"Human Impacts on Sediment in Faga'alu"

Presentation for CRTF, August 23, 2012

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Minds that move the world

Thank you to our collaborators in American Samoa:

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American Samoa Community College

Motivation and Research Question

Land-based sources of sediment and nutrients can damage coral…

Faga'alu Reef: Feb. 15,2012

…so ***where*** and ***when*** is the sediment generated in the watershed?

Objectives:

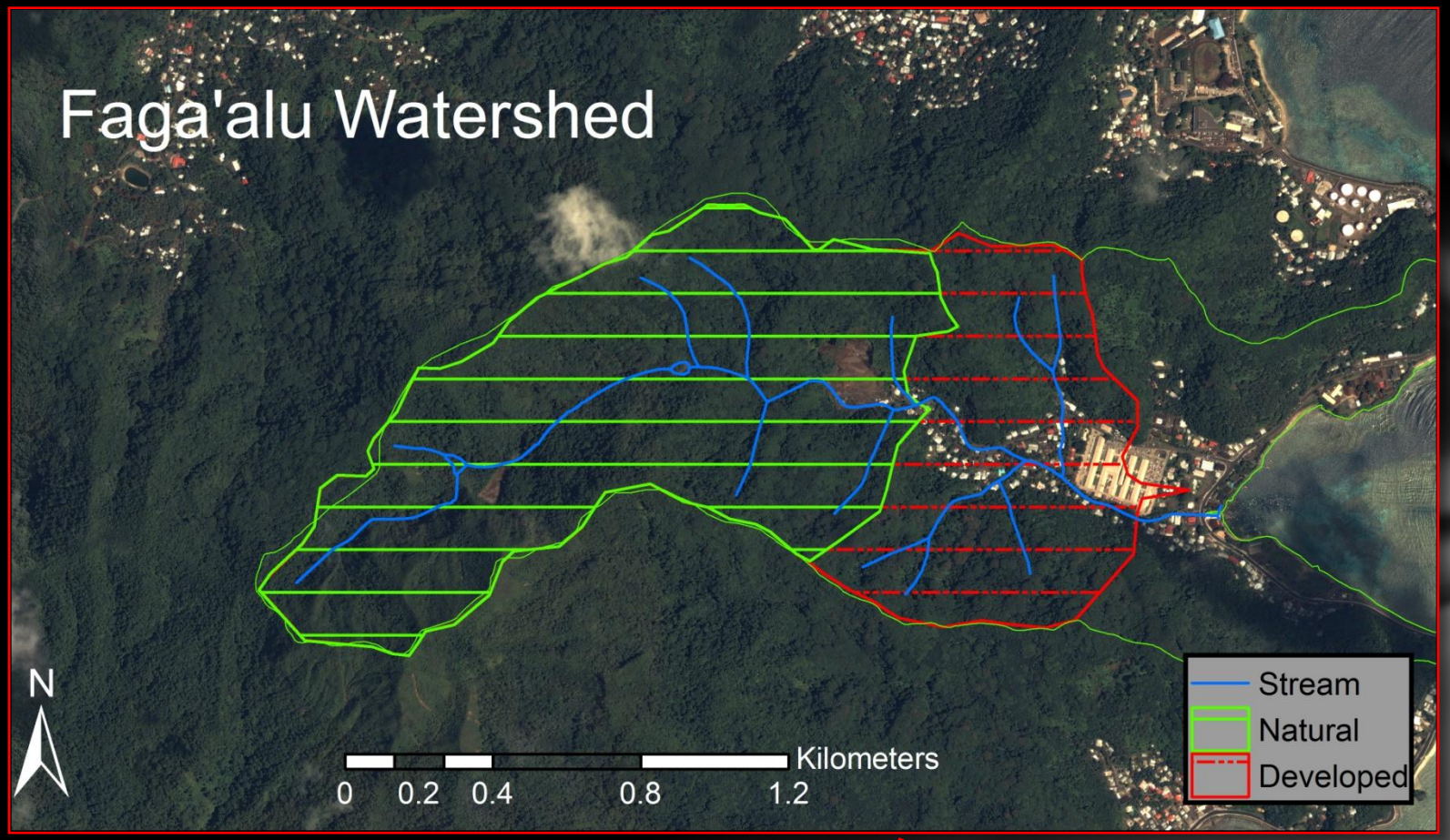
1) Reconnaissance of watershed to identify likely sources of sediment and nutrients

