



City of Antioch California

September 6, 2011

Via Email

Mr. Chad Dibble @ to cdibble@dfg.ca.gov
Department of Fish and Game
830 S Street
Sacramento, CA 95811

RE: Ecosystem Restoration Program Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions

Dear Mr. Dibble:

The City of Antioch (Antioch) is pleased to submit its comments for the California Department of Fish and Game's (DFG) Ecosystem Restoration Program's (ERP) Conservation Strategy for Restoration for the Delta.

Antioch supports the DFG's efforts to restore a more natural flow regime within the Delta. Antioch agrees that it is vitally important to consider historical salinity and flow conditions when establishing flow criteria and water quality standards that will affect the future biological and ecological integrity of the Delta. While Antioch agrees that it is not practical to completely restore historic conditions within the Delta, Antioch believes that such historic conditions must be accurately understood because native Delta species evolved and are adapted to such conditions.

Antioch testified on the historic water quality conditions within the Delta in testimony to the State Water Resources Control Board (SWRCB) at the Delta Flow Criteria Informational Proceeding on March 22, 2010. We have attached Antioch's submittals to the SWRCB. We concur with Contra Costa Water District (CCWD) comments to you dated August 22, 2011 and

with their historic salinity report (attached to their comments to you and also submitted to the SWRCB for the flow criteria hearings). One of the key facts in these documents is that the City of Antioch has diverted freshwater from the Delta for municipal purposes for more than 150 years. The conclusion to be drawn from the historical data is that salinity variability indeed occurred, but that it occurred in a much fresher Delta and much farther to the west than has been reported, and than data from 1920 and later indicate.

Antioch also asks that the DFG consider the importance of Three Mile Slough and Georgiana Slough as vital tributary sources of Sacramento River water to the central and western Delta. In fact, most of the water diverted from the Delta at Antioch's intake originates in the Sacramento River. Putting gates or blocking these tributaries will have potential impacts on Western Delta drinking water quality.

We are also concerned with the discussion of experimenting with variable salinity regimes in the Delta. The science behind this approach seems sketchy at best and uses incorrect historical salinity data. We refer you to Dr. Susan Paulsen's testimony on behalf of the City of Antioch to the SWRCB Flow Criteria hearings, and to Contra Costa Water District's Historical Salinity Report for the historical facts about Delta salinity.

Please call me at (925) 779-7025 if you would like more information regarding historical water quality conditions in the Delta or if you have additional questions.

Sincerely,

A handwritten signature in cursive script, appearing to read "P. Harrington".

Phillip Harrington
Director of Capital Improvements/Water Rights
City of Antioch
P.O. Box 5007 Antioch, CA 94531-5007

Attachment: City of Antioch testimony to SWRCB, February 16, 2010



February 16, 2010

Division of Water Rights
State Water Resources Control Board
Attn: Phillip Crader
P. O. Box 2000
Sacramento, CA 95812-2000

Re: Delta Flow Criteria Informational Proceeding

Dear Mr. Crader:

The City of Antioch has been diverting Sacramento River water for drinking water use from the western Delta since the 1860s, and as such, has information and data directly relevant to the SWRCB's current proceedings to establish Delta flow criteria. The City, because of its position in the western Delta, is also concerned with the ecological health of the Delta and the long-term viability of the City's historic freshwater fishing and recreational opportunities.

Please find attached the City of Antioch's exhibits and supporting documents describing the historical salinity conditions at Antioch. The City of Antioch believes that it is vitally important to consider historical salinity and flow conditions when establishing flow criteria and water quality standards that will affect the future biological and ecological integrity of the Delta, and we believe that the SWRCB should not allow flow to be reduced below, or salinity to be increased above, levels currently allowed by both D-1641 and X2 requirements. In fact, the City asks the SWRCB to establish flow and salinity standards in line with the Delta's historic fresh condition.

We appreciate your consideration in this matter. Please feel free to contact me with any questions.

Sincerely,

Phil Harrington
Director of Capital Improvements and Water Rights
City of Antioch

Attachments:

- City of Antioch's Witness List
- City of Antioch's Exhibit Identification List
- City of Antioch's Response to Key Questions
- City of Antioch's Written Summary
- City of Antioch's supporting document – a powerpoint presentation on historical salinity conditions
- City of Antioch's supporting document – A report by Thomas Means (1928): "Salt Water Problem"
- City of Antioch's supporting document – Excerpts from the DWR (1931) Report: "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay"
- City of Antioch's supporting document – DWR (1960) Report: "Delta Water Facilities"

WITNESS IDENTIFICATION LIST (Revised January 29, 2010)
(Due 12 Noon, Tuesday, February 16, 2010)

Delta Flow Criteria Informational Proceeding

Scheduled to Commence
Monday, March 22, 2010

The City of Antioch plans to call the following
witnesses: (name of individual participant or group of participants)

| NAME | PROPOSES PARTICIPATION ON THE FOLLOWING PANEL(S) note panel number) | WILL THE WITNESS SUBMIT TESTIMONY (no if only responding to questions) |
|--|--|---|
| Susan C. Paulsen, Ph.D., P.E., Vice President, Flow Science Incorporated | Hydrology (Panel 1) and Hydrodynamics (Panel 5) | Yes |
| E. John List, Ph.D., P.E., Principal Consultant, Flow Science Incorporated | Hydrology (Panel 1) and Hydrodynamics (Panel 5) | No |
| Phil Harrington, Director of Capital Improvements and Water Rights, City of Antioch | Hydrology (Panel 1) and Hydrodynamics (Panel 5) | No |
| Matthew L. Emrick, Special Water Counsel to the City of Antioch | Hydrology (Panel 1) and Hydrodynamics (Panel 5) | No |

EXHIBIT IDENTIFICATION LIST
(Due 12 Noon, Tuesday, February 16, 2010)

Delta Flow Criteria Informational Proceeding

Scheduled to Commence
Monday, March 22, 2010

PARTICIPANT: **The City of Antioch**

| Exhibit Identification Number | Exhibit Description |
|--------------------------------------|--|
| Antioch Doc #1 | City of Antioch's Cover Letter |
| Antioch Doc #2 | City of Antioch's Witness Identification List |
| Antioch Doc #3 | City of Antioch's Exhibit Identification List |
| Antioch Doc #4 | City of Antioch's Response to Key Questions |
| Antioch Doc #5 | City of Antioch's Written Summary |
| Antioch Doc #6 | City of Antioch's supporting document – a powerpoint presentation on historical salinity conditions |
| Antioch Doc #7 | City of Antioch's supporting document – A report by Thomas Means (1928): "Salt Water Problem" |
| Antioch Doc #8 | City of Antioch's supporting document – Excerpts from the DWR (1931) Report: "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay" |
| Antioch Doc #9 | City of Antioch's supporting document – DWR (1960) Report: "Delta Water Facilities" |

Response to Key Questions

Delta Flow Criteria Informational Proceeding March 22, 2010

The following are brief “bullet-point style” responses to the five questions posed by the State Water Board in its original notice. The written testimony and the supporting documents submitted by the City of Antioch elaborate on these responses.

Key Question #1

What key information, in particular scientific information or portions of scientific information, should the State Water Board rely upon when determining the volume, quantity, and timing of water needed for the Delta ecosystem pursuant to the board’s public trust obligations?

- The current Delta ecosystem is very different than the historical Delta – both flow and salinity are altered compared to historical conditions. For example:
 - since European settlement in the 1850s, dramatic changes to the Delta landscape have occurred, including removal of tidal marsh and building of permanent river channels
 - water management operations (reservoir storage and diversions) since the early 1900s have increased reservoir storage in the upstream watersheds to more than 30 million acre-feet (MAF)
 - water exports from the Delta have been steadily increasing since the 1950s to the present, from about 0.5 MAF/yr to about 5 MAF/yr
- Before 1918 (i.e., before large-scale diversions for upstream agricultural operations), freshwater conditions were pervasive in the western Delta as indicated by literature and technical reports (e.g., testimony from the Antioch lawsuit in 1920, DPW 1931 and DWR 1960)
- Salinity monitoring data indicate that salinity at Antioch has increased from 1965 to present; the increase in salinity continues in recent years.
- Salinity intrusion under current management conditions occurs earlier in the year (currently beginning in about March, as compared to June-July historically). Salinity intrusion also persists longer; currently, the period of high salinity persists for about 10 months on average, compared to about 5 months on average for unimpaired flow conditions (i.e., without any current management operations but with the current Delta channel configuration).

