



Quality ■ Value ■ Reliability ■ Customer Service
For all of San Diego...every day!



San Diego's Surface Water Augmentation Projects

Potable Reuse via Surface Water Augmentation:
Issues and Opportunities for Bay Area Agencies

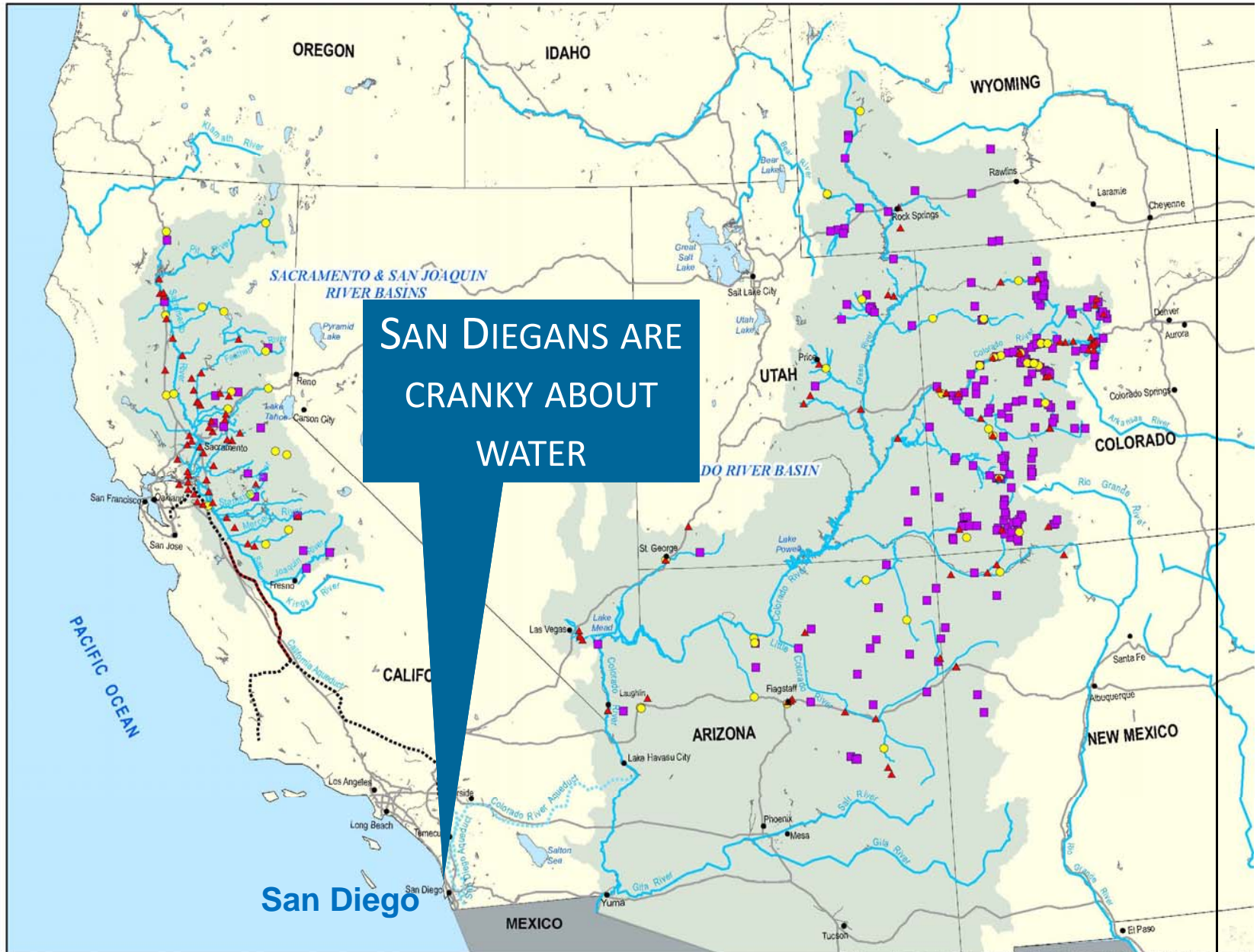
December 4, 2015



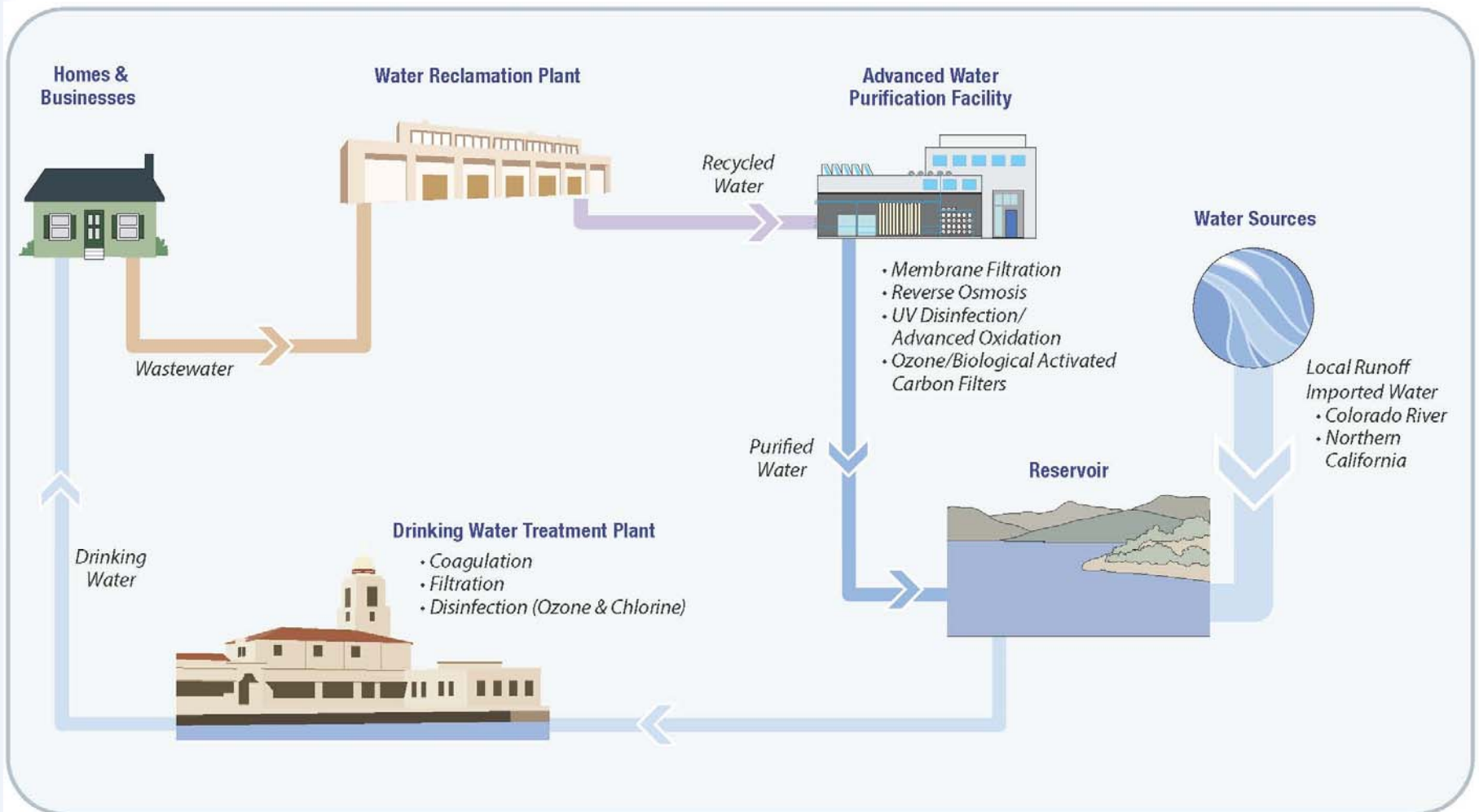
THE CITY OF SAN DIEGO PUBLIC UTILITIES DEPARTMENT *Quality, Value, Reliability – In Every Drop!* 

topics

- San Diego's Pure Water Program
- role of a reservoir in potable reuse
- reservoir studies
- regulatory approvals
- current and future work



