Proposed California Chromium-6 Drinking Water Regulation Coachella Valley Impact

WESTCAS 2013 Fall Conference

Regulatory Session

October 30, 2013

Chromium Regulation Timeline

- 1977: Existing <u>total</u> chromium limits
  - ✓ National (EPA) = 100 ppb
  - ✓ State (CA) = 50 ppb
- 1999: State raises Cr-6 ingestion concern
- 2000: Erin Brockovich movie increases interest
- 2001: Law requires chromium-6 limit by 2004
- 2008: Rodent study completed to calculate risk
- 2009: Draft Public Health Goal (PHG) released
- 2011: State sets PHG (0.02 ppb)
- 2012: NRDC & EWG sue State
- 2013: State proposes draft Cr-6 limit (10 ppb)

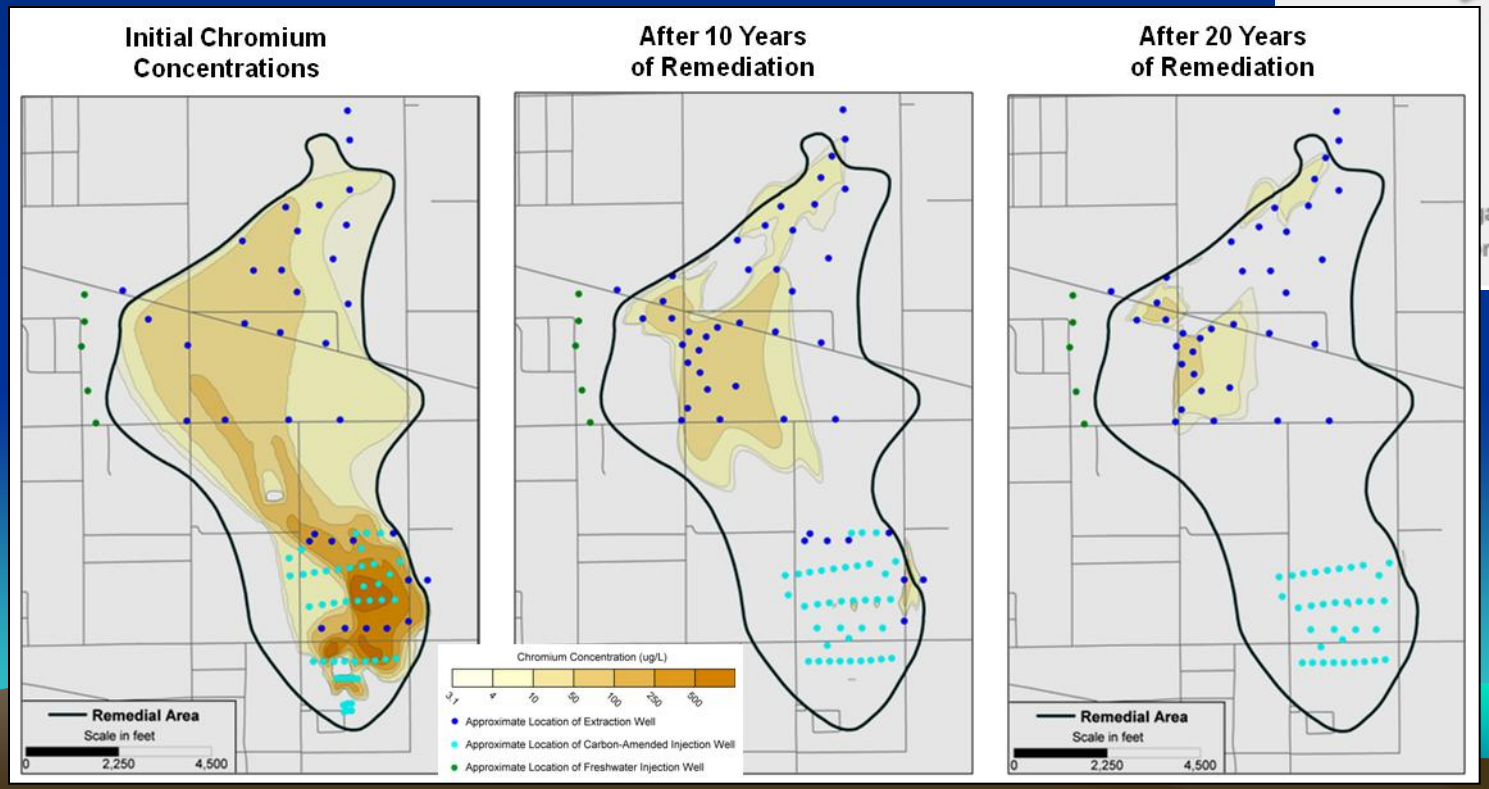
- 2013: EPA working on Cr-6 risk assessment

