Maui's Bacteria Issues

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Purpose of Presentation

- Educate
- Pass on Oahu's Experience
- Recommendations
- Collaborate

Duties of CWB Monitoring & Analysis Section

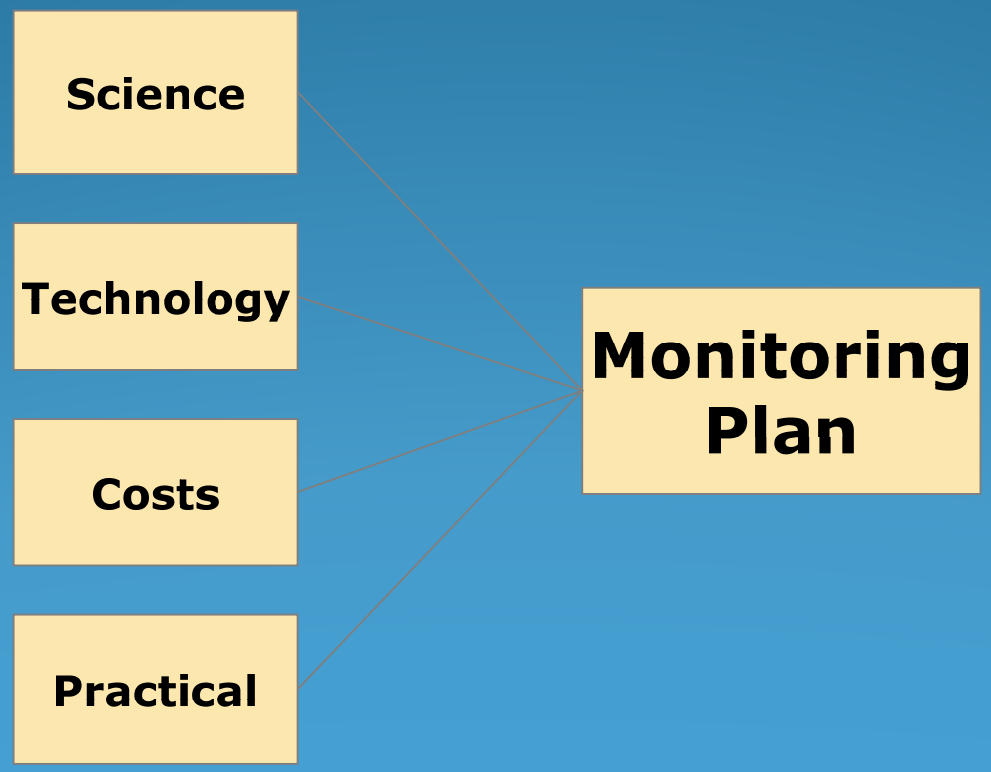
- Monitor all State surface waters
  - BEACH Program
  - Coastal Monitoring support 319h and OSDS Program
  - Priority Watershed Program EPA West Maui
- Investigate complaints
  - Kauai, Maui, Molokai, Lanai, and Hawaii
- CDC National Outbreak Reporting System
  - Water Borne Disease
- 303d-305b Integrated Report
- Total Maximum Daily Load
- WQ standards

Beach Act of 2000

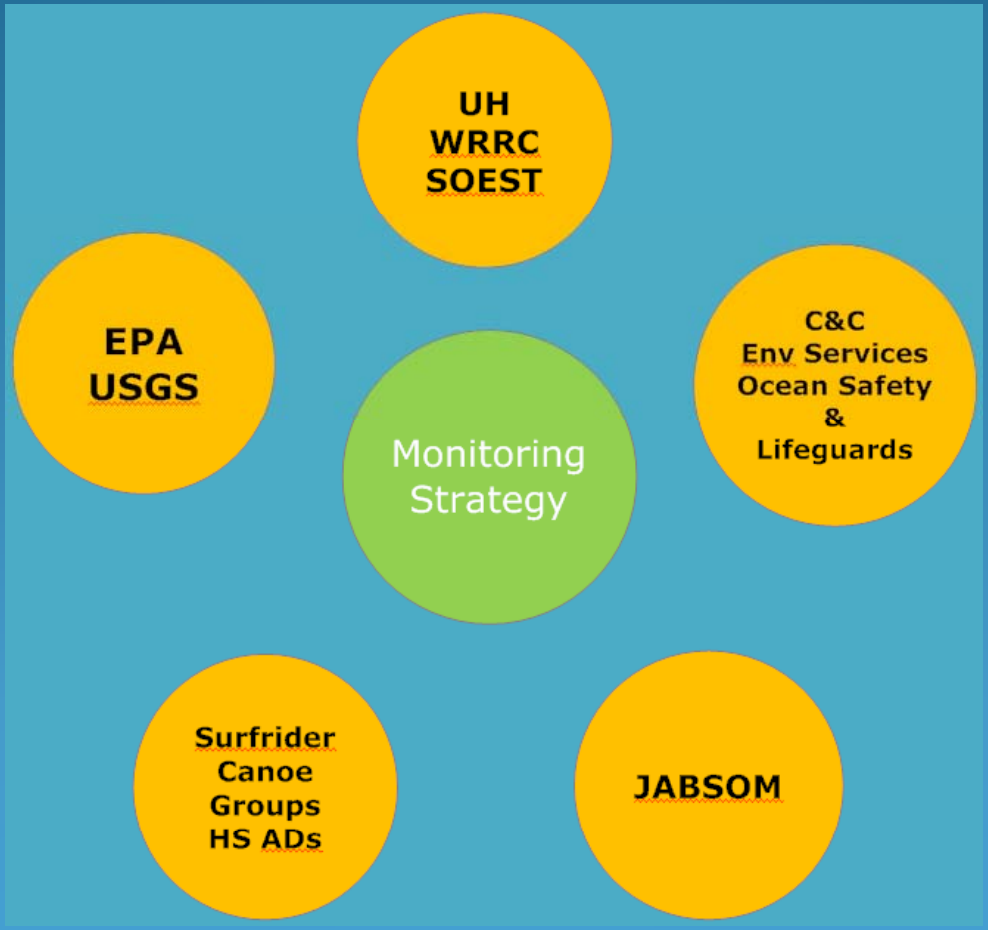
- Beaches Environmental Assessment and Coastal Health Act of 2000 amended the Clean Water Act in Part by adding section 303(i). Section 303(i)(1)(A) requires that not later than April 10, 2004, "each State having coastal Recreational waters shall adopt and submit to the Administrator water quality criteria and standards for the coastal recreation waters of the State for those pathogens and pathogen indicators for which the Administrator has published criteria under section 304(a)."

Implementor

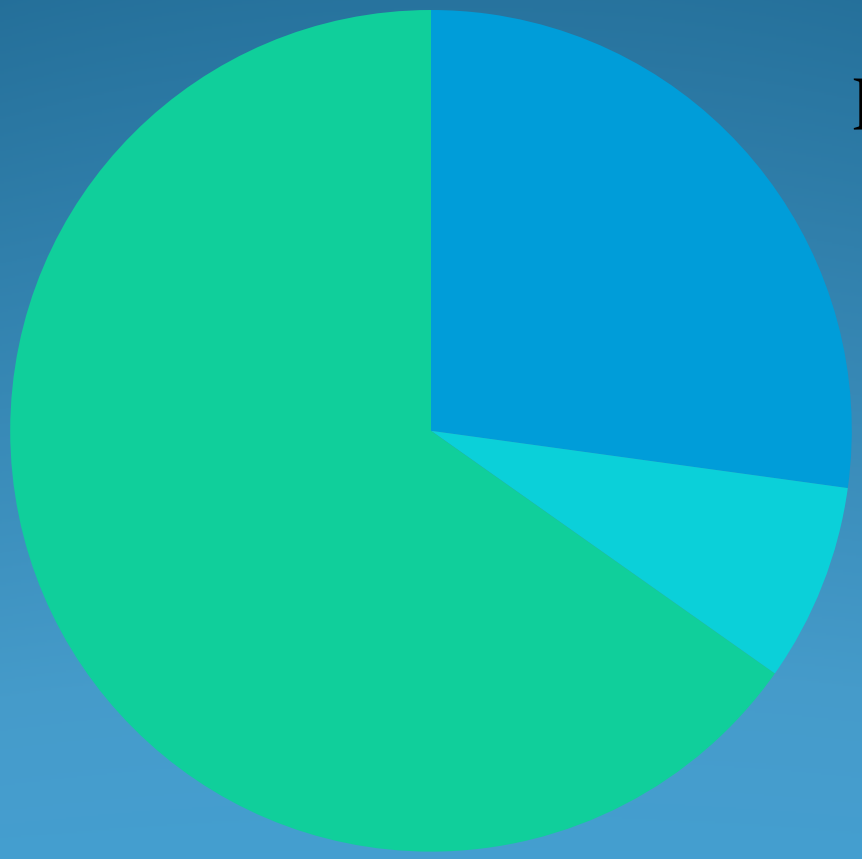
to give practical effect to and ensure actual fulfillment by concrete measures



