



Integration of Seismic Modeling Software with Emergency Response Software

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The Challenge

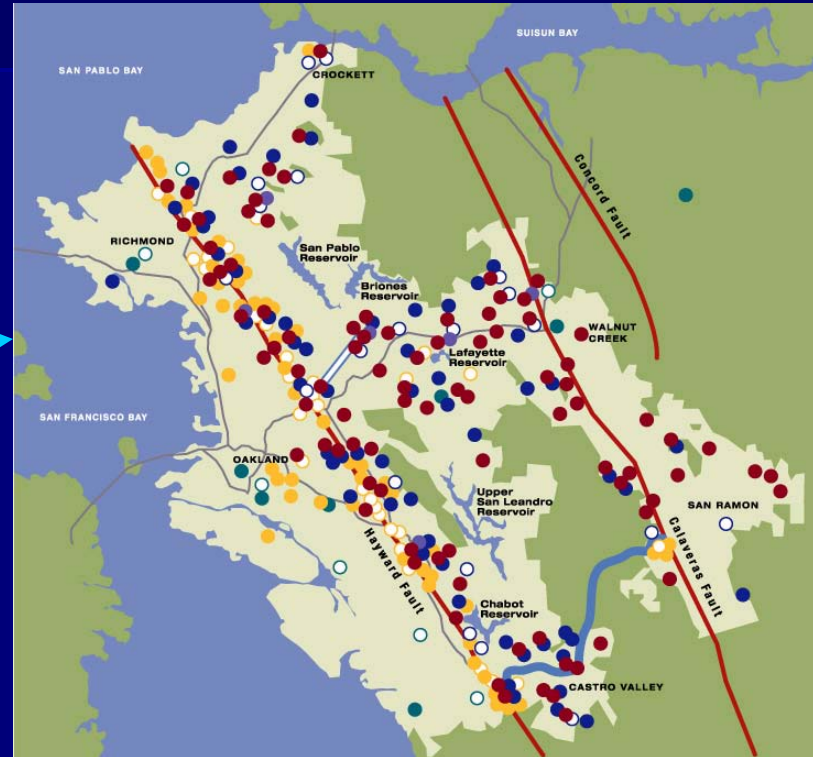


Loma Prieta, October 17, 1989



San Fernando Dam, Feb 9, 1971

EBMUD's Seismic Setting



- 4,000 miles of pipe
- 30 dams
- 400 major facilities

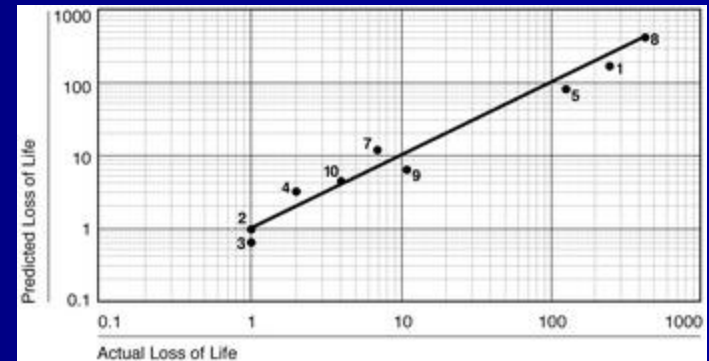
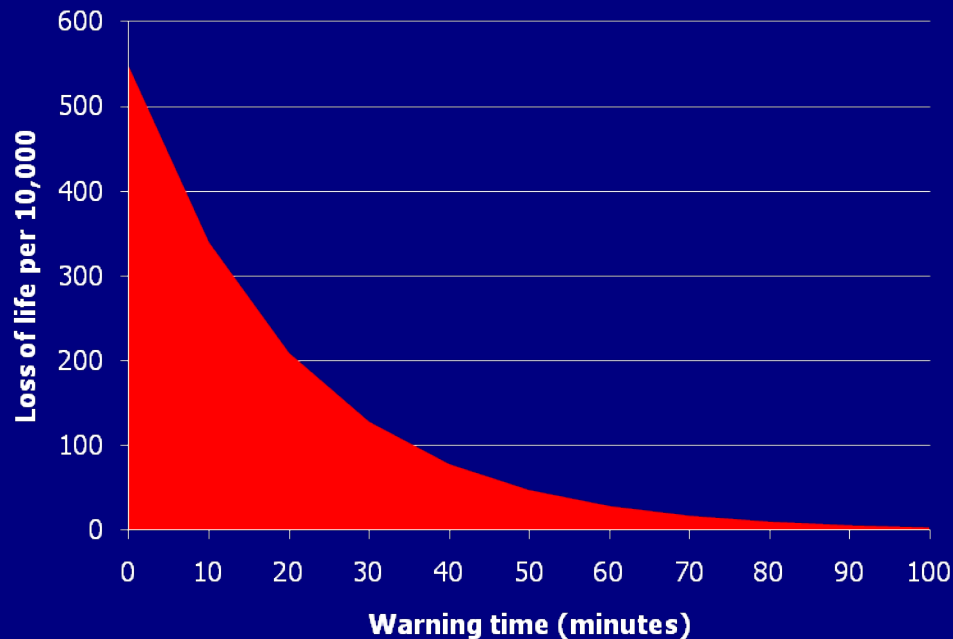
Why Do Seismic Modeling?

