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### Radioactive Contamination of Water At the Santa Susana Field Laboratory

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Daniel Hirsch

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**Radioactive Contamination of Water  
At the Santa Susana Field Laboratory**

By

Daniel Hirsch

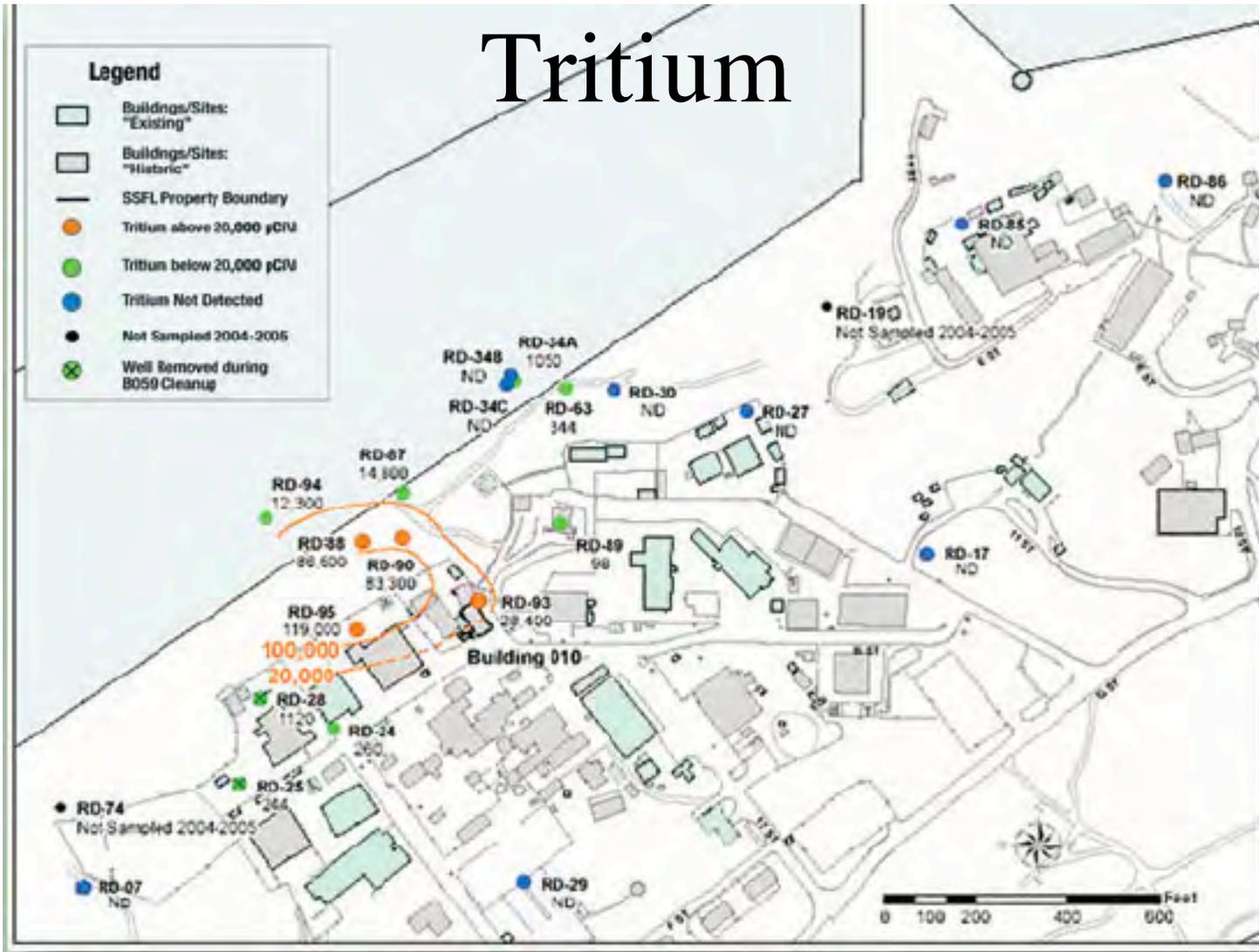
Committee to Bridge the Gap

Presentation to SSFL InterAgency Work Group  
Community Meeting

April 2006

*Supported by a Grant from  
the Citizens' Monitoring and Technical  
Assessment Fund*

