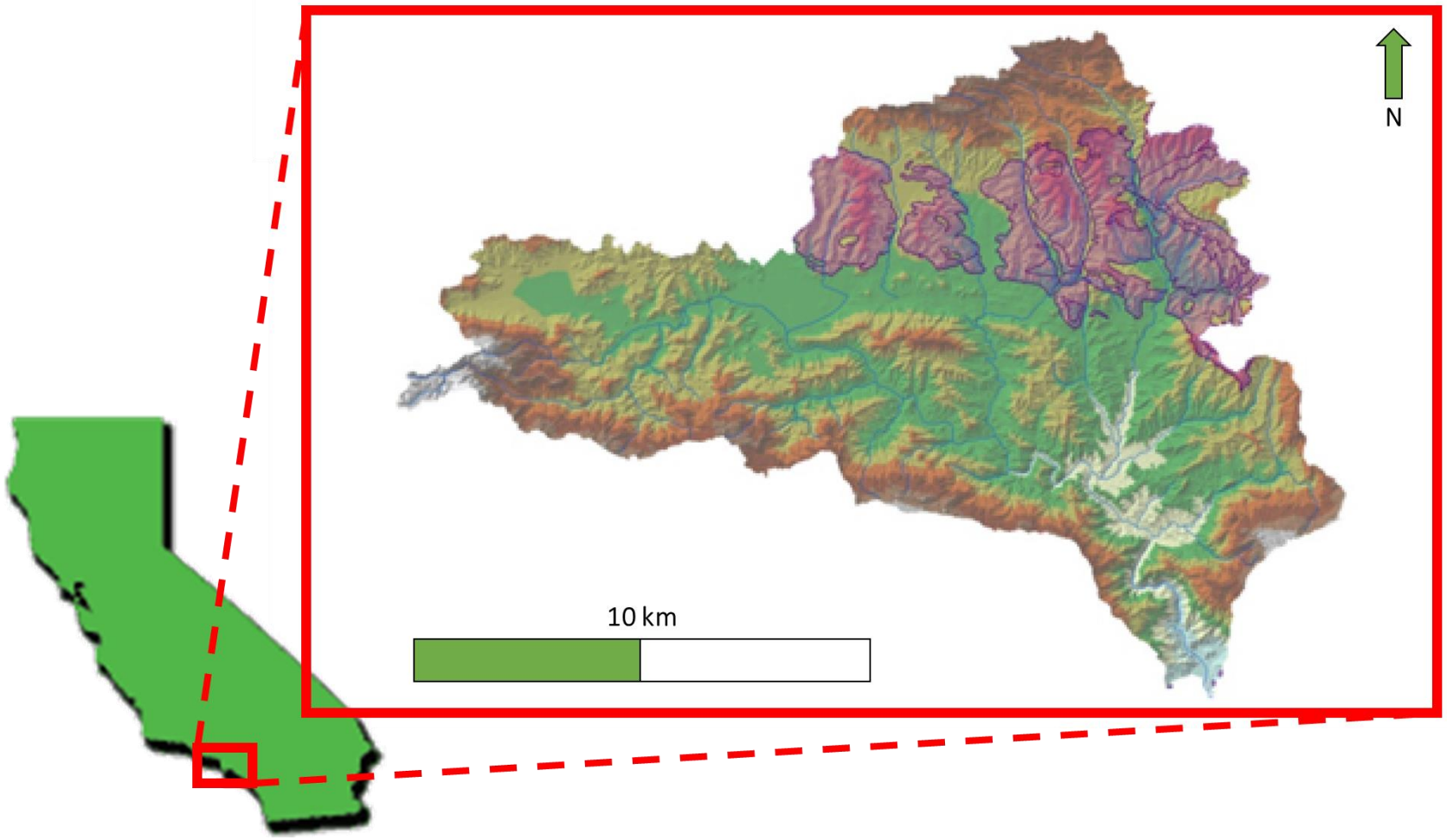
Overview

- Background
- Objectives
- Methods
- Results
- Discussion
- Conclusions

Background

<u>Malibu Creek Watershed</u>

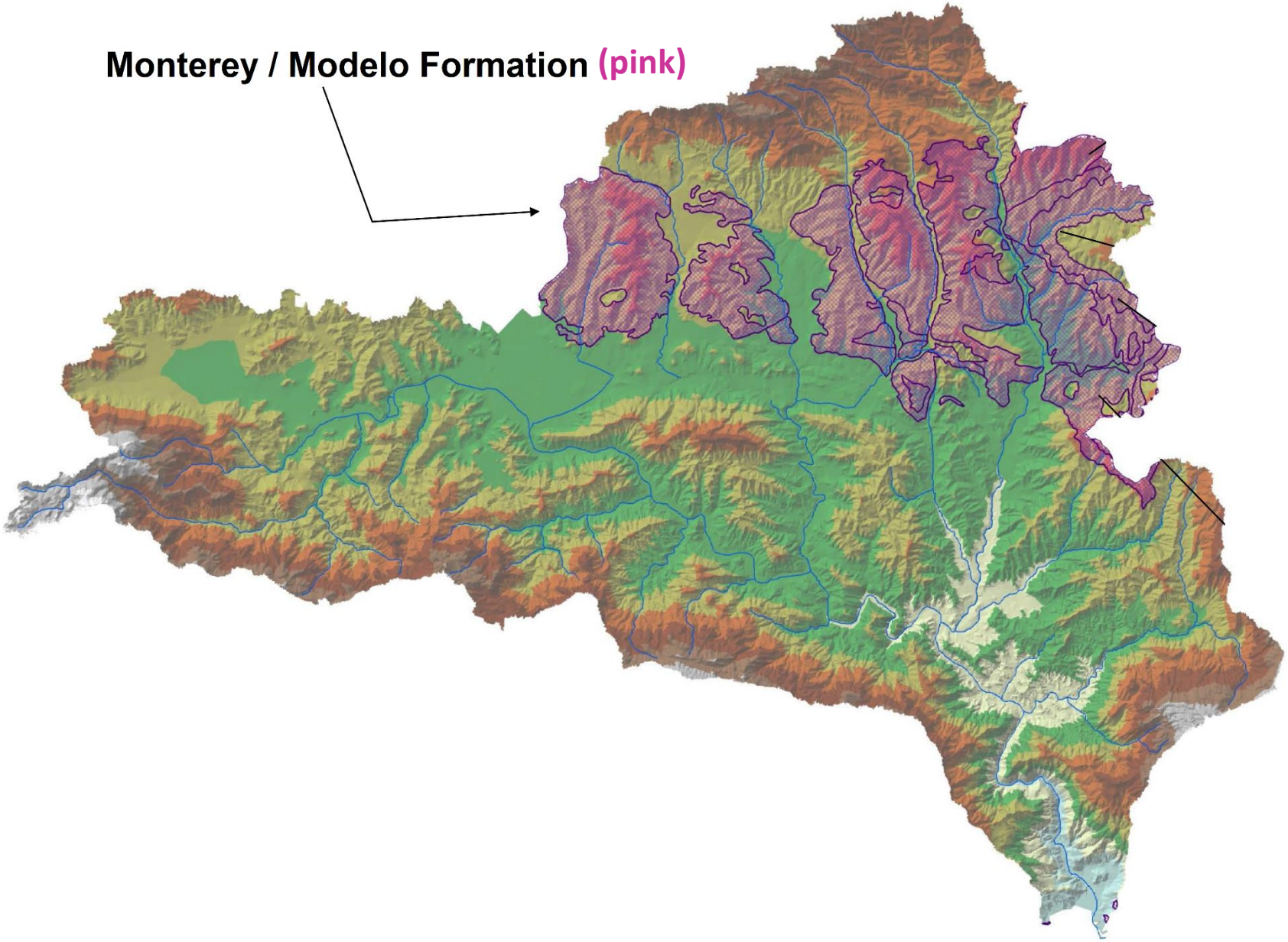
- Los Angeles and Ventura County
- Five feeder drain into the Santa Monica Bay



(Modified from LVMWD n.d.)

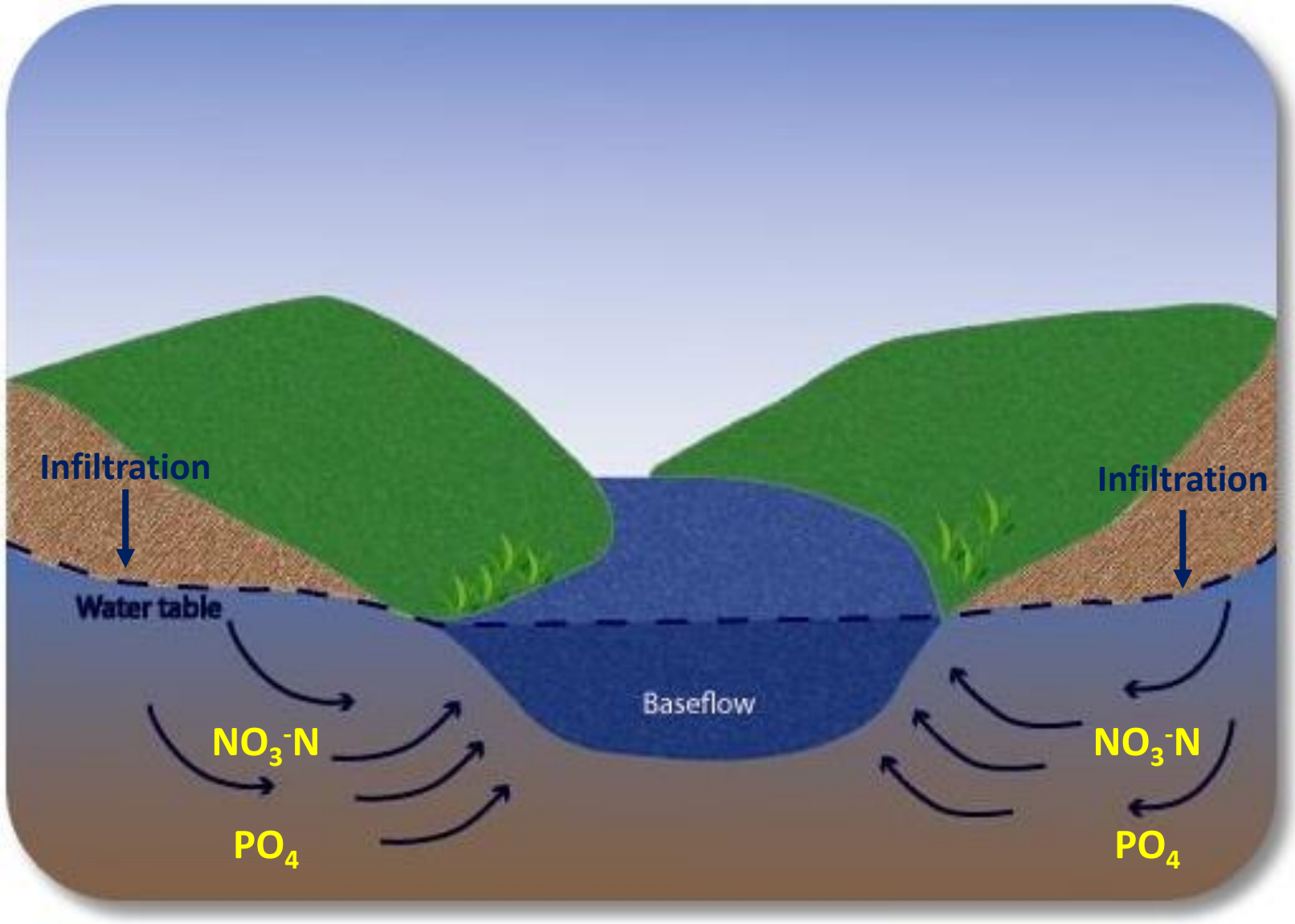
Background

- The Monterey-Modelo Formation, a Miocene marine mudstone deposit is exposed in the upper portion of the watershed



