VALUE OF FORECASTS
SAN FRANCISCO BAY AREA CASE STUDY

BAFPAA-CHARG ANNUAL CONFERENCE 2015
SEA LEVEL RISE, EXTREME WEATHER AND REGULATORY HURDLES: THE NEW CHALLENGES FOR FLOOD PROTECTION

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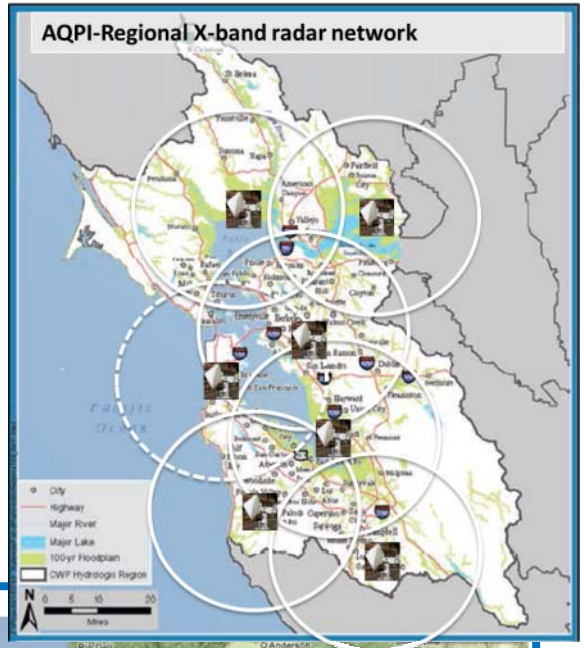
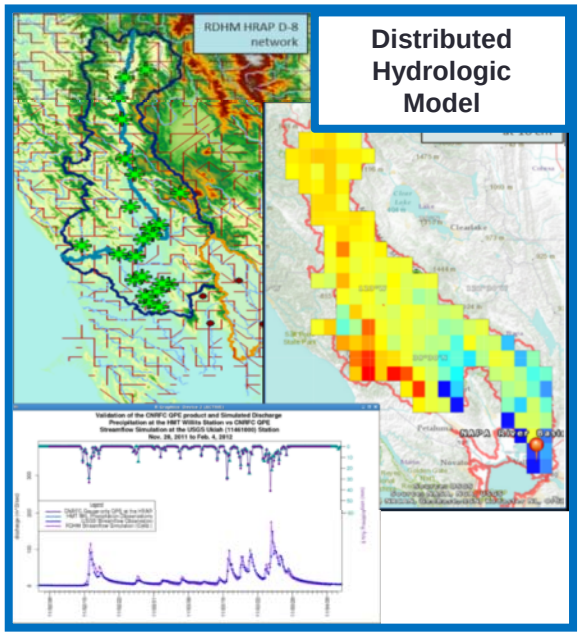
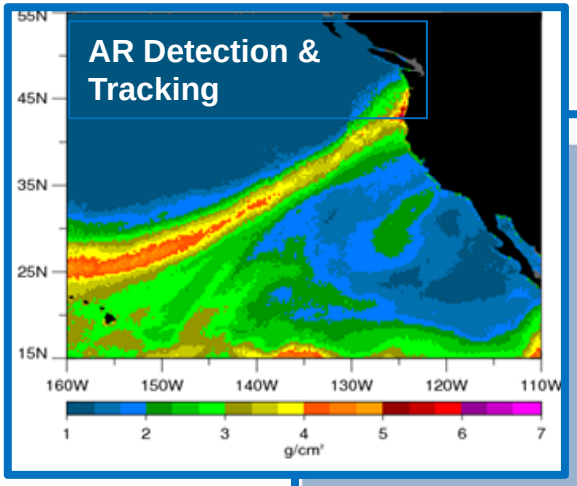
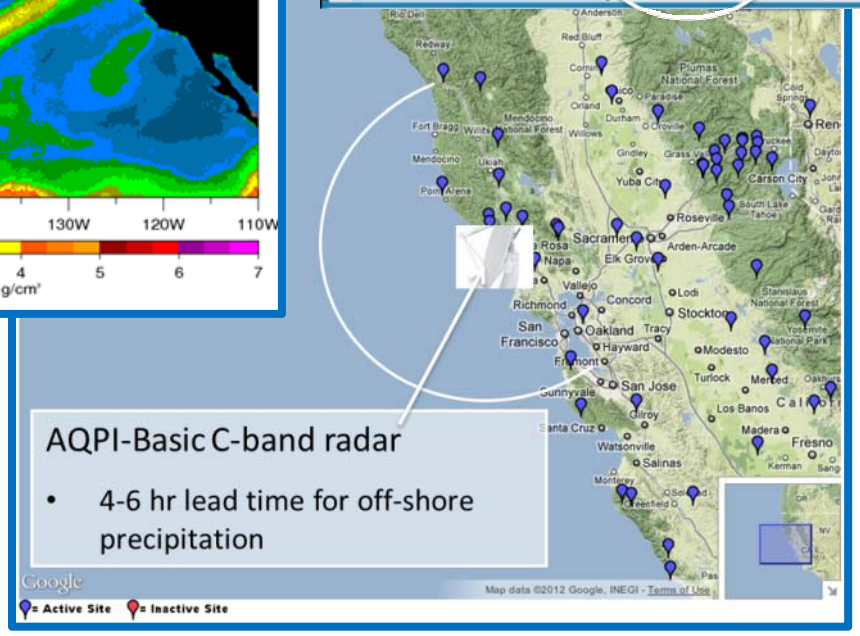
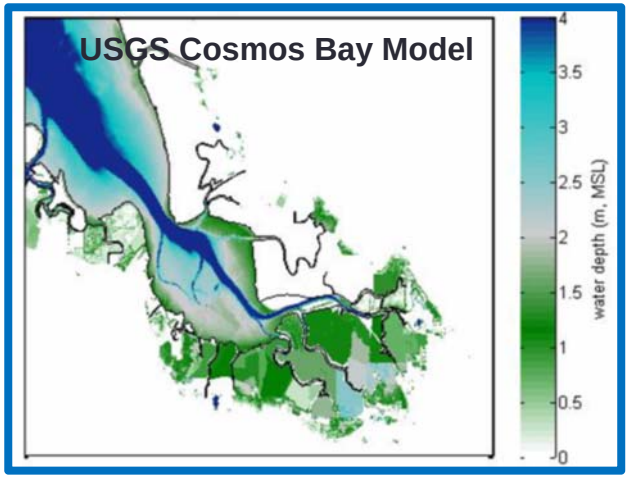
ADVANCED QUANTITATIVE PRECIPITATION INFORMATION SYSTEM











