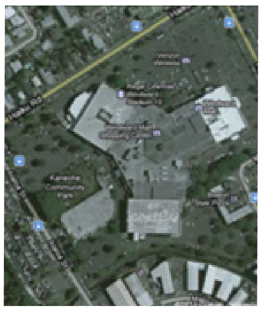
Name: ______________________________

Pacific Islands Watershed Institute

June 13-16th, 2011
He'eia State Park, Oahu, Hawaii



Pacific Islands Watershed Institute, June 13-16, 2011

Agenda

Time	***The Context of Watershed Planning*** **Monday, June 13**	***Identifying Watershed Projects*** **Tuesday, June 14**
8:00-9:00	**Registration and Institute Welcome** (8:30 start) *– Kathy Chaston and John Christensen*	**E. Watershed Assessment Field Trip:** Practice various field assessment techniques used to identify watershed restoration and protection opportunities such as stream assessments, stormwater retrofitting, neighborhood source assessments, and pollution hotspot source investigations. Individually drive /carpool from He'eia to the Windward Mall for morning field investigations. A **picnic lunch** will be provided at a nearby stream restoration site prior to neighborhood assessments. You will not need waders; however, be sure to wear a hat, bring sunscreen, and carry a bottled water with you. Be prepared for inclement weather.
9:00 – 10:00	**A. Characteristics of Pacific Island Watersheds:** How are Pacific island watersheds influenced by unique hydrologic and geomorphic conditions, local culture, and water resources? *– Kathy Chaston and Rich Claytor*	
10:00-11:00 **11:00 – 12:00**	**B. Components of a Good Watershed Plan:** What are the basic elements of an effective watershed plan? Discuss the planning and implementation process as illustrated in the Hui o Koolaupoko and the Piti-Asan watersheds. *– Anne Kitchell, Todd Cullison, and Maria Kottermair*	
12:00- 1:00	**Lunch**	
1:00 – 2:00 **2:00 – 3:00**	**C. Overview of Watershed Assessment Methods:** An after-lunch "Watershed Scavenger Hunt" on the grounds of He'eia State Park provides an introduction to common field and desktop assessment techniques. Hone your skills at catchment delineation, drainage investigation, and pollution prevention in small groups. *–Laurel Woodworth*	**F. Tropical Roundtables**: Attend <u>two</u> concurrent technical discussions (see session handout for topic descriptions): 1. Rural land management – *Carolyn Stewart & Jean Brokish* 2. Pollution tracking & monitoring – *Robin Knox & Dwayne Minton* 3. Climate change –*Victoria Keener & Melissa Finucane* 4. Groundwater protection – *Esther Taitague* 5. Wastewater management – *Hudson Slay & Rich Claytor* 6. Land conservation – *Butch Hasse & Umiich Sengebau*
3:00– 4:00	**D. Regulations and Policies:** Discuss local (or island-wide) codes and policies that are needed to support successful watershed planning and implementation. *– Dave Hirschman*	**G. Watershed Accounting and Project Ranking**: How do you document the costs and benefits associated with restoration projects. Review the metrics and methods of measuring performance, prioritizing projects, and estimating pollution load reduction. *– Dave Hirschman*
4:00-5:00	**Island Teams Session #1:** The first of four facilitated group work sessions designed to advance planning and implementation activities in priority island watersheds or areas of interest. This session focuses on evaluating existing watershed planning efforts and environmental programs.	**Island Teams Session #2:** The second of four group work sessions. Use this time in your island group to revise assessment needs, report out from roundtables, and brainstorm an accounting framework that might be applicable to your area of interest.
After hours	**Evening Social:** Stick around He'eia for refreshments	**On your own**

Time	*Managing Island Stormwater* **Wednesday, June 15**	*Implementation* **Thursday, June 16**
8:00-9:00	**H. Erosion & Sediment Control (ESC) for Islands:** Discuss impact of inadequate ESC at construction sites. Review availability of ESC practices in Pacific islands, discuss common installation and maintenance issues, and preferred inspection and enforcement procedures. This session includes a group exercise for reading and evaluating an erosion control plan. *–Michelle West*	**K. Engaging Stakeholders:** Discuss when and how to involve elected/appointed officials, military officials, mayors, agencies, watershed groups, and other public stakeholders in watershed planning and implementation process. As group, brainstorm effect ways to bring challenging stakeholders to the table. *–Laurel Woodworth, Joyce Beouch, and Alyssa Miller*
9:00 – 10:00		**L. Implementation & Funding:** What are key factors in ensuring the successful implementation of watershed plans and projects. Discuss tips for identifying and securing implementation funding in Pacific islands. *–Rich Claytor and Hudson Slay*
10:00-11:00	**I. Stormwater BMPs for Islands** Review stormwater performance measures and standards across the Pacific islands, and discuss site design techniques to reduce stormwater generation at new development and redevelopment projects. This session will introduce a variety of large and small structural best management practices (BMPs), how they can be adapted to island settings, and ways to make them better. *–Rich Claytor and Dave Hirschman*	**Island Teams Session #4**: In the last team work session, identify at least three actions items for your priority watersheds or areas of interest back home. Discuss key stakeholder involvement and potential sources of funding.
11:00 – 12:00		**M. Wrap-Up & Evaluation:** Island teams will report out their top action items and next steps. Participants will be asked to provide feedback on PIWI and complete evaluation forms.
12:00- 1:00	**Lunch**	**Lunch will not be provided**
1:00 – 2:00	**J. Field Trip: Stormwater & Pollution Prevention** Learn the ins and outs of rain garden design, construction, and maintenance; explore various applications of compost socks for managing construction site runoff and long-term slope protection; and identify both structural and non-structural approaches for managing pollution at a nearby boat landing. *–Todd Cullison, Adrian Sanchez, Michelle West*	
2:00 – 3:00		
3:00 – 4:00		
4:00-5:00	**Island Team Session #3:** The third of four work sessions. Use this time to refine ESC and stormwater program evaluations, identify demonstration sites back home, and/or evaluate existing design plans.	
After hours	**Luau & PIWI Awards**: Join us at He'eia for a not only a Hawaiian culinary tradition, but also an Institute tradition recognizing unforgettable participants and watershed moments.	

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Pacific Island Watershed Institute
June 13-16, 2011

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2011 Pacific Island Watershed Institute
Evaluation Form

Your Name *(optional)*: ____

Your Organization Type : ☐ Non-Profit ☐ Local Gov. ☐ State/Territorial Gov. ☐ Federal Gov.
☐ Private Consultant ☐ Academic ☐ Other:______________________

Sessions: Please rate the quality of the information presented during each institute session.	**Poor**	**→**	**Adequate**	**→**	**Excellent**	**Did Not Attend**
Day 1						
Session A: Characteristics of Pacific Island Watersheds	1	2	3	4	5	N/A
Session B: Components of a Good Watershed Plan	1	2	3	4	5	N/A
Session C: Overview of Watershed Assessment Methods/He'eia Drainage Detection	1	2	3	4	5	N/A
Session D: Regulations and Policies	1	2	3	4	5	N/A
Day 2						
Session E: Watershed Assessment Field Trip	1	2	3	4	5	N/A
Session F: Topical Roundtables						
Rural and Land Management	1	2	3	4	5	N/A
Wastewater Management	1	2	3	4	5	N/A
Pollution Tracking and Remediation	1	2	3	4	5	N/A
Groundwater Protection	1	2	3	4	5	N/A
Land Conservation	1	2	3	4	5	N/A
Climate Change	1	2	3	4	5	N/A
Session G: Watershed Accounting and Project Ranking						
Day 3						
Session H: Erosion and Sediment Control	1	2	3	4	5	N/A
Session I: Stormwater BMPs for Islands	1	2	3	4	5	N/A
Session J: Stormwater Field Trip	1	2	3	4	5	N/A
Day 4						
Session K: Engaging Stakeholders	1	2	3	4	5	N/A
Session J: Implementation and Funding	1	2	3	4	5	N/A

Favorite or most useful session(s) attended?

Least beneficial of the sessions attended?

Overall PIWI: Please rate the following	**Poor**	**→**	**Adequate**	**→**	**Excellent**	**Did Not Attend**
Overall quality of the PIWI sessions	1	2	3	4	5	N/A
Technical content	1	2	3	4	5	N/A
Group Activities and Field Time	1	2	3	4	5	N/A
Notebook usefulness	1	2	3	4	5	N/A
Usefulness of Island Work Sessions	1	2	3	4	5	N/A

Recommendations for next time (please circle):			
Pace of sessions	Same	Slower	Faster
Length of each session	Same	Shorter	Longer
Total number of sessions offered	Same	Fewer	More
Time spent in the field	Same	Less	More
Lecture time	Same	Less	More
Time to work in small groups	Same	Less	More
Hands-on activities	Same	Less	More

New topics to cover:

Instructors: Please rate the following:	**Poor**	**→**	**Adequate**	**→**	**Excellent**
Overall, how would you rate the instructors?	1	2	3	4	5
Technical knowledge	1	2	3	4	5
Ability to convey technical knowledge your level	1	2	3	4	5

Anyone in particular that stood out?

Logistics: Please rate the following:	**Poor**	**→**	**Adequate**	**→**	**Excellent**
Conference facilities at He'eia	1	2	3	4	5
Food service	1	2	3	4	5
Lodging (if applicable)					

Additional Comments:

Mahalo. We appreciate the feedback.

Speaker Bios

Pacific Island Watershed Institute

June 13-16, 2011

Margaret Aguilar is a Senior Program Coordinator for the Guam Environmental Protection Agency. She joined Guam EPA in 2003; and began her assignment with the water division in 2007 primarily coordinating non point source related projects. Margaret's current projects include: the upcoming 2011 Guam Stormwater Workshop; an ARRA grant project to develop an updated management plan for a priority water resource watershed; the development and administrative adjudication of the proposed *Guam Erosion Control and Stormwater Management Rules and Regulations*; and the development of Guam's 2012 Integrated Surface Water Quality Monitoring and Assessment Report. Ms. Aguilar has a B.S. degree in Biology from the University of Guam and nearly fifteen years of experience as a planner in the government sector.

Joyce Beouch is the Belau Watershed Alliance Coordinator with the Palau Conservation Society where she has spent the last three years engaging community partners in watershed protection and restoration activities. Before Conservation, she worked as an educational technology coordinator for Ministry of Education. Joyce has a BA in Social Science with a focus on Cultural Anthropology & a minor in Sociology.

Jean Brokish is a Project Manager with the Oahu Resource Conservation and Development Council, where she works with members of the agricultural community to reduce soil erosion and protect good water quality. Jean has experience working with EPA 319 funds and is currently implementing watershed plans in the Waimanalo and Honouliuli Watersheds on Oahu. She is familiar with agricultural best management practices, the conservation planning process, NRCS Farm Bill programs, and the roles of Soil and Water Conservation Districts. She received a B.S. in Agronomy from the University of Wisconsin-River Falls and a M.S. in Soil Science from Purdue University.

Kathy Chaston is the Hawaii coral management liaison and Pacific watershed management specialist for NOAA's coral reef conservation program based in Honolulu. With over 15 years experience in marine and coastal management, Kathy supports coral reef and watershed management activities in Hawaii, Guam, CNMI, and American Samoa. Before joining NOAA, Kathy was extension faculty at the University of Hawaii. For 3 years, she coordinated a state-wide strategy aimed at reducing land-based pollution impacts to Hawaii's coral reefs. Kathy was also the coastal resource manager for the Koror State Government in Palau, the development officer for the Yap Community Action Program in Yap, FSM, and an environmental consultant in Queensland, Australia. Kathy has a PhD in Marine Botany from the University of Queensland in Brisbane, Australia examining the impacts of agricultural runoff on coastal ecosystems.

Rich Claytor, P.E., LEED AP, is the Principal Engineer at the Horsley Witten Group, Inc. (HW) in Sandwich, MA. Rich has more than 25 years of water resource management experience with specific expertise in watershed management, stormwater management design, program assessment, policy, and evaluation. Rich has conducted trainings and development of stormwater design standards throughout the Pacific, including development of the current Guam/CNMI stormwater manual. Rich has a Bachelor of Science degree in Civil Engineering from Union College, with a concentration in Hydrology, Hydraulics, Water Resources, and Geotechnical Engineering. He is a licensed Professional Engineer in Massachusetts, New Hampshire, Maryland, and New York.

Todd Cullison is the Executive Director of Hui o Ko`olaupoko (HOK), which proactively implements projects in the Ko`olaupoko moku (Makapu`u to Kualoa) that address land-based pollution/watershed health as they impact water quality and the receiving waters of Waimanalo, Kailua and Kane`ohe Bay. Prior to Todd's tenure with HOK, he worked for over five-years on the North Oregon coast and in the Columbia River Estuary. His focus was community-based watershed restoration with an emphasis on salmon. Projects included design and implementation of large-scale estuarine and riverine habitat restoration and associated project effectiveness monitoring.

Rob Ferguson is the Coral Reef Watershed Management Specialist for NOAA's Coral Reef Conservation Program, where he works primarily on issues of land-based sources of pollution in the Atlantic/Caribbean region. Rob has a long history working on environmental issues on and with island communities. Rob has assisted local communities in the Caribbean, the South Pacific, and in Central America to create marine resource adaptive management plans, mitigate the impacts of over fishing, conduct coral reef monitoring surveys, tag sea turtles, and develop environmental education programs. He received his B.S. in Biology from Buena Vista University and dual M.S.

degrees in Natural Resources and Sustainable Development from American University in Washington D.C. and the United Nations Mandated University for Peace in Costa Rica.

Dr. Melissa Finucane is a Senior Fellow at the East-West Center in Honolulu, Hawai`i. She received her Ph.D. in Psychology from the University of Western Australia. Her empirical research focuses on the interplay of emotion and cognition and the role of socio-cultural factors in judgment and decision processes under conditions of uncertainty. Dr. Finucane's research has been funded by the National Science Foundation, National Institutes of Health, NOAA, and other organizations. She has published numerous book chapters and peer-reviewed journal articles and is a member of the Society for Judgment and Decision Making.

Butch Haase has a background in hydrogeology and forest ecology, and is the current Executive Director for the Molokai Land Trust (MLT), which was incorporated in 2006 and manages about 1,900 acres on Molokai. To address siltation of nearshore marine resources through the eradication of invasive species and the revegetation of native species, MLT is currently engaged in a 60-acre dune restoration program, a 2-acre hardpan restoration project in conjunction with the USDA NRCS Plant Materials Center on the West Molokai Preserve, and a 2 acre ohia watershed restoration project on our East Molokai Preserve. The two MLT preserves comprise two very different ecosystems - low elevation dry/desert and mid elevation mesic forest.

Dave Hirschman serves as a Program Director for the Center for Watershed Protection. In this capacity, he helps coordinate the Center's stormwater, better site design, local restoration, and training projects, focusing on technical and program tools for use by local, state, and territorial governments. He has also developed stormwater program materials for various states, territories, and local governments, and has led numerous workshops on stormwater design and program implementation. Dave has 27 years of experience in stormwater and water resources management in the public, private, and non-profit sectors.

Dr. Victoria Keener is a Research Fellow at the East-West Center in Honolulu, Hawai`i, and the Program Manager of the Pacific RISA. Dr. Keener received her Ph.D. in Agricultural & Biological Engineering from the University of Florida, specializing in hydro-climatological research dealing with the effects of climate variability and ENSO on both physical modeling and statistical hydrology of freshwater pollutant loads. She has also done interdisciplinary research on the integration of climate information into public Water Utilities' decision making.

Anne Kitchell is a senior environmental planner with the Horsley Witten Group (HW) and has been working for over 12 years with practitioners throughout the mainland US, the Pacific islands, and the Caribbean on watershed planning, stormwater management, and erosion and sediment control training. She has developed dozens of watershed plans to reduce impacts to impaired waters and to protect coral reefs, drinking water supplies, and other aquatic resources. Prior to joining HW, Anne was a program manager at the Center for Watershed Protection, where her obsession for detecting and eliminating polluted runoff was first realized. She has BS degrees in both Marine Science and Biology from the University of South Carolina, and a MS in Marine Policy from the University of Delaware.

Robin Knox is the Coordinator for Southwest Maui Watershed Plan and Principal Scientist for Water Quality Consulting, Inc. She is an environmental scientist with 30 years experience including clean water regulation, coastal ecology research, ecosystem restoration, and water quality planning and management. For the past 6 years, Robin has been studying the relationships of pollution sources to observed water quality impairments, and analyzing the relevant policies which are intended to regulate pollution sources, mitigate impacts, or manage natural resources.

Maria Kottermair is a recent graduate of the University of Guam Environmental Science Master's Program. While there she developed a watershed management plan for Piti-Asan as part of a NOAA scholarship she received and worked on a thesis project that analyzed the temporal-spatial dynamics of badlands in southern Guam. Having received a diploma (bachelor equivalent) in Cartography and Geomedia-Technology from the Munich University of Applied Sciences, she has considerable expertise in Geographic Information Systems. She works now at the Bureau of Statistics and Plans Coastal Management Program on different watershed-related GIS projects.

Alyssa Miller was recruited in 2005 to start up the local community-based conservation organization Mālama Maunalua. The organization's mission is to conserve and restore Maunalua Bay by engaging and empowering community, and by forming strong partnerships with scientists, government, business and NGOs in order to execute strategic actions to address the high priority threats affecting marine and watershed resources. Miller previously worked as environmental planner on coastal management projects, and was a co-author of the *Hawaii Coastal Nonpoint Pollution Control Management Plan.* She has a Master of Urban and Regional Planning degree and a Ph.D. in Geography from the University of Hawaii.

Dwayne Minton is a coral reef biologist who has worked on marine management and conservation issues across the Pacific, including Indonesia, Guam, the Northern Mariana Islands, the Federated States of Micronesia, Kwajalein, Hawaii, and Palmyra. He has always taken a watershed approach to management, firmly believing that effective coral reef management begins on land. He has conducted studies on the link between wildfire and coral reef health and sediment effects on coral recruitment. For several years, he worked as a technical expert responsible for assessing damage to coral reefs resulting from human activity and developing mitigation approaches capable of offsetting those impacts. In 2010, he joined The Nature Conservancy as a Science Advisor.

Adrian Sanchez is with Certified Erosion Control Hawaii, an Oahu-based firm that provides a range of erosion and sediment control and compost utilization services. Adrian has specialized expertise in the various applications of Filtrexx products, including living wall systems, and on the selection of compost materials for improved stormwater filtration and product performance. He was formerly a structural mechanic in the United States Navy, which is what originally brought him to the Aloha state on the Kon-Tiki.

Umiich Sengebau is the Deputy Director of Conservation for The Nature Conservancy – Micronesia Program based in the Palau Field Office. He oversees the implementation of The Conservancy's conservation program within Micronesia Region. His knowledge and practical experiences are in the areas of biodiversity conservation, environmental monitoring, impact assessments, and environmental planning and policy. Prior to joining TNC, he was an environmental specialist for Dueñas & Associates, Inc firm preparing and conducting environmental impact assessment reports, biological baseline surveys and environmental monitoring for development projects in Guam. He received a M.S. in Environmental Science from University of Guam and B.A. in Anthropology from University of Hawaii at Manoa.

Hudson Slay works as an environmental scientist for the U.S. Environmental Protection Agency, Region 9 and is based in the Pacific Islands Contact Office in Honolulu. He currently coordinates EPA water program activities in Hawaii and is involved in a wide variety of water quality and watershed management issues. He has extensive experience with EPA's coastal and watershed-related regulatory and management programs. He received a Bachelor of Science in Biology and Environmental Studies from Emory University and a Master of Environmental Management from Duke University.

Carolyn Stewart is a Principal Consultant with Marine and Coastal Solutions (MCS) International, Inc., a Hawaii-based environmental resources management planning firm. She has over 20 years of experience working in coastal and marine resources management, with an emphasis on polluted runoff control and watershed management.

Esther Marie G. Taitague is a Watershed and Stormwater Planner with the Guam Coastal Management Program of the Bureau of Statistics and Plans. She worked on the development of the Piti-Asan Watershed Management Plan and completion of the Conservation Action Plan (CAP) for the Piti watershed. Other experiences include reforestation, streambank stabilization, and community based watershed outreach projects for Piti. Esther provided technical expertise in the development of NOAA's Coral Reef Conservation Program Priority Setting document for Guam's Coral Reef Management Priorities. Esther has over 10 years of experience in public service. Previously working as a spokeswoman for Guam Waterworks Authority, she has always believed that "our actions on land ultimately affect the water – the water we drink and the water we leisure in." She has a BS in Public Administration from the University of Guam.

Laurel Woodworth is a Stormwater and Watershed Planner with the Center for Watershed Protection, working out of the Charlottesville, VA office. Her areas of knowledge and expertise include the design features and maintenance of stormwater management practices, erosion control practices, and local stormwater and watershed management program development. Her past work experience includes working for the County of Albemarle, VA on stormwater BMP maintenance inspections and coordinating the citizen water quality monitoring program and other projects for the Alliance for the Chesapeake Bay. She received a B.A. in Environmental Science and a B.A. in Environmental Thought & Practice from the University of Virginia.

Michelle West is an engineer with Horsley Witten Group, based on Cape Cod, MA. She has more than 8 years of water resource design and assessment experience with specific expertise in low-impact development (LID), stormwater management, and watershed planning. Michelle was the principal author for the CNMI and Guam Stormwater Management Manual, assisted with the Palau Stormwater manual, and has presented at rural LID, stormwater design, and ESC workshops in Guam, CNMI, Palau, and Hawaii. She graduated from the University of Michigan with BS in Civil and Environmental Engineering and Natural Resources Management, as well as a MS in Environmental Engineering. Go BLUE!

Island Work Sessions

2011 Pacific Island Watershed Institute

Description: Each day, participants will be divided into island groups and asked to complete a portion of this packet. The intent of these sessions is to allow you to reflect on the discussions from each day of the institute and to apply those lessons on your island or in priority watershed(s) back home. As a group, you are charged with answering the following 10 questions designed to help you advance watershed planning and implementation. You should begin each session with a quick review of the material covered in previous sessions that day. Each group will need to select a spokesperson to report out during Session M, the last session of the Institute. Each group will also be assigned a PIWI facilitator to help guide you through the material.

Monday, Session #1: The Context of Watershed Planning

Area(s) of Interest: List the priority watershed(s) or larger island area that will be the work session focus.

Watershed Plan(s): List existing watershed plan/report(s) in your area(s) of interest. Please indicate if no plans currently exist, or if efforts are underway. Rate implementation efforts as "advanced," "moderate," "preliminary," or "non-existent."

Group Spokesperson: Who in your group will report out your findings at the end of the Institute?

1. Do the watershed plans in your area of interest include all the elements of a comprehensive planning process discussed in Sessions B and C? If not, where are the major gaps and how do you propose to fill them? If you do not have completed watershed plans, brainstorm key tasks you think the process should include. For each new task, identify existing information/resources that are available and new data that will have to be generated.

2. Identify territorial regulatory/programmatic gaps that may affect your island watersheds based on discussions from Session D. Circle the top three gaps you think are priorities for addressing. See the Self-Assessment completed as part of Session D. *Note that ESC and post-construction programs will be revisited on Wednesday*.

Tuesday, Session #2: Identifying Watershed Opportunities

3. Based on today's field trip, are there any additional assessments you think need to be conducted in your area of interest to identify potential watershed restoration/protection opportunities? Review yesterday's work session (see Question #2).

4. What lessons from the Session F roundtables are applicable to watersheds in your area of interest? Identify one or two actions/next steps for each of the topics listed below:

Land Conservation

Wastewater Management

Climate Change

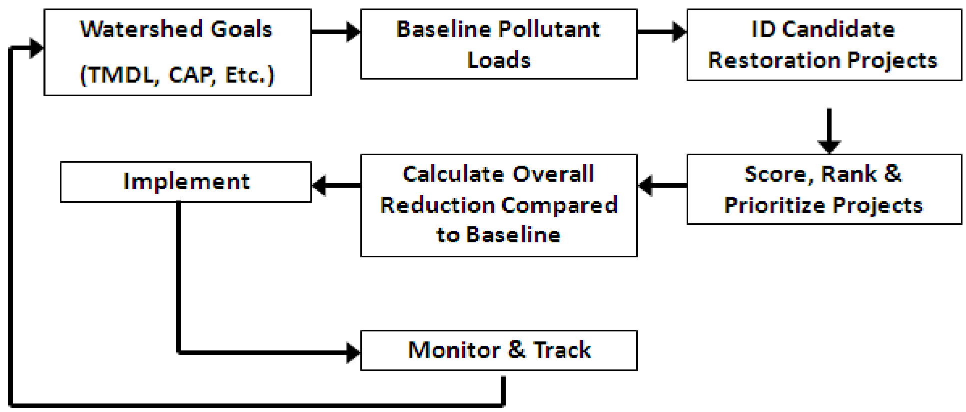
Groundwater Protection

Rural Land Management

Monitoring

5. Review the watershed accounting framework presented in the Session G and shown below.

Watershed Accounting Framework



A. Do your watershed goals have quantitative targets that can be measured and tracked over time? If not, brainstorm potential goals for your watershed(s) that do.

B. What are the pollutants of concern in your watershed(s)? Have baseline pollutant load estimates been adequately estimated for watersheds in your area of interest? If not, propose a process for doing so, or document why it is not necessary.

C. Which ranking metrics do you think should be used to prioritize watershed projects for implementation?

D. Have pollutant load reductions been adequately accounted for from projects implemented in your area of interest. If not, brainstorm a process for estimating and tracking of this information.

Wednesday, Session #3: Stormwater Management

6. Based on Sessions H and J, identify technologies or additional program elements needed to improve erosion and sediment control (ESC) in your area of interest. Review your previous work session notes (Question #3).

7. Based on Sessions I and J, identify technologies or additional program elements needed to improve post-construction stormwater management. Review your previous work session notes (Question #3).

8. Based on the pollution prevention discussions during the field trips each day, identify program elements needed to improve pollution prevention activities in your area of interest.

9. Identify one or two stormwater demonstration projects, or sites to investigate when you get home (e.g., parks, government buildings). Describe what needs to be done to advance implementation (e.g., parties or agencies that need to buy into the project, who to contact, design, grant funding). Alternatively, if you brought some designs with you, evaluate existing plans as a group.

Thursday, Session #4: Implementation

10. Identify 3 actions items (e.g. programmatic changes, project implementation, and planning activities), key stakeholders, and potential funding options for completing these activities in your area of interest.

Action 1.

Major players who must be involved:

Potential sources of funding:

Action 2.

Major players who must be involved:

Potential source of funding:

Action 3.

Major players who must be involved:

Potential source of funding:

Don't forget to complete the PIWI evaluation form in your notebook. Mahalo.

Session A: Characteristics of Pacific Island Watersheds

2011 Pacific Island Watershed Institute

Description: How are Pacific island watersheds influenced by unique hydrologic and geomorphic conditions, local culture, and water resources?

Speakers:

- Kathy Chaston, NOAA Coral Reef Conservation Program
- Rich Claytor, Horsley Witten Group

Topics/Notes:

1. Island watersheds and associated coral priorities

2. The economics and cultural of island watersheds

3. How does island hydrology and geology impact watershed management approaches?

4. Alone on an island: The affect of isolation

Pacific Island Watershed Institute

Session A: Pacific Island Watersheds

June 13-16, 2011

He'eia State Park, Oahu

Outline:

- Why care about watersheds?
- Overview of Island Watersheds
- Why Islands are Different
  - Hydrology
  - Terrain
  - Geology and soils
  - Vegetation
  - Near-shore environment
  - Impacts of development and LBSP
  - Capacity issues
  - Cultural and economic considerations

Why Island Watersheds?

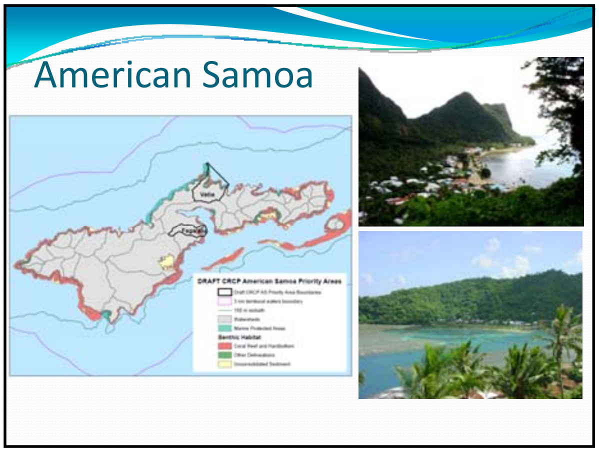
Land & Sea are Connected

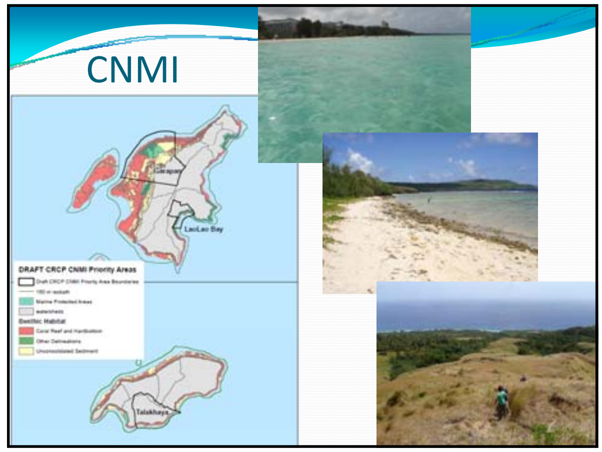
Photos courtesy of USGS

Overview of Island Watersheds

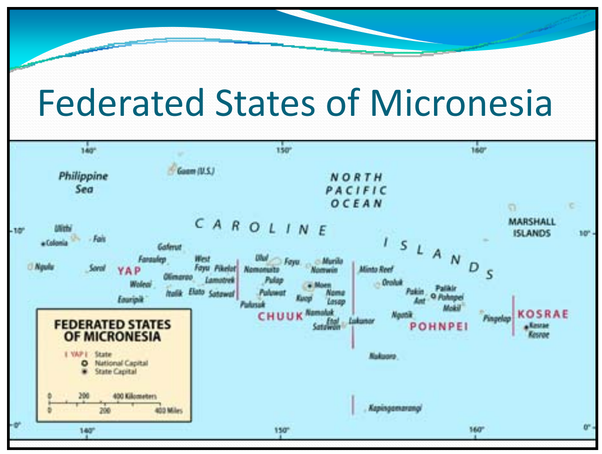
Two types:

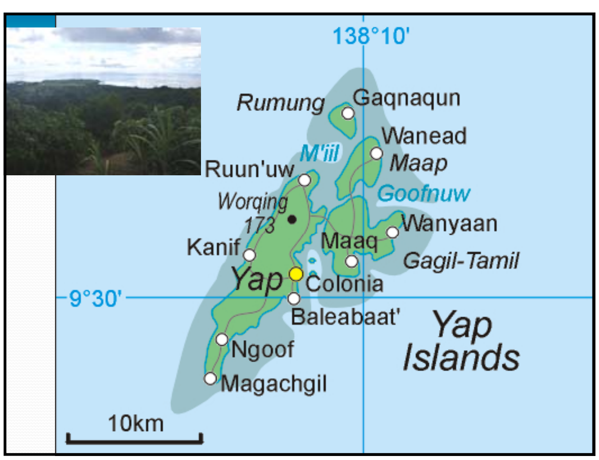
1. State/jurisdiction/NOAA coral program priorities
   (9 watersheds, 6 Islands)
2. Community/ watershed group priorities
   (10 watersheds, 6 Islands)

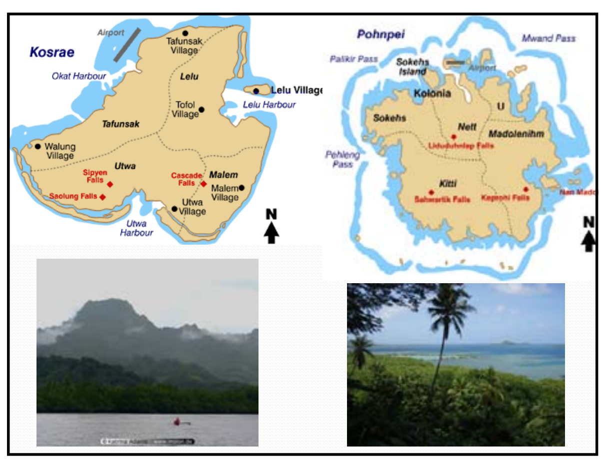

American Samoa
DRAFT CRCP American Samoa Priority Areas

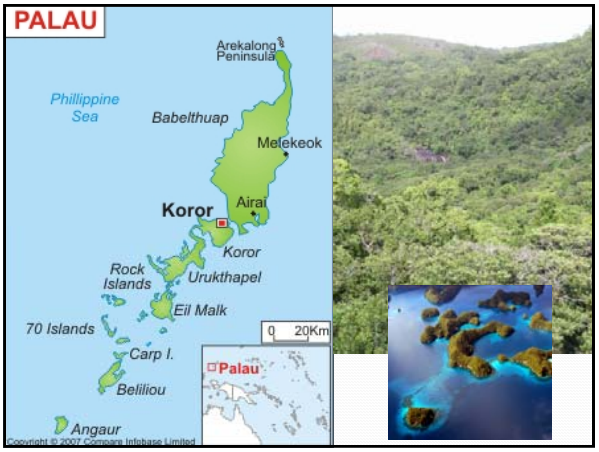

CNMI
DRAFT CRCP CNMI Priority Areas

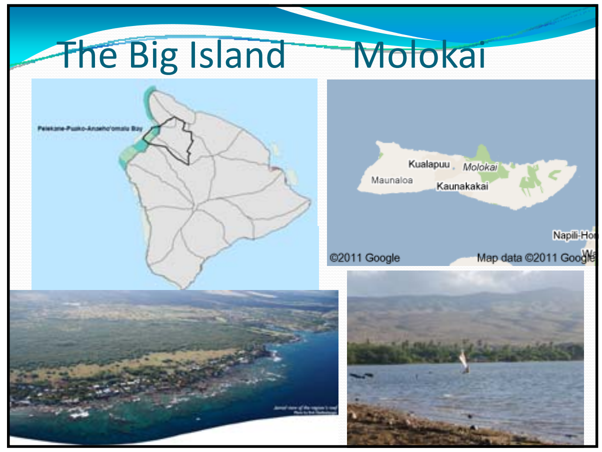

Guam
DRAFT CRCP Guam Priority Areas

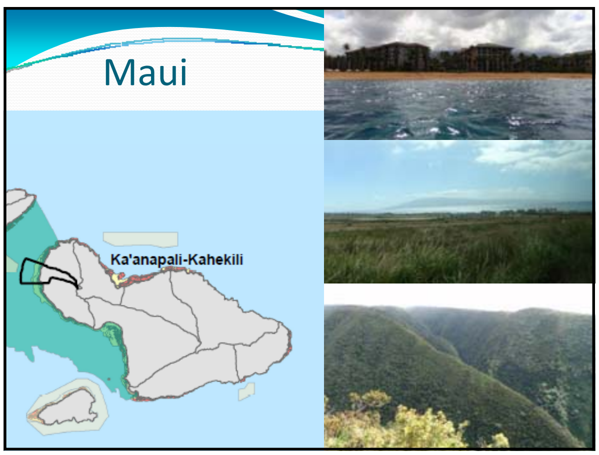

Federated States of Micronesia
Philippine Sea
NORTH PACIFIC OCEAN
CAROLINE ISLANDS
MARSHALL ISLANDS
YAP
CHUUK
POHNPEI
KOSRAE
FEDERATED STATES OF MICRONESIA


138°10'
Rumung
Gaqnaqun
Wanead
Maap
Ruun'uw
M'iil
Goofnuw
Worqing
173
Wanyaan
Kanif
Maaq
Gagil-Tamil
Yap
Colonia
9°30'
Baleabaat'
Yap Islands
Ngoof
Magachgil
10km


Kosrae
Okat Harbour
Tafunsak Village
Lelu
Lelu Village
Lelu Harbour
Tofol Village
Tafunsak
Walung Village
Utwa
Malem
Malem Village
Utwa Village
Utwa Harbour
N
Pohnpei
Sokehs Island
Kolonia
Sokehs
Nett
Madolenihm
U
Kitti
N







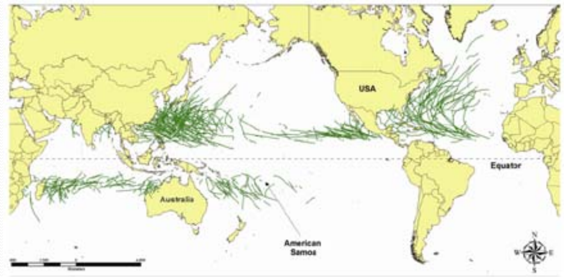
Why Islands are Different:
The key technical factors

- Hydrology (Rainfall, infiltration, evapotranspiration);
- Terrain*;
- Geology* - soils and geologic formations;
- Vegetation*
- Near shore environment*;
- Development patterns;
- Local capacity and experience; and
- Construction materials.