Background

- High concentrations of selenium, metals, phosphorus, nitrate, and sulfate have been found in the upper portion of the watershed



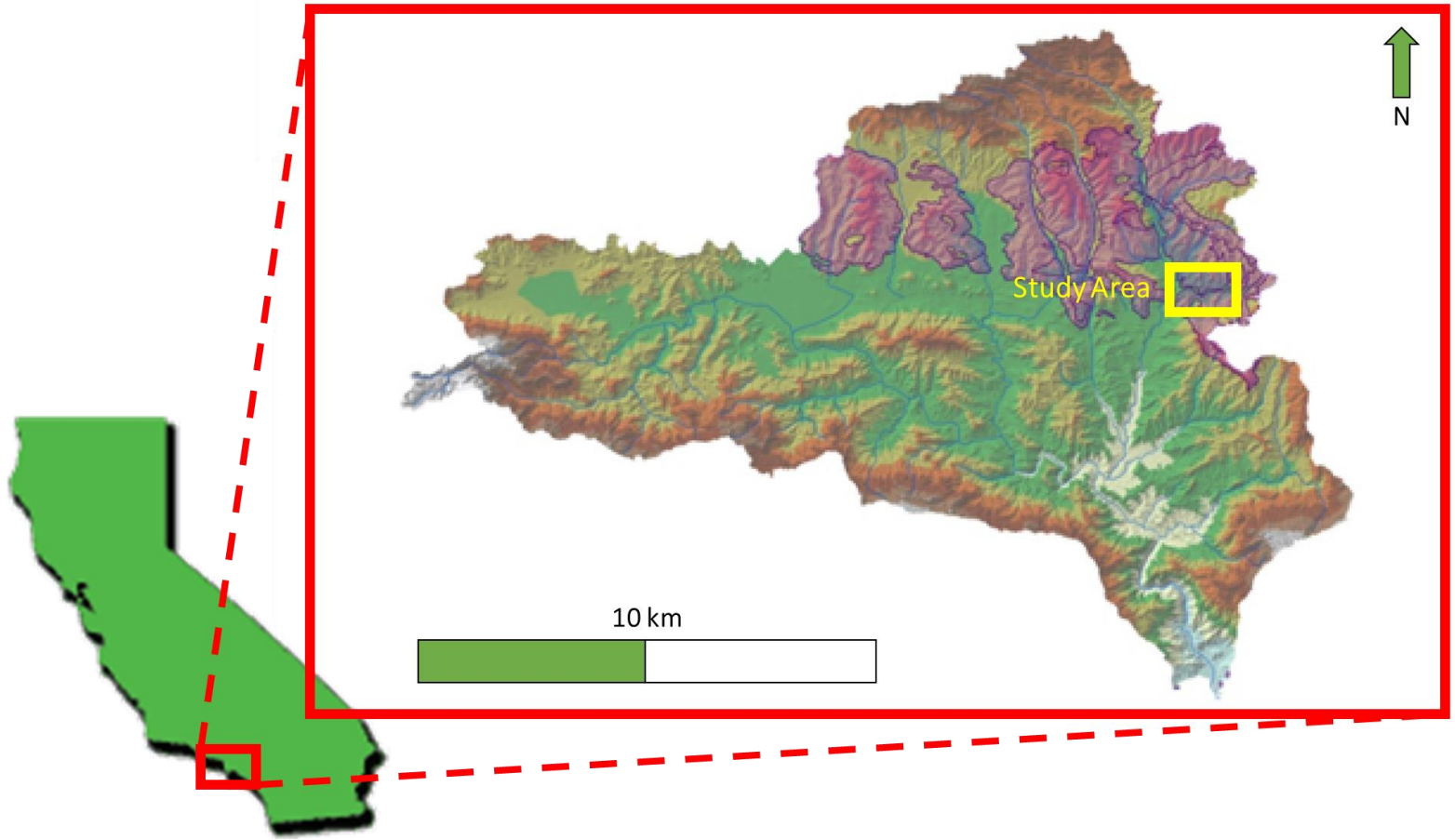
(Modified from DWASA, n.d.)

Background

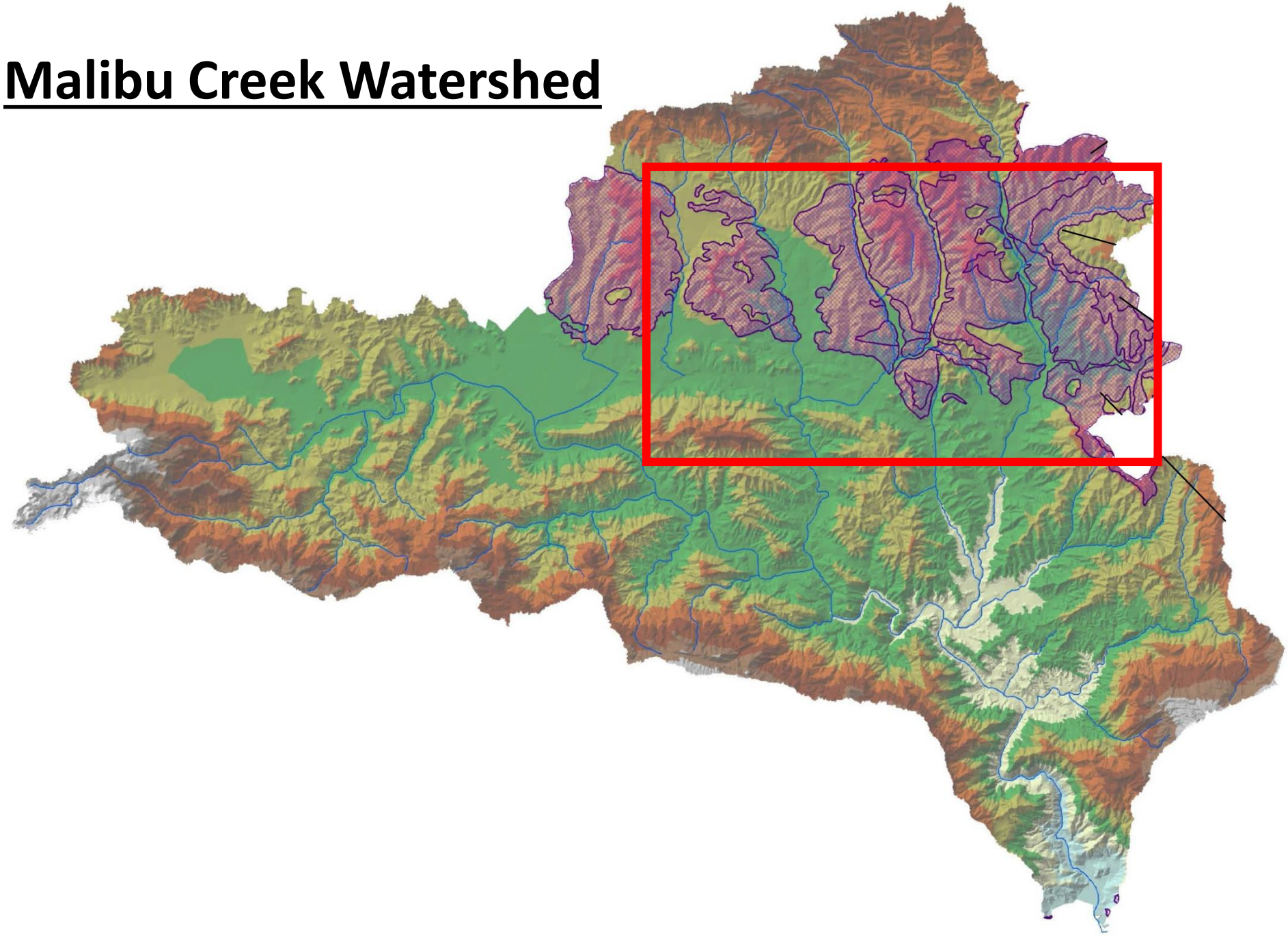
- Recent studies suggest that high concentrations of phosphorus and nitrate may be more of a result of dry weather runoff from urban landscapes

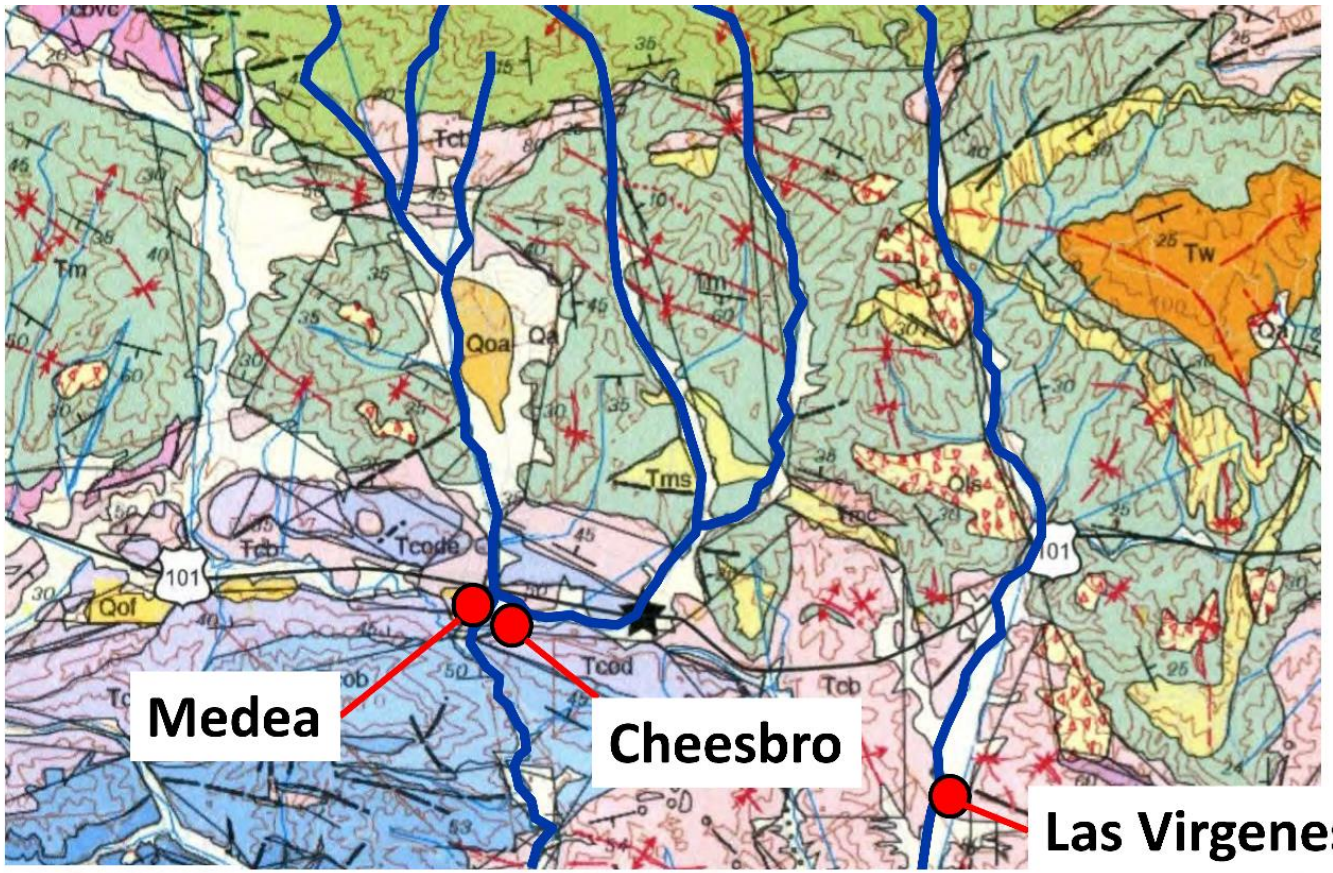
Objectives

- This study investigates El Camino Real Creek, a tributary in the Malibu Creek Watershed that traverses Monterey-Modelo Formation strata
- Serves as a controlled area that removes the variables associated with a larger study