Collaborate



What and Who Protects you



Golden Rules

- Assess Risk
- Practice Personal Hygiene
- Maintain Strong Immune System
- Keep Skin Intact
- At First Sign of Infection, See your Doctor
- Don’t Spread Rumors

What we Monitor

Bacteria

- Enterococcus
  - Aerobic
- Clostridium perfringens
  - Anaerobic

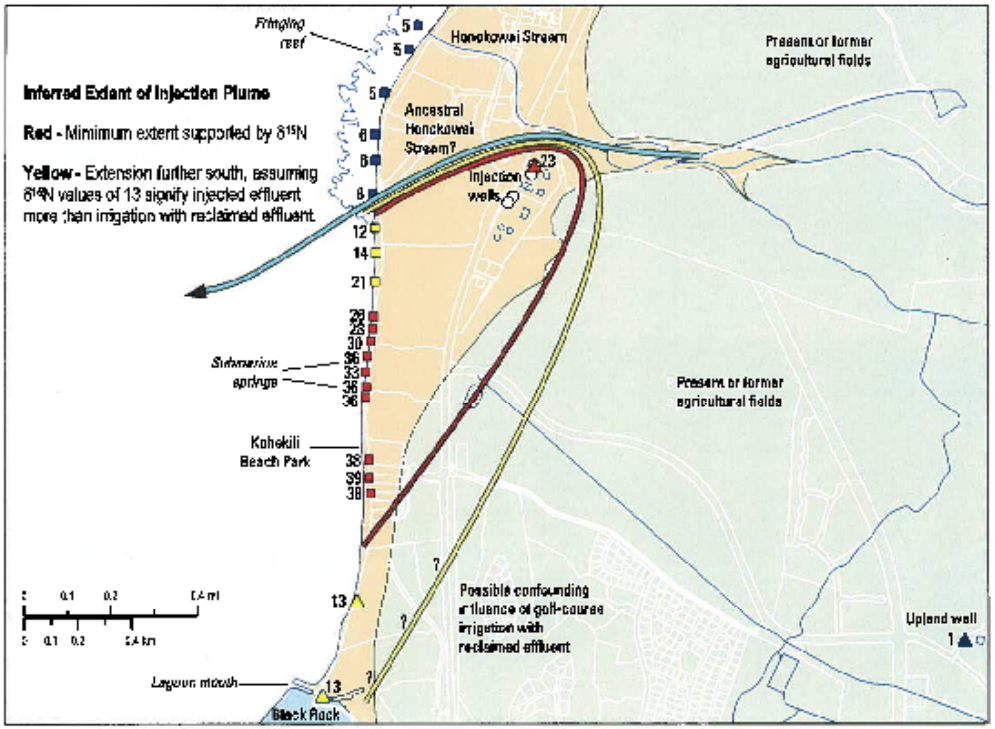
Water

- Physical
  - Temp, salinity, DO, DO%, pH, turbidity
- Chemical
  - TSS, dissolved ammonia, nitrite-nitrate, TN, TP, dissolved silicate, chlor a
- Multi-tracer
  - Pharmaceuticals, waste water compounds, fabric brighteners

USGS
science for a changing world

Prepared in Cooperation with the Hawaii State Department of Health, Clean Water Branch

A Multitracer Approach to Detecting Wastewater Plumes from Municipal Injection Wells in Nearshore Marine Waters at Kihei and Lahaina, Maui, Hawaii



Scientific Investigations Report 2009–5253

U.S. Department of the Interior
U.S. Geological Survey

Definitions

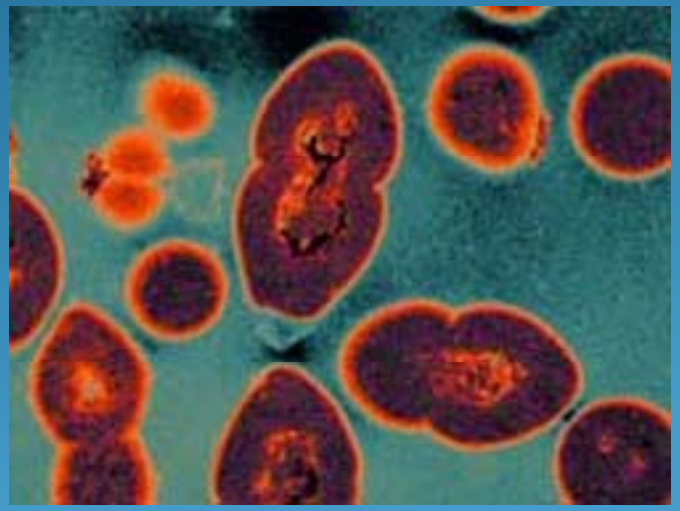
- Indicator Bacteria
- Pathogen
- Enterococci
- Clostridium perfringens
- Staphylococcus aureus
- MRSA
- HA MRSA
- CA MRSA
- Streptococcus
- Toxic shock syndrome
- Necrotizing faciitis

Indicator Bacteria

- Indicator bacteria are selected groups of microorganisms that are found to indicate the likelihood of the presence of disease-causing pathogens. It is difficult to detect every pathogenic organism in the water due to the wide array of the microbes in the natural environment. As a solution, indicator organisms are used because they are easy to detect. It is important to realize that indicator bacteria only suggest the presence of disease-causing organisms, and generally are not pathogenic themselves.

Indicator Bacteria

Enterococcus



Clostridium perfringens

PATHOGEN

- Any disease producing agent or microorganism.
  - Bacteria: salmonella, anthrax, etc
  - Virus: hepatitis, herpes, AIDS, etc
  - Protozoa: giardia, plasmodium (malaria),etc
  - Fungi: Tinea (ringworm), etc
  - Parasites: roundworm, tapeworm, etc

Enterococci

- Enterococci is a bacteria found in the feces of humans and other warm blooded mammals and birds. It is the EPA recommended indicator bacteria for Marine Waters. However, enterococci has been shown to replicate outside of the human body in soils, biofilm, sand, and decaying seaweed.

Clostridium perfringens

- Anaerobic bacteria found in large numbers in the feces of humans, cats, pig, sheep, cows, dogs, and ducks. It does not reproduce outside of the host. Not recognized by EPA but allows Hawaii to use it as a secondary tracer. Not a perfect indicator but used properly, it is an effective tool in making human fecal contamination decisions.

ASSESSING THE APPLICABILITY OF USEPA RECREATIONAL WATER QUALITY STANDARDS TO HAWAII AND OTHER TROPICAL ISLANDS

Roger S. Fujioka
and
Muruleedhara N. Byappanahalli

WRRC Project Completion Report: WRRC 96-01

July 1996

Prepared for:

The Department of Health
State of Hawaii
P. O. Box 3378
Honolulu, Hawaii 96801

Agreement Number: 94-517
Project Period: June 15, 1994 to June 30, 1996
Principal Investigator: Roger S. Fujioka