NRDC
THE EARTH'S BEST DEFENSE

EWG.ORG

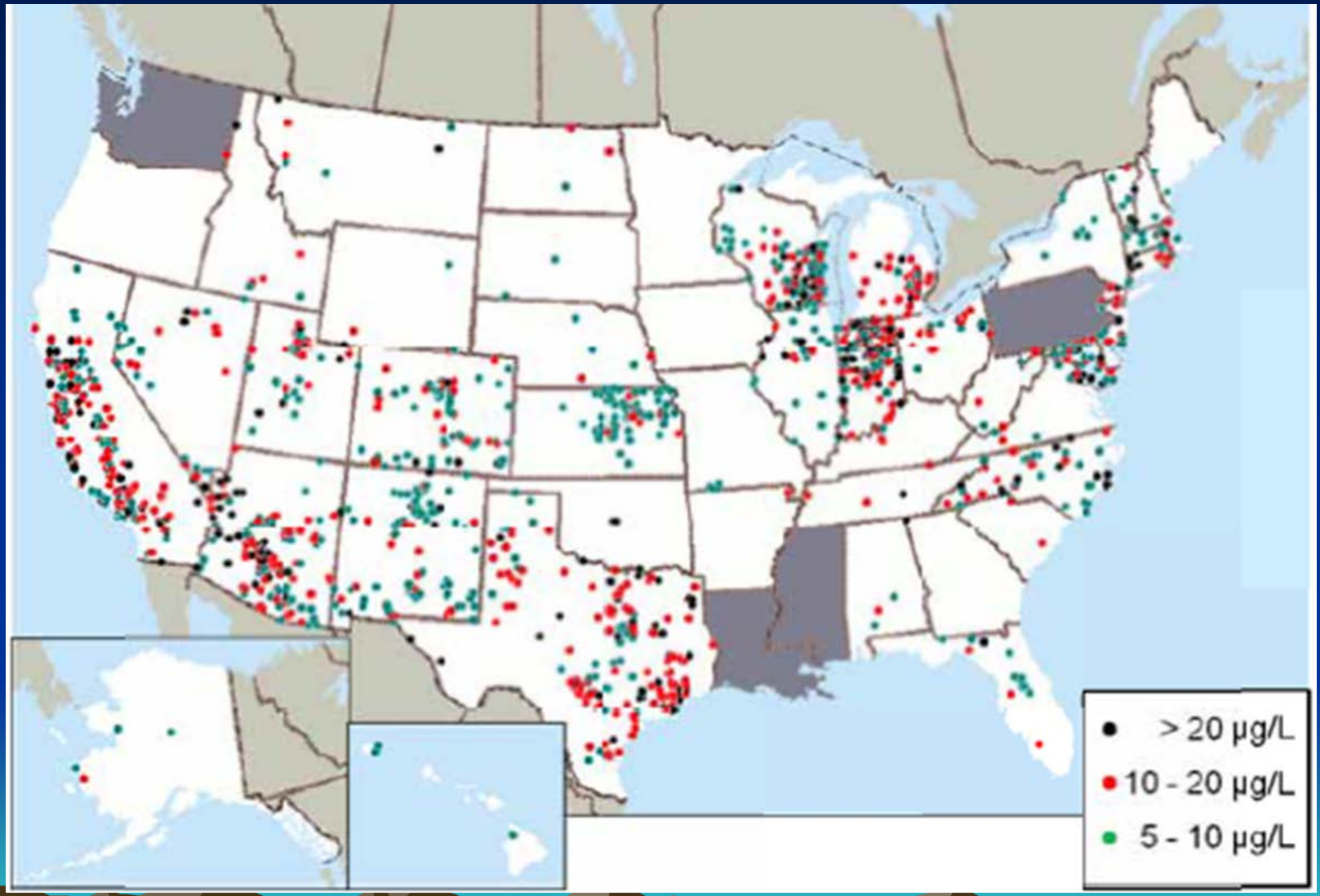
PG&E – Hinkley, CA

- Cooling tower blow-down (1950's-60's)
- Contaminated groundwater with Cr-6
- PG&E settlement $400 M plus
- California Cancer Registry (three Hinkley studies)
  - No increased cancer rate found



Occurrence

U.S. Total Chromium Occurrence

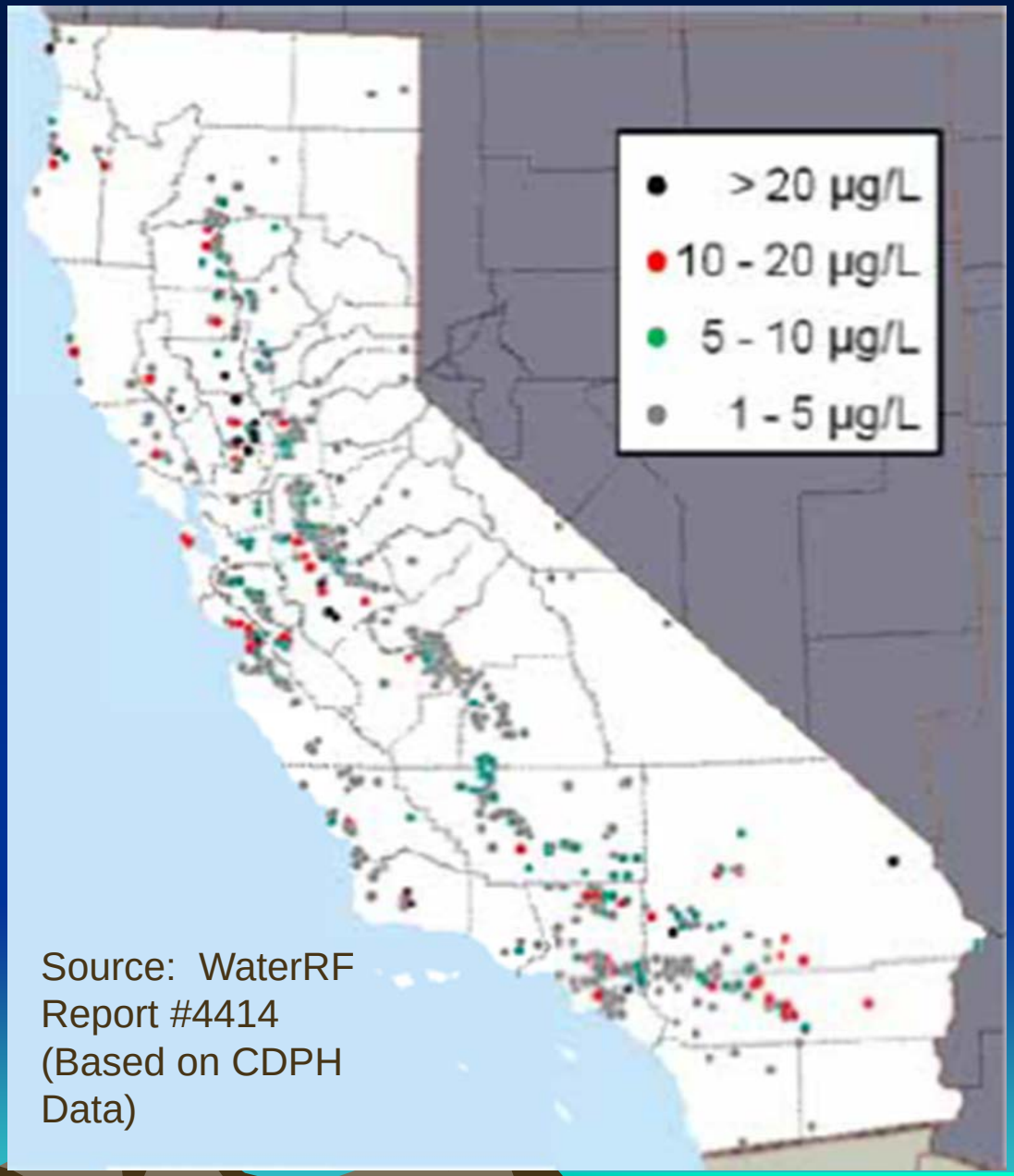


Source: WaterRF Report #4414
(Based on USEPA Data)

California Cr-6 Occurrence*

- Detectable Cr-6 (1 ppb) found throughout state
- Statewide about 60% of drinking water sources tested for Cr-6
- Cr-6 accounts for over 98% of total Cr in tested groundwater sources (Seidel et al, 2013)
- State estimates 311 water system sources have Cr-6 >10 ppb, 67 above 20 ppb