Malibu Creek Watershed





SYMBOLS

Surface Fault

Concealed Fault

MAP UNITS

Qls - landslide deposits

Qa - alluvium

Tm - Modelo Formation (undivided)

Tms - Modelo Formation (sandstone)

Tcb - Calabasas Formation (undivided)

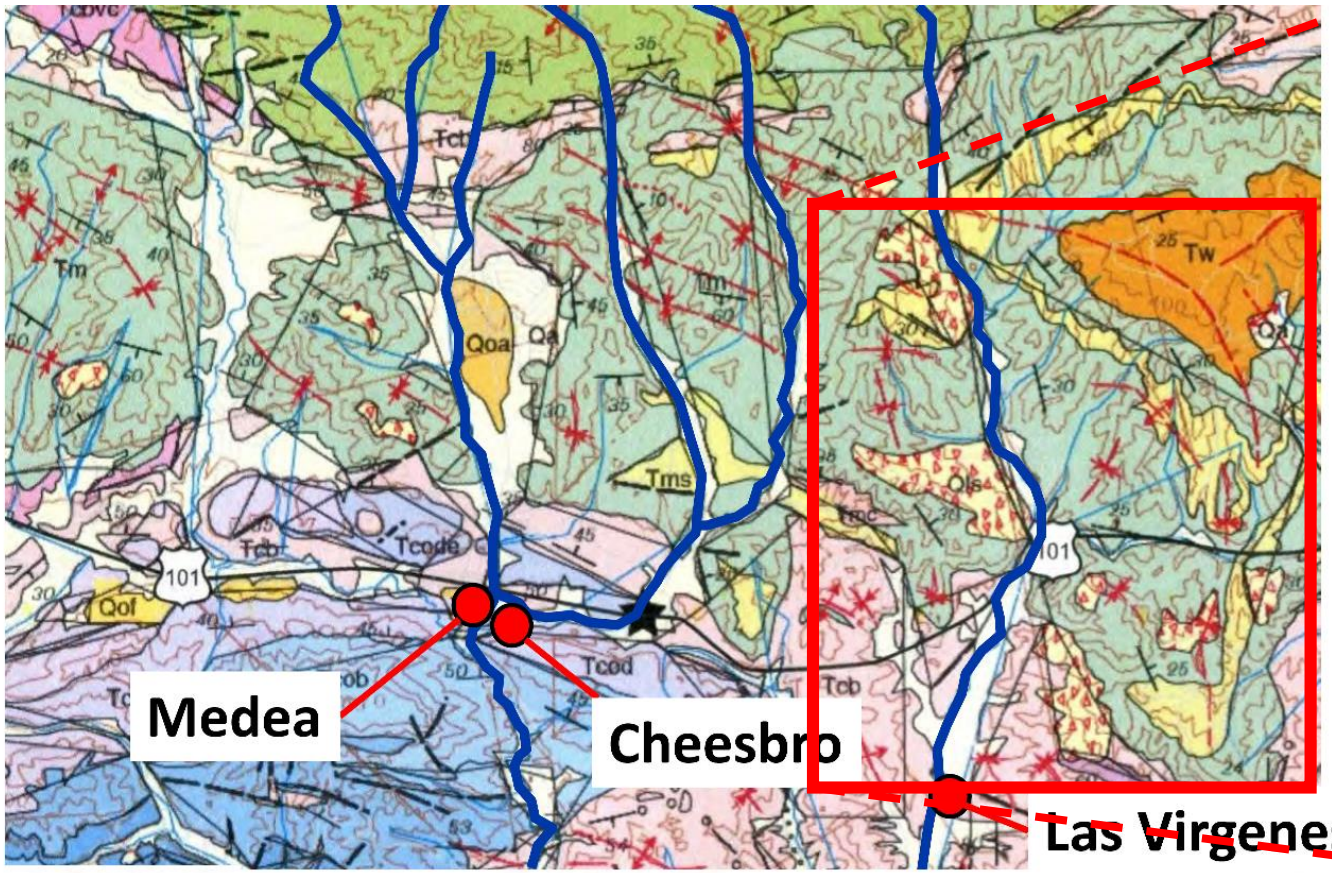
Tcod - Conejo Volcanics (dacite)

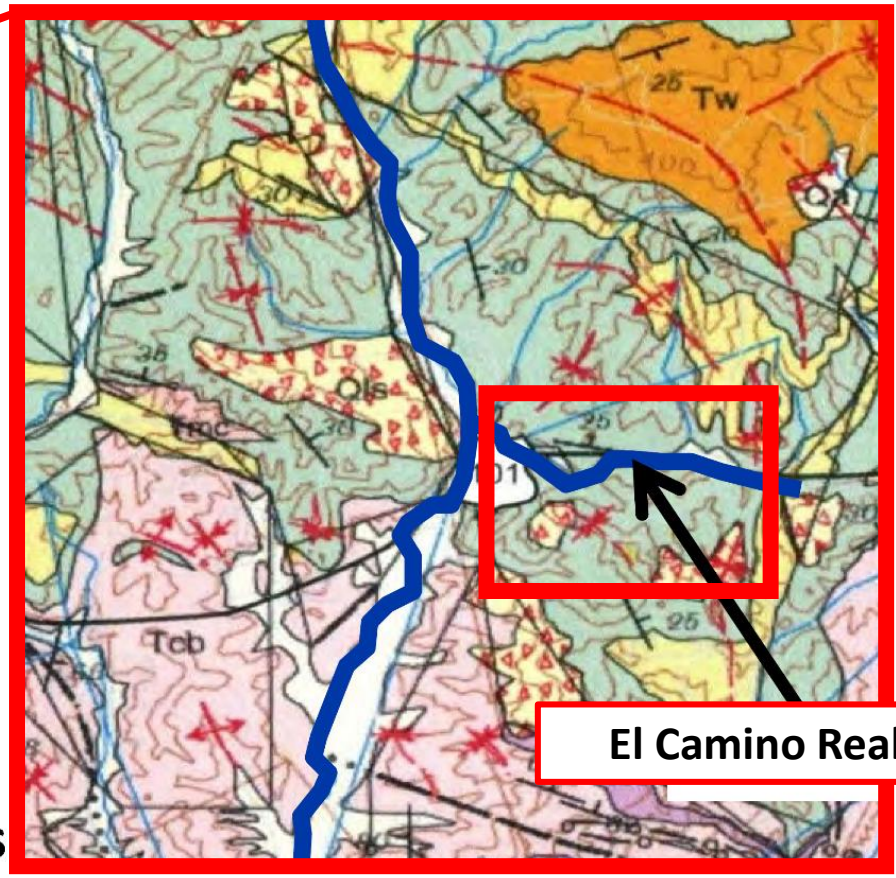
Tcode - Conejo Volcanics (dacite w/ epiclastic lens

Tcoob - Conejo Volcanics (basalt)

Figure modified from Kleinfelder West, Inc., 2011

*Refer to Yerkes and Campbell (2005) for a complete explanation and list of units and symbols





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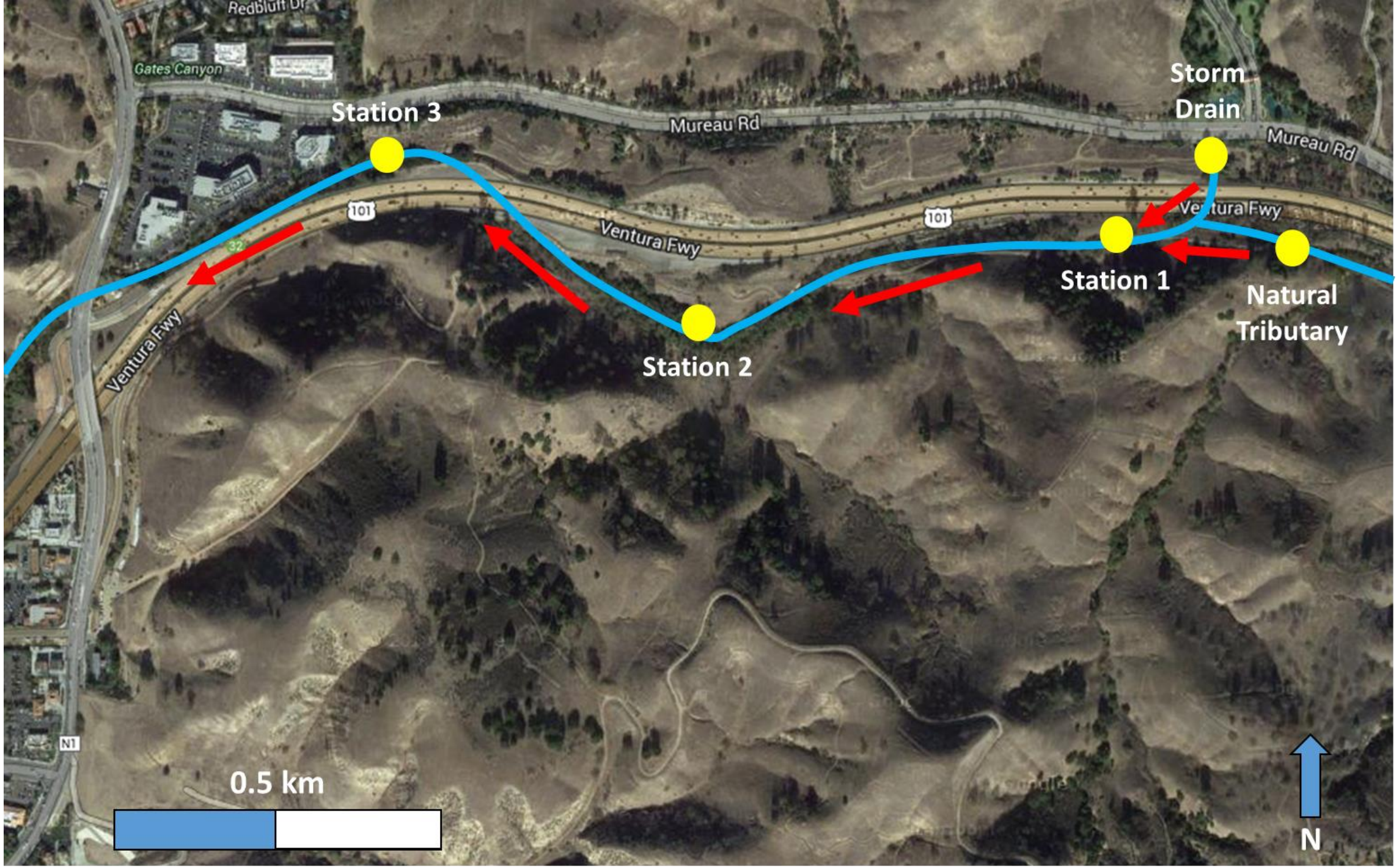

