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Environmental Policy & Planning Group

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Water Resources Research Center

August 17, 2021

Commission on Water Resources Management

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Groundwater management for people and ecosystems under a changing climate: Insights from the Pu‘uloa aquifer

Leah Bremer, Ahmed Elshall, Christopher Wada, Laura Brewington,
Aly El-Kadi, Clifford Voss, Jade Delevaux, Kimberly Burnett

Mahalo to: ‘Ike Wai EPSCOR; United States Geological Survey (Kolja Rotzall, Delwyn Oki, Steve Anthony); CWRM

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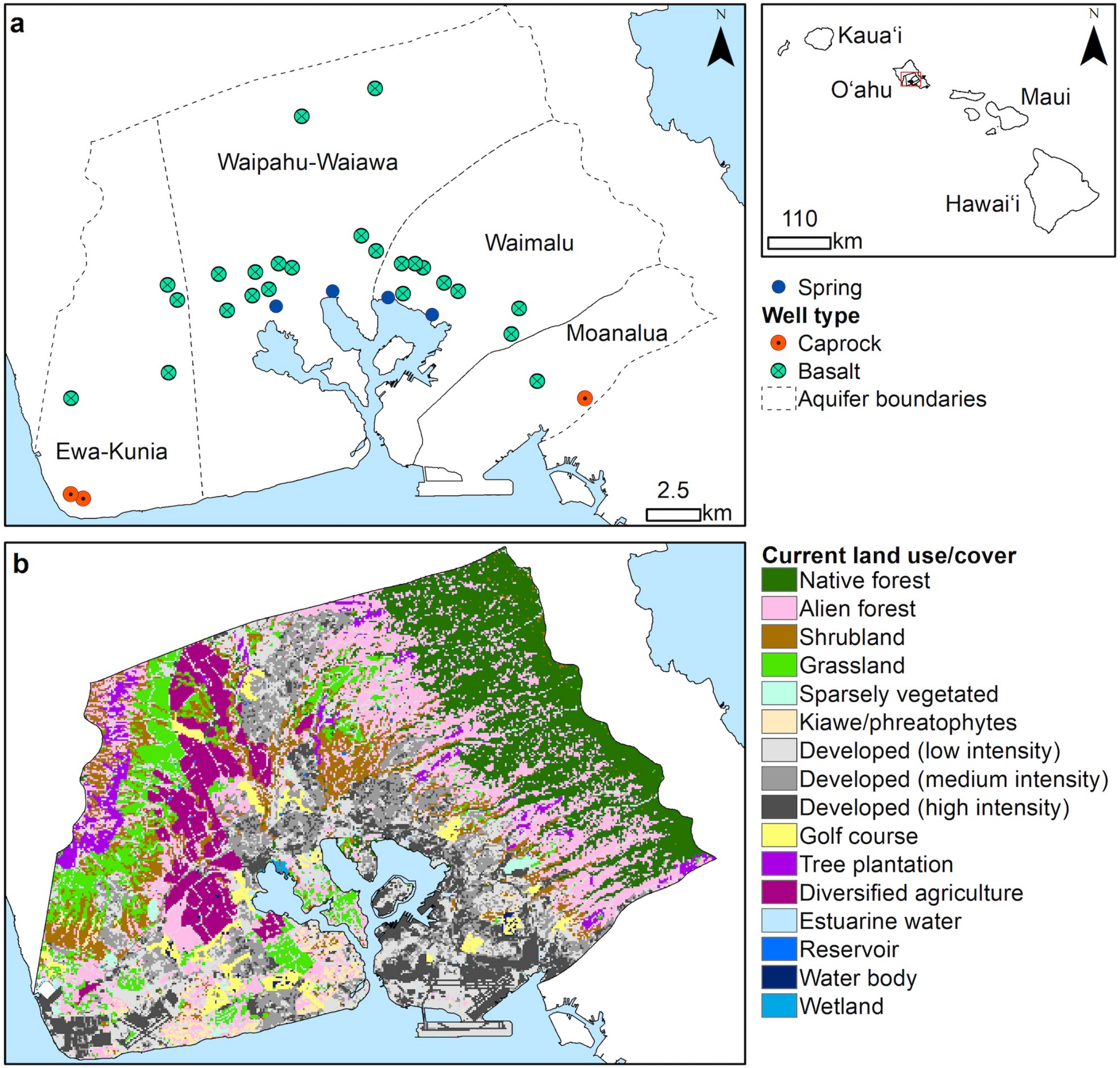
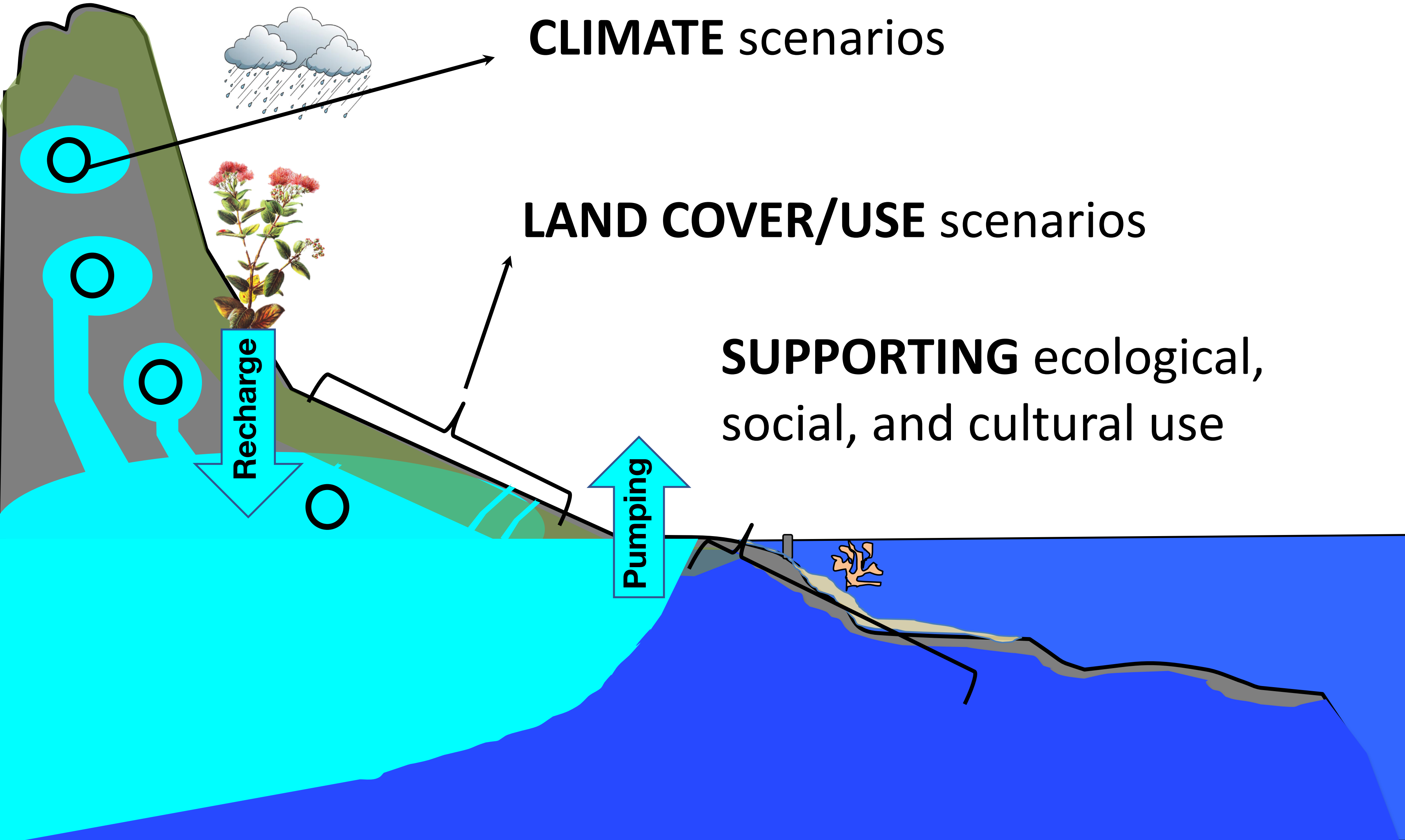
Pu'uloa (Pearl Harbor Aquifer)



- 2/3rds of O'ahu's drinking water
- Culturally and ecologically important springs
  - ↓ 50% (Oki 2005)
- Mixed urban, conservation, agricultural
- Sustainable yield =182 MGD; RAM2
- Current pumping = 117 MGD