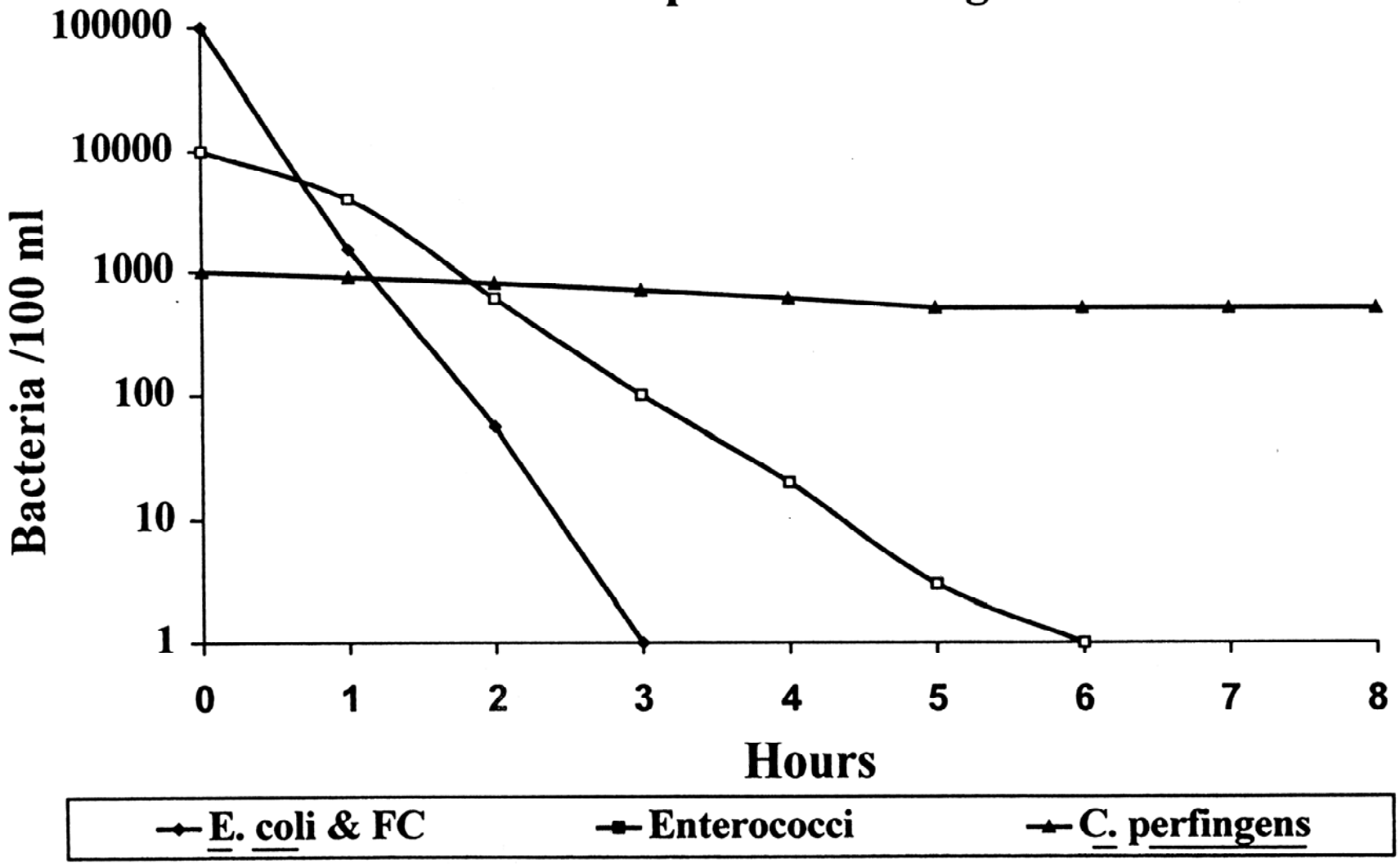
Water Resources Research Center
University of Hawaii at Manoa
2540 Dole Street
Honolulu, HI 96822

Enterococci	Clostridium
Aerobic	Anaerobic
Found in Rats, Mice, and Pigeons. Urban type of animals.	Not found in Rats, Mice, and Pigeons in significant numbers.
Significant numbers found in all other animal Feces.	Significant numbers found in Cat, Pig, Sheep, Cow, Dog, and Duck feces.
Survives 3 hours in water exposed to sunlight.	Spores survives weeks in water exposed to Sunlight.
Established itself as an indigenous population in soil. Other soil microorganisms hold enterococci in check by efficiently utilizing available nutrients and by producing by-products which inhibit the growth of entrococci.	Spore not affected by other microorganisms in soil.
Persistent and opportunistic, waits for nutrient sources to trigger growth. Under natural conditions, growth is slow.	Tendancy for spores to collect in pockets along streams.

Table 6. Concentrations of Indicator Bacteria in Animal Feces

SAMPLE	BACTERIA (CFU/gram)			
	Fecal Coliform	*Escherichia coli*	Enterococci	*C. perfringens*
Guinea Pig	8.0×10^3	1.17×10^3	1.57×10^3	<67
Rat	1.08×10^7	1.03×10^7	6.33×10^6	<67
Chicken	1.62×10^8	1.62×10^8	3.81×10^7	<67
Cat	1.32×10^6	1.46×10^6	3.57×10^5	5.5×10^4
Rabbit	1.55×10^7	1.57×10^7	3.23×10^6	<67
Mice	2.03×10^6	3.83×10^6	1.99×10^6	<67
Monkey	1.45×10^7	2.35×10^7	1.35×10^5	<67
Pig	5.73×10^7	5.8×10^7	9.33×10^6	1.73×10^5
Quail	5.4×10^7	3.4×10^7	5.8×10^6	<67
Sheep	3.47×10^5	2.8×10^5	1.67×10^6	4.07×10^4
Cow	1.87×10^6	1.87×10^6	4.27×10^4	2.67×10^2
Dog	6.47×10^4	7.13×10^4	5.33×10^4	1.47×10^4
Pigeon	1.87×10^7	1.71×10^7	5.0×10^6	<67
Duck	7.6×10^5	1.6×10^6	1.4×10^6	2.9×10^5

Fig. 14 Comparative Survival of Fecal Indicator Bacteria in Water Exposed to Sunlight



Staphylococcus aureus

- "Staph" are bacteria commonly carried on the skin or in the nose of healthy people. About 1/3 of the population has it on their skin and/or in their nose. The "colonized" population do not show any signs of infection. Staph are one of the most common causes of skin infections in the United States. Most as minor pimples or boils that are easily treatable.

MRSA

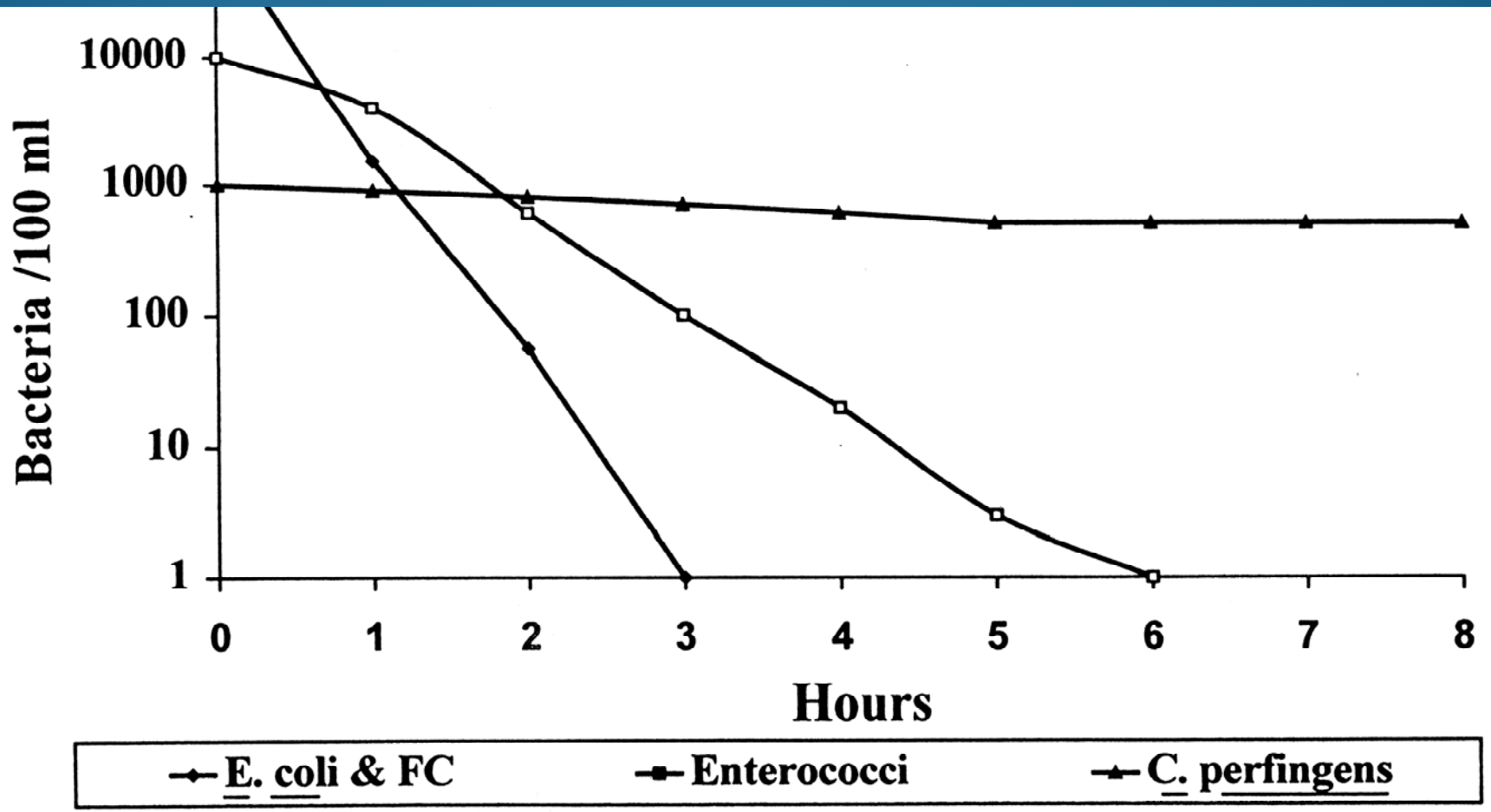
- Methicillin resistant staphlyococcus aureus.
- MRSA found in 1 to 5% of population in their noses and can be found in palms of hand.
- "Carriers" show no illness.
- Some researchers feel that resistance is due to overuse of antibiotics.
- Occurs most frequently in health care settings.