For large reports or documents, what pages or chapters should be considered?

- Specific page number references have been provided in the detailed exhibit and supporting documents.

What does this scientific information indicate regarding the minimum and maximum volume, quality, and timing of flows needed under the existing physical conditions, various hydrologic conditions, and biological conditions?

- Historic Delta was significantly fresher than the current Delta.
- Characterization of the Delta as “historically saline” is false and is not based on scientific evidence.
- Salinity intrusion under current management conditions occurs earlier (timing) and persists longer (duration) compared to unimpaired flow conditions (i.e., without any current management operations but with the current Delta channel configuration).
- Salinity has continued to increase in recent years at Antioch.
- The fraction of time that water at Antioch is suitable for use (when salinity is < 250 mg/L chlorides or 1000 µS/cm EC) has declined significantly.
- Historical fresh conditions must be considered in any effort to restore ecological conditions in the Delta.

With respect to biological conditions, what does the scientific information indicate regarding appropriateness of flow to control non native species?

- This question is not addressed in the City’s submittal.

What is the level of scientific certainty regarding the foregoing information?

- Salinity and flow monitoring data were collected using scientific techniques which are universal and reliable.
- Testimony and historical evidence presented is consistent with historical literature reports, measurements made by the California & Hawaiian Sugar Refining Corporation (C&H) during the early 20th century, and also with paleo records constructed from tree rings and sediment cores (presented by others and in CCWD salinity report).

Key Question #2

What methodology should the State Water Board use to develop flow criteria for the Delta? What does that methodology indicate the needed minimum and maximum volume, quality, and timing of flows are for different hydrologic conditions under the current physical conditions of the Delta?

- The City suggests that, given historical conditions, salinity should not be allowed to rise (and flows should not be allowed to decline) beyond existing levels as required by D-1641 and X2 operations criteria.
- The City requests that compliance points should not be moved land-ward.
- The SWRCB should consider using the gauging station at Antioch as a point of interest for monitoring of both salinity and flow conditions in the western Delta.

Key Question #3

When determining Delta outflows necessary to protect public trust resources, how important is the source of those flows?

- Even though Antioch is on the San Joaquin River, the Sacramento River was historically and continues to be the main source of water at Antioch. Thus, the Sacramento River has historically been the main source of water in the western Delta, and the source of water to which Delta species have been historically exposed and to which they may have adapted.
- In the context of flushing of the South Delta, baseline residence times should be established based on current conditions, and to be used as a measure by which future actions (e.g., BDCP) can be assessed.

How should the State Water Board address this issue when developing Delta outflow criteria?

- This question is not addressed in the City's submittal.

Key Question #4

How should the State Water Board address scientific uncertainty when developing the Delta outflow criteria?

- The City of Antioch respectfully suggests, in light of the information provided, that the SWRCB should err on the side of not allowing greater salinity intrusion.

Specifically, what kind of adaptive management, monitoring, and special studies programs should the State Water Board consider as part of the Delta outflow criteria, if any?

- This question is not addressed in the City's submittal.

Key Question #5

What can the State Water Board reasonably be expected to accomplish with respect to flow criteria within the nine months following enactment of SB 1? What issues should the State Water Board focus on in order to develop meaningful criteria during this short period of time?

- This question is not addressed in the City's submittal.

**State Water Resources Control Board
Delta Flow Criteria Informational Proceeding
March 22, 2010**

**Exhibit by City of Antioch
Summary of Historical Freshwater Availability at Antioch**

Summary

The historic (pre-1918) Delta was significantly fresher than the current Delta. The characterization of the Delta as “historically saline” is false and is not based on scientific evidence. Historical salinity and flow conditions must be considered when: (i) establishing Delta outflows and inflows to protect public trust values which adapted to these conditions, (ii) establishing the criteria (volume, timing and quality) required by Senate Bill 7X 1, and (iii) establishing drinking water quality standards for the Delta.

1. Introduction

The City of Antioch (Antioch), located along the San Joaquin River in the western portion of the Sacramento and San Joaquin River Delta (Delta), is one of the oldest towns in California. Since the 1860s, Antioch has obtained all or part of its freshwater supply directly from the San Joaquin River.¹ The City, because of its position in the western Delta, is also concerned with the ecological health of the Delta and its long-term viability as a recreational destination.

As part of the informational proceeding on establishing flow criteria in the Delta, this document summarizes the historical salinity and flow conditions near Antioch and contrasts them with the largely saline conditions prevailing today. The supporting document to this summary is a “powerpoint style” document containing text and figures relevant to the material presented in this summary.

2. Systemic changes have reduced freshwater flows and increased salinity in the western Delta, including at Antioch

Salinity in the western Delta (including at Antioch) is influenced both by natural factors, including ocean tides and hydrology of the upstream watersheds, and by artificial factors, including channelization of the Delta, elimination of tidal marsh, reservoir storage and release operations, and water diversions.

Major anthropogenic modifications to the Delta that affect salinity intrusion began with the European settlement of the region around 1850. Tidal marsh acreage in the Delta decreased from over 250,000 acres in the 1870s to less than 30,000 acres in the 1920s and

¹ Much of the water in the western Delta (including the City’s water supply) comes from the Sacramento River. Historically, significant amounts of Sacramento River water flowed into the San Joaquin River east of Antioch at Three Mile and Georgiana Sloughs. Sacramento River water also reaches Antioch where the river merges with the San Joaquin River just west of the City. Town of Antioch v. Williams Irrigation District et al. (1922) 188 Cal. 451, 455

has since continued to decrease (CCWD 2010), producing significant changes in the Delta landscape (Att. at pg. 7). For example, dredging of the Delta river channels to create the Stockton and Sacramento Deep Water Ship Channels affected the salt transport and distribution in the Delta (CCWD 2010). Construction of reservoirs for storage purposes started in the early 1900s and the largest reservoirs of the Central Valley Project (CVP, Lake Shasta) and the State Water Project (SWP, Lake Oroville) were completed in 1945 and 1968, respectively (CCWD 2010). Total upstream reservoir storage capacity increased from 1 million acre-feet (MAF) in 1920 to more than 30 MAF by 1979 (CCWD 2010). Water exports from the Delta have been steadily increasing since the 1950s, and the combined annual exports from CVP and SWP have increased, on average, from about 0.5 MAF/yr in the late 1950s to about 5 MAF/yr during the recent period (Att. at pg. 8).

3. Historical extent of freshwater

Testimony from the lawsuit filed by the Town of Antioch in 1920 and from various literature reports demonstrates that freshwater (low salinity conditions) prevailed in the western Delta in the late 1800s and early 1900s.

3.1 Testimony from Antioch's lawsuit in 1920

In 1920, the Town of Antioch filed a lawsuit against upstream irrigation districts alleging that the upstream diversions were causing increased salinity intrusion at Antioch (Town of Antioch [plaintiff] v. Williams Irrigation District et al. [defendants] (1922, 188 Cal. 451)). The testimony from the Antioch lawsuit provides a perspective of the salinity conditions prevailing in the early 1900s.

3.1.1 Pre-1918: Freshwater was available at Antioch year-round

Testimony from the defendants in the Antioch lawsuit indicated that in the late 1800s, water at Antioch was known to be brackish at high tide during certain time periods, but Antioch was able to pump freshwater at low tide throughout the year, with the possible exception of the fall season during one or two dry years. Water at Antioch was fresh at low tide at least until around 1915 (when the pumping plants started pumping continuously, regardless of tidal stage) (Att. at pg. 11).

Testimony from the plaintiff in the Antioch lawsuit indicated that Antioch's freshwater supply was obtained directly from the San Joaquin River (see footnote 1 above) from about 1866 to 1918, first by private water companies and then by the municipality after 1903 (when the City acquired pre-existing water rights) (Att. at pg. 12). Plaintiff's testimony included salinity measurements taken at Antioch (1913-1917) that indicated that prior to 1918, freshwater was available at Antioch even during dry years and in the fall (Att. at pg. 12).