1. Better Scenario Planning, pre-event
 - Traditional use of modeling
 - Guides capital investment, emergency planning
 - \$200,000,000 Seismic Improvement Program by EBMUD based on this kind of modeling
2. Improved Response, post-event
 - Focus response on high priorities
 - *Must be fast* or there's no point doing it at all

Post-event Modeling Must Be *Fast*

$$LOL = \frac{P^*ef}{1 + 13.277(P^*ef)^{0.44}e^{-x}}$$

DeKay and McClelland, 1993,
 $X = 2.982 WT - 3.790$



Simsience 1999, USBR 1989), from
<http://www.waterpowermagazine.com/story.asp?storyCode=2028213>

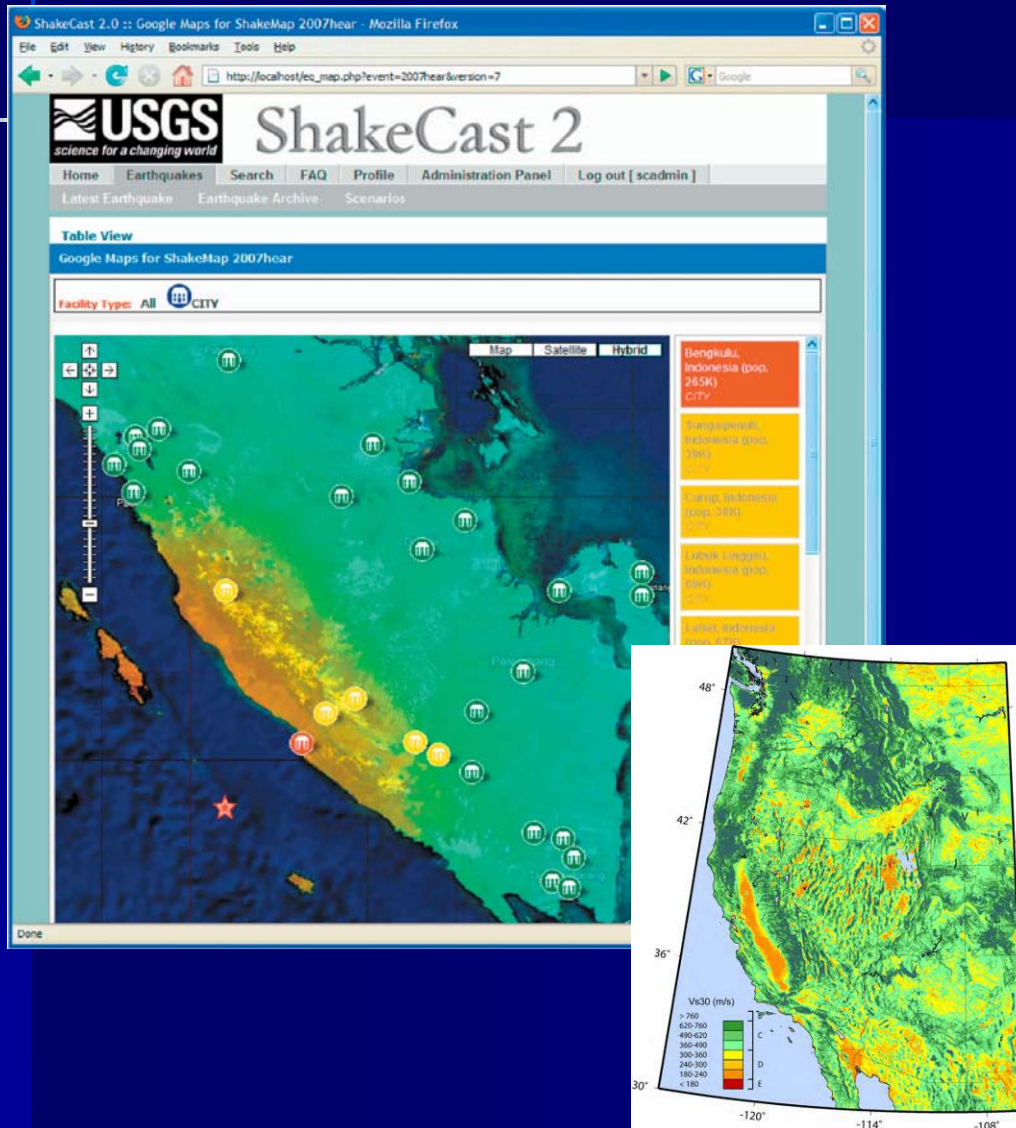
Seismic Modeling in the Old Days

- Proprietary
- Slow
- Costly



c. 1868 seismic modeler

Enter *ShakeCast*



- Shakemaps within minutes of an EQ
- Worldwide scope
- Cutting-edge science, e.g., VS30 modeling
- Free, open system

ShakeCast for Facility Owners

Build Your Inventory Database Prior to Earthquakes

- Define regions of interest
- Collect structure information (location and fragility)
- Identify notification recipients, notification thresholds, and message formats

- Multi-building campus
- SSH Low Code
- SSH Pre Code
- SSL Low Code
- SSL Pre Code
- SSM Low Code
- SSM Pre Code
- URML Low Code
- URML Pre Code
- URMM Low Code
- URMM Pre Code
- W1 High Code
- W1 Moderate Code
- W1 Low Code
- W1 Pre Code
- W2 High Code
- W2 Moderate Code
- W2 Low Code
- W2 Pre Code
- Bridge
- Multi-building campus

Automatically Receive the Earthquake Notification

- Alert from the ShakeCast system soon after an earthquake is located and ground shaking data is estimated
- Alert message contains earthquake source parameters and the number of facilities likely affected
- Quick summary table indicates the estimated damage state of facilities sorted according to impact