2) ***When, How much:*** Quantify streamflow, sediment, and nutrients during storm and inter-storm periods

3) ***Where:*** Where does the sediment go?

4) Watershed model and management scenarios

5) Build capacity for field monitoring and land-based pollution assessment in A.S.



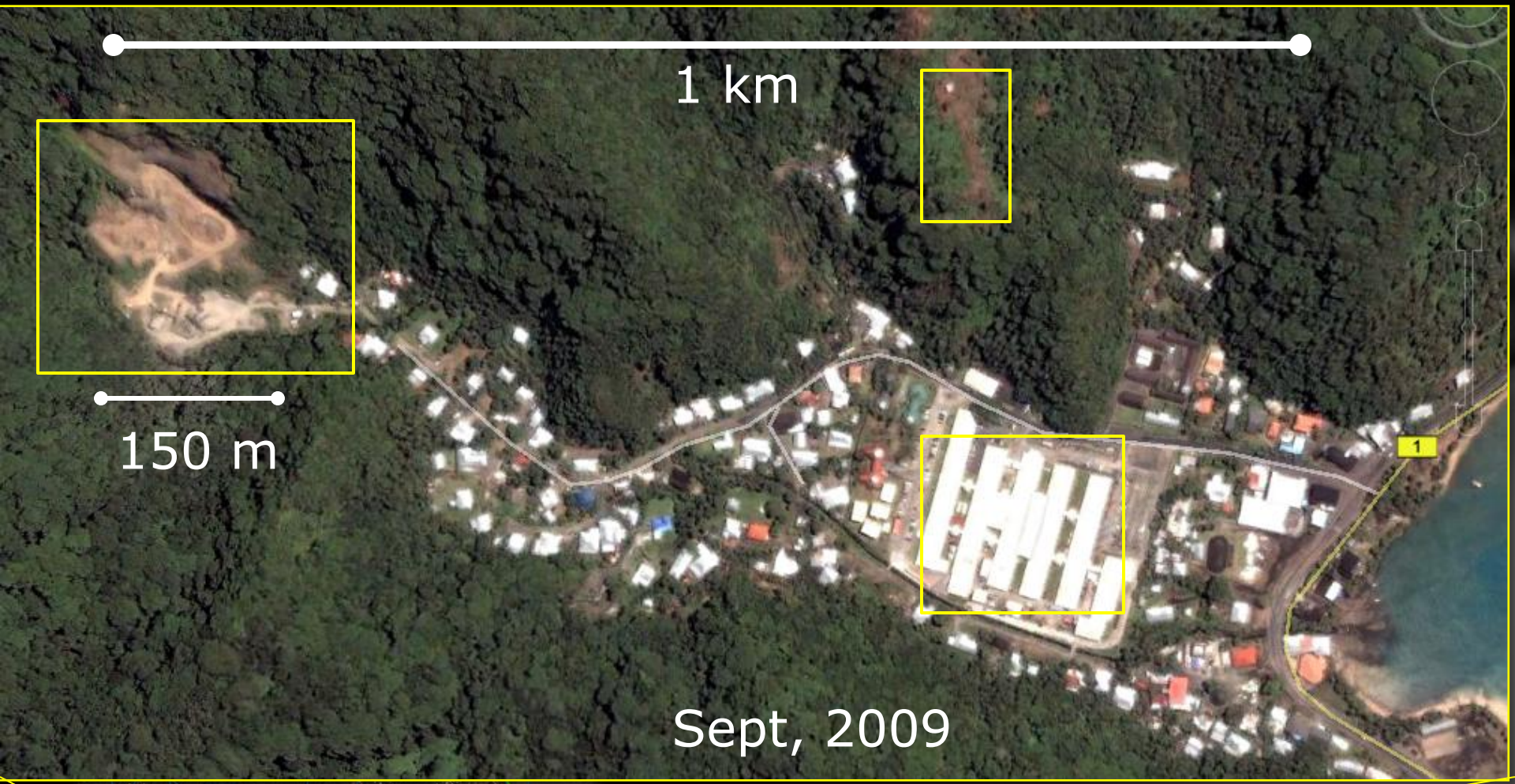
Two parts:

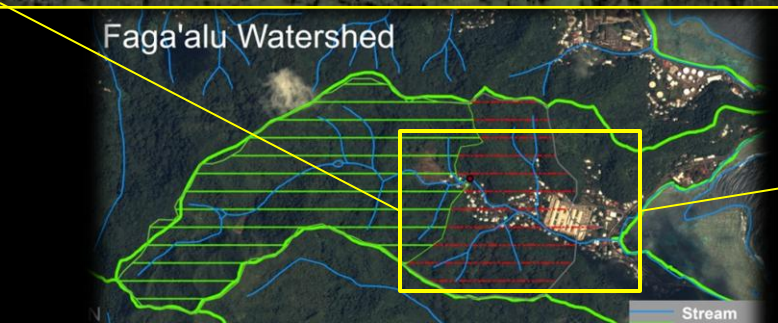
- Upper natural/undisturbed portion
- Lower developed/impacted portion

Potential Sediment Source: Natural Areas
Landslides, pig disturbance?

Can be a natural, significant source of sediment but recover quickly

Potential sources: Quarry, urban areas, agriculture





Quarry:

High levels of sediment runoff during rains

Key factor seems to be rainfall intensity

Possible source:
Hospital storm drain

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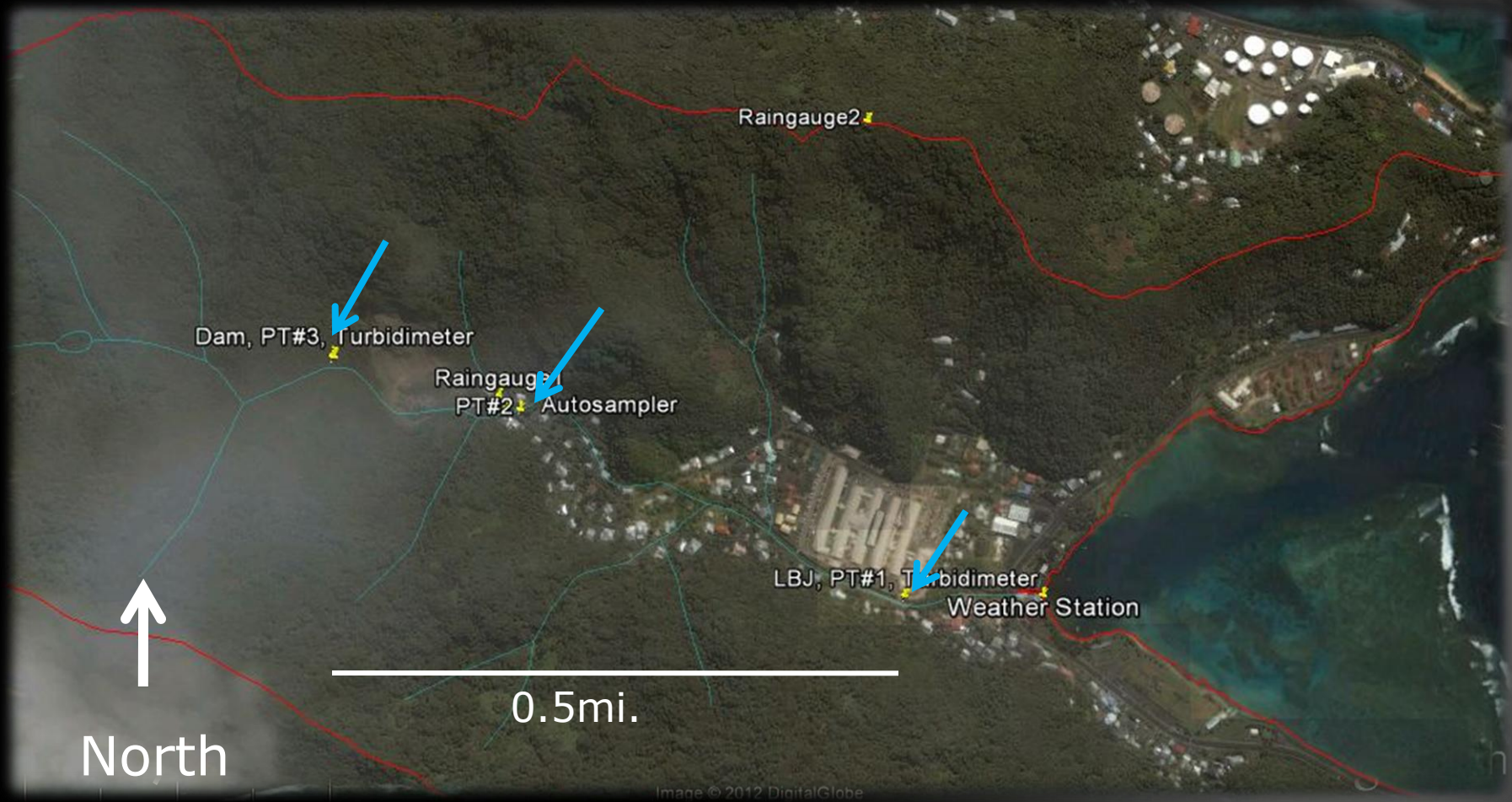