TIME FRAMES AND WATER MANAGEMENT PURPOSES

Time Frame / Purpose	Nowcast (0 min – 6 hrs)	Near Real-time (6 hr – 24 hrs)	Short-term (1 day – 5 days)	Near-term (1 wk – 1 month)	Mid-term (3 month – 1 yr)	Long-term (5 years+)
Flood Mitigation	Flood assessment FF warning	Reduce flood damages	d warning; ponse acts; ervoir FBO	Flood warning; Response acts; Reservoir FBO	Over-year storage allocation	Flood freq; Capacity devel; Climate adapt.
Water Supply	Status assessment; Intake ops	Intake and outlet operations	Increase water supply	y sched.; oir FBO; vation	Over-year drought mit. Conservation	Capacity devel; Demand mana; Climate adapt.
Ecosystem Enhancement	Status assessment	Threat assess; River & Reservoir FBO	Threat assess; River & Reservoir FBO	Threat assess; River & Reservoir FBO	Threat assess; Capacity devel Drought mit.	Ecosystem & Capacity devel; Climate adapt.
Water Quality	Status asses Real-time control	Reduce CSDs	Threat assess; Sys. optimize	Threat assess Capacity devel Sys. optimize	Threat assess Capacity devel Sys. optimize	Capacity devel Climate adapt.
Recreation	Weather status; Warning	Event scheduling	Reservoir FBO	Reservoir FBO	Capacity development	Capacity development
Transportation	Increase public safety	status;	Threat assess Mitigation deployment	Threat assess Mitigation deployment	Threat assess Mitigation deployment	Mitigation planning; adaptation
Hydro-Power	Release operations	Reservoir FBO	Reservoir FBO; Demand schedule	Reservoir FBO; Demand schedule	Over-year drought mit.	Capacity devel.; Climate adapt.