* Hydrology is a big part of these factors as well

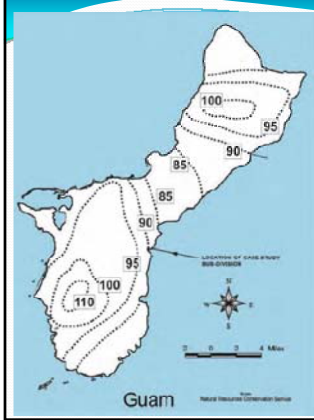
Hydrology

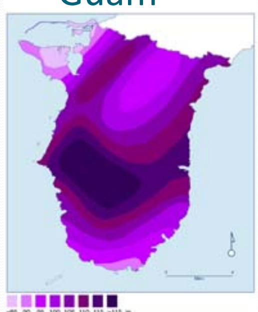
- Highly variable annual rainfall depending on elevation and aspect--10 to 300 inches per year;
  - (Mainland 15 to 60 inches)
- Leeward areas have extensive dry seasons;
- Evapotranspiration sends 60 to 70 inches back to the sky (mainland 15 to 30)
- Fog as much as 30% of annual rainfall at high elevations



Tracks of tropical cyclones during the 10-year period 1994-2003.

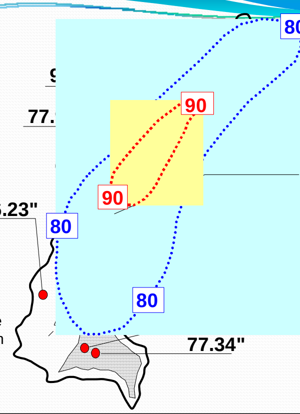
Guam





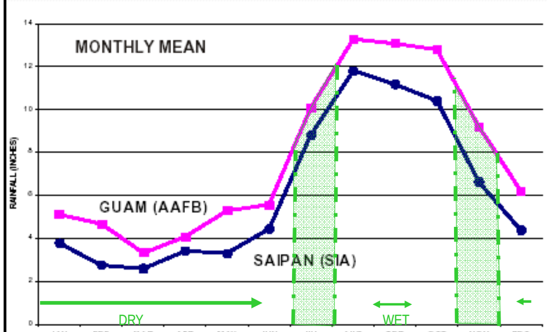
*www.hydro**guam**.net/**map**-clim-**rainfall**.php*

CNMI

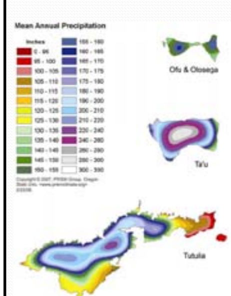


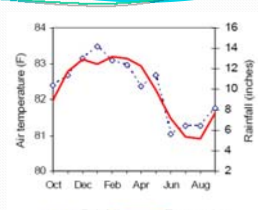
Average Annual Rainfall Amounts on the Island of Saipan

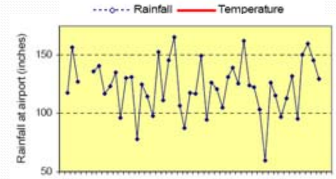
Precipitation Characteristics



American Samoa



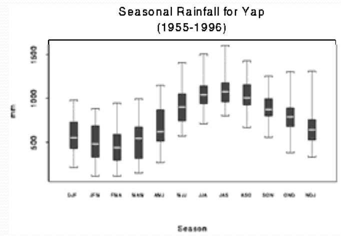


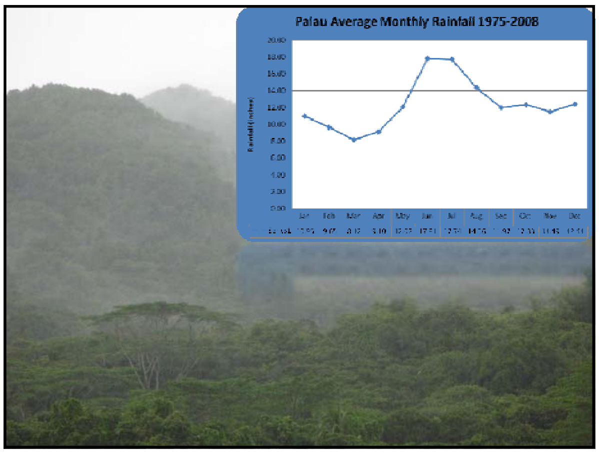


Satellite photo of Cyclone Olaf (Category 5) moving southward through the Samoan islands (dark red spots) in February 2005.

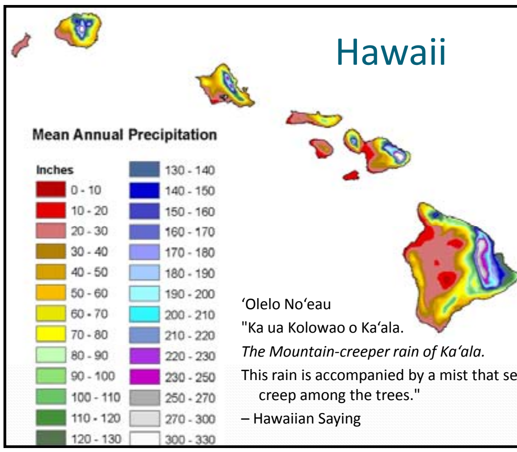
Yap

http://www.cpc.ncep.noaa.gov/pacdir/CLIM11.shtml





Hawaii



'Olelo No'eau

"Ka ua Kolowao o Ka'ala.

The Mountain-creeper rain of Ka'ala.

This rain is accompanied by a mist that seems to creep among the trees."

– Hawaiian Saying

24-hour Rainfall Events for Northern Guam

(adapted from Lander, 2004)

Values derived from the precipitation frequency analysis from long-term continuous meteorological observatory on northern Guam

Recurrence Interval (years)	Exceedance Frequency (%)	Average Rainfall Amount (inches)
1	100	3.5
2	50	7.0
10	10	10.0
25	4	20.0
50	2	27.0

Terrain

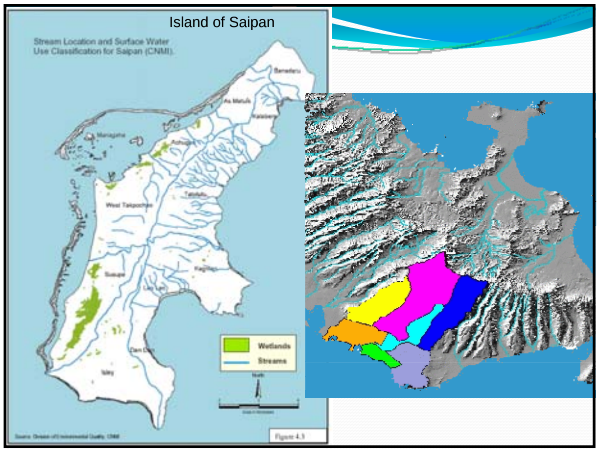
- Most islands have
  - areas of steep and flat terrain
  - very small watersheds
  - very short streams
- Steep terrain is recharge area for aquifers used in flat terrain

Steep Terrain Issues

- Extremely steep slopes;
- Hillslope erosion and landslides;
- Extensive erosion from road systems;
- Erodible but thin soils;
- Received 3 to 10 times more rainfall;
- Forest slopes are primary island recharge areas;
- Small short streams.

Flat Terrain Factors

- Low Head;
- Ditch drainage (streams are rare);
- Deeper soils;
- High water table;
- Lot of water to move;
- Wetlands present.



Geology and Soils

- Thin soils (a few feet deep);
- Nutrient poor and acidic;
- Highly permeable (6 to 20 inch/hr);
- Poor water holding capacity;
- Highly erodible;
- Vary depending on whether are of volcanic or coral origin;

Makes it hard to establish dense vegetative cover after soils are exposed during construction

Island Soils

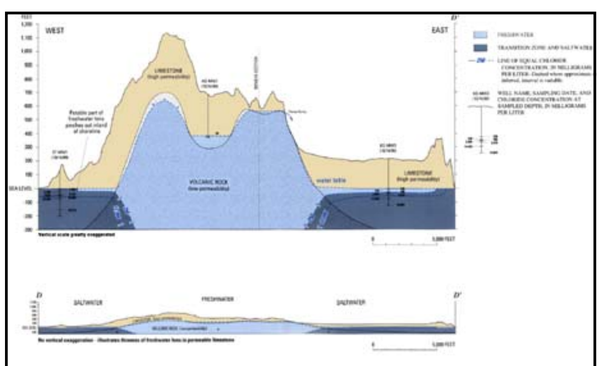
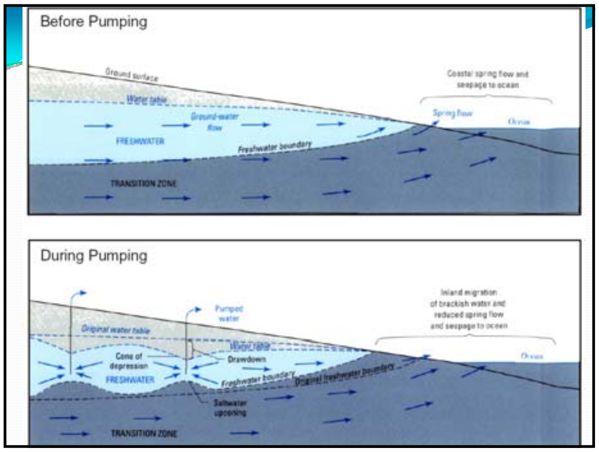
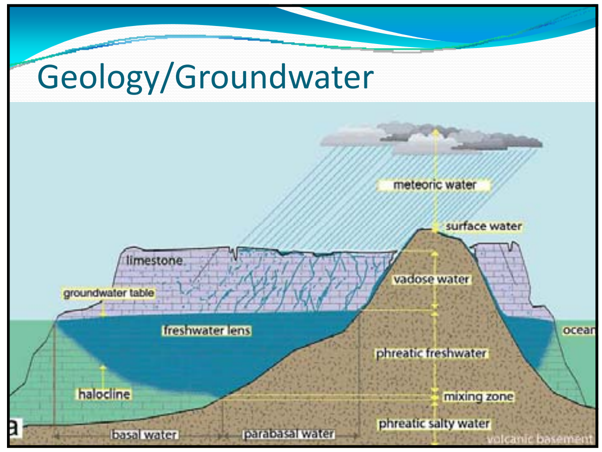
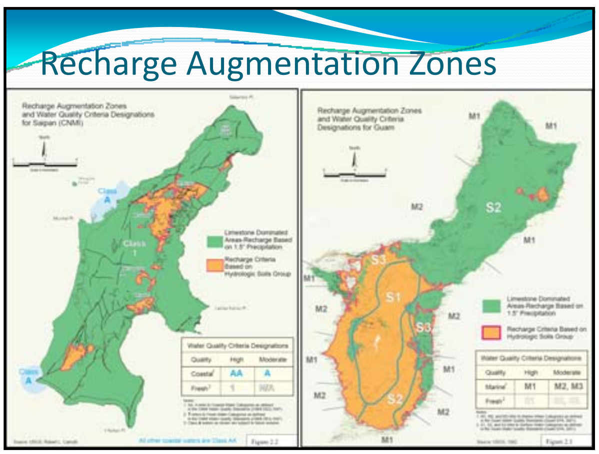
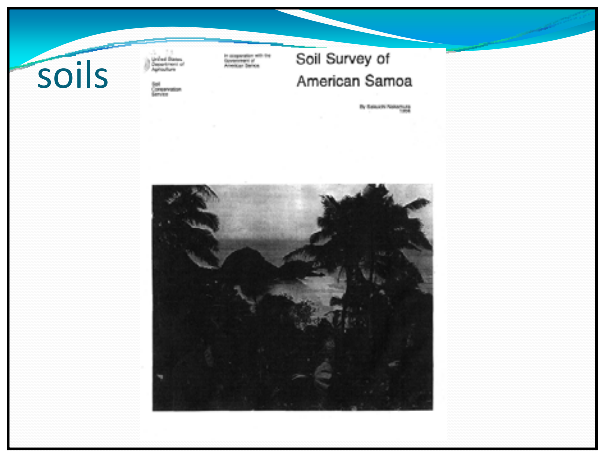


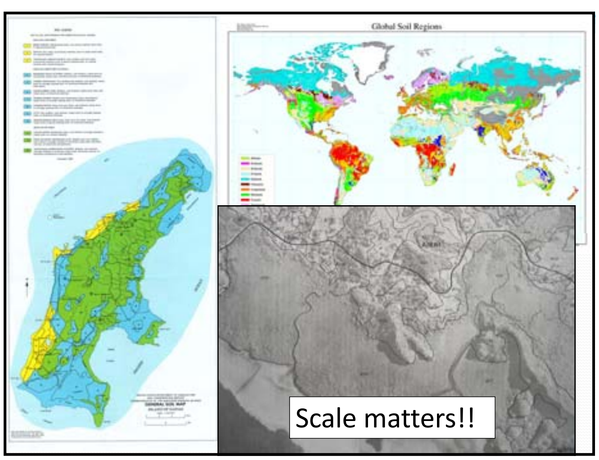
Figure 4.1 Geologic and groundwater resource characteristics of Saipan (CNMI)
(Source: USGS, Robert L. Carruth)

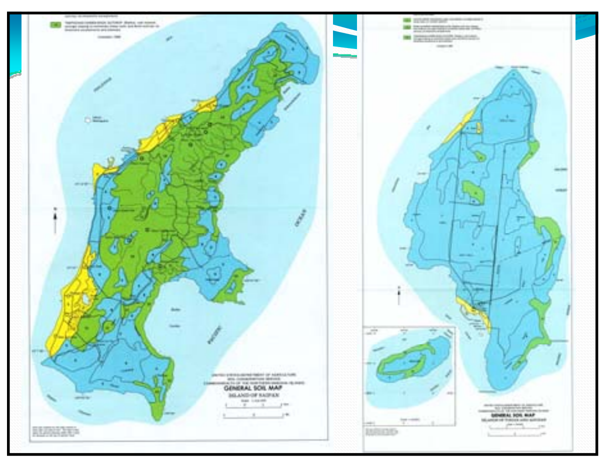

Before Pumping
Ground surface
Water table
Ground-water flow
FRESHWATER
Freshwater boundary
TRANSITION ZONE
Coastal spring flow and seepage to ocean
Spring flow
Ocean
During Pumping
Pumped water
Original water table
Water table
Cone of depression
Drawdown
FRESHWATER
Freshwater boundary
Original freshwater boundary
Saltwater upconing
TRANSITION ZONE
Inland migration of brackish water and reduced spring flow and seepage to ocean
Ocean


Geology/Groundwater
meteoric water
surface water
limestone
vadose water
groundwater table
freshwater lens
ocean
phreatic freshwater
halocline
mixing zone
phreatic salty water
basal water
parabasal water
volcanic basement

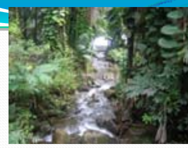

Recharge Augmentation Zones
Recharge Augmentation Zones and Water Quality Criteria Designations for Saipan (CNMI)
Class A
Class 1
Recharge Augmentation Zones and Water Quality Criteria Designations for Guam
S1
S2
S3
M1
M2
Water Quality Criteria Designations


soils
Soil Survey of
American Samoa


Global Soil Regions
Scale matters!!

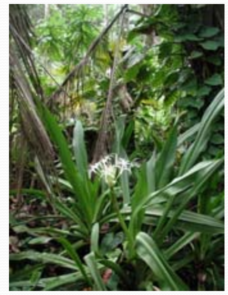


Vegetation



- Year round growing season;
- Invasive species a problem;
- Warm season grasses vary widely in their tolerance and nitrogen requirements;
- Some site preparation and soil amendments may be needed to get vegetation started;
- Native plant availability from island nurseries?
- Some traditional island plants may show promise (coir, taro)

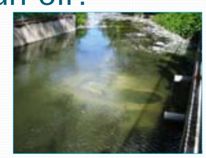
Lots of Growth



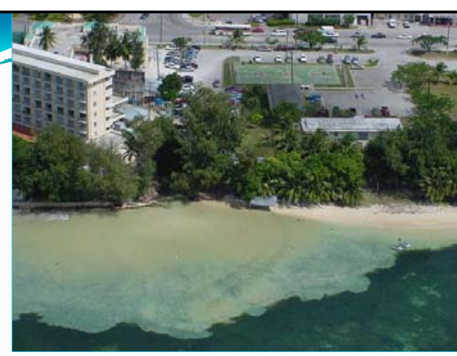
Near-shore Ecosystems

- Streams/rivers/estuaries
- Mangroves/ wetlands
- Seagrass beds
- Coral reefs **

What's in run-off?

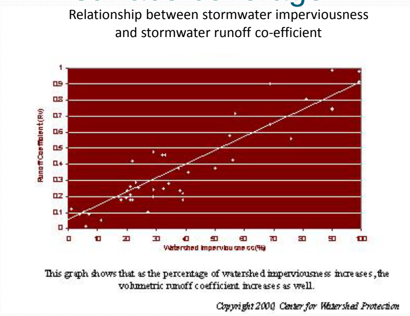


- •Sediments
- •Nutrients
- •Trash & debris
- •Oil and Grease
- •Heavy metals
- •Chemicals (pesticides, herbicides, pharmaceuticals)
- •Harmful microrganisms (pathogens) and other pollutants from overflowing septic systems, animal feces
- •Sewage from overflowing manholes
- •Fresh water & heat



Pollutants are transported in surface water runoff and groundwater seepage into coastal waters

Watershed health related to impervious surface coverage



Graph courtesy of www.cwp.org

Many sediment sources

Terrestrial Runoff is known to impact :

- Growth & survival of hard coral colonies
- Organisms that interact with coral populations & community structure

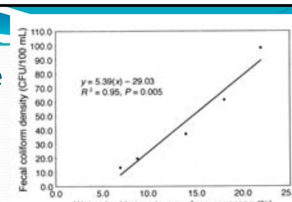
- Sediments reduce light and decrease coral growth
- Sediments smother corals
- Sloughing wastes energy
- Runoff effects coral reproduction & recruitment
  - Coral settlement rates are near zero on sediment covered surfaces
  - Sediment tolerance is lower in new recruits

Nutrients in Island Runoff

- High loadings of Nitrogen and Phosphorus;
- Stormwater runoff and septic systems;
- Harm to coral reefs, seagrasses;
- Very hard to remove;
- Hi delivery rates.

Concentrations exceed
Levels to protect coral
Reefs by 100 to 1000 times

The Bacteria Challenge



- Swimming, shellfish harvesting and recreational contact limited in many urbanized watersheds;
- Storm water f.coli levels exceed standards by factor of 20 to 50;
- Stormwater practices need to reduce bacteria levels by 99% to meet standards.

Island Development Patterns

- Rapid growth focused on flatter terrain;
- New growth spreading up the hills;
- Hi land prices;
- Small parcels;
- On-site wastewater Disposal;
- Scarce fresh water;
- Rainwater harvesting.

Deboy and Faris, 1918

Some Recent Residential Development Patterns

Land Cover/Erosion

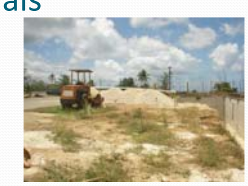
Local Capacity

Local Experience

- Many designers, contractors and reviewers are not familiar with innovative BMPs ;
- Simple construction techniques desirable ;
- Plan on limited long term maintenance, beyond vegetative management;
- High sediment loads should be expected, even w/ ESC controls.

Construction Materials

- Many construction materials may not be available or extremely expensive to import (e.g., peat, hardwood mulch, riverstone, geotextiles);
- Other indigenous materials should be promoted (sand, local stone, shredded coconut fiber, native plants);
- Seed and compost sources should be locally derived to prevent introduction of invasive plants.



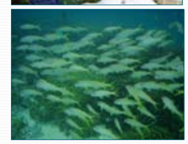
Social & Cultural Considerations

- Part of our way of life
- Traditional food, medicine, cultural & religious customs
- Spiritual relationships to ancestors and gods (renewed at marine and coastal areas or offering or marine resources)
- Part of creation legends
- Land-ownership



Coral Reefs are Valuable

- Tourism
- Fisheries
- Shoreline Protection
- Biodiversity
- Carbon Sequestration
- Pharmaceuticals
- Education
- Culture
- Social values

We depend on reefs

*500 million people depend on reefs for food, coastal protection , cultural items and tourism income

*30 million people depend on reefs entirely for food

*Reefs are the main resource for small island developing states

Economic Value of Coral Reefs

Island	Total Ecn Value/YR	Tourism	Fisheries	Coastal Protection	Biodiversity
Global 2008	$29.8 billion	$9.6B	$9B	$5.7B	$5.5B
Am Samoa 2004	$5 million		$775K	$582K	
CNMI 2006	$61.2M	$42.3 M	$1.3M	$8M	
Guam 2007	$127.3M	$94.6M	$4M	$8.4M	$2M
Hawaii (main) 2001	$364M	$304M	$1.3M		$10.5M

Reference: Conservation International 2008, Global Values of Coral Reefs, Mangroves & Seagrass

*Palau shark diving: 8% GDP (Tourism 39% GDP), sharks $179K annually, each shark lifetime value $1.9 M (Viana et al. 2010)

Session B: Components of a Good Watershed Plan

2011 Pacific Island Watershed Institute

Description: Discuss the key components of an effective watershed plan and why a comprehensive process is important for successful implementation. See how the watershed approach is evolving in two watersheds in Hawaii in Guam.

Speakers:

- Anne Kitchell, Horsley Witten Group
- Todd Cullison, Executive Director, Hui o Koolaupoko, www.huihawaii.org
- Maria Kottermair, Water & Environmental Research Institute, University of Guam

Resources:

- EPA Watershed Planning Criteria: www.epa.gov/fedrgstr/EPA-WATER/2003/October/Day-23/w26755.htm
- Center for Watershed Protection: Urban Subwatershed Restoration Manual Series www.cwp.org
- Global Coral Reef Monitoring Network and James Cook University: Catchment Management and Coral Reef Conservation www.gcrmn.org/

Topics/Notes:

1. What is a watershed plan?

2. Planning to Implementation: Ko'olaupoko Watershed Case Study

3. Integrating Conservation Area Plans with Watershed Management: Lessons from the Piti-Asan Watershed

US EPA Nonpoint Source Program and Grants Guidelines for States and Territories

These guidelines apply to grants appropriated by Congress in Fiscal Year 2004 and in subsequent years.
http://www.epa.gov/owow_keep/NPS/cwact.html

Beginning in FY 2004, the following information must be included in watershed-based plans to restore waters impaired by nonpoint source pollution using incremental Section 319 funds:

a. An **identification of the causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).

b. An **estimate of the load reductions** expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

c. A **description of the NPS management measures** that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

d. An **estimate of the amounts of technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

e. An **information/education component** that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

f. A **schedule for implementing** the NPS management measures identified in this plan that is reasonably expeditious.

g. A **description of interim, measurable milestones** for determining whether NPS management measures or other control actions are being implemented.

h. A set of **criteria that can be used to determine whether loading reductions are being achieved over time** and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

i. A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Pacific Island Watershed Institute
Session B: Watershed Plans

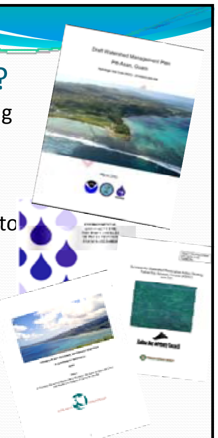
June 13-16, 2011
He'eia State Park, Oahu

Topics to Cover

- What is a watershed plan
- Various watershed planning frameworks
- Tips on avoiding failure
- Case Studies
  - Ko'olaupoko Watershed, Oahu
  - Piti-Asan Watershed , Guam

What is a watershed plan?

- Road map for protecting or restoring local water resources
- Comprehensive strategy to address LBSP
- List of priority actions and projects to help meet water quality goals and resource objectives
- Implementation strategy
  (who, what, when, where, and how $...)
- A community vision
- Cheap, short, and sweet
- Out-dated in 5 years



What's in a Name?

Common Outcomes of Watershed Planning

- **Adopt/update** development regulations
- **Direct** new development
- **Conserve** or acquire critical lands
- **Install** restoration projects
- **Improve** watershed awareness & stewardship
- **Integrate** efforts into daily municipal operations
- **Create** a watershed organization
- **Enhance** local capacity to manage watershed development
- **Improve** or **maintain** quality of water resource (hopefully)

There is a ton of "how to" guidance available…

Pacific Island Watershed Institute: Session B: Watershed Plan Components

Common Steps in the Watershed Planning Process

- Getting Started
- 1. Characterize watershed
- 2. Classify & screen priority subwatersheds
- 3. Identify restoration/protection projects
- 4. Conduct detailed assessments
- 5. Assemble recommendations into plan
- 6. Determine if plan meets goals
- 7. Implement the plan
- 8. Evaluate over time


Desktop Analysis


Field Assessment


Stakeholder Input


Management Decision

In the Beginning…

- **Getting Started**
- 1. Characterize watershed
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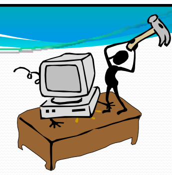
Getting started with your core team, compiling what you know, and scoping out your preferred planning process and stakeholder strategy

We will be developing a scope this afternoon

What do you have to work with…



- Getting Started
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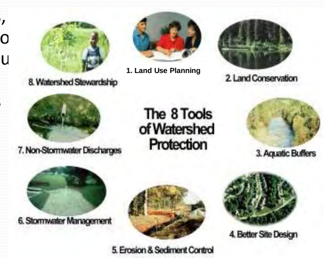
Establish baseline conditions outlining reg/program needs and capabilities, watershed impairments, and resources

Desktop analyses (*i.e. future land use, natural area inventory, pollutant load)* and using GIS to generate comparable subwatershed metrics can be useful when identifying planning priorities

Evaluate Local Regs & Programs

- Audit of local programs, codes and ordinances to see how they measure u against watershed protection benchmarks
- Results in specific recommendations for changes to local codes, ordinances, programs, zoning, and comprehensive plans



We will do some of this later today in Session D, H, and during your Island Work Sessions

Common Analyses

- **Current and future land use** – breakout of current land use in the watershed based on GIS data and prediction of buildout conditions
- **Water balance/budget:** particularly where groundwater recharge is important
- **Sensitive areas inventory** – maps and acreage of sensitive areas in the watershed and subwatersheds
- **Future impacts to sensitive areas** – estimate future loss of sensitive areas due to land development
- **Protection and restoration sites** – identify specific sensitive area sites that have protection or restoration potential

Depends on watershed characteristics..lets talk during Session F

Estimate Pollutant Loads

- "accounting" may be required as part of TMDLs, NPDES, etc
- Which tributaries and sources are the biggest culprits
- Where do we get the biggest bang for the buck
- Estimate pollutant loads for current watershed conditions and future land use scenarios
- Simple or complex models can be used

We will do some of this in Session G

Potential factors to determine priorities

Assessment criteria
- Public health impairment
- Drinking water impairment
- Coastal resource (e.g., coral reefs) and marine resource impairment
- Threatened and endangered species habitat impairment
- Degradation of biodiversity

Management criteria
- High probability of success
- Likelihood of future development
- Planned restoration activities

Classifying Watersheds:

Example: Guam's Clean Water Action Plan

Category I - Watersheds needing restoration

Category II - Watersheds needing preventive action to sustain water quality (i.e., meeting goals)

Category III - Watersheds with pristine conditions on public lands

Category IV - Watersheds with insufficient data to make an assessment

List of Watersheds with Hydrologic Codes.

Category	Restoration Year	Watershed	NRCS Number	Priority Ranking
1	FY 1999-2000	Northern	20100003-000-001	1
		Ugum	20100003-000-009	2
		Talofofo	20100003-000-011	3
1	FY 2001-2005	Agana	20100003-000-002	
		Agat	20100003-000-010	
		Apra	20100003-000-008	
		Asalonso	20100003-000-013	
		Geus	20100003-000-020	
		Inarajan	20100003-000-017	
		Pago	20100003-000-003	
		Togcha	20100003-000-007	
		Ylig	20100003-000-005	
		Piti/Asan	20100003-000-006	
4		Cetti	20100003-000-014	
		Dandan	20100003-000-015	
		Fonte	20100003-000-004	
		Manell	20100003-000-019	
		Taelayag	20100003-000-012	
		Toguan	20100003-000-018	
		Umatac	20100003-000-016	

Getting your feet wet!

Getting Started
1. Characterize watershed
2. Classify & screen priority subwatersheds
3. Identify restoration/protection projects
4. Conduct detailed assessments
5. Assemble recommendations into plan
6. Determine if plan meets goals
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8. Evaluate over time

Desktop analysis can only go so far…
…walking shorelines, streams, and uplands is the best way to identify REAL restoration/protection opportunities in your watershed.

Get ideas and permission from the locals

Conduct Stream Corridor and Shoreline Assessments

- Stream habitat/biological assessments
- Geomorphic assessments
- Wetlands inventory
- Continuous stream walks
  - channel stabilization
  - fish barrier removal
  - outfall inventory & discharge investigations
  - buffer planting opportunities
  - trash cleanup locations
  - maintenance locations
- Floodplain evaluations
- others

We will do some of this in field trips on Days 1-3, Sessions C, E, and J

Conduct Upland Assessments

- Done in combination with stream assessments
- Identify potential pollutant sources and restoration projects

Residential neighborhoods

Stormwater "hotspots"

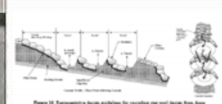
Retrofit inventories

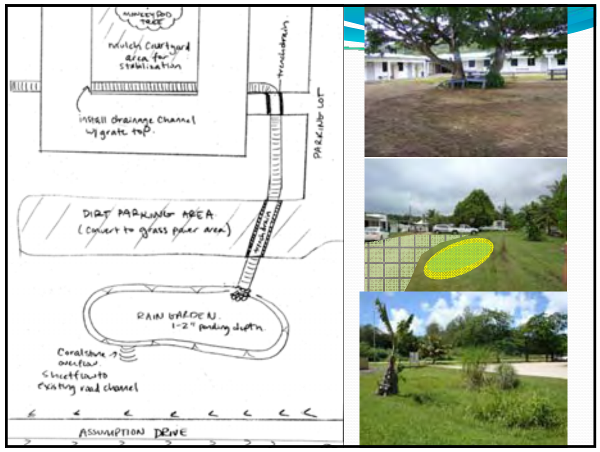
Special area assessments

Pervious areas

Streets and storm drains

Station	Description	Site Photo
8	• Private Road/Driveway (Antoinette's property). • Recent work by homeowner to repair 24-inch culvert and convey runoff across driveway and through property. • **Maintain swale** on driveway at private residence to prevent backup and overflow of offsite drainage into patio/driveway areas	
9	• Install one (1) **waterbar/trench** starting below the rocky outcrop downhill of telephone pole. Deflect runoff into inside ditch. • Install **check dam(s)** in ditch to create small step-pool to help reduce velocity and trap sediment. Maintenance critical to ensure step pool(s) does not push water back into the road. • Linked to paving Station 7 bend.	
10	• Install two (2) **waterbars** above driveway to divert runoff into inside of road. • **Excavate four (4) step pools along inside** shoulder to help trap sediment and reduce **runoff velocities**. • Existing rock outcrops on inside ditch are relatively soft, making excavation of pools/sediment traps at this location ideal.	
11	• Install four (4) **waterbars** to divert runoff **into inside of road**. • Install **flow splitter** with small step pool/trap at a location just upfall of the existing telephone pole with "PLZ SLO" sign. Smaller storm flows can be taken across the road in a culvert to stable discharge outlet into existing gut, remaining flow directed into inside ditch (minor excavation to increase capacity). • Excavate/install 3-5 **step pools** to slow flow and trap sediment.	





Document your findings

- Getting Started
- 1. Characterize watershed
- 2. Classify & screen priority subwatersheds
- 3. Identify restoration/protection projects
- 4. Conduct detailed assessments
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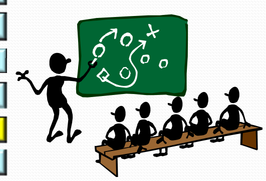
Work with stakeholders to finalize goals, assign priorities, and draft your watershed plan



Discuss stakeholder involvement in Session K

Draft the Watershed Plan

- Watershed plan recommendations:
  - Priority protection and restoration projects
  - Regulatory and programmatic changes
  - Land use changes and management approaches
- Map of project locations
- Implementation plan!!!
  - Schedule
  - Costs
  - Responsible parties
  - Next steps

This is EPA's biggest focus area for watershed plan criteria

Link to EPA's Watershed Plan Elements a-i

a) ID causes & sources of pollution
b) ***Determine load reductions needed***
c) Develop management measures to achieve goals
d) ***ID technical & financial assistance***
e) Develop information / education component
f) Develop implementation schedule
g) Develop milestones to track implementation
h) Develop criteria to measure progress
i) Develop monitoring component

See back of your handout!

Reality Check…

- Getting Started
- 1. Characterize watershed
- 2. Classify & screen priority subwatersheds
- 3. Identify restoration/protection projects
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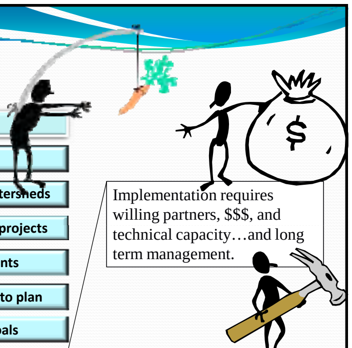
Before finalizing plan, make sure your recommendations will help you meet the goals, particularly for load reductions.