Sustainable Yield



ʻIke Wai research: Incorporating springs, climate, and land cover into sustainable yield

- Springs

Incorporating Historical Spring Discharge Protection Into Sustainable Groundwater Management: A Case Study From Pearl Harbor Aquifer, Hawaiʻi

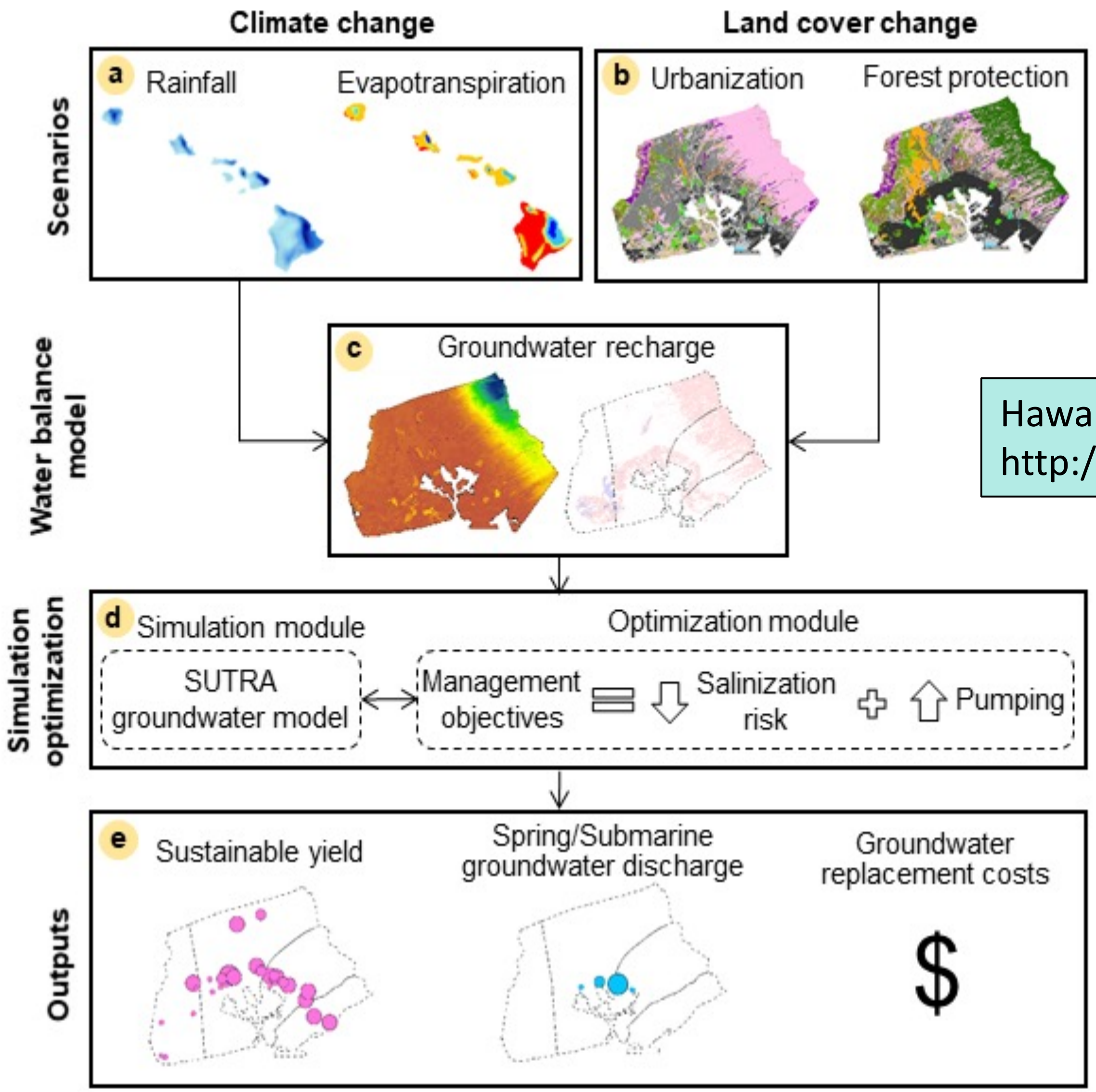
Kimberly M. Burnett[1,2], Ahmed S. Elshall[2,3], Christopher A. Wada[1,2], Aida Arik[4], Aly El-Kadi[2,5], Clifford I. Voss[2], Jade M. S. Delevaux[6] and Leah L. Bremer[1,2]*