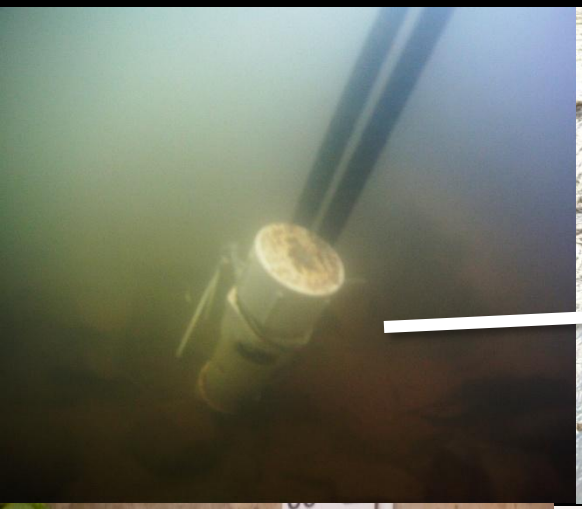
Objective 2: Load (tons) = Q x C

Measure stream flow (Q) and sediment concentration (C) at 3 locations

a) Upper watershed ("Dam", PT#3)
b) Stream below quarry ("Quarry", PT#2)
c) Outlet to the ocean ("LBJ", PT#1)



Measuring stream flow (Q) (L/sec)



Measure depth
Or "Stage"
(like a ruler)

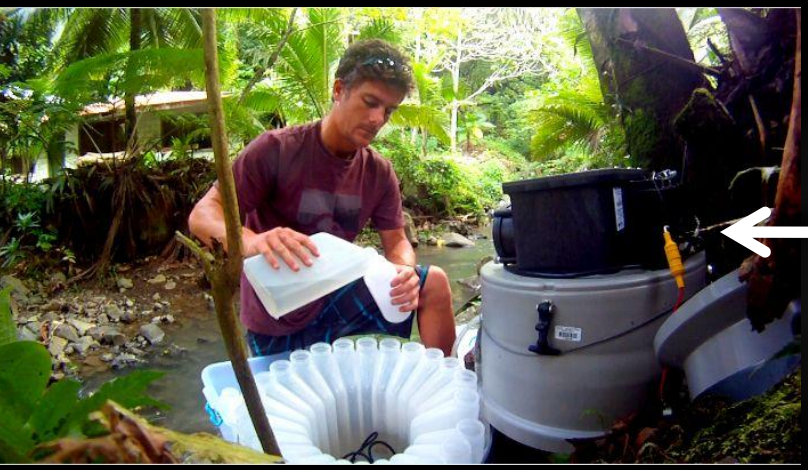
Flow measurements relate "Stage" to streamflow (Q) (Height to Volume)