Redbluff Dr
Gates Canyon
Station 3
Mureau Rd
Storm
Drain
Mureau Rd
101
Ventura Fwy
101
Ventura Fwy
32
Station 1
Natural
Tributary
Ventura Fwy
Station 2
N1
0.5 km
N

Methods

Field Methods

- Samples are collected at designated stations along El Camino Real Creek
- Stations are tested on site with water quality probes to measure pH, conductivity, salinity, temperature, and dissolved oxygen
    - Stream discharge is also calculated on accessible stations

Methods

Laboratory Analysis

- Phosphate and nitrate tests are conducted using standard wet lab methods

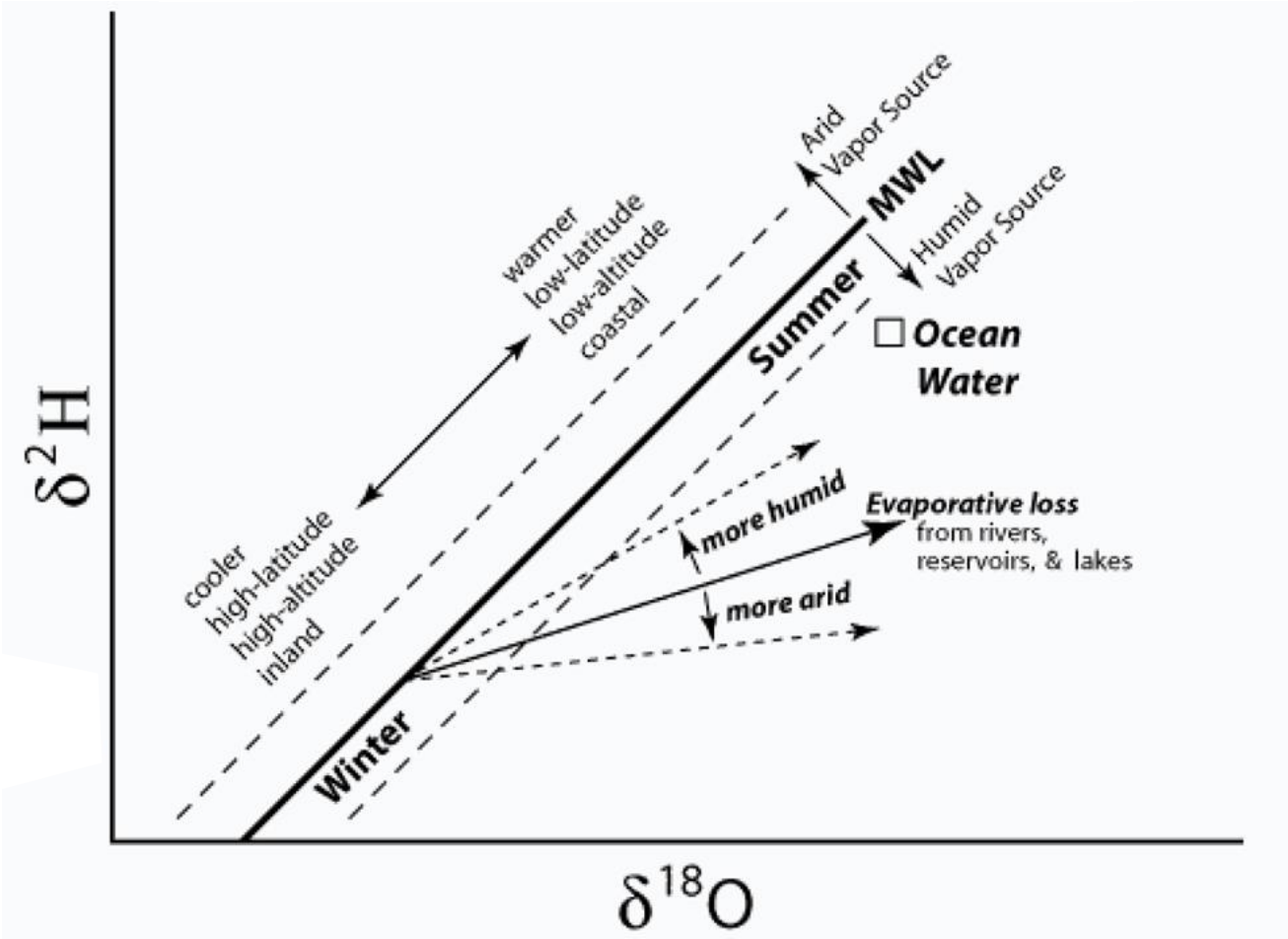
Methods

$$\delta^{18}O(‰) = \left(\frac{(^{18}O/^{16}O)_{sample} - (^{18}O/^{16}O)_{SMOW}}{(^{18}O/^{16}O)_{SMOW}} \right) \times 1000$$

$$\delta^{2}H(‰) = \left(\frac{(^{2}H/^{1}H)_{sample} - (^{2}H/^{1}H)_{SMOW}}{(^{2}H/^{1}H)_{SMOW}} \right) \times 1000$$

Laboratory Analysis

- Stable water isotopes allow an estimation on the source water.
- Used to determine whether the water source is local or imported



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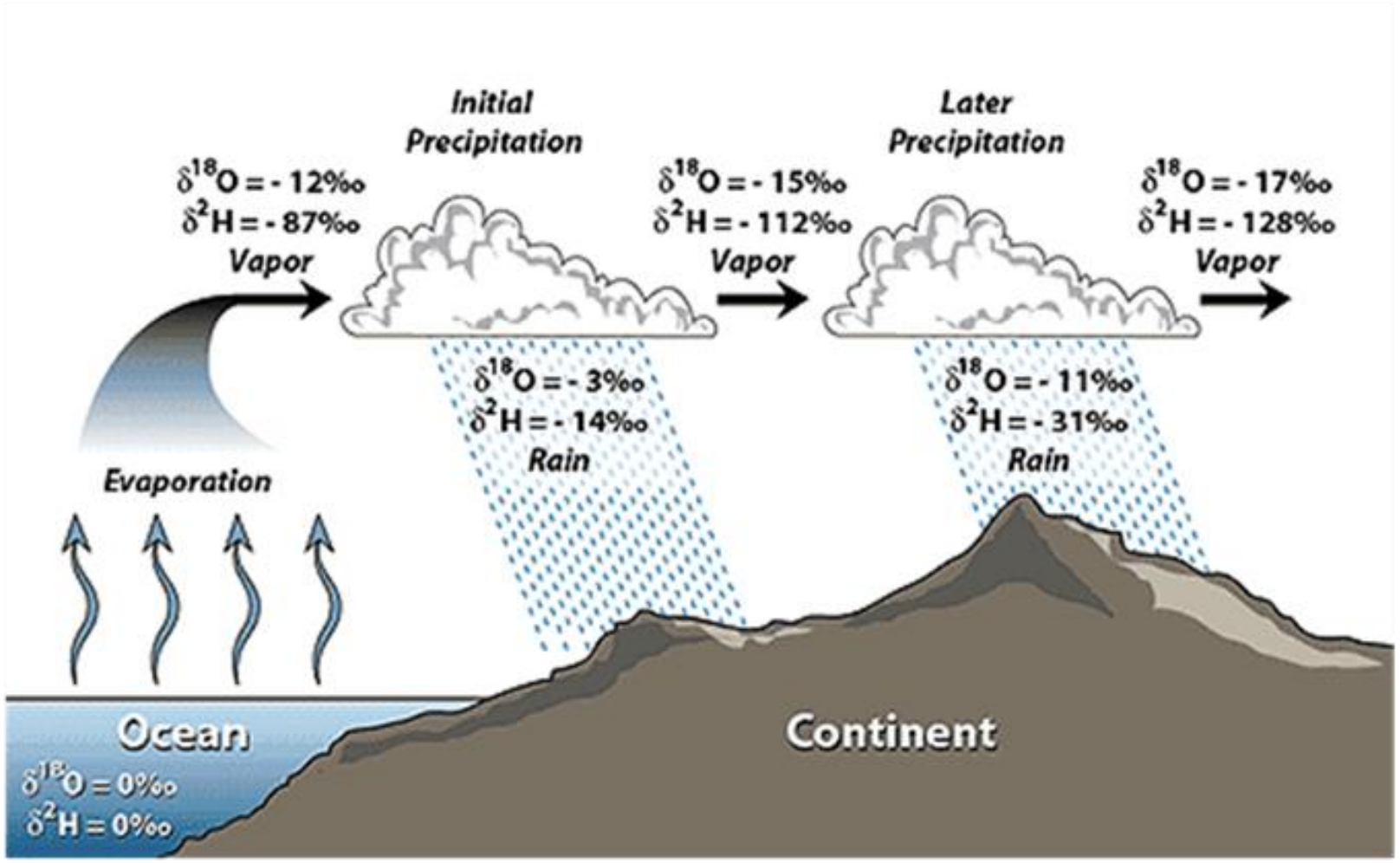
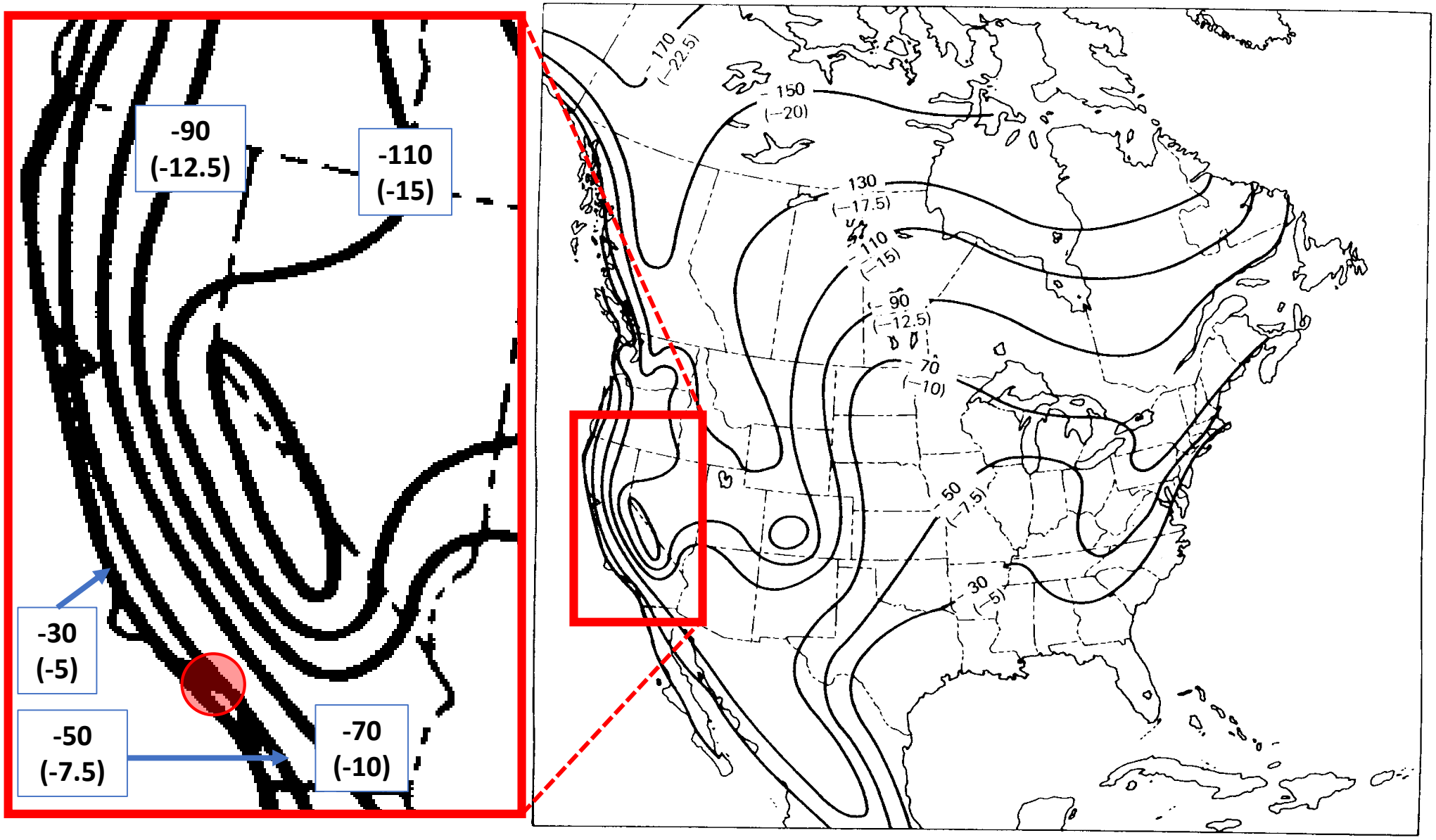