- Climate and Land cover change

Effects of land-cover and watershed protection futures on sustainable groundwater management in a heavily utilized aquifer in Hawaiʻi (USA)

Leah L. Bremer[1,2] • Ahmed S. Elshall[2,3] • Christopher A. Wada[1,2] • Laura Brewington[4] • Jade M.S. Delevaux[5] • Aly I. El-Kadi[2,6] • Clifford I. Voss[2] • Kimberly M. Burnett[1,2]

Groundwater optimization simulation



Hawai'i Groundwater Recharge Tool:
http://recharge.ikewai.org/#/home

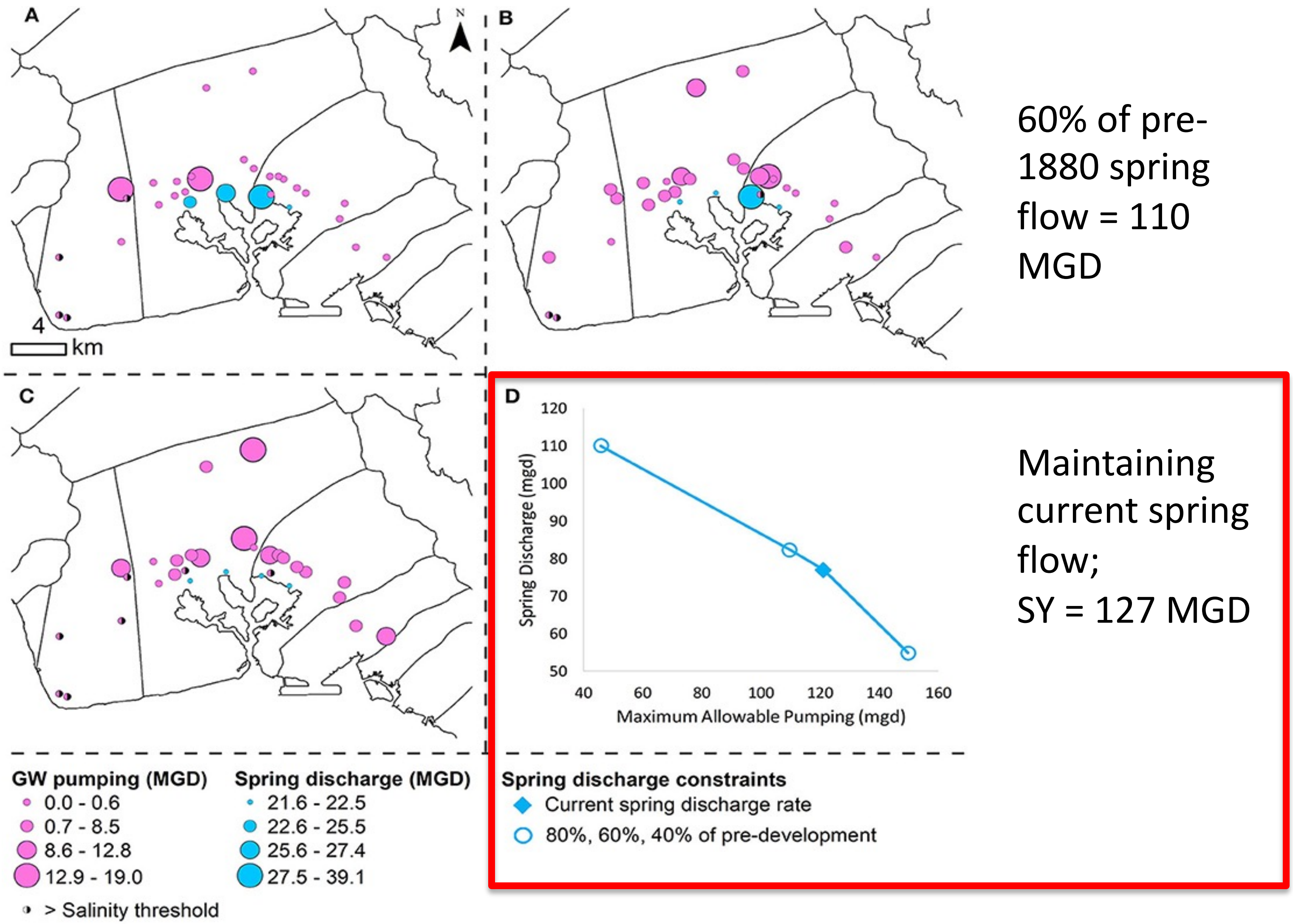
Tradeoffs in spring flow and groundwater pumping in SY estimates

