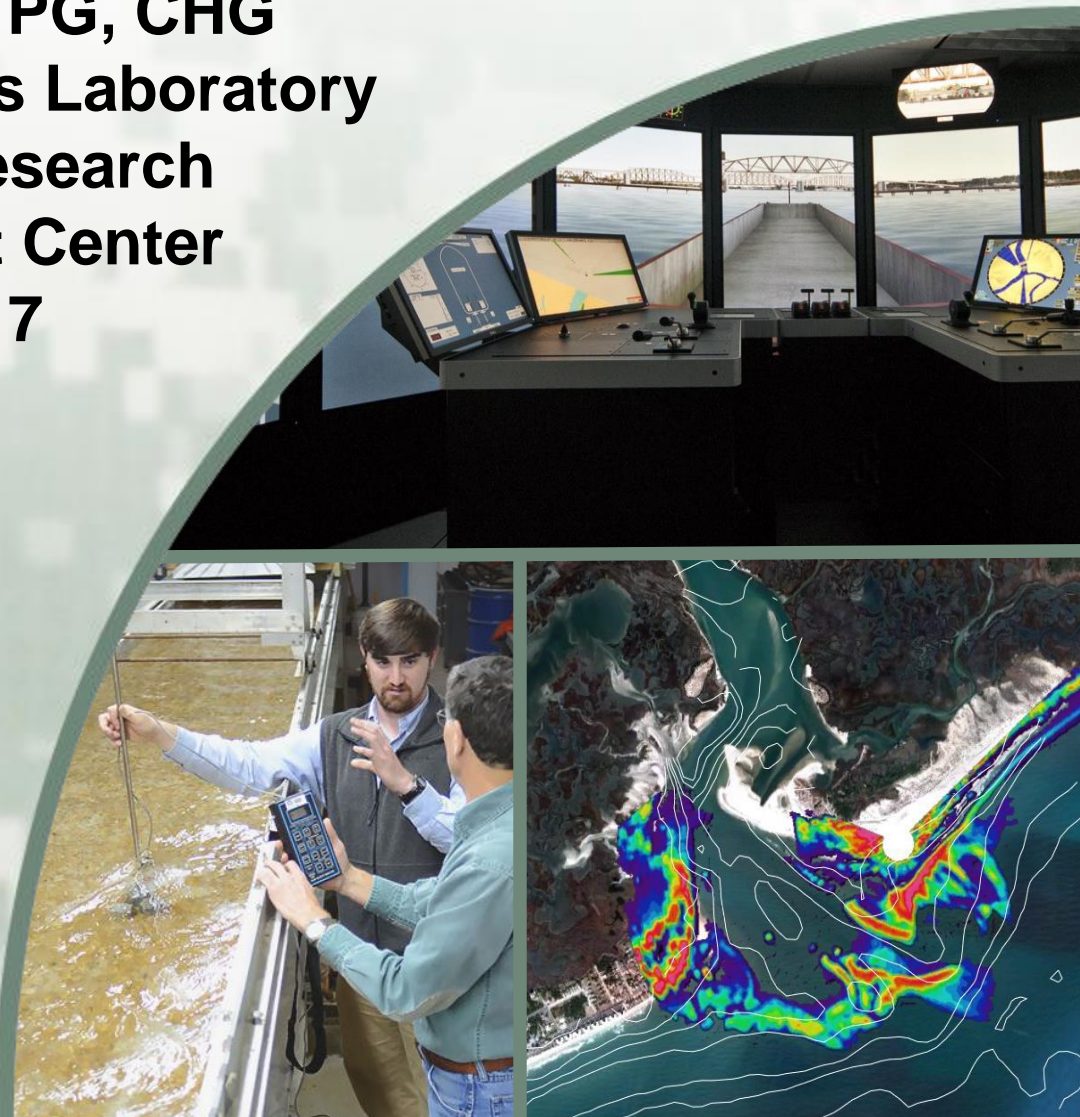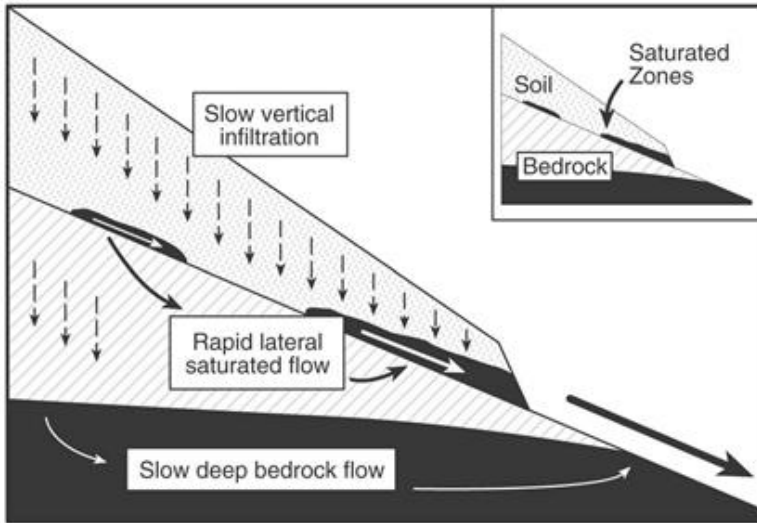**Charles W. Downer Ph.D., PE, PMP
and Steve Turnbull PG, CHG
Coastal and Hydraulics Laboratory
COE Engineer Research
and Development Center
May 31, 2017**
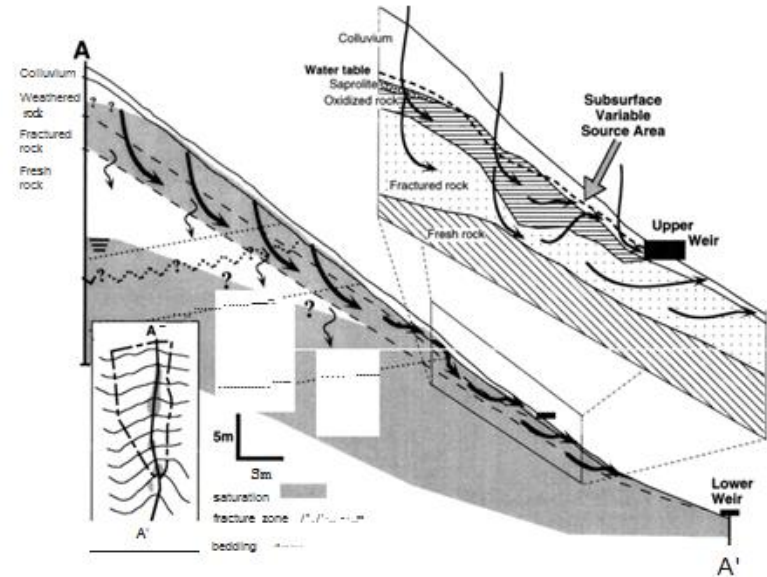
Hillslope Hydrology Considerations – Coast Ranges