**CDPH, PICME database*

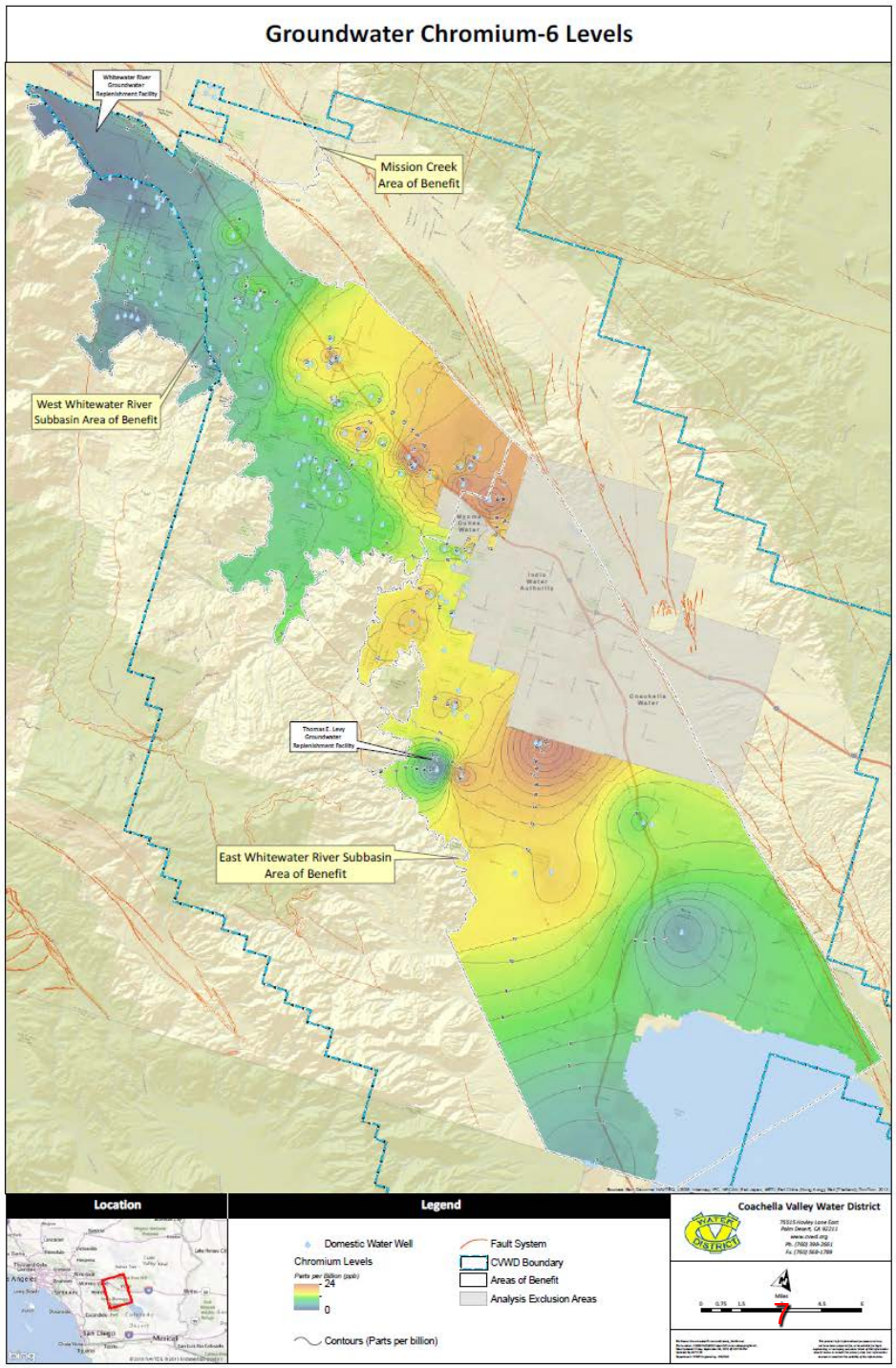


Source: WaterRF Report #4414 (Based on CDPH Data)

Coachella Valley Chromium-6 Occurrence*

- Found Naturally in Coachella Valley Groundwater
  - Erosion of ultra-mafic sediments found near faults
- Levels from <1 to 21 ppb
- Over 50% of CVWD delivered water exceeds draft 10 ppb limit
- Chromium-6 levels below detection in Colorado River water used for aquifer replenishment

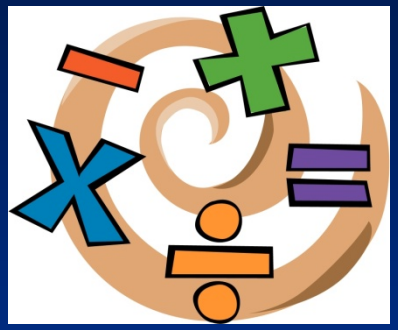
**U.S. Geological Survey Studies and local water agency routine monitoring*



Health Effects

Chromium Biochemistry*

- Cr-3 is essential
  - Needed for metabolic functions
  - Food/supplements
  - 50-200 micrograms/day
- Cr-6 is less stable and more reactive
- Cr-6 readily reduced to Cr-3
  - Ideal conditions in stomach
    - ✓ Low pH
    - ✓ Organic matter
    - ✓ Vitamin C
- Cr-3 does not oxidize back to Cr-6 once in plants and animals



- ✓ One microgram per liter = one part per billion (ppb)
- ✓ One ppb = one drop in 10,000 gallons (small swimming pool)

**EPA Scientific Workshop, Factors affecting reduction of hexavalent chromium in the GI tract (Sept, 2013), and Cr VI Public Health Goal Report, California Office of Health Hazard Assessment (2011)*

Chromium (Cr) Health Effects*

- Cr-3/Cr-6 non-cancerous effects at high doses
- Cr-6 studied extensively
- Inhaling Cr-6
  - Occupational exposure
  - Lung and oral cavity cancer
  - Observed in humans and animals
- Ingesting Cr-6
  - California assessment
    - ✓ Clear evidence of carcinogenicity in animals
    - ✓ Possible human carcinogen
    - ✓ No human studies suitable for calculating drinking water Public Health Goal (PHG)
    - ✓ National Toxicology Program rodent study most suitable for setting PHG
  - U.S. EPA – evaluating recent studies

"Given these observations and until more human and/or animal studies become available that clearly indicate otherwise, it is prudent to consider this hazard in the development of a PHG for Cr VI."

(California Office of Environmental Health Hazard Assessment, 2011)

**Cr VI Public Health Goal Report, California Office of Health Hazard Assessment (2011)*

National (NTP) Rodent Study* Results

Organ	Tumor Type	Cr6 Drinking Water Exposure				
		Control	5,000 ppb	10,000 ppb	30,000 ppb	90,000 ppb
Male Mice Small Intestine	Adenoma (Benign Tumor)	1/49	1/49	1/49	5/50	17/48
	Carcinoma (Malignant Tumor)	0/49	2/49	1/49	3/50	5/48
	Adenoma or Carcinoma	1/49	3/49	2/49	7/50	20/48
Yellow-highlighted values are statistically significant (Fisher's exact test)						

**National Toxicology Program study summary, table 5 (pg. 51), Cr VI Public Health Goal Report, California Office of Health Hazard Assessment (2011)*

New Research

- American Chemistry Council MOA Work
  - 14 peer reviewed published papers
  - Shows threshold effect
    - High doses overwhelmed reduction in mice
    - Humans have more robust reduction
    - Cell damage only in highest doses
    - Repair process is key event for tumor formation
  - DWEL of 210 ppb is fully protective
- EPA postpones Risk Assessment to consider this research