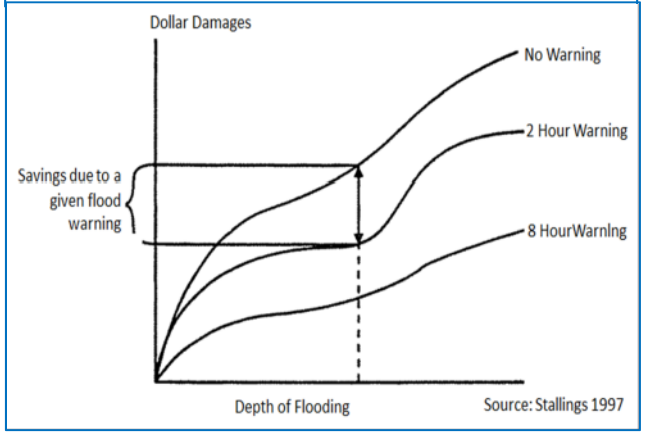
AQPI Focus

FBO = Forecast-Based Operations
FIRO = Forecast-Informed Reservoir Operations

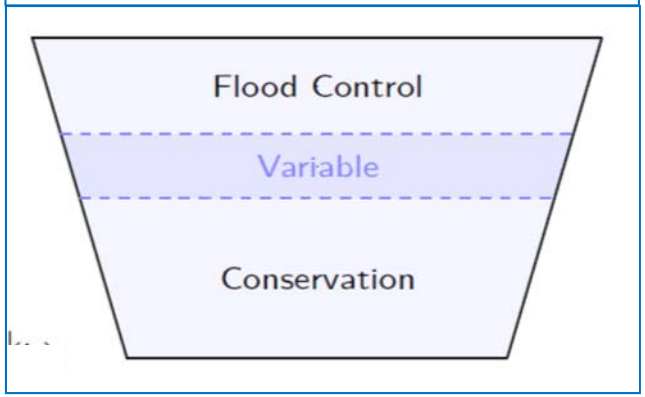
AQPI BENEFITS ASSESSMENT

- **ECONOMICS OF HYDROMET INFORMATION**
  - Flood Mitigation
    - Avoid damages by early, site specific warning
  - Water Supply
    - Capture flood runoff in reservoirs
  - Ecosystem Services
    - Maintain flows for fisheries and recreation
  - Water Quality
    - Capture combined sewer flows for treatment
  - Transportation
    - Avoid dangers and delays on roads, air, rail and ports
- **REGIONAL BENEFITS ACCOUNTING**
  - Extensive literature review
  - “Concurrence of opinions”
  - Reconnaissance-level tabulation
  - Data for all jurisdictions
  - Bounding of estimates
  - Conservative interpretations
  - Uncertainty assessment
  - Qualifications