ShakeCast Event: Magnitude 7.3

FACILITY Shaking Estimates from ShakeMap

VA Hospital Name	Damage Level	Metric	Value	Exceedance Ratio
Charlottesville, VA Hospital	Severe	MMI	10	1.429
Columbus, VA Hospital	Severe	MMI	7.0	1.000
Atlanta, VA Hospital	Severe	MMI	6.52	0.960
Emporia, VA Hospital	Severe	MMI	6.32	0.660
Salisbury, VA Hospital	Severe	MMI	5.66	0.330
Greensboro, VA Hospital	Severe	MMI	5.5	0.250
Johnston City, VA Hospital	Severe	MMI	5.4	0.200

Check the Damage Assessment Estimate

- The ShakeCast web interface provides quick summary of affected facilities, earthquake information, and Google Maps GIS tools
- Event Table contains detailed information on ground shaking measures, facility information, and damage estimates
- The GIS interface groups both ShakeMap and users' facilities into categories for better navigation and damage assessment



Provide Updates for Post-Earthquake Response

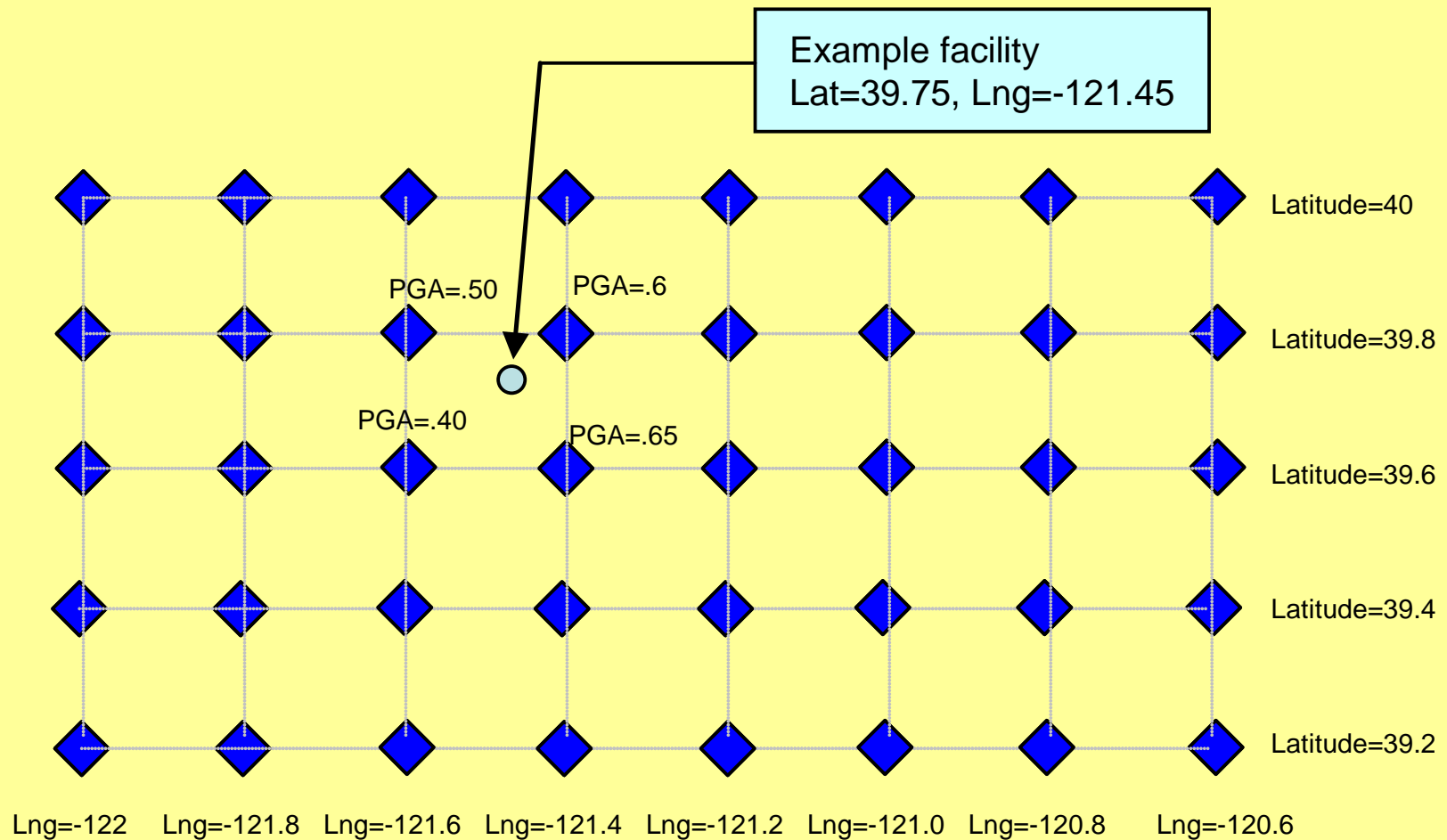
- ShakeCast system continues to receive ShakeMap updates and to provide updated prioritized list of facilities for inspection
- ShakeCast system automatically downloads selected ShakeMap products for comprehensive damage analysis
- ShakeCast system is capable of processing scenario earthquakes for the purpose of emergency planning and exercise