Estimate Pollutant Reductions

- Evaluate the effect of implementation of protection and restoration practices on pollutant loads
- Use EMCs for various pollutants and urban land uses, removal efficiencies for protection/restoration practices
- Use results to recommend best practices to meet pollutant reduction goals
- Use results to modify recommendations or update project rankings to ensure pollutant reduction goals are met

We will do some of this in Session G and island work sessions

Just Do it!



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Implementation requires willing partners, $$$, and technical capacity…and long term management.

It can take decades. Changing conditions require plan updates

Implementing Plan

- Devise a long-term strategy for getting the plan adopted so it doesn't sit on the shelf
  - No universal method for adoption
  - Must involve elected officials, local staff, regulators, media, and stakeholders
- Funding
- Training staff, contractors, etc
- Educating watershed citizens
- Setting up management structure and reporting/tracking mechanism

Discuss in more detail during Session L and your next steps during session M

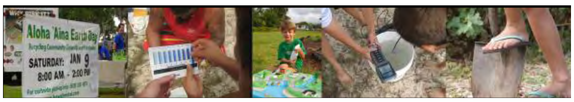
Tips for an effective plan

1. Assign a lead
2. Plan at appropriate scale
3. Don't spend all your time and $ on planning
4. Be strategic in new analyses and field work
5. Integrate with existing plans, local initiatives, stormwater requirements, capital budgets, etc
6. Involve stakeholders & implementation partners early
7. Include an implementation Strategy
8. Meet EPA 9 elements
9. Keep plan short and sweet and updated
10. Use technical memos to hold geeky watershed information

Pacific Island Watershed Institute:
Session B: Watershed Plan Components

hui o ko'olaupoko

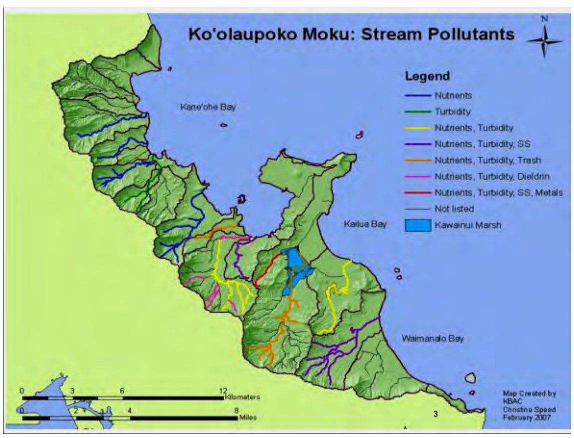
To protect ocean health by restoring the 'āina: mauka to makai



Outline of Presentation

- Watershed Restoration Action Strategy
- Missed Planning Opportunties
- Past and Current Restoration Projects
- Current Planning Efforts
- Urban Assessment Data Sheets
- Future Efforts
- Questions

2



Watershed Restoration Action Strategy (WRAS)

- EPA/Hawai'i Dept. of Health, Clean Water Branch 319 grant
- Ko'olaupoko: EPA Priority Watershed(s)
- Two-year project
- Largely GIS-based and literature review
  - Attempt to bring in ideas from community
- Focused on watersheds on the 303 (d) list
  - Should have looked at other issues, opportunities, etc. outside of 303 (d)

4


Table of Contents

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What our planning effort missed?

- More time conducting field assessments
  - Higher resolution of watershed problems
  - Followed by prioritization
- Better modeling of watersheds
  - General analysis of entire 43,000 acres
  - Inter vs. intra
    - I.e. Conservation land vs. urban
- Connecting with other entities, especially agencies
  - Other watershed planning efforts
- Setting benchmarks and goals for restoration efforts
- Low-hanging fruit
  - More difficult to identify when working with NPS

6

6

Pacific Island Watershed Institute:
Session B: Watershed Plan Components

Kāneʻohe Storm Water Project

7

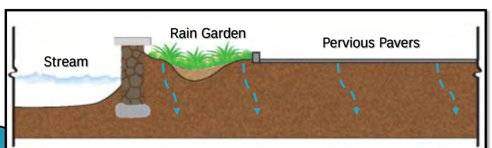
He'eia Riparian Restoration

Over 3,000 hours of community volunteer hours replanting more than 2,000 feet of riparian habitat.

HPU, Hui Ku Maoli Ola, DOH/EPA

8

LIR in Kailua



9

Waiheʻe Stream Fish-passage

BWS, KEY Project, USFWS, USGS, CCH Parks, DAR, HOK

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Kaha Gardens

Kaha Garden is a living example of how individual homeowners can help improve the local environment through the use of native vegetation and xeriscape gardens.

11

Rain Gardens

- Developing Hawaiʻi Rain Garden Manual
- Building/cost sharing 50 rain gardens with Koʻolaupoko homeowners

12

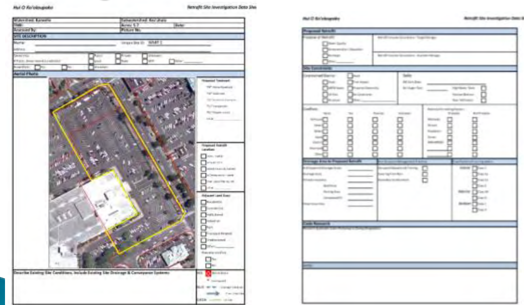
Urban Watershed Assessment

- Focusing on urban areas to prioritize storm water retrofit opportunities
  - Land use
  - Parcel Size
  - Opportunity for retrofits in highly developed areas
    - BMPs
    - Pollution Prevention/Education and Outreach
- > pollution reduction = higher prioritization
- Ultimately, at the community level, all projects are

ACTIVELY OPPORTUNISTIC

13

Field Assessment in an Urban Setting



14

What's Next?

- Position HOK as leading entity promoting and encouraging Green Infrastructure
- Implement LIR projects in urban areas
- Coordination with CCH on Green Streets program
- Continue low-tech, community support projects, i.e riparian restoration, water quality monitoring, rain gardens and education

15

hui o ko'olaupoko
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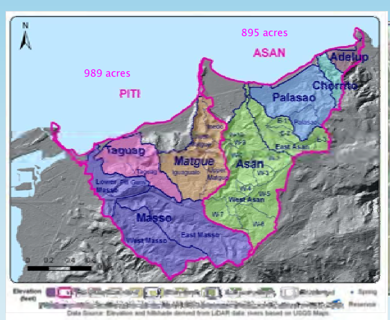
Piti-Asan Watershed Management Plan – Integration of CAP –

Maria Kottermair
Water & Environmental Research Institute
University of Guam
June 13th 2011

Overview

- Project area
- Priority watershed
- CAP process
- WMP process
- Management goals
- WMP
- Next steps

Project Area



Priority Watershed

- Adjacent marine preserve
- Lots of work/ studies have been done
- Accessibility, visibility
- Versatile area

WMP – good reference for future work

- Gives an overview of watershed
- Summarizes existing efforts
- Points out threats
- Contains specific management action
- Avoids duplicating efforts

Conservation Action Plan Process

Project-specific Threats		Threats Across Targets: Coral Reef Ecosystem	Native Forest	Fresh Water Ecosystem	Native Terrestrial Wildlife	Reef Fish	Overall Threat Rank
		1	2	3	4	5	
1	Invasive species	Medium	Very High	Low	Very High		Very High
2	Urban development		High		Very High		High
3	High levels of pollutants	Very High				Medium	High
4	Illegal fishing					Very High	High
5	Sedimentation	Very High					High
6	Wildland fires		Very High				High
7	Degraded habitat			Medium		High	Medium
8	Poor land use practices		High	Medium			Medium
9	Recreational use	Medium				Medium	Medium
10	COTS	Medium					Low
Threat Status for Targets and Project		Very High	Very High	Medium	Very High	High	Very High

Source: TNC, 2010

WMP Process

- Watershed assessment
  - Literature review
  - Data collection (or hunting!) from agencies
  - Field assessments (photo documentation, GPS outfalls)
  - **GIS analysis/ creating maps** (WS delineation)
- Management Goals Strategies
  - Compiling and synthesizing existing documents
    → CAP, CWP&HW, Natural Resources Strategy, *etc.*

Pacific Island Watershed Institute:
Session B: Watershed Plan Components

Management Goals Example

Goal 1. Improve Stormwater Quality and Reduce Runoff.

Goal 1.1. Improve stormwater-related issues and demonstrate innovative practices.

- **Strategic Action:** improve existing infrastructure.
- **Strategic Action:** incorporate "green" infrastructure for new developments.
- **Strategic Action:** Prevent municipal and commercial pollution.
  - *Action Step #1:* conduct public awareness campaign (waste storage/ wastewater discharges.
  - *Action Step #2:* organize street sweeping and catch-basins cleanouts.
  - *Action Step #3:* ensure long-term maintenance of existing BMPs.

Goal 1.2. Reduce erosion and sedimentation.

....

Outline of Plan

- Watershed profile
- Watershed values
- Threats
- Conservation Status
- Monitoring Programs
- Management Strategies
- Next Steps

Outline of Plan

- Watershed profile
- Watershed values
- Threats
- Conservation Status
- Monitoring Programs
- Management Strategies
- Next Steps

Watershed Profile – Example

Outline of Plan

- Watershed profile
- Watershed values
- Threats
- Conservation Status
- Monitoring Programs
- Management Strategies
- Next Steps

Watershed Values

Threats

- Invasive species
- Erosion and Sedi[...]
    - Freshwater Sedi[...]
    - Terrestrial (deer, pig[...]
    - Streambank erosion
    - Mass wasting
    - Shoreline erosion
- Wildland fires
- Development
- Pollutants

Conservation Status

Monitoring Programs

Management Goals

- Improve Stormwater Quality
- Increase Biodiversity
- Increase Watershed Awareness
- Report Management Progress
- Enhance Coral Reef Ecosystem

Next Steps

- Implementation of Plan
- Establish a Watershed Clearing House
- Report Status of Conservation Efforts
- Combining Efforts

Session C: Overview of Watershed Assessment Methods

2011 Pacific Island Watershed Institute

Description: After lunch “Watershed Scavenger Hunt” on the grounds of He’eia State Park as an introduction to common field and desktop assessment techniques.

Exercise #1: **Examine the map of the Heiaa/Kea’ahala watershed and answer the following:**

1. Outline the stream corridor. How many miles of stream in each watershed? What would be your strategy for assessing stream conditions here?

2. Circle locations where retrofit and hotspot inventories would be useful.

3. What type of pollutants or other watershed issues do you anticipate in this watershed?

4. What restoration opportunities would you anticipate focusing on?

5. What other information would be useful in developing your field assessment strategy?

Exercise #2: Using the State Park aerial map, go outside and complete the following steps:

1. Delineate impervious cover on site (don't cross road or stream).

2. Draw in catchments/drainage paths and discharge locations on map.

3. Identify potential sources of pollution. Describe here:

4. Come up with at least one restoration project concept – "structural" or "non-structural." Describe here:

Pacific Island Watershed Institute

Session C: Watershed Assessments

June 13-16, 2011
He'eia State Park, Oahu

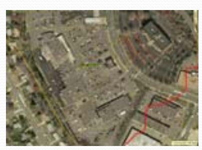
WHY Assess Your Watershed?

- Examine current problems in the watershed
- Find **restoration opportunities**

HOW to Assess Your Watershed?

2-Steps:

1. *"Desktop" analysis* – look at maps to plan your field assessments

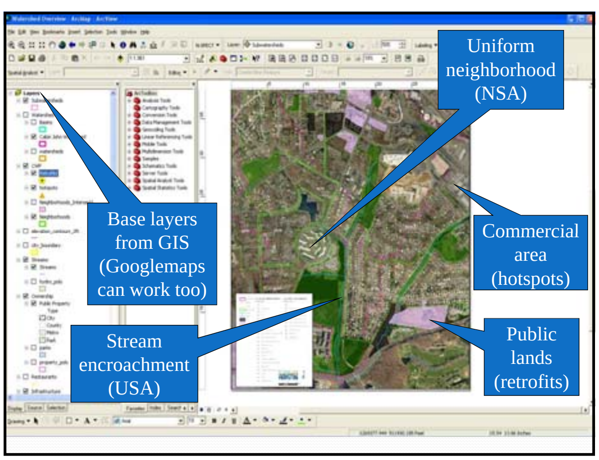


2. *Field assessments* – get out there!

[Only way to *really* find specific restoration opportunities.]

Terminology

- *Subwatershed* = 10 sq. miles or less
- *Stream corridor* = channel, its banks, and floodplain
- *Upland areas* = everything up-hill of stream corridor



Look on Maps for…

Survey Site	Impacts You'll Find	Restoration Options
1. Stream Reaches & access points	•Bank erosion •Trash •Pollutant discharge •Channelization •Etc.	•Bank restoration •Cleanups •Pollution prevention •Habitat restoration •Etc.

Look on Maps for…

Survey Site	Impacts You'll Find	Restoration Options
2. Neighborhoods	•Trash •Excess runoff •Household pollutants •Fertilizer usage	•Cleanups •Retrofits •Education


Look on Maps for…

Survey Site	Impacts You'll Find	Restoration Options
3. Large parking lots/roofs	•Excess runoff •Hot runoff •Bad waste mngmt •Fertilizer/herbicide	•Retrofits •Trees •Pollution prevention •Nutrient mngmt


Look on Maps for…

Survey Site	Impacts You'll Find	Restoration Options
4. Large Turf areas	•Fertilizer/herbicide •Excess runoff	•Nutrient mngmt •Revegetation •Retrofit adjacent impervious areas


Look on Maps for…

Survey Site	Impacts You'll Find	Restoration Options
5. Storm drain outfalls	•Outfall erosion •Signs of polluted discharge	•Outfall protection •Infrastructure repairs (e.g., sewer)


Look on Maps for…

Survey Site	Impacts You'll Find	Restoration Options
6. Hotspots	•Trash •Wash water •Grease, oils	•Better waste mngmt •Education/signage •Secondary containment


Field Assessment Methods

Tomorrow we will practice…

- Stream assessment
- Stormwater retrofit investigation
- Hotspot site investigation
- Neighborhood/residential assessment

Others:

- Pervious/natural area assessments
- Illicit discharge detection


Stream Assessment
Culvert
Sewer Crossing
Outfall
Impacted Buffer
Channelized stream
Confirm condition and identify impacts in riparian corridor


Infrastructure Assessment


Stream Stabilization Projects


Stormwater Retrofit Investigation
CanVIS computer simulation
Restoration Options: Stormwater management practices in locations where stormwater controls did not previously exist or were ineffective


"Hotspot" Sites
Transportation-Related Operations
Commercial Operations
Industrial Operations
Institutional Operations
Municipal Operations
Produce higher levels of pollutants
AND / OR
Present higher potential risk for spills, leaks or illicit discharges


Hotspot Site Investigation
What do you see?
Restoration Option: Better maintenance practices
Storm drain full of grease!
Restoration Option: Install secondary containment for waste

Neighborhood/Residential Assessment

- Yards and Lawns
- Driveways, Sidewalks, and Curbs
- Rooftops
- Common Areas

- **Restoration Options:** Pet waste containers & outreach; No-mow along streams; Downspout disconnection; Erosion repairs

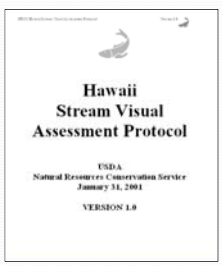
Assessing Pervious Areas

CanVIS computer simulation

- **Restoration Options:** Tree plantings or re-forestation; Conservation of intact natural areas

Hawaii Stream Visual Assessment Protocol (by NRCS)

Available at:
http://www.pia.nrcs.usda.gov/technical/intohsvap.html


Hawaii
Stream Visual
Assessment Protocol

USDA
Natural Resources Conservation Service
January 31, 2001

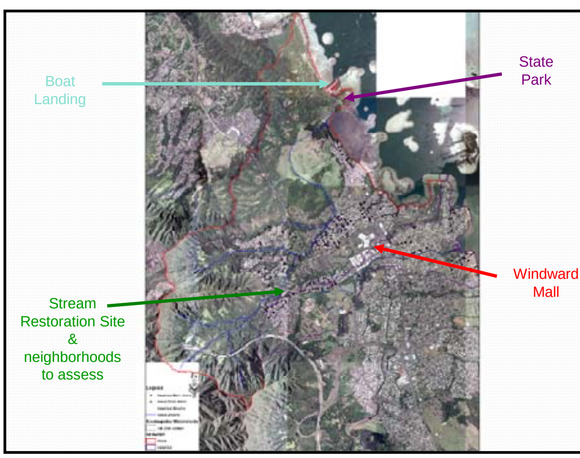
VERSION 1.0

CWP's **Restoration Manual Series**

Available at www.cwp.org

Exercise #1

- Examine large map of He'eia Stream & Kea'ahala Stream watersheds
- Answer questions on session worksheet



Session D: Regulations & Policies

2011 Pacific Island Watershed Institute

Description: A brief review of the overlapping federal/jurisdictional regulations and policies that affect watershed planning and outcomes. Much of the session will about local (or island-wide) codes and policies that are needed to support successful watershed planning and implementation. One of the objectives is to identify gaps that participants can work on during the Island Team Sessions.

Speakers:

- David Hirschman, Center for Watershed Protection
- Margaret Aguilar, Guam Environmental Protection Agency

Topics/Notes:

1. Why local/island codes are important to supplement existing federal regulations.

2. Guided activity to fill out questionnaire. From a local regulations standpoint, identify your island's strong points and gaps to work on.

3. Case study about Guam Erosion Control and Stormwater Regulations.

Pacific Island Watershed Institute Session D: Regulations & Policies

Quick Program Self-Assessment

The self-assessment is designed to help you evaluate the current status of your island program regulations and policies for watershed and stormwater management.

What program elements are you doing a great job with? Which ones need work? What are the major program gaps? This self-assessment will help you begin answering these questions. The assessment is not exhaustive, but just hits the high points for each program category.

To fill out the self-assessment, read the question and possible responses, and assign a number between 1 and 10 that best reflects the status of your program. The scale is a continuum, so you can select any number between 1 and 10. When you are done, tally your points, and see how you score on a 100-point scale. Use the results to brainstorm the top program strengths and gaps on the last page. This brainstorming can carry over to your island team work sessions later in the day.

For a more comprehensive assessment tool for coastal natural resources programs, see the Center for Watershed Protection's *Coastal Community Watershed Management Checklist* (part of the Coastal Plain Watershed Information Center):

www.cwp.org (click on "Coastal Plain Watershed Information Center on left side, then scroll to bottom of page)
OR go directly to: http://www.cwp.org/component/content/article/39/112-coastal-plain-watershed-information-center.html

The *Coastal Community Watershed Management Checklist* provides a comprehensive self-assessment for a variety of issues, including:

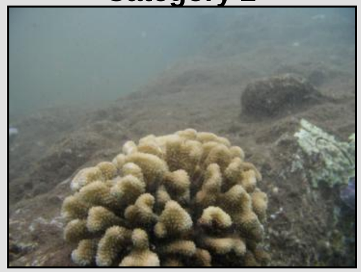
- Land Use Planning
- Hazard Mitigation Planning
- Pollution Sources
- Shoreline Management
- Site Design
- Stormwater Management

The tool is geared to the Atlantic Coastal Plain, but many of the resources and assessments are applicable to the Pacific Islands.

For the topic of post-construction stormwater management, a more comprehensive self-assessment can be obtained as part of *Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program.* There is a downloadable tool that steps through all of the programmatic aspects of a post-construction stormwater program:

www.cwp.org/postconstruction

Quick Program Self Assessment

Program Question	Category 1: 	Category 2 	Category 3 	Your Notes
1. Land Use Planning & Land Conservation				
1.1. Is there a zoning code that directs development to most suitable places and protects sensitive resources?	Zoning a bad word on our island	We have zoning, but it does a poor job of directing development to suitable locations	Zoning does exist to create incentives for development in suitable locations and controls density in sensitive areas	
points	1 2 3	4 5 6	7 8 9 10	
1.2. Is there a program (public or private) to identify and protect high value conservation lands?	No	Some land is protected	There is an active program to protect sensitive lands	
points	1 2 3	4 5 6	7 8 9 10	
2. Development Codes & Site Design				
2.1. Do development codes promote less impervious cover and less site disturbance?	Development codes don't address impervious cover or the amount of land disturbance	These things are done in some areas or on a case-by-case basis	Our codes promote better site design and low-impact development, and some examples have been built	
points	1 2 3	4 5 6	7 8 9 10	
2.2. Are there buffers or setbacks from the coastline, waterways, and/or drinking water wellheads?	No buffers or setbacks	Buffers and setbacks exist in some situations or on a case-by-case basis	We have a good program for buffers and setbacks for at least of the following: coastline, wetlands, waterways, wellheads	
points	1 2 3	4 5 6	7 8 9 10	

3. Construction Site Stormwater (Erosion & Sediment Control)				
5.1. Does your program have legal authority and tools to control stormwater from **construction sites during active construction**?	Some loose regulations may exist, but no practical application during plan review	We have regulations, but many sites still can get away with having few erosion and sediment controls	We have good regulations that give us authority to ensure adequate design, installation, and maintenance of ESC techniques	
points	1 2 3	4 5 6	7 8 9 10	
5.2. Is there adequate inspection and enforcement of ESC application on site	No, enforcement is lacking in almost all cases	We have an inspection and enforcement program, but it is complaint-driven, enforcement is spotty, and staffing is limited	Inspections take place at almost all sites and enforcement actions are taken when necessary	
points	1 2 3	4 5 6	7 8 9 10	
4. Post-Construction Stormwater Management				
4.1. Does your program have the legal authority and tools to control **post-construction stormwater** (after the active construction phase)?	No post-construction regulations, standards, or design criteria	We have regulations and standards, but they are not widely utilized/implemented	We have sufficient post-construction regulations and guidance tools, provide enforcement, and encourage innovative island practices	
points	1 2 3	4 5 6	7 8 9 10	
4.2. Are post-construction requirements and BMP standards used for public works and transportation projects?	Generally, these projects do not incorporate BMPs to adequately manage stormwater	Post-construction BMPs are applied on a case-by-case basis, and generally follow island standards	Public projects routinely follow the most stringent post-construction stormwater standards and designs, even if private projects do not.	
points	1 2 3	4 5 6	7 8 9 10	
5. Pollution Sources				
5.1. Are there standards for septic systems (e.g., minimum setbacks, reserve drainfields, minimum depth to bedrock or water table)?	Not really. Just a minimum lot size, which is generally too small	There are some standards, but they need to be updated and improved because most on-site systems are failing	There are standard setbacks from water features, bedrock, and water table. On-site systems are designed to boost treatment efficiency	
points	1 2 3	4 5 6	7 8 9 10	
5.2. Do Marinas employ good practices to control pump-outs, fueling, etc. – such as the Clean Marina Program?	Generally not.	A few practices on a case-by-case basis, but these are the exceptions.	Most marinas use good practices as part of a Clean Marina Program or similar effort	
points	1 2 3	4 5 6	7 8 9 10	
				Total Points Out of 100

Major Program Strengths:

1. ____

2. ____

3. ____

4. ____

5. ____

Major Program Gaps/Things to Work On:

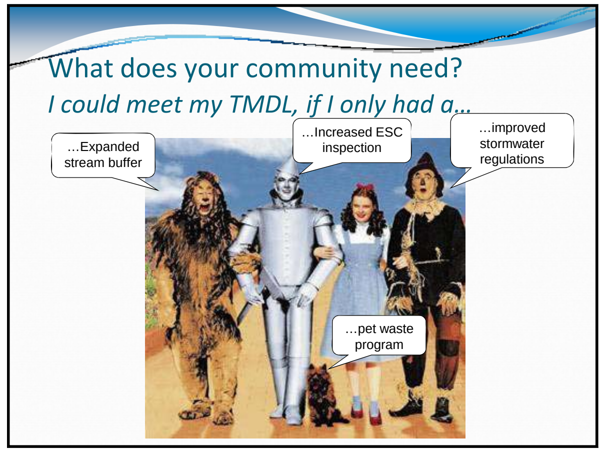
1. ____

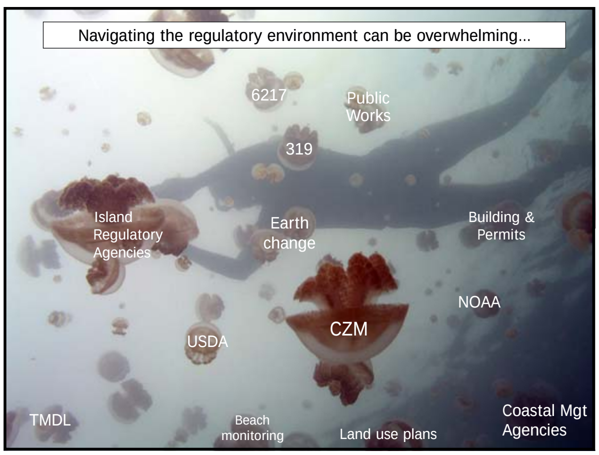
2. ____

3. ____

4. ____

5. ____

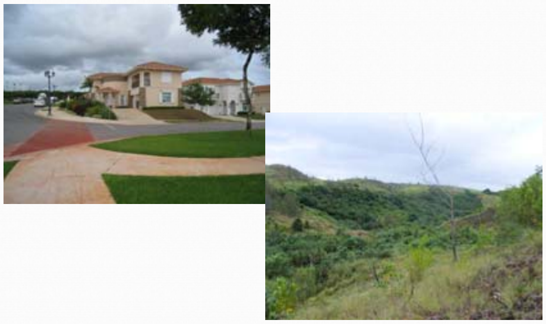




#1 Land Use Planning & Land Conservation

- Development in suitable locations (e.g. public utilities) – provide incentives
- ID most sensitive areas
- Limit growth in most sensitive areas
- Protect sensitive areas

Develop in Suitable Areas



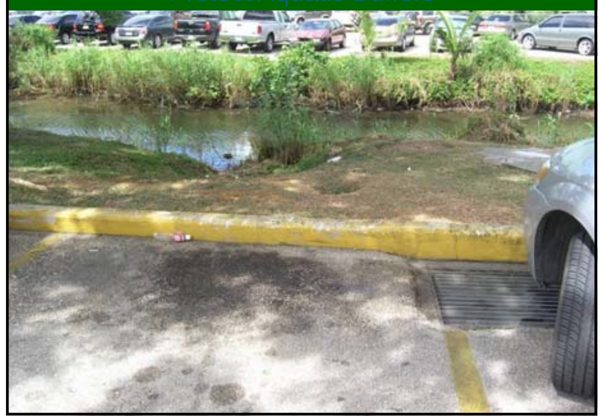
#2 Development Codes & Site Design

- Minimize impervious cover & site distrubance
- Compact development, open space, skinny streets
- Buffers/setbacks from coastline, wetlands, waterways, drinking water source areas

Waterway Buffers

Criteria for the protection, restoration, creation, or reforestation of stream, wetland, coastal, and other waterway buffers

Protect Aquatic Buffers



#3 Construction Site Stormwater (Erosion & Sediment Control)

- Erosion & Sediment Control standards and regulations
- Design tools, review checklists
- Authority to inspect/enforce
- (Adequate staff)
- Training

We will discuss further on Wednesday Session H

#4 Post-Construction Stormwater Management

- Post-Construction stormwater standards and regulations
- Authority to review plans, inspect, enforce
- Application to public works & transportation projects
- Allow/authorize low-impact development & innovative practices
- (Adequate staff)

We will discuss further on Wednesday Session I

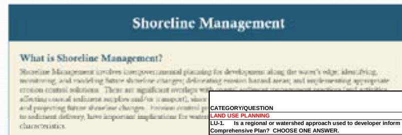
#5 Pollution Sources

Evaluate operations and maintenance programs for locating, quantifying, and controlling non-stormwater pollutant sources in the watershed

- Septic Systems
- Sanitary Sewer Overflows
- Industrial Discharges
- Confined Animal Feeding Lots
- Illicit Discharges
- Marinas

Program Strengths & Gaps

Coastal Community Watershed Management Checklist



CATEGORY/QUESTION	Points for each Question	Total Possible Points	Your Score
LAND USE PLANNING			
LU-1. Is a regional or watershed approach used to developer inform your local Comprehensive Plan? CHOOSE ONE ANSWER.			
A. The Plan was developed in cooperation with neighboring localities to provide a regional/watershed approach to multi-jurisdiction issues such as drinking water supply, nonpoint source pollution, shoreline management, and wetland/dune systems.	3		
B. No regional or watershed scale approaches are used.	0	3	
LU-2. Does your community have an inventory of natural resources? [e.g., wetlands (including isolated wetlands), floodplains, contiguous forests, intermittent and perennial streams, steep slopes, prime soils, etc.]. MARK ALL THAT APPLY.			
A. A natural resources inventory is created and used to direct development away from the most critical resources.	2		
B. A natural resources inventory is created but not necessarily used to direct development away from the most critical resources.	1		
C. The local codes contain performance standards to ensure that development proximate to natural resources is done in an environmentally-sensitive manner including mitigation of disturbances. Performance standards are incorporated into overlay zones, zoning districts, open space requirements, or other local standards.	2		
D. The community has voluntary or incentive programs for natural resource protection, such a purchase or transfer of development rights, land acquisition or easement programs, cost-share programs, or other means.	1		
E. A natural resource inventory is not developed.	0	5	

Coastal Community Watershed Management Checklist

- Land Use Planning
- Hazard Mitigation Planning
- Pollution Sources
- Shoreline Management
- Site Design
- Stormwater Management
- http://www.cwp.org/component/content/article/39/160-coastal-checklist.html

Session E: Watershed Assessment Field Trip

2011 Pacific Island Watershed Institute

Description: Practice various field assessment techniques used to identify watershed restoration and protection opportunities such as stream assessments, stormwater retrofitting, and pollution prevention surveys. We'll also visit a nearby stream restoration site.

Agenda:

8:00	Meet at He'eia State Park
8:45-11:00	Assessments at Windward Mall
11:00-12:30	Stream Restoration and Neighborhood Assessments
12:30	Return to He'eia

Driving Directions:

From He'eia State Park to Windward Mall (8:15 am)

- Take a LEFT out of Park entrance, onto Kamehameha Hwy
- Go 1.5 miles and turn RIGHT onto Haiku Rd.
- Take first LEFT onto Alaloa St.
- Take first LEFT into mall parking lot & park close to cemetery.

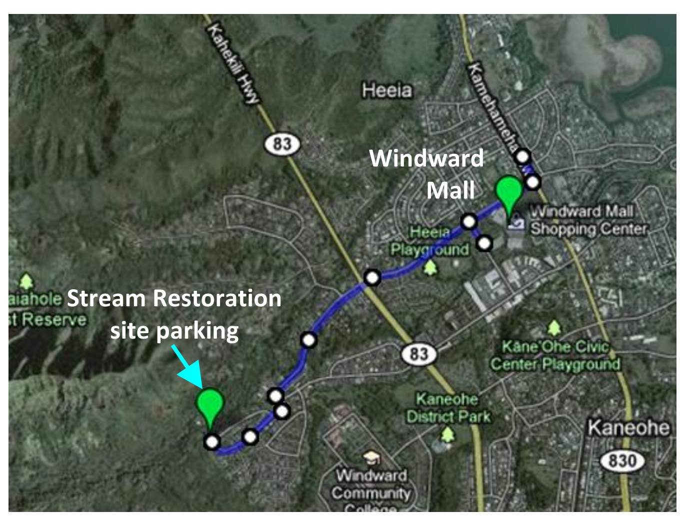
From Windward Mall to Stream Restoration site (11:00am)

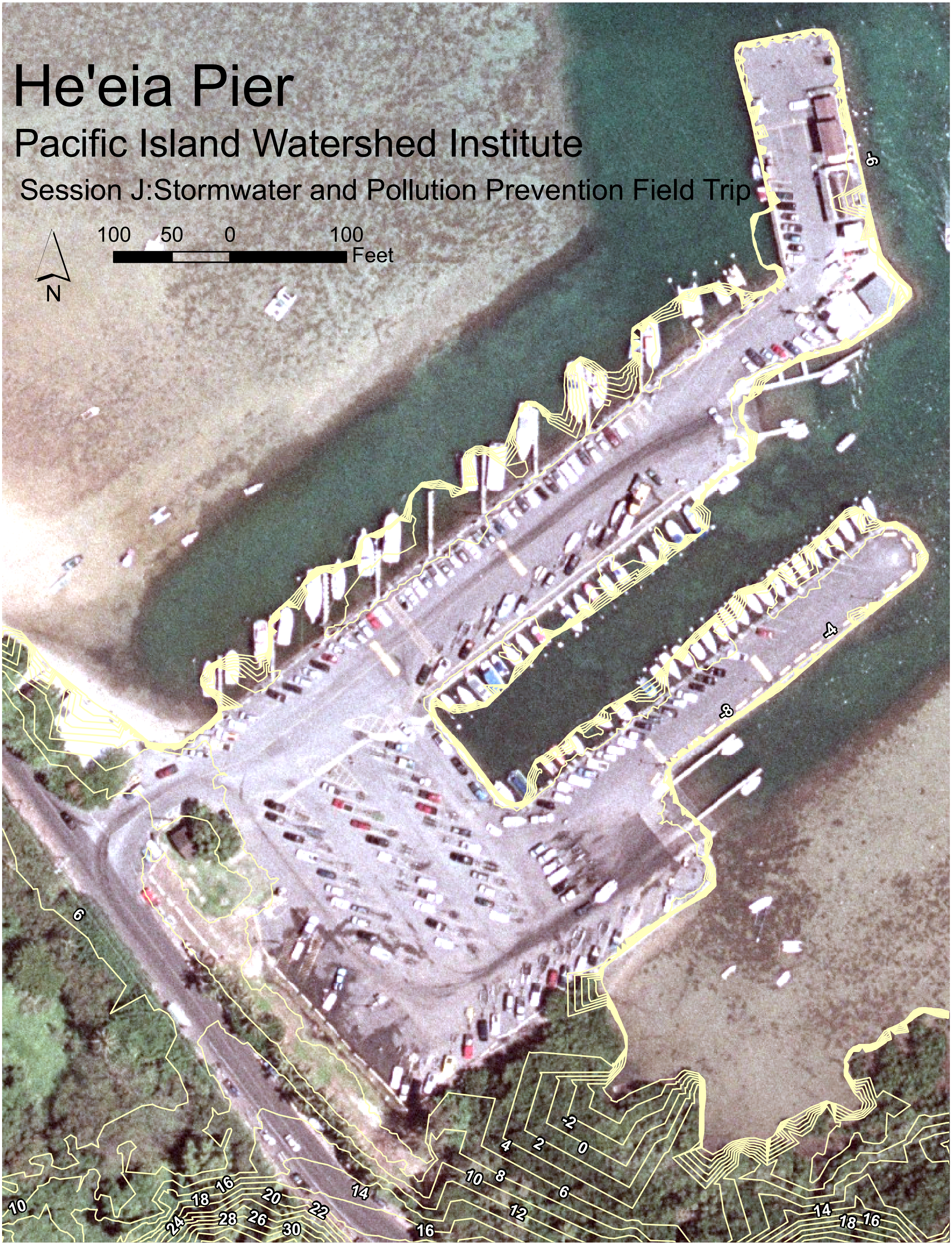
- Take RIGHT out of parking lot, onto Alaloa St.
- At first intersection, take LEFT onto Haiku Rd.
- Go 0.9 miles and follow road as it veers to the left.
- Take a RIGHT onto Kuneki St.
- At a "T" in the road turn right.
- Park in grassy area on your left or continue down paved road to next parking area.