Reduce Flood Expected Annual Damages

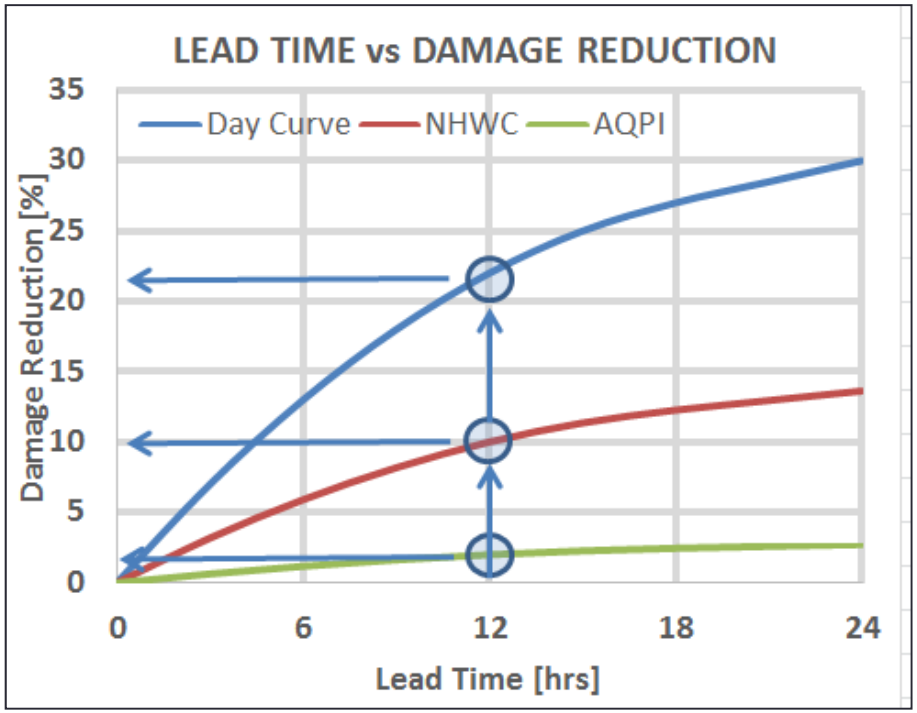


Increase Capture of Flood Waters for Supply



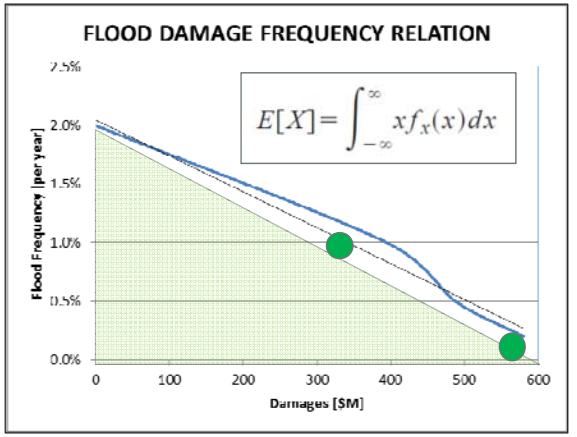
FLOOD LEAD TIME DAMAGE REDUCTIONS

- Day Curve
  - Circa 1970
  - 12 hr lead time ~22% damage reduction
- National Hydrologic Warning Council
  - 12 hr lead time ~10% damage reduction
- AQPI
  - 12 hr lead time ~2% to 5% damage reduction (incremental beyond current wx services)



EXPECTED ANNUAL DAMAGES AVOIDED

- Flood damage frequency relation
- Expected annual damages computation
- Household content value $50K to $100K
- 10% reduction best case estimate
- 2% to 5% incremental estimate for AQPI