3.1.2 Post-1918: Increased upstream diversions drastically increased salinity intrusion

Testimony and measurements from the Delta (1918-1920) presented by the plaintiff in the Antioch lawsuit indicated that after 1918, salinity abruptly increased during the irrigation (rice cultivation) season, but returned to a potable level after irrigation ceased (Att. at pg. 13). The effect of upstream diversions was also confirmed by records in the plaintiff's testimony from California & Hawaiian Sugar Refining Corporation (C&H) (CCWD 2010). Plaintiff's testimony indicated that although Antioch is located along the San Joaquin River, the source of much of the water at Antioch was the Sacramento River, which flowed to Antioch via Georgiana and Three Mile Sloughs (Att. at pg. 14-15); this was confirmed by the California Supreme Court (Att. at p. 15).

Information from the Antioch lawsuit is consistent with literature reports (see the following discussion) and with paleo records of salinity and river flow obtained from tree rings and sediment cores (CCWD 2010).

3.2 Literature reports

Several literature reports confirm that freshwater was available year-round in the western Delta (including Antioch) and Suisun Bay during the late 1800s and early 1900s. For instance, DPW (1931), the precursor to the Department of Water Resources, indicated that the City of Antioch obtained all or most of its freshwater supplies directly from the San Joaquin River until 1917, and that salinity intrusion prevented domestic use of water at the Antioch intake in summer and fall after 1917 (Att. at pg. 9). DPW (1931) and Tolman and Poland (1935) indicated that prior to the 1920s, water near the City of Pittsburg was sufficiently fresh for that City to directly obtain all or most of its freshwater (Att. at pg. 10). Dillon (1980) and Cowell (1963) indicated that prior to the 1920s, freshwater was available in the Suisun Bay and Carquinez Straits for use by the City of Benicia (Att. at pg. 10). Means (1928) indicated that Carquinez Strait (near Martinez in the western Delta) is the approximate boundary between salt water and freshwater under natural conditions. Moreover, Means (1928) also indicated that during the wet season freshwater extended up to the Golden Gate (Att. at pg. 9).

The California Department of Water Resources (DWR, 1960) estimated that water with a chloride concentration of 350 mg/L or less would be available at San Joaquin at Antioch about 85% of the time under "natural" conditions (Att. at pg. 16). DWR (1960) also estimated that chloride concentrations at Antioch would be less than 350 mg/L about 80% of the time in 1900 and about 60% of the time by 1940, with decreasing freshwater availability due to upstream diversions; DWR also projected further deterioration of water quality in 1960 and later, but did not include the effects of reservoir releases for salinity control (Att. at pg. 16).

4. Current Salinity Conditions at Antioch

Salinity data compiled by the Interagency Ecological Program (IEP) and California Data Exchange Center (CDEC) were used to analyze the present availability of freshwater at Antioch. These quantitative measurements from the present were compared to the

testimony from the Antioch lawsuit and to observation recorded by C&H to establish how salinity at Antioch and in the western Delta has increased over time compared to historical conditions.

4.1 Freshwater availability continues to decline

Availability of freshwater at Antioch continues to decline. Antioch may take water at its intake when salinity is less than 250 mg/L chlorides (equivalent to about 1000 $\mu\text{S/cm EC}$)². The number of days per year, expressed as a percentage, when daily average salinity at Antioch was below 1000 $\mu\text{S/cm EC}$ declined from about 70% in the late 1960s to about 40% during the recent period (Att. at pg. 19).

Even in years with above normal runoff in the Sacramento River watershed, freshwater at Antioch is less available than historically (Att. at pg. 20). For instance, during the above normal water year 2000, water at the City of Antioch's intake was below 1000 $\mu\text{S/cm EC}$ for the entire day for about four-and-a-half months (early February through mid-June) and for a portion of the day at low tide for another three-and-a-half months (mid-June through September). For the remaining four months (October-January), water at the City's intakes exceeded 1,000 $\mu\text{S/cm EC}$ for the entire day, regardless of tidal stage. Testimony from the Antioch lawsuit indicates that prior to 1918, water at the City of Antioch's intake was below 1000 $\mu\text{S/cm EC}$ for the entire day during above-normal years and in all but dry fall months.

Salinity at low tide at Antioch during the present is higher than historical conditions (Att. pg. 21). For instance, during the period 1985 to 2009, the tenth percentile low tide daily salinity was below 1,000 $\mu\text{S/cm EC}$ for about one-and-a-half months, and the 25th percentile low tide daily salinity was below 1,000 $\mu\text{S/cm EC}$ for about nine months. However, testimony from the Antioch lawsuit indicates that during the driest years prior to 1918, low tide salinity at the City of Antioch's intake was below 1000 $\mu\text{S/cm EC}$ for about nine months; for all but the driest years, salinity at low tide was below 1,000 $\mu\text{S/cm EC}$ throughout the year. These data establish that salinity is higher at Antioch for a wider range of hydrologic conditions and for a longer duration of the year than under historic conditions.

4.2 Salinity intrusion occurs earlier and extends farther

Since the early 1900s the California & Hawaiian Sugar Refining Corporation (C&H), located in Crockett near the western edge of Suisun Bay, obtained its freshwater supply in Crockett. When freshwater was not available at Crockett, C&H used barges that traveled upstream on the Sacramento and San Joaquin Rivers to procure freshwater. The measurements of distance to freshwater from Crockett, recorded during these barge operations, serve as a surrogate for the historical extent of freshwater in the western

² The freshwater salinity threshold of 250 mg/L chlorides at the San Joaquin River at Antioch is based on the 1968 agreement between the City of Antioch and DWR. This threshold is approximately equivalent to 1000 $\mu\text{S/cm EC}$, based on the site-specific empirical relationships between chloride concentration and EC (K. Guivetchi, DWR Memorandum dated June 24, 1986).

Delta. A comparison of C&H data during 1908-1917 and estimates³ of distance to freshwater from Crockett during the post-SWP construction period (1966-1975) indicates that salinity intrusion into the Delta occurs on average about 4 months earlier (in March instead of July) during the post-SWP construction period of 1966-1975 (Att. at pg. 17). Comparison of C&H data from 1908-1917 to estimates of distance to freshwater from Crockett during the period 1995-2004 indicates that salinity intrusion during the recent period not only occurs earlier (by 4 months) but also extends farther in to the Delta (by about 5 to 20 miles) (Att. at pg. 18).

5. Conclusions

- Prior to 1918, freshwater was almost always available at Antioch at least at low tide. Only during dry years and during high tide conditions did salinity at Antioch become brackish.
- Between 1918 and the late 1930s, drought conditions, upstream water diversions, and channelization increased the salinity of water at Antioch.
- By 1940 the drought receded, but salinity at Antioch remained elevated.
- Salinity has continued to increase in recent years at Antioch.
- The fraction of time that water at Antioch is suitable for use (when salinity is < 250 mg/L chlorides or 1000 μ S/cm EC) has declined significantly.
- “Historic” Delta was significantly fresher than the current Delta.

6. Request

The City of Antioch requests that the State Water Resources Control Board review and incorporate historic salinity data into its analyses when considering Delta outflow requirements to protect public trust resources in the Western Delta and the flow requirements of SB X7 1 (e. g., volume, timing and quality), and that the Board use historic data to establish and to adjust its “baseline” of water quality for both fisheries health and drinking water quality standards. In fact, the City asks the SWRCB to establish flow and salinity standards in line with the Delta’s historic fresh condition. The City also requests that the SWRCB consider using the gauging station at Antioch as a point of interest to ensure that flow criteria and salinity objectives are met.