MONTGOMERY AND DIETRICH: RUNOFF GENERATION IN A STEEP LANDSCAPE

Slow vertical infiltration

Soil

Saturated Zones

Bedrock

Rapid lateral saturated flow

Slow deep bedrock flow

ANDERSON ET AL: SUBSURFACE FLOW PATHS

- Overland Flow in Coast Ranges of California and Oregon can be complicated
    - Not clearly Hortonian Runoff locally with Regional Groundwater Flow
    - Can be complicated array of interactions that geochemical tracers can assist with evaluating.

COASTAL & HYDRAULICS LABORATORY

BUILDING STRONG®

CHL Experience with Streamflow, Rainfall, Soil Moisture Measurements, Geochemical Tracers

- Rainfall
  - Onset Computer Co. Hobo Rain Gages
- Streamflow
  - Solonist Levelloggers
  - Isco Automated Samplers
    - 730 Bubbler Flow Meters
    - 750 Area/Velocity Monitor
- Soil Moisture
  - Campbell Scientific CS616 Water Content Reflectometers with Dataloggers (CR1000 -16 channel).
- Geochemical Tracers
  - Age dating – (C14)
  - Natural Geochemistry (chloride, bicarbonate, etc.)
  - Stable Isotopes (D^2 and O^{18})

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Rainfall

- As many rain gages as possible.
  - ► Provide redundancy
  - ► Orographic impacts evaluated
- Rain Gage Lessons
  - ► Ants often nest in gages
  - ► Birds nest too
  - ► Good location top of fence posts

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Stream Gaging

- ## Solonist Levelloggers

  - Bury in PVC tubes, easy to hide.

  - Operate buried in soil/gravel.

- ## ISCO Automated Samplers in 80 Gallon Drums

  - 730 Bubbler Flow Meters accurate, durable, and can correlate sampling for geochemical parameters with flow

  - 750 Area/Velocity flowmeter, not good for streams with bed load. Also collect head level

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Soil Moisture Sensors

- Makua Military Reservation, Oahu, Hawaii - RDX Explosive Contamination Bioremediation Pilot Scale Evaluation as part of a lawsuit.

- 16 – CS616 Water Content Reflectometers

- Used to measure infiltration rates

- Soil properties use for modeling:

  ► Porosity, residual moisture content, field capacity, wilting point, initial soil moisture content.