From Stream Restoration site back to He'eia State Park (12:30)

- Take LEFT out of parking lot, onto Kuneki St.
- Turn Left on Kahuhipa, right on to Haiku Rd.
- Go 1.2 miles (pass the Windward Mall)and take LEFT onto Kamehameha Hwy (Rt. 830)
- Go 1.5 miles and turn RIGHT into He'eia State Park entrance.

Notes:




He'eia Pier
Pacific Island Watershed Institute
Session J:Stormwater and Pollution Prevention Field Trip
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Watershed Assessment Resources

Stormwater Retrofitting

*Urban Subwatershed Restoration Manual No. 3: Urban Stormwater Retrofit Practices (Version 1.0). Published by Center for Watershed Protection. http://www.cwp.org/categoryblog/92-urban-subwatershed-restoration-manual-series.html#Manual%203

CWP You-Tube video on Stormwater Retrofitting Reconnaissance (Part 1): http://www.youtube.com/watch?v=tHvuzReiDHQ

CWP You-Tube video on Stormwater Retrofitting Reconnaissance (Part 2): http://www.youtube.com/watch?v=Q-9j2RgLW3I&feature=related

CWP You-Tube video on Stormwater Retrofitting Reconnaissance (Part 3): http://www.youtube.com/watch?v=vmjyskDxzuU&feature=related

Stream Assessments

Hawaii Stream Visual Assessment Protocol (Version 1.0). Available from Natural Resources Conservation Service. http://www.nrcs.usda.gov/technical/ECS/aquatic/svapfnl.pdf

*Unified Stream Assessment: A User's Manual (Version 2.0). Center for Watershed Protection. http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series/87-manual-10-unified-stream-assessment-a-users-manual-.html

Rapid Watershed Assessments in Pacific Islands Area. Natural Resources Conservation Service. http://www.pia.nrcs.usda.gov/technical/rwa.html

Neighborhood/Residential Assessments

*Unified Subwatershed and Site Reconnaissance: A User's Manual (Version 2.0) – *Chapter 3*. Center for Watershed Protection. http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series/88-manual-11-unified-subwatershed-and-site-reconnaissance-a-users-manual.html

Hotspots Assessments

*Unified Subwatershed and Site Reconnaissance: A User's Manual (Version 2.0) – *Chapter 4*. Center for Watershed Protection. http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series/88-manual-11-unified-subwatershed-and-site-reconnaissance-a-users-manual.html

* Pollution Source Control Practices (Version 2.0). Center for Watershed Protection. http://www.cwp.org/documents/cat_view/68-urban-subwatershed-restoration-manual-series.html

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WATERSHED:	DATE: ___/___/_____	SITE ID:

A. SITE DATA AND BASIC CLASSIFICATION

Site Name/Contact: ______________________________ ______________________________

Category: ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Golf Course ☐ Transport-Related ☐ Marina ☐ Animal Facility

Basic Description of Operation: ____

SIC code (if available): ___________

NPDES permit? ☐ Y ☐ N ☐ Can't Tell

	INDEX*
B. VEHICLE OPERATIONS ☐ **N/A** *(Skip to part C)*	**Observed Pollution?** ☐
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: ____________	
B2. Approximate number of vehicles: _______	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☐ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☐ Y ☐ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☐ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○
C. OUTDOOR MATERIALS ☐ **N/A** *(Skip to part D)*	**Observed Pollution?** ☐
C1. Are loading/unloading operations present? ☐ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: _______ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○
D. WASTE MANAGEMENT ☐ **N/A** *(Skip to part E)*	**Observed Pollution?** ☐
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○
E. PHYSICAL PLANT ☐ **N/A** *(Skip to part F)*	**Observed Pollution?** ☐
E1. Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○○
E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	○
E4. Evidence of poor cleaning practices for construction (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○

*Index (optional). Fill circles if potential pollutant source, check box if pollutant observed

F. TURF/LANDSCAPING AREAS ☐ **N/A** *(skip to part G)*	**Observed Pollution?** ☐
F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____%	○
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants shed organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	○
F6. Is there an adequate vegetated buffer between site and adjacent resource areas? ☐ Y ☐ N ☐ NA	○
G. STORM WATER INFRASTRUCTURE ☐ **N/A** *(skip to part H)*	**Observed Pollution?** ☐
G1. Are storm water treatment practices present? ☐ Y ☐ N ☐ Unknown If yes, please describe: _________________	○
If so, are they infiltrating untreated stormwater? ☐ Y ☐ N ☐ Unknown	○
G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Curb/Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS

Index Alternative: Potential pollutants associated with:	**Pollutant of concern?**
☐ Vehicular operations (fueling, storage, maintenance)	☐Limited ☐Likely ☐Observed for **sediment loading**
☐ Waste management (dumping)	☐Limited ☐Likely ☐Observed for **oil/grease**
☐ Outdoor material storage (uncovered, leaking, no 2nd containment)	☐Limited ☐Likely ☐Observed for **trash**
☐ Landscaping (over fertilizing, irrigation)	☐Limited ☐Likely ☐Observed for **nutrient loading**
☐ Building/parking lot maintenance (washdowns)	☐Limited ☐Likely ☐Observed for **bacteria**
☐ Other:	☐Limited ☐Likely ☐Observed for **other:**

INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)

☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

I. RECOMMENDED ACTION

Follow-up Action:	**Severity of Problem:** ☐Low ☐Medium ☐High
☐ Refer for immediate enforcement	*Describe Conditions:*
☐ Suggest follow-up on-site inspection or review of SWPPP	
☐ Test for illicit discharge	
☐ Include in future education effort	
☐ Catchbasin cleaning or street sweeping	
☐ Relocate dumpsters	
☐ Provide secondary containment	
☐ On-site retrofit	
☐ Install spill response measures	
☐ Other:	

Notes:

*Index (optional). Fill circles if potential pollutant source, check box if pollutant observed

Site Name/ID: ______________________________ Watershed: ________________________

Date: ______________________________________ Assessed by: _____________________________

EXISTING CONDITIONS

Homeowners Association? ☐ No ☐ Yes ☐ Unknown If yes, name and contact information:

Main Road Names:

Approximate Neighborhood Area (acres) _______ # of lots ___________ (# or % undeveloped ___________)

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts., Condos)
☐ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Other

Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of existing units ☐ 5-10% ☐ >10%

Waste water Management? ☐ Public sewer ☐ On-site septic ☐ Small package plant
Problems observed with septic systems? ☐ No ☐ Yes (describe):

AVERAGE ROAD CONDITION

Pavement: Type ☐ All Paved ☐ mixed, mostly paved ☐ mixed, mostly unpaved ☐ all unpaved

Condition ☐ Good/mostly good (new, few areas requiring regrading or maintenance)
☐ Some road sections need attention (minor erosion, pavement repair needed, limited)
☐ Significant maintenance issues (most of road network in bad shape)

Drainage: Type ☐ Curb/gutter ☐ Mixed, mostly curbed ☐ Mixed, mostly open section ☐ Open drainage

Drain Inlets/Catch basins: ☐ None ☐ Clean ☐ Blocked ☐ Other:
Waterbars/dips/crossdrains: ☐ None ☐ Functioning ☐ Need maintenance ☐ Other:
Ditches: ☐ None ☐ Shallow ☐ Well-defined ☐ Stable ☐ Eroded ☐ Full of thick vegetation ☐ Other:
Discharge locations: ☐ Stable ☐ Some erosion ☐ Eroded ☐ Other:

Existing Stormwater BMPs on site? ☐ Unknown ☐No ☐ Yes, describe:

Average Lot Cover: _____%bare _____% turf _____%landscape (include trees) _____% rooftop ____%driveway

Average Driveway: ☐ Impervious ☐Pervious ☐ Eroded ☐ Drain to road ☐ Too variable

Evidence of rooftop or driveway runoff to road/drainage network?: ☐No ☐ Yes, describe:

Evidence of residential encroachment on riparian/wetland buffer? ☐No ☐ Yes, describe:

Average Lawn: ☐ highly maintained ☐moderate ☐ low maintenance

Evidence of Residential Pollution?
☐Limited ☐ Likely ☐ Observed for **sediment loading**
☐Limited ☐ Likely ☐ Observed for **oil/grease**
☐Limited ☐ Likely ☐ Observed for **trash and yard waste**
☐Limited ☐ Likely ☐ Observed for **nutrient loading**
☐Limited ☐ Likely ☐ Observed for **bacteria**
☐Limited ☐ Likely ☐ Observed for **other:**

Severity: ☐ Low ☐ Medium ☐ High

Describe source:

PROPOSED RESTORATION ACTIVITIES

Neighborhood-wide Actions:
☐ On-site retrofit potential individual lots?
☐ Street ROW retrofit
☐ Existing BMP retrofit

☐ Better lawn/landscaping practices?
☐ Buffer management
☐ Household hazardous waste
☐ Septic improvements

☐ Drainage infrastructure maintenance
☐ Road maintenance/repair
☐ Other action(s):

☐ SITE AERIAL INCLUDED

Narrative description/ Sketch:

SCORING SHEET FOR THE ELEMENTS

1. TURBIDITY (indicator of present erosion)

Condition	Score
Very clear; objects visible at depth to the bottom.	2.0 - 1.5
Moderately turbid	1. 0 – 0.5
Very turbid	0

2. PLANT GROWTH (indicator of eutrophication)

Condition	Score
Water clear with no significant algal scum or microalgae; rocks may be slimy but algae not obvious	2.0 - 1.5
Large clumps of macroalgae present, or distinctive green/brown scums visible on bottom or sides of stream	1. 0 – 0.5
Water distinctly green or pea green; or channel choked with grasses	0

3. CHANNEL CONDITION

Condition	Score
Natural Channel	2.0 – 1.8
Channelized by humans but natural walls and bottom	1.7 – 1.2
Walls Hardened (e.g. concrete, riprap)	1.1 – 0.6
Walls and Bottom Hardened	0.5 – 0

4. CHANNEL FLOW ALTERATION

Condition	Score
No withdrawals, diversions, or stormwater/ag water discharge entering segment.	2.0 – 1.8
Temporary, Intermittent withdrawals occurring within segment.	1.7 – 1.2
Permanent, Intermittent withdrawals or stormflow inputs (e.g. culverts occurring within segment.	1.1 – 0.6
Temporary, Constant withdrawals occurring within segment.	0.5 – 0.2
Permanent, Constant withdrawals occurring within segment.	0 – 0.2

5. PERCENT EMBEDDEDNESS

Condition	Score
< 10%	2.0
11 – 25 %	1.5 – 1.0
26 – 50 %	0.9 – 0.5
50 – 75 %	0.4 – 0.2
Completely sedimented in (includes hardpan sedimentation)	0

6. BANK STABILITY (total, both sides)

Condition	Score
> 90% Stable (not bare or erodable)	2.0
75 to 89% Stable (not bare or erodable	1.5 – 1.9
50 to 74% Stable (not bare or erodable)	1.4 – 1.0
25 to 50% Stable (not bare or erodable)	0.9 – 0.1
<25% Stable (not bare or erodable)	0

7. CANOPY / SHADE

Condition	Score
Mixed canopy, 20 - 80% cover	2.0 - 1.6
Closed but mixed canopy, >80% cover	1. 5 – 1.0
Closed monotypic canopy >80% cover	0.9 – 0.5
Open canopy, 0- 19% cover	0

8. RIPARIAN CONDITION

Condition	Score
Riparian area same width as floodplain, diverse vegetation, or stream is naturally incised, stable banks. Undisturbed.	2.0 – 1.8
Riparian area width at least two channel widths wide, diverse vegetation, or stream is naturally incised. Minimal Degradation	1.7 – 1.0
Riparian area width at least one channel width wide, or stream is naturally incised, riparian area is somewhat degraded. Regularly grazed, cropped or other disturbance.	0.9 – 0.5
Severely degraded riparian area, less than one channel width wide.	0.4 – 0.2
Little to no riparian vegetation, dirt-lined or fully channelized and lined.	0

9. HABITAT AVAILABLE FOR NATIVE SPECIES

Condition	Score
5 habitat types available	2.0
4 habitat types available	1.9 – 1.8
3 habitat types available	1.7 – 1.0
2 habitat types available	0.5 – 0.2
1 habitat type available	0

***Habitat types**: (1) seeps/springs (2) pools (3) runs (4) riffles (5) cascades*

10. LITTER/TRASH (indicator of urban/human influence)

Condition	Score
No litter or trash is present.	2.0 - 1.8
Litter or trash is evident but not prominent.	1. 0 – 0.5
Abundant trash, unsanitary wastes, eg. animal carcass or excrement, diapers, or many dead fish.	0

SCORING DATA SHEET

Date		*Time*		*Weather*	
Stream Name		*Reach ID*			
	Segment #1	*Segment #2*	*Segment #3*	*Segment #4*	*Segment #5*
Stream Type					
Segment Length (ft or m)					
Temperature					
Elevation					
Substrate	*1 2 3 4 %*	*1 2 3 4 %*	*1 2 3 4 %*	*1 2 3 4 %*	*1 2 3 4 %*
Silt/clay					
Sand					
Gravel					
Cobble					
Rock					
Boulder					
Bedrock or Concrete					
Embeddedness %					
Bank Vegetation % - looking downstream, left bank / right bank					
Trees					
Shrubs					
Herbaceous					
Leaf Litter					
None (bare)					
Avg % canopy/shade					
Avg Width					
Velocity and Depth					
Flow Status:	*high/normal/low*	*high/normal/low*	*high/normal/low*	*high/normal/low*	*high/normal/low*
Flow (cfs) or (cms)					
Sketch Channel cross-section, include low, normal, and high flow lines and existing water level					
Score Each Element - Use "Scoring Sheet for the Elements" Guidance					
1. Turbidity					
2. Plant Growth					
3. Channel Condition					
4. Channel Flow Alteration					
5. Percent Embeddedness					
6. Bank Stability					
7. Canopy					
8. Riparian Condition					
9. Habitat Available					
10. Litter/Trash					
Total score					
Total score / # of elements					
Rating of Average					
1.8 - 2.0 Very High					
1.5 - 1.7 High					
1.1 - 1.4 Medium					
0 - 1.0 Low					

***Notes**: ie. wildlife sightings, vegetation species, etc.*

Reach ID: ___________________ **Watershed:** _______________ **Date:** ____________________________

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☐ Clear ☐Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☐ some ☐ lots
Floating: ☐ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM
(Evidence of)
☐ Fish ☐ Beaver ☐ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank ____________(ft)
RT bank ____________(ft)
Width: Bottom ____________(ft)
Top ____________(ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair**: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.

5 4 3 2 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Excerpt from CWP Unified Stream Assessment

Site ID:

OUTFALLS AND POTENTIAL ILLICIT DISCHARGES

LOCATION: ☐ LT ☐ RT ☐ both ☐ in-stream ☐ floodplain

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter:______(in)

SUBMERGED: ☐ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ______(in) Width (Top):______(in) " (Bottom):______(in)

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ None ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION: ☐ None ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ Storm water retrofit ☐ Other:

Description:

OUTFALL SEVERITY: *(circle #)*

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5 4	3 2	1

SKETCH/NOTES: **REPORTED TO AUTHORITIES:** ☐ YES ☐ NO

TRASH AND DUMPING

TYPE: ☐ Industrial ☐ Commercial ☐ Residential

MATERIAL: ☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☐ Other:

SOURCE: ☐ Unknown ☐ Flooding ☐ Illegal dump ☐ Local outfall

LOCATION: ☐ Stream ☐ Riparian Area ☐ Lt bank ☐ Rt bank

LAND OWNERSHIP: ☐ Public ☐ Unknown ☐ Private

AMOUNT (*# Pickup truck loads*):

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping ☐ no ☐ Other:

If yes for trash or debris removal

EQUIPMENT NEEDED : ☐ Heavy equipment ☐ Trash bags ☐ Unknown

WHO CAN DO IT: ☐ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other

DUMPSTER WITHIN 100 FT: ☐ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)

A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
5	4 3	2 1

SKETCH/NOTES: **REPORTED TO AUTHORITIES:** ☐ YES ☐ NO

SITE ID

BANK EROSION

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition

☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both *(looking downstream)*

LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length *(if no GPS)* LT_______ft and/or RT_________ft

Bank Ht LT_______ft and/or RT__________ft

Bank Angle LT________° and/or RT________°

Bottom width _______ft

Top width __________ft

Wetted Width _______ft

LAND OWNERSHIP: ☐ Private ☐ Public ☐ Unknown

LAND COVER: ☐ Forest ☐ Field/Ag ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ No ☐ Grade control ☐ Bank stabilization ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access**: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

IMPACTED BUFFER

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: *(Facing downstream)*	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐ :
RT Bank	☐	☐	☐	☐	☐ :

DOMINANT LAND COVER:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐Active reforestation ☐Greenway design ☐ Natural regeneration

☐ no ☐ Invasives removal ☐ Other:

RESTORABLE AREA:

	LT BANK	RT
Length (ft):	_________	_________
Width (ft):	_________	_________

REFORESTATION POTENTIAL: (*Circle #*)	Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
	5 4	3 2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

Site ID:

CULVERTS/STREAM CROSSING

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ RCP ☐ CMP ☐ HDPE ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: _________(ft)
Height: _________(ft)
Culvert length: _________(ft)
Width: _________(ft)
Roadway elevation:_________(ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Failing embankment
☐ Sediment deposition ☐ Downstream scour hole
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight ($2^o - 5^0$) ☐ Obvious ($>5^o$)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Culvert Maintenance ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier
EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown
CAUSE:
☐ Drop too high ☐ Flow too shallow ☐ Other:
Water Drop: ______ (in) Water Depth:______ (in)

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls
5 4	3 2	1

CHANNEL MODIFICATION *(if applicable)*

TYPE: ☐ Channelization ☐ Bank armoring ☐ concrete channel ☐ Floodplain encroachment ☐ Other:

MATERIAL: ☐ Concrete ☐ Gabion ☐ Rip Rap ☐ Earthen ☐ Metal ☐ Other:

Does channel have perennial flow?	☐ Yes	☐ No
Is there evidence of sediment deposition?	☐ Yes	☐ No
Is vegetation growing in channel?	☐ Yes	☐ No
Is channel connected to floodplain?	☐ Yes	☐ No

DIMENSIONS:
Height _____________(ft)
Bottom Width _____________(ft)
Top Width: _____________(ft)
Length: _____________(ft)

BASE FLOW CHANNEL
Depth of flow _____________(in)
Defined low flow channel? ☐ Yes ☐ No
% of channel bottom __________%

ADJACENT STREAM CORRIDOR
Available width: LT________(ft) RT________(ft)
Utilities Present? ☐ Yes ☐ No
Fill in floodplain? ☐ Yes ☐ No

POTENTIAL RESTORATION CANDIDATE ☐ Structural repair ☐ Base flow channel creation ☐ Natural channel design
☐ no ☐ De-channelization ☐ Fish barrier removal ☐ Bioengineering ☐ Can't tell

CHANNEL-IZATION SEVERITY: (*Circle #*)	A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel.	A moderate length (> 200') ,but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.	An earthen channel less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3	2 1

NOTES: Reported ☐ **Yes** ☐ **No**

Session F: Tropical Roundtables

2011 Pacific Island Watershed Institute

Description: There are six topics that were selected from the initial PIWI survey. Each participant will select two of the following roundtables to attend during the two-hour session:

Topic #1: Rural & Agricultural Watershed Management Issues

Agricultural watersheds frequently show elevated sediment and nutrient loads, despite a suite of technical assistance and financial incentives from local, state/territorial and federal sources that encourage implementation of best management practices (BMPs). Join us to discuss some of the barriers and identify ways to increase adoption of BMPs.

Facilitators: Carolyn Stewart (MCS International), Jean Brokish (Oahu RC&D)
Assistant: Rob Ferguson

Topic #2: Pollution Tracking & Monitoring of Groundwater & Surface Water

Identifying problem pollutants with regard to land based sources, monitoring to characterize the problem, and tips for remediating pollutant sources. This may have relevance for TMDLs and pollutants that impact near-shore environments and reefs.

Facilitators: Robin Knox (Water Quality Consulting, Inc.), Dwayne Minton (The Nature Conservancy)
Assistant: Kathy Chaston

Topic #3: Climate Change & Islands

Big Topic – how climate change is expected to affect islands and adaptation strategies that are taking place, and how this may affect watershed planning efforts and drainage infrastructure.

Facilitators: Victoria Keener (Pacific RISA), Melissa Finucane (Pacific RISA)
Assistant: David Hirschman

Topic #4: Groundwater Protection

How groundwater "works" on islands in coral (limestone) and volcanic settings, drinking water aquifers vulnerability, and strategies to protect groundwater supplies from contamination from land-based activitities. Guam's Northern Aquifer as a case study.

Facilitators: Esther Taitague (Guam Coastal Management Program)
Assistant: Anne Kitchell

Topic #5: Small-Scale & On-Site Wastewater

Issues with the design, siting, and maintenance of small-scale wastewater systems. Ideas for remedies and new design strategies to enhance treatment.

Facilitators: Hudson Slay (EPA), Rich Claytor (Horsley Witten)

Topic #6: Land Conservation

Targeting, acquiring, and managing priority lands for conservation with focus on coral health. Strategies for working with landowners, fundraising, long-term management, etc.

Facilitators: Butch Haase (Molokai Land Trust), Umiich Sengebau (The Nature Conservancy)
Assistant: Michelle West

Topic #1: Rural and Agricultural Watershed Management Issues

General Description of Topic:
Despite numerous resources available to farmers and land managers in rural and agricultural watersheds to adopt appropriate best management practices (BMPs), problems like soil erosion from row crop agriculture, overgrazing, and poor animal waste management persist and, ultimately, contribute to land based stormwater pollution.

Responsibility for mitigating potential problems from agricultural lands is divided among a variety of agencies at the local, state / territorial and federal levels. Confusion surrounding which rules apply and which agencies can assist often hinders BMP implementation.

Additional potential barriers to widespread implementation of BMPs include: lack of landowner understanding of regulatory and non-regulatory processes; inadequate financial incentives; lease and land tenure structures that prohibit access to financial incentive programs; limited capacity to develop conservation plans and watershed plans for agricultural watersheds; inadequate water quality and pollutant load data; complex application and program management processes; complicated evaluation and monitoring requirements; and likely many more.

Increasing the adoption of BMPs requires successfully indentifying the responsible parties and getting a better understanding of the challenges and requirements. Only then, can specific suggestions and improvements be made. What do you see as the primary challenges and top priorities for improvement, and how would you go about it?

A Few Good Resources (see also general resources provided with workshop materials):

- Department of Health, Clean Water Branch documents: http://hawaii.gov/health/environmental/water/cleanwater/prc/index.html
- Guidelines for Livestock Waste Management: http://hawaii.gov/wastewater/forms.html
- Hawaiʻi Coastal Nonpoint Pollution Control Program documents: http://hawaii.gov/dbedt/czm/initiative/nonpoint.php
- NRCS Pacific Islands Area Field Office Technical Guide: http://www.pia.nrcs.usda.gov/technical/
- University of Hawaiʻi Cooperative Extension Service: http://www.ctahr.hawaii.edu/site/Extprograms.aspx

Contact Information for Session Facilitators:
Jean Brokish, Oahu Resource Conservation & Development Council. jean.brokish@oahurcd.org
Carolyn Stewart, MCS International. mcstewart@hawaii.rr.com
Rob Ferguson, NOAA. rob.ferguson@noaa.gov

Notes:

Topic #2: Land-based Sources of Pollution -- Identifying and Monitoring Pollution in Ground & Surface Waters

Land-based pollutants, such as sediments, nutrients, and contaminants are among the leading threats to coral reef ecosystems across the globe. It's estimated that up to 22 percent of the world's coral reefs are under medium to high threat from soil erosion and land-based pollution and as high as 50 percent are threatened in countries with wide-scale land clearing. Impacts to coral reefs include: direct and indirect coral mortality, decreased growth rates and reproduction, shifts in species composition, increased incidence of disease, loss of habitat for settlement of coral recruits.

Land-based pollutants differ from watershed to watershed depending upon historic and present-day land use practices. Identifying pollutants of concern and determining appropriate levels of these pollutants in ground and surface waters present significant challenges to local resource managers, but are critical to developing and implementing effective management actions and monitoring strategies.

This session will focus primarily on an inquiry-based process for identifying pollutants of concern and their land-based sources. This approach will touch on important considerations, including: identifying the intended use of the water and addressing both human and ecological health. As appropriate, this session will also address approaches to watershed planning, identification of pollutant sources, assessments of pollutant impacts on ecosystem functions and services, and development of monitoring strategies for pollutants and impacted resources.

A Few Resources About Pollution Tracking and Monitoring on Pacific Islands

- Golbuu, Y., E. Wolanski, P. Harrison, R. H. Richmond, S. Victor, and K. E. Fabricius. 2011. Effects of Land-Use Change on Characteristics and Dynamics of Watershed Discharges in Babeldaob, Palau, Micronesia. Journal of Marine Biology, vol. 2011, 17 pp.
- Houk, P., G. DiDonato, J. Iquel, and R. Van Woesik. 2005. Assessing the effects of non-point source pollution on American Samoa's Coral Reef Communities Environmental Monitoring and Assessment 107: 11–27.
- ISRS. 2004. The effects of terrestrial runoff of sediments, nutrients and other pollutants on coral reefs. Briefing Paper 3, International Society for Reef Studies. 18 pp.
- Storlazzi, C. D. M. E. Field and M. H. Bothner. 2011. The use (and misuse) of sediment traps in coral reef environments: theory, observations, and suggested protocols. Coral Reefs 30: 23-38.
- Dailer, M. l., Smith, J. E., Knox, R. S., Napier, M., & Smith, C. M. (2010). Using δ15N values in algal tissue to map locations and potential sources of anthropogenic nutrient inputs on the island of Maui, Hawaii. *Marine Pollution Bulletin , 60*, 655-671.

Contact Information for Session Facilitators:

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wqcinc@hawaii.rr.com
Dwayne Minton. The Nature Conservancy, 923 Nu'uanu Ave., Honolulu, Hawaii 9817. 808-587-6272.
dminton@tnc.org
Kathy Chaston, NOAA Coral Reef Conservation Program at Pacific Services Center: kathy.chaston@noaa.gov

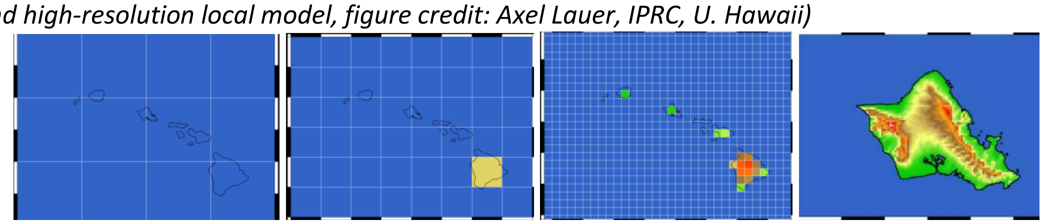
Notes:

Topic #3: Climate Change & Islands

General Description of Topic:
Climate variability (seasonal to decadal timescales) and change (multi-decadal and greater timescales) pose unique challenges for small islands. Island vulnerability stems from limited size, proneness to natural hazards including sea level rise, physical isolation, low adaptive capacity for some, and high adaptation costs relative to gross domestic product. Climate-related disasters can have domino effects causing one vulnerable sector to influence others. During the better part of the last century, air and ocean surface temperatures in the Pacific region have warmed by about 1.0°C (0.9°F) since 1910. Trends in extreme temperature across the South Pacific for 1961-2003 show increases in the annual number of hot days and nights, with decreases in the annual number of cool days and nights, particularly in the years following an El Niño. Annual rainfall amount in the next century is predicted to be only slightly different, however, the timing and amounts are expected to change, with trends towards more frequent heavy/extreme precipitation events. In the tropical South Pacific, small islands to the east of the dateline are highly likely to receive a higher number of tropical storms during an El Niño. Observed tropical cyclone activity in the South Pacific east of 160°E indicates an increase in level of activity associated with El Niño events. Sea level rise is occurring in a spatially diverse way throughout the Pacific, while the maximum observed rate of rise has been in the central and eastern Pacific, spreading north and south around the sub-tropical gyres of the Pacific Ocean near 90°E, mostly between 2 and 2.5 mm/yr but peaking at over 3 mm/yr.

Issues to Consider:

- The process of creating local future climate scenarios from Global Circulation Models (GCMs) is called **downscaling**. The figures below show maps of Hawaii in different climate model resolution grids. *(L to R: Hawaii in an AR-4, AR-5, regional, and high-resolution local model, figure credit: Axel Lauer, IPRC, U. Hawaii)*



- While downscaled predictions would assist with adaptation, it is difficult to create accurate downscaled climate projections for each island, as they are comparatively small, topographically diverse, and environmentally unique.
- Socio-economic contributors to island vulnerability include external pressures such as trade and globalization, financial crises, international conflicts, rising external debt, rapid population growth, incidence of poverty, political instability, unemployment, reduced social cohesion, and a widening gap between poor and rich.
- Fresh water is critical for islands. When supplies are affected by climatic events, food security, livelihoods, & public health are threatened. Aquifers are fragile and can be threatened by increasing demand & salt-water intrusion.
- How certain do predictions need to be before one takes concrete adaptation measures to protect a community?

Links and Resources for Climate Change & Pacific Islands

- The International Pacific Research Center, a source for academic climate research and *data: http://iprc.soest.hawaii.edu/*
- Pacific ENSO Applications Center (PEAC), a NOAA/NWS resource that provides current conditions and forecasts of the El-Nino/Southern Oscillation (ENSO) phenomena for stakeholders on the USAPI: *http://www.prh.noaa.gov/peac/*
- Pacific Climate Information System (PaCIS), an international region-wide "network of networks", providing a comprehensive snapshot of current climate research, assessment, and outreach activities: *http://noaaclimatepacis.org/#dataServices/noaaPartners*
- Kailua Beach & Dune Management Plan: a pilot-project on Oahu that takes sea-level-rise directly into account when considering beach management options for the present and future: *http://seagrant.soest.hawaii.edu/sites/seagrant.soest.hawaii.edu/files /publications/kailua_beach_mgmt_plan.pdf*

Contact Information for Session Facilitators

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Dr. Victoria Keener, East-West Center, Honolulu, Hawaii; Office: 808.944.7220; KeenerV@EastWestCenter.org; Website: http://www.PacificRISA.org

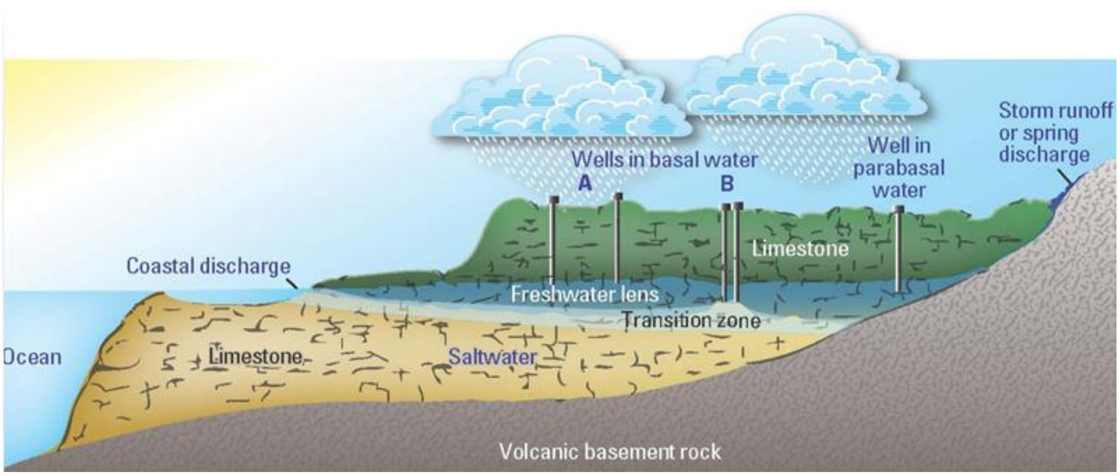
Topic #4: Groundwater Protection

Protecting groundwater resources from alterations in recharge caused specifically by watershed land use activities can be critical for islands where freshwater aquifers are a significant source of drinking water. Changes in water withdrawal rates and stormwater infiltration patterns can influence the quality and quantity of groundwater supplies, and there are a number of regulatory and technical approaches to minimize these impacts.

The U.S. territory of Guam is the southernmost island in the Mariana Archipelago and the largest island in Micronesia. With a population of about 178,000 people, the 214-square mile island is the most populated landmass in this part of the Pacific, and will undergo additional population increases as the Department of Defense prepares to move thousands of military personnel, their dependents and associated support staff to the island. This massive relocation project poses extraordinary challenges for natural resource management, particularly with respect to drinking water production and wastewater management.

Guam's southern half is volcanic, while the northern portion of the island is primarily uplifted limestone. The Northern Guam Lens Aquifer supplies about 80%of the island's drinking water, providing about 40 million gallons of water daily. Previous estimates of the aquifer's maximum sustainable yield estimated that about 57 million gallons of water could be safely drawn from the aquifer daily, but a new study to estimate MSY is underway to account for changing recharge rates, contamination issues, climate change and other factors. Through the years, some wells have shown increased chloride rates as the saltwater underlying the aquifer's freshwater layer is drawn upward through aggressive pumping, while others have shown chemical levels exceeding federal standards.

The high permeability of the limestone allows rapid infiltration of rainfall, so surface runoff occurs locally after intense rain. The limestone also offers little resistance to groundwater flow so the freshwater layer may be thin, and water levels can vary by several feet on a daily and seasonal basis. The nature of the lens makes it susceptible to a number of contaminants, which may come from sources including farms, underground storage tanks, dump sites, septic systems and cess pools, sewer lines, stormwater and a variety of other sources. As the majority of Guam's population lives over the aquifer, management of this critical resource can be a delicate balancing act.



Contact Information for Session Facilitators
Esther Marie G. Taitague, Guam Coastal Management Program, esther.taitague@bsp.guam.gov

A Few Good Resources About Groundwater on Guam
University of Guam, Water and Environmental Research Institute (WERI) www.weriguam.org
U.S. Geological Survey (USGS) http://pubs.usgs.gov/fs/2010/3084/fs2010-3084.pdf

Topic #5: Small-Scale & On-Site Wastewater

Potential wastewater impacts are often a critical component of watershed management and pose many questions. Do wastewater systems in my watershed pose risks to drinking water sources, recreational waters, aquatic ecosystems? How would I know? What types of wastewater treatment and disposal systems are used? Are these technologies effective? How well are these systems operated and maintained? Join us to discuss these issues and find out how your colleagues are addressing wastewater issues.