# Tritium





Sodium Reactor Experiment



Building 28



Building 24

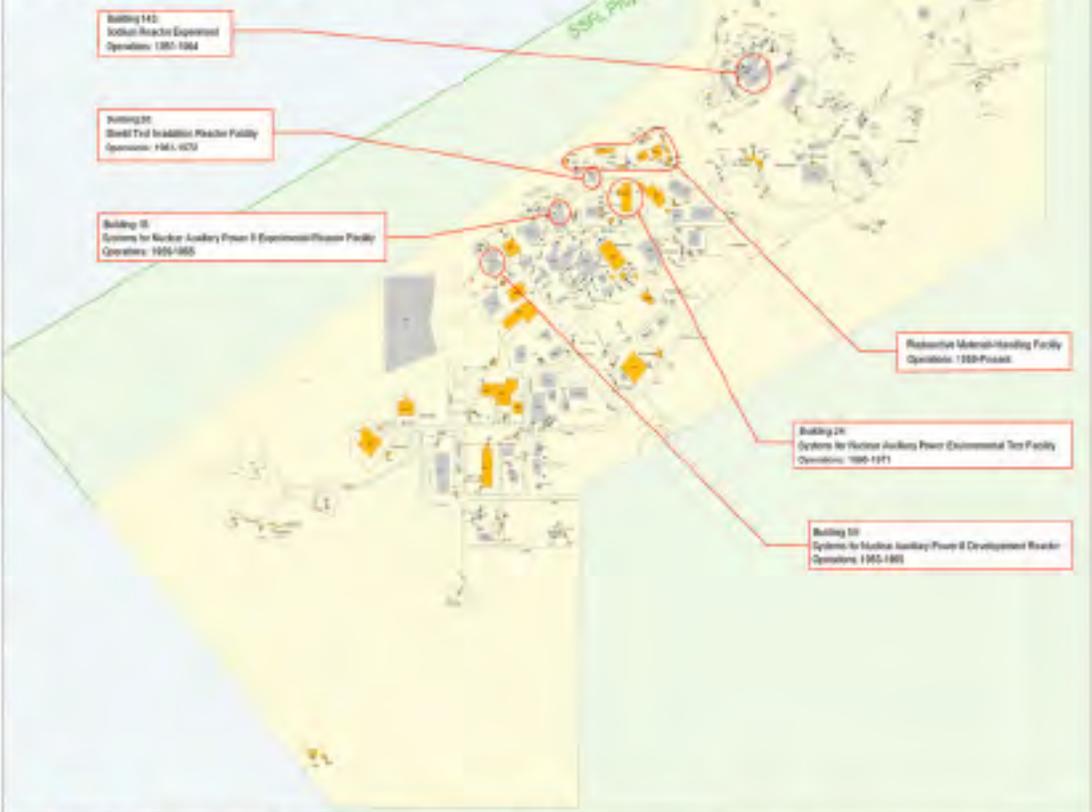


Building 10



Building 58

# Potential Sources of Tritium



Building 142  
Sodium Reactor Experiment  
Operations: 1957-1964

Building 28  
Steel Tank Addition Reactor Facility  
Operations: 1961-1970

Building 24  
Systems for Nuclear Auxiliary Power II Development/Process Facility  
Operations: 1955-1985

Resistor Material Handling Facility  
Operations: 1958-Present

Building 24  
Systems for Nuclear Auxiliary Power Development Test Facility  
Operations: 1960-1971

Building 58  
Systems for Nuclear Auxiliary Power II Development Reactor  
Operations: 1962-1985

Legend: Buildings/ Sites "Removed" Buildings/ Sites "Current"

DATE: September 2004



AREA IV at Santa Susana Field Laboratory

# Bldg 10 -- Site of SNAP8ER Reactor Accident



# Key Facts About Tritium

- Radioactive Isotope of Tritium
- Forms Radioactive Water - HTO (one of the hydrogen atoms in the water molecule is radioactive)
- It is not dissolved *in* the water; it *is* the water.
- Can't be filtered out.