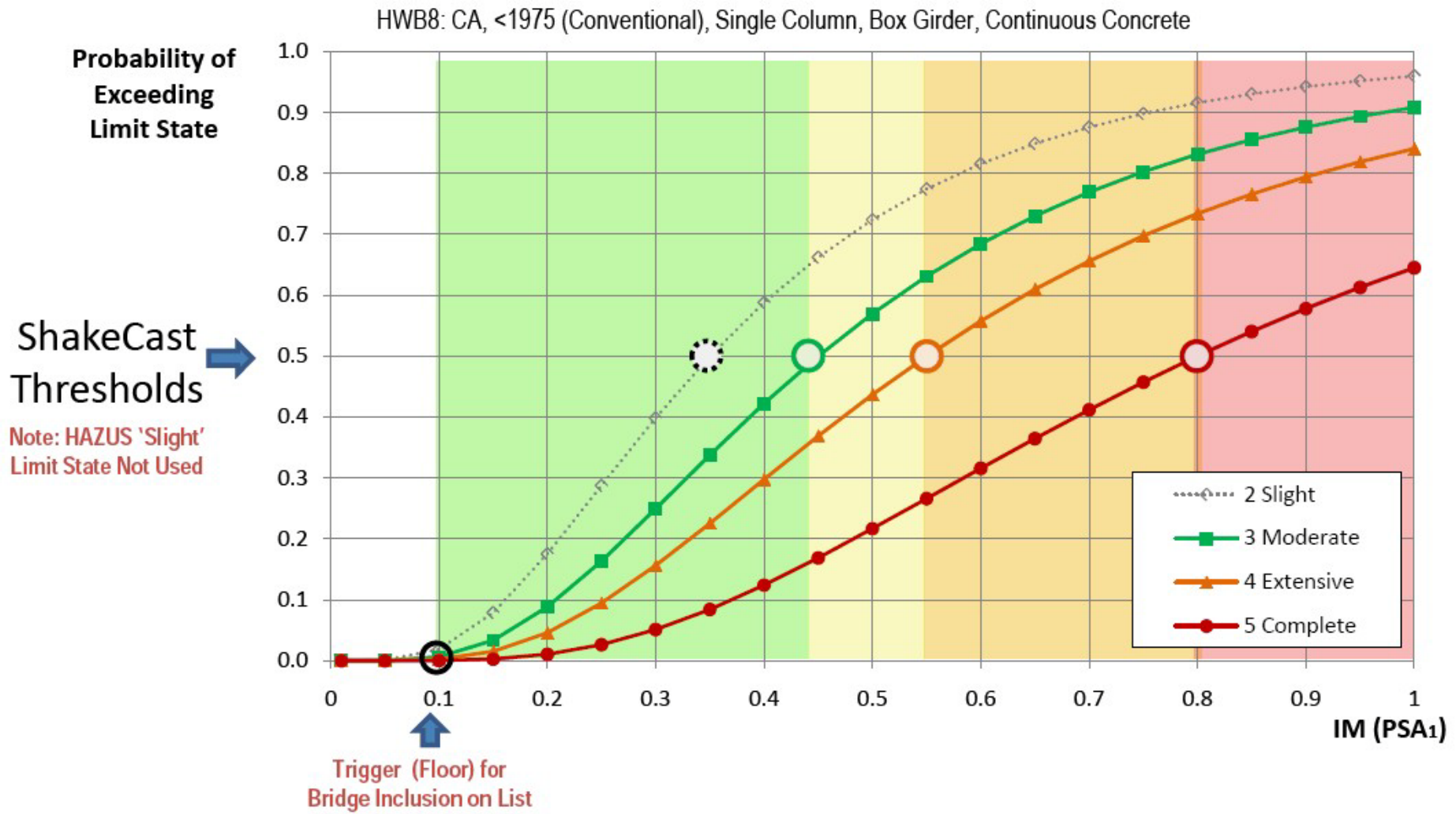
Typical Raw Earthquake Data

```
<shakemap_grid xsi:schemaLocation="http://earthquake.usgs.gov
http://earthquake.usgs.gov/eqcenter/shakemap/xml/schemas/shakemap.xsd"
event_id="2009ixae" shakemap_id="2009ixae" shakemap_version="2"
code_version="3.2.1 GSM" process_timestamp="2009-07-10T01:15:20Z"
shakemap_originator="us" map_status="RELEASED" shakemap_event_type="ACTUAL">
<event magnitude="5.3" depth="381.6" lat="47.909200" lon="148.248300" event_timestamp="2009-07-
10T00:49:10GMT"
event_description="NORTHWEST OF THE KURIL ISLANDS"/>
<grid_specification lon_min="146.264967" lat_min="46.585867" lon_max="150.264967"
lat_max="49.252533"
nominal_lon_spacing="0.083333" nominal_lat_spacing="0.083333" nlon="49" nlat="33"
nominal_pga_std="0.920000"/>
<grid_field index="1" name="LON" units="dd"/>
<grid_field index="2" name="LAT" units="dd"/>
<grid_field index="3" name="PGA" units="pctg"/>
<grid_field index="4" name="PGV" units="cms"/>
<grid_field index="5" name="MMI" units="mmi"/>
<grid_field index="6" name="PSA03" units="pctg"/>
<grid_field index="7" name="PSA10" units="pctg"/>
<grid_field index="8" name="PSA30" units="pctg"/>
<grid_field index="9" name="SDPGA" units="none"/>
<grid_field index="10" name="SVEL" units="ms"/>
-
<grid_data>
146.264967 49.252533 0.1449 0.4267 1.3300 0.2329 0.4507 0.0197 1.0000 360.0000
146.348300 49.252533 0.1465 0.4308 1.3400 0.2354 0.4551 0.0199 1.0000 360.0000
146.431633 49.252533 0.1481 0.4349 1.3500 0.2379 0.4594 0.0201 1.0000 360.0000
146.514967 49.252533 0.1497 0.4388 1.3600 0.2402 0.4635 0.0203 1.0000 360.0000
...
```

Grid of Earthquake Metrics



Damage vs. Earthquake Metric



Seismic Modeling is Not Enough

Facility	Modeled Damage Potential	Inspection Priority	Status	Notes
Achilles Dam	Moderate	??	??	??
Zertron Dam	None	??	??	??
Nimrod RCV	Severe	??	??	??
Ye Olde PP	Moderate	??	??	??