Pure Water San Diego

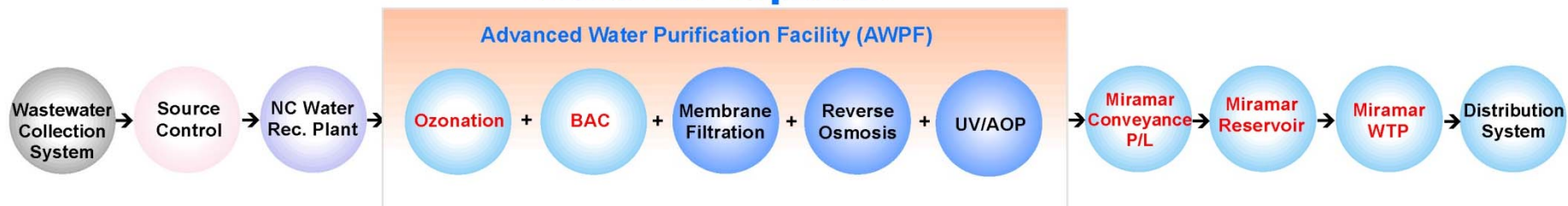


Potable reuse options

San Vicente Option



Miramar Option



Pure Water
will produce

1/3

of San Diego's
water locally

Phase 1

- ★2021 completion
- ★30 mgd
- ★North City AWPf to
San Vicente or Miramar



Pure Water
will produce

1/3

of San Diego's
water locally

Phase 2

- ✦ 2035 completion
- ✦ 28 – 53 mgd
- ✦ Central Area AWP to San Vicente or Lake Murray



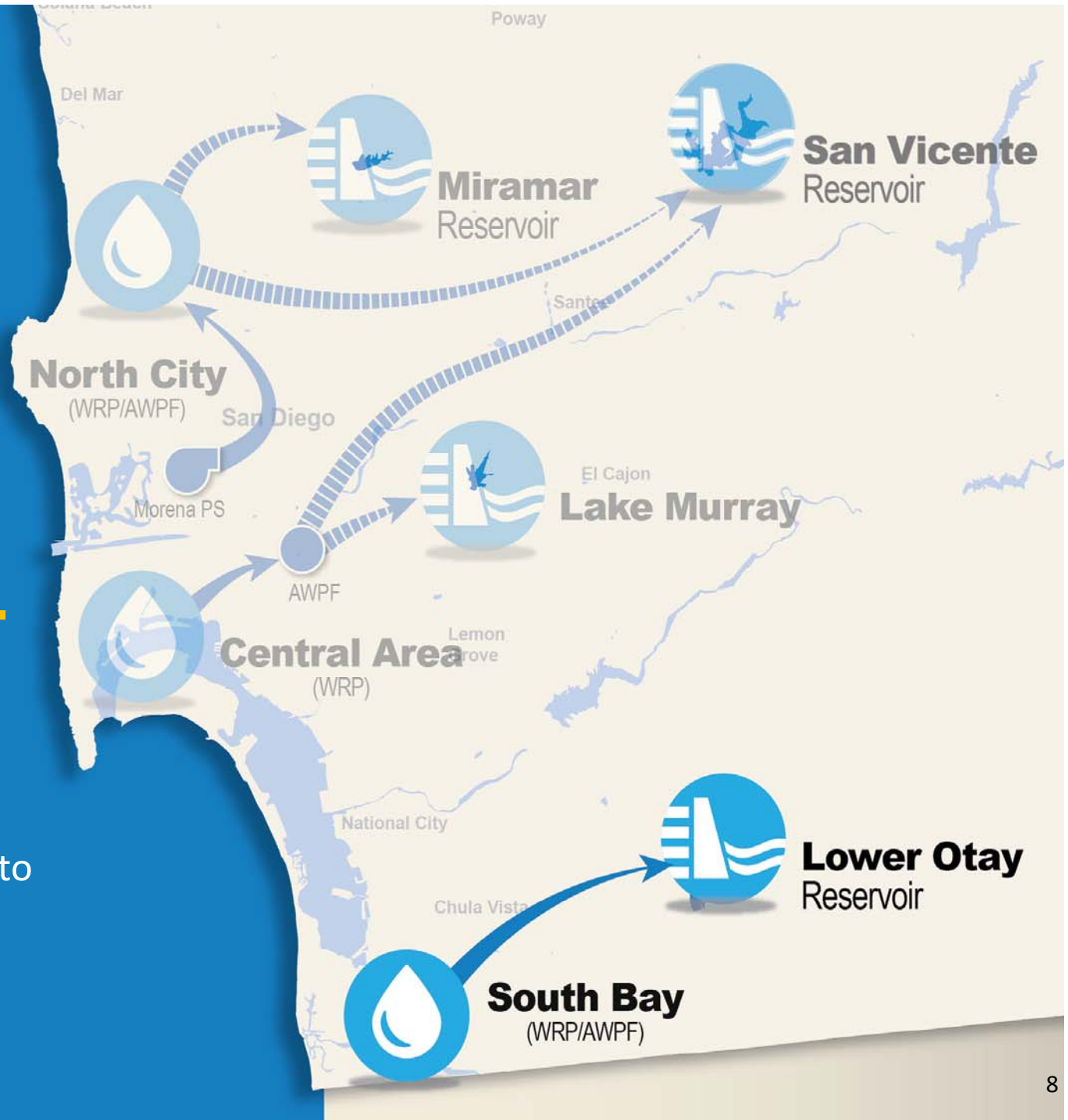
Pure Water
will produce

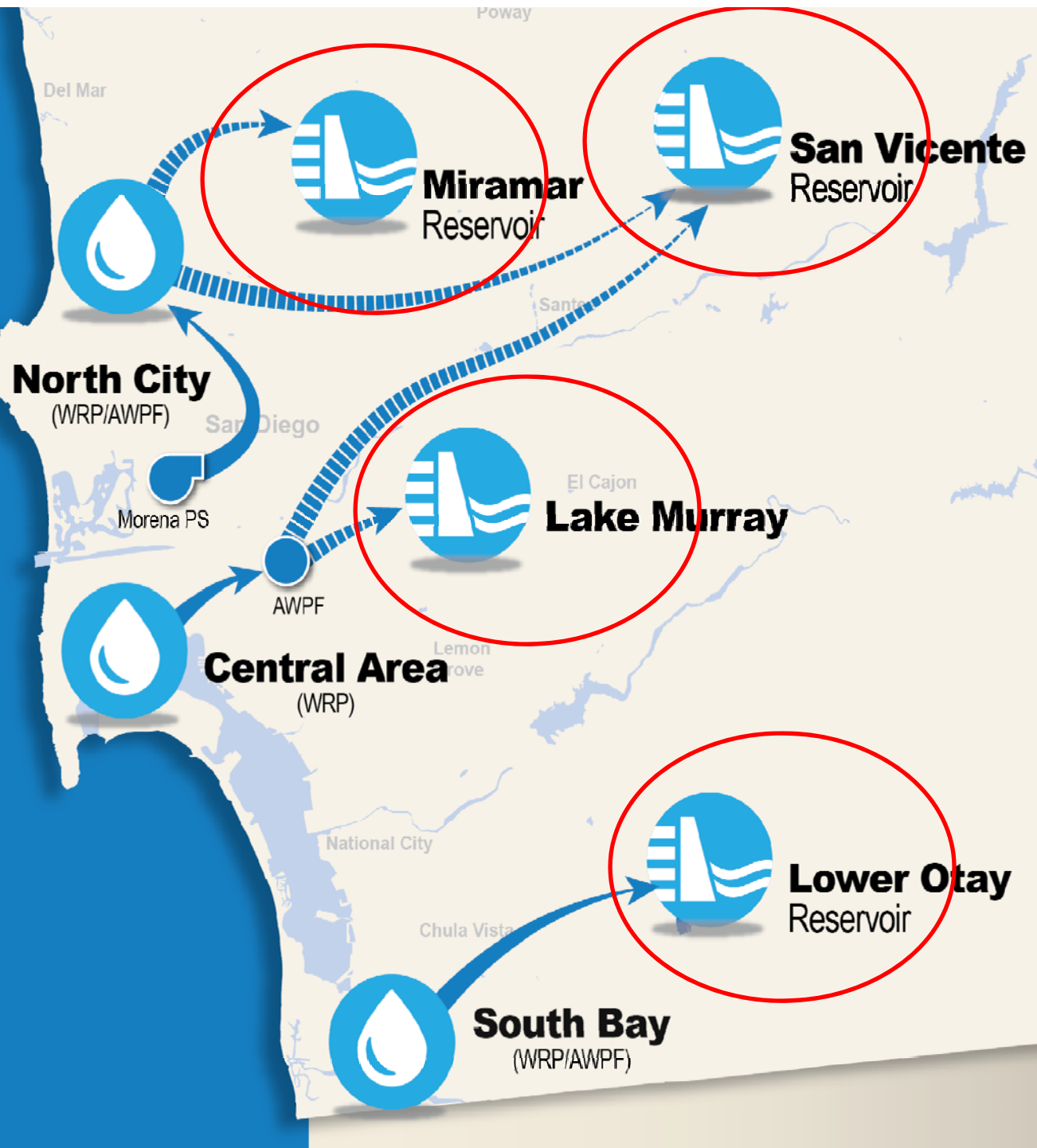
1/3

of San Diego's
water locally

Phase 3

- ★ 2035 completion
- ★ 0 - 15 mgd
- ★ South Bay AWPf to
Otay Reservoir







The role of the reservoir in a potable reuse project

The reservoir serves as an environmental buffer that provides:

- time to respond to a treatment failure at the Advanced Water Purification Facility
- attenuation of pathogens introduced with purified water
 - dilution
 - inactivation [aka “die off”]
- mitigation of chemical toxins, through dilution



San Vicente Reservoir



Maximum volume 247,000 AF

Normal operating pool 150,000 – 210,000 AF [design 170,000 AF]

2-1/2 miles long

Otay Reservoir



Maximum volume
47,000 AF

Normal operating pool
30,000 – 40,000 AF
[design 35,000 AF]

2-1/2 miles long

Miramar Reservoir



Maximum volume
7,200 AF

Normal operating pool
5,500 – 6,200 AF
[design 5,800 AF]

1 mile long



170,000 AF



35,000 AF



5,500 AF

State Water Board [DDW] draft regulations
for surface water augmentation

1a] 1% (100:1) dilution of any 24 hour inflow of purified water,
measured at the outlet

or

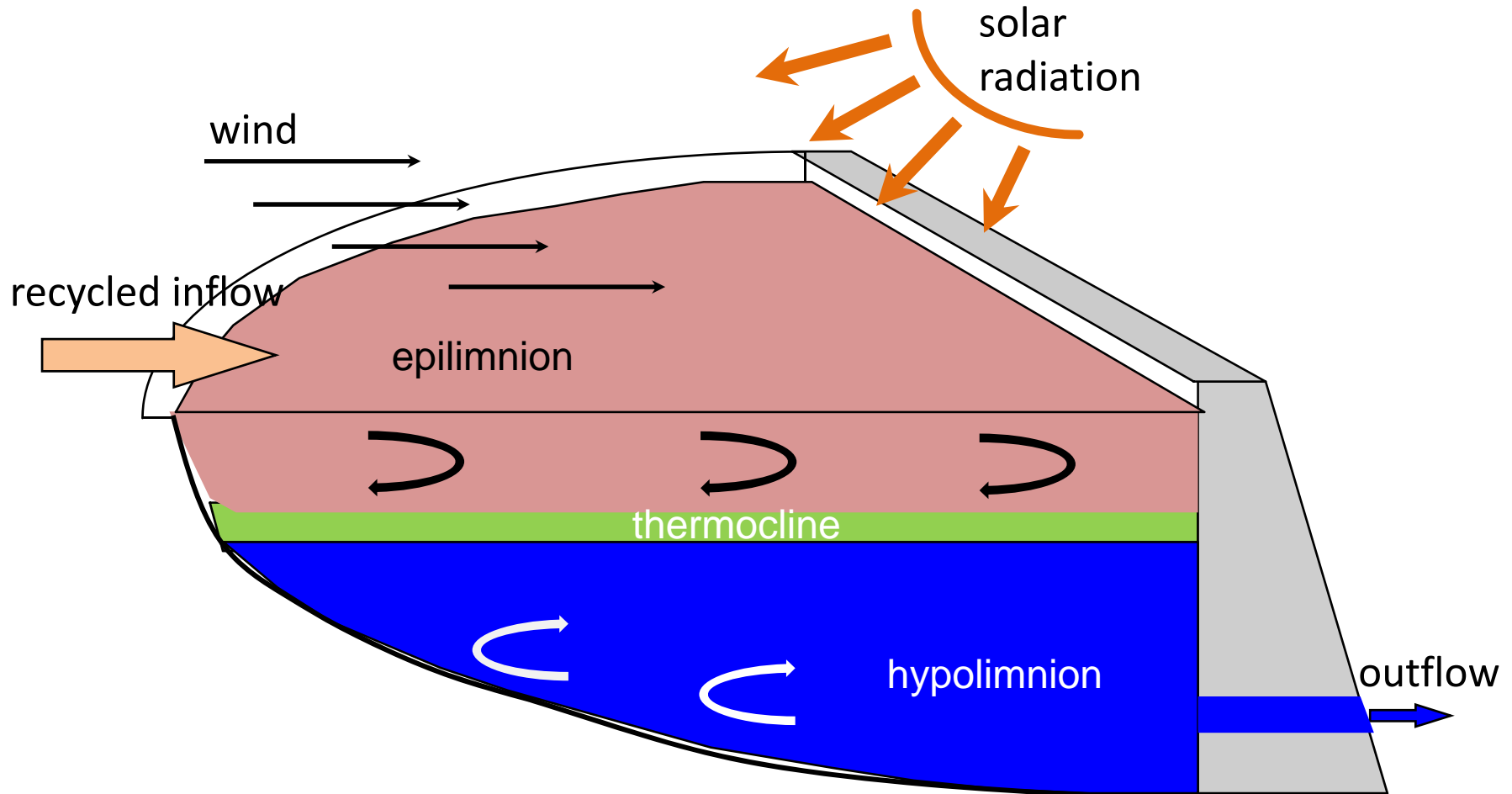
1b] 10% (10:1) dilution any 24 hour inflow of purified water,
measured at the outlet, plus an independent treatment step
providing one additional log-reduction of virus,
Cryptosporidium, and *Giardia*

and

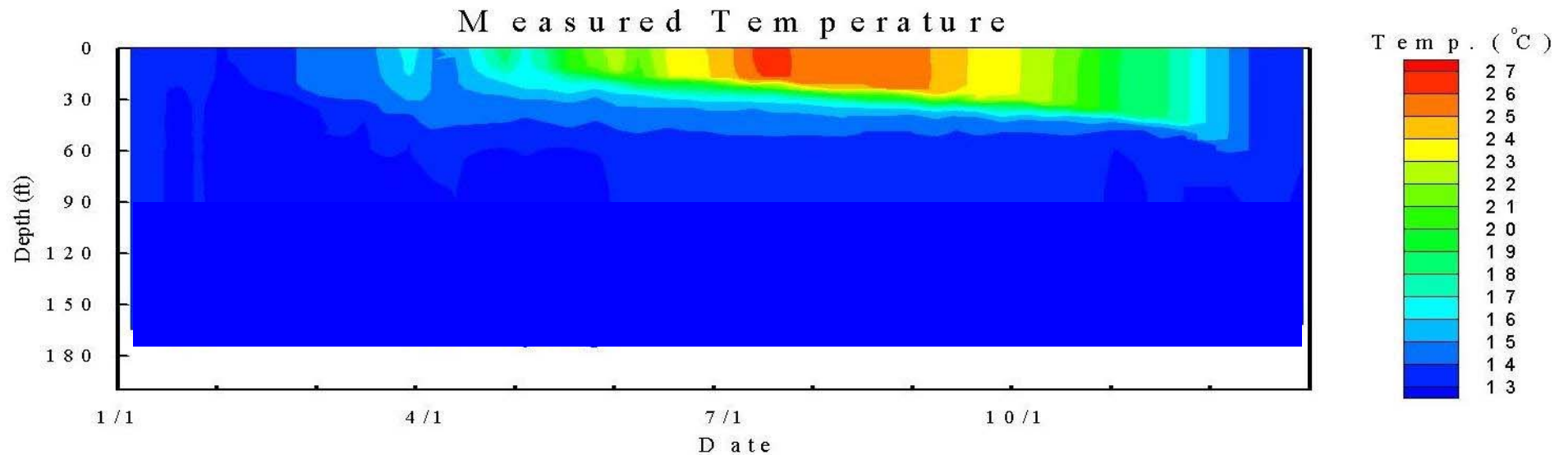
2] six month theoretical retention time

1990s

use density stratification,
a fundamental characteristic of reservoirs in
southern California [and NorCal]



typical density stratification in San Vicente Reservoir temperature, 1999





1990s

achieved regulatory acceptance for reservoir augmentation project at San Vicente Reservoir

criteria for the reservoir

- use density stratification [thermocline] and selective withdrawal to minimize “short-circuiting”
- tracer studies to demonstrate no “short-circuiting”
- twelve month average hydraulic detention time
- blending: recycled water <50% of withdrawal