MRSA, CA MRSA, and HA MRSA

- Methicillin-Resistant Staphylococcus aureus
- Community-Associated MRSA
  - Infections in the community in otherwise healthy people. Professional, Collegiate, HS sports, etc.
- Healthcare-Associated MRSA
  - MRSA occurs most frequently among patients who undergo invasive medical procedures or who have weakened immune systems and are being treated in hospitals and healthcare facilities such as nursing homes and dialysis centers. MRSA in healthcare settings commonly causes serious and potentially life threatening infections, such as bloodstream infections, surgical site infections, or pneumonia.

Ala Moana Beach Sampling Areas

Waikiki Sampling Areas


Bacteria /100 ml
10000
1000
100
10
1
0
1
2
3
4
5
6
7
8
Hours
E. coli & FC
Enterococci
C. perfingens

Survival of Enteroviruses in Sea Water and River Water

Virus Strain	Die-off Rates (in Days)*	
	Sea Water	River Water
Polio I	8	15
Polio II	8	8
Polio III	8	8
ECHO 6	15	8
Coxsackie	2	2

*Max number of days required to reduce virus population by 3 logs
Source: Adapted from Cioglia and Loddo (1962). "Annapolis Protocol 1999"

Staphylococcus Infection

MRSA in thigh of patient after surgery

Staphylococcal Infection

- MRSA infection in knee of prison inmate

Staphylococcus Infection

- Secondary staph infection after small pox vaccinnation

Staphylococcal Infection

- MRSA infection in hip

How can I prevent staph or MRSA Infections?

- Keep hands clean by washing w/soap and water, or alcohol base hand sanitizer.
- Keep cuts and scrapes clean and covered w/bandage until healed.
- Avoid contact with other people's wounds or bandages.
- Aviod sharing personal items such as towels, shirts, deodorant sticks, or razors.

Golden Rules

- Assess Risk
- Practice Personal Hygiene
- Maintain Strong Immune System
- Keep Skin Intact
- At First Sign of Infection, See your Doctor
- Don't Spread Rumors

Laboratory Confirmed Grp A Strep - Wound, Cases by County (2002-2006)

YEAR	HAWAII	HONOLULU	KAUAI	MAUI	Total
2002	56	59	16	56	187
2003	192	384	107	103	786
2004	275	573	113	245	1206
2005	333	665	66	360	1424
2006**	463	1181	119	455	2218

Laboratory Confirmed Grp A Strep - Invasive*, Cases by County (2002-2006)

YEAR	HAWAII	HONOLULU	KAUAI	MAUI	Total Of ID
2002	20	63	1	27	111
2003	15	103	7	29	154
2004	15	96	4	21	136
2005	22	84	3	20	129
2006**	9	103	9	15	136

*Includes streptococcal toxic shock syndrome.
**2006 data are provisional.

DOH Disease Investigation Branch Strep Wound and Invasive Cases

Laboratory Confirmed Grp A Strep – Wound, Cases by County (2002-2007)

YEAR	HAWAII	HONOLULU	KAUAI	MAUI	TOTAL
2002	56	59	16	56	187
2003	192	384	107	103	786
2004	275	573	113	245	1206
2005	333	665	66	360	1424
2006**	463	1181	119	455	2218
2007	757	1434	208	561	2960

From 2008 Disease Investigation Branch stopped following up on strep wounds.

Laboratory Confirmed Grp A Strep – Invasive*, Cases by County (2002-2009)

YEAR	HAWAII	HONOLULU	KAUAI	MAUI	TOTAL
2002	20	63	1	27	121
2003	15	103	7	29	154
2004	15	96	4	21	136
2005	22	84	3	20	129
2006**	9	103	9	15	136
2007	24	92	11	8	135
2008	24	97	7	14	142
2009	27	124	5	15	171

*Includes streptococcal toxic shock syndrome

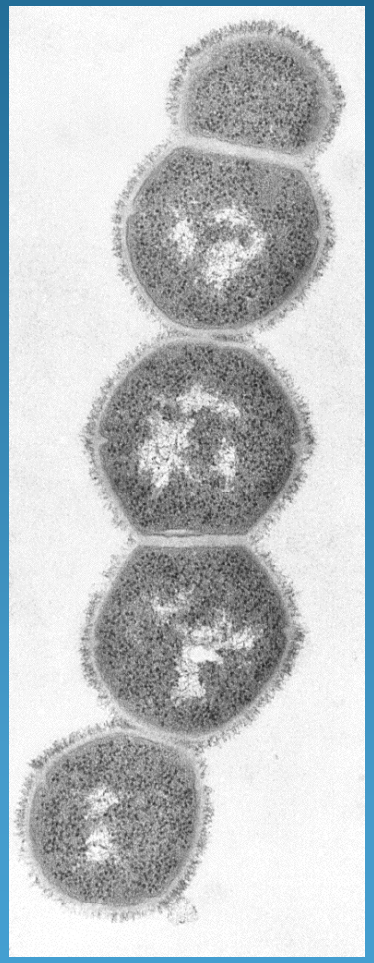
** 2006 data are provisional

Toxic Shock Syndrome

- Toxic shock syndrome is a rare complication that involves fever, shock, and problems with the function of several body organs.
- Menstruating women, women using barrier contraceptive devices, persons who have undergone nasal surgery, and persons with postoperative staphylococcal wound infections most at risk.
- Often toxic shock syndrome results from toxins produced by Staphylococcus aureus (staph) bacteria, but the condition may also be caused by toxins produced by group A streptococcus (strep) bacteria.

Streptococcus

- Group A streptococcus is responsible for a variety of health problems. Infections range from simple skin, throat, of to severe life threatening conditions such as streptococcal toxic shock syndrome and necrotizing fasciitis. 20% of NF and more than half of STSS die.



Strep Facts

- People may have strep in throat or on skin and have no symptoms of illness.
- Strep passed through direct contact with mucus from the nose or throat of infected person, or contact with infected wounds or sores.
- People who carry the bacteria and have no symptoms are less contagious.
- Treatment w/antibiotics for 24 hours or more eliminates ability to spread the bacteria.

NIH Public Access
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Pediatr Infect Dis J. Author manuscript; available in PMC 2006 February 13.

Published in final edited form as:
Pediatr Infect Dis J. 2004 July ; 23(7): 677–679.

CHARACTERIZATION OF A COMMUNITY CLUSTER OF GROUP A STREPTOCOCCAL INVASIVE DISEASE IN MAUI, HAWAII

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[†]*Tropical Medicine and Microbiology, University of Hawaii, John A. Burns School of Medicine, and the*

[‡]*State of Hawaii Department of Health, Honolulu, Hawaii*

Abstract

A community cluster of severe group A streptococcal skin infections occurred in Maui, Hawaii with 3 fatal cases of necrotizing fasciitis in 2002. *emm* types 1, 12, 58, 74, 85 and 109 were identified from 8 patients. *emm* types 74 and 109 have not been previously described in the United States according to the Centers for Disease Control and Prevention database. The identification of uncommon *emm* types suggested that group A streptococcal serotypes in Hawaii are different from those in the continental United States and can result in serious disease.

Keywords

necrotizing fasciitis; community cluster; group A Streptococcus; emm typing

Most cases of necrotizing fasciitis are associated with invasive group A streptococcal (GAS) infection.[1] In a recent population-based 5-state surveillance study, the annual incidence of invasive GAS disease was 2.2–4.8 cases/100,000 persons, with 7.1% of those developing necrotizing fasciitis.[2] The occasional clusters or outbreaks of necrotizing fasciitis have been mostly reported in hospital settings, and community-acquired clusters are rare.[3,4]

After 3 fatal cases of necrotizing fasciitis with toxic shock syndrome that occurred from February 2002 through April 2002, a cluster of severe GAS skin infections recurred in Maui, Hawaii (population 128,094) during the 3-month period of April 2002 through June 2002.[5] Molecular epidemiologic studies including *emm* typing, pulsed field gel electrophoresis (PFGE) and polymerase chain reaction (PCR) analysis of pyrogenic exotoxin A (*spe*A) gene were undertaken to characterize this unusual cluster of isolates.

Address for reprints: Guliz Erdem, MD, Department of Pediatrics, University of Hawaii John A. Burns School of Medicine, 1319 Punahou Street, Room 755, Honolulu, HI 96826. Fax 808-949-4232; E-mail gulizr@hawaii.edu.

Supported by grants from the American Heart Association, National Institutes of Health, Research Centers in Minority Institutions (P20RR11091-06) and the Geist Foundation-Hawaii Community Foundation.