  ► Hydrus was used for vadose zone modeling (field demo was in small burn pit to develop the model for the main burn pit area.

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Makua Military Reservation, Oahu, Hawaii - RDX Explosive Contamination Bioremediation Pilot Scale Evaluation
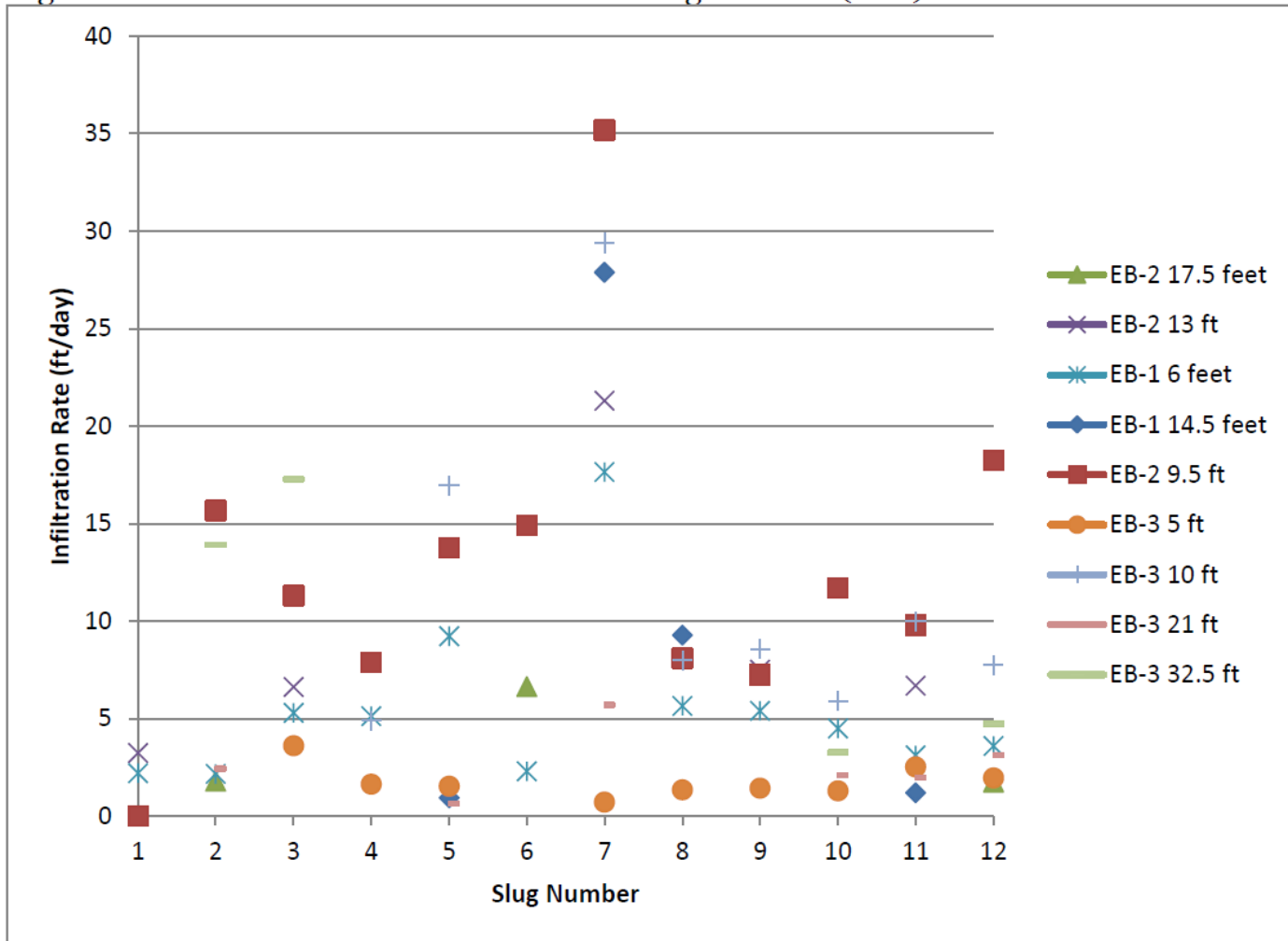