2007

potable reuse revived in San Diego

new concepts for reservoir criteria

- dilution and time to respond are the important factors
- properly treated recycled water is “just water”
- focus on a 24 hour pulse of inflowing recycled water
- focus on “worst case” events
- use three-dimensional hydrodynamic modeling to study the reservoir



Independent Advisory Panel

full, ten-member IAP met four times in 2009 -2011

four member
limnology sub-
committee has
met eight times,
with three more
meetings
planned

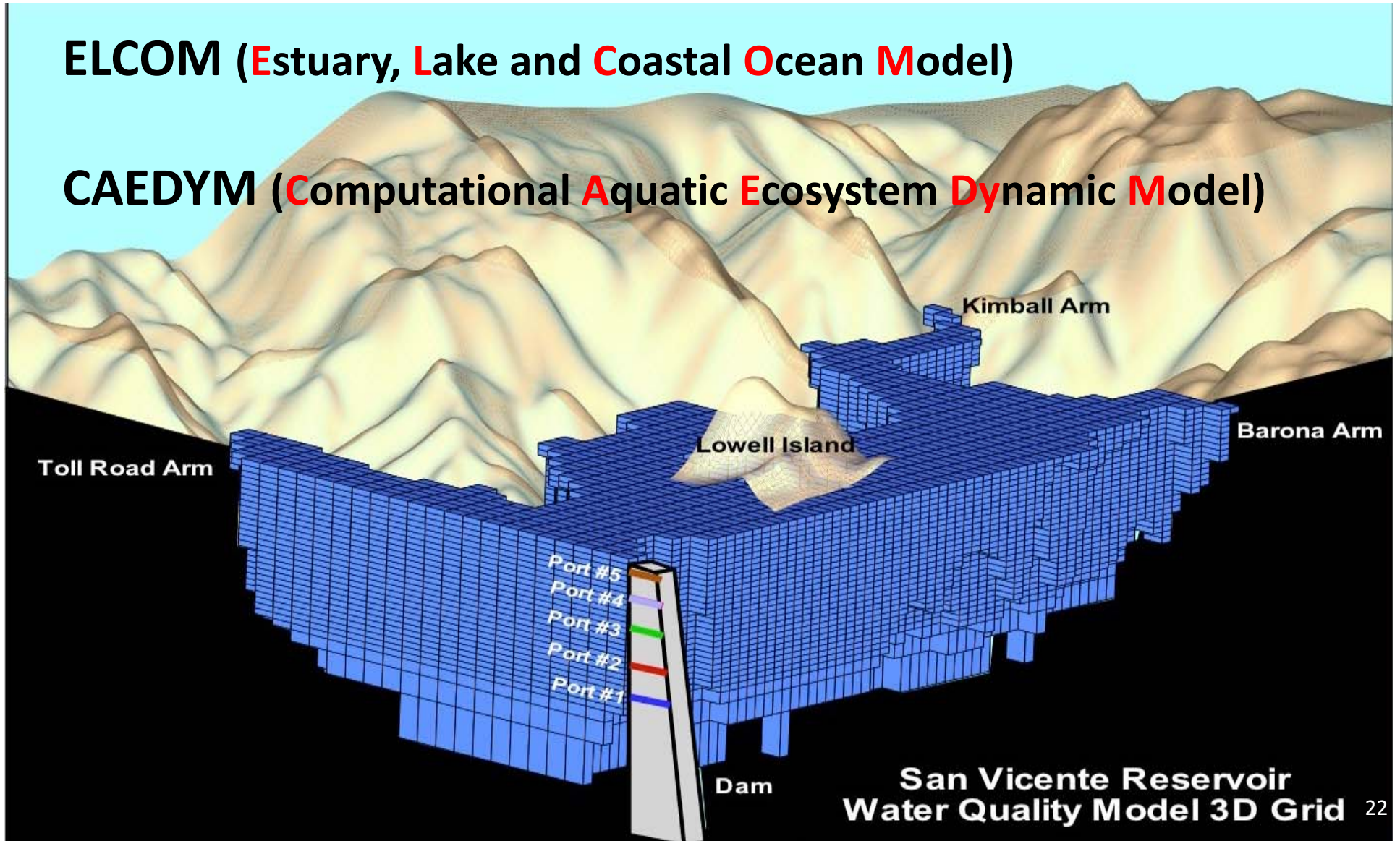


Savage Dam at Otay Reservoir, January 2014

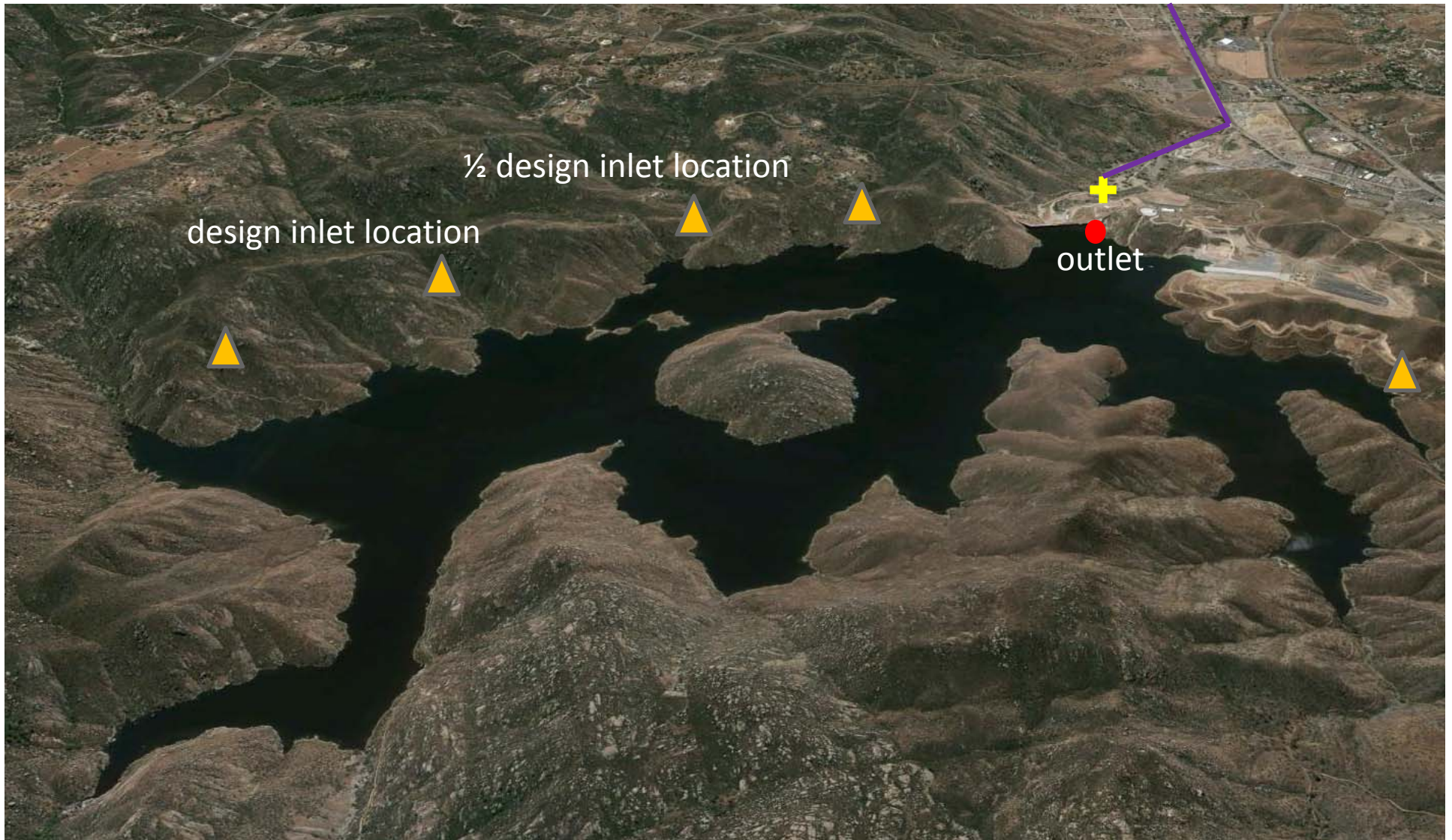
use three-dimensional hydrodynamic modeling

ELCOM (**E**stuary, **L**ake and **C**oastal **O**cean **M**odel)