While centralized wastewater systems are used in urbanized areas of our islands, a considerable amount of wastewater is treated/disposed with small-scale or onsite systems. Islands present unique wastewater management issues due to limited developable land, the high cost of land, the need to conserve water, and wastewater impacts on drinking water and aquatic resources. While there are opportunities to utilize new technology for new systems and retrofits, the reality of island wastewater management requires a comprehensive approach as well as addressing technology ranging from simple cesspools to sophisticated Membrane Reactor (MBR) treatment and wastewater reuse.

Evidence linking wastewater to water quality and human health impacts is often a complicated issue in tropical environments. Enterococcus is the current bacteria indicator used as to identify possible sewage contamination in surface waters because they are commonly found in human and animal feces. However, several studies strongly suggest enterococci may not be the best indicator of human sewage in tropical environments because it occurs and reproduces naturally in the environment. The use of multiple indicators to better refine the potential sources may required (e.g., *Clostridium perfringens*, coliphages, pharmaceuticals, optical brighteners).

Design and siting of wastewater systems considers geology, soils, proximity to groundwater and surface water, available land and, of course, cost. Guidance documents of current treatment and disposal systems along with advantages and constraints can help practitioners in the selection, design, construction, operation, maintenance, and permitting of these facilities. This guidance can provide useful information for watershed managers to highlight the most desirable small wastewater systems given watershed conditions and help influence government policy and management decisions.

Understanding the wastewater problem and potential solutions also requires understanding the types and geographic distribution of wastewater treatment and disposal within your watershed. This will assist in targeting the use of specific technologies for new and replacement systems, operation and maintenance as well as inspections.

A Few Good Resources: (see also general resources provided with workshop materials)

- Hawaii Department of Health. http://hawaii.gov/health/environmental/water/cleanwater/prc/septic.html
- National Small Flows Clearinghouse (NSFC). http://www.nesc.wvu.edu/wastewater.cfm
- EPA Septic Systems. http://cfpub.epa.gov/owm/septic/index.cfm
- Hawaii Low Impact Design Manual (2006). http://hawaii.gov/dbedt/czm/initiative/lid.php

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Notes:

NOAA Climate Data A Vital Asset to Oahu Construction Industry

Each year NOAA's Climate Prediction Center, a part of the National Weather Service, issues several long-range seasonal forecasts for our nation. These include winter, spring and hurricane outlooks and El Niño and La Niña advisories. NOAA meteorologists in Hawai'i then adapt these forecasts to island conditions, drawing on past and present climate data and local knowledge to develop a "wet season outlook." This outlook gives residents a heads-up about conditions that are critical to both their safety and the economy of Hawai'i.

PVT Land Company, in Nanakuli, HI

Newly constructed storm water pond at landfill

Road to landfill subject to erosion and washout during heavy rainfall.

Traditionally, wild land fire managers, the agriculture sector, and water supply agencies have been the primary consumers of NOAA climate data and forecasts. Irrigation reservoir operators for instance, use drought forecasts to implement water-use restrictions to help sustain the water supply for farmers.

In Hawai'i, as elsewhere across the nation, the demand for climate products beyond the usual user base is rising. This year, for example, climate data have been immensely valuable to the construction industry on Oahu. When Steve Joseph, vice president of PVT Land Company in Nanakuli, learned from a NOAA briefing last October that the winter season would be much wetter than usual, his firm went into mitigation mode. PVT upgraded structures to increase storm water capacity. It also improved road design and conditions, not only for dependable travel but to withstand storm water run-off and erosion. As a result, there were no shutdowns or washouts when the predicted wet weather hit this winter. Also avoided was the loss of $600,000 in gross sales, $100, 000 in lost salaries, and a potential $300,000 to $600,000 in damage to roads and landfill.

"No one wants to hear about washouts or shutdowns at a construction landfill. NOAA's long-range predictions have helped us mitigate the worst effects of a wet winter. They are vital to our long-range business planning and, therefore, to every one of our customers."

Steve Joseph, Vice President, PVT Land Company

Without the heads-up, not only PVT but Oahu's entire construction industry would have been hurt, with losses in the millions of dollars. As the only construction landfill on the island, more than 200 trucks come to PVT each day. A shutdown would have stopped some construction projects completely and slowed down others, affecting hundreds of construction and trucking jobs across the island.

PVT's landfill area usually gets 10 to 14 inches of rain annually. So far this year, 18 inches have fallen. Despite nine inches of rain from a single storm in January, PVT was up and operational within 24 hours. A nearby landfill, without the same level of mitigation measures, was shut down for two weeks.

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Session G: Watershed Accounting & Project Ranking

2011 Pacific Island Watershed Institute

Description: Increasingly, watershed plans must document the costs and benefits associated with implementing various types of restoration projects. This type of watershed accounting may be required for TMDLs and other compliance issues, to secure grant funding for projects, and certainly to rank and prioritize the various projects identified in the plan. How can we tell which projects may be the highest priority for implementation? What are some objective ways to score and rank projects? This session will review the metrics and methods of measuring performance, prioritizing projects, and estimating pollution load reduction. The session will feature hands-on exercises using spreadsheets and scoring worksheets.

Speakers:

- David Hirschman, Center for Watershed Protection

Topics/Notes:

1. Why watershed accounting is needed.

2. Where does watershed accounting fit into the overall context of watershed planning? How can we tell if our plans are meeting restoration goals?

3. Overview of screening factors, scoring, and ranking based on various metrics, including pollutant loads, cost, and more qualitative measures.

4. Using sites identified during the morning field trip, assign scores and rank selected projects using the spreadsheet and scoring form

5. How can you use this work to help with your island work sessions?

Session G: Watershed Accounting & Project Ranking

This is an example of a scoring matrix to allow multiple restoration projects to be scored, ranked, and prioritized based on a set of objective and subjective criteria. Developing these screening factors and scoring systems is an important step in developing a watershed restoration plan.

SAMPLE SCORING MATRIX FOR PROJECT RANKING & PRIORITIZING				
SCREENING FACTOR	**DESCRIPTION**	**MAX. POSSIBLE SCORE**	**SCORING[1]**	**SCORE**
Total Nitrogen (N) Removed (pounds per year)	Measures area treated combined with pollutant removal efficiency of practice.	20	< 1 pound of N = 5 points 1 to 2 pounds of N = 10 points 2 to 4 pounds of N = 15 points > 4 pounds of N = 20 points	
Cost Per Pound of N Removed ($)	Measure of cost-effectiveness.	20	> $27K per pound = 5 points $20K to $26K per pound = 10 points $12K to $19K per pound = 15 points < $12K per pound = 20 points	
Total Construction Cost ($)	Measure of the total cost to compare to program budgets.	20	> $30K = 5 points $13K to $29K = 10 points $7.5K to $12K = 15 points < $12K = 20 points	
Public Visibility/Outreach	How well will the practice serve to engage and educate the public?	10	Low Visibility & Education Opportunity; practice on private land, not very accessible = 0 points Medium Visibility & Education Opportunity; may be on public or private land, but not in high traffic or pedestrian area = 5 points High Visibility & Education Opportunity; located on public land (school or park) = 10 points	
Quick Implementation	Is there momentum to implement the practice; are agencies supportive; are there other projects it can be attached to.	10	Low = project must develop agency support & funding = 0 points Medium = supported by agencies, but funding is not secured; project must stand on its own for implementation = 5 points High = supported by agencies, likelihood to be combined with another project, funding likely = 10 points	

Long-Term Maintenance Burden	How difficult and costly will it be to maintain the practice over time.	10	High = practice will require frequent and intensive maintenance = 0 points Medium = practice will require maintenance of structural elements, such as dams and pipes, as well as vegetation = 5 points Low = practice maintenance depends largely on maintaining vegetation, mulch, and maybe small weirs or underdrains = 10 points	
Use of Innovative Practices	Is this an innovative practice you'd like to see demonstrated on your island?	10	Not Innovative = practice is routine on the island = 0 points Somewhat Innovative = practice is used on island, but it is not widespread and the proposed practice would be a good example = 5 points Innovative = the practice is very rare or not used, and it would be an excellent demonstration project = 10 points	
TOTAL SCORE		100		
[1] For Total Nitrogen Removed, Cost Per Pound of Nitrogen Removed, and Total Construction Cost, the ranges used for scoring were derived from an existing CWP project. The data were listed for all candidate projects and divided into quartiles. The lowest quartile (bottom one-quarter of all data values) was assigned a score of 5, the second quartile a score of 10, the third a score of 15, and the top quartile (best values for the categories) a score of 20. This is one way to assign a score to projects with a range of values. Ideally, the quartiles would be derived from the actual projects you are scoring. Therefore, the ranges given here should be considered place-holders.				

This table uses pre-selected screening factors as an example. A fuller list of screening factors is provided below. You may want to discuss which are most relevant to your priority watershed in your Island Work Sessions. In general, you might want to select 5 or 6 screening factors as a basis for prioritizing projects.

- Cost ($)
  - Total
  - Per Treated Acre
  - Per Pound of Pollutant Removed (select priority pollutant)
- Pollutant Removal (total pounds/year)
- Long-Term Maintenance Burden
- Landowner Issues
- Permitting
- Coordination With Other Efforts – does the project leverage or support existing efforts
- Quick Implementation – are there opportunities for quick implementation based on funding and agency programs
- Neighborhood Acceptance
- Regulatory/Compliance
- Access to the Practice
- Innovative Practices
- Partnership Opportunities
- Public Visibility & Outreach Opportunities
- Habitat Creation
- Community Benefits

Session H: Erosion and Sediment Control (ESC) for Islands

2011 Pacific Island Watershed Institute

Description: Discuss the impact of inadequate ESC at construction sites, review basic ESC principles and practices used to manage erosion on site; review an erosion control plan in small groups; and discuss the basic elements of an ESC program

Speakers:

- Michelle West, Horsley Witten Group
- Anne Kitchell, Horsley Witten Group

Resources:

- US EPA NPDES General Construction Permit http://cfpub.epa.gov/npdes/stormwater/cgp.cfm
- Hawaii DOT Erosion Control Manual 2008 http://stormwaterhawaii.com/resources/
- 2006 CNMI/Guam Stormwater Management Manual www.deq.gov.mp/article.aspx?secID=6&artID=55
- American Samoa Runoff Control Guidance Manual: asepa.gov/_library/documents/.../part1_**runoff**controlguidance**manual**.pdf

Topics/Notes:

1. Why proper ESC matters

2. ESC Principles and construction sequencing (see back of page)

3. What are the common ESC practices applied on site?

   a. Sediment barriers

   b. Conveyances

   c. Traps

   d. Stabilization

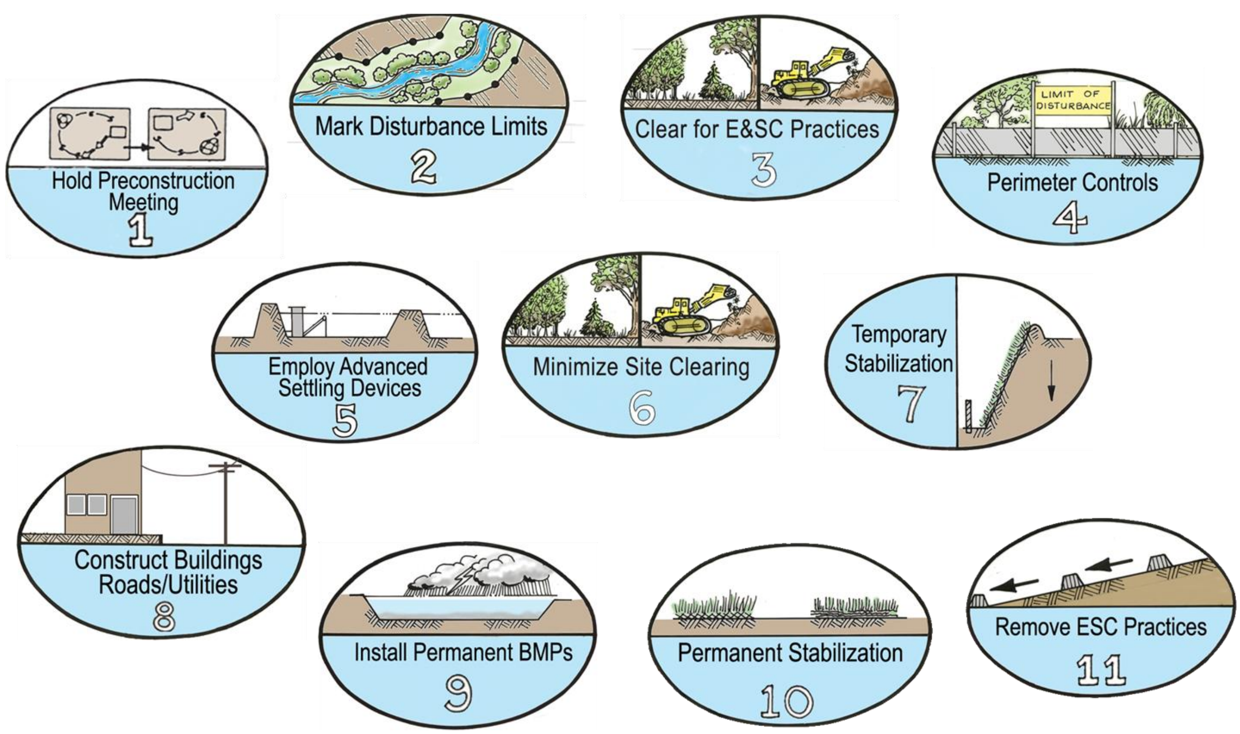
   e. Inlet/outlet protection

4. What are basic elements of an effective ESC program?

Common Principles of ESC

1. Minimize clearing and grading
2. Protect waterway buffers and stabilize drainage ways
3. Phase construction to limit soil exposure
4. Stabilize exposed soils immediately (7-14 days)
5. Protect steep slopes and cuts
6. Install perimeter controls to filter sediments
7. Employ advanced sediment settling devices
8. Certify contractors on ESC plan implementation
9. Conduct a pre-construction site meeting and adjust plan if necessary
10. Schedule construction during the least rainy season (if possible)
11. Maintain ESC throughout construction

Construction Sequence



Session H: Erosion and Sediment Control (ESC) on Islands
Group Exercise on Example ESC Plan

Task 1 – Review the Site Plan.

- Use the blue highlighter to outline the stream and stream buffer.
- Locate the proposed tree line and highlight with green. What else is located in the same place as the proposed tree line?____
- Identify the highest point on the site and mark it with an "X."
- Locate the proposed storm sewer system and highlight it with orange.
- Locate the following ESC measures and highlight them with yellow:
  - construction entrance
  - materials stockpile area
  - inlet protection
  - pipe slope drain
  - level spreaders
  - diversion and temporary dikes
  - outlet riprap protection
  - sediment basin

Task 2 – Conveyance.

- Draw a flow path from the highest point on the site to the stream. What practices are used to divert this "clean," offsite runoff around the site?______________________________
- What practices convey runoff through the site and into the sediment basin?

  ____

Task 3 – Review the construction sequence. Indicate which step in the sequence the following activities belong (for example, "construction entrance" belongs in Step 1 of the sequence):

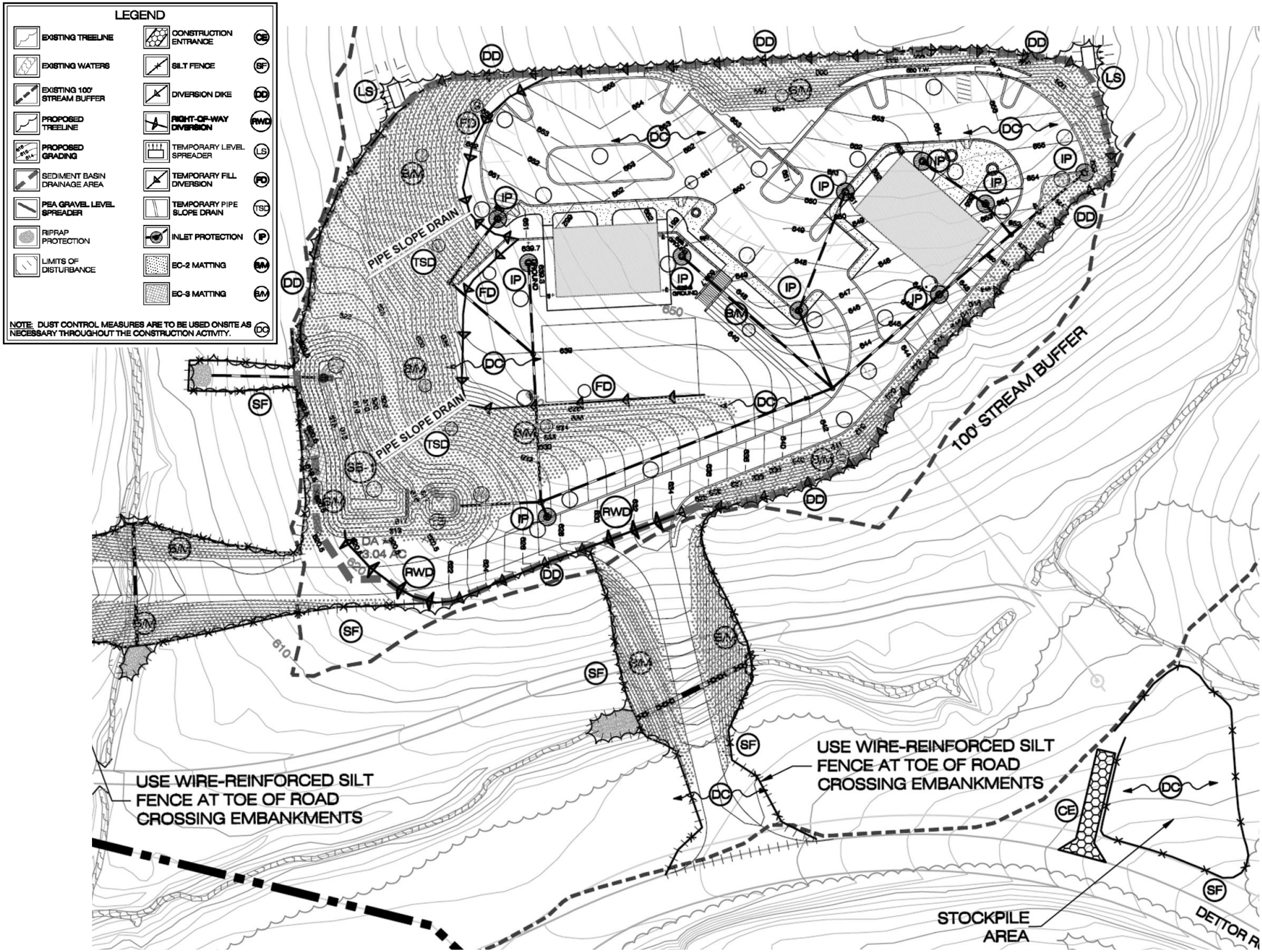
	Sequence Step
Clearing of site	___________
Removal of all temporary ESC Measures	___________

Task 4 – Locate and circle the Maintenance section of the notes. When should sediment be removed from behind the silt fences at this site?____

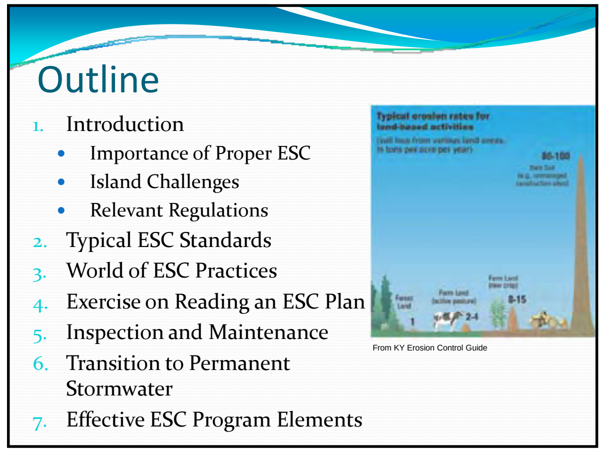
Task 5 – Review the Erosion and Sediment Control Notes. According to #6, who is responsible for the installation of any additional ESC measures required at the site? ______________________

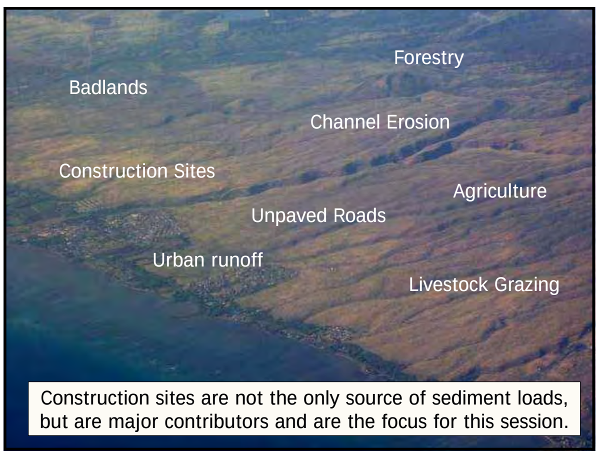
Task 6 – Review the detail for a diversion dike. What is the minimum height for the dike?________ Should the dike be compacted? Yes or No (circle one).

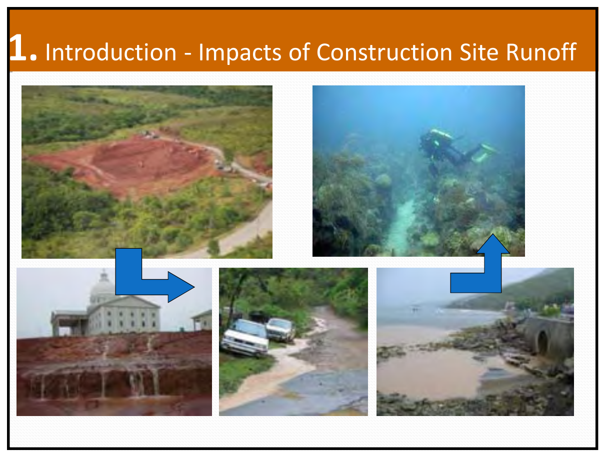
Additional Notes:

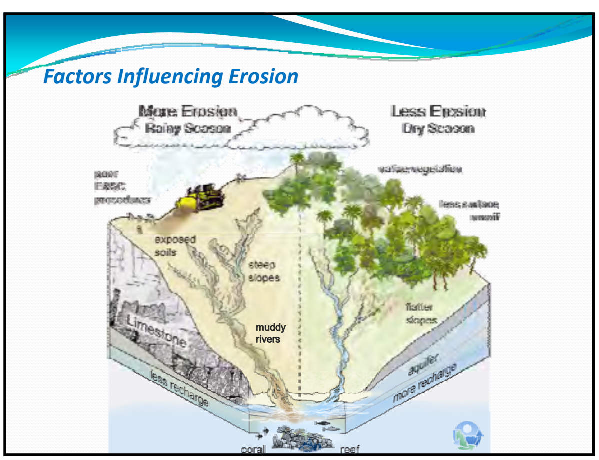

LEGEND
EXISTING TREELINE
EXISTING WATERS
EXISTING 100' STREAM BUFFER
PROPOSED TREELINE
PROPOSED GRADING
SEDIMENT BASIN DRAINAGE AREA
PEA GRAVEL LEVEL SPREADER
RIPRAP PROTECTION
LIMITS OF DISTURBANCE
CONSTRUCTION ENTRANCE
CE
SILT FENCE
SF
DIVERSION DIKE
DD
RIGHT-OF-WAY DIVERSION
RWD
TEMPORARY LEVEL SPREADER
LS
TEMPORARY FILL DIVERSION
FD
TEMPORARY PIPE SLOPE DRAIN
TSD
INLET PROTECTION
IP
EC-2 MATTING
EC-3 MATTING
NOTE: DUST CONTROL MEASURES ARE TO BE USED ONSITE AS NECESSARY THROUGHOUT THE CONSTRUCTION ACTIVITY.
DC
PIPE SLOPE DRAIN
PIPE SLOPE DRAIN
SB-1
100' STREAM BUFFER
USE WIRE-REINFORCED SILT FENCE AT TOE OF ROAD CROSSING EMBANKMENTS
USE WIRE-REINFORCED SILT FENCE AT TOE OF ROAD CROSSING EMBANKMENTS
STOCKPILE AREA
DETTOR R

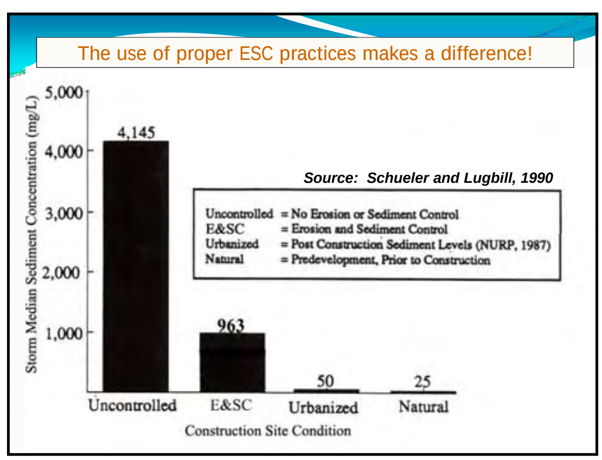

Pacific Island Watershed Institute
Session H: Erosion & Sediment Control (ESC) for Islands
June 13-16, 2011
He'eia State Park, Oahu


Outline
1. Introduction
• Importance of Proper ESC
• Island Challenges
• Relevant Regulations
2. Typical ESC Standards
3. World of ESC Practices
4. Exercise on Reading an ESC Plan
5. Inspection and Maintenance
6. Transition to Permanent Stormwater
7. Effective ESC Program Elements
Typical erosion rates for land-based activities
From KY Erosion Control Guide


Forestry
Badlands
Channel Erosion
Construction Sites
Agriculture
Unpaved Roads
Urban runoff
Livestock Grazing
Construction sites are not the only source of sediment loads, but are major contributors and are the focus for this session.


1. Introduction - Impacts of Construction Site Runoff


Factors Influencing Erosion
More Erosion
Rainy Season
Less Erosion
Dry Season
exposed soils
steep slopes
muddy rivers
flatter slopes
Limestone
less recharge
aquifer
more recharge
coral
reef


The use of proper ESC practices makes a difference!
Storm Median Sediment Concentration (mg/L)
5,000
4,000
3,000
2,000
1,000
4,145
963
50
25
Uncontrolled
E&SC
Urbanized
Natural
Construction Site Condition
Source: Schueler and Lugbill, 1990
Uncontrolled = No Erosion or Sediment Control
E&SC = Erosion and Sediment Control
Urbanized = Post Construction Sediment Levels (NURP, 1987)
Natural = Predevelopment, Prior to Construction

Why is ESC Important?

- ESC **reduces** runoff and sediment loads to streams, lakes, wetlands, coastal areas, groundwater
- ESC **mitigates** the impacts of erosion and sedimentation:
  - Direct environmental impacts
  - Economic impacts
  - Impacts to stormwater BMPs
  - Impacts to abutting properties

Models estimate that 22% of all coral reefs world-wide are at high or medium threat from inland pollution and soil erosion (Bryant et al. 1998)

PICRC

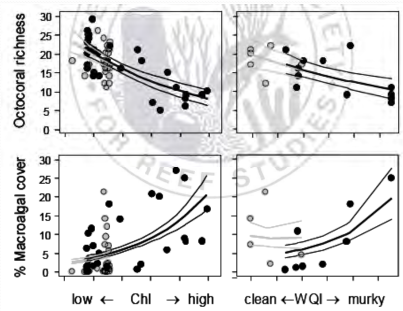


Figure 1: Changes in the taxonomic richness of octocorals and in macroalgal cover along water quality gradients in the Great Barrier Reef; black points represent reefs exposed to runoff from agriculturally used watersheds, gray points are reefs exposed to runoff from watersheds with little agriculture. The chlorophyll data (Chl, left panel) are based on 10-years chlorophyll monitoring by the Great Barrier Reef Marine Park Authority. The inshore water quality index (WQI, right panel) is based on a composite index of concentrations of nutrients, chlorophyll and suspended solids on inshore reefs over 3 years. Adapted from Fabricius and De'ath (2004).

Sediment loading harms the environment and the economy.

Environmental Impacts = Economic Impacts

- Reduces water quality
- Limits photosynthesis
- Reduces oxygen availability
- Clogs fish gills
- Fills spawning grounds
- Smothers bottom communities
- Reduces visibility for feeding and predator avoidance

→

- Costs more to filter drinking water
- Less fish, hard on fisherman and seafood lovers
- Swimming areas closed, reduced recreation
- Looks bad, less tourists

Impacts to Stormwater Infrastructure

- Filling-in of permanent stormwater ponds
- Clogging of infiltration devices
- Smothering of swales and buffers
- Clogging of drain pipes and inlet/outlet structures

...which can limit your ability to get beer after a long day.

Island Challenges

Relevant Regulations and Guidelines in the Islands

- USEPA National Pollutant Discharge Elimination System (NPDES)
- American Samoa Water Quality Standards, ASAC 24.02
- American Samoa Coastal Management Program, ASAC 26.02
- AS-EPA's Guidance Manual for Runoff Control
- Palau Regulations on Earthmoving and Marine and Fresh Water Quality
- 2010 Palau Stormwater Management Manual
- CNMI Earthmoving and Erosion Control Regulations
- 2006 CNMI/Guam Stormwater Management Manual
- 2008 Hawaii DOT Erosion Control Manual

U.S. Jurisdiction

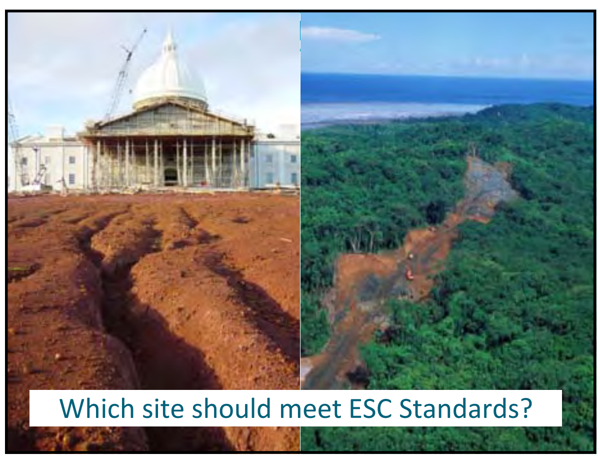
- **All new construction and redevelopment sites** should be subject ESC and stormwater criteria
  - ESC plan requirements
  - ESC standards
- All **sites over 1 acre** of disturbance must:
  - Submit NOI to EPA for NPDES permit
  - Prepare a Stormwater Pollution Prevention Plan (SWPPP)

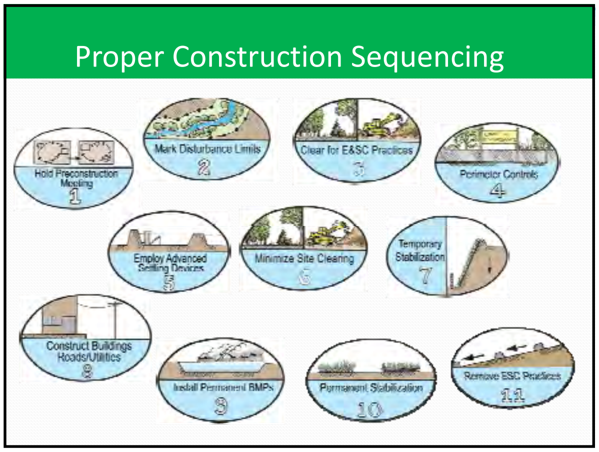
FSM and Republic of Palau?

2. Typical ESC Standards

1. Minimize clearing and grading
2. Protect waterway buffers and stabilize drainage ways
3. Phase construction to limit soil exposure
4. Stabilize exposed soils immediately (7-14 days)
5. Protect steep slopes and cuts
6. Install perimeter controls to filter sediments
7. Employ advanced sediment settling devices
8. Certify contractors on ESC plan implementation
9. Conduct a pre-construction site meeting and adjust plan if necessary
10. Schedule construction during the least rainy season (if possible)
11. Maintain ESC throughout construction

Which site should meet ESC Standards?




Proper Construction Sequencing
Hold Preconstruction Meeting 1
Mark Disturbance Limits 2
Clear for E&SC Practices 3
Perimeter Controls 4
Employ Advanced Settling Devices 5
Minimize Site Clearing 6
Temporary Stabilization 7
Construct Buildings Roads/Utilities 8
Install Permanent BMPs 9
Permanent Stabilization 10
Remove ESC Practices 11

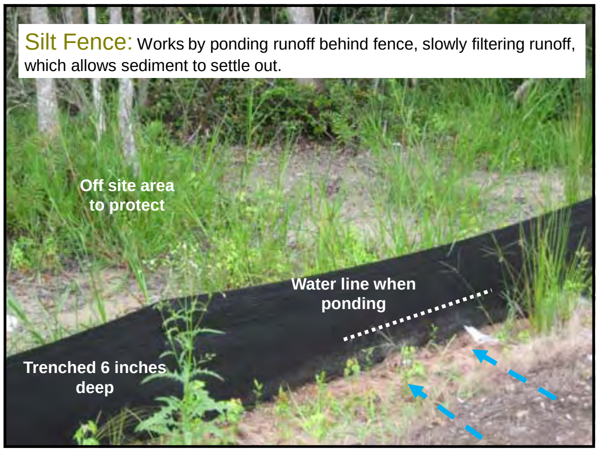

3. ESC Practices
1. Sediment Barriers
2. Diversions & Conveyances
3. Settling Devices
4. Stabilization
5. Inlet Protection
6. Outlet Protection


Sediment Barriers
Objective: Keep sediment from leaving site
Natural area protection
Stable construction entrance
Silt fence
Alternative "fencing"
Turbidity curtains


Tree and Buffer Protection: Visible demarcation with fencing and signage of *Limits of Disturbance* from construction activities.
TREE PROTECTION AREA
DO NOT ENTER
ZONA DE PROTECCION
PARA ARBOLES- NO ENTRE


Mark limits of disturbance and install perimeter fencing BEFORE clearing


Extend beyond drip line
Does this fencing fully protect this tree?


Silt Fence: Works by ponding runoff behind fence, slowly filtering runoff, which allows sediment to settle out.
Off site area to protect
Water line when ponding
Trenched 6 inches deep


Copyright Center for Watershed Protection 2001

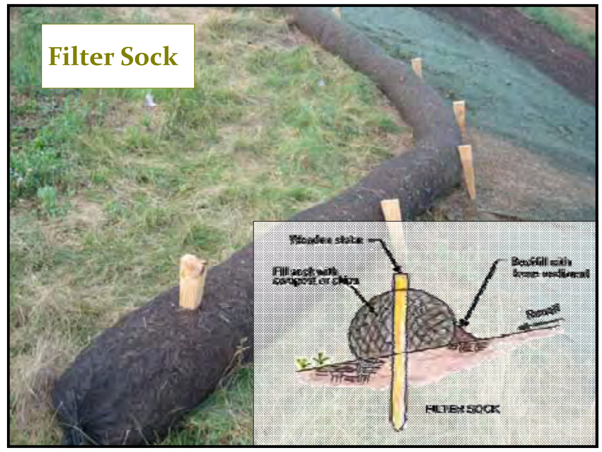

Bobcat
Poorly trenched fence will not hold back runoff.