# Tritium Facts Continued

- Moves faster than any other radionuclide in water
- Generally the leading edge of a contaminant plume
- 12.3 year half life (dangerous ~250 years)
- Permissible level in drinking water: 20,000 pico-Curies per liter (pCi/L)
- Background tritium levels are ~10 pCi/L

# Tritium Findings cont'd.

- >20 wells have had statistically significant levels of tritium in groundwater samples, exceeding background
- Tritium levels are currently as high as 119,000 pCi/L
- More than 110 samples have tested positive for elevated tritium

# DHS Conclusions

- “It is evident from these sampling results that tritium is present at elevated concentrations in groundwater....”
- “Tritium concentrations in some wells not identified as containing statistically significant tritium concentrations are likely elevated also....”

## DHS Conclusions (cont'd.)

- “The wells containing the highest concentrations are located down gradient from the former test reactor locations in SSFL Area IV.”

# What do these Tritium facts tell us?

- Tritium found now at 119,000 pCi/L is SIX times the permissible level and 20,000 times background
- If the spill occurred ~1957, when reactor activity really got going at SSFL, 4 half lives of tritium have passed ( $49 \text{ years} / 12.3 = 4$ )
- So tritium concentrations originally would have been 1,900,000 pCi/L
- That is 95 times the Safe Drinking Water level

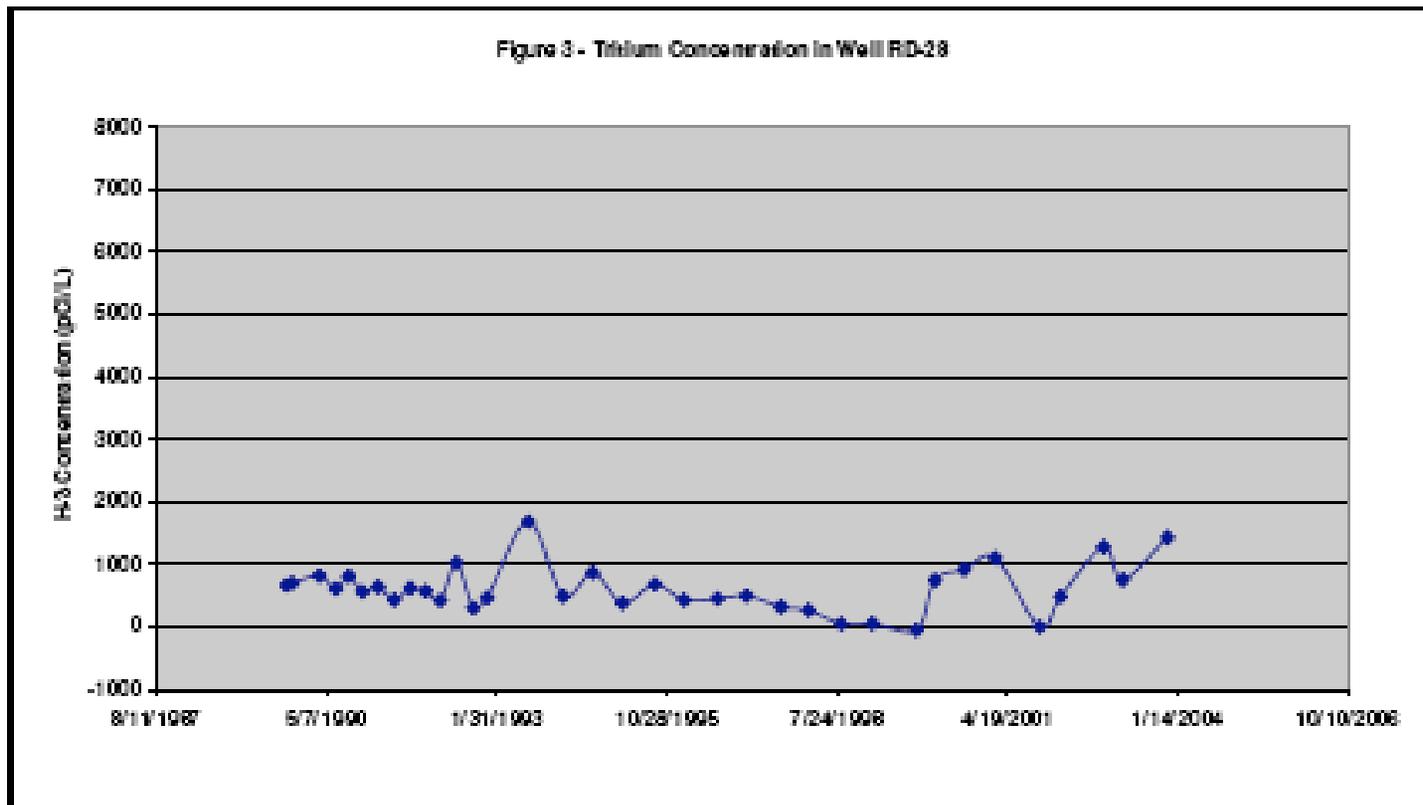
# Tritium Implications (cont'd)