Treatment

Cr-6 Pilot Treatment Technologies

- City of Glendale Research (about $10 million)
- Three technologies identified
  - Reduction Coagulation Filtration (RCF)
  - Weak Base Anion (WBA) Exchange
  - Strong Base Anion (SBA) Exchange
- Pilot tested RCF and WBA technologies
- Developed cost models for both technologies

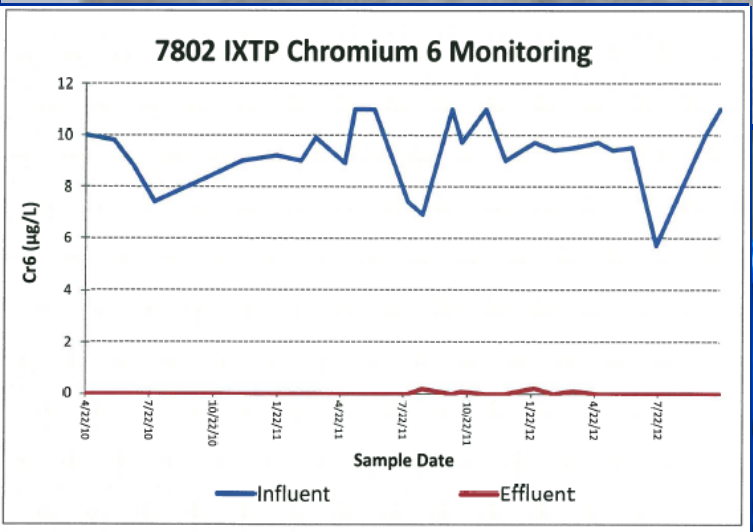

Glendale 100 gpm RCF

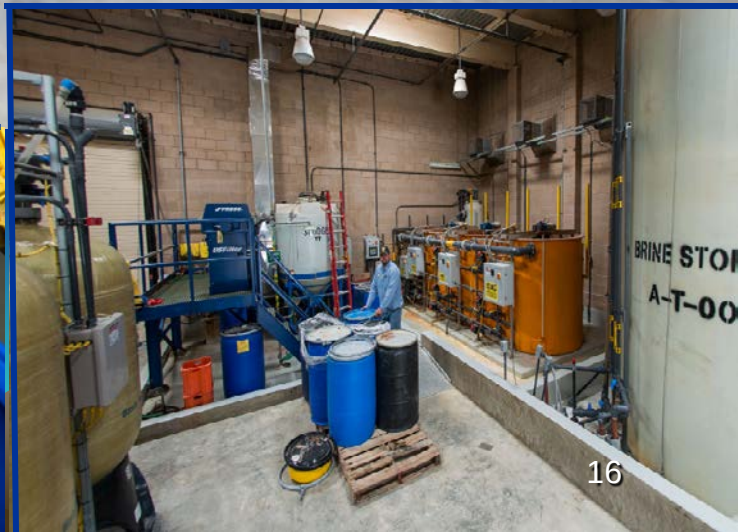

Glendale 425 gpm WBA

East Coachella Valley Water Treatment

- Arsenic Rule Compliance (about $20 million for CVWD systems)
- Secondary goal of Cr-6 & Vanadium removal
- 3 Facilities (1,000-4,000 gpm)
- Operating data (6+ years)
- Includes brine treatment

Inside a Water Treatment Plant





WRF #4445 - Scope ($355,000+)

- Impact of variable water quality
- Preliminary treatment strategy and monitoring plan
- Treatment testing
  - RCF (Bench)
  - WBA (Bench, Pilot)
  - SBA (Full-scale)
- Compliance costs for multiple MCL options
- Decision framework and systematic approach for other water utilities
- 2-year study

Parameter	CVWD wells
Cr(VI) (µg/L)	<1 – 21
Cr(T) (µg/L)	<10 – 24
Nitrate (mg/L-NO_3^-)	< 2 – 40
Uranium (pCi/L)	< 1 – 12
Arsenic (µg/L)	ND – 16
pH	6.9 – 8.7
Sulfate (mg/L)	< 0.5 – 280
Orthophosphate (mg/L)	NA – 0.04
Silicate (mg/L)	NA – 17
Total Iron (µg/L)	< 100 – 230
Alkalinity (mg/L)	68 – 164
TDS (mg/L)	130 – 1200

Water Research Foundation/CVWD Chromium-6 Removal Testing

WRF #4516 – Scope ($175,000)

Brine Management Optimization

- Brine Management = Largest SBA O&M cost
- Driven by liquid waste hauling
- Explore brine recycling for As/Cr6
- Alternative disposal options

Concept Pilot Test

- RCMF with chlorine
- Reduced reduction/ oxidation time compared to RCF with aeration
- Smaller treatment footprint = more viable for well-head treatment

CDPH Draft Cr 6 MCL Review

CDPH Cost Analysis* for Draft MCL (10 ppb)

	Based on These Service Connection Groups			
	<200	200-999	1,000-9,999	>10,000
Impacted Sources	65	13	81	152
Impacted Systems	55	10	29	34
Impacted Service Connections	2,453	4,418	113,550	1.6 M
Total Annualized Cost	$13.6 M	$3.8 M	$37 M	$101.4 M
Average Annual Cost Per Service Connection	$5,627	$857	$326	$64

**Procedure for Cost-Benefit Analysis of Hexavalent Chromium (CDPH, 2013)*

Problems with CDPH Cost Estimate*

- Occurrence
  - Used existing State Cr-6 data
    - Limited by 2001-2002 test approach
  - Did not use surrogate total Cr data
  - Did not account for variability
- Water Supply Conditions
  - Estimated well sizes
    - Did not use regional office data
  - Estimated well use
    - Did not use data in annual reports
- Treatment technology
  - Feasible
  - Used results of City of Glendale studies
    - Did not adjust costs for residential well sites (land and buildings)

Key Cost Driver	CDPH Assump-tions	CVWD Well Data
Wells Impacted	27	57
Well Design Capacity (gpm)	325	1,903
Well Use Rate	67%	33%
Land & Buildings	No	Yes

Procedure for Cost-Benefit Analysis of Hexavalent Chromium (CDPH, 2013)