Presented at the Eighth Research Centers in Minority Institutions International Symposium on Health Disparities, Honolulu, HI, December 2002.

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TABLE 1

Patient Characteristics and *emm* Typing of Isolates

Patient	Disease Onset	Sex	Age (yr)	Diagnosis	Predisposing Factors	Outcome	Culture Site	*Emm* Type	speA
1	2/15/02	M	48	NF, STSS	Insect bite	Died	NA	NT	NT
2	3/5/02	M	51	NF, STSS	Minor trauma to left knee, splenectomy	Died	NA	NT	NT
3	4/11/02	F	57	NF, STSS	Coral reef cut	Died	Blood	74	+
4	5/11/02	F	60	Cellulitis	Insect bite	Alive	Leg	12	−
5	5/12/02	F	66	Cellulitis	Schizophrenia	Alive	Leg	85	−
6	5/13/02	F	58	Cellulitis	None	Alive	Leg	109	−
7	5/22/02	M	54	Cellulitis	Alcoholism, schizophrenia, homeless	Alive	Toe, shin	74	+
8	6/8/02	M	33	Cellulitis	Coral reef cut	Alive	Foot	58	−
9	6/12/02	M	74	Cellulitis	None	Alive	Blood	85	−
10	6/22/02	M	18	Septic arthritis	Fall to right knee. streptococcal pharyngitis	Alive	Knee fluid	1	−

NA indicates not available; NF, necrotizing fasciitis; NT, not tested.

From: Pediatr Infect Dis J. Author manuscript; available in PMC 2006 February 13.
Published in final edited form as:
Pediatr Infect Dis J. 2004 July; 23(7): 677–679.
doi: 10.1097/01.inf.0000130956.47681.88

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Streptococcal Infection

- Common Strep throat in child

Streptococcal Infection

- Note white of tongue

Streptococcal Infection

- Early signs of strep infection. Swelling and redness with pain.

Streptococcal Infection

- Impetigo due to strep

Strephtococcal Infection

- Strep infection in hand of inmate that resulted in heart problems from strep entering into blood stream. Endocarditis.

Streptococcal Infection

- Inflammation of skin leading to fluid containing, elevated lesions and leading to Necrosis of skin and subcutaneous tissue.
- Necrotizing fasciatis

Streptococcal Infection

- Initial severe pain due to Strep A infection leading to necrotizing fasciitis (flesh eating bacteria)

Streptococcal Infection

- Healing process

Vibrio vulnificus

- Found in all coastal waters of the US and brackish water bodies. World wide.
- It is found in Hawaii.
- Sick by eating contaminated seafood or have an open wound exposed to seawater.
- Oyster Industry highly regulated by FDA.
- Immuno-compromised people are most at risk.
- Gets into blood stream and organs, death in 3 days.
- Two deaths: Thermal Pond at Ahalanui Park, Ala Wai Yacht Harbor.

Vibrio vulnificus

- Vibrio vulnificus is turquoise color
- V. parahaemolyticus is mauve color.
- If color blind cannot be a microbiologist

Death at Ahalanui

- Man with open wound swims in thermal pond and dies three days later. Vibrio vulnificus recovered from wound. Person was immuno-compromised.
- Vibrio bacteria are opportunistic pathogens with many virulent genes that are used to grow under specific conditions such as wound or intestines.
- High salinity and low nutrients, vibrio levels are low.
- Vibrio can be expected in places like : harbors, warm ponds, brackish waters, and estuaries.

Pohoiki Thermal Pond, Big Island

Star Bulletin .com

Tuesday, April 4, 2006 .

Thursday April 20, 2006.

Group Testing Waikiki Sand for Bacteria: Health officials insist effort to count bacteria will be inaccurate.

G

Vol. 11, Issue 95 - Wednesday, April 5, 2006

Man dying after fall into polluted Ala Wai

34-year-old mortgage loan officer Oliver Johnson has flesh-eating disease

Vol. 11, Issue 95 - Wednesday, April 5, 2006

Few diseases after rain, spills

>> State reopens Waikiki beaches
>> Man dying after fall into polluted Ala Wai

Vol. 11, Issue 120 - Sunday, April 30, 2006

Paddlers steering clear of Ala Wai

Better water quality is unlikely to lure all canoe clubs back

Death at Ala Wai Yacht Harbor

- Man gets thrown or falls into waters of Ala Wai Yacht Harbor and sustains wounds(2006).
- Person was drinking before and after fall and did not receive proper medical treatment.
- Death in 3 days. Classic case.
- Liver ailment releases iron into blood, which "energizes" Vibrio vulnificus.
- Mice pre-injected with iron readily killed by Vibrio vulnificus.
- Sewage spill blamed for death.

Necrotizing faciitis

- Commonly known as flesh-eating disease or flesh eating bacteria syndrome, is an infection of the deeper layers of skin and subcutaneous tissues.
- Effects of toxins from certain bacteria , destroying cellular walls and thus give the impression of the flesh being eaten away.

World Health Organization
Sustainable Development and Healthy Environments

WHO/SDE/WSH/99.1
Original: English
Dist.: Limited

HEALTH-BASED MONITORING OF RECREATIONAL WATERS: THE FEASIBILITY OF A NEW APPROACH (THE 'ANNAPOLIS PROTOCOL')

OUTCOME OF AN EXPERT CONSULTATION,
ANNAPOLIS, USA CO-SPONSORED BY USEPA

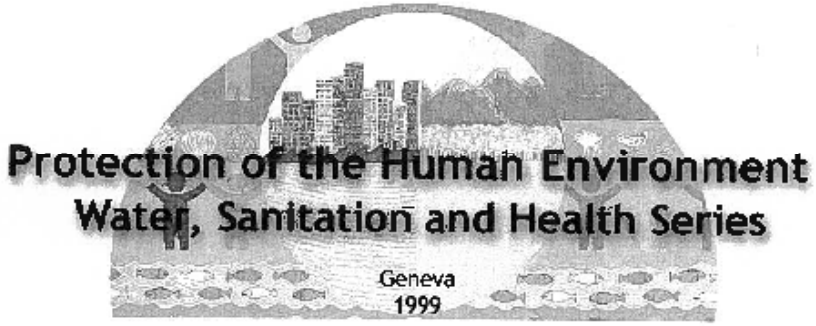


Table 9 Pathogen removal during sewage treatment

Treatment	Enteric viruses	*Salmonella*	*C. perfringens* [4]	*Giardia*
Raw sewage L^{-1}	100,000-1,000,000	5,000-80,000	100,000	9,000-200,000
[1]Primary treatment % removal Nos. remaing L^{-1}	50-98.3 1,700-500,000	95.5-99.8 160-3,360	30 70,000	27-64 72,000-146,000
[2]Secondary treatment % removal Nos. remaining L^{-1}	53-99.92 80-470,000	98.65-99.996 3-1,075	98 2,000	
[3]Tertiary treatment % removal Nos. remaining L^{-1}	99.983-99.9999998 0.007-170	99.99-99.9999995 0.000004-7	99.9 100	98.5 to 99-99995 0.099-2.951

1 Primary = physical sedimentation.
2 Secondary = primary sedimentation, trickling filter/activated sludge and disinfection.
3 Tertiary = primary sedimentation, trickling filter/activated sludge, disinfection, coagulation-sand filtration and disinfection, note that tertiary does not involve coagulation-sand filtration and second disinfection steps for *C. perfringens*.
4 Source: Long and Ashbolt (1998)
5 Source: Adapted from Yates and Gerba (1998)

Summarizing

- Staph and MRSA can be found in water but it is not their natural habitat and we believe die off is similar to indicator bacteria, enterococci.
- Strep is transmitted from person to person.
- Vibrio vulnificus can be deadly but need not be.
- Keep skin intact is first line of defense.
- Strong Immune system is second line of defense.
- Knowledge is power and third line of defense.