Do not install across streams unless trying to trap cows or pigs.


CAT
What factors are contributing to this failure?


30


Filter/compost socks
Filter strip
Perimeter berm
Silt dike
Silt Fence Alternatives:

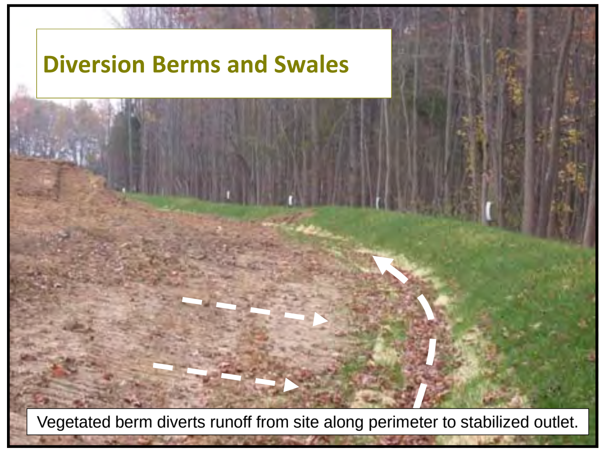

Filter Sock
FILTER SOCK

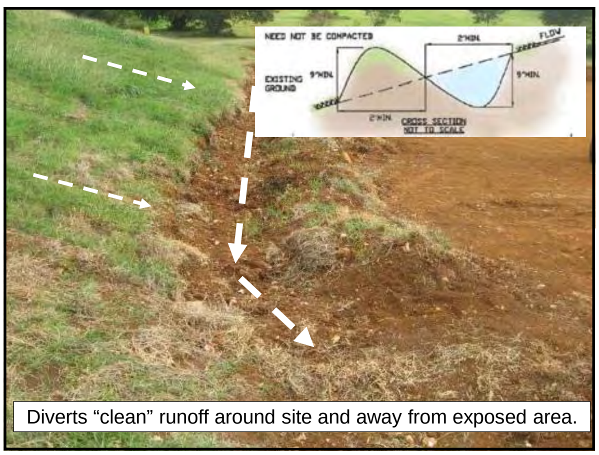

Alternative products are only as good as their installation and maintenance


Turbidity Curtain

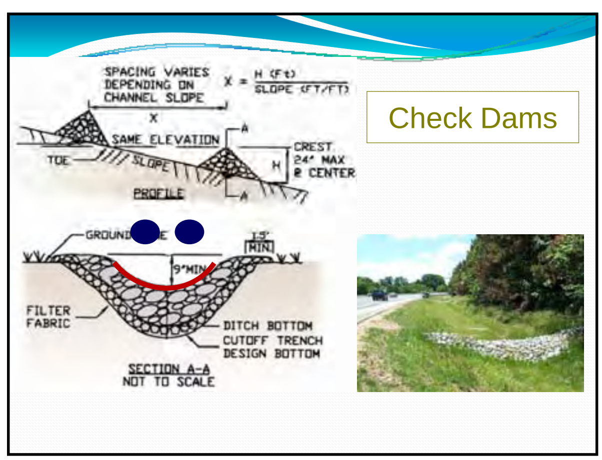

Curtains should not be the only ESC practice on site…


Diversions & Conveyances
Should convey 10-yr storm
Objective: Convey "clean" and "dirty" runoff safely around or through site
Earth berms
Diversion swales
Vegetated/lined waterways
Check dams


Diversion Berms and Swales
Vegetated berm diverts runoff from site along perimeter to stabilized outlet.


NEED NOT BE COMPACTED
FLOW
EXISTING GROUND
CROSS SECTION NOT TO SCALE
Diverts "clean" runoff around site and away from exposed area.


Check Dams
Source: Center for Watershed Protection


SPACING VARIES DEPENDING ON CHANNEL SLOPE
X = H (Ft) / SLOPE (FT/FT)
SAME ELEVATION
TOE
SLOPE
CREST 24" MAX @ CENTER
PROFILE
GROUND
FILTER FABRIC
DITCH BOTTOM
CUTOFF TRENCH
DESIGN BOTTOM
SECTION A-A
NOT TO SCALE
Check Dams

Settling Devices

Should retain 1.5-inch runoff

Objective: Temporarily pond runoff to let sediment settle out before discharging off site

- small depression
- simpler outlet structure

- larger excavation
- can be permanent
- more infrastructure

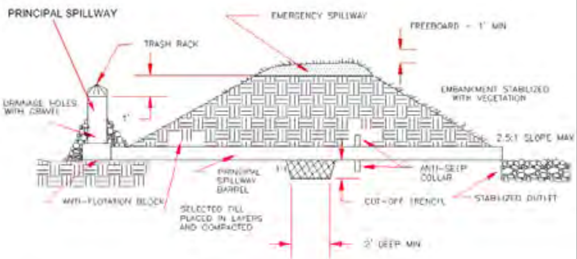
Basins vs. Traps

	Basins	Traps
Max Drainage Area	100 acres	5 acres
Size	5,500 cubic ft/acre of drainage; > 2:1 length to width	
Dam Height	10-15 ft max.	5 ft max.
Dam Width	8-10 ft min.	4 ft min.
Dam Side Slopes	2.5:1 or flatter	2:1 or flatter
Outlet	Riser with spillway	Riser or grass/rock outlet
Riser Height	2 ft below top of dam, 1 ft below spillway.	1 ½ ft below top of dam
Status	Temporary or Permanent	Temporary

Simple excavated grass outlet sediment trap with gentle slopes and stabilized with vegetation.

Sediment basins are structurally more complicated than traps. Should be at least twice as long as wide to maximize flow path

Sediment Basin – Spillway Profile



Converting ESC Basins to Permanent Stormwater BMPs

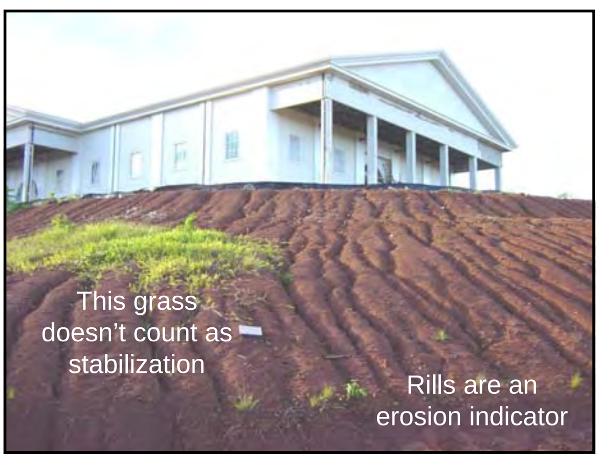
Construction Sequence should include:

- Remove accumulated sediment
- Regrade to new post-construction specifications as designed
- Replace/install outlet risers
- Stabilize banks, inlets, and outlets

**Sediment basins should NEVER be converted to an infiltration practice

Stabilization Practices

Objective: Protect bare soils and slopes from eroding



A lot of dirt came off this site. This gully indicates:

- lack of stabilization
- failure to comply with ESC requirements
- failure to enforce ESC regs.

This only happens on Guam…


…and Palau

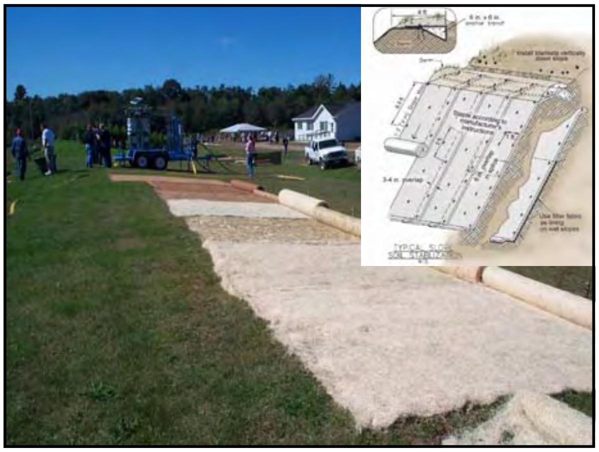

This is great!


Surface Roughening: Creation of horizontal depressions, steps, or grooves that run parallel to contour of land and slow runoff.


Vegetative, Mulch, or Soil Stabilization: Uniform application of seed and organics to rapidly stabilize exposed soil either temporarily or permanently.

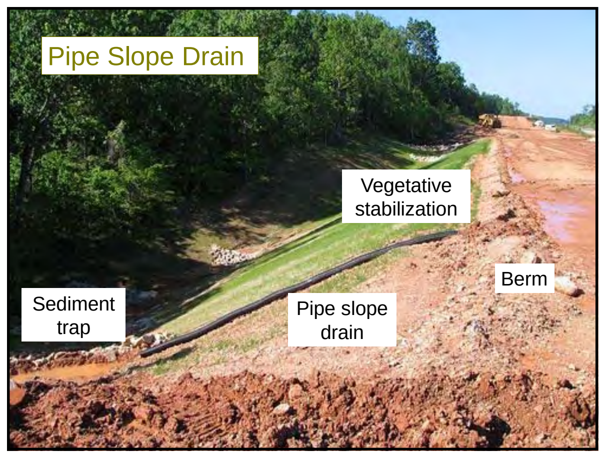

grass seed
+
mulch
+
glue
= happy coral reef

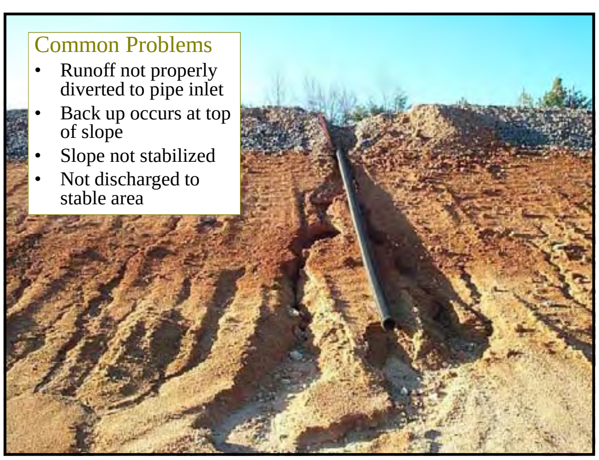

Erosion Control Blankets: Biodegradable or synthetic matting used to cover bare slopes and channels to prevent erosion and help vegetation establish.
Unprotected slope
Protected slope

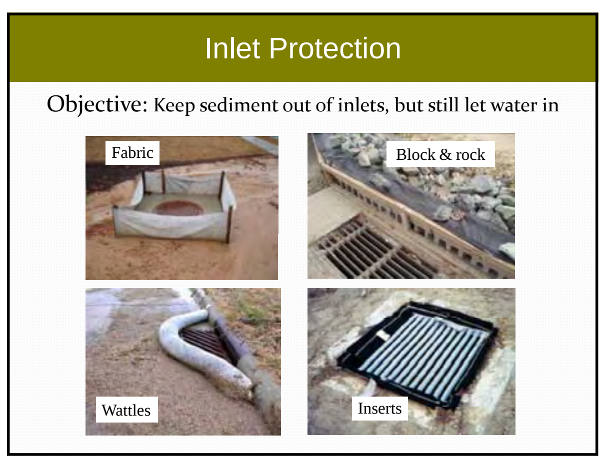



What is wrong with the installation in this photo?


63

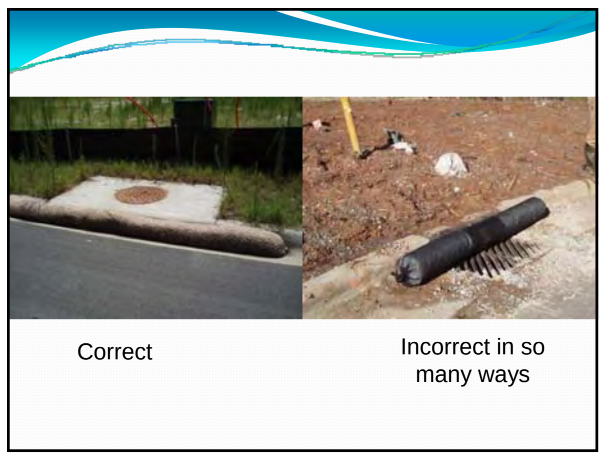

Pipe Slope Drain
Vegetative stabilization
Berm
Sediment trap
Pipe slope drain


Common Problems
• Runoff not properly diverted to pipe inlet
• Back up occurs at top of slope
• Slope not stabilized
• Not discharged to stable area


Inlet Protection
Objective: Keep sediment out of inlets, but still let water in
Fabric
Block & rock
Wattles
Inserts


You want to avoid this.

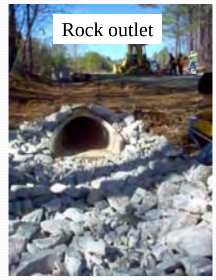

Installation Block/Rock
1. May vary, be creative
2. Place blocks across opening (allow water to pass)
3. Insert wire mesh
4. Pile rock outside mesh (filter)

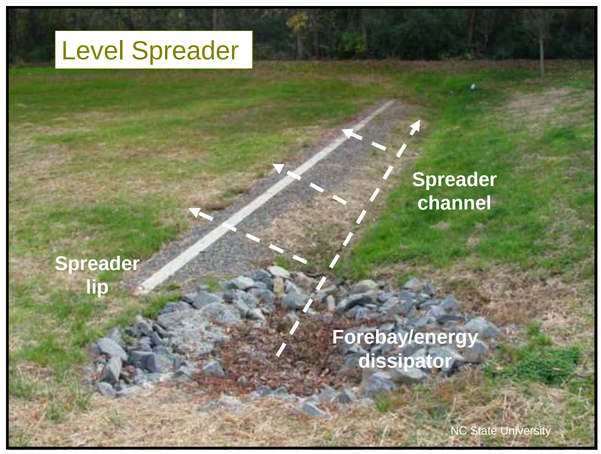

Correct
Incorrect in so many ways


Water still needs to be able to overflow into inlet to prevent flooding problems during large rain events.

Outlet Protection

Objective: Prevent erosion at point of discharge by slowing and spreading flow





ESC Practice Summary

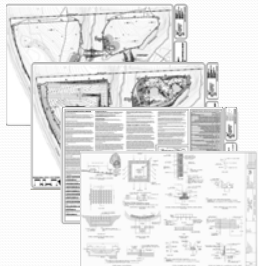
- **Sediment Barriers**– to prevent sediment from leaving site
- **Diversions**-to convey non-erosive runoff through/around site
- **Traps/Basins**-to pond runoff and allow sediment to settle out before discharging "clean" water
- **Stabilization** – To prevent erosion of bare soils and slopes
- **Inlet protection** – To let water pass, but keep sediment out
- **Outlet protection** – To prevent erosion at discharge points

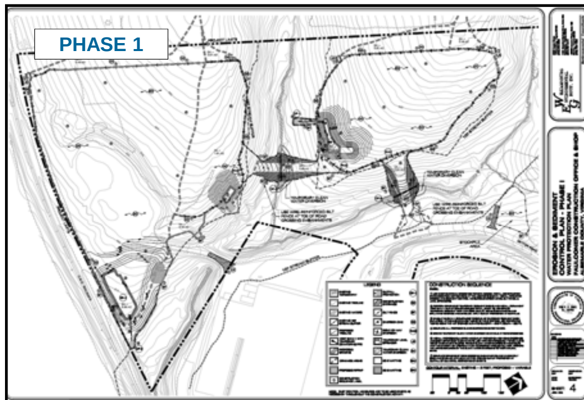
4. Reading a Site Plan

1. Elements of an ESC plan
2. Contractor information
3. Group Activity

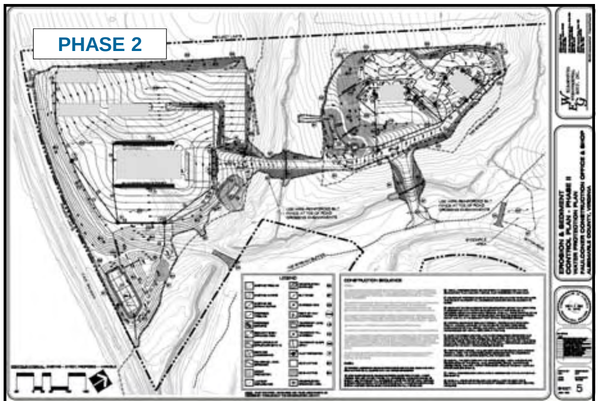
Elements of an ESC Plan

- Prepared by engineer (P.E.)
- Clearing, grading, and sequencing schedule
- Location, details, construction specs, and maintenance requirements
- Re-vegetation/stabilization plan for temporary and permanent conditions

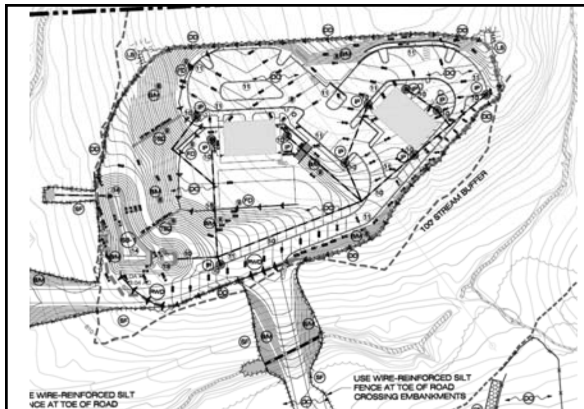




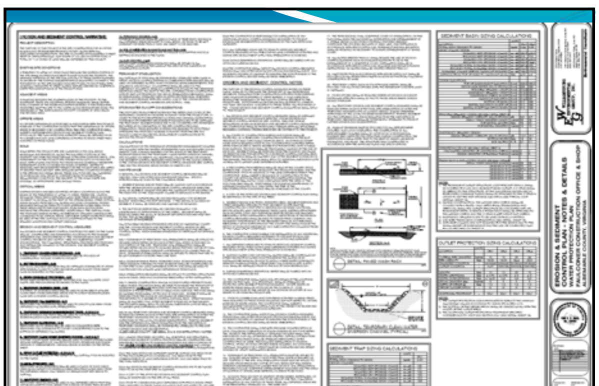
Shows grading, sequence of construction, phases of development



Shows grading, sequence of construction, phases of development



Location of ESC practices. You will study this portion in your groups!



Construction notes/details provide important information on sequencing, installation, and maintenance procedures.

Contractors must:

- Read the ESC plan
- Implement the ESC practices called for in the plan
- Follow the construction sequence
- Install and maintain practices according to plan
- Recommend/make adjustments to plan based on field conditions

Inspectors:

- Review the plan
- Have copies in the field during inspections
- Make sure on-the-ground conditions match ESC plan

Adjust ESC Plan for Field Conditions

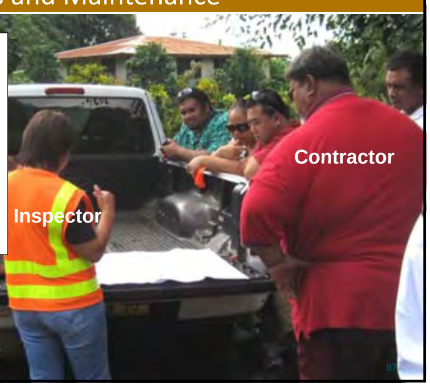
Stage	Basis of Plan Change
Pre-construction meeting	Plan impractical from contractor's standpoint, site visit confirms plan unsuitability.
After clearing/grading and sediment controls installed	"As-built" grading or sediment controls differ from original plan.
During inspection after storm event	Poor performance may require adjustments. May need engineer approval.

ESC Plan Activity

1. Break up into groups and appoint one note-taker
2. Take copy of sample ESC plan
3. Follow instructions in your handout, such as:
   - Locate protected areas
   - Review grading
   - Locate practices on plan
   - Identify construction sequencing
   - Review notes and details
4. Report out

5. Inspections and Maintenance

Contractors and inspectors are responsible for ensuring practices are installed, maintained, and operating properly.



Compliance for Commonly Used ESC Practices

Practice	Installed	Installed Properly	Adequately Maintained
Silt Fence	67%	58%	34%
Sediment Trap	86%	86%	58%
Stable entrance	89%	89%	67%

It helps if you:
- Include ESC maintenance $ in budget
- Designate on-site contractor for maintenance
- Set self-inspection schedule

NC Study, CWP

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Relative Maintenance Burden

Practice	High	Med	Low	Frequency
Silt fence	✓			Daily
Stable entrance		✓		Daily
Berms/swales		✓		Weekly
Check dams			✓	After rain event
Traps/basins		✓		When ½ full
Erosion mats			✓	After rain events
Inlet protection	✓			
Rock outlet			✓	
Level spreaders			✓	

Routine maintenance by workers

- Removing sediment tracked on road
- Repair torn fabrics in fencing, inlet protection, and erosion control matting
- Replace natural area protective fencing
- Replace rocks from entrances, check dams, and outlet protection
- Fill gullies and rills
- Irrigate vegetation
- Remove sediment behind sediment barriers, check dams, and in trapping devices

90

Inspectors should:

- Know the ESC plan
- Inspect at required frequency (7 days, after storm events, installation, final)
- Evaluate practice effectiveness
- Identify corrective actions
- Concentrate on areas with highest failure potential:
  - Where sediment can build up
  - Concentrated flow areas
  - Steep cut and fills
  - Around outfalls
- Document conditions and required actions
- Notify/provide report copies to all parties
- Follow up with enforcement

91

Make sure you inspect areas receiving drainage from your construction site…

Document with approved inspection report, take photos, describe corrective actions to be taken and timeframe for completion

Date: ______ Inspector: ______

Location of Potential Erosion, Sedimentation, Blockage or Damage	Evidence of Erosion, Overflow, Blockage or Damage?		Erosion/ Sedimentation Controls Functioning Properly?		Describe Condition and Recommend Corrective Action
	Yes	No	Yes	No	
Silt Curtains/Fences					
Sediment Traps					
Drainage Ditches/Swales		✓		✓	Not installed correctly
Culverts/Storm Drains/ Catch Basins					
Roads					
Slopes/Berms					
Coverings/Surface Protection/Vegetation					
Discharge Points/Outfalls					

Yes ☐ No ☐

Inspectors should follow up on repair jobs…

Good or Bad?

95

Removing ESC Practices

No site can be closed out until:

- Temporary practices removed
- Permanent stormwater management in place
- Construction waste removed/properly disposed
- Vegetation established on all bare soil areas
- All ditches and slopes are stable
- Final inspection

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6. Transition to Permanent Stormwater Management

- Install permanent practices as designed
- Protect practices from sediment during construction activities
- Maintain drainage paths during final site grading and paving
- Make sure all permanent practices are inspected before temporary practices are removed
- Remove sediment and debris before "turning on" practices

97

Do not "turn on" permanent drainage until site is stabilized and your permanent stormwater practices are in place…

7. Effective Program Elements

- Regulations and Standards
- Reference Guide
- Inspections
- Enforcement
- Training/Certification
- Incentives
  - Equipment for rent
  - Demonstrations on public projects

99

Regulations/Standards

- Adopt regulations that require ESC standards at all construction sites
- Adopt minimum ESC standards to be applied

Reference Guide

Inspections

- Checklists
- Third-party inspectors?

EXHIBIT 2
EROSION & SEDIMENTATION CONTROL - INSPECTION AND MONITORING

To be filled out by inspector weekly and after each significant storm for the appropriate project controls.

Date: ______________ Inspector: ______________

Location of Potential Erosion, Sedimentation, Blockage or Damage	Evidence of Erosion, Overflow, Blockage or Damage?		Erosion/Sedimentation Controls Functioning Properly?		Describe Condition and Recommend Corrective Action
	Yes	No	Yes	No	
Silt Curtains/Fences					
Sediment Traps					
Drainage Ditches/Swales					
Culverts/Storm Drains/Catch Basins					
Roads					
Slopes/Berms					
Coverings/Surface Protection/Vegetation					
Discharge points/Outfalls					

To be filled out by person responsible for erosion control plan:

Have corrective action(s) been implemented to correct deficiencies noted during inspection? Yes ( ) No ( )

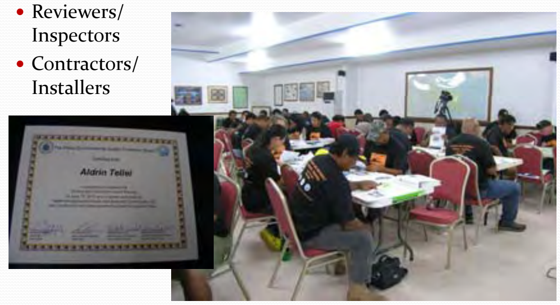
Date(s) corrective action(s) completed: ______________

Enforcement

- Performance Bonds
- Fines
- Stop-work Order

Training/Certification

- Designers
- Reviewers/ Inspectors
- Contractors/ Installers



Incentives

http://www.watercrunch.com/2010_01_01_archive.html

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Session I: Stormwater BMPs for Islands

2011 Pacific Island Watershed Institute

Description: Review stormwater performance measures and standards across the Pacific islands, and discuss site design techniques to reduce stormwater generation at new development and redevelopment projects. This session will introduce a variety of large and small structural best management practices (BMPs), how they can be adapted to island settings, and ways to make them better.

Speakers:

- Rich Claytor, Horsley Witten Group
- David Hirschman, Center for Watershed Protection

Resources:

- HI DOT. 2007 Stormwater Manual. www.coralreef.gov/transportation/permanent**manual**.pdf
- HI Commission on Water Resource Management. 2008. Handbook for Stormwater Reclamation and Reuse BMPs www.state.hi.us/dlnr/cwrm/planning/hsrar_handbook.pdf
- Stormwater resources (including pollution prevention guidance for businesses and homeowners) http://stormwaterhawaii.com/resources/
- 2006 CNMI/Guam Stormwater Management Manual www.deq.gov.mp/article.aspx?secID=6&artID=55
- RI Stormwater Design and Installation Manual. 2010. www.dem.**ri**.gov/pubs/regs/regs/water/sw**manual**.pdf
- VA Runoff Reduction Method and Stormwater Design Manual. www.dcr.virginia.gov/stormwater_management/stormwat.shtml
- Center for Watershed Protection (CWP). 2008. Post-construction Guidance Manual. www.cwp.org
- CWP. 1998. Better Site Design: A handbook for changing development rules in your community www.cwp.org
- United States Nav. 2010. Low Impact Development Design Manual www.wbdg.org/ccb/DOD/UFC/ufc_3_210_10.pdf#search=%22low%20impact%20development%20ufc%22

Topics/Notes:

1. What are my island's performance measures, standards, and environmental drivers?

2. Site planning techniques to minimize stormwater impacts.

3. Large and small BMPs and island adaptations (see Article handout)

4. Ways to improve BMP effectiveness

5. Site design group exercise (see Exercise handout)

Pacific Islands Watershed Institute: Session I Stormwater BMPS for Islands

Site Design and BMP Exercise

First, review the site plan provided:

Take a look at the design features of the site such as the roadway layout, sidewalks, lot geometry, stormwater management/conveyance system, and potential impacts to natural resources, including groundwater.

Question 1) Identify the site design features you think may alter hydrology and negatively impact natural resources, as well as features that help protect the environment.

Good Site Design Features	Not so Good Site Design Features

Question 2) Next, Evaluate the proposed stormwater management and conveyance system and identify measures you think meet or don't meet resource protection objectives.

Stormwater BMPs that Work	Suggested BMP Improvements

Question 3) Finally, suggest what site design revisions/modifications might serve for better resource protection, better water quality, and stabilized hydrology.

Pacific Island Watershed Institute

Session I: Stormwater Best Management Practices for Islands

June 13-16, 2011
He'eia State Park, Oahu

Presentation Outline

- BMP Control Objectives;
- Runoff Reduction through Better Site Design;
- Small Practices (Recharge);
- Big Practices (Storage);
- Short Exercise;
- Performance.

Stormwater BMPs Need to Control the Range of Rainfall Amounts

- Multiple control points:
  - Flooding and drainage
  - Water quality
  - Groundwater recharge
  - Habitat/resource protection
  - Drinking water protection

Island Stormwater Design Objectives

- Keep sediment and pollutants out of coral reefs
- Promote recharge rates to replenish groundwater resources
- Keep pollutants from entering groundwater
- Prevent serious floods and mudslides
- Protect streams and wetlands

Treat rain as a resource!

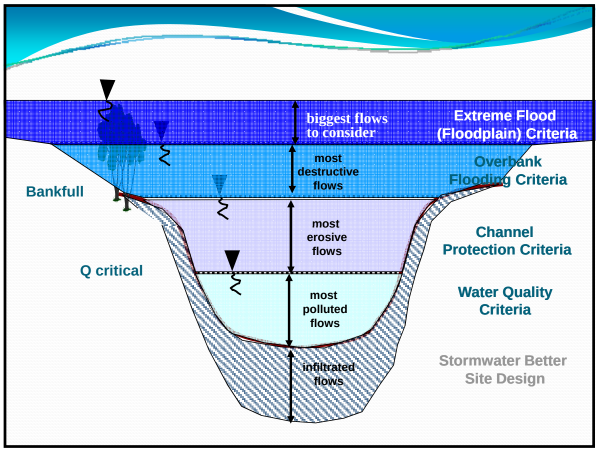
Design Storm Events

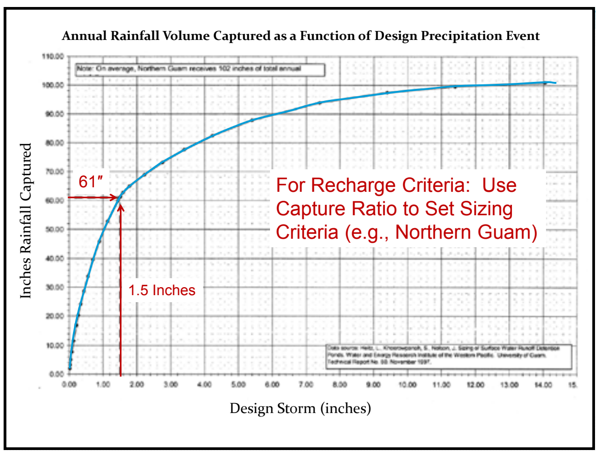
Storm events are ranked in terms of their statistical return frequency. For example, a storm that has a 50% chance of occurring in any given year is termed a "two-year" storm.

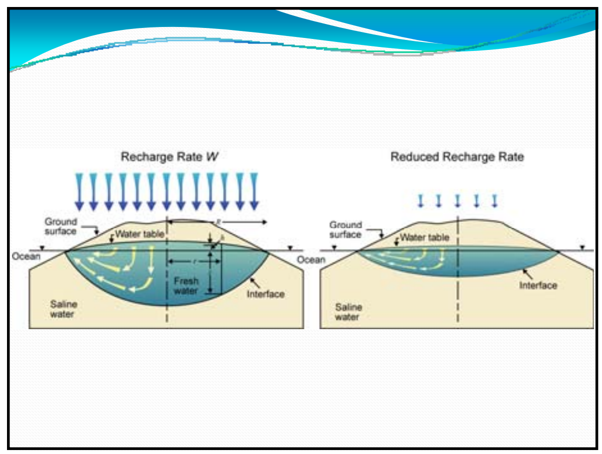
Similarly, a storm that has a 10% chance of occurring in any given year is termed a "ten-year storm." For example: A ten-year storm for Northern Guam occurs when a storm event produces 10.0 inches of rain in a 24-hour period.

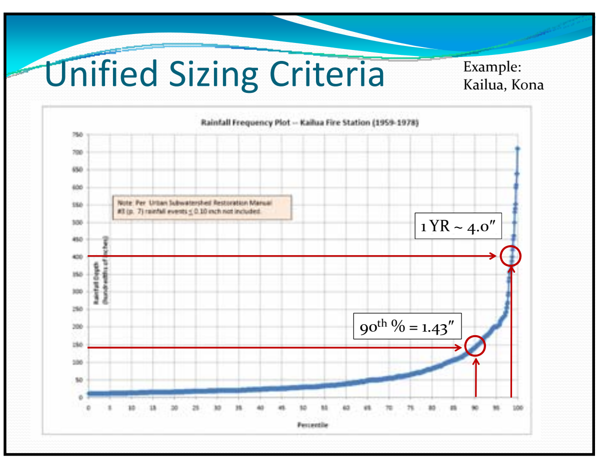
Rainfall Data Used to Derive Stormwater Management Criteria

- **Small-sized, frequently occurring storms** account for the majority of rainfall events that generate stormwater runoff AND for a significant portion of the annual pollutant loadings.
- **Larger storms** also have impacts - channel degradation, surface erosion, gullying, and flood damage.