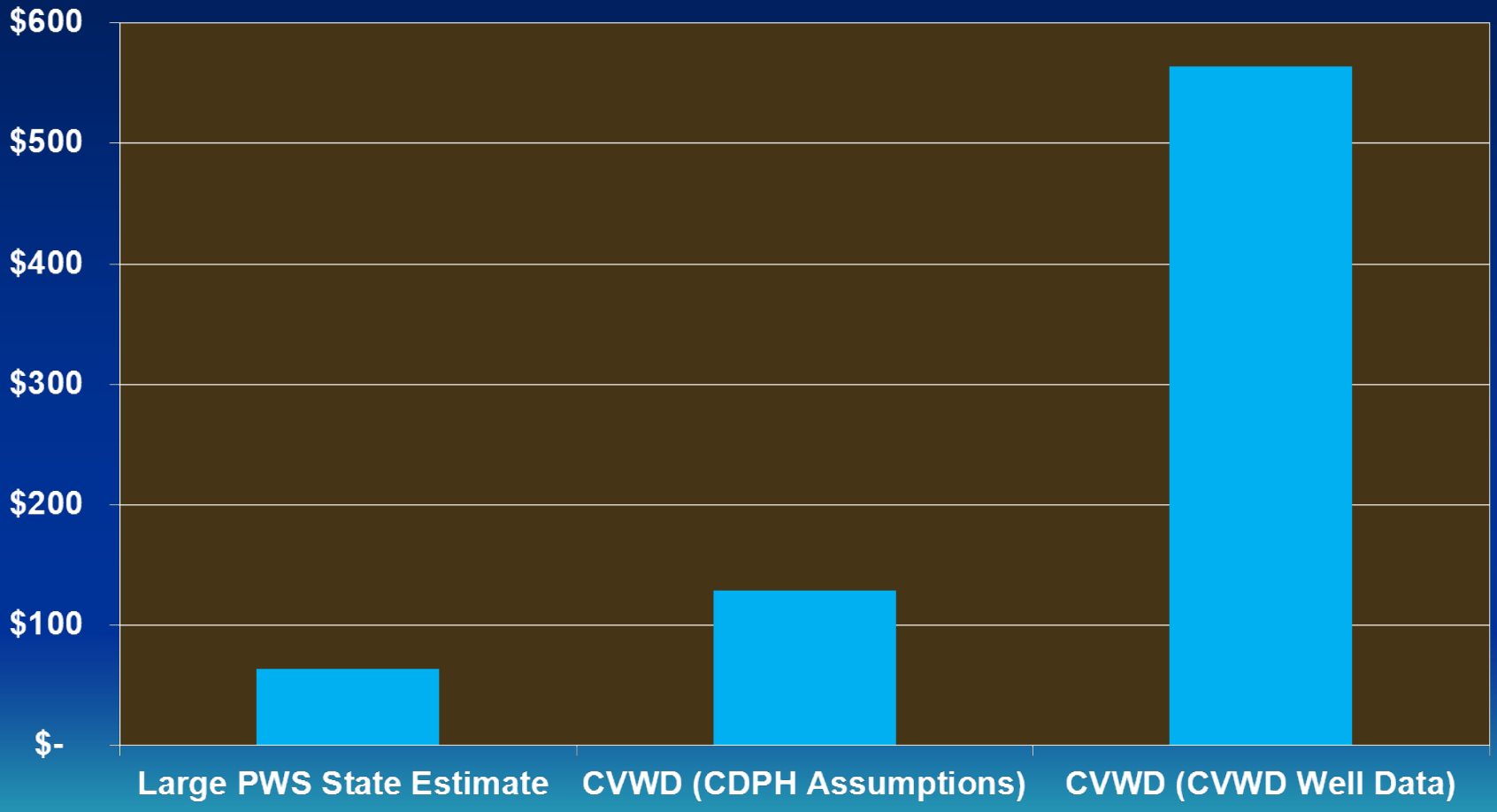
Statewide Impact of Draft MCL (10 ppb)

	CDPH Estimate	ACWA, AWWA, AWWA (CA/NV), CWA Consultants[1] Estimate
Wells Impacted	311	1,360
Capital Cost	$871 million	$4.1 billion*
Annualized Cost	$156 million	$616 million*

* After excluding PWS's with mixed surface water and groundwater sources there were 1,027 impacted groundwater sources used for these cost estimates.

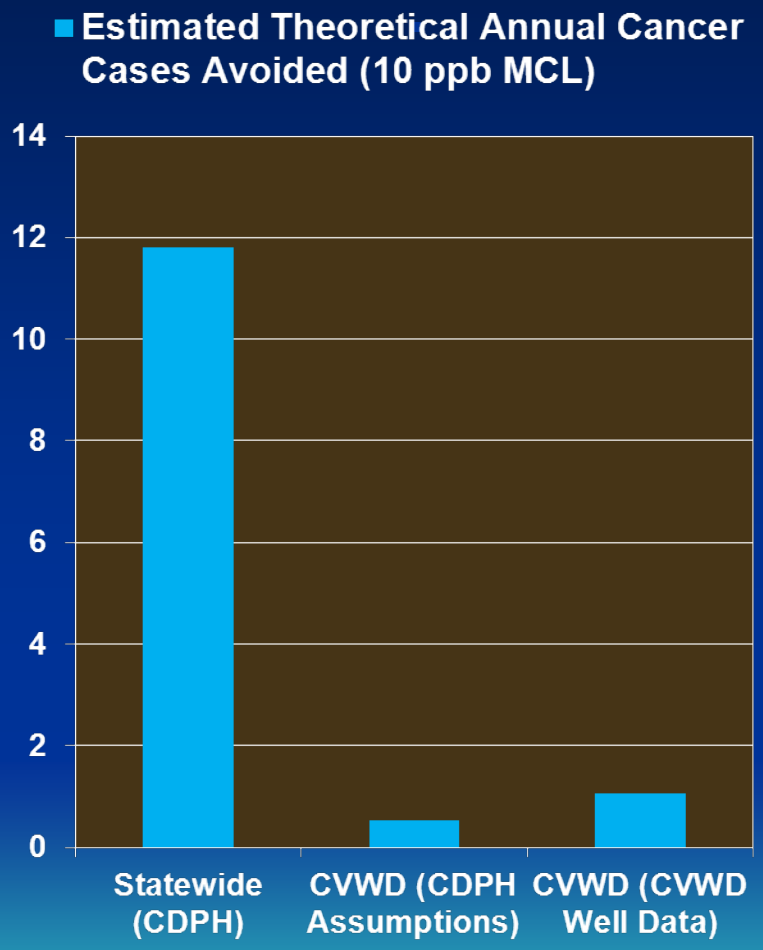
[1] Jacobs Engineering Group (2013) and Water Quality and Treatment Solutions, Inc. (2013) Technical Review of Occurrence and Economic Analyses for California Draft Chromium-6 Drinking Water MCL

