Modeling Hydrology in the Los Angeles Region: LSPC and GWAM

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Geosyntec Consultants

- LSPC and GWAM development and background

- Groundwater recharge methodology in both models

- Strengths and limitations of LSPC and GWAM

- LADWP Stormwater Capture Master Plan as a case study for both models

LSPC (Loading Simulation Program in C++)

- Lumped parameter watershed model

- Nearly identical to HSPF, but converted from FORTRAN to C++

- Developed and supported by US EPA since 2003 as key TMDL model

- Model of Los Angeles County created by LACDPW in 2011
- Continually being updated
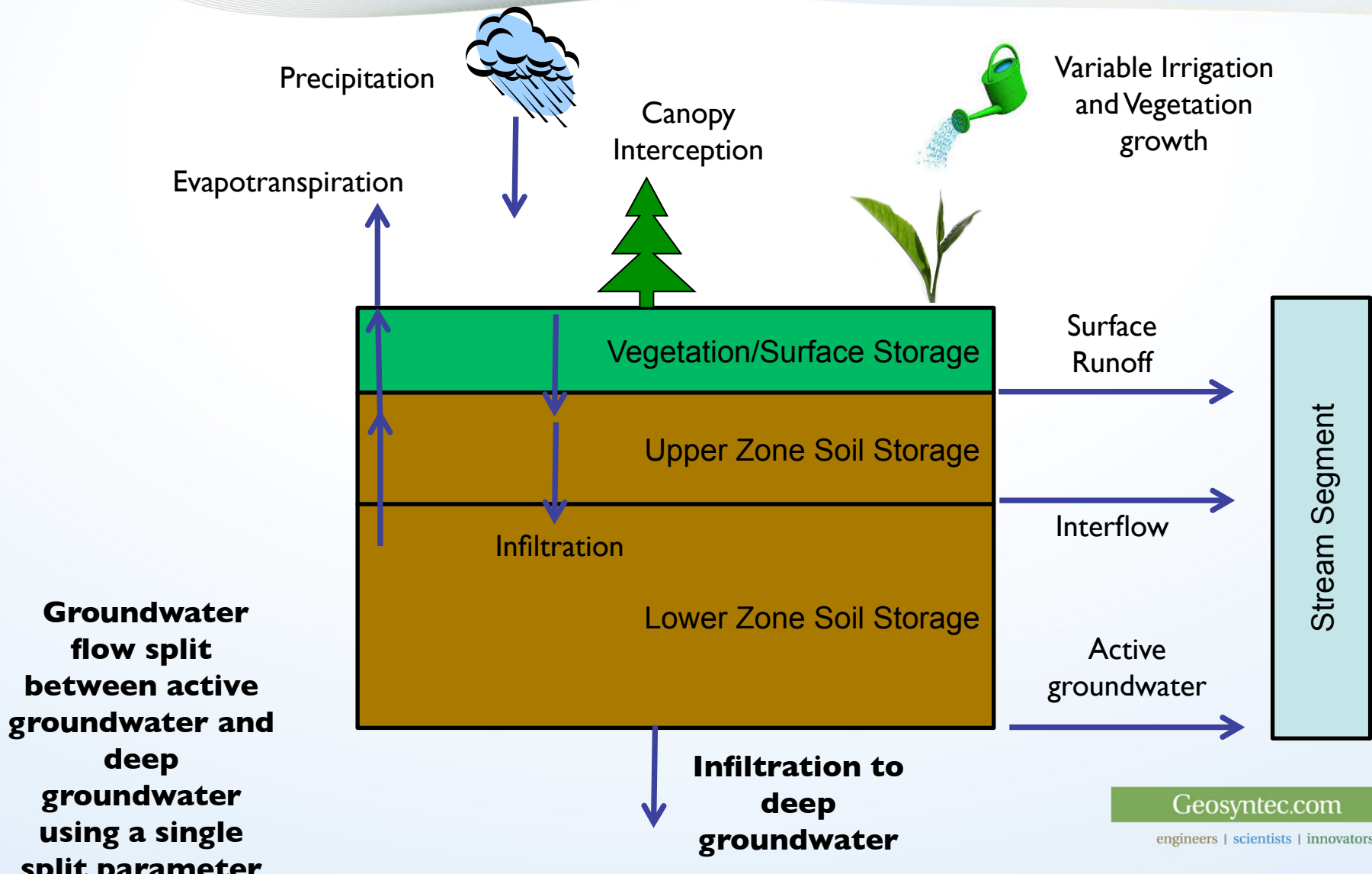
GWAM (Groundwater Augmentation Model)
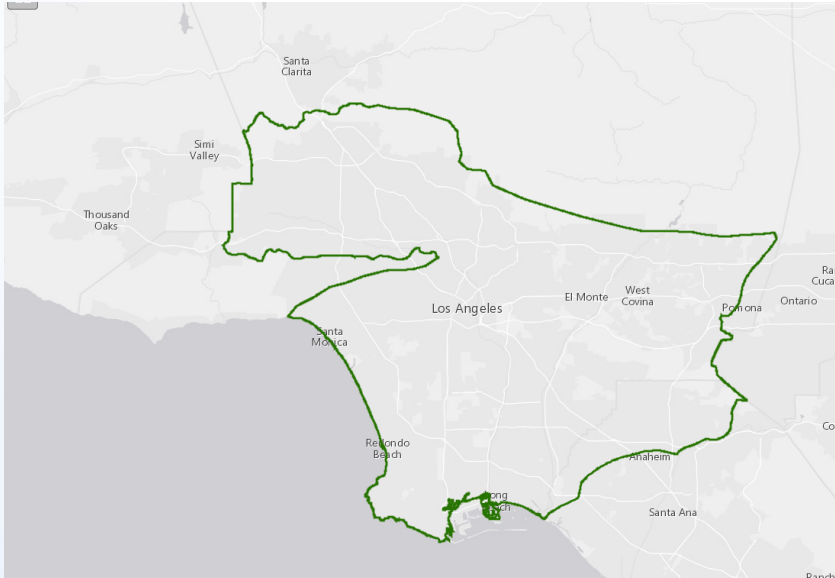
- Developed by Bureau of Reclamation and Council for Watershed Health specifically for LA region in 2007