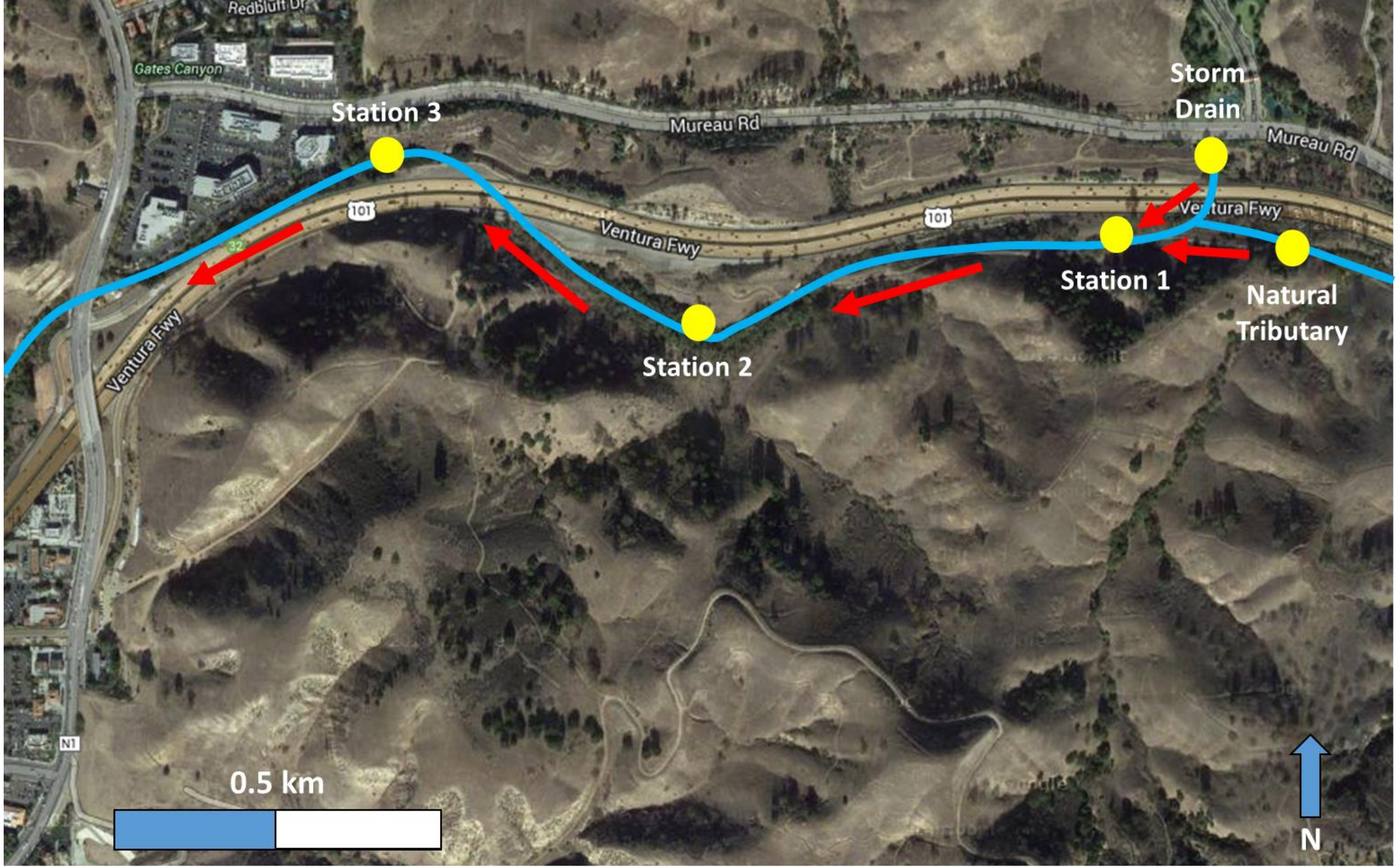
(SAHRA, 2003)

Methods



(Sheppard et al 1969)