← Measuring flow at dam above quarry

Measuring sediment (C): Storm, inter-storm sampling

a. Manual/Auto sampling - six storms, >300 samples
b. Turbidimeter – continuous, January – May 2012, two sites

Convert turbidity to sediment concentration using observed relationship



Auto-sampler at Quarry site

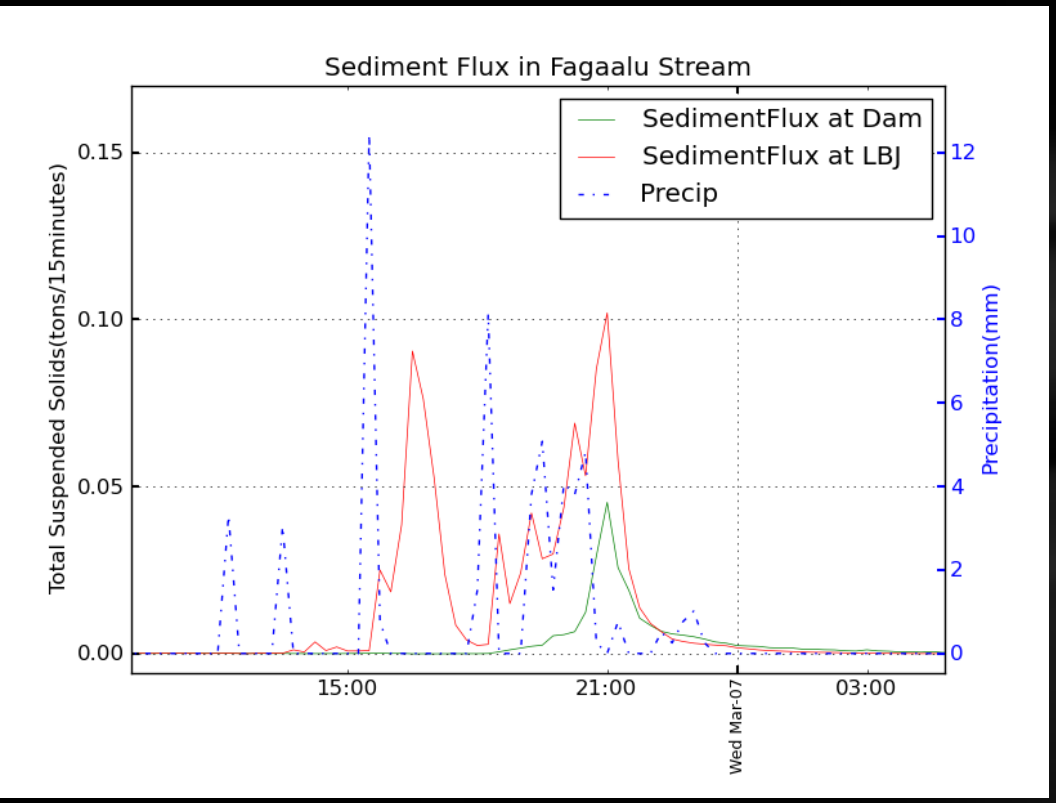
Filtering and weighing sediment at DMWR lab