References

- [CCWD] Contra Costa Water District. 2010. Report titled "Historical Freshwater and Salinity Conditions in the Western Sacramento-San Joaquin Delta and Suisun Bay".
- Cowell, J. W. 1963. History of Benicia Arsenal: Benicia, California: January 1851 – December 1962. Berkeley, Howell-North Books.
- [DPW] Department of Public Works. 1931. *Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay*. Bulletin No. 27. State of California, Department of Public Works, Division of Engineering and Irrigation.
- [DWR] Department of Water Resources. 1960. *Delta Water Facilities*. Bulletin No. 76. State of California.
- Dillon, R. 1980. Great Expectations: The Story of Benicia, California, Fresno, California. 241 pp.
- Means, T. 1928. Salt Water Problem: San Francisco Bay and Delta of Sacramento and San Joaquin Rivers, San Francisco, California, April 1928. Report prepared for the Association of Industrial Water Users of Contra Costa and Solano Counties.
- Tolman, C. F. and J. F. Poland. 1935. *Investigation of the Ground-Water Supply of the Columbia Steel Company Pittsburg, California*. Stanford University, California, May 30, 1935.
- Town of Antioch v. Williams Irrigation District (1922, 188 Cal. 451).

³ These estimates were made using IEP data in CCWD (2010), which will be presented by the Contra Costa Water District during this informational proceeding.

Testimony by City of Antioch

For SWRCB Delta Flow Criteria
Informational Proceeding
Submitted February 16, 2010
For hearings beginning March 22, 2010

Overview

- Antioch has taken fresh drinking water from the Delta since the 1860s
- Infrastructure and flow diversions have changed distribution and timing of freshwater flows
- Historic conditions were far fresher than current conditions
- Quality of water at Antioch has declined markedly

Why Is This Important ?

- Characterizations of the Delta as “historically saline” are false
- Native species are adapted to historical conditions, so historic salinity and flow patterns must be considered in establishing appropriate flow and salinity standards

What Should Happen ?

- SWRCB should review and incorporate historic salinity data into its analyses
- SWRCB should use historic data to establish an historic baseline of water quality and flows for both fisheries and drinking water quality standards

What Should Happen ?

- SWRCB should ensure that flows are not reduced, nor salinity increased, beyond levels assured by D-1641 and current X2 requirements
- In fact, the City of Antioch asks the SWRCB to establish flow and salinity standards in line with the Delta's historic fresh condition
- SWRCB should state that characterizations of the Delta as "historically saline" are false
- SWRCB should consider using Antioch's gauging station as a 'point of interest' to gauge flow and salinity conditions

Systemic Changes Have Influenced Flows and Salinity

Factors Influencing Salinity

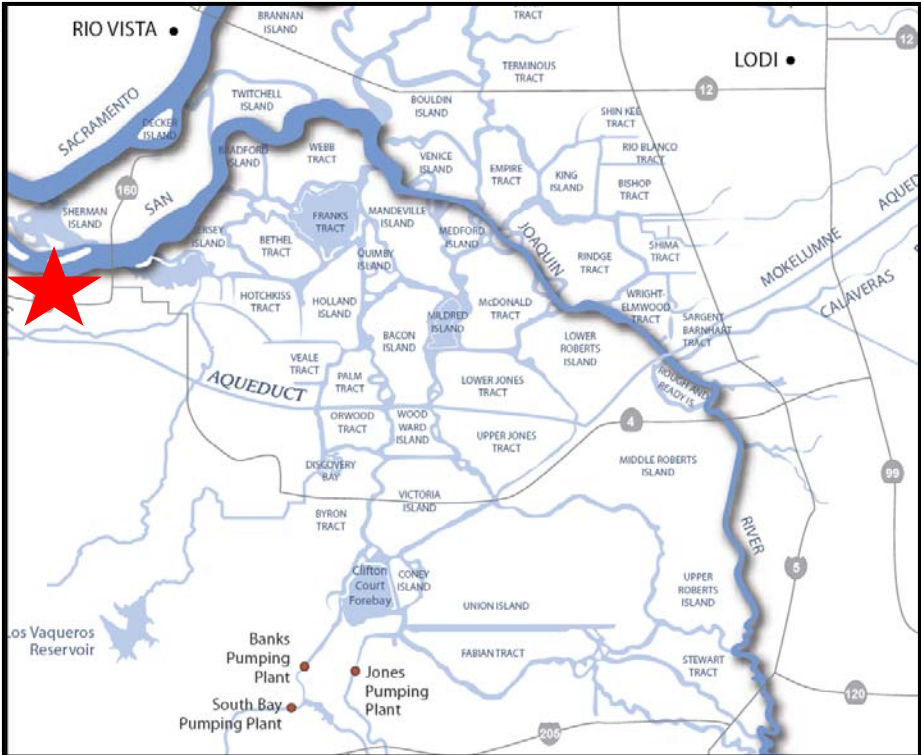
- Hydrology
- Changes to the Delta landscape
- Water Management
 - Exports
 - Diversions
 - Reservoir Storage