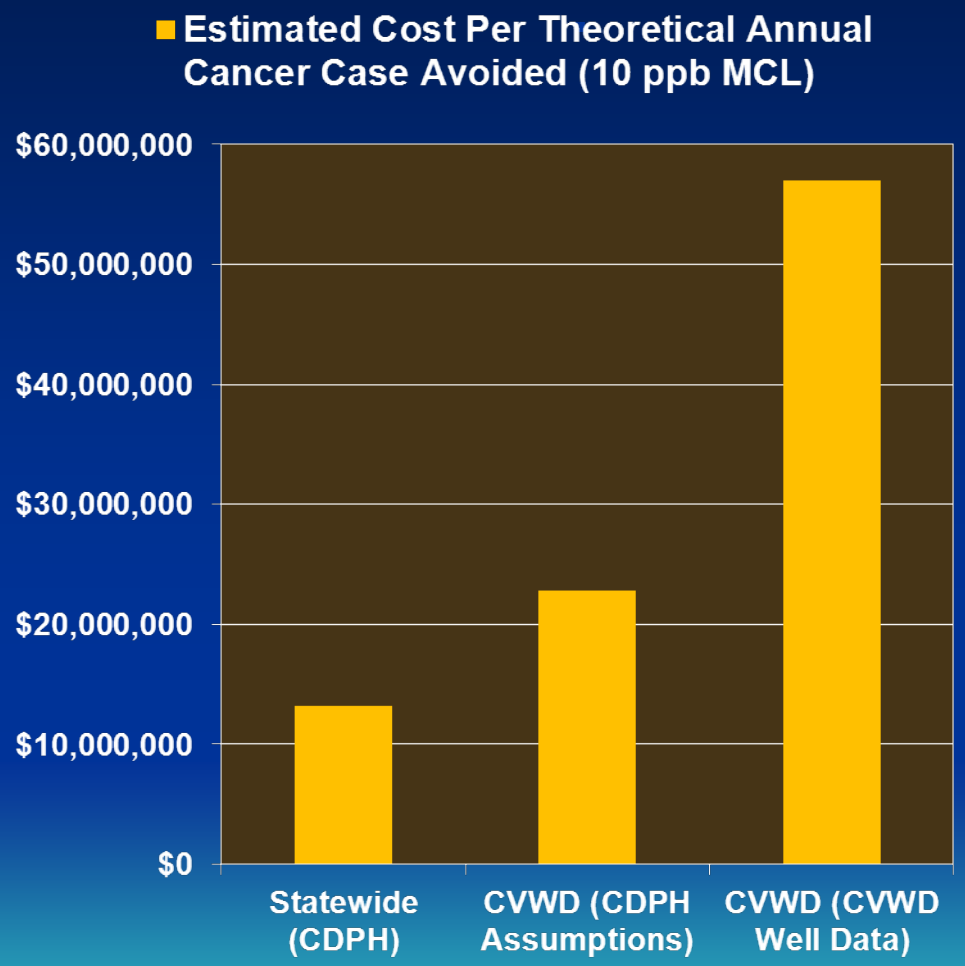
Estimated Annual Compliance Cost Per Customer*



**CDPH Initial Statement of Reasons (Table 8) and Procedures for Cost-Benefit Analysis of Hexavalent Chromium (CDPH, 2013)*

Cost Benefit Analysis*



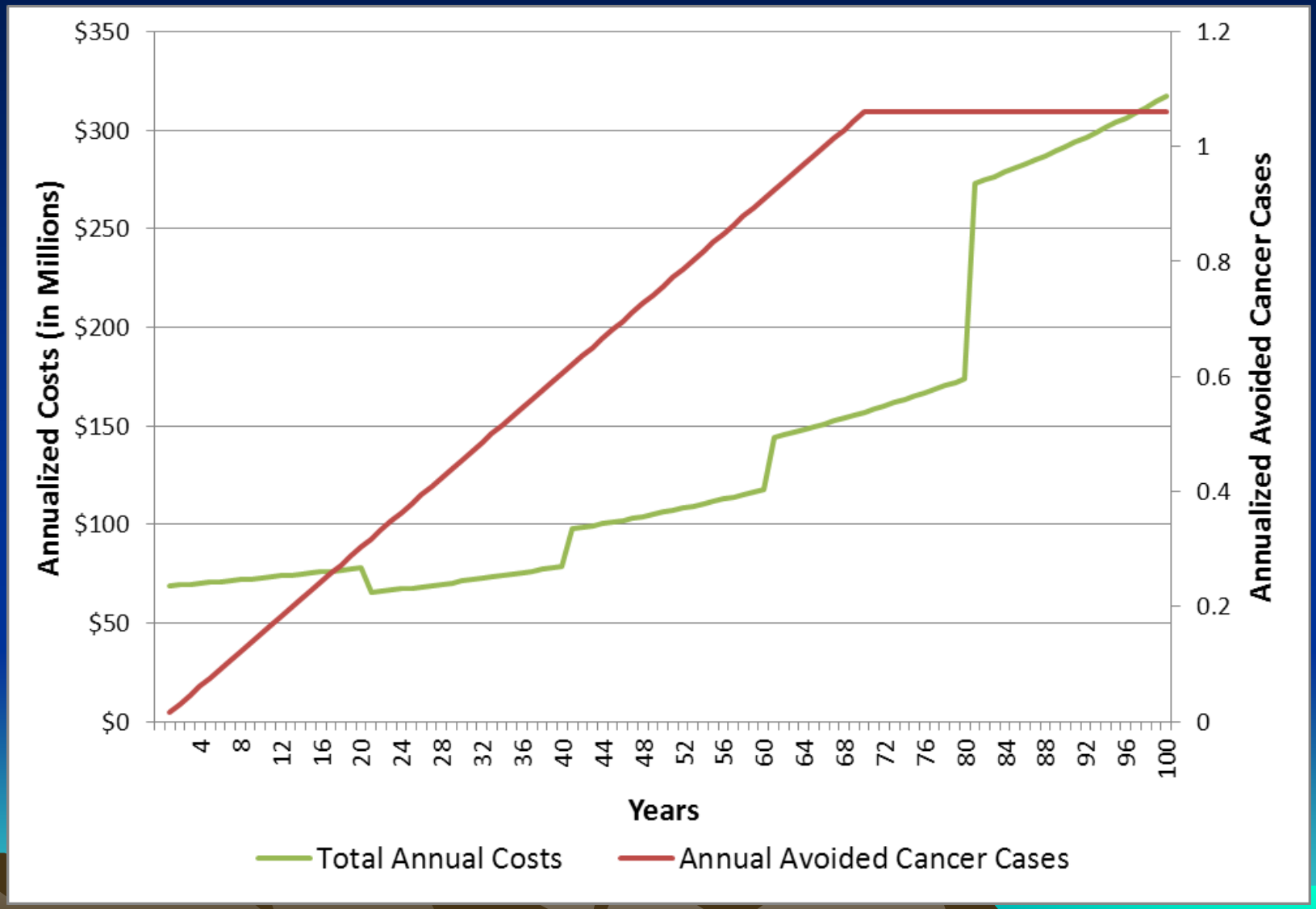


**Data for CVWD public water systems is based on calculations found in Procedure for Cost-Benefit Analysis of Hexavalent Chromium (CDPH, 2013)*