Figure 4: Test Plot and Borehole Diagrams
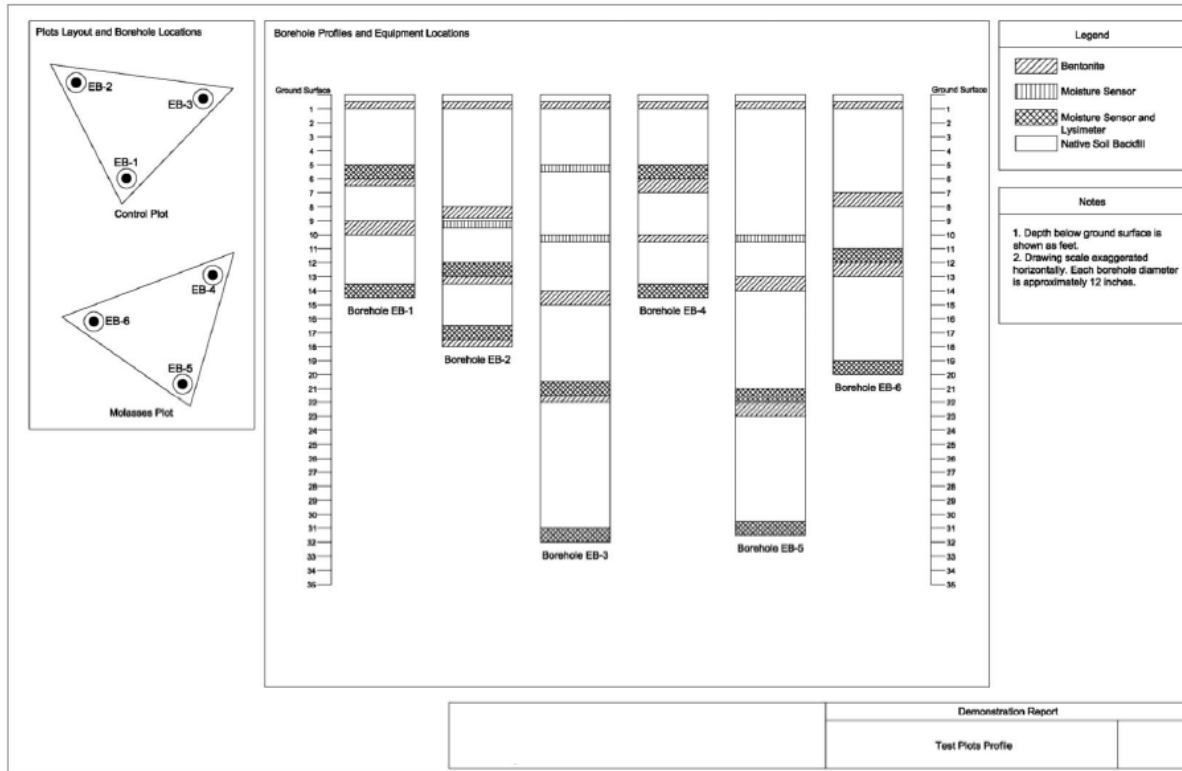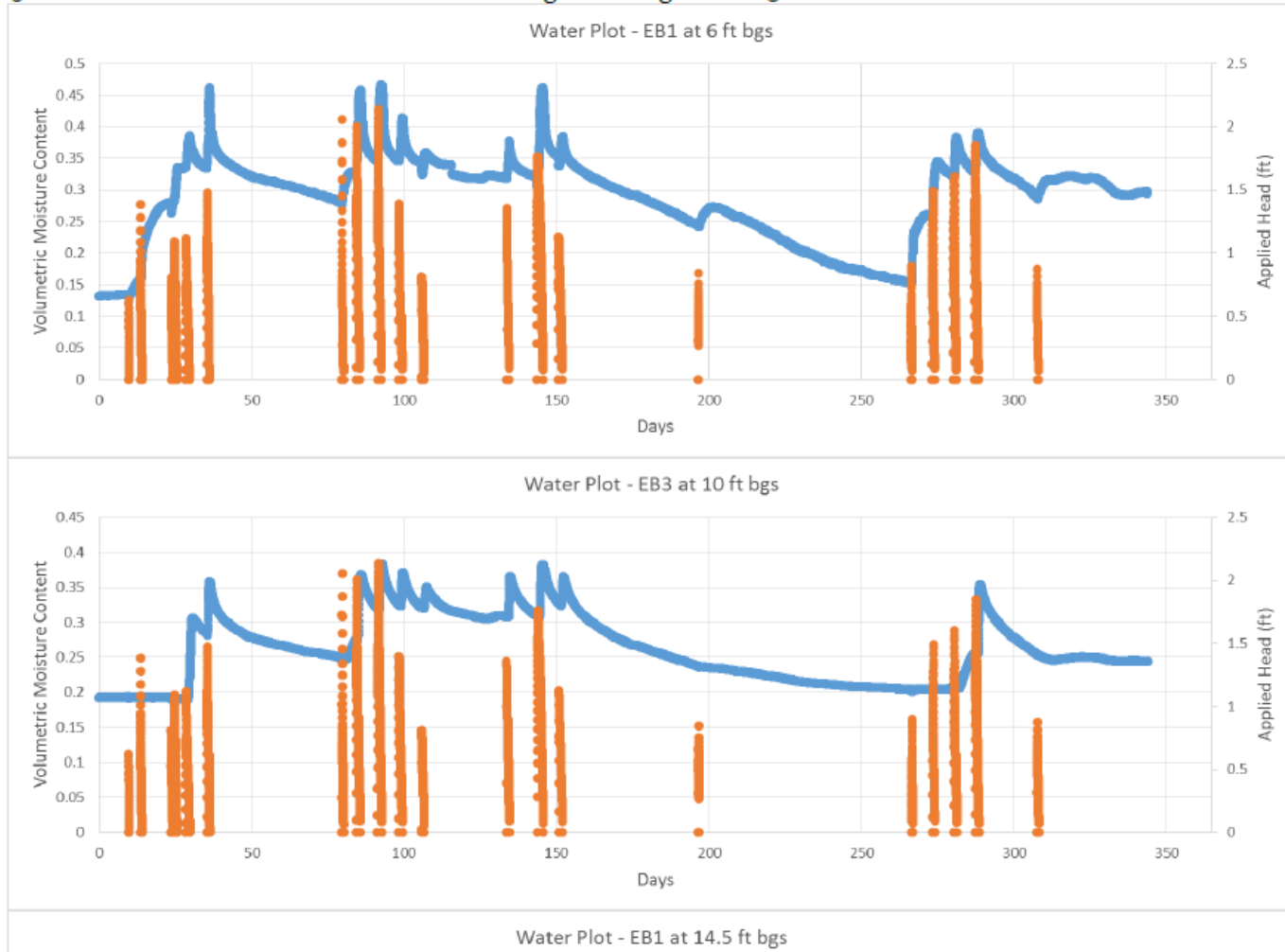
Note:
Molasses plot = test plot