Results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Station 3
Mureau Rd
Storm
Drain
Mureau Rd
101
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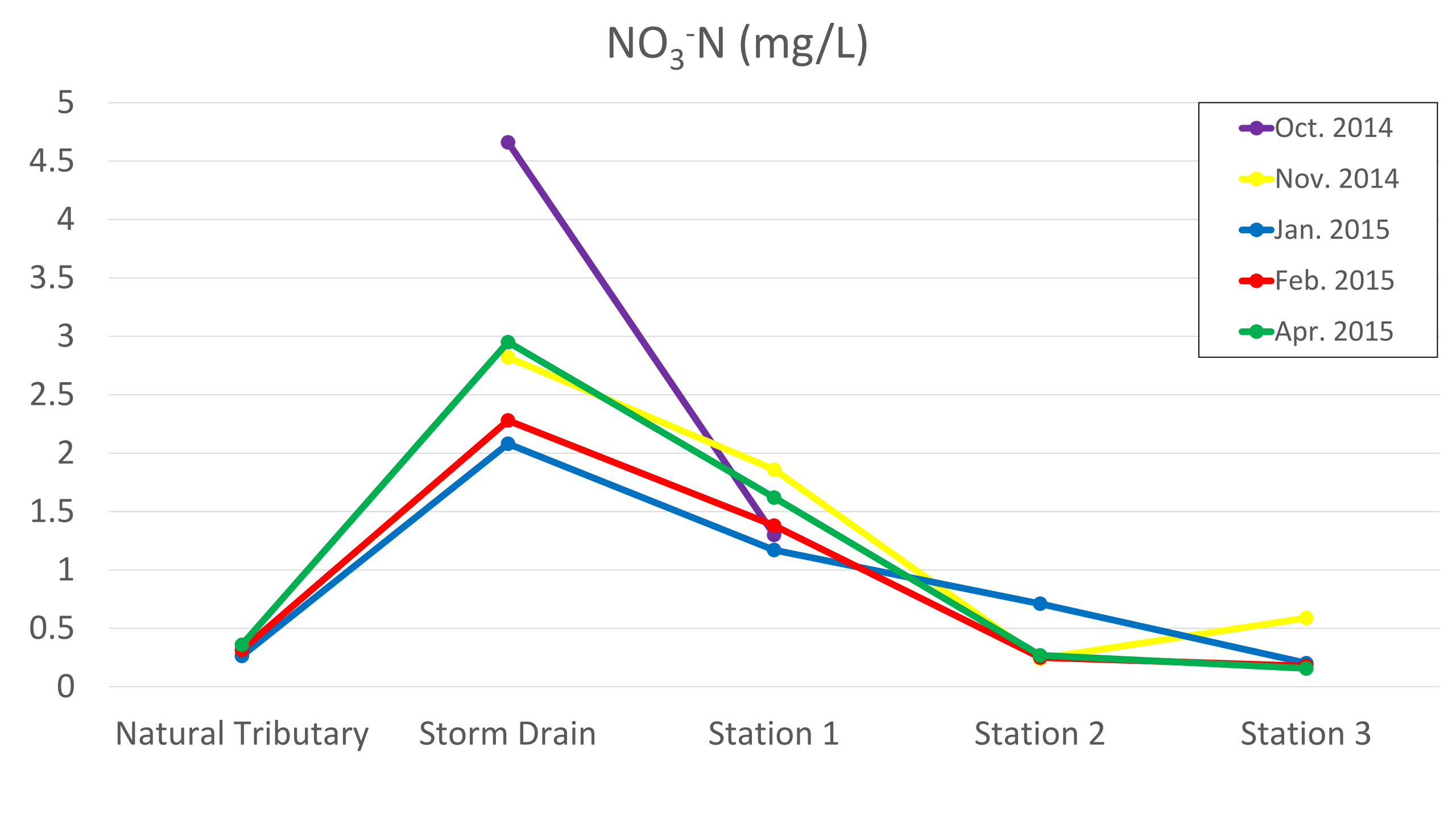
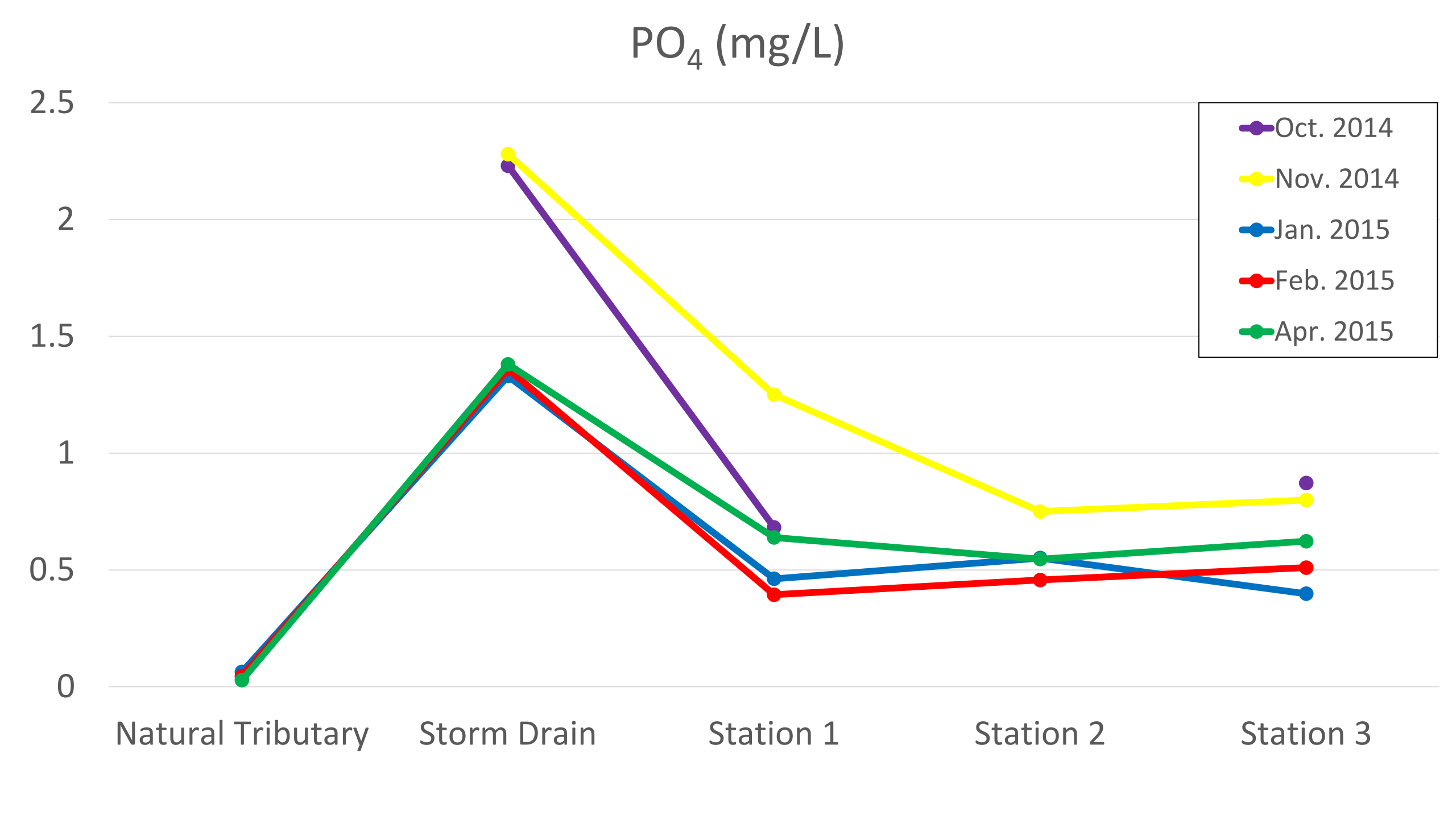
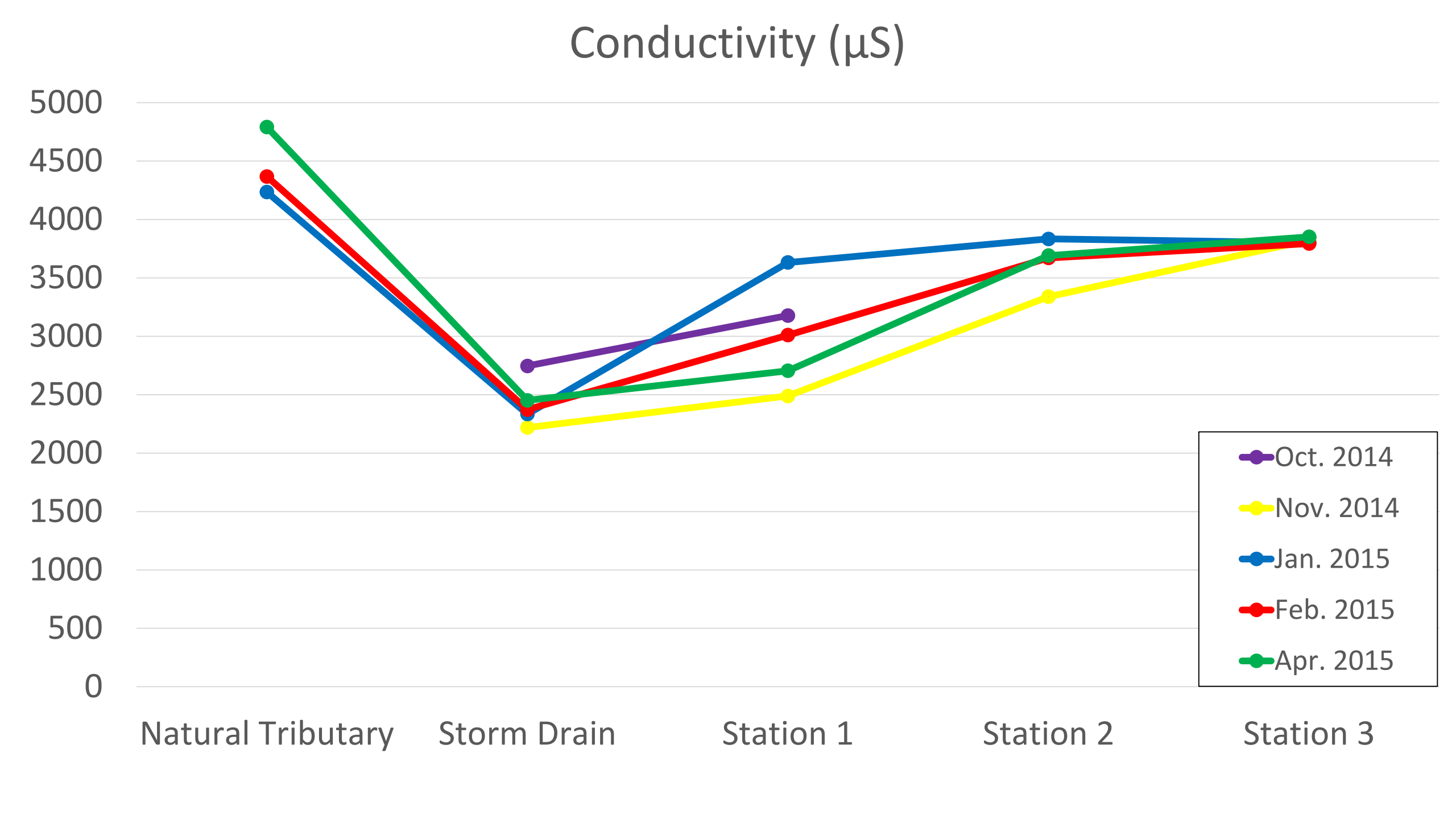
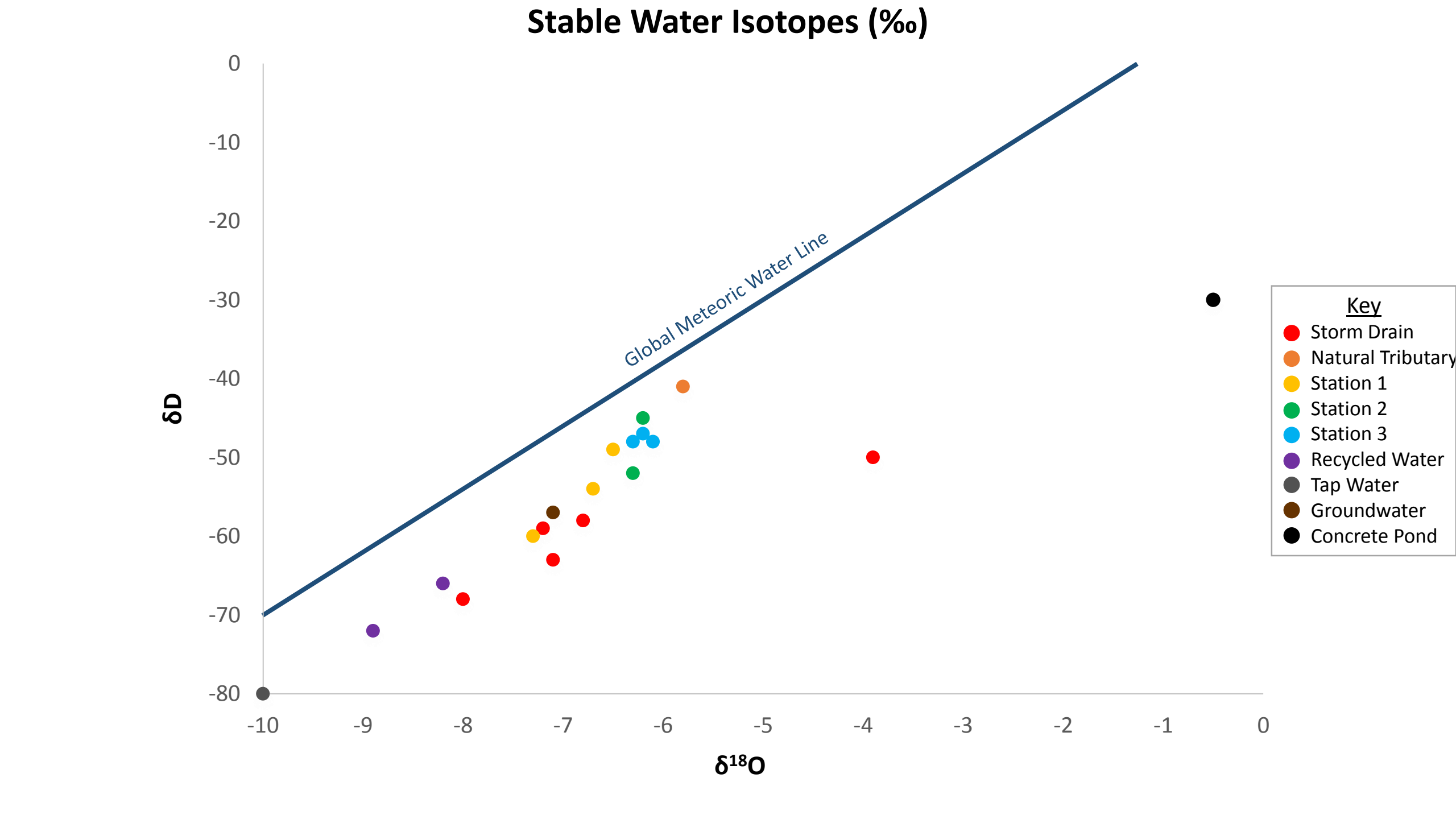
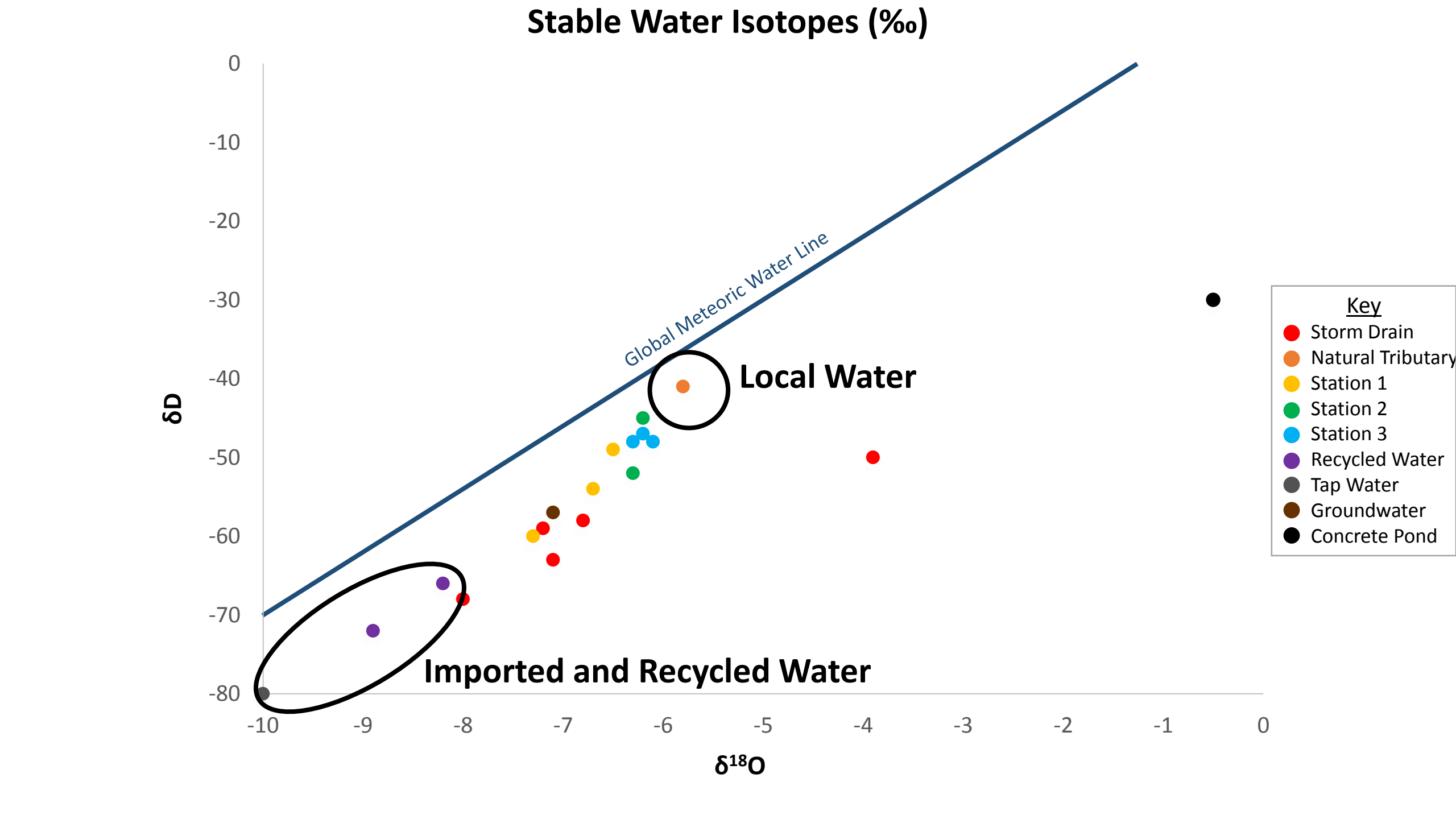
Station 1
Natural
Tributary
Ventura Fwy
Station 2
N1
0.5 km
N