- But that assumes there has been no dilution or migration in half a century
- Infiltrating rainwater dilutes tritium in groundwater
- Migration of groundwater dilutes it as well
- So the true peak concentrations could have been far higher than 95 times “safe” levels

## Implications (cont'd)

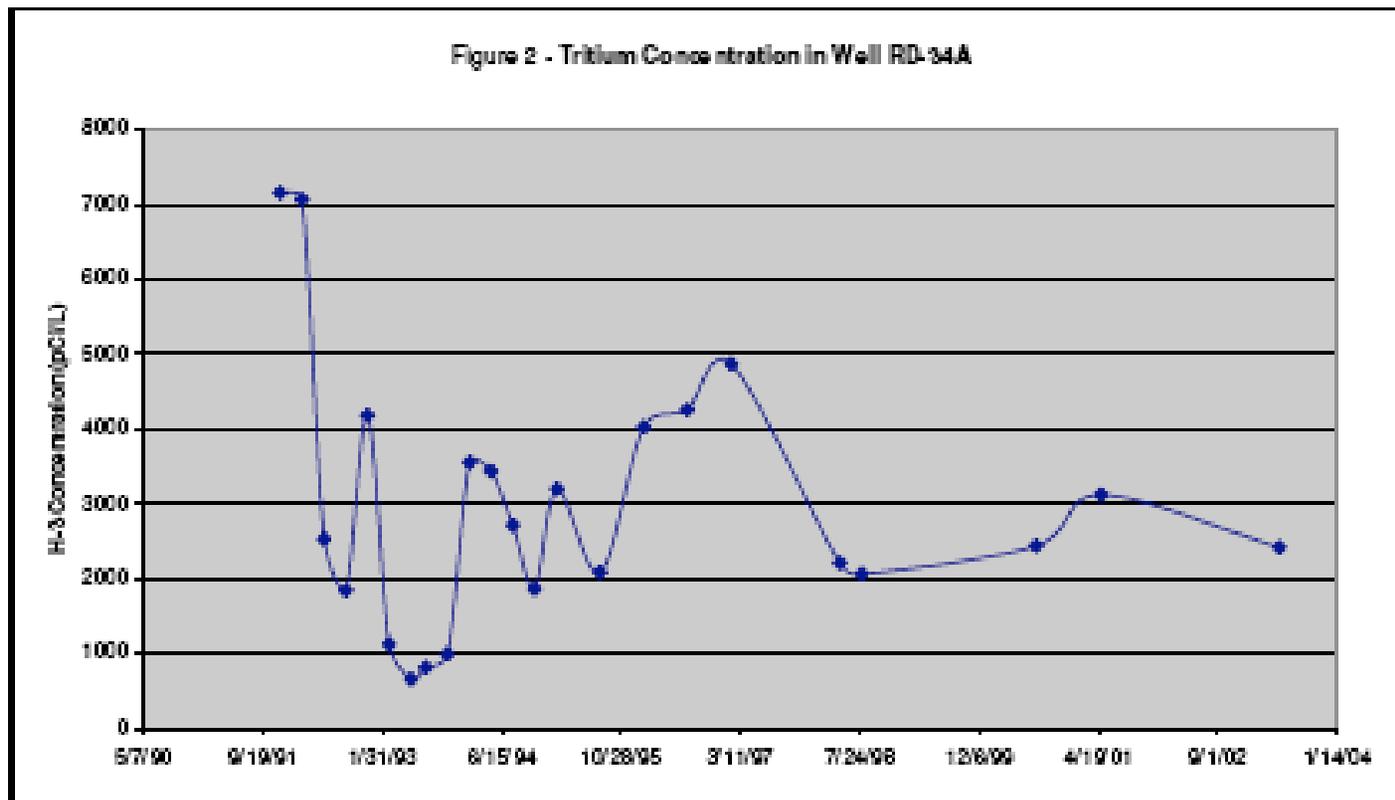
- Because tritium can't be filtered, if there were a mix of radionuclides in water, it is tritium you would expect to find in filtered samples