Makua Military Reservation Burn Pit Infiltration Rate

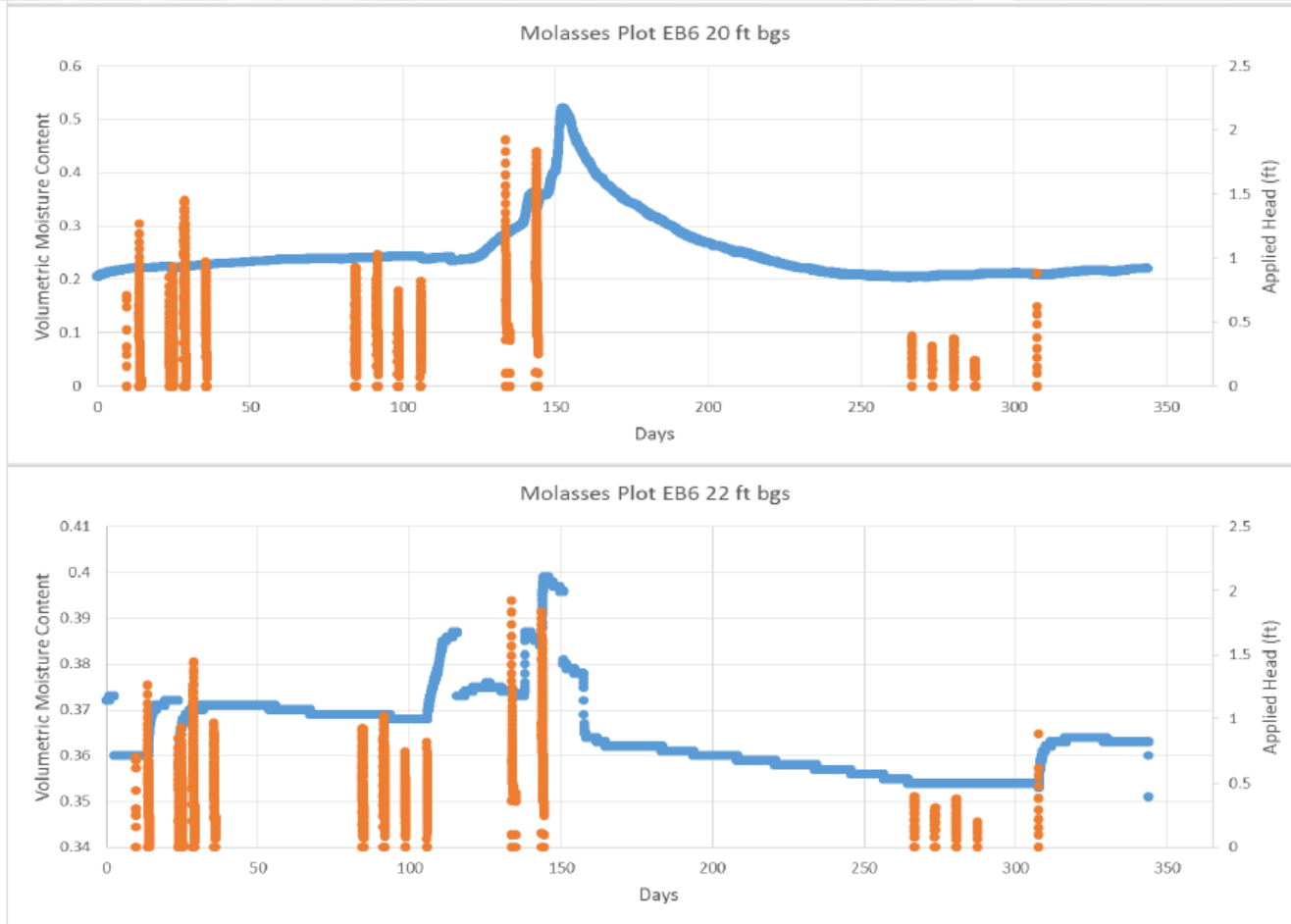Figure 8: Control Plot Infiltration Rate vs. Slug Number (1-12)