NO_3^-N (mg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Natural Tributary
Storm Drain
Station 1
Station 2
Station 3
Oct. 2014
Nov. 2014
Jan. 2015
Feb. 2015
Apr. 2015


PO_4 (mg/L)
2.5
2
1.5
1
0.5
0
Natural Tributary
Storm Drain
Station 1
Station 2
Station 3
Oct. 2014
Nov. 2014
Jan. 2015
Feb. 2015
Apr. 2015

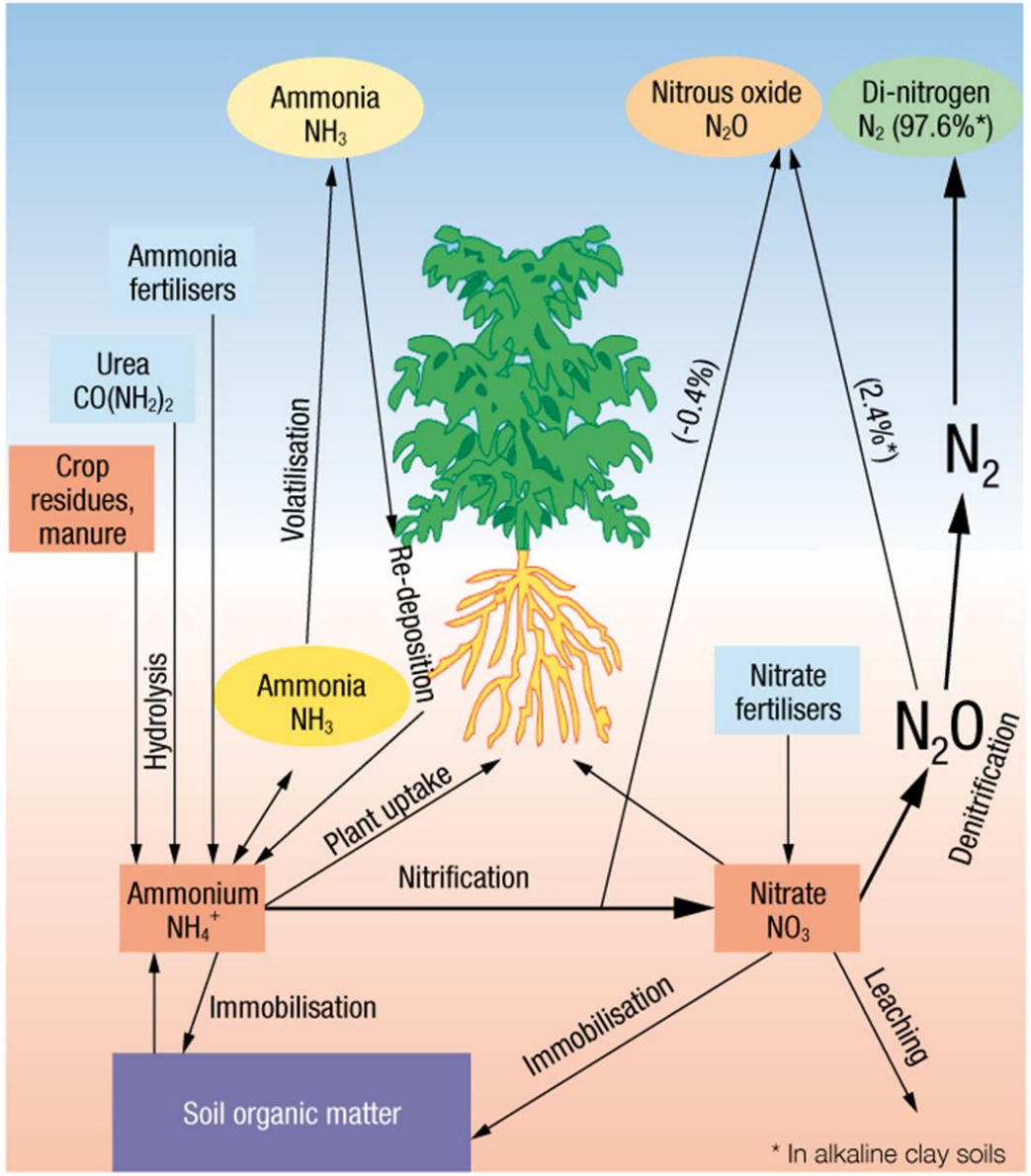

Conductivity (µS)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Natural Tributary
Storm Drain
Station 1
Station 2
Station 3
Oct. 2014
Nov. 2014
Jan. 2015
Feb. 2015
Apr. 2015


Stable Water Isotopes (‰)
0
-10
-20
-30
-40
-50
-60
-70
-80
δD
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
δ18O
Global Meteoric Water Line
Key
Storm Drain
Natural Tributary
Station 1
Station 2
Station 3
Recycled Water
Tap Water
Groundwater
Concrete Pond


Stable Water Isotopes (‰)
0
-10
-20
-30
-40
-50
-60
-70
-80
δD
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
δ18O
Global Meteoric Water Line
Local Water
Imported and Recycled Water
Key
Storm Drain
Natural Tributary
Station 1
Station 2
Station 3
Recycled Water
Tap Water
Groundwater
Concrete Pond

Discussion

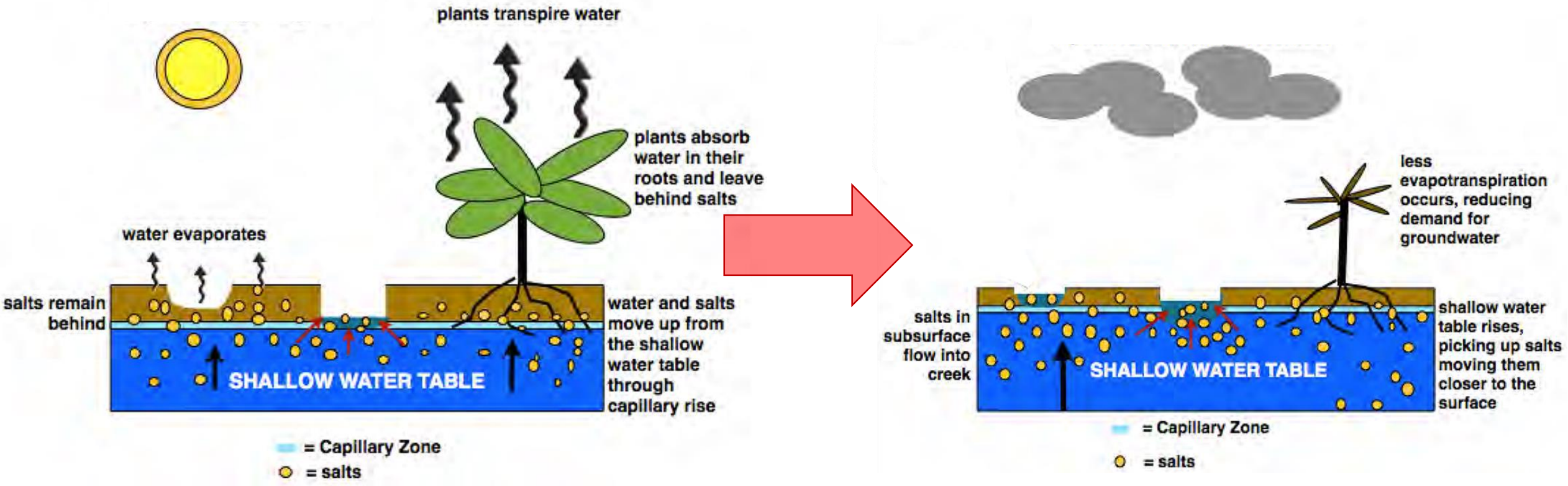
- Decrease in nutrient content downstream is due to transformational processes such as denitrification, vegetation uptake, and mixing with nutrient dilute groundwater baseflow
- Stabilization of phosphorus may be a result of groundwater leaching from phosphatic bearing strata in equilibrium with vegetation uptake