# Tritium Not Diminishing Over Time -- Continuing New Source?



Source: DHS/RHB created from data found in Haley & Aldrich (2003)

# Up and Down Pattern Indicative of Slugs of Add'l Tritium?



Source: DHS/RHB created from data found in Haley & Aldrich (2003)

# Adequacy of DOE/Rocketdyne Response

- DOE & Rocketdyne failed to measure for tritium for decades
- Only when EPA's Gregg Dempsey did his inspection in 1989 did the issue arise
- He was told they had no tritium measurements, so he took samples from a french drain
- HE FOUND TRITIUM

## Adequacy of Response (cont'd)

- Subsequent additional measurements found more tritium
- But matter was dropped, not pursued
- A couple of years ago DHS identified the T contamination as an unresolved issue, recommended more wells.
- The new wells found very high tritium

# The Current Problem

- Extent and source of tritium contamination still unknown
- No plans for cleaning it up
- Very difficult to remediate
- Can't filter it out of the water because it is part of the water - HTO
- Raises serious questions about adequacy of monitoring

## Current Problem (cont'd)

- Because Boeing's practice of filtering water samples wouldn't filter out the tritium, but would remove/reduce most other radionuclides, finding tritium raises questions about what other radionuclides would be found if the samples weren't filtered and the filters discarded.

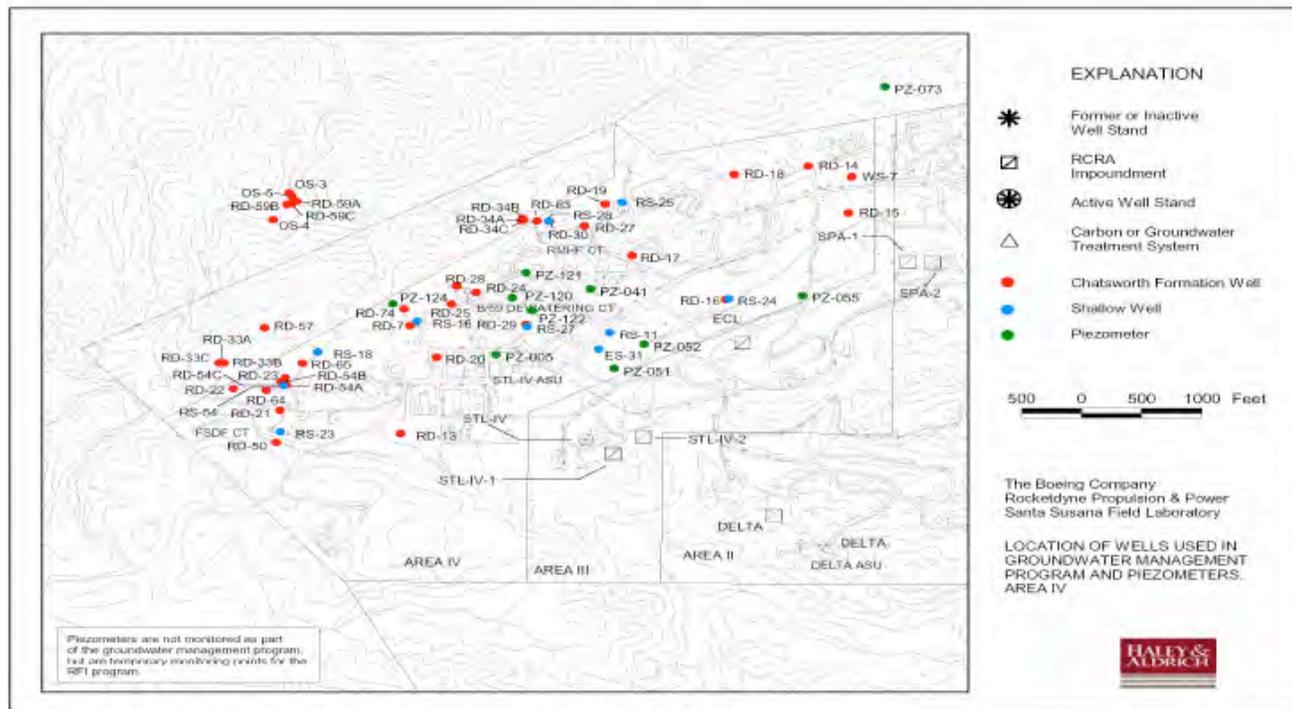
# Radioactivity Other Than Tritium in Groundwater