Sewage Spill Response

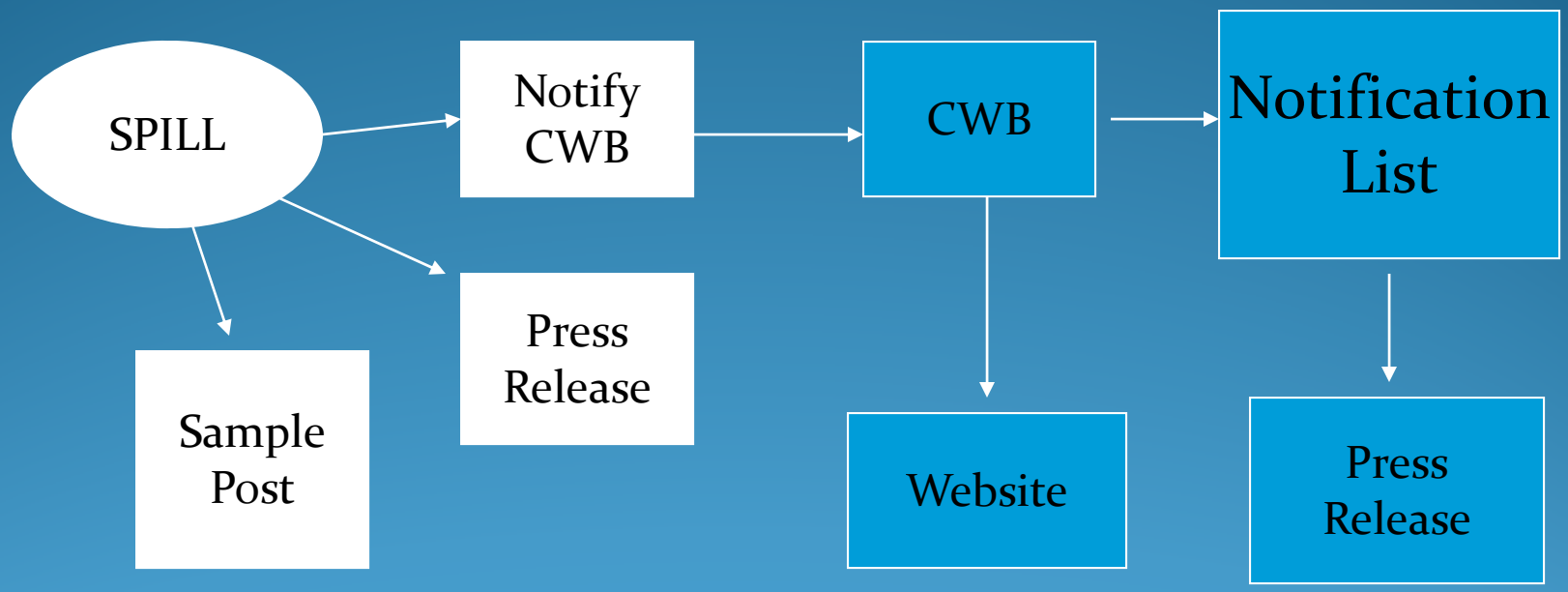
Major Players in Spill Monitoring

C&C	STATE	FEDERAL
Monitoring & Compliance Branch Leslie Toyota	Clean Water Branch Monitoring & Analysis Watson Okubo	EPA Region 9 Water Division Monitoring & Assessment Janet Hashimoto

DOH Requirements to Protect Public Health

- Immediate Reporting to CWB
- Immediate Sampling; continue daily
- Immediate Posting of Warning Signs
- Do Press Release
- Send bacteria results to CWB as soon as available
- Notification