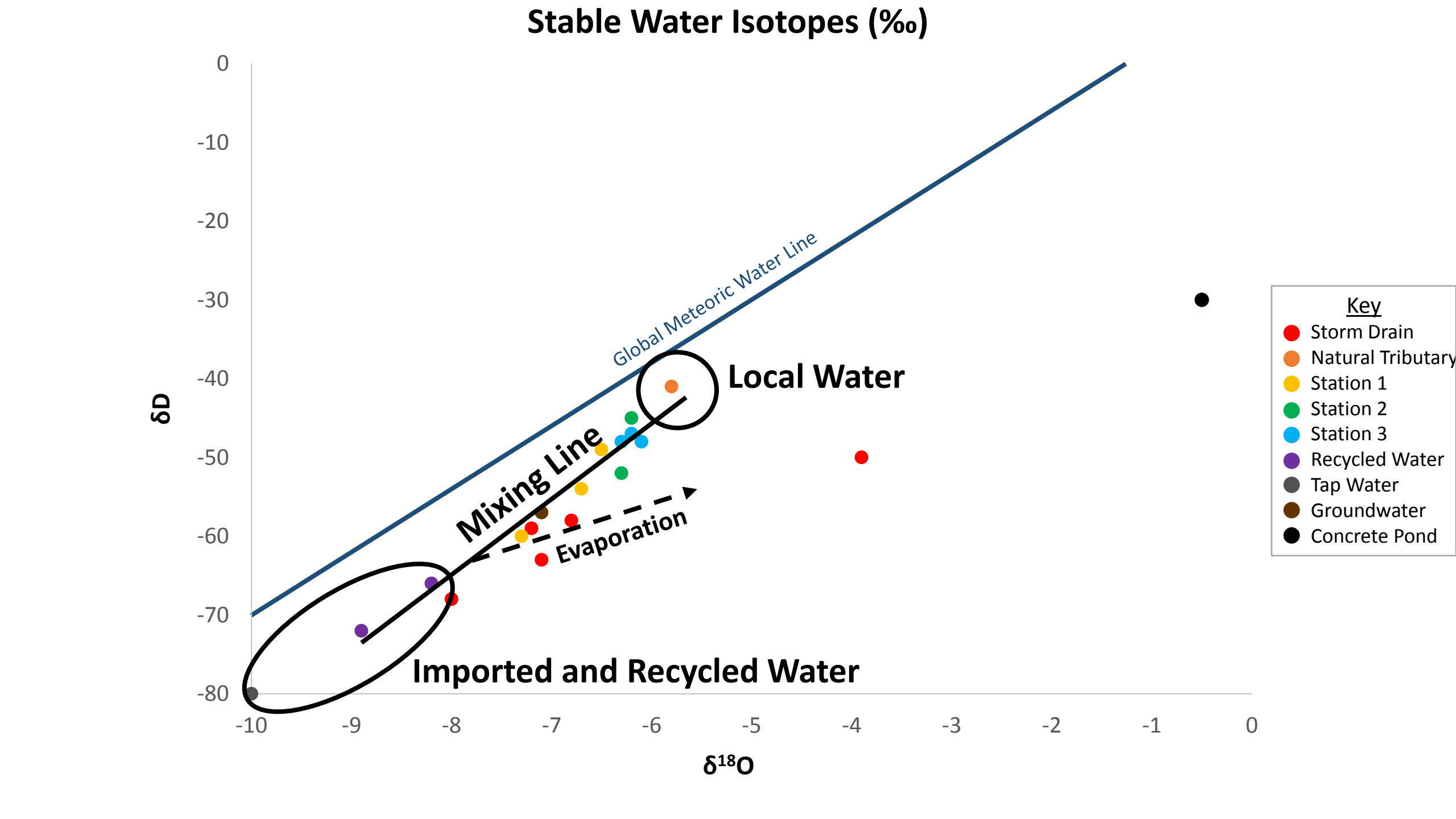
(Dixon 2014)

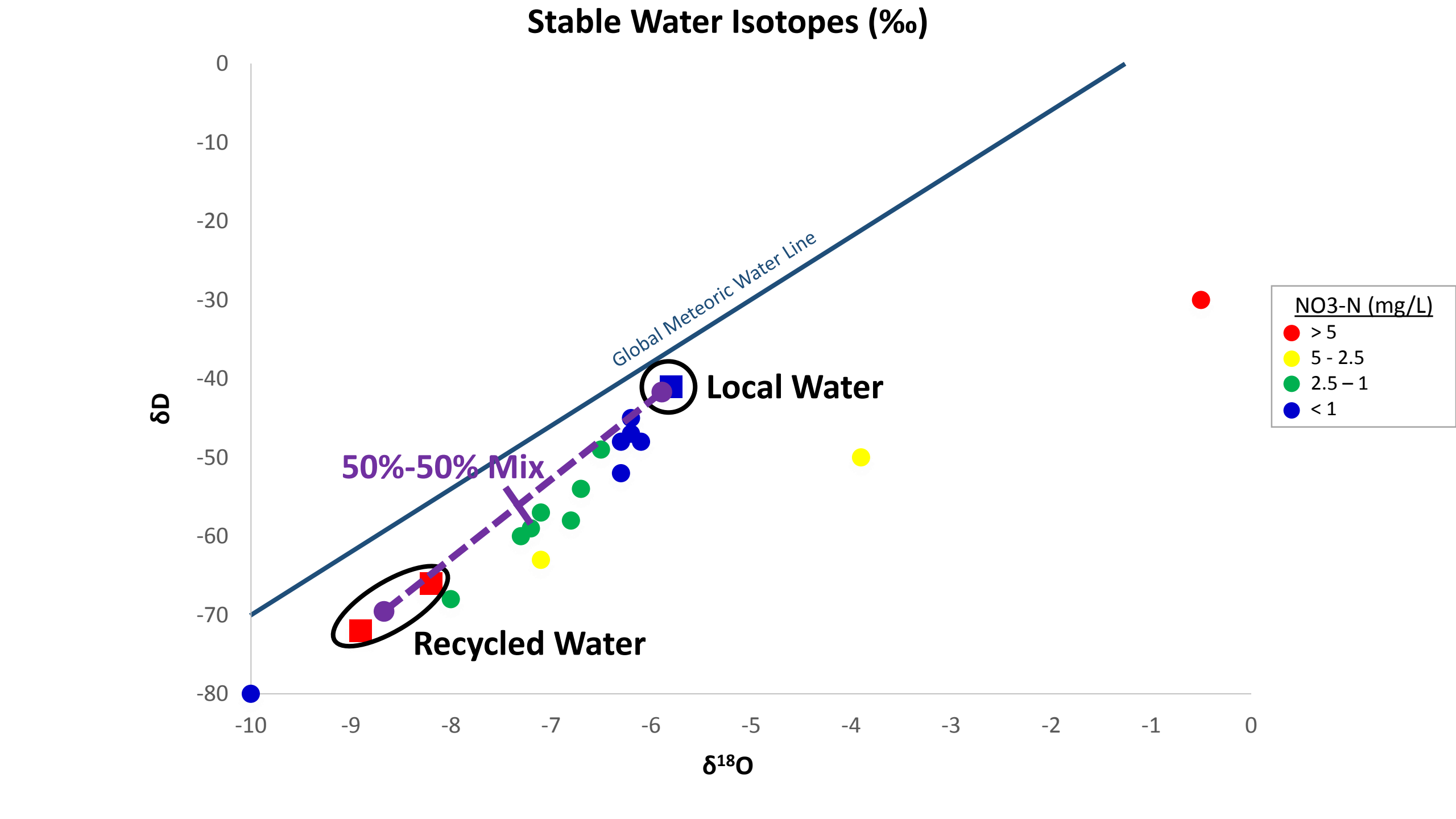
Discussion

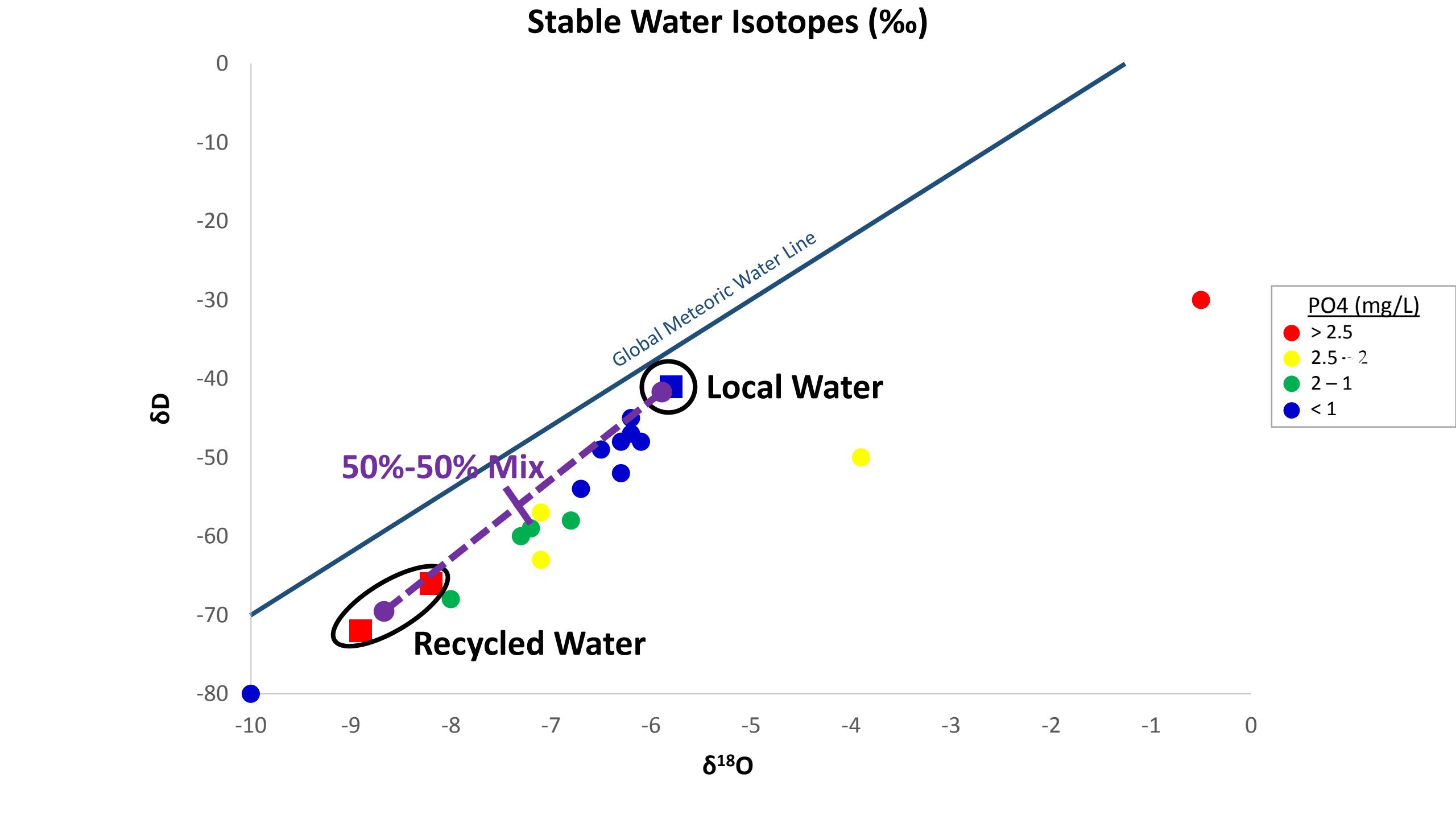
- Increase in salinity downstream is a result of evapotranspiration processes and saline groundwater baseflow



(Modified from Kuepper 2013)


Stable Water Isotopes (‰)
0
-10
-20
-30
-40
-50
-60
-70
-80
δD
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
δ18O
Global Meteoric Water Line
Local Water
Mixing Line
Evaporation
Imported and Recycled Water
Key
Storm Drain
Natural Tributary
Station 1
Station 2
Station 3
Recycled Water
Tap Water
Groundwater
Concrete Pond


Stable Water Isotopes (‰)
0
-10
-20
-30
-40
-50
-60
-70
-80
δD
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
δ18O
Global Meteoric Water Line
Local Water
50%-50% Mix
Recycled Water
NO3-N (mg/L)
> 5
5 - 2.5
2.5 – 1
< 1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0
-10
-20
-30
-40
-50
-60
-70
-80
δD
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
δ18O
Global Meteoric Water Line
Local Water
50%-50% Mix
Recycled Water
PO4 (mg/L)
> 2.5
2.5 - 2
2 – 1
< 1

Conclusions

- Stable isotopes of hydrogen and oxygen show mixing of recycled water with local groundwater downstream
  - Demonstrates that nutrients in this creek are not strictly dominated by geologic sources
- Further studies are needed in several areas within the creek and watershed
- This investigation is relevant because streams within the Malibu Creek Watershed contain pollutants that have not met water quality standards set by regulatory agencies such as the U.S. Environmental Protection Agency

Acknowledgements

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- University of Arizona