The Delta Landscape is Dramatically Different

1873

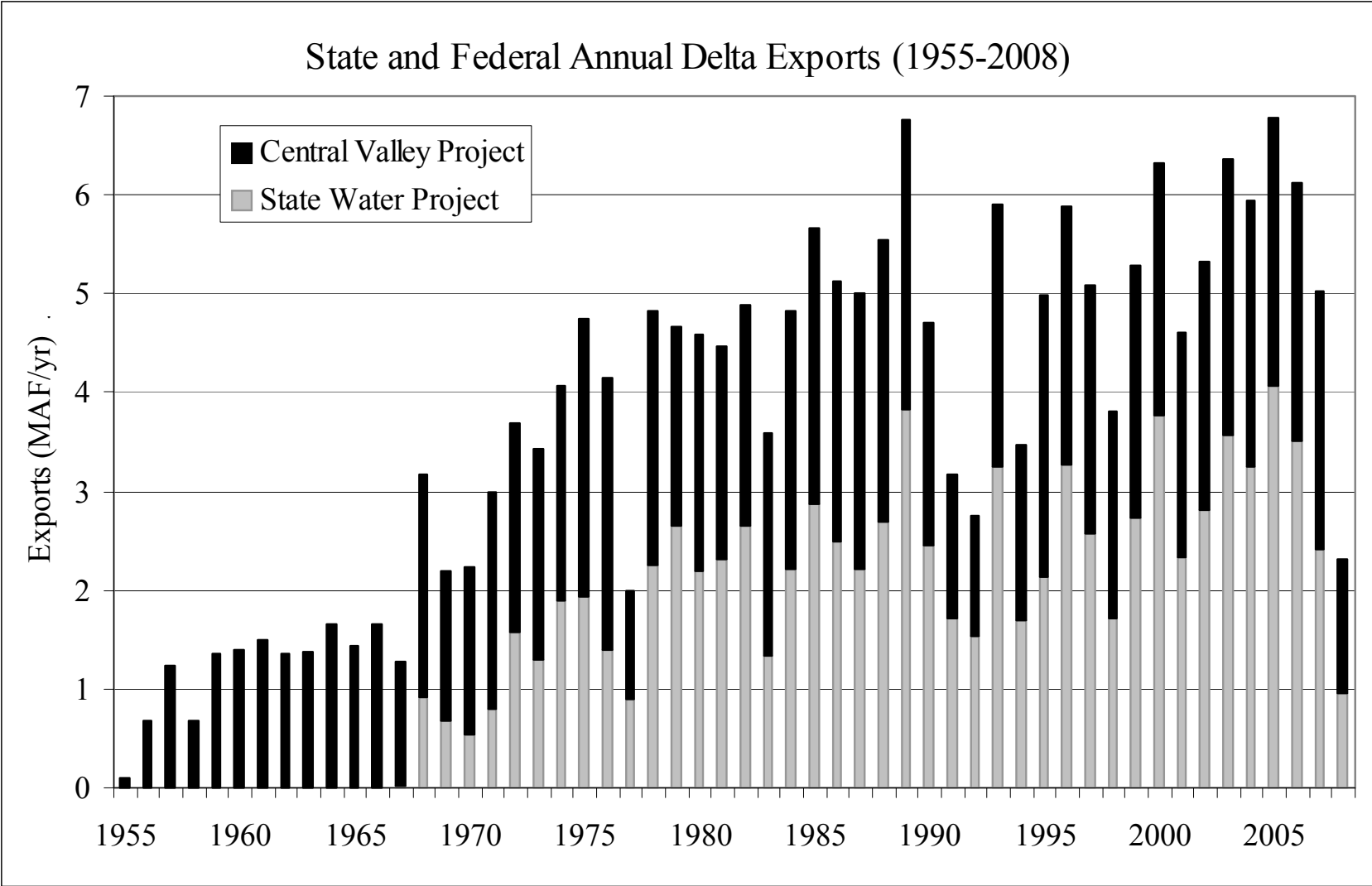


2010



Approximate location of City of Antioch's water intake

Water Exports Have Increased and Remove Fresh Water from Delta



Pre-1918, Fresh Water was Available in Western Delta Nearly Year-round

| Location | Quotation |
|----------------------------------|---|
| Antioch, CA | <i>“From early days, Antioch has obtained all or most of its domestic and municipal water supply from the San Joaquin River immediately offshore from the city... However, conditions were fairly satisfactory in this respect until 1917, when the increased degree and duration of saline invasion began to result in the water becoming too brackish for domestic use during considerable periods in the summer and fall.” (DPW, 1931, pg. 60)</i> |
| Western Delta | <i>“The dry years of 1917 to 1919, combined with increased upstream irrigation diversions, especially for rice culture in the Sacramento Valley, had already given rise to invasions of salinity into the upper bay and lower delta channels of greater extent and magnitude than had ever been known before.” (DPW, 1931, pg. 22)</i> <i>“It is particularly important to note that the period 1917-1929 has been one of unusual dryness and subnormal stream flow and that this condition has been a most important contributing factor to the abnormal extent of saline invasion which has occurred during this same time.” (DPW, 1931, pg. 66)</i> |
| Carquinez Strait (Western Delta) | <i>“Under natural conditions, Carquinez Straits marked, approximately, the boundary between salt and fresh water in the upper San Francisco Bay and delta region...” (Means, 1928, pg. 9)</i> <i>“For short intervals in late summer of years of minimum flow, salt water penetrated at lower river and delta region, and in wet seasons the upper bay was fresh, part of the time, to the Golden Gate.” (Means, 1928, pg. 9 & pg. 57)</i> |

DPW (1931). Bulletin No. 27. State of California, Department of Public Works, See <http://www.archive.org/details/variationcontrol27calirich>
Means, T. (1928). Salt Water Problem: San Francisco Bay and Delta of Sacramento and San Joaquin Rivers, San Francisco, California, April 1928. A report prepared for the Association of Industrial Water Users of Contra Costa and Solano Counties.

Pre-1918, Fresh Water was Available in Western Delta Nearly Year-round

| Location | Quotation |
|-----------------------------|---|
| Benicia, CA (Suisun Bay) | <p><i>“In 1889, an artificial lake was constructed. This reservoir, filled with fresh water from Suisun Bay during the spring runoff of the Sierra snow melt water ...”</i> (Dillon, 1980, pg. 131)</p> <p><i>“...in 1889, construction began on an artificial lake for the [Benicia] arsenal which would serve throughout its remaining history as a reservoir, being filled with fresh water pumped from Suisun Bay during spring runoffs of the Sacramento and San Joaquin Rivers which emptied into the bay a short distance north of the installation.”</i> (Cowell, 1963, pg. 31)</p> |
| Pittsburg, CA | <p><i>“From 1880 to 1920, Pittsburg (formerly Black Diamond) obtained all or most of its domestic and municipal water supply from New York Slough [near Pittsburg at the confluence of the Sacramento and San Joaquin Rivers] offshore.”</i> (DPW, 1931, pg. 60)</p> <p><i>“There was an inexhaustible supply of river water available in the New York Slough [near Pittsburg at the confluence of the Sacramento and San Joaquin Rivers], but in the summer of 1924 this river water showed a startling rise in salinity to 1,400 ppm of chlorine, the first time in many years that it had grown very brackish during the dry summer months.”</i> (Tolman and Poland, 1935, pg. 27)</p> |

Cowell, J. W. 1963. History of Benicia Arsenal: Benicia, California: January 1851 – December 1962. Berkeley, Howell-North Books

Dillon, R. 1980. Great Expectations: The Story of Benicia, California, Fresno, California. 241 pp.

Tolman, C. F. and J. F. Poland. 1935. Investigation of the Ground-Water Supply of the Columbia Steel Company Pittsburg, California. Stanford University, California, May 30, 1935

Testimony from Antioch Lawsuit: Pre-1918, Fresh Water was Available at Antioch Year-round

- Antioch lawsuit in 1920: Town of Antioch [plaintiff] v. Williams Irrigation District et al. [defendants] (1922, 188 Cal. 451)
- Plaintiff alleged that the upstream diversions were causing increased salinity intrusion at Antioch
- Testimony from defendants in the Antioch lawsuit (from the supporting Supreme Court record on file at the State Archives) (CCWD, 2010)
 - In the late 1800s, water at Antioch was known to be brackish at high tide during certain time periods.
 - Antioch was able to pump fresh water at low tide throughout the year, with the possible exception of the fall season during one or two dry years.
 - Water at Antioch was apparently fresh at low tide at least until around 1915 (when the pumping plants started pumping continuously, regardless of tidal stage).

Testimony from Antioch Lawsuit: Pre-1918, Fresh Water was Available at Antioch in Fall

Testimony from plaintiff in the Antioch lawsuit (from the supporting Supreme Court record on file at the State Archives)

- Antioch’s freshwater supply was obtained directly from the western Delta from about 1866 to 1918 (pg. 47-48).
- Prior to 1918, freshwater was available at Antioch even during dry years and in the fall (pg. 23-24).

| Date | Location | Salinity (ppm) |
|--|----------|----------------|
| 1913 (Sept; a dry year) | Antioch | 66 |
| 1916 (Aug. 5 th ; wet year) | Antioch | 22.3 |
| 1916 (Aug. 9 th ; wet year) | Antioch | 12.3 |
| 1916 (Sept. 19 th ; wet year) | Antioch | 101.3 |
| 1917 (Sept. 14 th ; wet year) | Antioch | 141.6 |

Testimony from Antioch Lawsuit: Post-1918, Upstream Diversions Drastically Increased Salinity Intrusion

Testimony from plaintiff in the Antioch lawsuit (continued)

- After 1918, salinity abruptly increased during irrigation (rice cultivation) season, and returned to a potable level after irrigation ceased (pg. 18-20)

| Date | Location | Salinity (ppm) |
|---|---------------|----------------|
| 1918 (Sept. 25 th ; dry year) | Antioch | 1360 |
| 1920 (mid-July; critical year) | Pittsburg, CA | 4500 |
| 1920 (end-July; critical year) | Pittsburg, CA | 6000 |
| 1920 (mid-Aug.; critical year) | Pittsburg, CA | 9500 |
| 1920 (end-Sept.; critical year) | Pittsburg, CA | 2500 |
| 1920 (during rice irrigation; critical year) | Antioch | 12,500 |
| 1920 (end-Oct, after irrigation; critical year) | Pittsburg, CA | fresh |

Measurements at Pittsburg, CA, are from the Great Western Electro Chemical Co.

- Information on the effect of upstream diversions is also confirmed by records in the plaintiff’s testimony from C&H Sugar (see CCWD 2010).

Testimony from Antioch Lawsuit: Water at Antioch is from Sacramento River

- Testimony from plaintiff in the Antioch lawsuit (continued)
 - Plaintiff testimony asserted that in 1920 “the amount of water which the San Joaquin carried was dependent entirely upon the amount of water in the Sacramento,” and that “the San Joaquin itself carried practically no water at all. In other words, **it was demonstrated that the amount of fresh water which came into the San Joaquin and down as far as the Town of Antioch was practically all Sacramento River water.**” (pg. 15)
 - Water was delivered to the San Joaquin River from the Sacramento River via two main conduits: Georgiana Slough and Three Mile Slough. 1920 flow rates in these sloughs were the basis of the assertion quoted above.