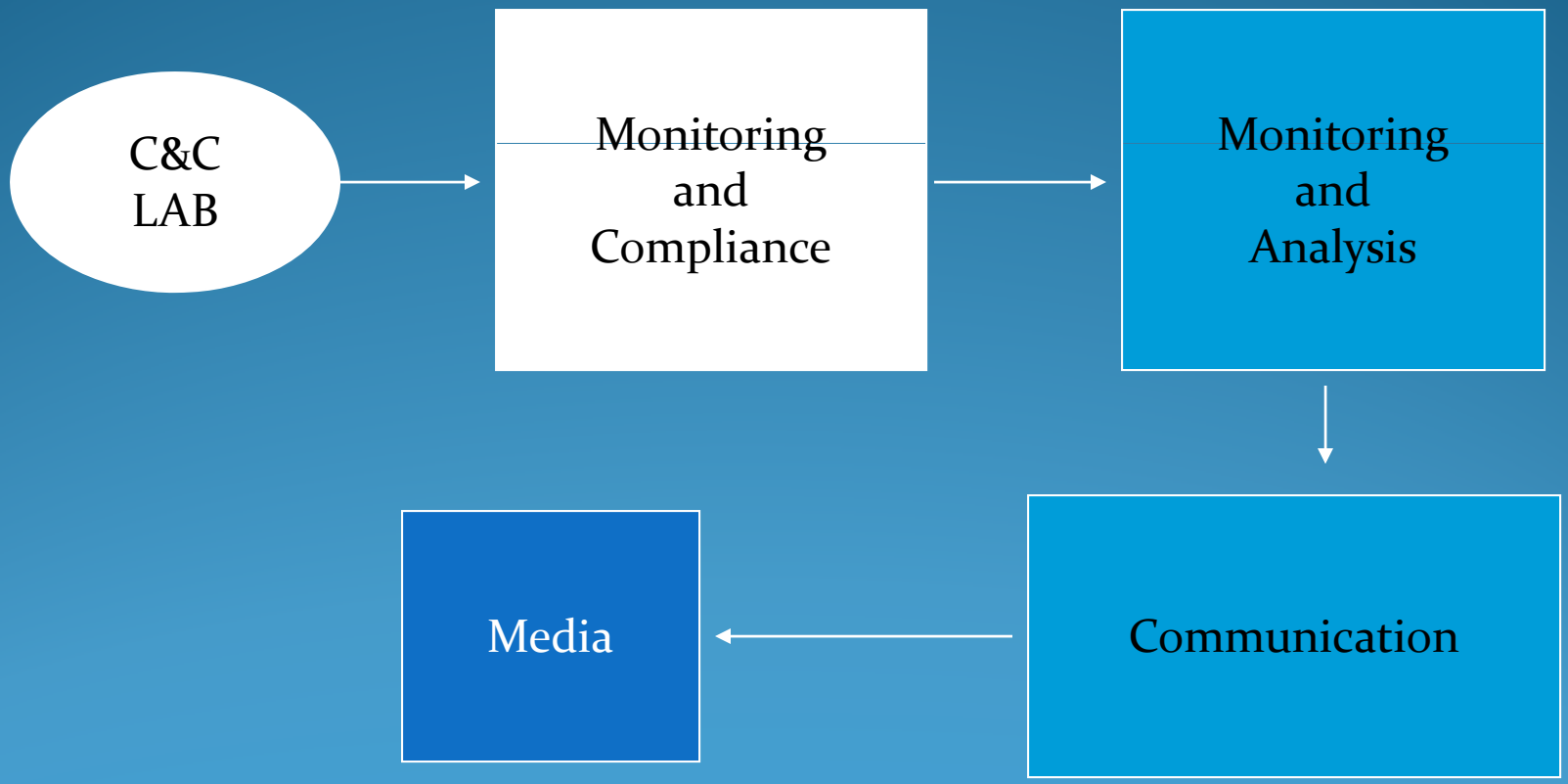
Notification Procedures



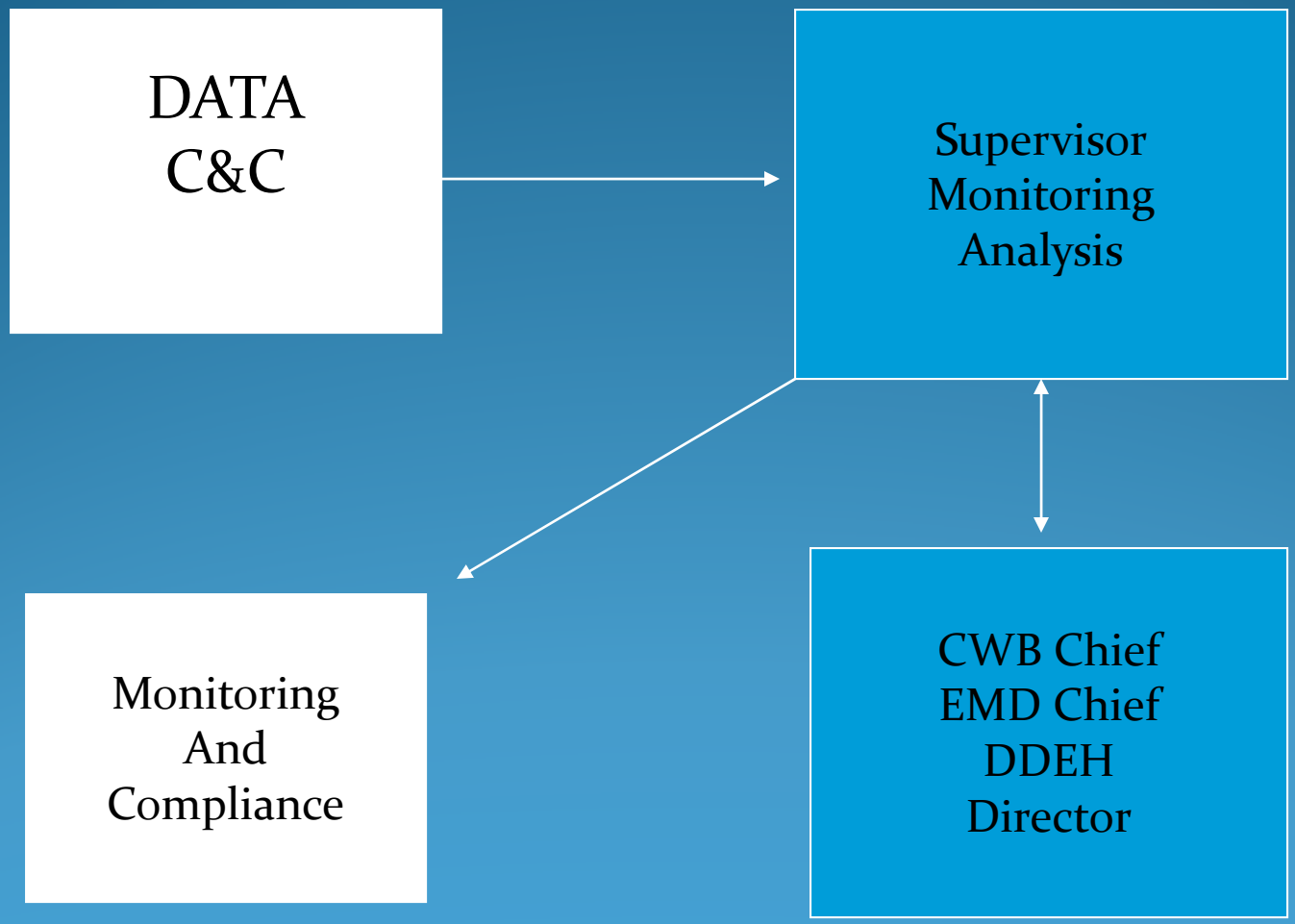
Notification List

- EPA Region 9
- Hickam,Bellows AFB
- Kaneohe MCBH
- SEAL DVT1
- USCG
- DOH Communication, DDEH
- Gov Lingle Tourism Liason
- HVCB, Kauai VB
- State Civil Defense
- Coconut Island
- UH Compliance Office
- Elected Officials
- C&C ES, EMS, Ocean Safety & Lifeguards
- Surfrider National, Oahu and Maui Chapter
- Hanalei Watershed Hui
- Sierra Club, Blue Water Campaign
- Hawaii Thousand Friends
- Our Children's Earth
- OHCRA, Hui Wa'a, Na Opio Canoe
- Waikiki Improvement Association
- Media, Print, Radio, and TV
- Others

Information Data Transfer



How Decisions were Made



Absence of Branch Chiefs

- Denis Lau, Clean Water Branch Chief, DOH and Ross Tanimoto, Monitoring & Compliance Branch Chief, Environmental Services (ES) were in San Francisco meeting with EPA Region 9 officials.
- Absence did not hinder spill response. Both DOH and ES monitoring staffs are very experienced, well trained, and know what needs to be done.
- Constant communication by cell phone, email, and fax. 7 days a week, almost 24 hr/day.

Extraordinary Monitoring Effort

March 24, 2006 Day of spill	City initiated daily Drogue Survey out of Ala Wai Canal from dawn to dusk.
March 28, 2006	DOH/CWB initiated Surf Site Monitoring at 10 surf sites from Point Panic to Paradise.
April 1, 2006	16 waste water overflows around Oahu due to heavy rains. CWB prioritized overflows and assists C&C with monitoring.
April 4, 2006	DOH/CWB evaluated surf data and focused on surf sites front and east of Magic Island.
May 2, 2006	DOH/CWB samples surf sites at surface and at 8 foot depth over concerns that sediments were sewage laden.

View from Hawaii Prince Hotel

View from Hawaii Prince Hotel

View from Hawaii Prince Hotel

Surf Site Results 3/28/06

Site	Time	Entero	Clostridium	Salinity
Point Panic	0735	31	3	34.59
Kewalos	0800	137	10	33.85
Concessions	0810	10	1	34.82
Secrets	0815	75	11	34.44
Bamburas	0820	64	17	34.66
Bowls	0825	2005	260e	26.89
Rockpile	0830	2005	470e	32.24
Kaisers	0835	324	23	34.74
Fours	0840	124	8	34.81
Paradise	0845	10	3	34.59

Surf Site Results 4/4/06

Site	Time	Entero	Clostridium	Salinity
Bamburas	0700	2.3	2	34.74
Bowls	0705	364	16	25.74
Rockpile	0710	10	6	34.8
Kaisers	0715	2.3	8	34.79
Fours	0720	2.3	7	34.72
Threes	0725	2.3	6	34.73
Poplars	0730	2.3	12	34.8
Canoes	0735	2.3	4	34.72
Queens	0735	10	6	34.73
Publics	0745	2.3	5	34.87

Surf Site Results 5/2/0

Site	Time	Entero	Clostridium	Salinity
Bamburas	0715	2.3	1	NA
Bowls	0800	53	7	33.05
Rockpile	0805	2.3	2	34.44
Kaisers	0810	2.3	1	34.74
Fours	0815	2.3	3	34.97
Poplars	0820	2.3	<1	34.96
Canoes	0825	2.3	<1	35.05
Queens	0830	2.3	1	35.05
Publics	0835	10	2	35.05
Kapua Channel	0840	2.3	1	35.10

Enterococci at Confluence of Manoa/Palolo and Ala Wai Canal

Site	3/2806 5th	3/29/06 6th	3/30/06 7th	3/31/06 8th	4/4/06 12th	5/19/06 57th
Date Street	4200	1500	1300	7300 est	1800	4100
Seaside Ave	35,000	200,000 est	3000	3000	300	93
Kaiolu Street	60,000	140,000 est	700	4300	700	3400

CWB Conclusions

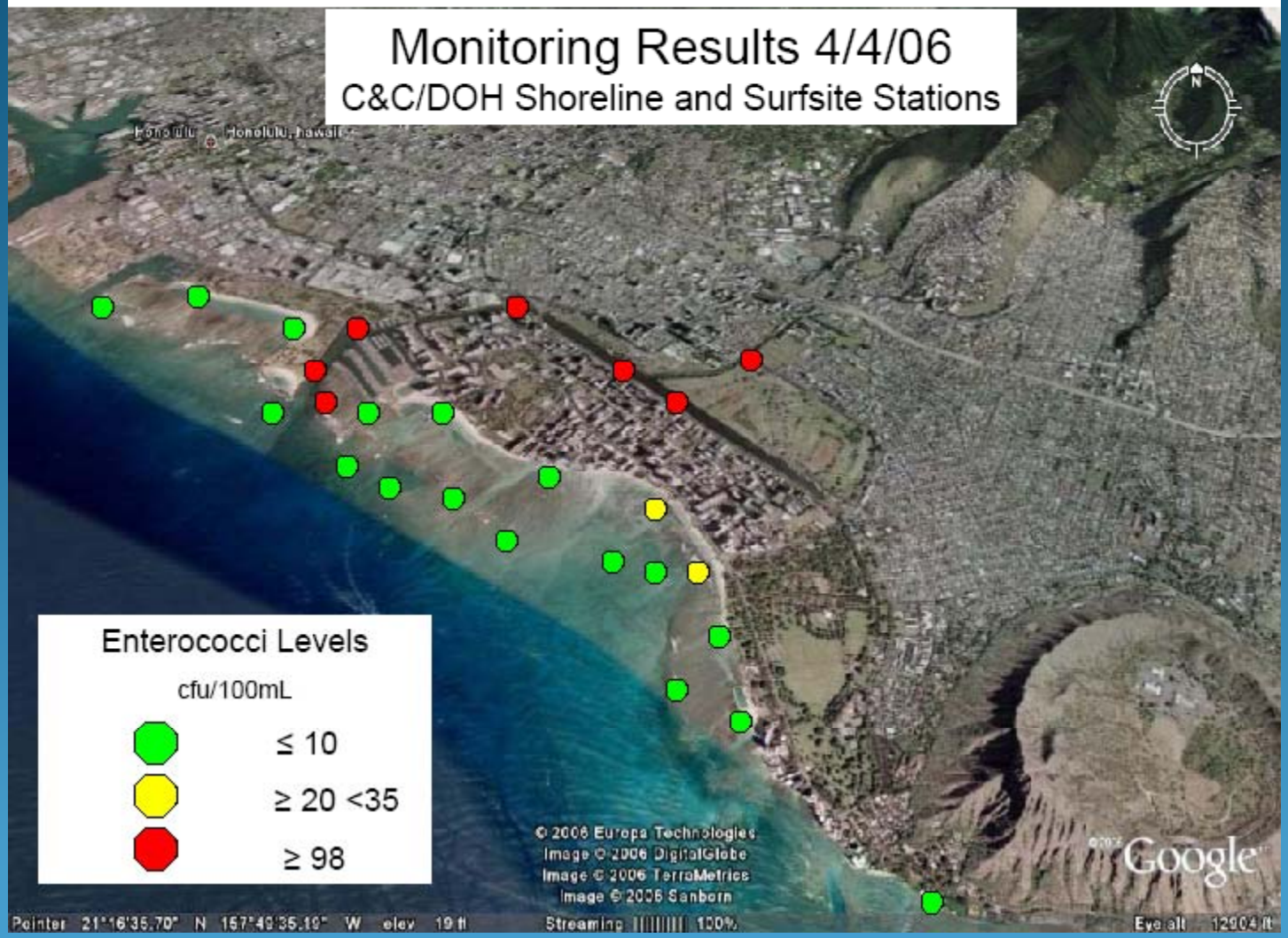
- Storm water runoff of March 31, 2006 had a positive impact on the Spill.
- City showed initiative in conducting drogue studies.
- Drogue studies and Surf site monitoring are valuable tools to determine beach safety.
- The City and State effectively monitored the largest Waste Water Spill in Hawaii's history.
- The UH/WWRC showed itself to be an effective third party in monitoring the spill.
- CWB needs to continue upgrading their website.
- DOH failed in getting the correct message out.