To be *truly useful*, model results must be integrated with real-time field data.

Conceptual *ShakeCast-Marconi* Integration

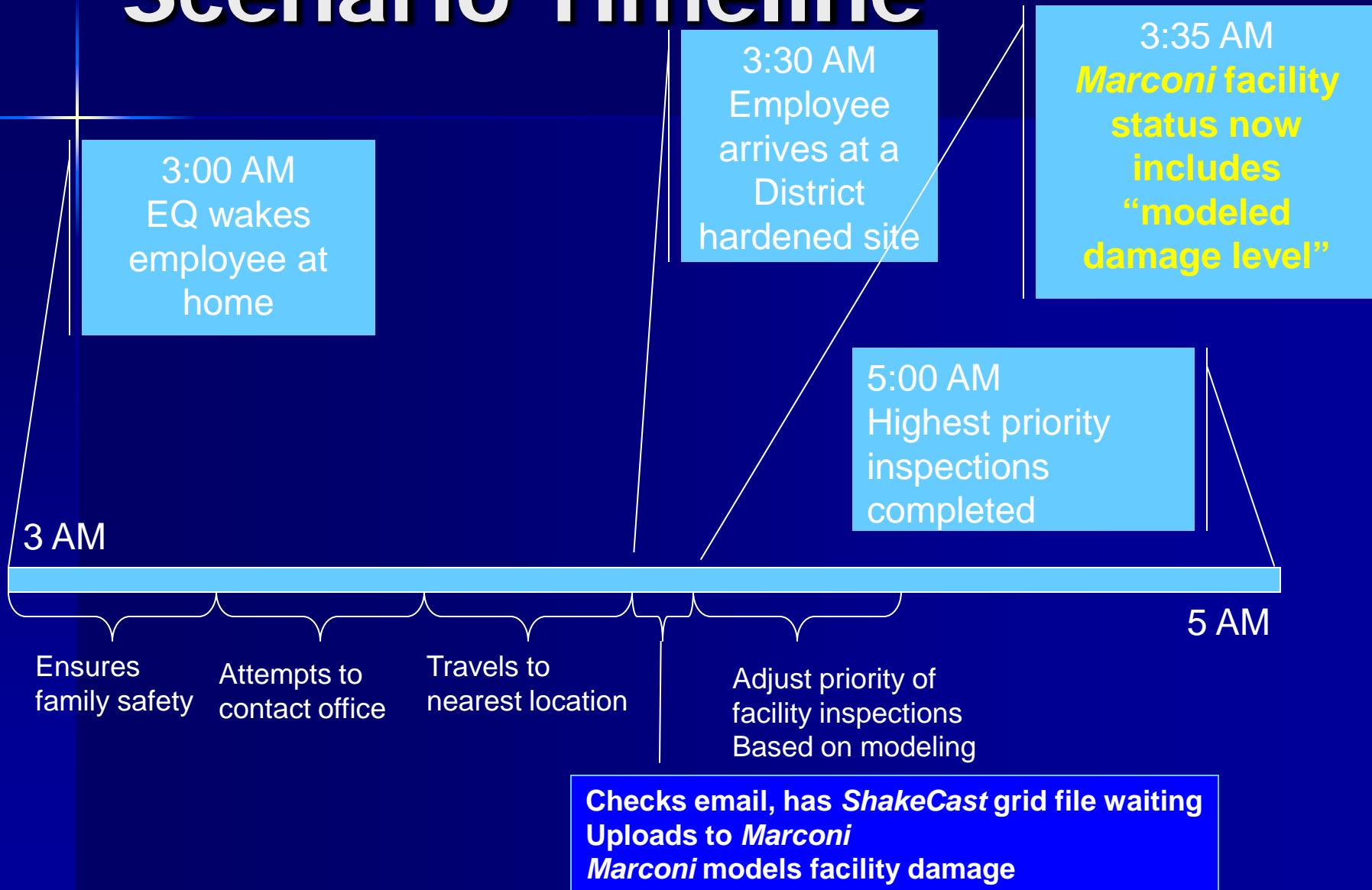
Facility	Modeled Damage Potential	Inspection Priority	Status	Notes
Achilles Dam	Moderate	High	Inspection under way	This dam was our Achilles heel during tabletop also
Zertron Dam	None	Low	Inspect tomorrow	Zertron is built like a tank
Nimrod RCV	Severe	Low	Inspect tomorrow	Nimrod is non-essential
Ye Olde PP	Moderate	Medium	Inspection set for 17:00 today	Storage in zone adequate for now

A Scenario

- Major Hayward EQ at 3 AM
- In many locations, Internet and phone service not immediately available
- District's internet linkages intact at major sites such as service yards



Scenario Timeline



Response

MARCONI

er² Emergency Response and Recovery

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(admin) [Login/out](#)