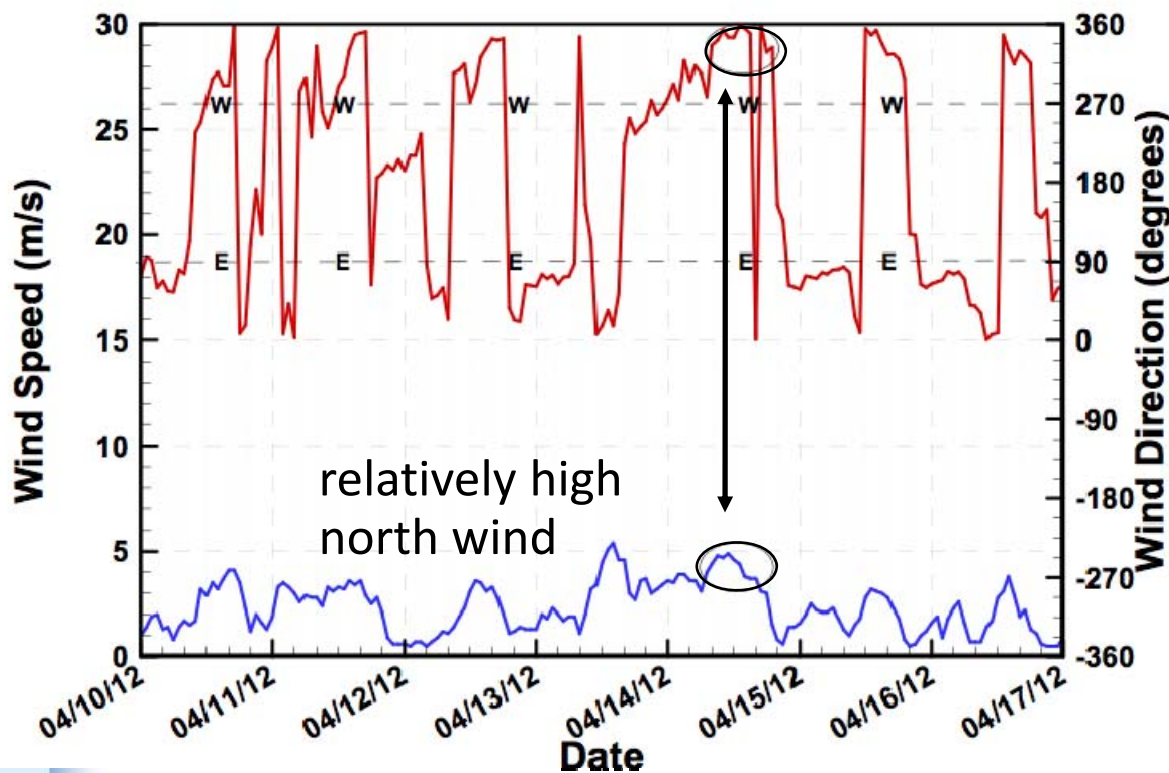
CAEDYM (**C**omputational **A**quatic **E**cosystem **D**ynamic **M**odel)