- Geared specifically toward estimating aquifer recharge in LA area (Not a watershed model)

- Domain includes urban areas of LA Basin

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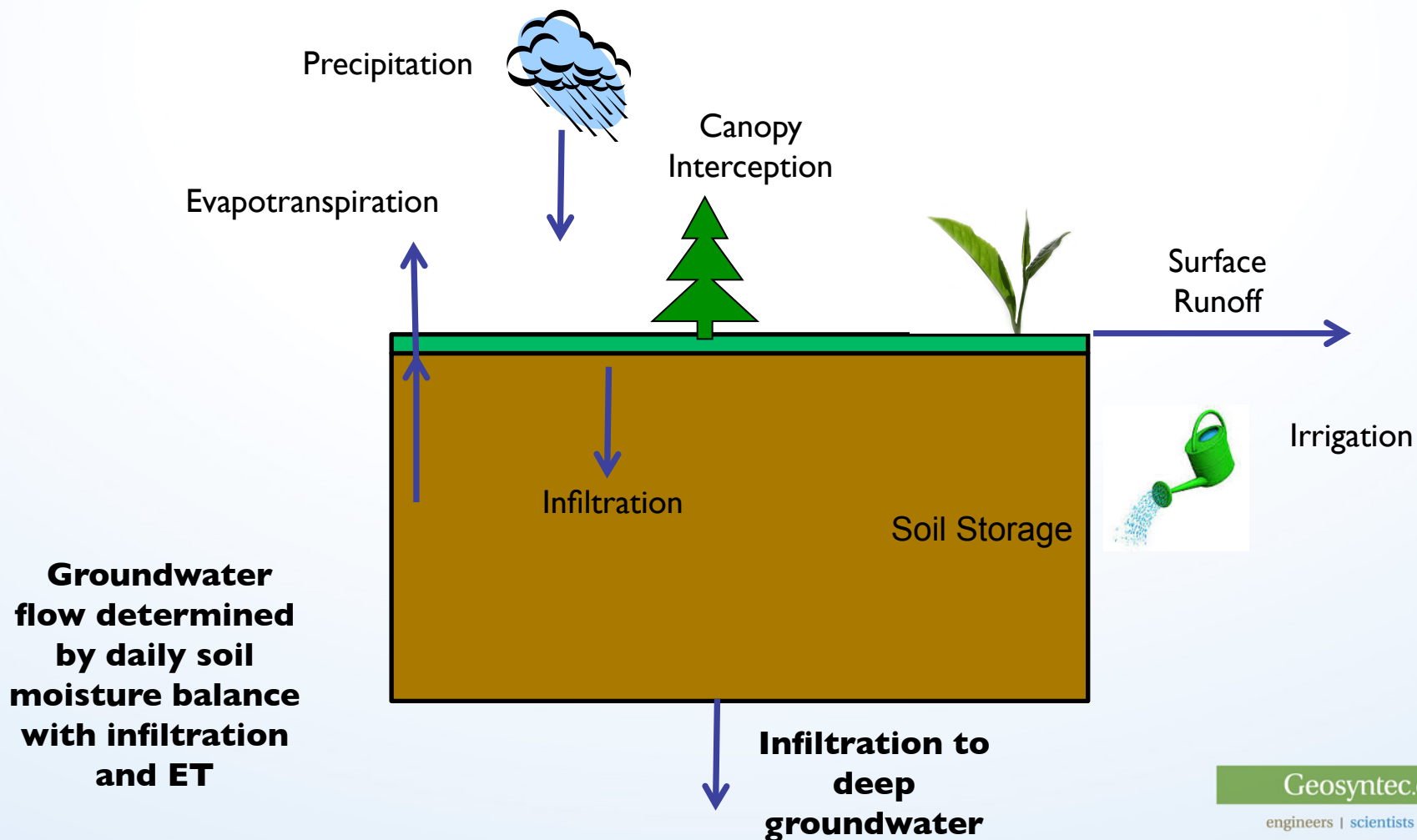
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LSPC