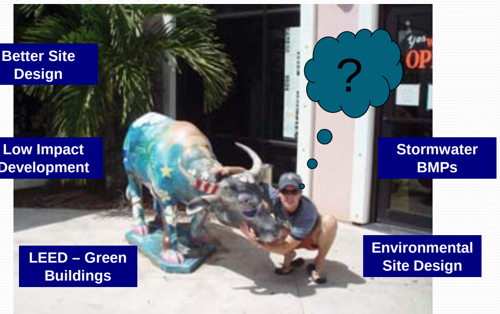




Typical Stormwater Sizing Targets

- Groundwater Recharge/Runoff Reduction
  - 90% in Limestone
  - Ave. annual recharge in Volcanic
- Water Quality
  - 90% for high quality waters & hotspots
  - 80% for moderate quality waters
- Channel Protection
  - Extended detention for 1-year storm (e.g., 3.5" for Northern Guam, 4.0" for Kailua, Hawaii)
- Flood Control
  - Peak rate control for 25-year storm (20 inches for Northern Guam)

The Choices



Bringing It All Together

First: Reduce Stormwater Runoff By Design

- Better site planning & design techniques
  - Preserve natural areas
  - Conservation design
  - Reduce clearing & grading limits
  - Reduce roadway widths
  - Use alternative cul-de-sacs
  - LEED sites
  - And more…

www.cwp.org > Online Store > Better Site Design

Second: Reduce Pollutants Carried By Stormwater Runoff

- Source control practices
  - Storm drain marking
  - Street sweeping
  - Covered fueling areas
  - Spill response plans
  - And more…
- Small Practices
  - Soil restoration
  - Downspout disconnection
  - Rain gardens/small bioretention
  - Rainwater harvesting
  - Permeable pavement
  - And more…

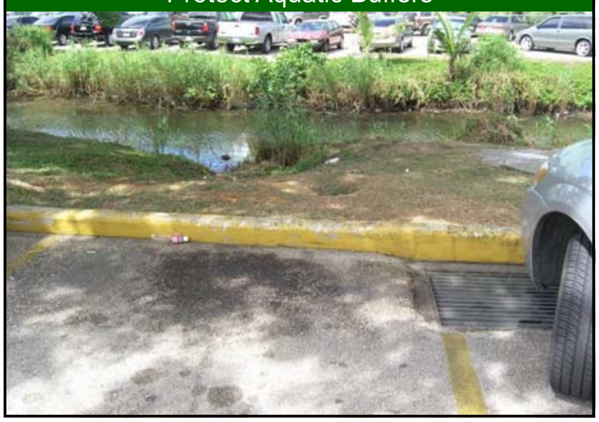
Third: Capture & Treat Remaining Stormwater Runoff

- Large Practices
  - Stormwater ponds
  - Stormwater wetlands
  - Larger bioretention
  - Infiltration
  - Sand filters
  - Swales
  - And more…

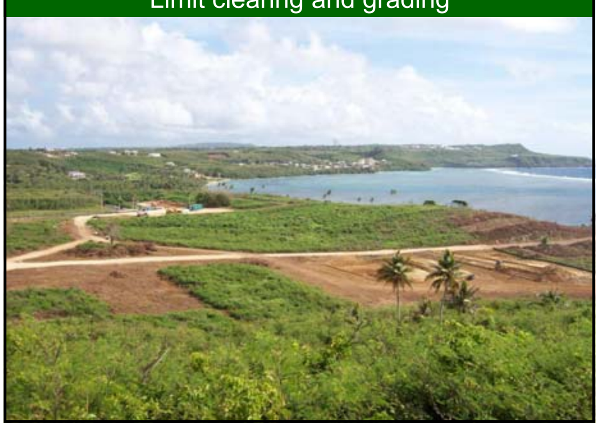
- Clearing and grading of whole site
- Wide streets and cul-de-sacs
- Lots of impervious cover
- Removal of native soils
- Enclosed drainage systems for stormwater conveyance
- Reliance on "hole-in-the-ground" detention basins & ponding basins

- Limited clearing
- Efficient use of impervious cover
- Taking advantage of natural hydrology
- Combination of small & large stormwater practices
- Conservation of natural areas

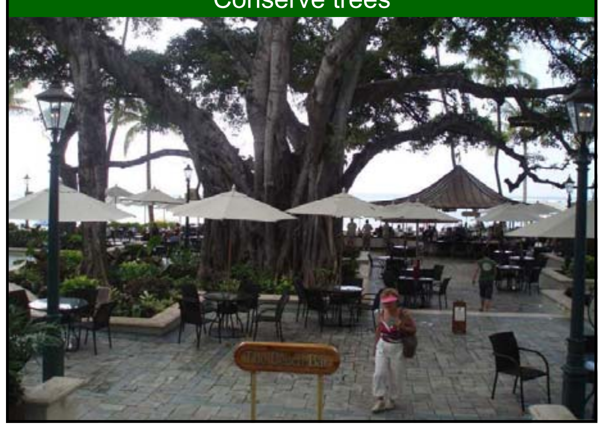
Protect Aquatic Buffers



Limit clearing and grading



Conserve trees




Conventional??


Minimize Cul-de-Sacs

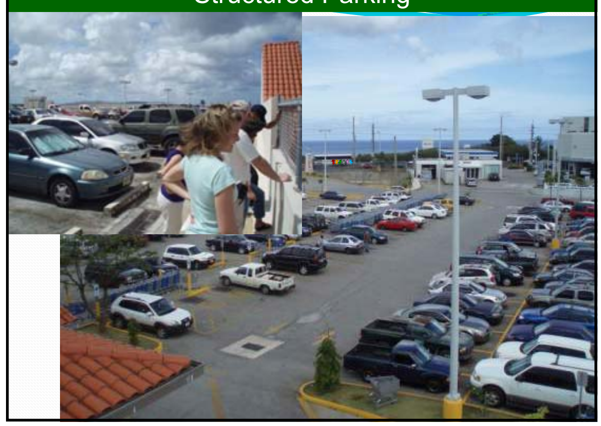

Disconnect Impervious Surfaces (Rooftops)


Downspout Disconnection

Reduce Parking Lot Imperviousness

- Set appropriate parking ratios
- Provide compact car spaces
- Minimize stall dimensions
- Incorporate efficient parking lanes
- Use pervious material in spillover areas

Structured Parking



Small Practices

Quick Review

- Rooftop Practices
- Rain Gardens
- Micro-Infiltration
- Green Roofs
- Vegetated Channels

More In-Depth

- Island Bioretention
- Permeable Parking
- Rainwater Harvesting

Managing Rooftop Runoff

Residential Rain Garden

- Max impervious area: 1,000 ft²
- Typical ponding depth = 6"
- Soil media = 18" to 24"
- Basic Sizing: SA = 3% to 5% of contributing Drainage Area
- Setbacks from foundations

Micro-Infiltration

- Minimum infiltration rate ≥ 0.5 inches/hour
- Use ½ field-measured rate
- Pretreatment required

Small-Scale Infiltration

Green Rooftops

Vegetated Channels

Managing Parking Lot Runoff

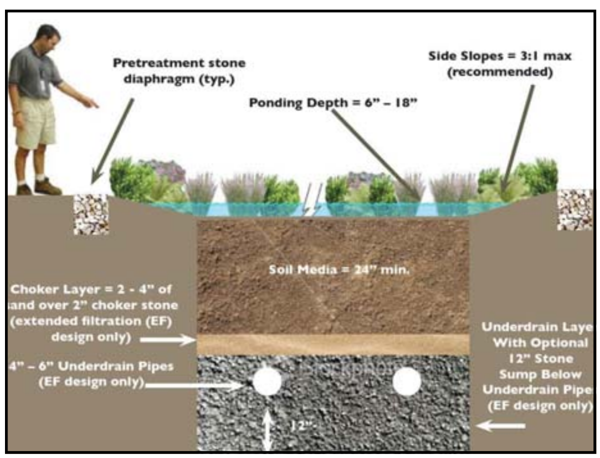
Island BMP Specifications


ISLAND STORMWATER
PRACTICE DESIGN
SPECIFICATIONS

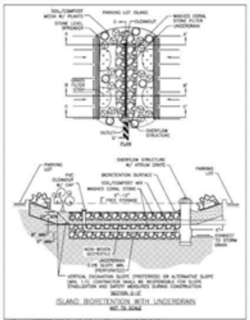
Small Island BMP Adaptations

- Island Bioretention
- Permeable Parking & Walkways
- Rainwater Harvesting

Island Bioretention Filter



Island Bioretention



Island Adaptations

- Coral Stone
- Limited Soil/Compost Media
- Flow Path from Coral Stone to Compost Media
- Island Plants
- Enhanced Pretreatment/By-Pass

Native Materials

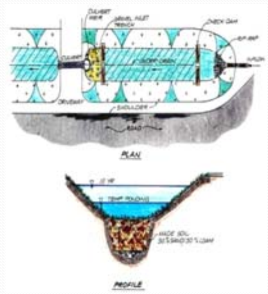
•Coral Stone

•Shredded Coconut Mulch

•Native Trees & Shrubs

Coral Stone & Island Plants

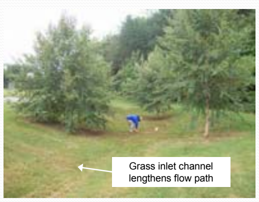
Linear Applications: Water Quality Swale

Benefits

- Criteria:
  - Groundwater Recharge
  - Water Quality
  - Partial Channel Protection/Flood Control
- Aesthetics – integrated with site design
- Community involvement
- Low to moderate maintenance

Geometry: Long Flow Path, Good Treatment



Long flow path from inlet to outlet

Geometry: Short Flow Path, Less Treatment



These practices have a lack of storage and treatment due to:

- Curb inlets too close to outlets
- Outlet structure flush with filter surface
- Direct or almost direct conveyance from inlet to outlet

Pretreatment

- Nature of pretreatment depends on size of bioretention area and type of flow it experiences
  - **Concentrated flow**: two cell design with a small trapping "forebay" and level spreader
  - **Sheet flow**: grass filter strip, stone diaphragm, stone ring berm


Pretreatment (types)

Grass Filter Strip

Grass Channel

Forebay

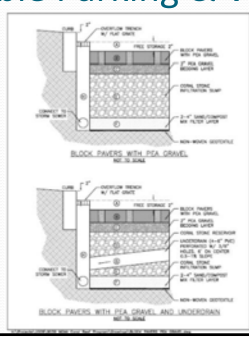
Stone Flow Spreader

Stone/Rip Rap Apron

Soil Media/Compost

Permeable Parking

Permeable Parking & Walkways



Island Adaptations

- Coral Stone – Limit "Dust"
- Sand/Compost Filter Layer at Bottom
- Underdrain

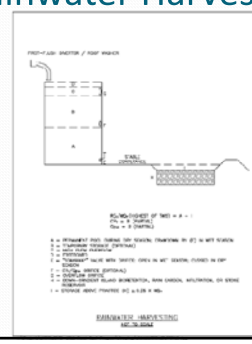
Island Applications

Benefits

- Criteria:
  - Groundwater Recharge
  - Water Quality
  - Partial Channel Protection/Flood Control (depends on thickness of base layer)
- Efficient use of land area – can help with cost
- Aesthetics (paver blocks)
- Low to moderate maintenance

Rainwater Harvesting

Rainwater Harvesting



Island Adaptations

- Uses of Rainwater
- Pre-Treatment Filter
- Treatment of Overflow (Downstream Practice)

Island Applications

Benefits

- Criteria:
  - Groundwater Recharge (if slow release to secondary practice)
  - Water Quality
  - Partial or Full Channel Protection/Flood Control (depends on tank size and drawdown)
- Efficient use of site
- Moderate cost
- Save potable water supply – e.g., Northern Aquifer
- Uses rainfall as a resource

Combining Practices

Site Design & Small Practices Take-Home Points

- Reduce impacts by design – reduce impervious & site disturbance
- Use small practices close to the source in combination with larger, end-of-system practices
- Use specifications to ensure proper design & to adapt to island conditions

Island Ponding Basins

Mainland Detention Basins HIGs

Remember the key Island technical factors?

- Hydrology (Rainfall, infiltration, evapotranspiration);
- Terrain;
- Geology - soils and geologic formations;
- Vegetation
- Near shore environment;
- Development patterns;
- Local capacity and experience; and
- Construction materials.

Island Design Considerations

- Soil Limitations;
  - Very shallow soils;
  - Limestone permeability;
  - Vegetation;
  - Erodability;
  - Nutrients?
  - Variability.

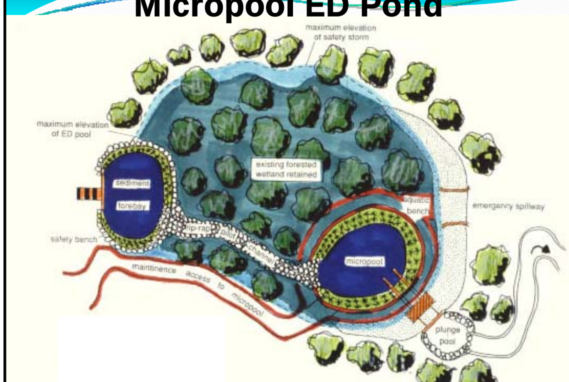
Soils Testing and Materials

Design Features of Ponds/Wetlands

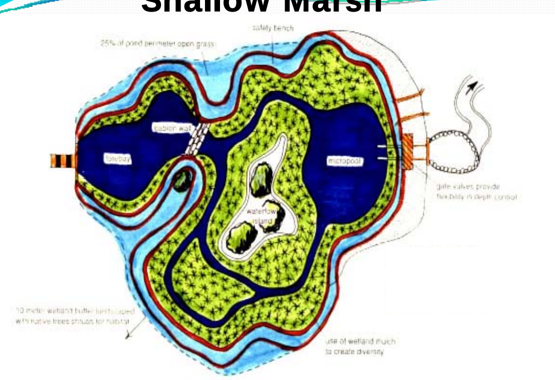
(for enhanced pollutant removal and overall performance)

- Treatment of WQv
- Multiple treatment pathways
- Pond geometry
- Sediment forebay
- Non-clogging outlet structure
- Assess to outlet structure
- Emergency spillway
- Embankment specifications
- Inlet/outlet protection
- Pond benches/safety features
- Landscaping plan
- Buffers and setbacks
- Maintenance access and considerations

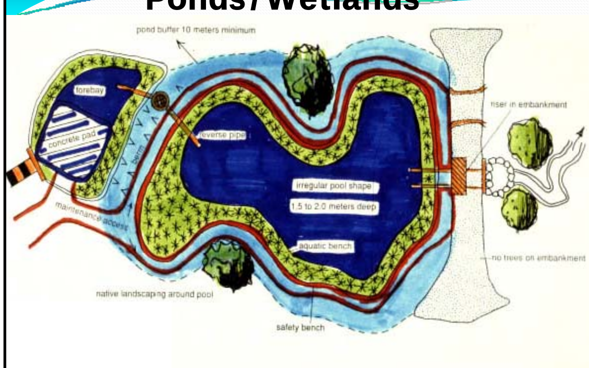
Micropool ED Pond



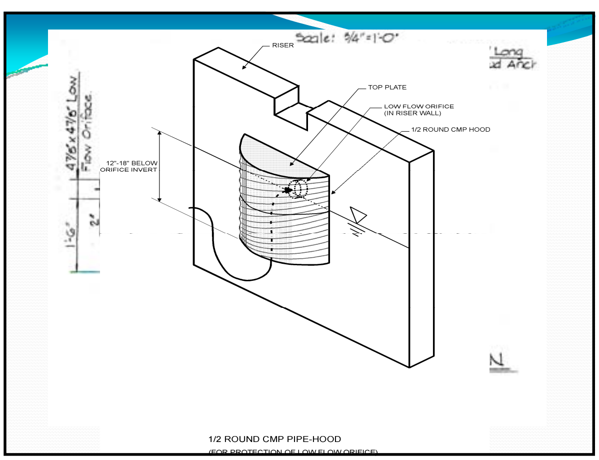
Shallow Marsh

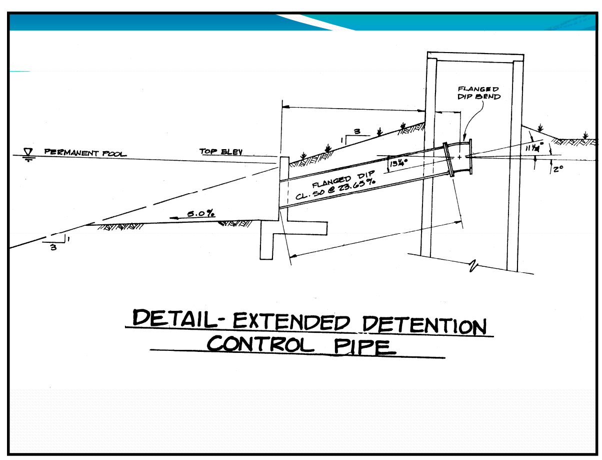


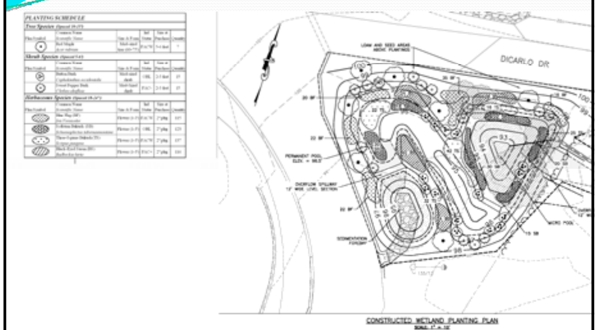
Ponds/Wetlands




Riser Box
Dam Embankment
Trash Racks
Permanent Pool
BMP12 Extended Detention Basin
Malcolm Brook Subbasin


Scale: 3/4"=1'-0"
RISER
TOP PLATE
LOW FLOW ORIFICE
(IN RISER WALL)
1/2 ROUND CMP HOOD
12"-18" BELOW
ORIFICE INVERT
1'-6"
2"
1/2 ROUND CMP PIPE-HOOD


FLANGED
DIP BEND
PERMANENT POOL
TOP ELEV
FLANGED DIP
CL. 50 @ 23.63%
5.0%
DETAIL- EXTENDED DETENTION
CONTROL PIPE

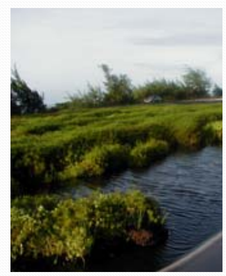


Micropool ED Pond: Design Notes

- Micropool and forebay prevent resuspension and clogging;
- Useful for fingerprinting;
- Lower community acceptance;
- Inundation may harm vegetation;
- Cost effective urban retrofit option.

Shallow Marsh: Design Notes

- Deeper forebay and micropool are essential;
- Shallow depths over remaining surface area;
- High surface area to volume ratio;
- Complex internal microtopography;
- Potential wildlife habitat creation;
- Consumes most land of any pond/wetland option.



Wet Pond: Design Notes

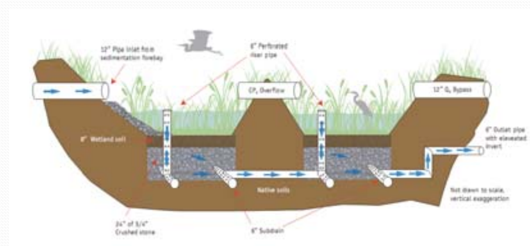
- Algal uptake/settling increases nutrient removal:
- Documented improvement in adjacent property values:
- Careful location to prevent environmental impacts:
- Benches create fringe wetlands.

Multiple Pond System: Design Notes

- Highest pollutant removal observed of any pond option
- Long flow path is key in removal
- Useful option at complex or linear sites
- Internal cells can be formed by gabions or earthen embankment

Gravel Wetland

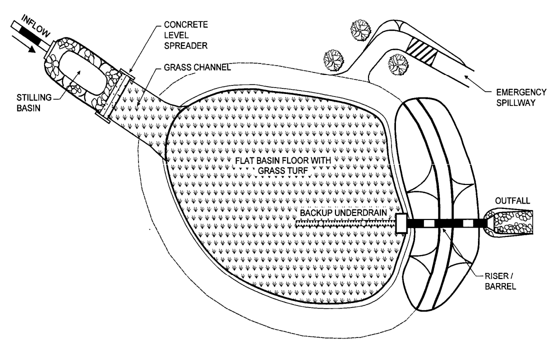
Gravel Wetland Schematic



Submerged Gravel Wetland: Design Notes

- Adapted from wastewater treatment applications;
- Algal growth on rock surfaces promotes greater uptake;
- Additional maintenance includes pump-out of "muck."

Infiltration Basin

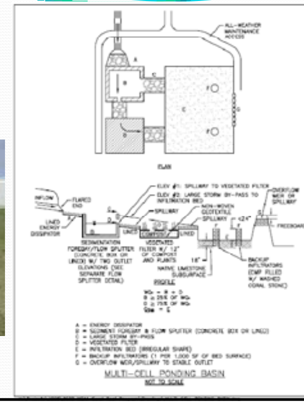


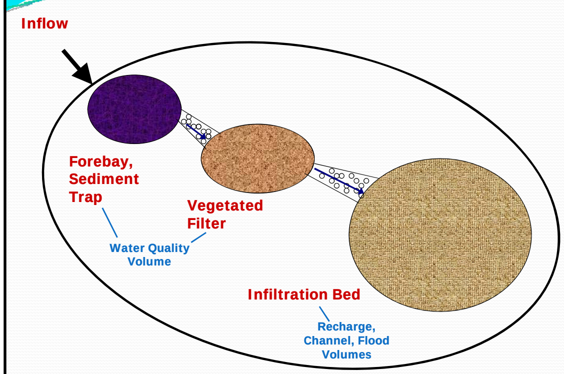
Infiltration Basin: Design Notes

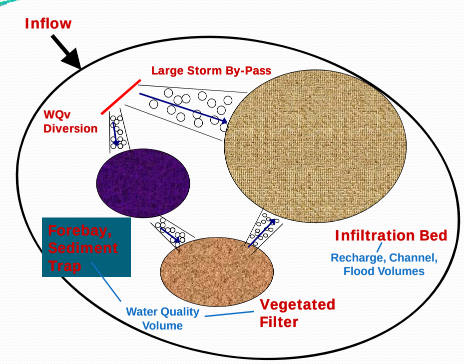
- Pretreatment essential (dry or wet sedimentation, filter strips, grass channels);
- Frequent maintenance necessary to retain soil permeability;
- Limiting use to small sites may reduce some potential problems.
- Field verification of soil permeability essential;

Multi-Cell Ponding Basin

Multi-Cell Ponding Basin







Benefits

- Criteria:
  - Water Quality (Pre-Treatment)
  - Groundwater Recharge
  - Channel Protection
  - Flood Control
- Adapt Common Practice;
- Low to moderate maintenance.

Ensuring BMP Effectiveness

Planning and Design

- Good planning (concept plans, integrated with site design);
- Good design and agency review;
- Designer should envision maintenance requirements;
- Plan sheet(s) showing practice locations/types and maintenance access (easements); and
- O&M plan includes required inspection and maintenance frequency and estimated annual costs.

Ensuring BMP Effectiveness (Cont.)

Construction

- Clearly defined construction specifications and bidding documents;
- Contractor expertise (minimum qualifications/experience identified in bid docs);
- Construction layout by a surveyor;
- Pre-construction meeting and regular progress meetings;
- Construction observations at clearly identified milestones (by the designer where possible – using checklists);
- Interim and final As Built plans.

Ensuring BMP Effectiveness (Cont.)

Maintenance

- Make short-term maintenance easy (e.g. forebay with easy access for sediment removal);
- Implement long-term vegetation management;
- Incorporate progressive enforcement and corrections;
- Instill owner inspection co-responsibility

Take Home Points
BMP Effectiveness

- Amount of runoff reduction achieved by practice;
- Estimated pollutant removal based on prior monitoring
- Contributing drainage area to a BMP
- Annual precipitation fraction that is captured by a BMP
- Criteria employed for the design/implementation
- Construction inspection/enforcement capabilities of watershed managers
- Maintenance performed over the long term

WATER RESOURCES IMPACT

ADAPTING STORMWATER BMPs FOR TROPICAL WATERSHEDS AND CORAL REEF PROTECTION

David Hirschman and Kelly Collins

INTRODUCTION

Due to its proximity to the Indo-Pacific center of marine biodiversity, the coral reef environments in Guam and the Commonwealth of the Northern Marianas Islands (CNMI) host some of the richest ecosystems among the United States (U.S.) jurisdictions (Burdick *et al.*, 2008). However, negative impacts of existing island development on coral reef ecosystems are already known and evident. Pollution from stormwater runoff and construction activities, problems with aging infrastructure (e.g., sewer overflows), overfishing, and recreational overuse have contributed to problems including reef sedimentation, excessive algal growth, coral bleaching, and coral disease. The result has been a significant decline in the health of the coral reef ecosystems. According to the Guam Division of Aquatic and Wildlife Resources, fish populations associated with the Coral Reef alone declined 70% from 1987 to 2002 (Turgeon *et al.*, 2002).

As part of the U.S. military base realignment and closure (BRAC) activities, the island of Guam is anticipating receiving an estimated 40,000 additional military personnel and their families, and an additional 20,000 civilians over the next few years, or approximately a 30% increase over the existing population. As a result of this realignment, the island will be undergoing rapid development over a very short time period. In order to better protect sensitive coral reef ecosystems against future land-based sources of pollution, the Center for Watershed Protection and the Horsley Witten Group worked with the Guam Coastal Management Program, Guam Environmental Protection Agency, and the National Oceanic and Atmospheric Administration Coral Program to produce guidance on designing and building innovative and island specific better management practices (BMPs) appropriate for use in tropical climates.

Islands are a challenging environment for stormwater BMP designs due to a limited availability of local materials, tropical rainfall patterns, wet and dry seasons, and limestone and volcanic underlying soils. Of paramount interest is promoting BMP designs that can help protect coral reef ecosystems as land is developed. This involves addressing pollutants of concern (sediment, nutrients, bacteria, temperature) and controlling the quantity and quality of discharges to the near shore environment and its tributaries.

The original *CNMI and Guam Stormwater Design Manual* was produced by the Horsley Witten Group in 2006 (Horsley Witton Group, 2006). The *Manual* outlines standards and specifications for meeting "post-construction" stormwater criteria. These criteria outline the storage requirements for practices that are installed on a permanent basis once site construction is complete (thus the term "post-construction"). Various criteria apply to groundwater recharge, water quality protection, downstream channel erosion protection, and flood control. Since the *Manual* was produced, various efforts have taken place to incorporate the BMPs into policy and practice on the islands.

The current effort involves expanding the list of BMPs to include several innovative practices and adapting designs for the island environment. The new BMPs include: (1) multi-cell ponding basins, (2) island bioretention, (3) permeable parking, and (4) rainwater harvesting. New design specifications include information on BMP feasibility, sizing computations, design procedures, materials, construction guidance, landscaping, maintenance, and standard details.

Currently, the most commonly designed BMPs on the island are large, end-of-pipe ponding basins designed primarily to infiltrate water. Few of these practices are designed with pretreatment in mind, despite the rapid infiltration of stormwater into the groundwater drinking supply. Many of these ponds may not meet island infiltration and water quality criteria.

At the beginning of this process, the project team facilitated a design charette involving design professionals, architects, and engineers who were active in site planning and plan review. The purpose of the charette was to solicit ideas and input on BMPs that would be most appropriate for use in Guam. Feedback from this charette was used to advance the development of the four BMP specifications. It is anticipated that these specifications and fact sheets will be incorporated by reference into the *Manual*, and the designs will support the post-construction stormwater criteria in the *Manual* and also in Guam's proposed revisions to erosion control regulations.

It is also quite feasible that these specifications, along with other tropical BMPs, can be adapted to other tropical locations, such as the Caribbean. Modifications would be needed to account for local materials and rainfall patterns.

Tropical islands that are experiencing development pressure are in critical need of stormwater management practices that can help protect coral reef ecosystems and near-shore environments ... four innovative stormwater practices adapted to the tropical environment of Guam are presented

Each section below briefly describes the practice and its island adaptations along with an example of the typical details. The full specification document should be consulted for all the particular details on a certain practice.

PRACTICE NO. 1: MULTI-CELL PONDING BASINS

This specification adapts the most commonly used stormwater practice in the limestone regions of CNMI and Guam (the "ponding basin," see Figure 1) to meet the water quality requirements of the *Manual*. The adaptations involve incorporating multiple cells in order to manage all of the required sizing criteria. Whereas a ponding basin constructed in limestone generally provides recharge (until clogging occurs) and manages runoff volumes for large storm events, it does not provide water quality treatment and is not acceptable as a stand-alone system under the requirements of the *Manual*. However, by adding a pretreatment and a filter cell to the system, all requirements can be met.

Figure 1. Example of an Existing Ponding Basin on Guam With a Forebay (concrete structure on left).

This system combines the concepts of bioretention as well as infiltration to meet all of the stormwater management goals (see Figure 2 for standard details). Multi-cell ponding basins are very versatile because the multiple cells can be designed with varying geometry to fit into different development sites. This system is generally suitable for most land uses, as long as the drainage area is limited to a maximum of about ten acres.

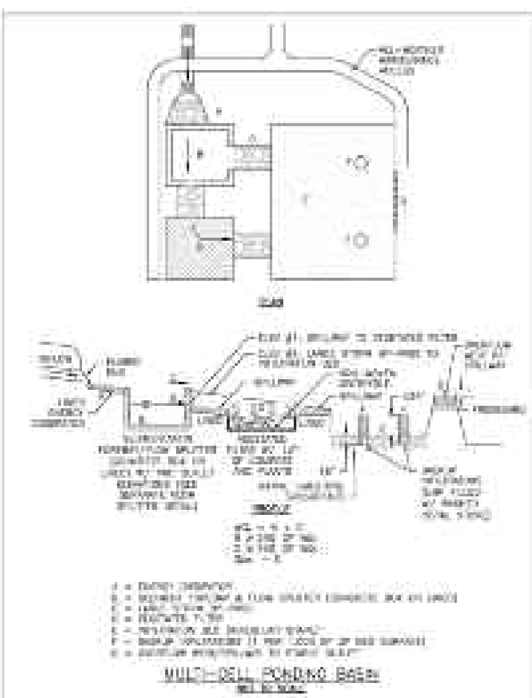


Figure 2. Plan View and Profile for a Multi-Cell Ponding Basin.

PRACTICE NO. 2: ISLAND BIORETENTION

Bioretention was developed in the U.S. Mid-Atlantic mainland area and was originally designed to replicate the pollutant removal mechanisms of a forested ecosystem. Since that time, the concept has been adapted to other regions and climates. This specification adapts the concept of bioretention to the tropical island environment of CNMI and Guam. The adaptations involve substituting native materials for filter bed components that are unavailable and would be expensive to import, modifying designs to account for wet and dry seasons, and specifying locally available plant materials (see Figure 3).

Figure 3. Example of "Coral Stone" Filter on Guam. This contains same (but on all) of the adaptations for Island Bioretention.

There are two basic design adaptations for "Island Bioretention:" (1) ***Infiltration Design*** – Design without an underdrain for sites where soil testing indicates suitable infiltration rates, relatively low water tables, and a low risk of groundwater contamination (e.g., not located at a stormwater hotspot). Figure 4 provides an example of the standard details; and (2) ***Filter Design*** – Design with an underdrain for sites where native soils do not percolate as readily (less than 0.5 inch per hour). These designs still incorporate some level of infiltration, especially during the dry season, by providing a stone "sump" below the underdrain pipe.

PRACTICE NO. 3: PERMEABLE PARKING AND WALKWAYS

Permeable parking and walkways are alternatives to the conventionally paved surfaces they allow stormwater runoff to filter through voids in the pavement surface into an underlying stone layer, where it is temporarily stored and/or infiltrated (Figure 5). All permeable pavements have a similar structure, consisting of a surface pavement layer, a bedding layer, an underlying stone layer, a filter layer and a geotextile installed on the bottom. While a variety of permeable pavement surfaces are available, this specification focuses on the use of permeable interlocking concrete pavers (PICP) and concrete grid pavers (CGP), which are more commonly found in CNMI and Guam (Figure 6).

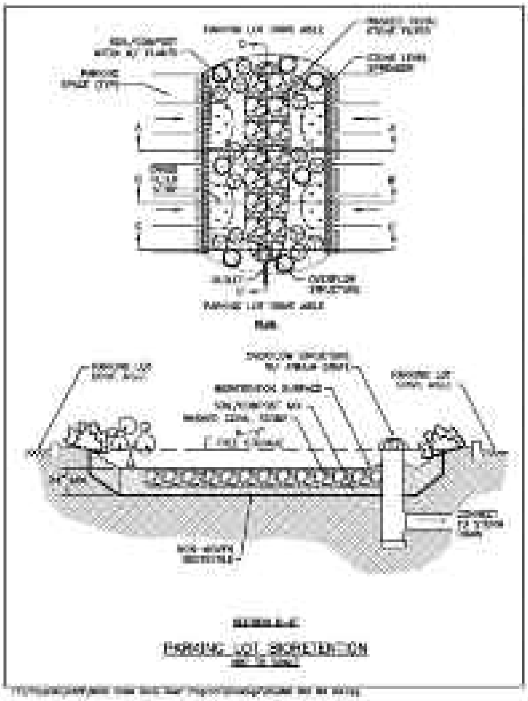


Figure 4. Example of a Plan and Profile for the Island Bioretention Infiltration Design.

Figure 5. Example of Permeable Parking on CNMI.

The thickness of the underlying stone layer is determined by both a structural and hydrologic design analysis. This layer serves to retain stormwater and also supports the design traffic loads for the pavement. As with Island Bioretention, there are two basic design adaptations for Permeable Parking and Walkways – the infiltration design (no underdrains) and the filter design (with underdrains).

This type of system is recommended for CNMI, Guam, and other tropical locations to reduce the volume of stormwater generated and encourage groundwater recharge. These practices may also provide some water quality benefit as stormwater is filtered through a soil/compost mix layer.

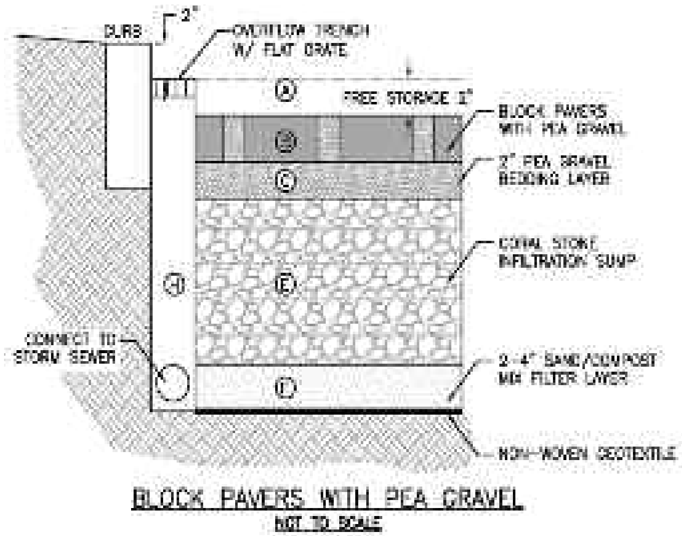


Figure 6. Cross-Section for Permeable Interlocking Concrete Paver (PICP) Infiltration Design

PRACTICE NO. 4: RAINWATER HARVESTING

Rainwater harvesting systems intercept, divert, and store rainfall for future use (Figure 7). Rainwater that falls on a rooftop is collected and conveyed into an above-ground or below-ground storage tank where it can be used for nonpotable water uses and on-site stormwater infiltration. Nonpotable uses may include flushing of toilets and urinals inside buildings, landscape irrigation, exterior washing (e.g., car washes, building facades, sidewalks, street sweepers, fire trucks, etc.), fire suppression (sprinkler) systems, supply for chilled water cooling towers, dust control, replenishing and operation of water features and water fountains, and laundry, if approved by the local authority. Replenishing of pools may be acceptable if special measures are taken, as approved by the appropriate regulatory authority.

Figure 7. Example of Rainwater Harvesting on Guam.

In certain cases, harvested rainwater can be used for small-scale potable water supply if approved by the proper regulatory authority. Appropriate treatment systems to treat water to potable standards would need to be added to the system components. Many tropical locations have historic and cultural traditions of rainwater harvesting, so the current specification is an attempt to revive the practice and adapt it specifically for stormwater management.

This type of system is recommended for CNMI, Guam, and other tropical environments to (1) reduce the volume of stormwater generated and (2) to relieve pressure on the potable water supply. This can be particularly relevant for Guam's northern aquifer region, where both recharge and reducing demand may be important objectives in light of increased demand for this resource. Rainwater harvesting (Figure 8) can be adapted to the wet season and dry season conditions by adding a "soak-away" valve to help drain the tank during the wet season and/or adjusting the indoor and outdoor uses of the water.