use model to assess different inlet locations



The Black Swan focus on “worst case” events

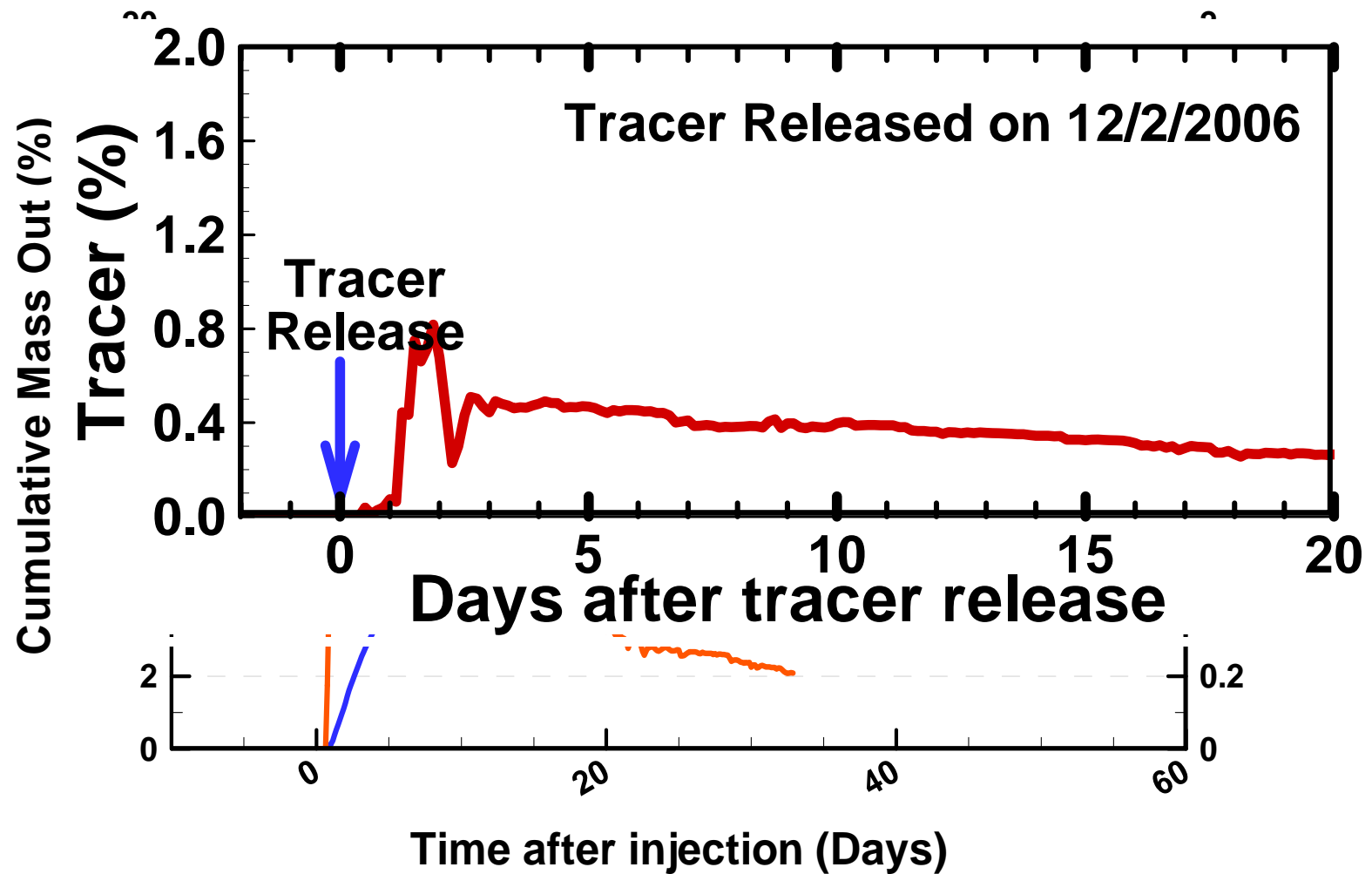


winter season when
reservoir not
stratified

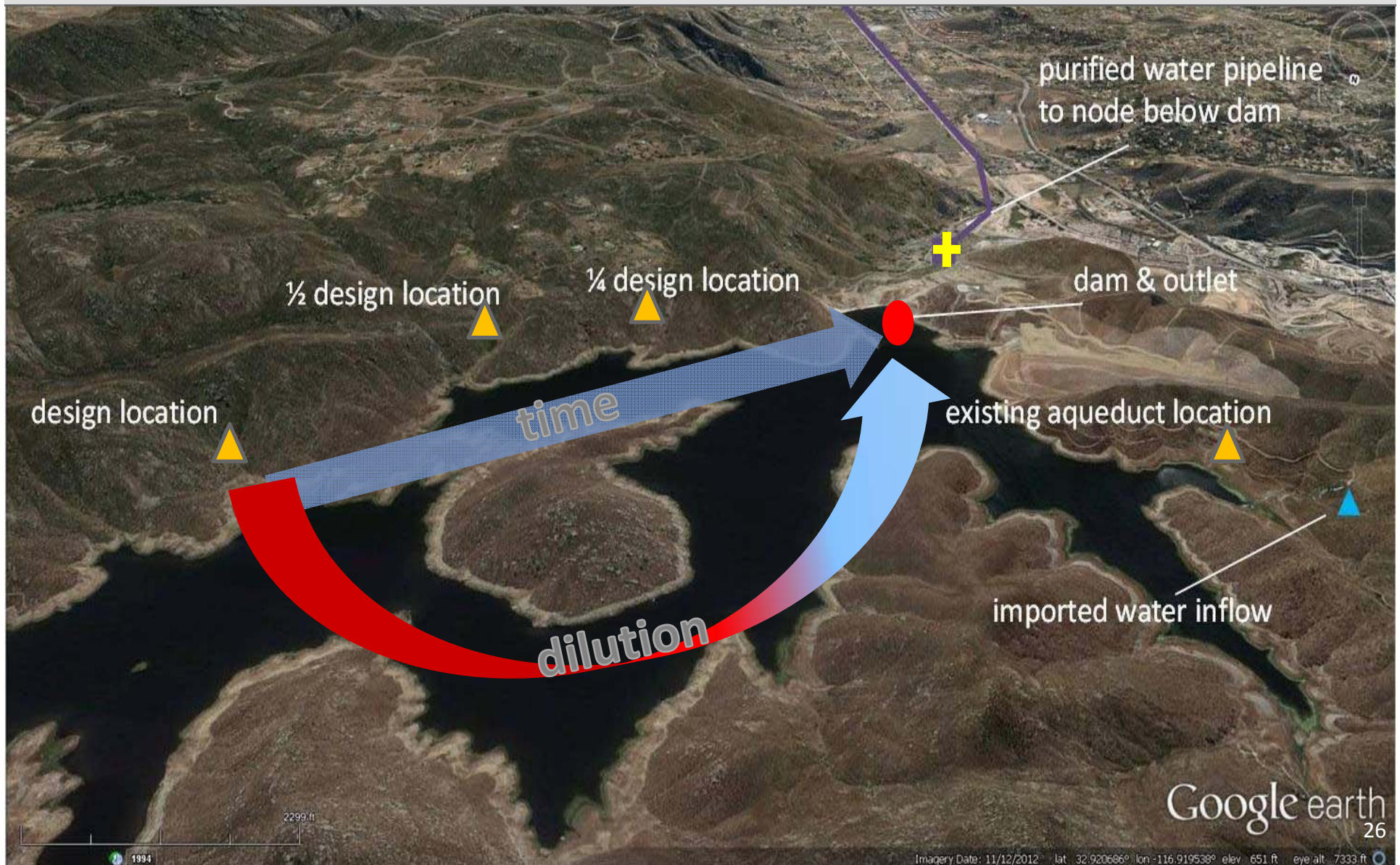
low reservoir levels

high wind events
from inlet toward
outlet

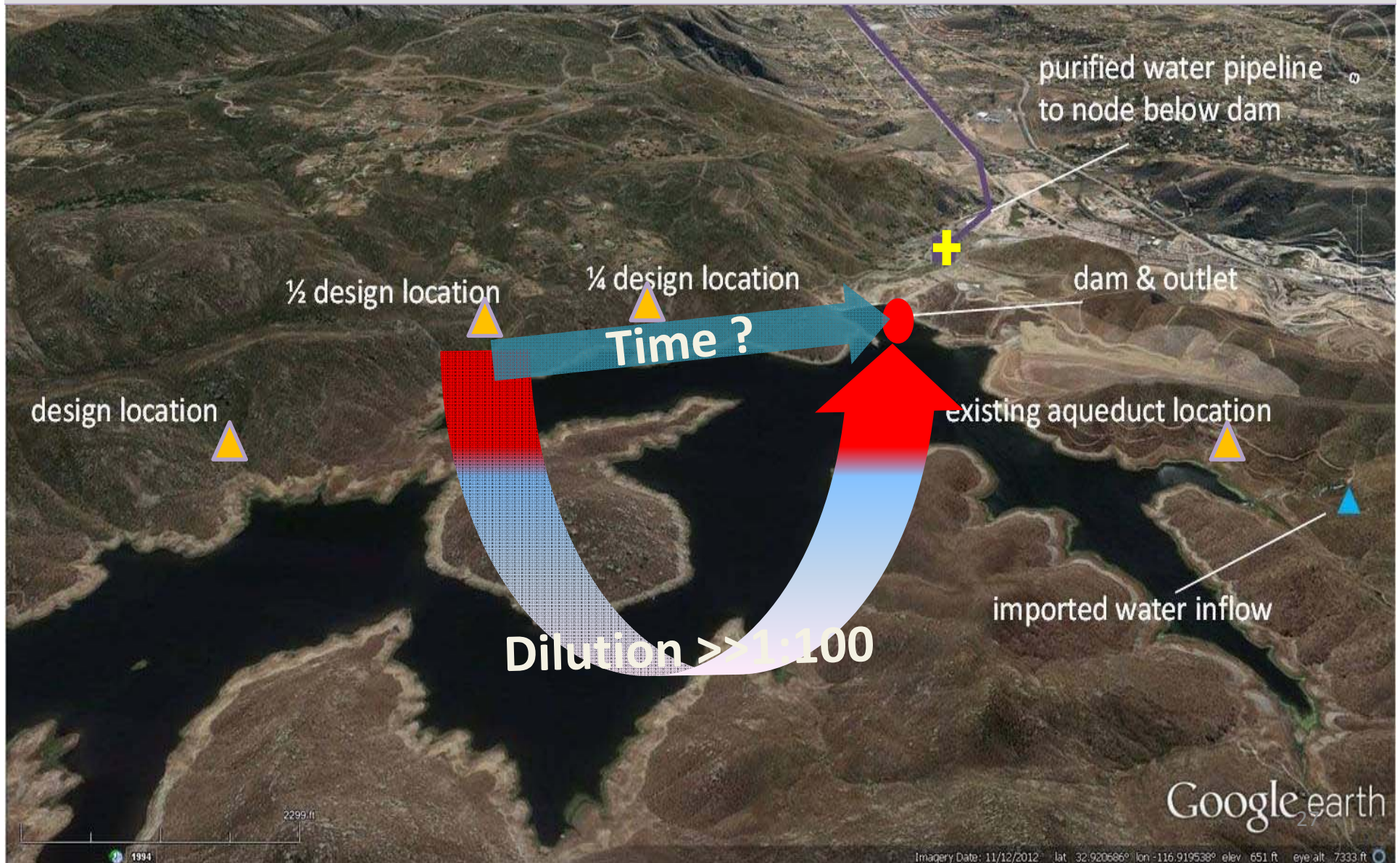
use model to calculate dilution and time to respond



use model to assess different inlet locations

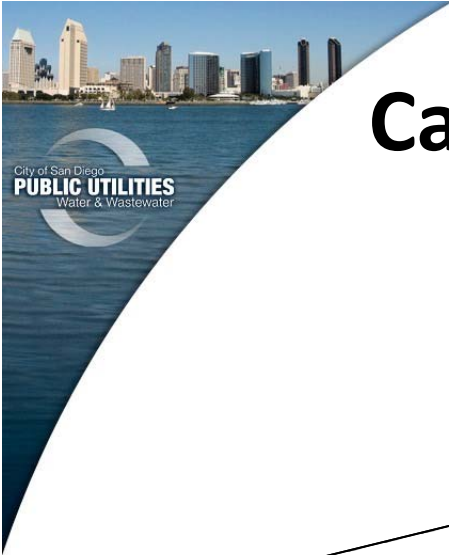


Key findings for San Vicente Reservoir: inlet location, dilution, and time



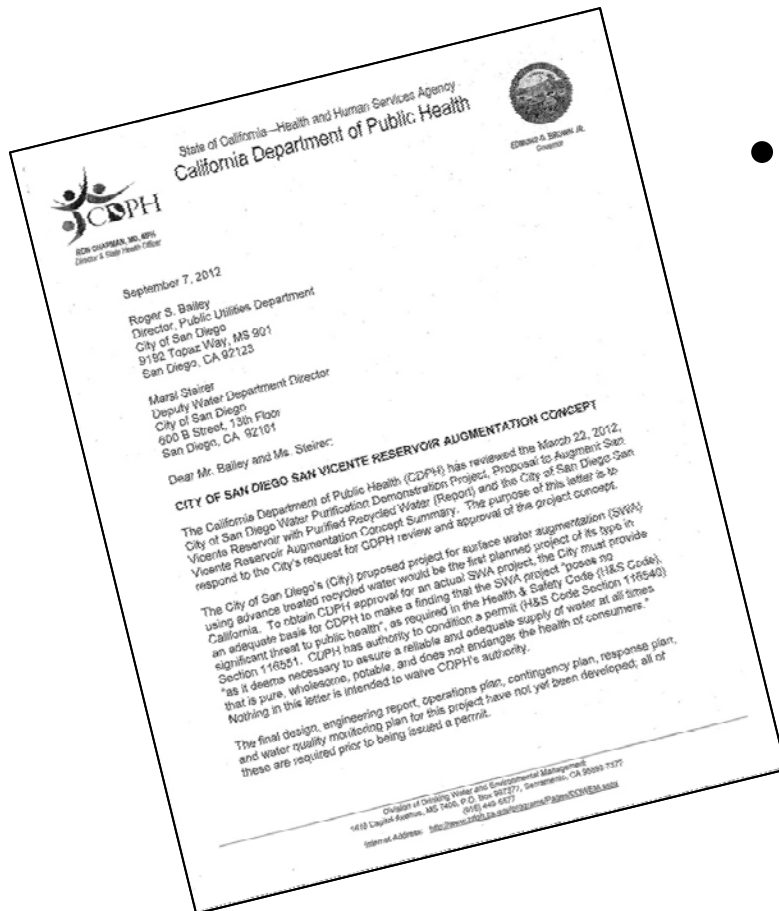
Key findings for San Vicente Reservoir

- Adding purified water to the reservoir will not affect hydrologic conditions, specifically seasonal stratification
- Dilution and retention provides a substantial environmental barrier
- **Purified water will be diluted at least 100:1 (1%) under all anticipated reservoir operations, at the selected purified water inlet locations**
- Adding purified water to the reservoir will not affect water quality



California Department of Public Health concept approval

- City submitted concept proposal in March 2012
- concept approval letter September 7, 2012



“Based on CDPH’s review of the City’s ... submittal ... CDPH approves the San Vicente Reservoir Augmentation Concept.”