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Makua Military Reservation Burn Pit Infiltration Response

Figure 5: Control Plot VWC with Ponded Water Heigth During the 2013 Field Effort
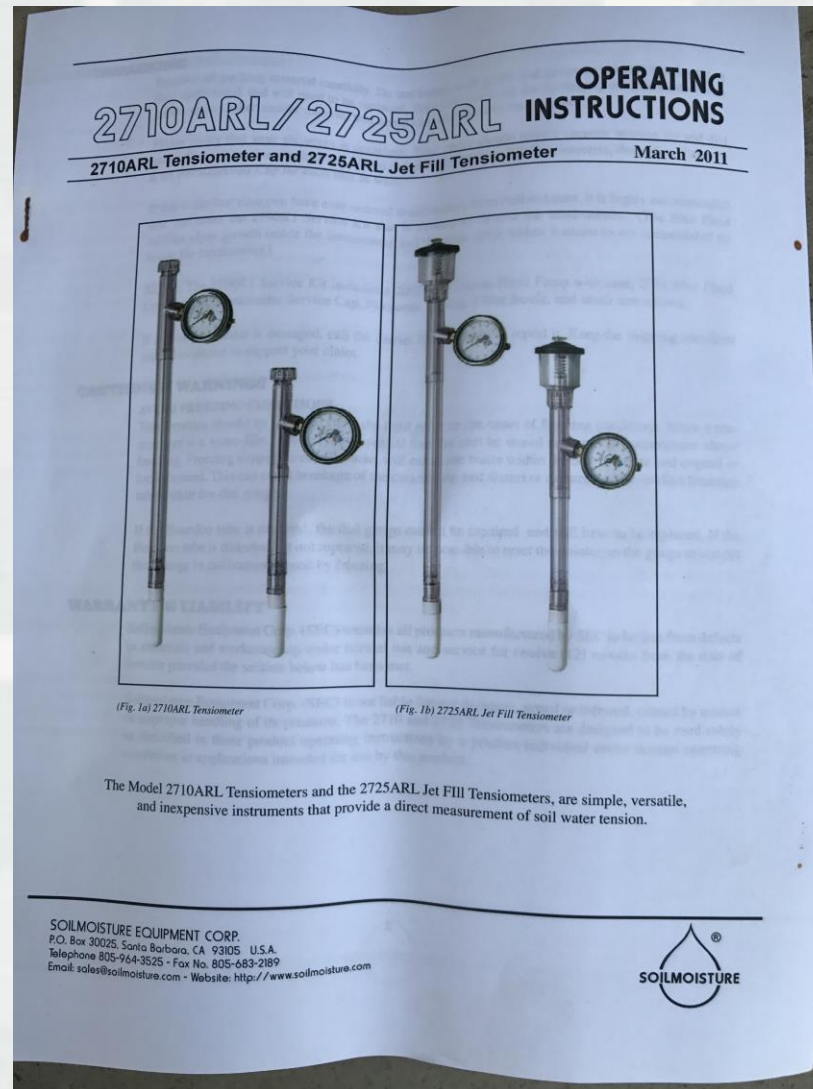
Makua Military Reservation Burn Pit Infiltration Response