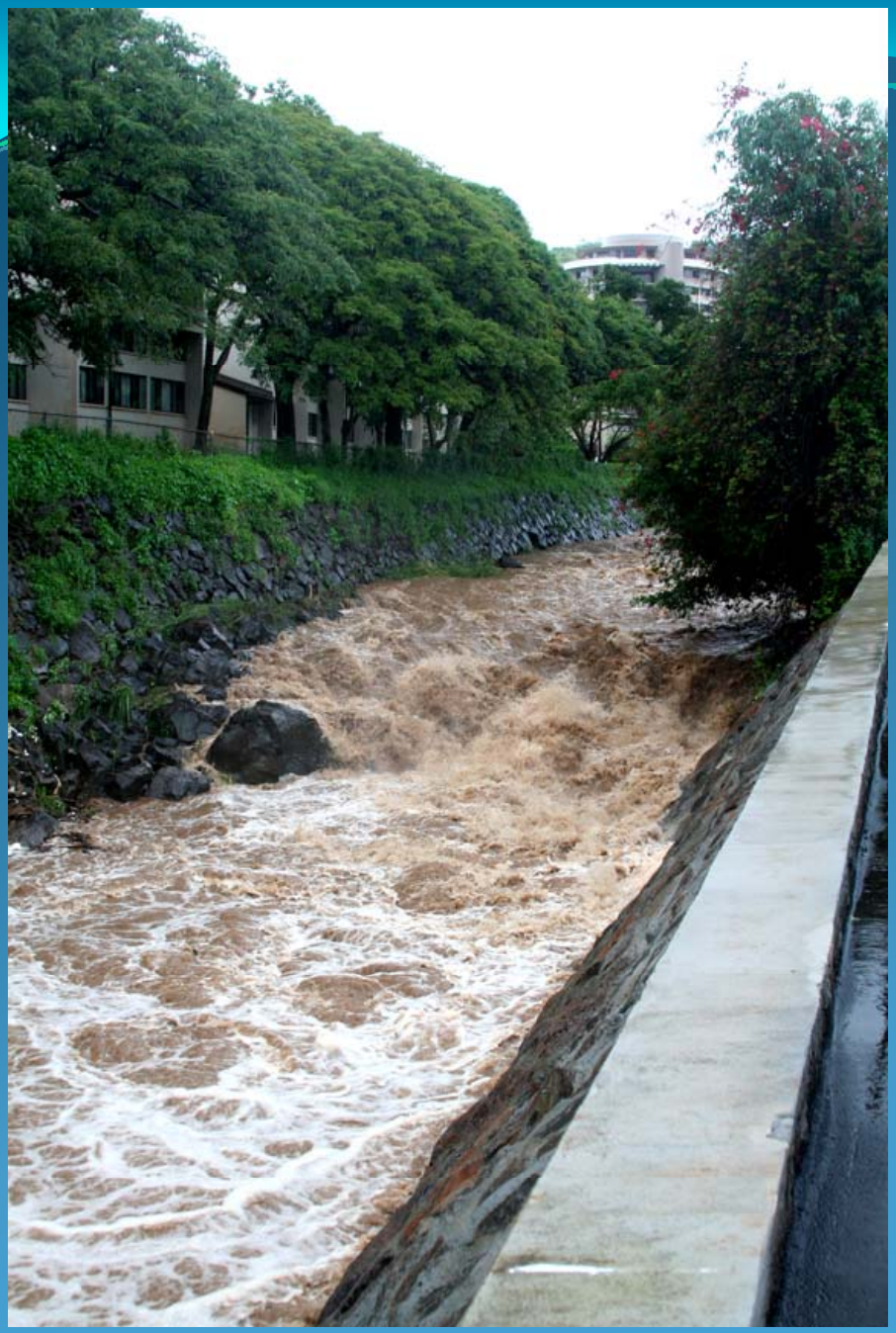
Lessons Learned

- Rely only on Scientific Data.
- Attend Outreach Activities (NB, Organizations, and Special Interest Groups).
- Share the data; be transparent but give out at a certain time everyday.
- The media will exploit any angle and even make the news.
- DOH/EMD needs to develop an Incident Command System and spokesperson to respond to major spills/events.
- Keep a cool head, keep things in perspective, and always look at the big picture.

CRAIG T. KOJIMA / CKOJIMA@STARBULLETIN.COM

This sign was among many along Waikiki's beach yesterday warning people to stay out of the sewage-polluted water.


Monitoring Results 4/4/06
C&C/DOH Shoreline and Surfsite Stations
Enterococci Levels
cfu/100mL
≤ 10
≥ 20 <35
≥ 98
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Image © 2006 TerraMetrics
Image © 2006 Sanborn
Google



Raging Manoa Stream at time of spill

UH Monitoring Data for Ala Wai Canal and Beaches for Human-Specific *Bacteroides* 16S rRNA Genes by PCR

Sample sites	ASSAY METHOD											
	QPCR-HF183F[a]				*B. theta*[b]				HF183[c]			
	3/29	3/31	4/2	4/18	3/29	3/31	4/2	4/18	3/29	3/31	4/2	4/18
Ala Moana	+	+	-	-	+	+	-	-	+	+	-	-
Magic Island	+	+	-	-	+	+	-	-	+	+	-	-
Waikiki	+	+	-	-	+	+	-	-	+	+	-	-
Ala Wai Canal	+	+	-	-	+	+	-	-	+	+	-	-

Seurinck *et al.* 2005, Carson *et al*. 2005, Field *et al*. 2003

CONCLUSIONS OF UH MONITORING DATA DURING SEWAGE SPILL INTO ALA WAI CANAL AND BEACHES

1. **Beaches were cleared of sewage contamination by April 2 (4 days after spill ended) based on monitoring data: FRNA coliphage & *Bacteroides* by PCR.**
2. **The data support DOH decision of opening beach on April 4th to the public.**
3. **The data support the DOH use of monitoring *C. perfringens* to close and open beaches.**

Recovery of Fecal Indicator Bacteria from Beach Sand 4/26/06 (Ala Moana, Magic Island, Kuhio Beach, Sand Souci Beach)

Sand Sites	Enterococci (CFU/100 ml)	*E. coli* CFU/100 ml	*C. perfringens* (CFU/100 ml)	FRNA (MPN/100 ml)
Ala Moana Wet Sand	294	<4	<1	<0.01
Ala Moana Dry Sand	2,058	3,888	<2	0.01
Magic Island Wet Sand	<4	<4	<1	<0.01
Magic Island Dry Sand	836	<4	<2	<0.01
Kuhio Beach Wet Sand	8	<4	<1	<0.01
Kuhio Beach Dry Sand	98	<4	<1	<0.01
Kuhio Beach Back Dirt/Sand	2,120	2,420	<1	<0.01
San Souci Wet Sand	4	22	<1	<0.01
San Souci Dry Sand	452	44	<2	<0.01

What we know

- When it rains, expect high Enterococcuc
- Initial storm water flush is high in Enterococcus and Clostridium
- Beach erosion results in high Enterococcus
- Monk Seals means high Enterococcus
- Ducks/Geese high Enterococcus and Clostridium
- Swash zone high in Enterococcus
- Streams are naturally high in Enterococcus

Dr. Tao Yan WERF Grant

- Concentration Dynamics of Fecal Indicators in Hawaiian Coastal and inland Sand, Soil, and Water During Rainfall Events (PATH6RO9).

- DOH Project: Survival and Die-Off of Enterococci and Fecal Pathogens in Tropical Beach Sand. Funded by the Kualoa SEP consent agreement.