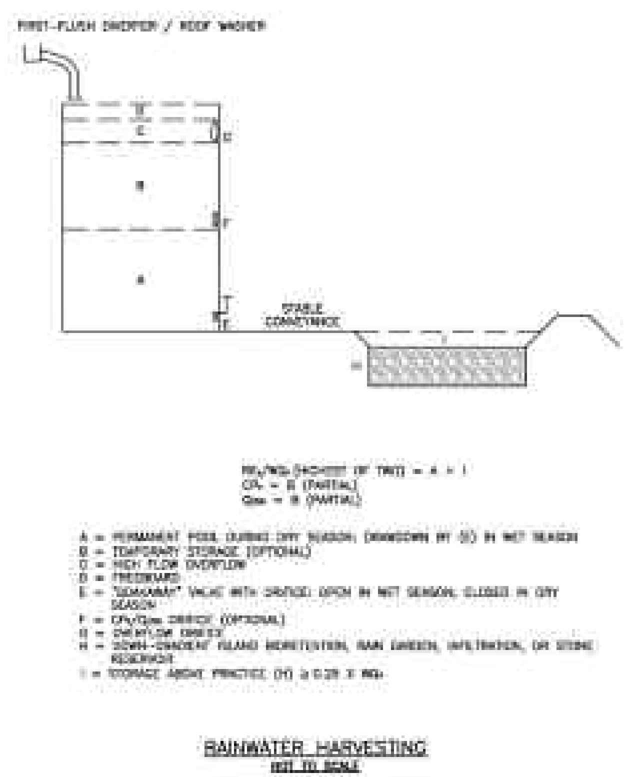


Figure 8. Typical Configuration for an "Island" Rainwater Harvesting System.

CONCLUSION

Tropical islands are a challenging environment for stormwater best management practice (BMP) design due to a limited availability of local materials, tropical rainfall patterns, wet and dry seasons, and limestone and volcanic underlying soils. Of paramount interest is promoting BMP designs that can help protect coral reef ecosystems as land is developed. This involves addressing pollutants of concern (sediment, nutrients, bacteria) and controlling the quantity and quality of discharges to the near-shore environment and its tributaries. Tropical jurisdictions should continue to explore and adapt stormwater BMP designs to match local conditions and applications. The four practices presented in this article may be a good starting point, and other "tropical" BMP adaptations are also encouraged.

ACKNOWLEDGMENTS

The authors would like to acknowledge the substantial contributions of our design team partners from the Horsley-Witten Group: Anne Kitchell, Michelle West, and Rich Claytor. Tom Schueler from the Chesapeake Stormwater Network also contributed ideas and specification language to these island designs. Alex Foraste was instrumental in developing content for the rainwater harvesting specification.

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David J. Hirschman has served as a Program Director for the Center for Watershed Protection since 2005. In this capacity, he helps coordinate the Center's stormwater, better site design, local restoration, and training projects, focusing on technical and program tools for use by local and state governments. He has over 25 years of experience with water resources and stormwater management in the public, private, and nonprofit sectors.

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Session J: Stormwater and Pollution Prevention Field Trip

2011 Pacific Island Watershed Institute

Description: Rotate through three site stations to: 1) learn the ins and outs of rain garden design, construction, and maintenance; 2) explore the various applications of compost socks for managing construction site runoff and long-term slope protection; and 3) put on your pollution prevention hat and identify structural and non-structural approaches for managing pollution at a nearby boat landing.

Speakers:

- Todd Cullison, Executive Director, Hui o Koolaupoko, www.huihawaii.org
- Adrian Sanchez, Certified Erosion Control Hawaii
- Michelle West, Horsley Witten Group

Agenda/Notes:

1. Instructions to group and compost sock Installation Video

2. Divide into three groups

3. Rotate through three stations. You will have approximately 45 minutes at each station.

Station 1. Rain Gardens. Meet in classroom. See handouts.

Station 2. Silt socks Demonstration. Meet at designated area in He'eia parking lot

Station 3. Meet at boat landing. See handouts/map. The best route for walking to the sites will be announced. Please be extremely careful walking to the boat landing.

Station 1: Rain Gardens

The following information is a summary from several rain garden guides. *The Oregon Rain Garden Guide*, (Oregon State University, Sea Grant) was heavily referenced for this information and may not be accurate for the State of Hawaii or other Islands. However, it will provide PIWI participates with the basics of building a rain garden. For more information, see:
http://seagrant.oregonstate.edu/sgpubs/onlinepubs/h10001.pdf

Step 1. Map your site. Draw a schematic of your property. Include structures such as trees, retaining walls, other property, cesspools, etc

Step 2. Determine location of your rain garden

- ✓ Several issues need to be considered before determining the exact location of your rain garden, before building, your rain garden should be:
  - Two feet from a crawl space or slab
  - Three feet from a sidewalk/driveway
  - Six feet from a basement
  - Ten feet from a retaining/decorative wall

- ✓ Additionally, you should not build your rain garden:
  - On top of a septic drain fields or cesspool, provide a minimum of 50 feet between your rain garden and these structures
  - Areas that stay consistently wet during the rainy season, this indicates poor drainage
  - In soils that have drainage of ½ inch per hour infiltration or bedrock
  - Under trees or within close proximity that roots will be damaged during digging

Step 3. Percolation test. The last step in determining the location of your rain garden is based on a simple soil percolation test. You should not build a rain garden if the soil has less than ½ infiltration per hour. To conduct a soil percolation test, follow the attached sheet. Use the following chart as a guidance based on your results:

Drainage rate	Recommendation
Less than 1/2 inch per hour	Do not build a rain garden on this site without professional assistance
Between 1/2 and 1 inch/hour	Low infiltration for a rain garden. Homeowners may want to build a larger or deeper garden, or likewise plan for additional overflow during high-rainfall storms
Between 1 and 1 1/2 inches/hour	Adequate infiltration for a rain garden. Plan for sufficient overflow during high-rainfall storms
Between 1 1/2 and 2 inches/hour	Adequate infiltration for a rain garden. Plan for sufficient overflow during high-rainfall storms
Faster than 2 inches/hour	High infiltration for a rain garden. Design should feature fewer moisture-loving and more drought-tolerant plants. The rain garden may also be sized to hold smaller amounts of water, have a deeper mulch layer, or have denser plantings.

Chart: OSU, Sea Grant: The Oregon Rain Garden Guide

Determine the size of your rain garden. The size of your rain garden is based on the amount of impervious surface you want to treat as well as rainfall intensity. Most rain garden document research suggest a 10% sizing. Using the example below, if your treatment area is 200 square feet, your rain garden should be ten percent of the treated area.

(Width of Surface Area x Length of Surface Area) x.10 = size of rain garden Example: 20 eet x 10 feet = 200 sq ft. x.10 = 20 sq ft.

What you will need for Construction

- ✓ List of tools
  - Shovel(s)
  - Hammer(s)
  - Gloves
  - Rope or garden hose (to outline footprint)
  - 3' level
  - Wheel barrow
  - 10" x 10" blue tarp
  - Two stakes
  - Survey line (two is best)
  - Line Level (two is best)
  - Measuring Tap
  - Calculator

- ✓ Call for utilities location
- ✓ Delineate your rain garden with rope, garden hose, surveyors paint
- ✓ Excavate to desired depth
- ✓ Connect water source (underground pipe, rock line channel, etc.)
- ✓ Construct over flow. Make sure overflow is not directed at other property of other structures as noted above.

Choosing the Plants

- ✓ Plants will be specific to each Island and rainfall regime. Check with University Extension, NRCS or other resources to determine best match for locale climate
- ✓ Don't plant invasive vegetation in your rain garden
- ✓ Don't use edible plants when collecting drainage from roads, driveways, or parking lots

Don't forget about Maintenance

- ✓ Weeding
- ✓ Plant replacement

Notes

Testing Soil for Rain Gardens

The quality of your soil—its ability to hold and drain water is one of the most important considerations for understanding your site and sizing a rain garden. How fast your soil drains depends on its ability to absorb water at the surface and then allow it to percolate down into the lower layers. The constituent parts of the soil, organic matter, sand, silt, and clay all play into this ability. Testing soil also helps you find out if high water tables and underlying bedrock may make a rain garden impractical on a site.

There are two steps for assessing your site's soil. First, you will dig a hole and test the soil's infiltration ability. Then you will use your senses to learn about the consistency of the soil and its constituent parts.

Testing Infiltration: the Simple Approach

1. Dig a test hole in the area where you expect to build your rain garden. Try to site the hole so that it is in what you think will be the middle of your garden. If your garden will be 6 inches in depth, then excavate to 6 inches (or 9 or 12 inches respectively). Set the spoils from your hole aside for a "feel" test later.
2. If you run into a hard layer that cannot be penetrated with a shovel or, you come across water in the hole, then stop and note this. Rain gardens should not be sited over high water tables, so your site is inappropriate. If your hard surface is rock, you may also want to move the rain garden to another location where you don't have that layer.
3. Fill the hole with water to just below the rim. Record the exact time you stop filling the hole and the time it drains completely.
4. Refill the hole again and repeat step 3 <u>twice more</u>. The third test will give you the best measure of how quickly your soil absorbs water when it is fully saturated as it would be during a rainy period of the year or during a series of storms that deliver a lot of rainfall in a short period of time. Building a rain garden to handle these conditions is a way to be safe that you will not cause damage to your own or a neighbor's property.
5. Divide the amount the water dropped by the amount of time it took for it to drop. For example, if the water dropped 1 inch in 2 hours, then 1 divided by 2 equals 0.5 inch per hour of infiltration.

Testing Infiltration: the Modeling Approach

1. Dig a hole to the proposed rain garden depth (6, 9 or 12 inches).
2. Fill with water, measure depth, record time and depth.
3. Measure depth and record time at regular intervals until water drains completely. If the water drains quickly, then check it at least every minute. If it drains slowly, check it every 10 minutes for at least an hour or until all of the water is gone. Record the distance the water had dropped from the edge of the hole.
4. Calculate infiltration rate for **each time period** = depth (inches) / time (hours)
5. Repeat process at least two more times or until the slowest measured rate does not vary.
6. The slowest rate measured is the "design" infiltration rate and can be used with a sizing table and precipitation map, provided separately.

Note that some jurisdictions require the slowest rate to be divided by 2 as a safety factor, thus increasing the size of the rain garden.

Interpreting the Infiltration Test(s)

If your soils drained water between 0.5 and 2 inches per hour, then you have adequate infiltration for a rain garden. If you drained faster than 2 inches/hour, then you will need to plan for more drought-tolerant plants in your rain garden, since it will likely absorb most of the water at the inflow points.

If you have less than 0.5 inches per hour of infiltration, then you should not build a rain garden at that site. Most local governments will not allow a rain garden to be installed in a site where soils are poorly drained (below 0.5 inch/hour), over high water tables, or over close to the surface bedrock.

Using the "Feel" Test for Soil Consistency

1. Take a handful of the soil you have excavated from your infiltration test. Pulverize it in your hand and remove any bits of organic matter or obvious rocks.
2. Wet it with a small amount of water and rub it between your thumb and index finger. Don't saturate it until it is runny mud. You might feel stickiness, grittiness or smoothness. The grittier the feel, the more sand is present in your soil. The slicker the soil, the more clay in it. Smooth soils are sometimes an indicator of a fine silt or loam. Discard the soil.
3. Next, take another sample in your hand. Wet it until it has the consistency of dough. You should be able to form a ball with the soil in your palm that holds together. If you cannot get the ball to form, then your soil is very sandy. In most soils, however, you should be able to create a rough ball.
4. Knead the soil together between your thumb and fingers. Again, remove any obvious organic matter or rocks. You should be able to form a ribbon with the soil. As you build the ribbon, it will either hold together or break off. If the soil breaks quickly in the process, then it has a high sand content. If the ribbon forms quickly and stays strong, it has more clay.

Interpreting the Soil Consistency Test and Using it with the Infiltration Test

Soils that have a high sand content will drain quickly and might need to have some amendments added to increase moisture holding ability during the dry periods. Alternatively, you may want to plant more drought tolerant plants in rain gardens with sandy soils.

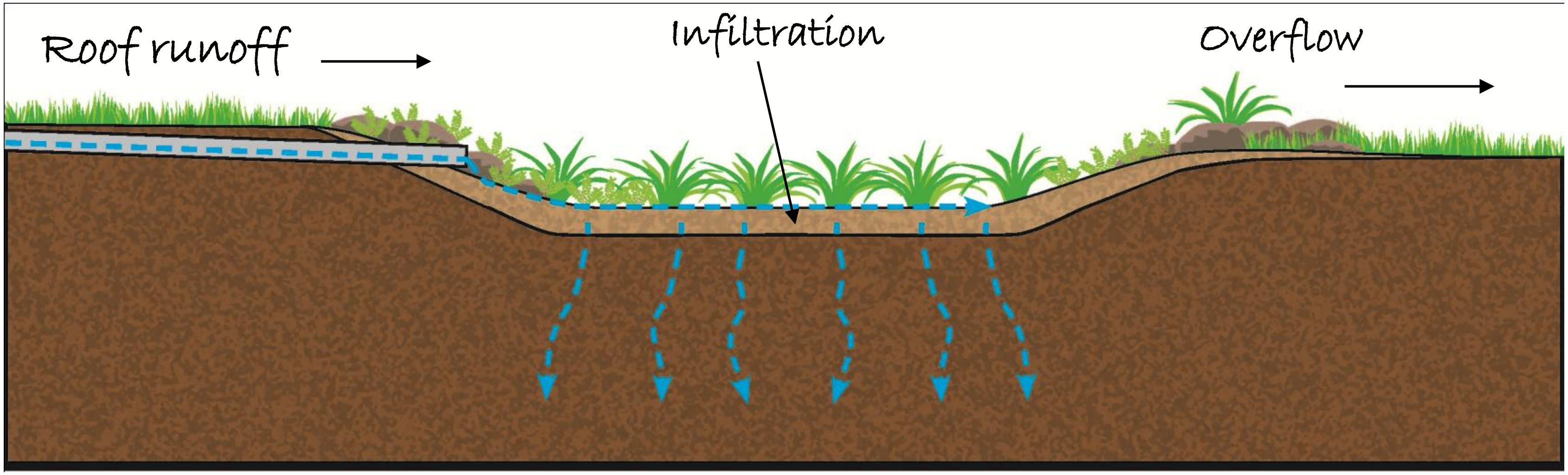
Soils with high clay content will drain slowly or sometimes, not at all. High clay soils will need some organic matter added to increase infiltration. Conversely, you may need to plan for a larger rain garden (doubling the size for example) or a constructing a deeper basin (12" instead of 6" for example) that will hold more water. With high clay soils, plan for plants in that type of soil that will be flooded more often and for longer periods. Even on the coast, however, these plants may need to be irrigated in the summertime or should be tolerant of drought during a 2-3 month period.

hui o ko'olaupoko

To protect ocean health by restoring the 'āina: mauka to makai

What is a Rain Garden?

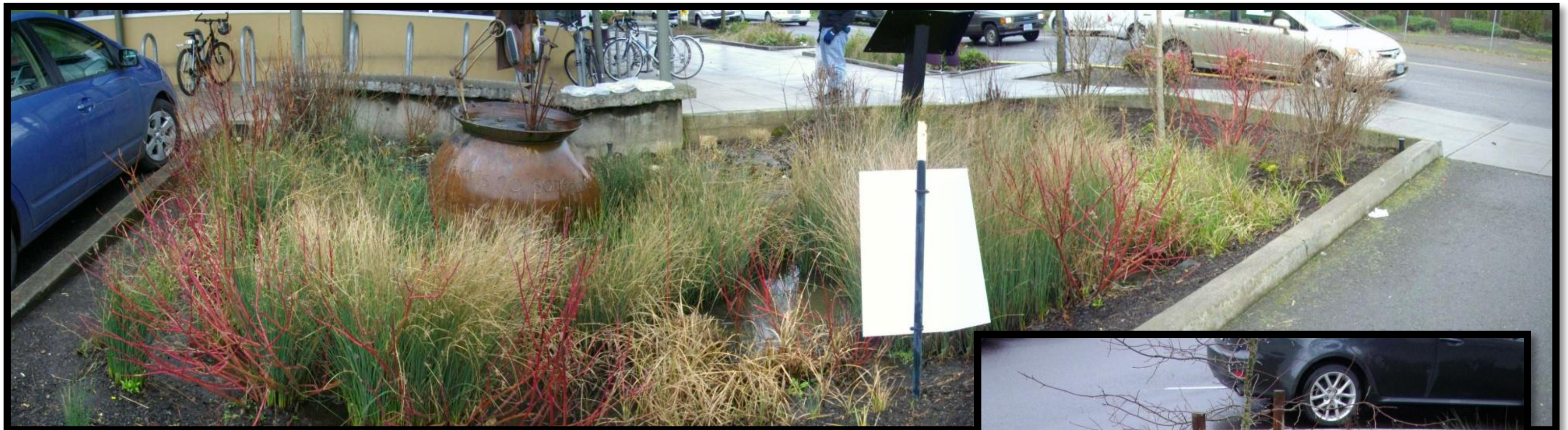
A rain garden is a constructed depression planted with native or non-invasive vegetation that allows storm water from impervious surfaces such as roofs and driveways, to collect, briefly store and then infiltrate into the groundwater.

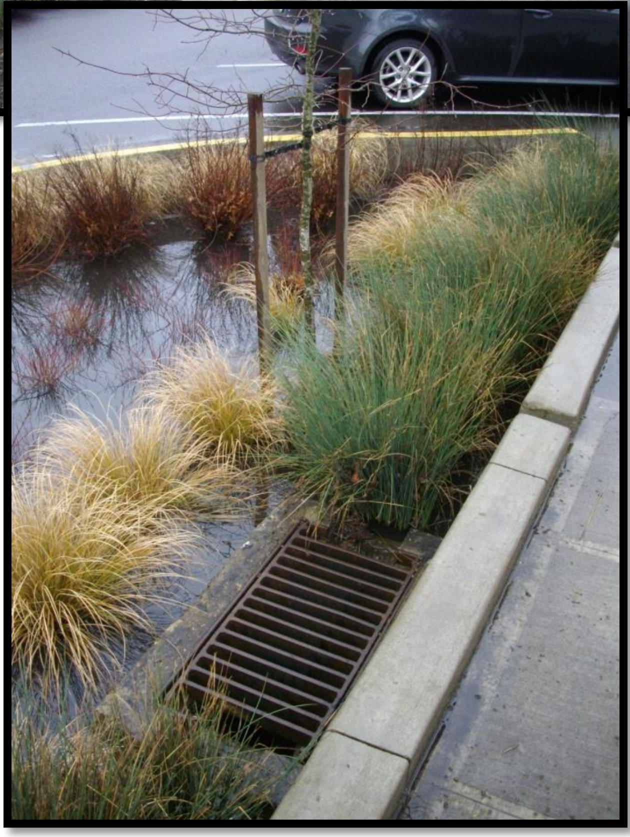


Outline of Presentation

- What is a Rain Garden?
- Examples of Rain Gardens
- Rain Garden located at He‘eia State Park
- Elements of a Rain Garden (outside with a garden hose)

Various Applications



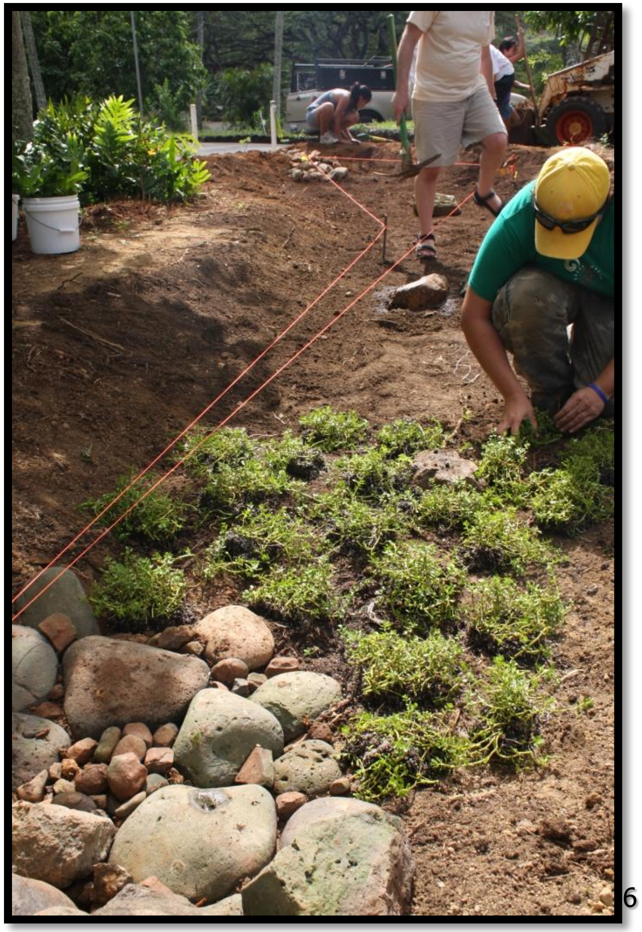


HOK’s Rain Garden Co-op

- Developing Hawaiʻi Rain Garden Manual
- Building/cost sharing 50 rain gardens with Koʻolaupoko homeowners

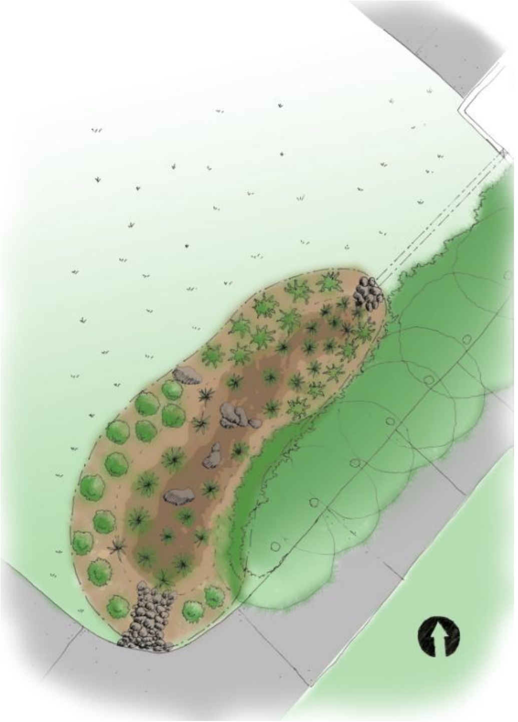
Rain Garden at He'eia State Park

- University of Hawaiʻi Sea Grant
- Oregon State University Sea Grant
- Kamaʻāina Kids
- EPA/DOH 319 funded



Elements of a Successful Rain Garden

- Mapping your site (house, structures, vegetation, etc.)
- Determining location of your rain garden
- Percolation test
- Size of your rain garden
- Construction
- Plants
- Maintenance



Station 3: Pollution Prevention at the Boat Landing

1. What are the potential sources of pollution at this site?

2. What could be done to reduce pollutants generated at this site?

A. Education

B. Non-structural

C. Structural

Session K: Engaging Stakeholders
2011 Pacific Island Watershed Institute

Description: Discuss when and how to involve elected/appointed officials, military officials, mayors, agencies, watershed groups, and other public stakeholders in the watershed planning and implementation process.

Speakers:

- Laurel Woodworth, Center for Watershed Protection
- Joyce Beouch, Palau Conservation Society www.nature.org/ourinitiatives/regions/asiaandthepacific/micronesia/explore/watershed-alliance.xml
- Alyssa Miller, Malama Maunalua, Oahu, Hawaii http://malamamaunalua.org/about-us.asp

Topics/Notes:

1. The world of watershed stakeholders

2. Engaging political officials: Babeldoab Watershed case study

3. Public involvement and engaging funders: Lessons from Maunalua

4. Group discussion: Bringing the challenging ones to the table

   a) Who are the key stakeholders in your watershed?

   b) Which ones are the most challenging to engage?

   c) Tips for bringing them to the table:

Stakeholder Resources

Pacific Island-focused

NOAA. Participatory Learning and Action (PLA) – Resource Guide for Practitioners. http://data.nodc.noaa.gov/coris/library/NOAA/CRCP/project/10126/PLA_Resource_Guide_Practitioners_Am_Samoa.pdf

Locally-Managed Marine Areas: A guide to supporting Community-Based Adaptive Management. Available from the Locally-Managed Marine Area (LMMA) Network. http://lmmanetwork.dreamhosters.com/files/lmmaguide.pdf

Collaborating for Sustainability: A Resource Kit for Facilitators of Participatory Natural Resource Management in the Pacific. Published by International Waters Project, Pacific Regional Environment Programme (SPREP). http://www.sprep.org/iwp/documents/IWP_Complete_version_001.pdf

Participatory Learning and Action – A Trainer's Guide for the South Pacific. Authored by Pretty, J.N., Guijt, I., Thompson, J., Scoones, I. (1995). IIED Participatory Methodology Series.

General Information

Getting In Step: Engaging and Involving Stakeholders in Your Watershed. Available from the US Environmental Protection Agency. www.epa.gov/owow/watershed/outreach/documents/stakeholderguide.pdf

Getting In Step: A Guide to Conducting Watershed Outreach Campaigns. Available from the US Environmental Protection Agency. www.epa.gov/owow/watershed/outreach/documents/getnstep.pdf

Watershed Management Starter Kit. Available from the Conservation Technology Information Center (CTIC). Phone: (765) 494-9555. http://ctic.org/resourcedisplay/111/

People, Partnerships and Communities Series. Available from the Natural Resources Conservation Service (NRCS). http://www.ssi.nrcs.usda.gov/publications/#ppcs

Stakeholder Coordination. Available from the National Association of State Departments of Agriculture (NASDA). http://www.nasda.org/nasda/nasda/Foundation/protect/guide.html#stake

Community Toolbox: Decision Making Tools. Available from the National Park Service (NPS) Rivers, Trails and Conservation Assistance Program. http://www.nps.gov/phso/rtcatoolbox/dec_actionagenda.htm

EPA Office of Water, Office of Wetlands, Oceans, and Watersheds, Watershed Outreach Webpage. http://www.epa.gov/owow/watershed/outreach/outreachnonjs.html

River Talk! Communicating a Watershed Message. Available from the River Network. Phone: (503) 241-3506. https://www.rivernetwork.org/marketplace/product_details.php?item_id=55346

Culvert Action: How to Interest Your Local Media in Polluted Runoff Issues. Available from the Lindsay Wildlife Museum. Phone: (925) 935-1978.http://www.wildlife-museum.org/

Sourcebook for Watershed Education. Available from Acorn Naturalists. Published by the Global Rivers Environmental Education Network. http://www.acornnaturalists.com/store/SOURCEBOOK-FOR-WATERSHED-EDUCATION-P7183C0.aspx

Water Words That Work http://waterwordsthatwork.com/

Session L: Implementation and Funding

2011 Pacific Island Watershed Institute

Description: What are key factors in ensuring the successful implementation of watershed plans and projects. Discuss tips for identifying and securing implementation funding in Pacific islands.

Speakers:

- Rich Claytor, Horsley Witten Group
- Hudson Slay, EPA

Resources:

Topics/Notes:

1. Incorporating implementation strategies in your watershed plan
2. Key factors in ensuring successful implementation of restoration projects
3. What are your likely funding options?
4. Keys to successful grant writing

Pacific Island Watershed Institute

Session L: Implementation and Funding

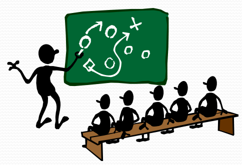
June 13-16, 2011
He'eia State Park, Oahu

Topics to cover

- Implementation Traps and Tips
- Who are key implementation partners
- Securing long-term funding
  - Sources
  - What funders want to know
- Components of an Implementation Strategy/Plan
- Getting projects in the ground

How Implementation Fits into the Planning Process

- Getting Started
- 1. Characterize watershed
- 2. Classify & screen priority subwatersheds
- 3. Identify restoration/protection projects
- 4. Conduct detailed assessments
- 5. Assemble recommendations into plan
- 6. Determine if plan meets goals
- 7. Implement the plan
- 8. Evaluate over time



Improving a plan's chances of success will require having a well thought out implementation strategy.

Implementation Traps

1. Lack of political will and community support;
2. Programmatic inertia and agency "turf" battles;
3. Empty piggy banks;
4. Non-targeted education and training;
5. Inability to show success (i.e. local demo, monitoring, missed windows of opportunity);
6. Too many sticks and not enough carrots;
7. Undiscovered watershed champion;
8. Loss of momentum and evolving community concerns;

What are some others you have experienced?

Implementation Tips

1. Involve key implementation partners early, encourage formal agreements;
2. ID programmatic overlaps and gaps, integrate into daily municipal operations;
3. Be creative in securing long-term funding (i.e. federal, provincial, private, local cost-sharing)
4. Choose appropriate messages, target pollutants/behaviors.

More Implementation Tips

5. Get easy projects in the ground fast, starting at home;
6. Find a balance between regulated and voluntary stewardship;
7. Designate person/group to coordinate implementation efforts;
8. Track progress and re-evaluate strategy over time.
9. Lets hear some of YOUR IDEAS!

Hijack Someone Else's Radar Screen (instead of inventing a new one)

- Budgeting;
- Procurement;
- Design Phase;
- Construction Management;
- Focus on Recurring Processes.

Existing Process/Projects as Potential Hijacking Candidates

- Agency Budget Planning;
- Comprehensive Plan;
- Site Plan Review;
- Rezoning Requests;
- Water Supply Planning/Mitigation;
- TMDL;
- NPDES Phase 1 & 2 Permits;
- Municipal Operations (good housekeeping).

More Hijacking Candidates

- Capital Improvement Program (CIP);
- Utility Planning/CIP/Maintenance;
- Transportation Planning/CIP/Maintenance Activities;
- Parks Planning/CIP/Maintenance;
- WTP Permitting/Nutrient Trading;
- Mitigation Fee-In-Lieu Programs.

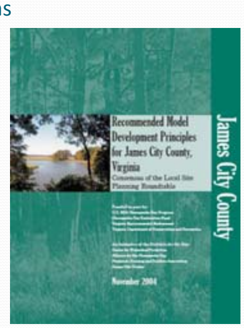
Involve Key Implementation Partners Early; Encourage Formal Agreements

- Westchester Co., 13 local governments, New York City, non-profit orgs, & state
- Partnership builds on Watershed Advisory Committee; now known as the Bronx River Watershed Coalition
- **Mayors and supervisors signed non-binding MOA to develop a water quality improvement plan**

http://www.westchestergov.com

ID Programmatic Overlaps & Gaps; Integrate Plan into Daily Municipal Operations

- Reviewed existing regulations and program tools for James City County as part of watershed plan;
- Held roundtable for recommending changes to development codes ;
- **Site plan review now requires a check against subwatershed management plans**



http://www.james-city.va.us

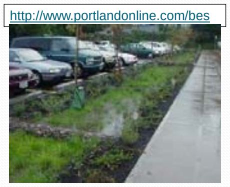
Example: Worcester County, MD Comprehensive Plan Update

- 2001 plan update, county worked with MD DNR to craft watershed plan for Isle of Wight Bay
- **County incorporated watershed recommendations into Comprehensive Plan**

http://www.co.worcester.md.us

Be Creative in Securing Long-Term Funding

http://www.portlandonline.com/bes



- Green streets program in Portland, OR
  - Provide $ and technical support to residents to improve street drainage through CIP.
- Montgomery County, MD
  - – Budget for watershed management projects used to leverage multiple funding sources.
  - Funded mainly thru stormwater utility fee
  - –Budget contains specific performance measures

Implementation Funding Advice

- Partnerships
- Leveraging
- Results
- Money is tight and competition fierce
- Not all funding sources are a good fit

Funding Sources and Examples

Grants:
- NOAA International Coral Grant Program
- National Fish and Wildlife Foundation
- NOAA Coral Reef Conservation and Habitat Restoration
- NOAA Coastal and Estuarine Land Conservation Program (CELCP)
- Section 319 Nonpoint Source
- Private foundations (especially international)
- Intergovernmental Orgs. (e.g., SPREP, UNEP)
- Embassies (small grant programs)

Funding Sources and Examples

Loans/Cost-Share:
- State Revolving Fund
- U.S. Army Corps of Engineers continuing authorities
- Natural Resources Conservation Service

Funding Sources and Examples

State/Local:
- County budget
- Hawaii CREP/Forest Stewardship Program
- Hawaii Tourism Authority
- Harold K.L. Castle Foundation
- Supplemental Environmental Projects (SEPs)/enforcement settlements
- In-Lieu Fee compensatory mitigation

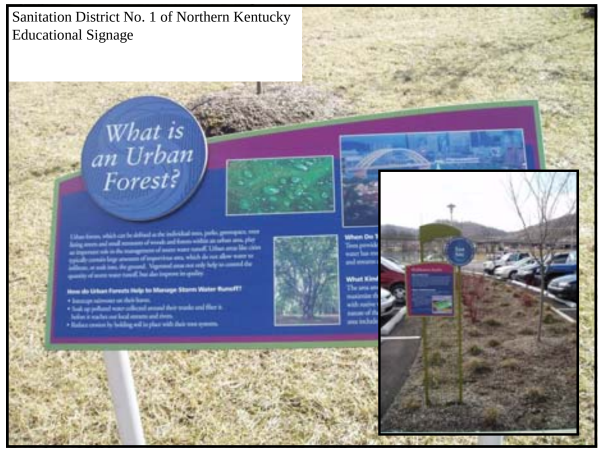
Choose Appropriate Messages and Target Pollutants/Behaviors of Concern

- Tell them what they want to hear
  - Seattle, WA--“salmon” gardens
  - Chicago, IL-- green roofs are for “saving money”, not stormwater
  - Austin, TX--bilingual educational material
- Address the problem
  - N loading problems in Neuse River Basin, NC -- target lawn fertilization practices
  - Portland, OR volume reduction issue -- rainbarrel program

Get Easy Projects in the Ground Fast, Starting at Home

Buffer planting in Annapolis, MD

Bioretention at James City County, VA Municipal Complex



Sanitation District No. 1 of Northern Kentucky Educational Signage

Implementation Projects: Construction Summary

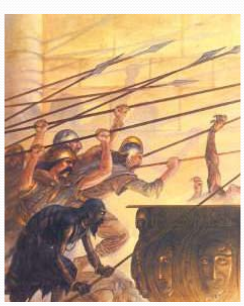
- Good planning (concept plans, integrated with site design);
- Good design and agency review;
- Clearly defined construction specifications and bidding documents;
- Contractor expertise (minimum qualifications/experience identified in bid docs);
- Construction layout by a surveyor;
- Pre-construction meeting and regular progress meetings;
- Construction observations at clearly identified milestones (by the designer where possible – using checklists);
- Interim and final As Built plans.

Project Implementation Maintenance Summary

- Good planning, design & construction;
- Designer should envision maintenance requirements;
- Plan sheet(s) showing project locations/types and maintenance access (easements);
- O&M plan includes required inspection and maintenance frequency and estimated annual costs;
- Make short-term maintenance;
- Implement long-term vegetation management;
- Incorporate progressive enforcement and corrections;
- Instill owner inspection co-responsibility

Implementation Plan

- Priority Projects
- Costs & Funding Sources
- Responsible Parties & Partners
- Phasing for Design & Construction (Schedule)
- Strategic Actions



Measure Improvement Over Time (Indicators)

- Sentinel Monitoring
  - Physical
  - Biological
  - Chemical
  - Community
- Performance Monitoring
  - Structural or Vegetative Integrity
  - Actual Performance (pollutant removal)

Other Important Tracking & Evaluation Steps

- # Projects Implemented;
- Budget;
- Partners;
- Management Structure;
- Adaptive Management.