Home	Scenario ▾	People ▾	Incidents ▾	Maps ▾	Facilities ▾	Communications ▾	Resources ▾	Admin ▾	Help ▾
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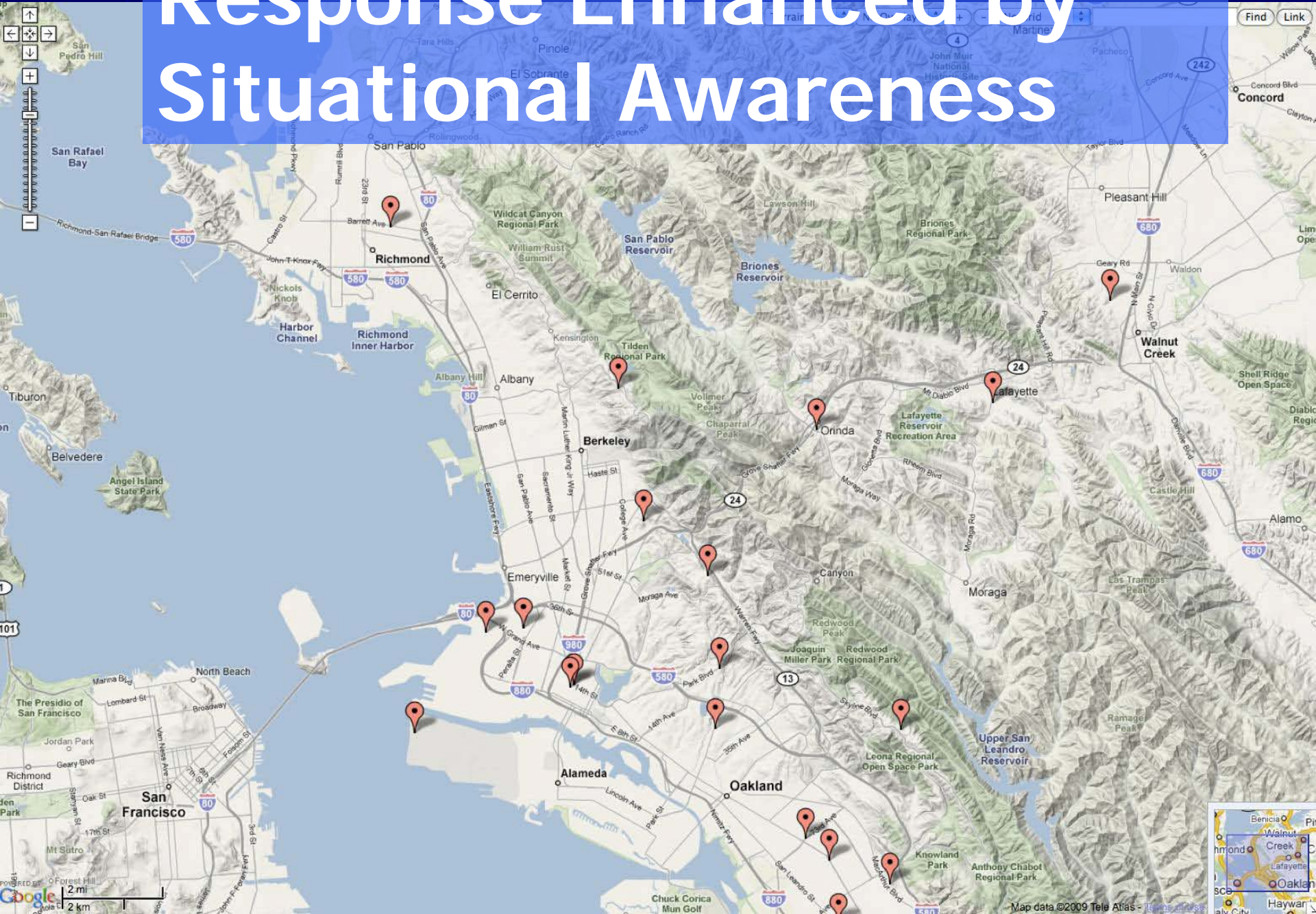
Manage Incidents [View crisis details](#)

[Report a new incident](#)

List of Incidents

Action	Name	Facility	Incident Type	Status	Priority	City	Updated	Crisis
View Edit Delete	Fire reported at Broadway and 12th		Wildfire	Confirmed and unresolved	Low priority		2009-01-08 14:11:38	18
View Edit Delete	Sams WTP power failure	Sams WTP	Power outage	Confirmed and unresolved	High priority		2009-01-09 13:51:49	18
View Edit Delete	Bay Bridge collapse		Other	Confirmed and unresolved	Lowest priority		2009-01-08 14:13:12	18
View Edit Delete	Linesky Main Break		Pipeline leak	Confirmed and unresolved	Medium priority	Oakland	2009-01-09 11:54:42	18
View Edit Delete	Mainbreak at Sunshine and Oscar Drives		Pipeline leak	Confirmed and unresolved	Medium priority	Oakland	2009-01-09 11:57:14	18
View Edit Delete	Nomad Dam		Dam emergency	Confirmed and unresolved	High priority		2009-01-09 11:58:05	18

Response Enhanced by Situational Awareness



Information Only Useful If It Is Acted Upon Promptly



LIDAR scans of susceptible dams
(from GEER, Japan 2008 EQ)



Protect cracks from water intrusion
(from GEER, Japan 2008 EQ)