- Various Watershed Management Plans
- LA Basin Plan
- LA Stormwater Capture Master Plan
- LA One Water
- Gehry Vision Plan
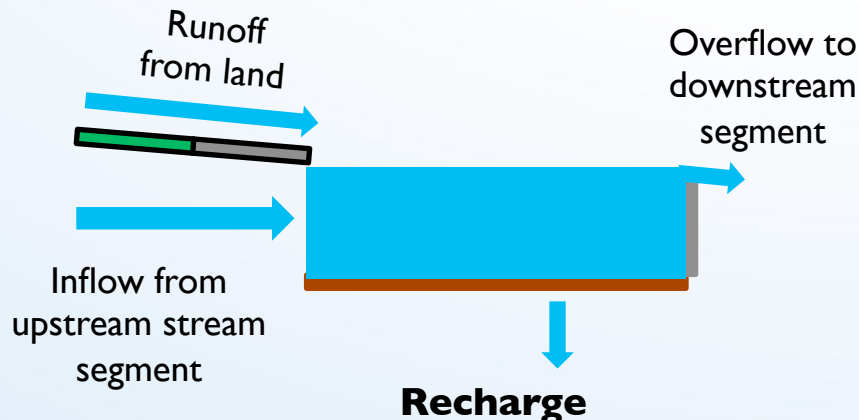- Coastal Conservancy Climate Ready

GWAM

- Water Augmentation Study
- LA Stormwater Capture Master Plan
- Green Infrastructure and Water Supply Case Study
- Coastal Conservancy Climate Ready
- Arroyo Seco Report Card
- Pacoima Beautiful Greening Plan

Deep Percolation-LSPC

Geosyntec consultants

Precipitation

Evapotranspiration

Canopy Interception

Variable Irrigation and Vegetation growth

Vegetation/Surface Storage

Surface Runoff

Upper Zone Soil Storage

Interflow

Infiltration

Lower Zone Soil Storage

Active groundwater

Stream Segment

Groundwater flow split between active groundwater and deep groundwater using a single split parameter

Infiltration to deep groundwater

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Deep Percolation-GWAM

Precipitation

Evapotranspiration

Canopy Interception

Surface Runoff

Irrigation

Infiltration

Soil Storage

Groundwater flow determined by daily soil moisture balance with infiltration and ET

Infiltration to deep groundwater

LSPC

- Build BMPs into stream segment network
- Split flow from BMPs sent directly to recharge