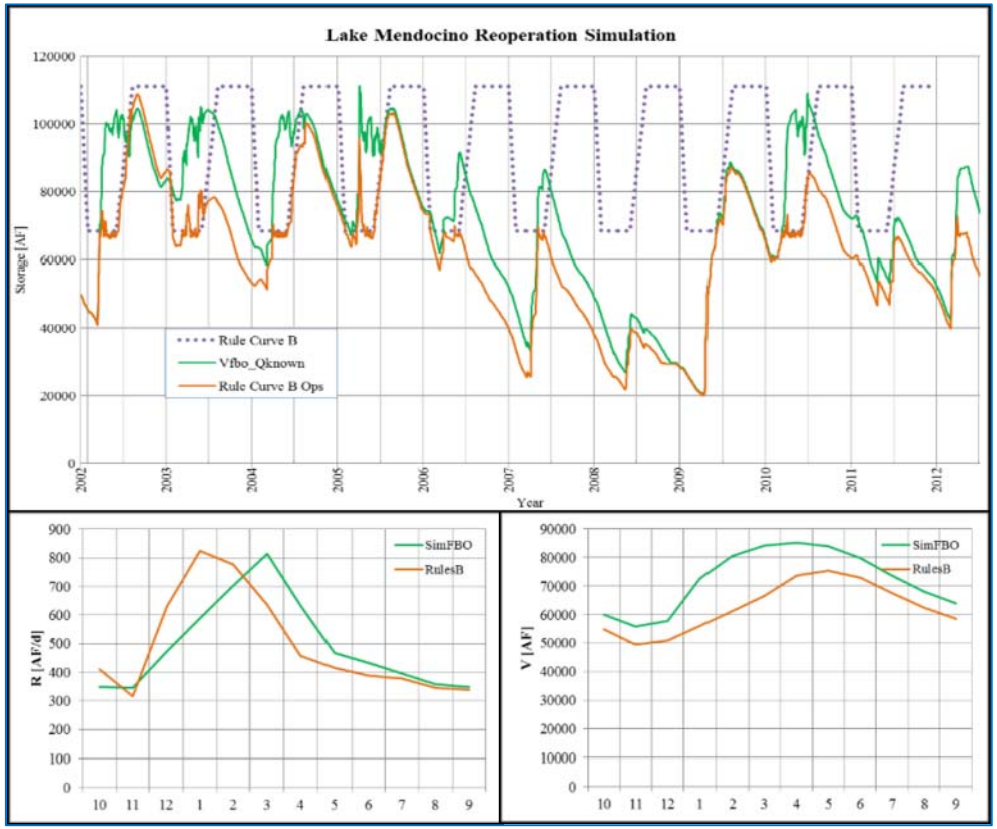
County	Structures in 100-yr Floodplain	Structures in 500-yr Floodplain	100-Yr Contents Damages* [$M]	500-Yr Contents Damages* [$M]	Exp. Annual Contents Damages [$M/yr]
Alameda	10,100	38,500	$505	$1,925	$11.5
Contra Costa	15,300	25,300	$765	$1,265	$11.7
Marin	13,300	22,100	$665	$1,105	$10.2
Napa	4,900	6,500	$245	$325	$3.5
San Francisco	0	0	$0	$0	$0.0
San Mateo	30,300	44,700	$1,515	$2,235	$22.2
Santa Clara	37,100	201,600	$1,855	$10,080	$52.9
Solano	7,200	23,100	$360	$1,155	$7.5
Sonoma	7,900	11,600	$395	$580	$5.8
Total	126,100	373,400	$6,305	$18,670	$125.3

* Assuming contents at $50K per structure

Ref: CaDWR 2013: California's Flood Future: Attachment D - Summary of Exposure and Infrastructure - Inventory by County