State Water Board [DDW] draft regulations
for surface water augmentation

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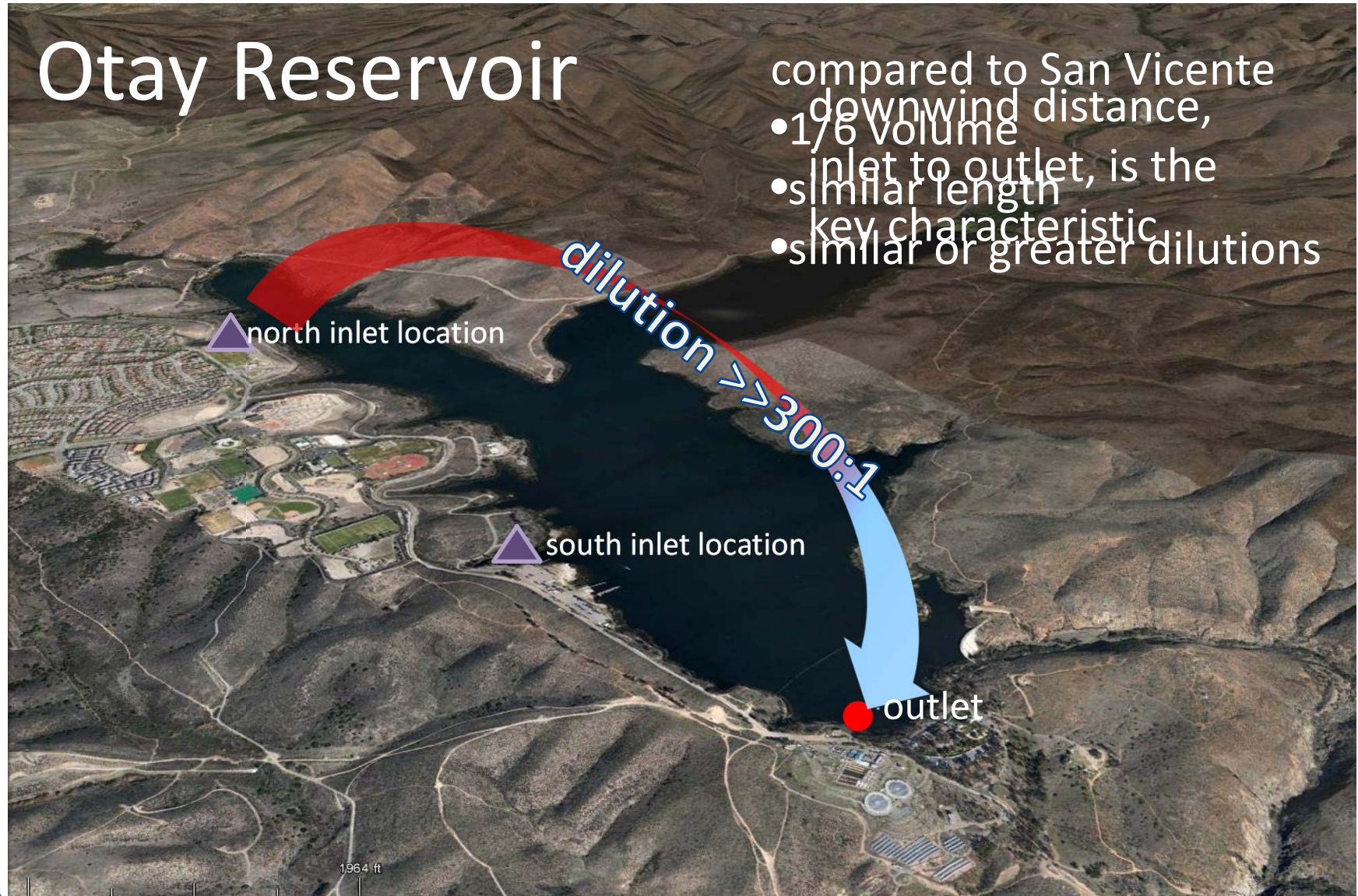
and

2] six month theoretical retention time

Otay Reservoir: inlet locations, dilution, and time to respond

Otay Reservoir

- compared to San Vicente
- downwind distance, 1/6 volume
 - inlet to outlet, is the similar length
 - key characteristic
 - similar or greater dilutions



Miramar Reservoir

dilution $> 10:1$

time to respond ?

Anticipated findings for Miramar Reservoir

- scaling down from San Vicente or Otay to Miramar should provide reasonable estimates of dilution
- Miramar is one fifth the volume of Otay, and the purified water inflow rate is double; thus at Miramar expect dilutions $(1/5) \times (1/2) =$ one tenth of Otay
- expect dilutions at Miramar to be 30:1 to 60:1, and always greater than 10:1
- theoretical retention time < 6 months [~ 2 months]

conclusions

*“Most agree a surface water reservoir does
provide additional public health protection
provides additional response retention time
provides an opportunity for dilution”*

*“A reservoir of any size can make an important
contribution to public health protection in a
potable reuse project . . . ”*

R. Rhodes Trussell, Trussell Technologies, Inc.,
presentation to DDW Advisory Panel, 20 Oct 2015



Summary: criteria for the reservoir in a surface water augmentation project

- Metric for dilution is at hand

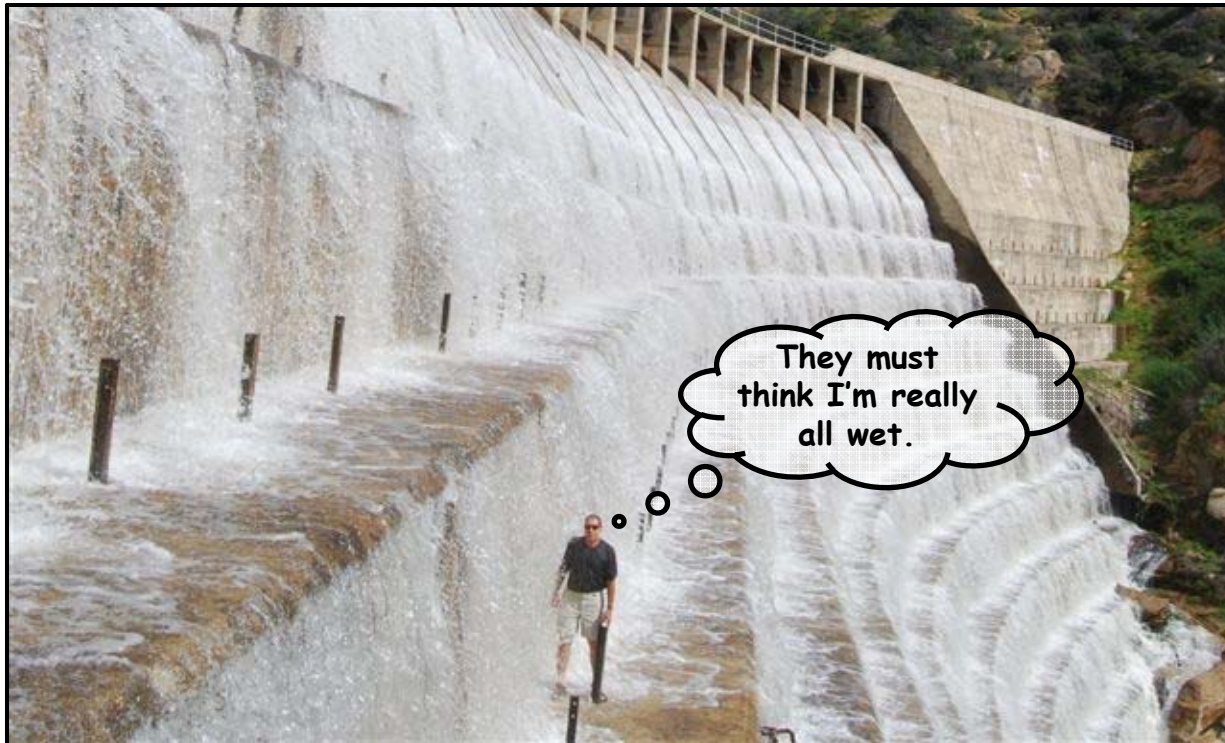
Dilution of a 24 hour inflow, measured at the reservoir outlet