GWAM

- **Pervious runoff:** A fraction of runoff sent to soil storage (increasing recharge)
- **Impervious runoff**: A fraction of runoff sent directly to recharge
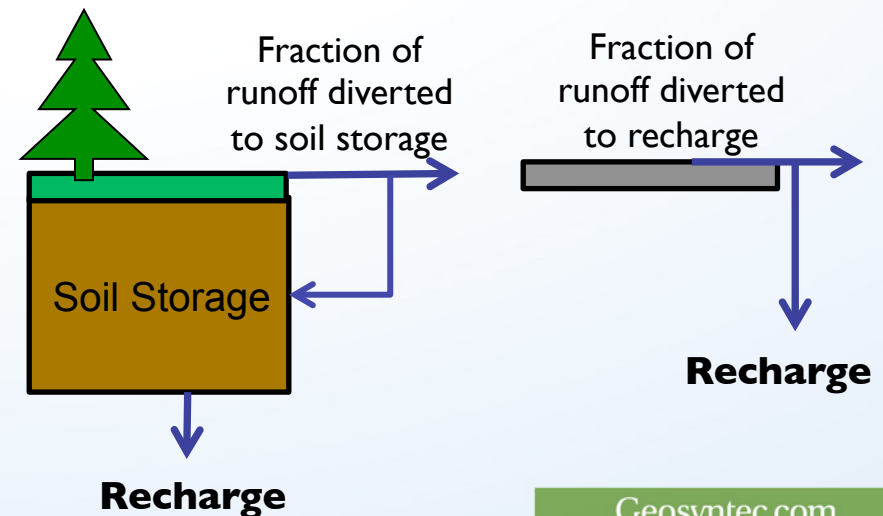
Strengths

- Stream routing and BMP modeling
- Flexibility
  - Adjustable date ranges
  - Wider use area
  - More parameters and options
  - Can be changed/adapted
- Finer time step
- More output options
- Sediment/ water quality

Limitations

- Groundwater recharge not calibrated
- Single-split factor for groundwater recharge
- More parameters
- Fewer vegetation types, surface uses, soil parameters
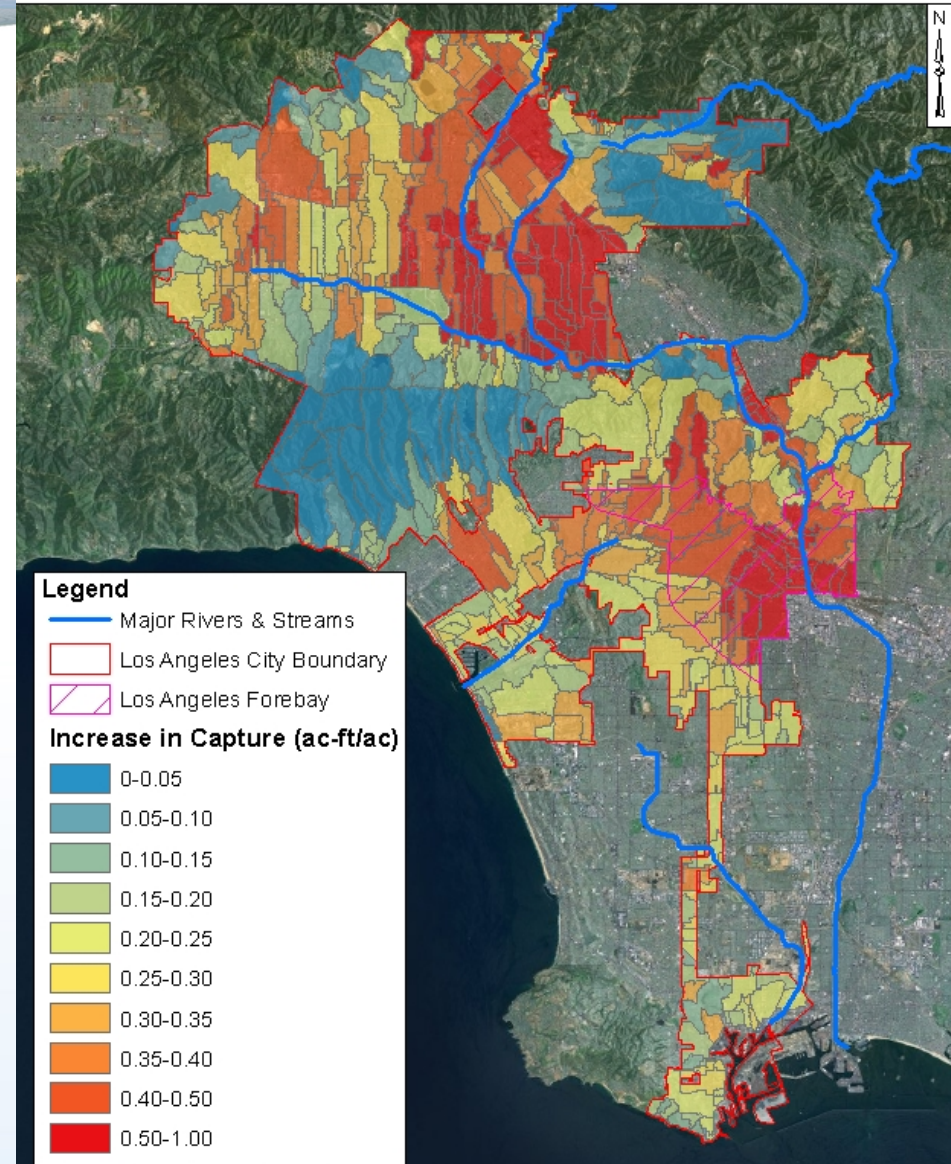 - In LA County model (could be adjusted to make any combination)