Increased sediment during stormflows

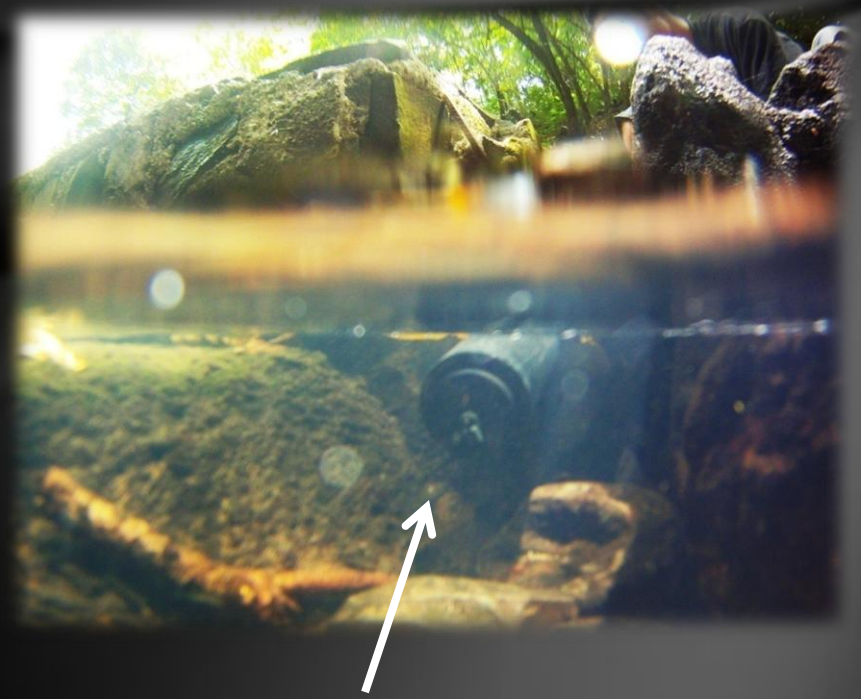
Results: Example from one sampled storm

(March 7, 5.6 cm of rain)

- Sediment load highest at LBJ, outlet to ocean
- Responsive to rainfall – essential to monitor storms



- Sediment flux higher near hospital
- Responsive to rainfall



Turbidimeter above quarry

Results: Storm Data

#	Date	Duration (Days)	Precipitation (mm)	Sediment(Tons)			% of Total Sediment	
				Upper	*Lower*	*Total*	*Upper*	*Lower*
1	1/31/12	11	224	0.88	7.28	8.15	10	89
2	2/05/12	2.5	104	0.73	4.84	5.57	13	86
3	3/05/12	2.5	78	0.31	1.12	1.43	21	78
4	3/08/12	3	50	0.43	0.26	0.69	62	37
5	3/15/12	4	88	0.15	0.53	0.68	22	77
6	3/19/12	3	77	0.16	0.49	0.65	23	76
	Total:	26	621	3	15	**Average:**	**26**	**74**

74% of sediment comes from the human- impacted lower watershed, most of it from the quarry

26% of sediment comes from the upper watershed from natural erosion and landsliding