Notes:
bgs = below ground surface
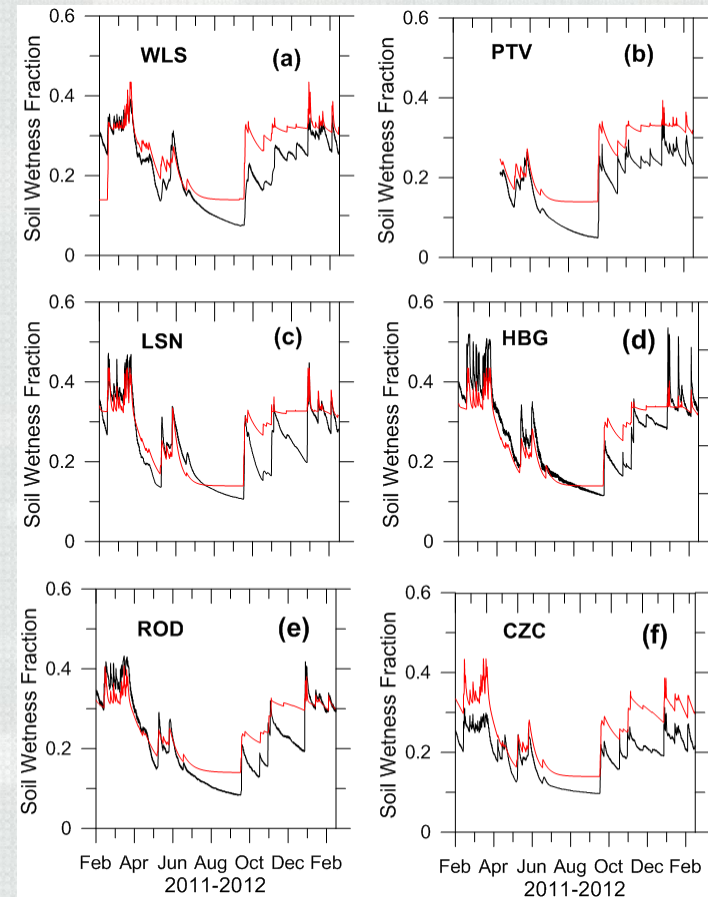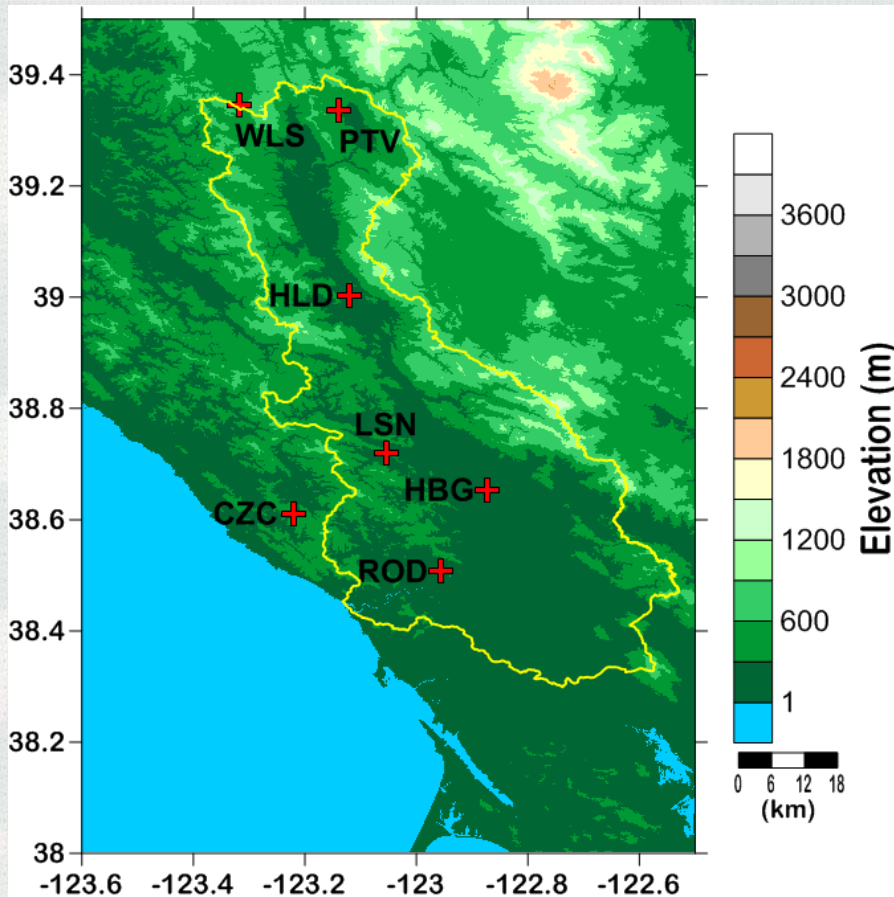Molasses plot = test plot

Hydraulic Conductivity – Add Tensiometers

Soils in Russian River Valley
(Incorporate soil moisture from NOAA)