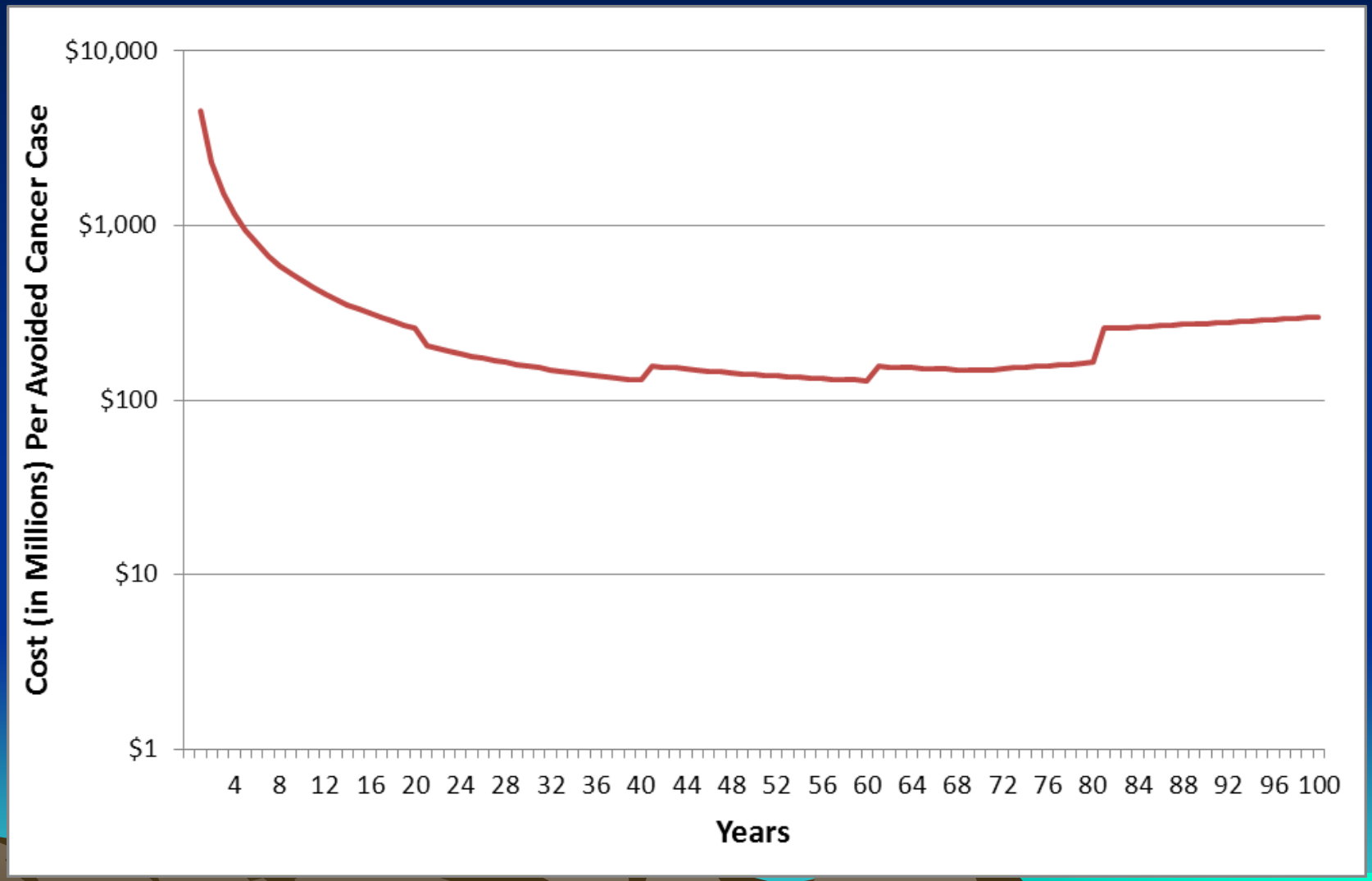
More Errors in CDPH Cost Benefit Analysis

- Risk is based on 70-year exposure
  - Full benefits do not occur until year 70
  - First year benefit is 1/70th of full benefit
- Benefits and Cost must use same horizon
  - Annualized costs used a single 20-year life cycle (capital replacement costs not included)
  - Benefits accrued indefinitely

Draft MCL Cost Benefit Comparison (CVWD PWSs)



Draft MCL Cost-Effectiveness (CVWD PWSs)