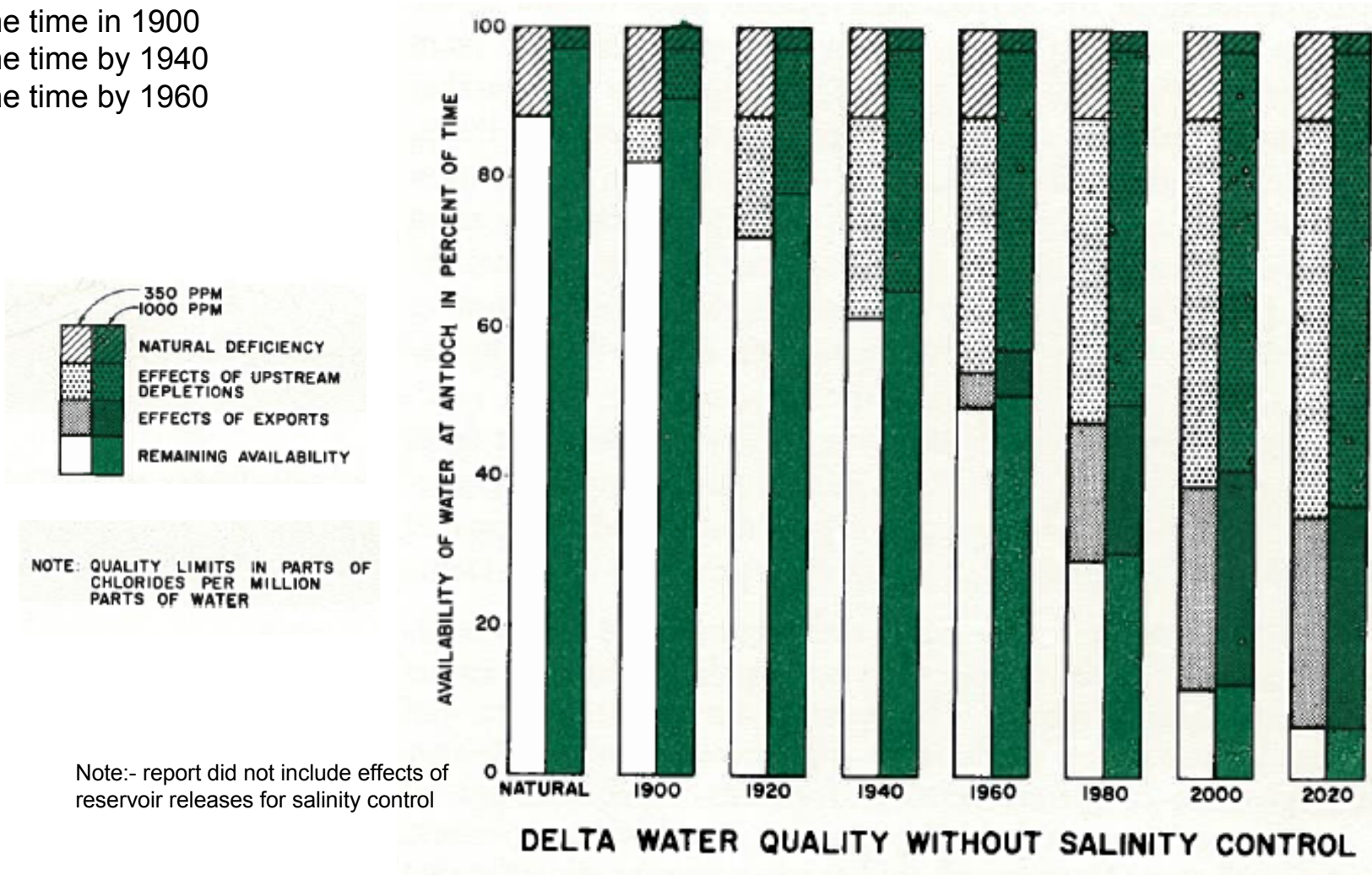
Testimony from Antioch Lawsuit: Water at Antioch is from Sacramento River

- “It is necessary here to state some additional facts to explain how this pollution comes about and why **diversions from the Sacramento River** may or **do affect the volume and quality of the water flowing down the San Joaquin River** . . . From the Sacramento River at two points, one about eight [Three Mile] and the other about twenty - three miles [Georgiana] above its mouth, sloughs diverge, into which parts of its waters escape and flow through the said sloughs and into the San Joaquin River at points several miles above the place of the diversion by the city of Antioch.” Town of Antioch v. Williams Irrigation District et al. (1922) 188 Cal. 451, 455

Freshwater Availability has Declined

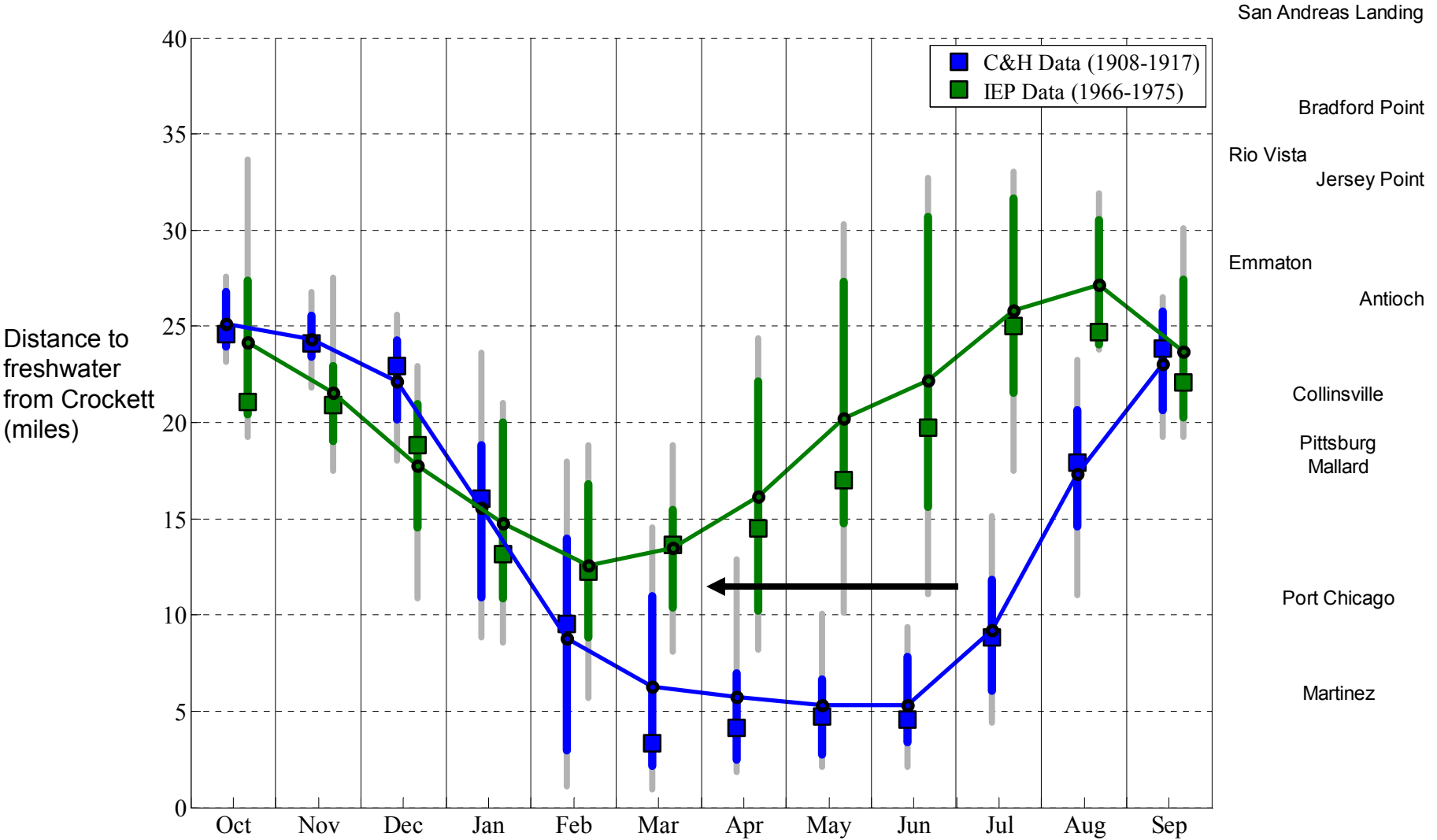
DWR (1960, pg. 13) found that freshwater was available at San Joaquin River at Antioch:

- 85% of the time under “natural” conditions
- 80% of the time in 1900
- 60% of the time by 1940
- 50% of the time by 1960



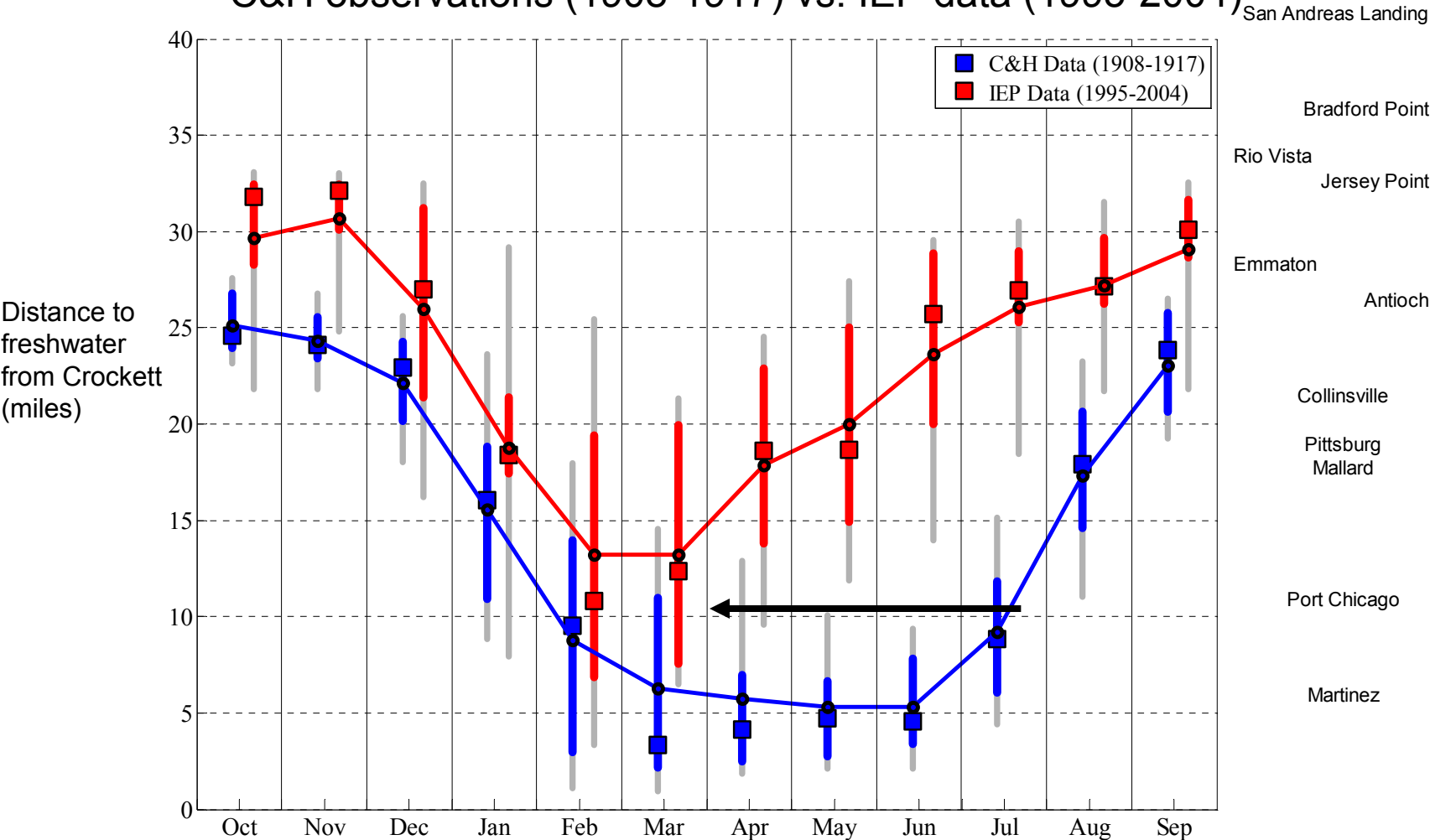
Salinity Intrusion Occurred Earlier by 1975

Distance to freshwater from Crockett (~25 miles west of Antioch)
C&H observations (1908-1917) vs. IEP data (1966-1975)



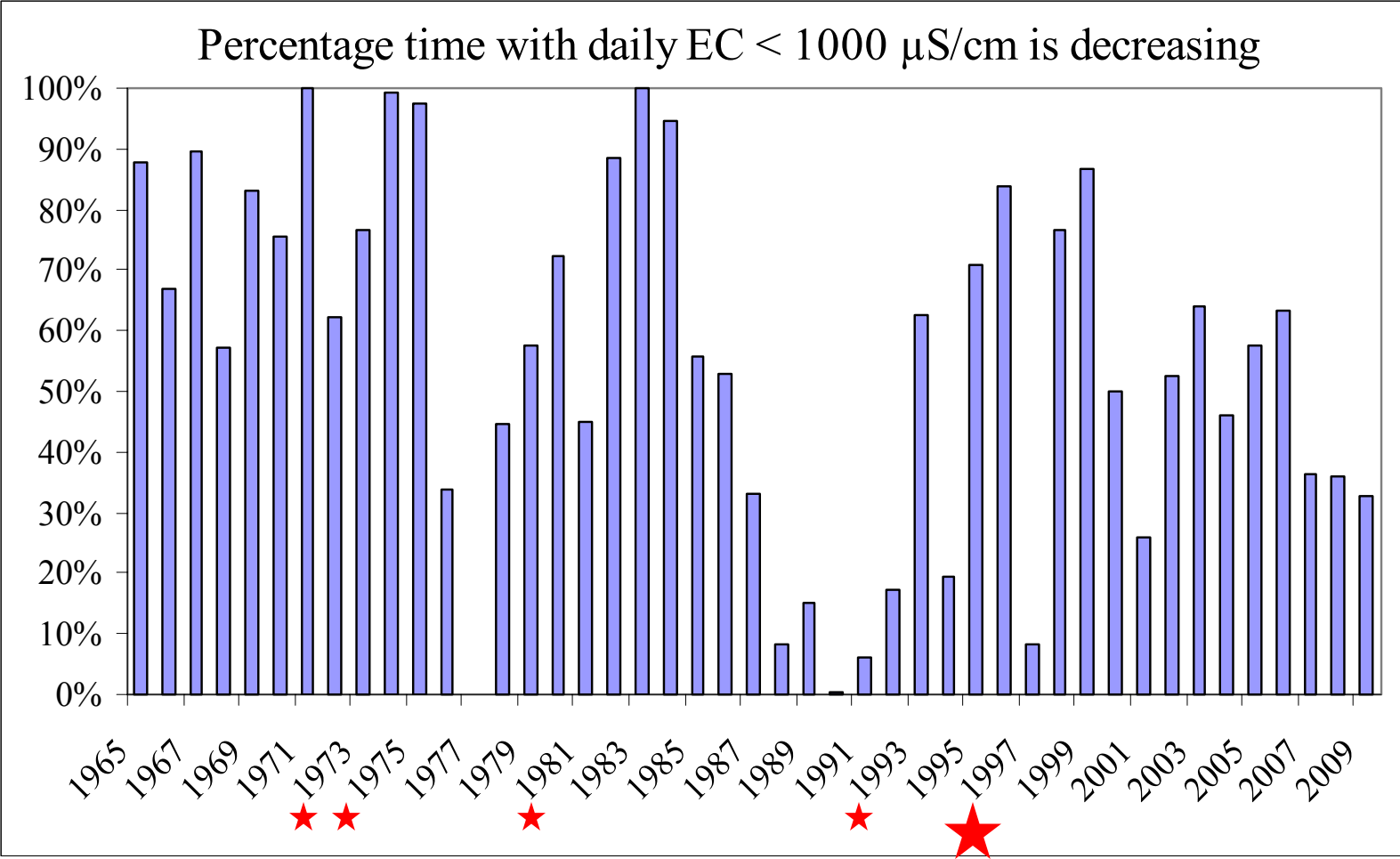
Salinity Intrusion Occurred Even Earlier and Extended Farther by 2004