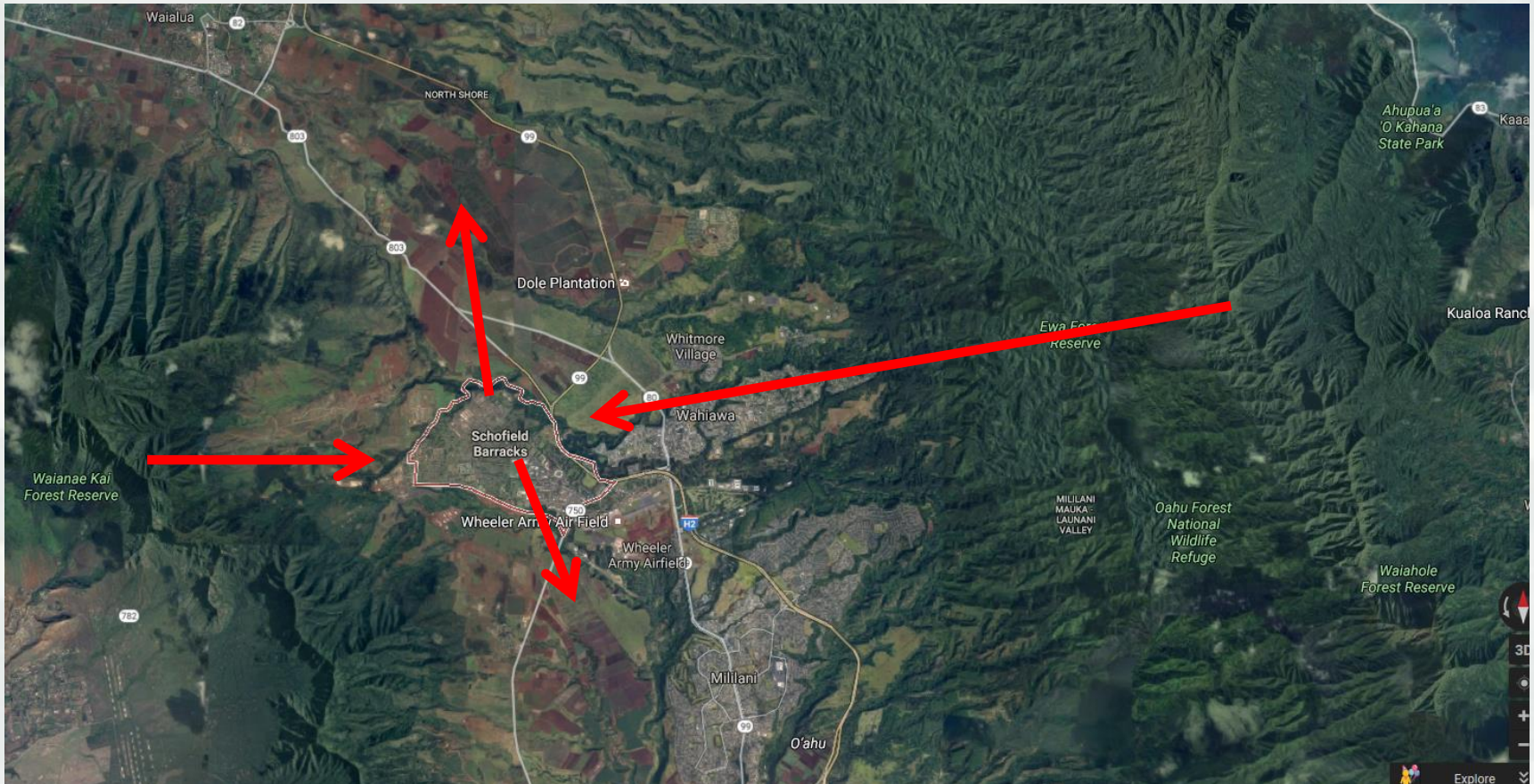Bob Zamora, NOAA ESRL Physical Sciences Division

Infiltration Parameters from Russian River Soil Moisture Sensors

Name	Bedrock	Eff Poro	Field Capacity	Wilting Point	Residual
WLS	Yes	0.35	0.3	0.175	0.1
PTV	Yes	0.33	0.25	0.13	0.07
LSN	No	0.47	0.34	0.2	0.1
HBG	No	0.5	0.36	0.21	0.1
ROD	No	0.42	0.3	0.15	0.1
CZC	Yes	0.3	0.2	0.15	0.1
HOPLAND	No	0.45	0.35	0.2	0.1
Bedrock Ave		**0.325**	**0.25**	**0.1625**	**0.1**
Alluvium Ave		**0.434**	**0.32**	**0.178**	**0.094**

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Age Dating and Stable and Radioactive Isotopes

Bedrock Map from USGS