Can be calculated with modeling or measured with real-world tracer studies

- Reservoir volume is important for dilution
- Distance from inlet to outlet may be more important
- Metric for response retention time yet to be worked out



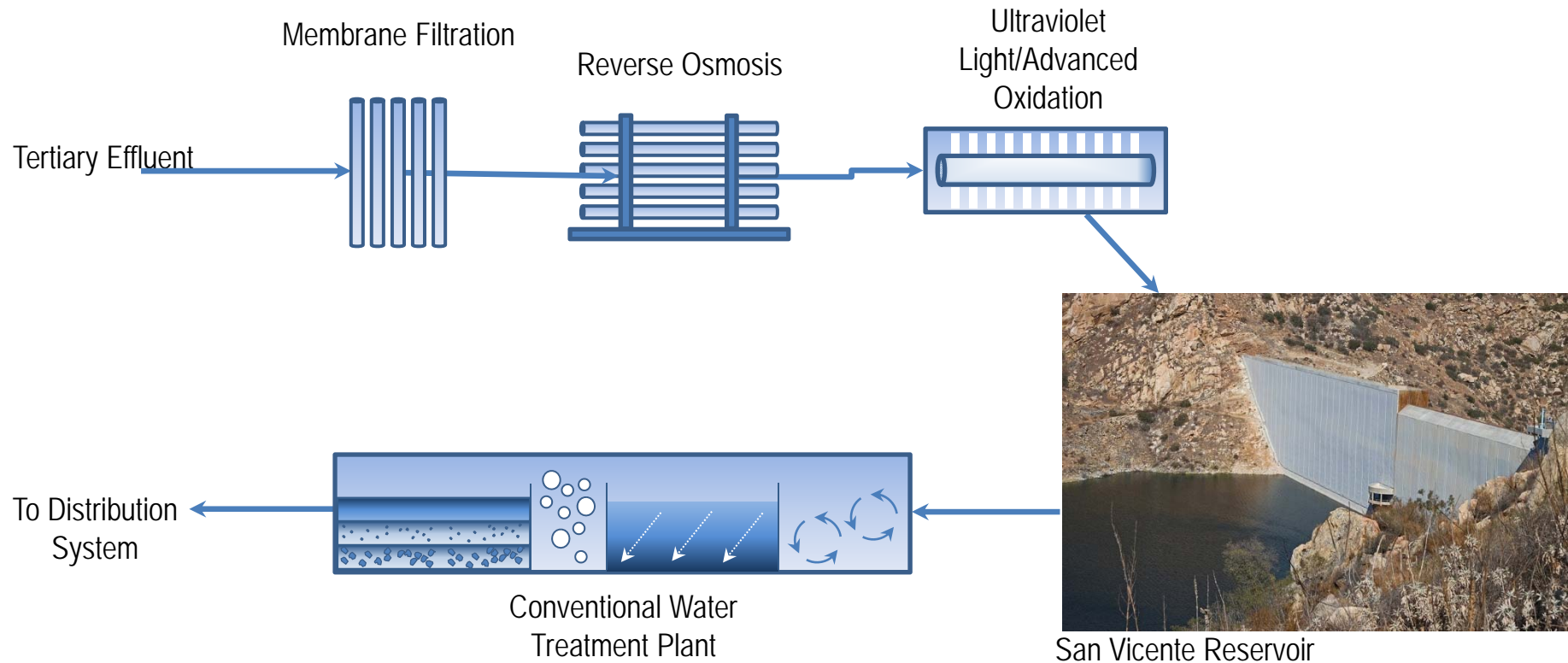
questions and discussion



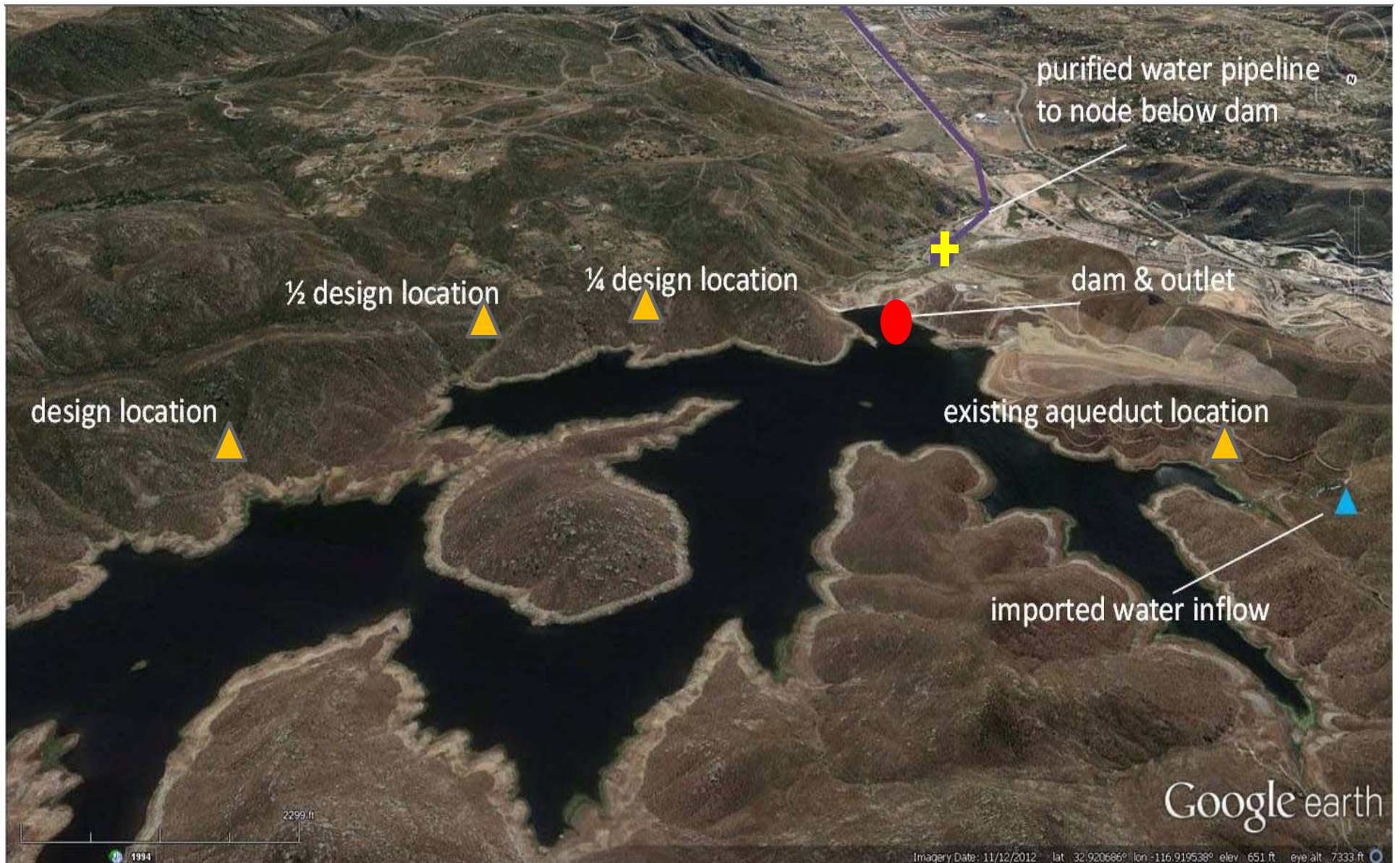
“The . . . Water Board, with concurrence from USEPA, strongly supports the efforts of the City to develop the San Vicente Reservoir Augmentation Project...”



reservoir augmentation treatment train



use model to assess different inlet locations



density stratification is consistent: San Vicente Reservoir, 2000-2007