Over 90% of sediment is moved during storms

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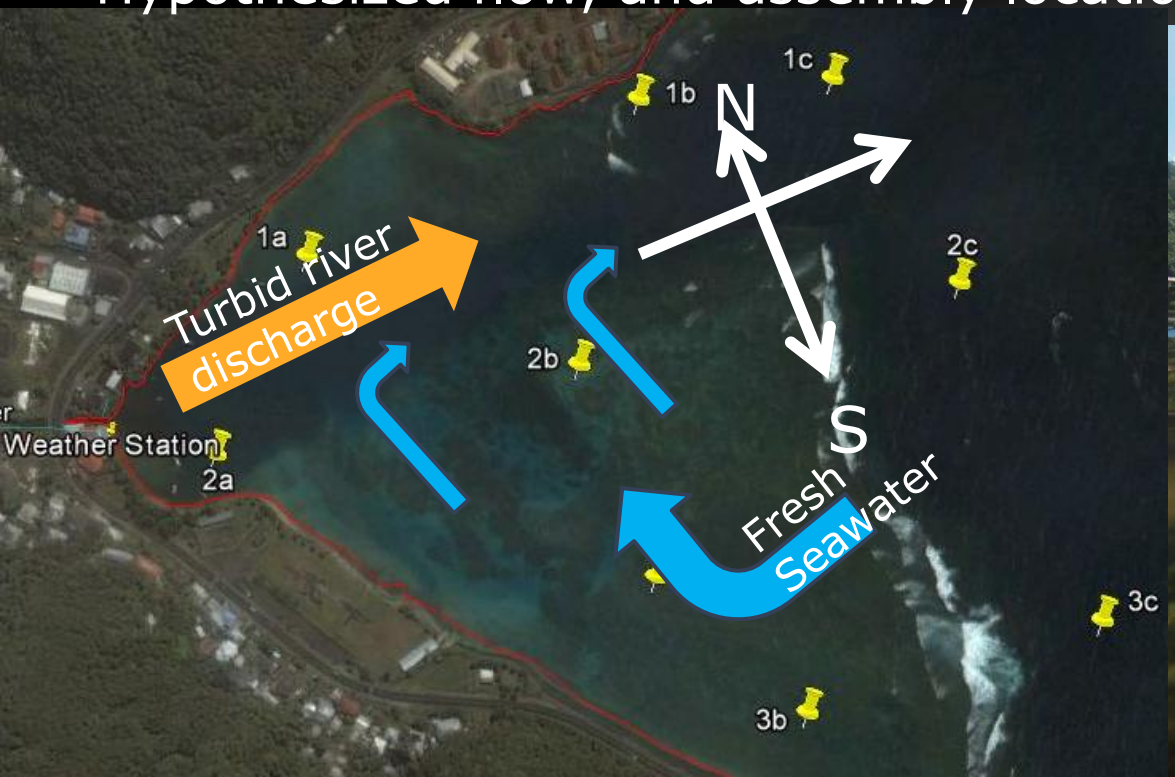
Measuring sedimentation rates on Faga'alu reef (pilot study)

1. Differences between North and South reefs
2. Gradient away from rivermouth
3. Only 2 Monthly samples: Feb and March

Hypothesized flow, and assembly locations



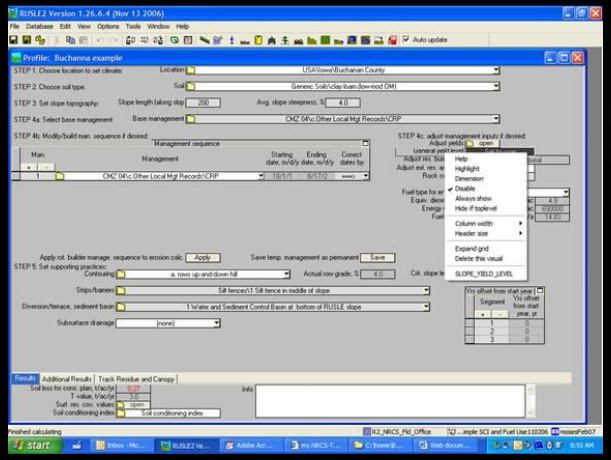
Improving models with new datasets

MODELS: *Predict sediment load based on processes but need to be calibrated to local conditions*

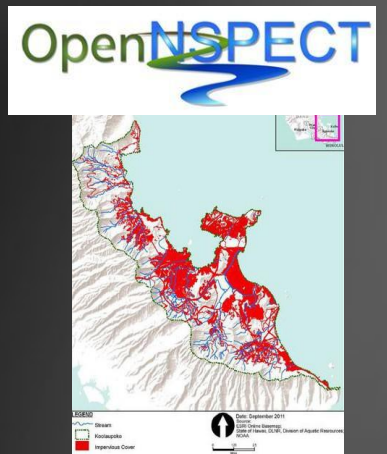
Model Objectives:

1. Scientific
    a. Extend existing datasets
    b. Quantify human impacts
2. Management
    a. Scenarios
    b. Watersed prioritization

Equations developed for mid-west agricultural management



Map-based tools developed in the tropics for coral conservation



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Next phase: CRTF Priority Watershed ->Management and Restoration

- If BMPs implemented at the quarry, and Village Watershed Plan implemented, how much is sediment reduced?
- How much coral will grow back naturally? With help?