80% of pre-1880 spring flow;
SY = 45 MGD

60% of pre-1880 spring flow = 110 MGD

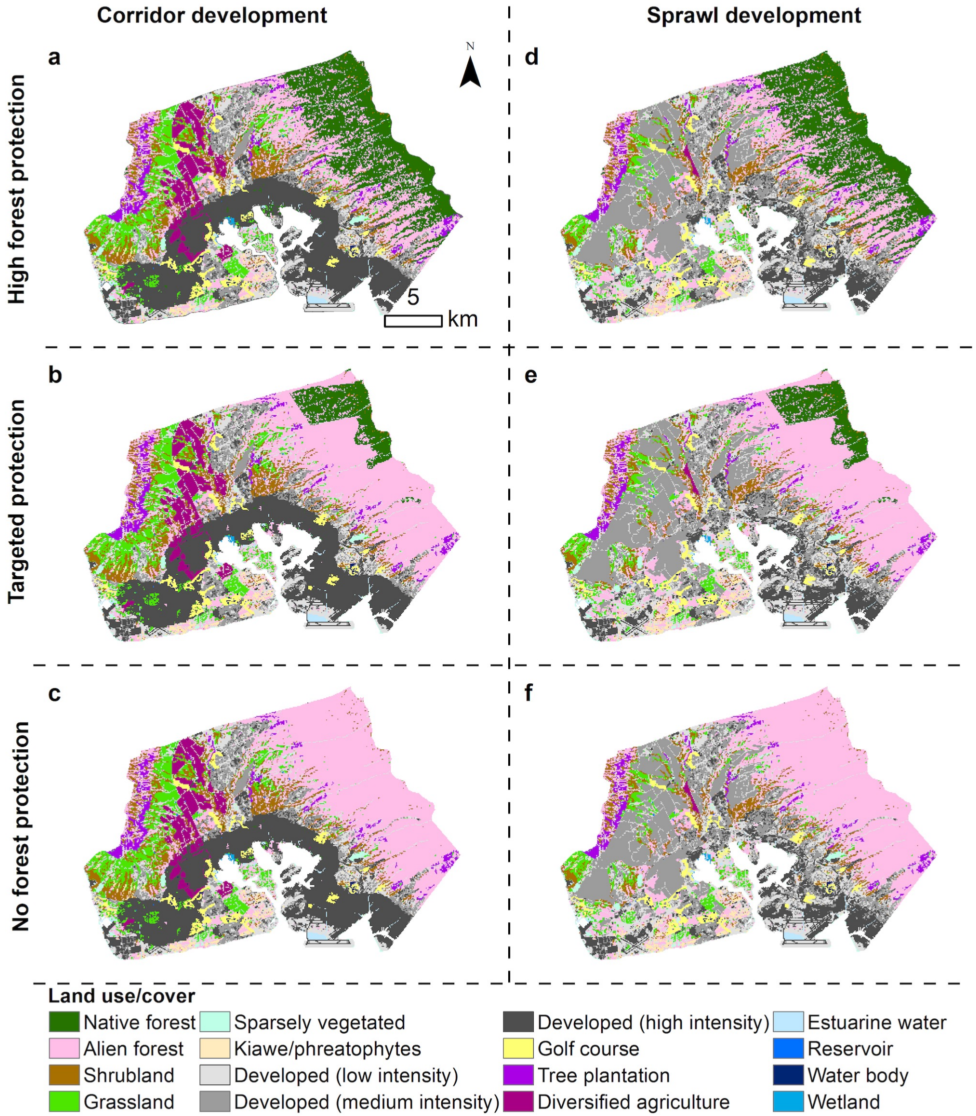
40% of pre-1880 spring flow;
SY= 150 MGD