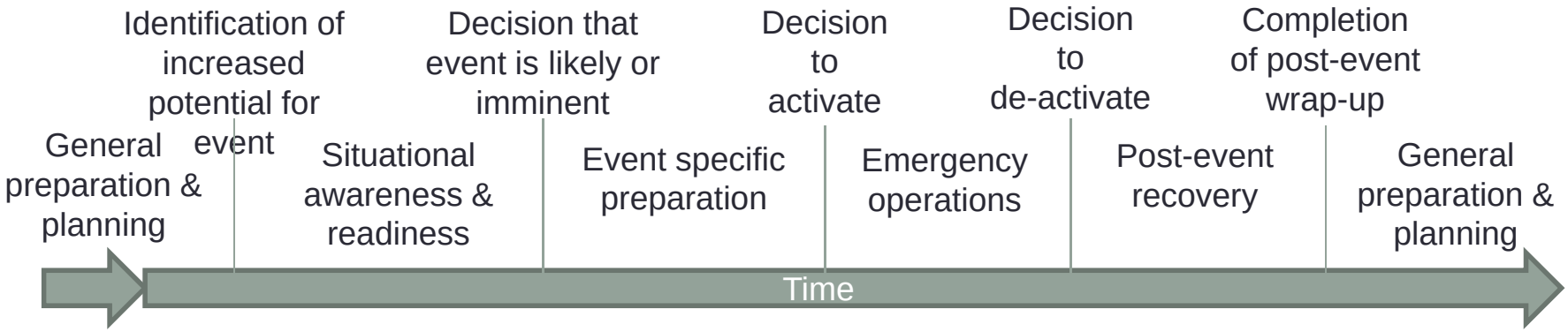
WATER SUPPLY BENEFITS

- FldOps simulation model
- Rule curves relaxed for
  a) flood pre-release if large rain forecast, and
  b) flood zone capture and hold if no rain forecast
- 10-day inflow volume look ahead
- Overall increase in storage levels
- Increases in release flows to later in Spring and Summer



WATER MANAGEMENT DECISIONS

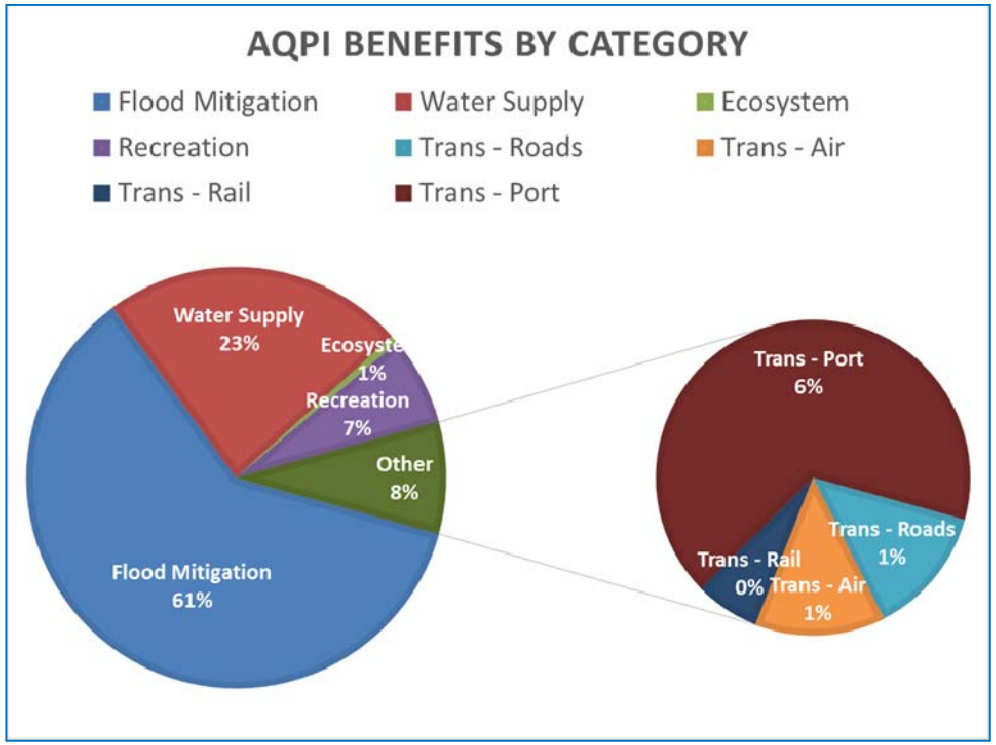
- Decisions must be made and actions taken for benefits to be realized.
- Response Efficiency = Frw x Fw x Fc
  - Frw = fraction of the public that receives a warning;
  - Fw = fraction of the public that is willing to respond;
  - Fc = fraction of the public that knows how to respond effectively and is capable of responding (or has someone to help them).
- Response Efficiency < 50% is poor; >90% is good.



(after Morss and Ralph 2007)

AQPI BENEFITS SUMMARY

- Overall
  - Total Wx Benefits ($240M/yr; $34/person)
  - Incremental AQPI Benefits ($62M/yr; $9/person)
- By Category
  - Flood Mitigation (61%)
  - Water Supply (23%)
  - Ecosystem Services (8%)
  - Transportation (8%)
    - Ports 6%
- Benefit/Cost Estimates
  - Base Case – 5:1
  - Best Case – 13:1
  - Worst Case - 2:1



Thanks!

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