Strengths

- Geared towards recharge in LA area, specifically
- Recharge calibrated
- Better representation of soil moisture accounting
- Larger built-in array of land uses, surface types, and soil profiles
- Finer-grained land use scale output

Limitations

- Inflexible
  - Only 2 computers, currently
- No routing between segments
- Limited BMP modeling
- Limited output types
- Limited to urbanized areas
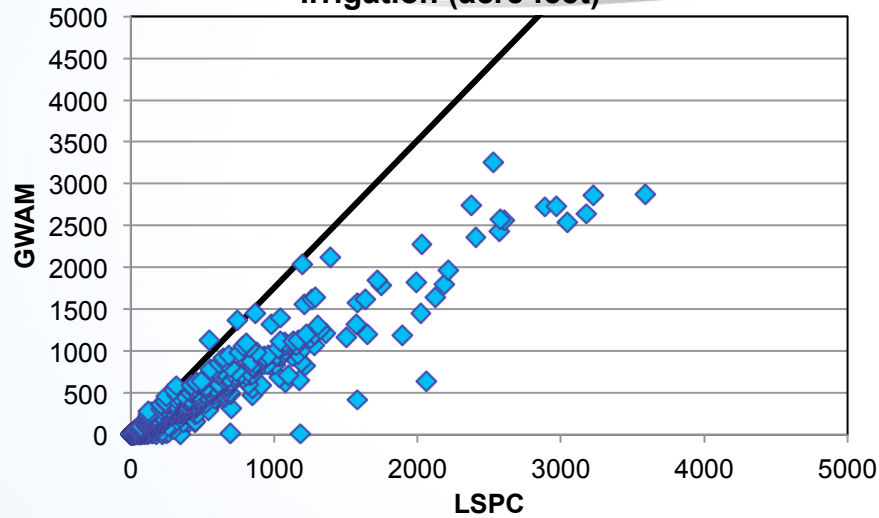- Cannot capture/infiltrate routed flows

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Leveraging the Strengths of Both Models

- **LADWP Stormwater Capture Master Plan 2015**
  - Also ongoing Coastal Conservancy Climate Ready by CWH

- **Used both LSPC and GWAM to model the watershed**

- **For overlapping areas compared:**
  - Precipitation
  - Irrigation
  - Runoff
  - ET
  - Recharge

- **Used GWAM results to adjust recharge/ET split in LSPC**

Legend
- Major Rivers & Streams
- Los Angeles City Boundary
- Los Angeles Forebay