•Sediment control at quarry

•Village Watershed Protection Plan implemented

-->cleaner stream

•Less sediment on reef

•Coral restoration

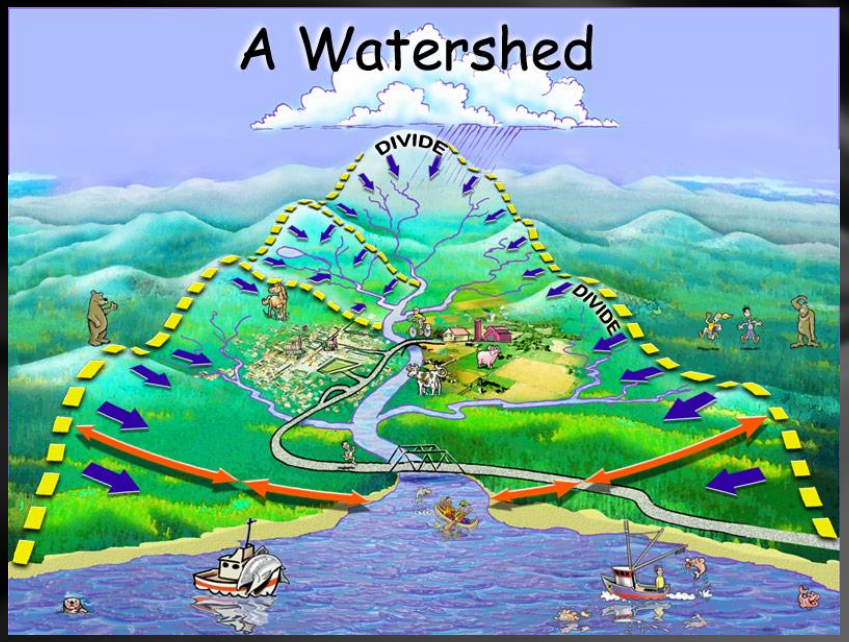
--> healthier coral

Fa’afetai!

Questions?

What is a watershed and why is it important for Faga'alu Reefs?

*Source and transportation of sediment and pollutants that can harm coral ecosystems



Storms cause muddy plume from stream to reefs

Turbid, freshwater layer during rains

Polluted, degraded ecosystem

Shallow, near rivermouth

Deeper, near reef crest

Pristine, functioning ecosystem

A history of monitoring in Faga'alu

- E. Bardi, 2005: Showed that Faga'alu was highly impacted by turbidity relative to other streams
- P. Houk, 2006: Related coral health to stream water quality and showed Faga'alu as highly degraded
- M. Sabater, 2007: Measured high rates of sediment accumulation on reefs in Faga'alu
- S. Curtis, 2011: Measured stream water quality parameters up and down stream to identify likely sources of sediment runoff

Candidate: Quarry

Quarry:

Flat, high traffic areas produce very turbid runoff

Inadequate sediment control practices
…for now…

Some quarrying activities/groundwater flow maintain high turbidity even under dry conditions

Candidate:
Agriculture

…. water samples don‘t indicate it is significant for sediment but maybe nutrients

Candidate: Bare surfaces/roads in residential areas…?

…contributed sediment historically, but paving of village road is now complete. Sparse grass areas are now more problematic

Conclusion from reconnaissance:

Sediment is most important, sources include:

1. Quarry
2. Hospital storm drain/urban area
3. Unpaved areas/sparse grass
4. Agriculture
5. Landslides

4 Tipping Bucket rain gauges

1 Rain gauge on Mt. Matafao:

- 2,142 feet, Highest point on the island
- Very difficult access trail, ~35% slope
- Starting point of watershed