Emergency Software Use Case Overview

Planning

Establish emergency response and recovery roles

Maintain personnel contact information

Develop detailed multi-hazard scenario plans and supporting documents

Study facility resilience vs. scenarios

Assemble key documents

Response

Communicate with personnel

Prioritize and investigate incidents

Assess damage

Develop overall situational status

Formulate response priorities

Communicate priorities and plans

Recovery

Implement response/recovery plans

Manage people and resources

Track and communicate progress

Track costs, process claims

Transition to everyday systems

Value Added by Seismic Model

Planning

Establish emergency response and recovery roles

Maintain personnel contact information

Develop detailed multi-hazard scenario plans and supporting documents

Study facility resilience vs. scenarios

Assemble key documents

Response

Communicate with personnel

Prioritize and investigate incidents based on model

Model and assess damage

Develop overall situational status

Formulate response priorities

Communicate priorities and plans

Recovery

Implement response/recovery plans

Manage people and resources

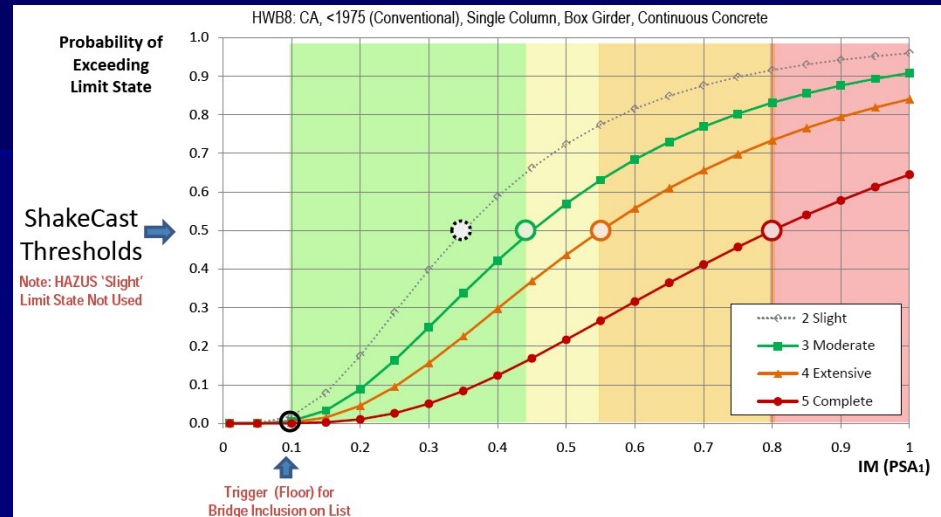
Track and communicate progress

Track costs, process claims

Transition to everyday systems

Planning Activities

Hayward M7 EBMUD Scenario Plan



Name	Emergency roles
Fudd, Elmer	Damage inspection
Coyote, Wile	Floor fire warden
Sam, Yosemite	Ops chief

DAISY DUCK

Supervisor:
Disney, Walt x1102w, 925-555-1212h, 925-555-1215c

Direct Reports:
Duck, Donald x1032w, 510-555-1215h, 925-555-1216c
Duck, Huey x1104w, 925-555-1218h, c
Duck, Louie x1091w, 510-555-1219h, 510-555-1218c
Duck, Dewey x1365w, 925-555-1210h, 925-555-1211c

Peers:
Mouse, Minnie x0577w, 415-555-1215h, 415-555-1212c
Mouse, Mickey x1037w, 925-555-1218, 925-555-1215c
Coyote, Wile E x1175w, 925-555-1219h, 925-555-1211c
Martian, Marvin x1665w, 510-555-1215h, 510-555-1218c
Junior, Sylvester x0335w, 510-555-1213, 510-555-1219c
Snow White x1191w, 510-555-1218h, c

Marconi: <http://ersquared.org/marconi>
EBMUD General: 866-40-EBMUD
Dispatch: 510-287-0600 OCC: 510-287-0755
Employee Care in EOC: 510-287-0559 or 510-287-0558
EOC at WCWTP: 925-943-6601 or 510-287-1033
Voicemail: 510-287-2001 or 800-273-0444
Orinda: 510-287-2029; North 510-287-0831
South: 510-287-0837; East 510-287-0834

Backup email: <https://ems.messageone.com>
Login: daisy@disney.com
Emerg Note System: receive cocteam email/866 voice msg
Response designation: Report to nearest County Facility
Report Location: West Yard, San Francisco

01/12/09

East Bay Municipal Utility District

Business Continuity Plan

For

Engineering and Construction Department

Updated
April 7, 2008

Recovery

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[Manage Incidents](#)--> **Edit Incident 17 Sans WTP power failure**

Incident is being watched. [Remove watch](#) [My watched incidents](#)

[General](#) [Tasks](#) [Journal and Docs](#)

[Create a new task](#)

List of Tasks for this Incident

Action	Task name	Description	Status
View Edit Delete	Carpenter	Work with electrician to rebuild control room.	IN_PROGRESS
View Edit Delete	Electrical	electrician required to assess severity of power failure	IN_PROGRESS
View Edit Delete	Security	Secure main gate. manually open for appropriate personnel	IN_PROGRESS

[Save](#)

Recovery



Michael D. Brown
Under Secretary
Emergency Preparedness and Response

National Processing Service Center
P.O. BOX 10055
Huntsville, MD 20782-7055
1-800-621-FEMA (3362)



Jeb Bush
Governor
State of Florida

08/30/2004

Disaster No.1539

Dear Mr. Ritchie:

The Federal Emergency Management Agency (FEMA) and the State of Florida have reviewed your request for disaster help and/or the inspection done on your home. Listed below are the decisions that have been made regarding your request for help. For a full explanation of the decisions, please refer to the section called "If You Are Not Eligible For Help" in HELP AFTER A DISASTER, Applicant's Guide to the Individuals & Households Program which was mailed to you after you applied for assistance.