# Groundwater Monitoring Wells

(excluding Green piezometer dots) Source: DHS 2004 Groundwater Rpt.

SSFL Groundwater

Figure 1



Source: Groundwater Map supplied by Mr. Ning Liu of Boeing September 19, 2003.

# Gross Alpha Radioactivity in Groundwater at SSFL

- In 2002 -- the year DHS reviewed -- 15 wells exceeded the drinking water standard of 15 pCi/L
- These wells are RS-18, RS-54, RD-07, RD-18, RD-19, RD-21, RD-24, RDE-27, RD-28, RD-29, RD-34A, RD-35B, RD-50, RD-54A, and RD-63

# Boeing's Explanation

- It's all coming from natural radioactivity, not from us.

# Problem with Boeing's Explanation

- All but one of wells that exceeded permissible levels for gross alpha were in Area IV, the nuclear area.
- ~85 wells tested below permissible gross alpha levels, most of those in the non-nuclear part of SSFL.
- How could high “natural radioactivity” by chance end up only in Area IV, the nuclear site?

# Problems with Gross Alpha/Beta Measurements

- Office of Environmental Health Hazard Assessment has concluded current gross alpha/beta limits are very much too high to protect public health
- Measurements are far too infrequent -- often just one sample per year
- Very rarely is there measurement for specific radionuclides

# Strontium-90 Recently Found In Surface Water Leaving SFL

- 11.4 pCi/L Strontium-90 (unfiltered) found leaving Outfall 3 on April 28, 2005
- 10.8 pCi/L filtered
- Maximum Concentration Limit is 8 pCi/L
- Source: 2nd Qtr 2005 NPDES Monitoring Report, August 12, 2005

# Strontium-90 Found Again

- “a surface water sample was collected during the 2nd Quarter 2005 from Outfall 003 and analyzed for Strontium-90. This sample result exceeded the **permit limit of 8.0 picocuries per liter (pCi/L).**”
- “follow-up samples were collected...during the 4th Quarter. Appendix F includes the results of the sample analysis. **Results did not exceed permit limits.**” (emphasis added)
- quoted from: Boeing ltr from Steve Lafflam to RWQCB February 15, 2006

# HOWEVER...

- No strontium data in Appendix F
- BUT, in Appendix E, strontium-90 reported at 8.44 pCi/L on October 18, 2005, again leaking from Outfall 003
- **8.44 is GREATER than 8.0**

# Significance

- Outfall 003 is from the Radioactive Materials Handling Facility, a seriously contaminated area
- Surface water releases from Outfall 003 flow towards Simi Valley via Brandeis
- Strontium-90 has previously been at Brandeis and the RMDF watershed

# ACTION TAKEN -- NONE

- Water Board has issued NO notices of violation for these strontium-90 exceedances of Boeing's pollution permit limits