Distance to freshwater from Crockett (~25 miles west of Antioch)
C&H observations (1908-1917) vs. IEP data (1995-2004)



Freshwater Availability at Antioch

Continues to Decline

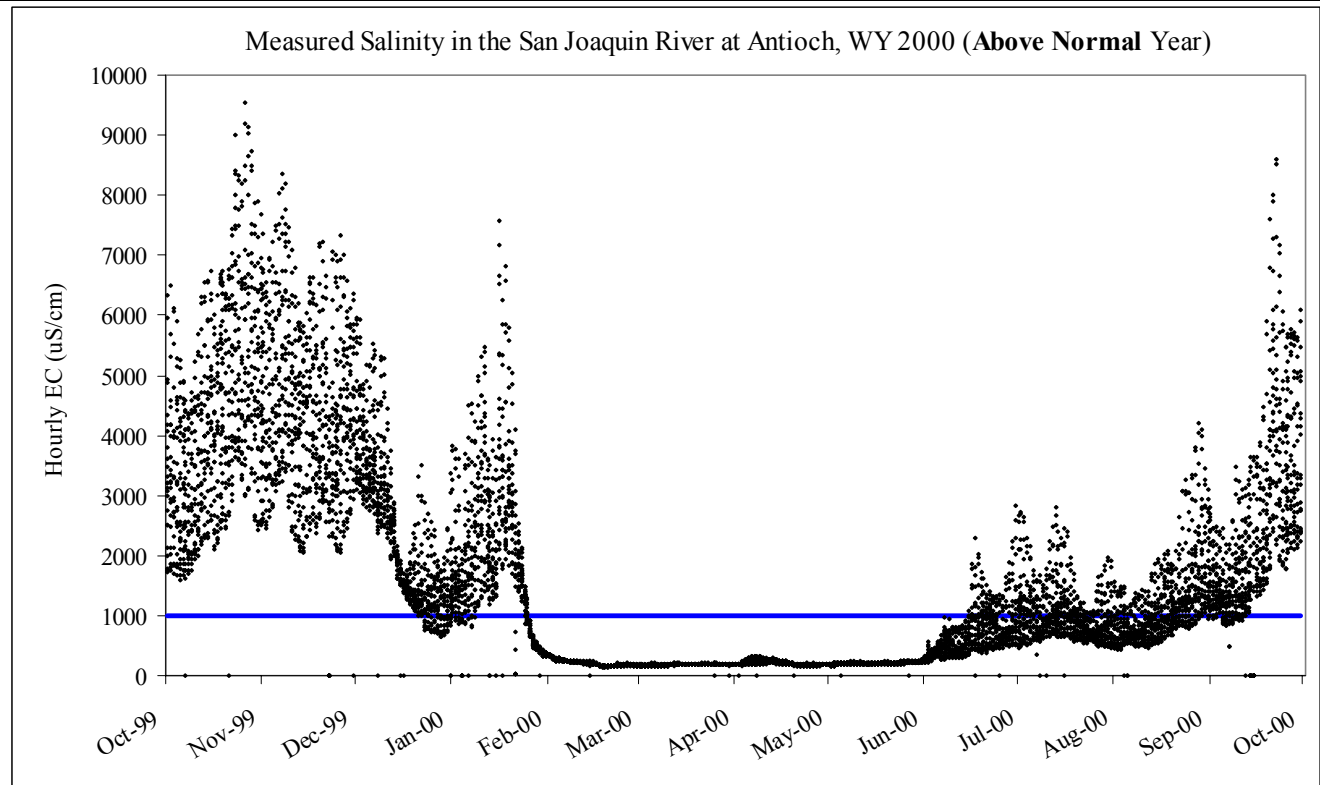


★ 10%-20% data missing

★ 80% data missing

Data from IEP & CDEC

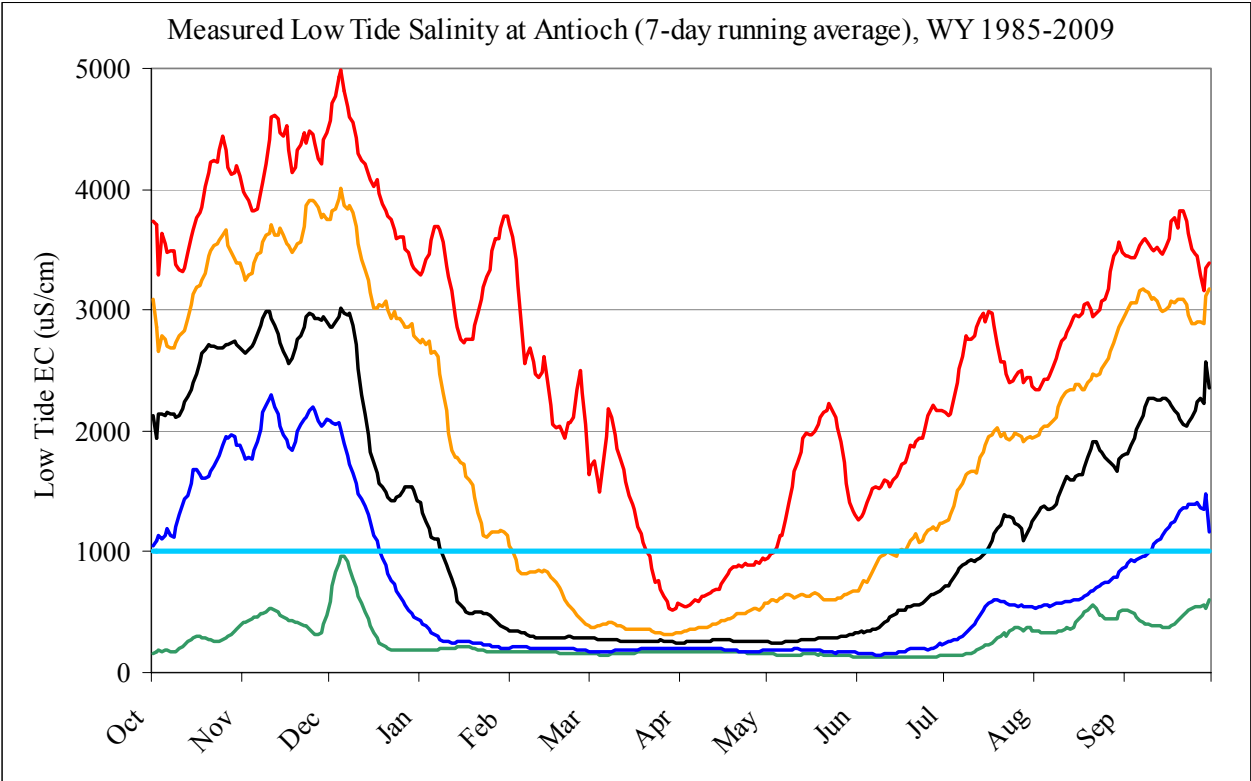
Even in Above Normal Years, Freshwater is Now Unavailable in Summer/Fall



Freshwater Criterion
< 1000 EC



Freshwater is Now Available at Antioch Far Less Often



Driest 10%
Driest 25%
Median
Wettest 25%
Wettest 10%

Pre-1918, freshwater was available year-round at low tide in all but driest years

Summary: The Western Delta was Historically Fresher

- Pre-1918, freshwater was almost always available at least at low tide.
- Between 1918 and the late 1930s, drought conditions, upstream water diversions, and channelization increased the salinity of water at Antioch.
- By 1940 the drought receded, but salinity at Antioch remained elevated.
- Salinity continues to increase in recent years at Antioch.
- The fraction of time that water at Antioch is suitable for use (when salinity is < 250 mg/L chlorides or 1000 $\mu\text{S}/\text{cm}$ EC) has declined significantly.
- “Historic” Delta was significantly fresher than the current Delta.

Conclusions

Consider historic fresh conditions to:

Establish Delta outflows and inflows to protect species adapted to these conditions.

Establish the criteria (volume, timing, quality) required by SB 7X 1.

Establish drinking water quality standards for the Delta.