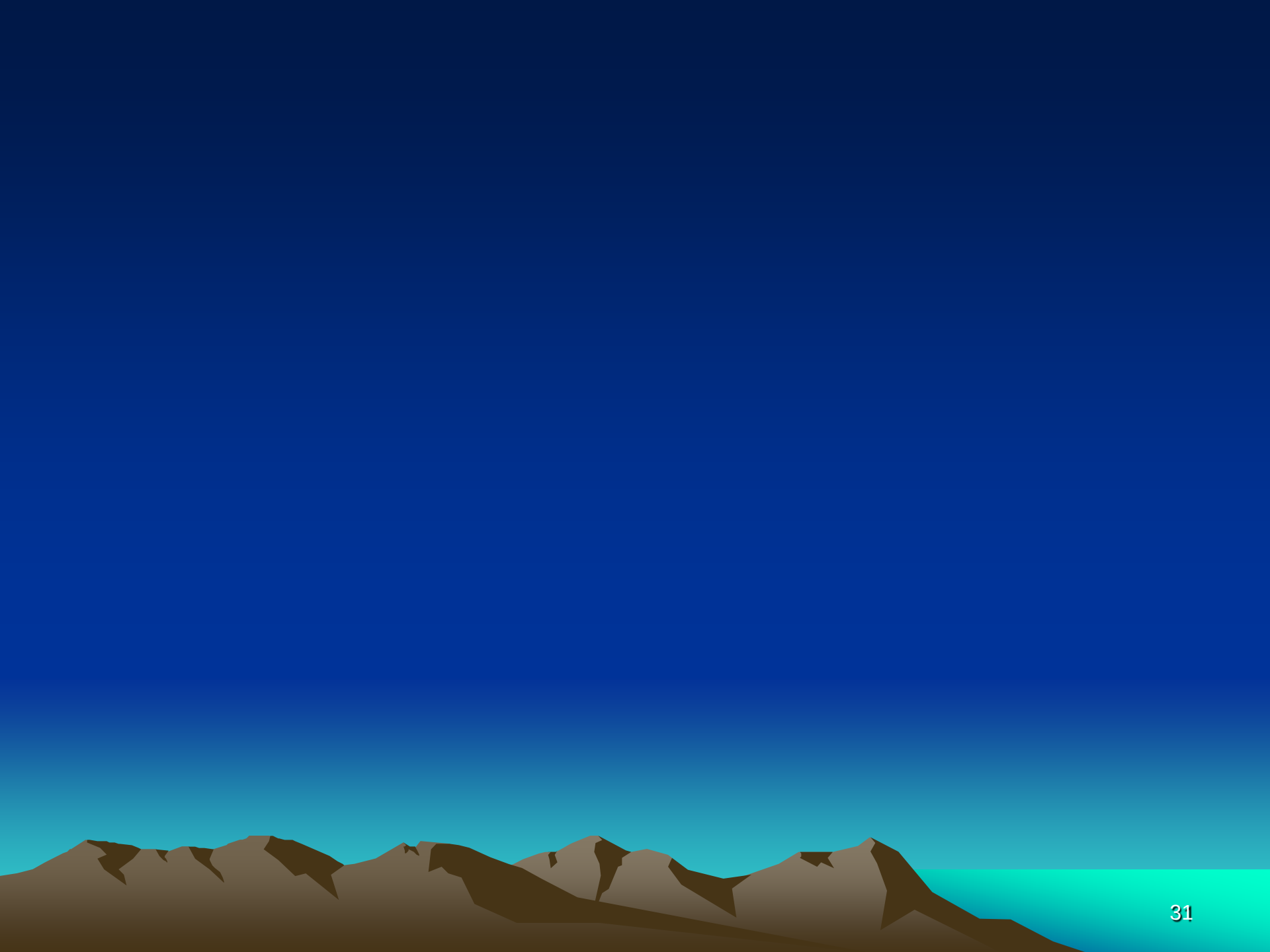


Next Steps

- EPA
  - Complete Cr-6 risk assessment
    - Will new rodent work make a difference?
- California
  - Reviewing 7,000+ comments
  - Respond to court
    - CDPH v. NRDC, EWG October 31 hearing
  - Prepare response to comments
  - Release revised regulatory package for comment???
  - Adopt final rule, new limit becomes effective
- Water Agency
  - Amicus letter
  - Compliance Planning/ Public Outreach
  - Hope for a revised draft MCL

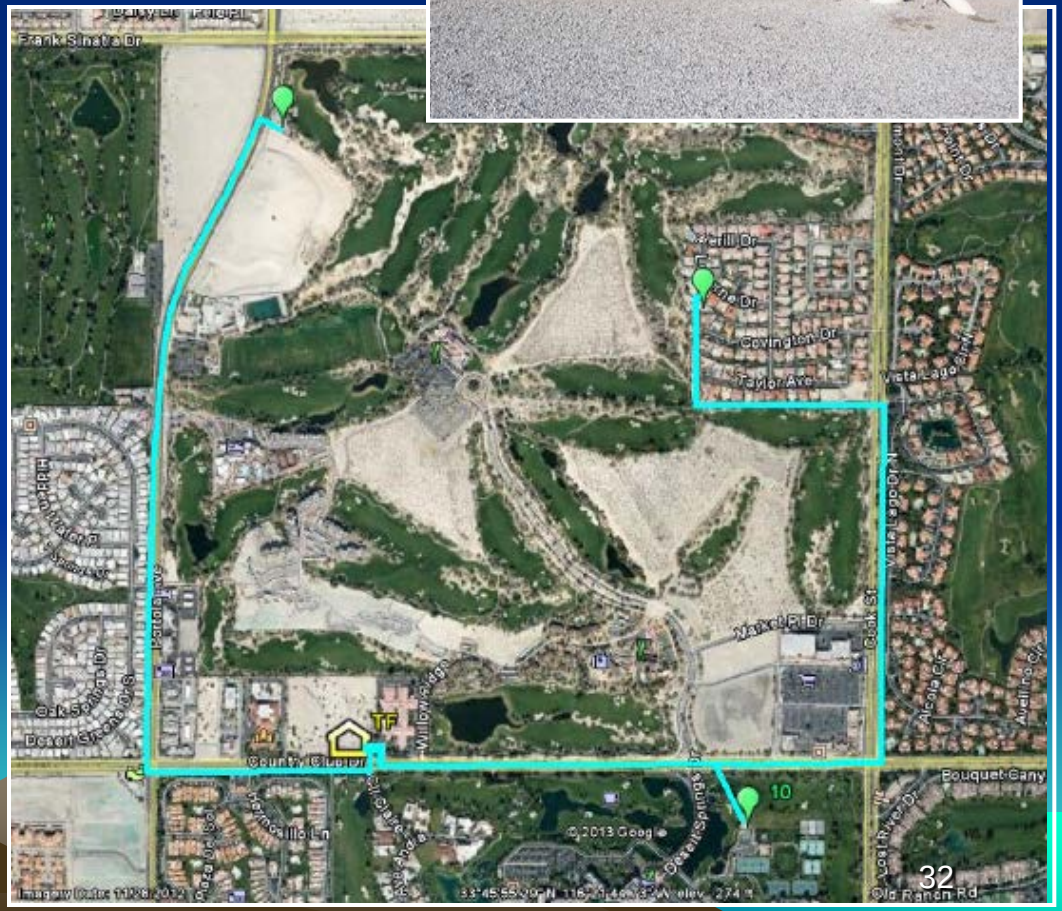
Q&A

Coachella Valley Water District Contact:
Steve Bigley
Director of Environmental Services
(760) 398-2651
sbigley@cvwd.org



CVWD Compliance Planning

- Complete treatment research (2014)
- Source of Supply Study
  - ✓ Evaluate Colorado River water & groundwater supplies
  - ✓ Multiple treatment technologies
  - ✓ Many consolidation options
- Evaluate funding options
- More public outreach
- Develop & implement compliance plan



Developing Drinking Water Regulations

Risk Assessment (Human/Animal)

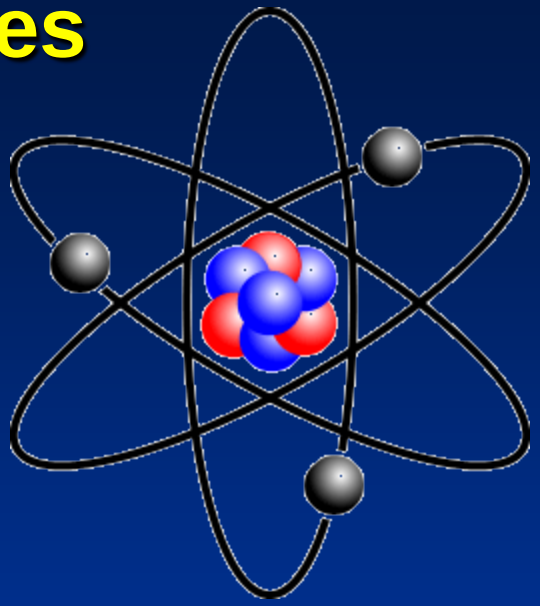
Drinking Water Occurrence

Technically Feasible (Measurable and Treatable)

$

Economically Feasible (Benefits justify Costs)

Chromium (Cr) Sources



- 21st most abundant element
- Chromic oxide - 9th most abundant compound in earth's crust
- Occurs primarily as Chromium-3 (Cr-3) or Chromium-6 (Cr-6) in water
  - Cr-6 is more soluble in water
- Sources in Water
  - Coachella Valley - erosion of natural ultra-mafic sediments
  - Statewide - primarily natural, some isolated industrial sources

Cr-3 + Cr-6 = Total Cr in H_2O

Outline

- Chromium characteristics
- Regulatory process
- Occurrence
- Health effects
- Treatment
- Costs
- Next Steps
- Discussion Period