La Agencia Federal Para el Manejo de Emergencias (FEMA) y su estado local han revisado su solicitud de ayuda. Abajo se le indica las decisiones que se han tomado respecto a su apelación. Para obtener una explicación completa de las decisiones, favor refiérase a la Guía para Solicitantes al Programa para Individuos y Familias - Ayuda Después de un Desastre - bajo la sección titulada "Razones por no ser elegible", el cual se le mandó por correo después de que solicitó ayuda.

CATEGORIES
CATEGORIAS
Housing Assistance
your insured status with FEMA
Total Grant Amount:

DETERMINATION
DETERMINACIONES
INS - Please review the Notices page of this letter for more information on
\$0.00

If a decision results in a monetary award, you will soon receive a check (s) at the mailing address you provided when you registered or electronic funds transfer to your bank for the Total Grant Amount listed above.

Si la decisión resulta en un otorgamiento monetario, dentro de poco tiempo recibirá un cheque(s) a la dirección que indicó como su dirección postal o una transferencia electrónica de fondos a su banco por el Monto Total de ayuda indicado arriba.

If you disagree with the decision(s) above, you have the right to appeal within 60 days of the date of this decision letter. If you have any questions about writing an appeal, please read the Notices on the back of this letter or call the FEMA Disaster Helpline at 1-800-621-FEMA (3362) (hearing/speech impaired only, call 1-800-462-7585).

Si tiene alguna pregunta acerca de esta decisión, favor refiérase a la Guía para Solicitantes al Programa para Individuos y Familias - Ayuda Después de un Desastre o llame a la Línea de Ayuda de FEMA al 1-800-621-FEMA (3362) (personas con impedimentos auditivos o del habla, llamar al 1-800-462-7585).

MARCONI

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Home Scenario People Incidents Maps Facilities Communications Resources Admin Help

Facilities

Limit by class: all facility classes

and Types:

☐ In selected cities only

Alameda
Alamo
Albany
Antelope
Antioch
Belvedere

Refresh facility list

Export facility list ...

[Add a new facility](#)

List of Facilities

Action	Facility	Status	Status notes	City	Type	Type	Computed Damage
View Edit Delete	Wile E. Water Treatment Plant	In service with no impairment		Richmond	Water treatment plant	Water system	
View Edit Delete	Sams WTP	In service with no impairment		Oakland	Water treatment plant	Water system	
View Edit Delete	Watershed HQ	In service with no impairment		Orinda	Office building	Administrative facilities	
View Edit Delete	Middleton Dam	In service with no impairment		Oakland	Terminal reservoir	Water system	
View Edit Delete	Chabot PP	In service with no impairment		Oakland	Pumping plant	Water system	
View Edit Delete	Jensen PP	In service with no impairment		Castro Valley	Pumping plant	Water system	
View Edit Delete	Claremont Reservoir	In service with no impairment		Berkeley	Distribution storage tank	Water system	
View Edit Delete	Donald Pumping Plant	In service with no impairment		Oakland	Pumping plant	Water system	
View Edit Delete	Filler RCS	In service with no impairment		Oakland	Rate control valve	Water system	

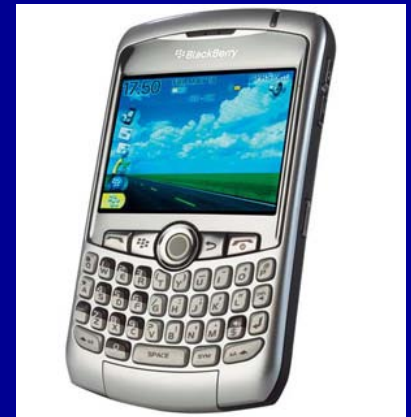
Marconi Design Assumptions

- Internet may not be uniformly available, but is probably available at least intermittently, at some locations
- IT staff will *not* be available for setup, help desk
- Core functions must work no matter what
 - Employee check-in
 - Damage assessment tracking
 - Situational status
- Additional functions should work to the extent possible
 - Enhanced map functions
 - Integrations with various systems such as AVL, Shakecast

Marconi Server Platforms



Marconi Client Platforms



Additional Marconi Client Options



Marconi Server Platform

<i>Feature</i>	<i>Marconi design</i>
Operating System	Any
Database	Any
Language	Java
Web server	Any Java EE such as Glassfish
Third-party component dependencies	None.
Cost per server	Zero

Marconi Client Platform

<i>Feature</i>	<i>Marconi design</i>
Browser	Any
Screen-size dependencies	None
Mapping system	Any
Mobile support	Mobile web, SMS, MMS, email
Plug-in dependencies	None
Cost per client	Zero

Crisis Terminology

e.g.,
"Hayward M7"

Incidents

Pipeline break at
Broadway & 12th

Possible dam
emergency @ San
Pablo

Danville PP not
running

Water running
downhill in
Montclair

Tasks

Shut off water

Dig hole

Fix pipe

Repave

Visual recon at
dam site

Geotech eval

Verify instrument
function

Terminology, continued

Journal

Incident

Pipeline break
at Broadway
& 12th

Tasks

Shut off water

Dig hole

Fix pipe

Repave

Visual recon at
dam site

Geotech eval

Verify instrument
function

Phone call re house
being flooded

Crews arrive on scene

Water flow stopped

Hillside collapsed

Assignments

Bob

Fred, lead role

Curly, support role

Demo (time permitting)

Summary

- Major Benefits to Integration of Emergency Information System and Seismic Modeling
 - Improved emergency response
 - Lower cost for systems, training, data maintenance
 - Multi-hazard perspective
- *ShakeCast* and *Marconi* integration exemplifies the concept
- Both are freely available and applicable worldwide