Increase in Capture (ac-ft/ac)
- 0-0.05
- 0.05-0.10
- 0.10-0.15
- 0.15-0.20
- 0.20-0.25
- 0.25-0.30
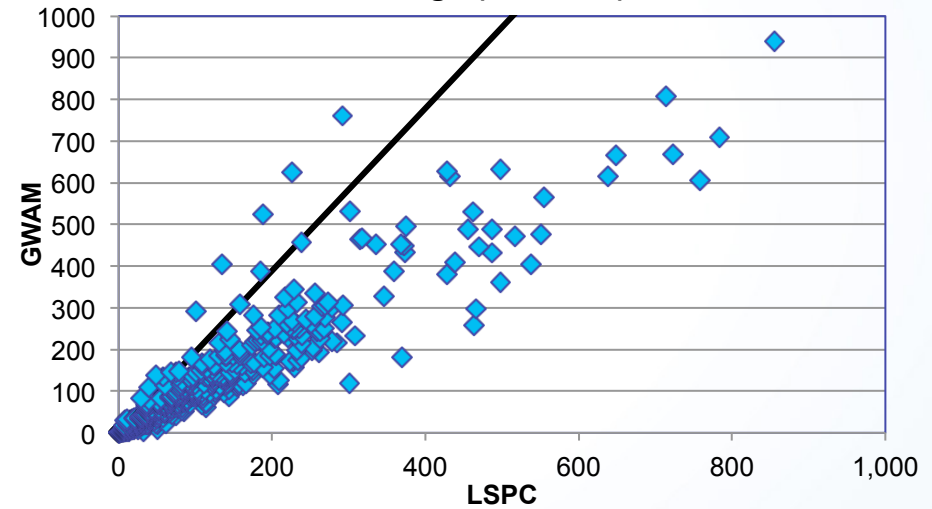- 0.30-0.35
- 0.35-0.40
- 0.40-0.50
- 0.50-1.00

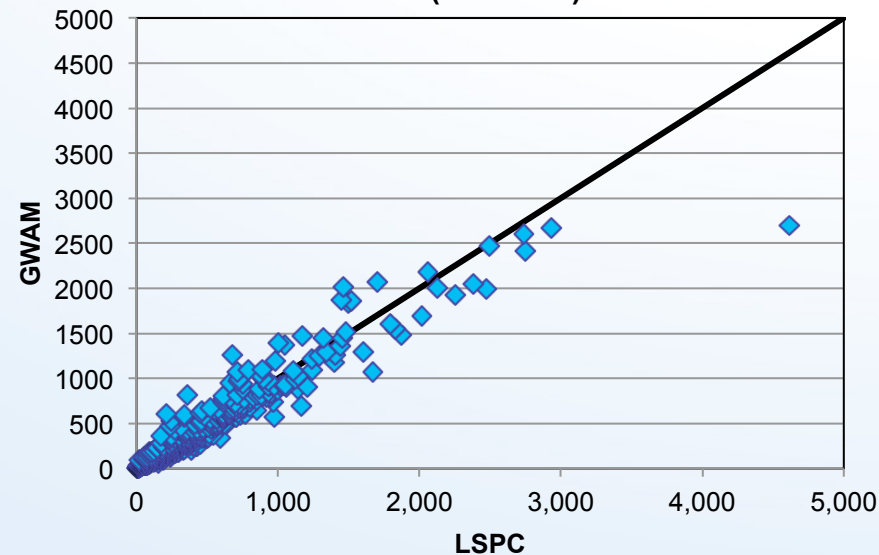# Leveraging the Strengths of Both Models

Irrigation (acre feet)

Recharge (acre feet)

Runoff (acre feet)

Both models agreed very well for precipitation, irrigation, capture, and runoff volumes

LSPC systematically sent more of the captured volume to deep groundwater and less to ET than GWAM

Adjusted LSPC to make the split between deep groundwater and ET match GWAM

- Both models estimate groundwater recharge by the volume that infiltrates below the root zone/lower soil zone
  - Neither accounts for losses/obstacles between the lowest modeled soil zone and the aquifer

- Neither model automatically accounts for confined or unconfined aquifers
  - This was done manually in the LA Stormwater Capture Master Plan

- Neither model accounts for the effect of the groundwater table on infiltration rates
  - For more accurate modeling, should be coupled with a groundwater model

- **Council for Watershed Health**
  - John Tangenberg

- **Los Angeles County Department of Public Works**
  - Lee Alexanderson
  - TJ Moon
  - Daniel Bradbury

- **Los Angeles Department of Water and Power**
  - Rafael Villegas

- **Santa Ana Watershed Protection Authority**
  - Mike Antos