Maintaining current spring flow;
SY = 127 MGD



Burnett et al. 2020, Frontiers in Water

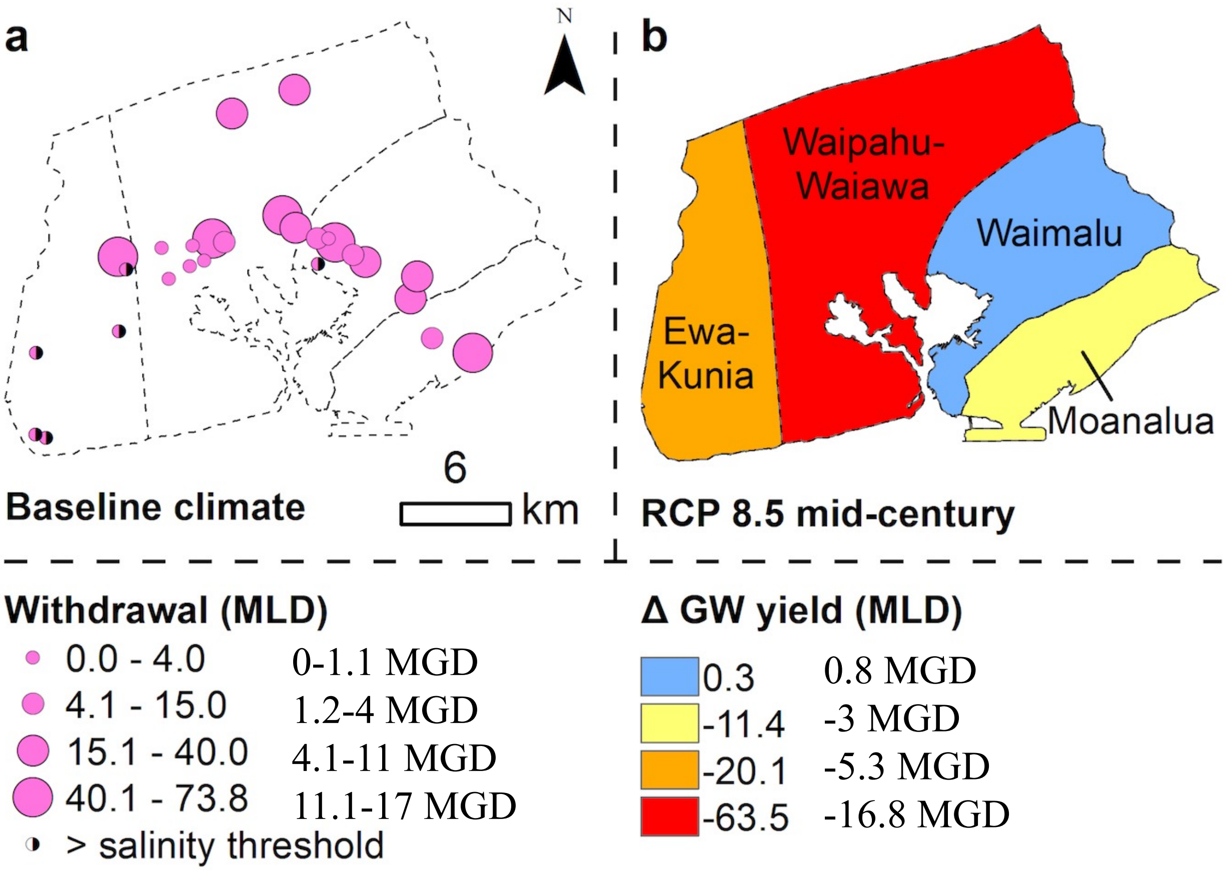
Incorporating future climate and land cover change into SY



- Land cover
  - Forest protection
  - Urban development
- Climate change
  - RCP 8.5 mid-century (~16% decrease in recharge across aquifer; Oliver-Timm et al. 2016)

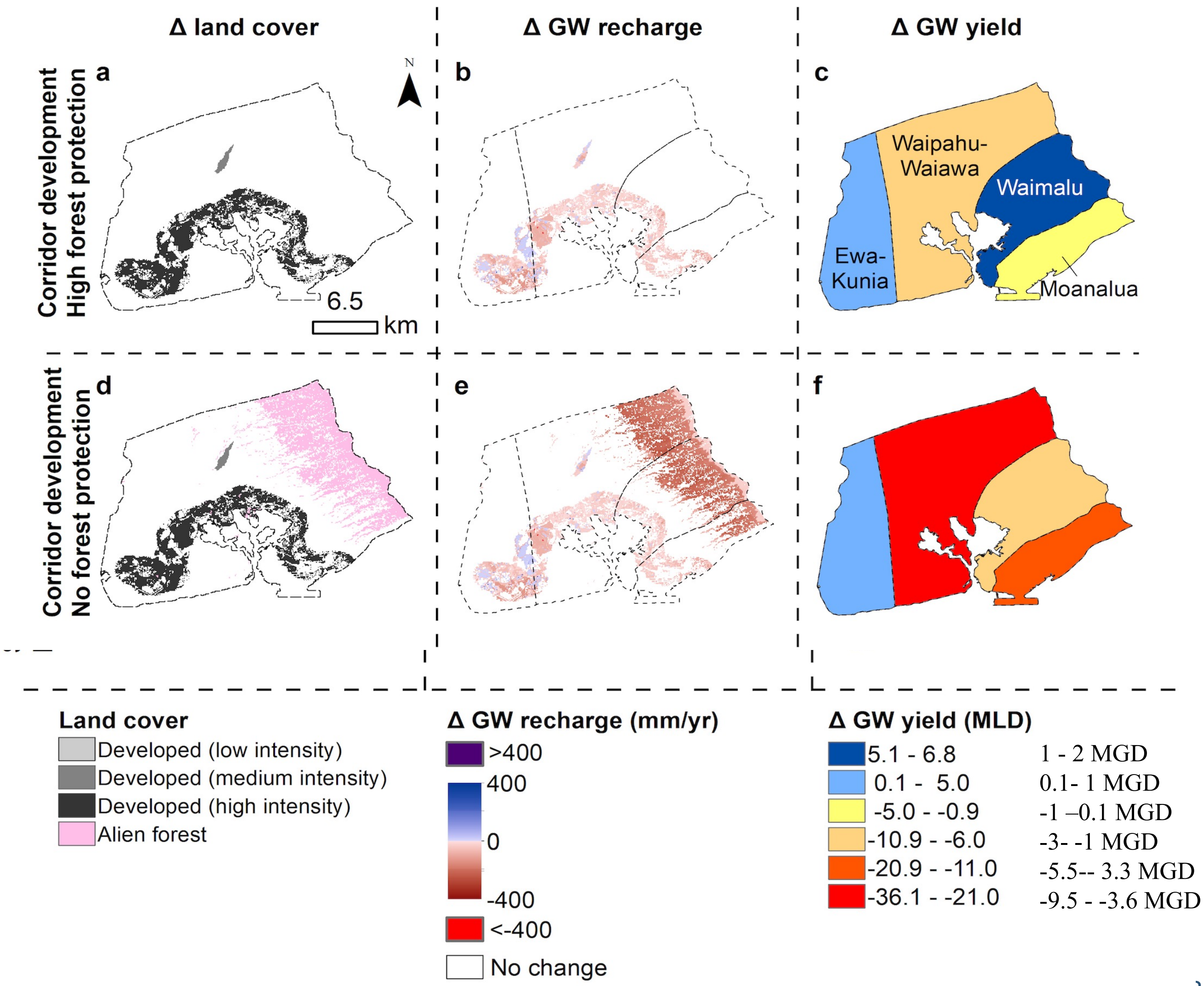
Bremer et al. 2021, Hydrogeology Journal

Climate change reduction in SY



- SY under current climate = 154 MGD (no spring constraint)
- SY under RCP 8.5 mid-century decreases by 18%
- Uneven impacts

Land cover change and SY: Forest protection largest land cover change impact



- Native forest prot. prevents loss of 8-10 MGD in SY (7-11% increase)
- Native forest prot. saves up to $40 million in water supply costs after 50-years
- Need additional ecohydrology research

Summary

- Maintaining spring discharge at current levels requires reducing SY to 127 MGD even under current climate (compared to 182 MGD currently)
- Restoring spring discharge to (higher) historic levels requires an even greater reduction in SY
- Climate change further reduces SY by ~ 18%
- Forest protection may help to protect recharge and increase SY compared to no protection helping to build resilience to climate change, but need additional data to reduce uncertainties.

Mahalo

- ‘Ike Wai EPSCoR
- United States Geological Survey
- Commission on Water Resources Management
- Sumida Farm
- See blog and citations within for more information: https://uhero.hawaii.edu/groundwater-management-for-people-and-ecosystems-under-a-changing-climate-insights-from-the-pu%ca%bbuloa-aquifer/
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