EXHIBIT A

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JOHN F. HANSON, JR.
OF COUNSEL

April 2, 2002

Paul Murphey
Division of Water Rights
SWRCB
Sacramento, California

Re: Workshop on Professor Sax's Report
SWRCB No. 0-076-300-0
April 10, 2002

Dear Mr. Murphey:

Professor Sax's Report is a significant document. The SWRCB should pay particular attention to Chapters V and VI. The solutions Professor Sax proposes in these two Chapters are important to water issues in the state and are particularly important to California's economy over the next fifty years. Our comments on the Report are divided into the following categories:

A. Background
B. Responses to the Questions Posed by the Board
C. People v. Forni
D. Indefinite Nature of California Water Rights
E. Existing Statutory structure

Background

Over the last thirty years lawyers in our Office have been involved in a number of different water issues in the State of California:

1>Developed the arguments and positions at the SWRCB on behalf of private clients which ultimately became People v. Forni.

2>Represented major landowners throughout California and Nevada.

3>Represented major financial institutions with concerns about their investments in California because of the water issue.

4>Co-Authored an article entitled "Restructuring America's Water Systems" published by the Reason Foundation. Neal, Kathy, Patrick J. Maloney, Jonas A. Marson and Tamer E. Francis, Restructuring America's Water Industry: Comparing Investor-Owned and Government-Owned Water Systems, Jan. 1996 (Reason Foundation, Policy Study No. 200). Many people see this article as an argument for privatization of the water delivery system in America. Morgan, Steven P. and Jeffrey I. Chapman, Issues Surrounding the Privatization of Public Water Service, Sept. 1996 (ACWA). The word "privatization" does not appear in the article. The article has received extensive criticism from organizations like ACWA, but the Reason Foundation article suggests public policy makers should rethink how water is distributed and managed in America and California in particular. The article has been purchased and studied by most significant water interests in the world including but not limited to financial institutions, water purveyors, engineering firms, and think tanks.

5>Developed the Instadjudicator. This is an interactive database that instantly determines a landowner's water rights or water entitlement in the Salinas Valley. The interactive database uses public source inputs such as chains of title, the APN system, assessor map overlays, County and State publicly available databases, defined engineering terms, the results of computer runs from the Salinas Valley Integrated Ground and Surface Water Model and other non-proprietary information. The utility of such a tool is to (1) quickly develop "what if" scenarios, and (2) to identify anomalous or skewed inputs or uses, e.g., identify by inferring from multiple sources that water use in a section of the analyzed area is substantially higher than the surrounding areas viz. unreasonable. We are not suggesting that the Instadjudicator is the only solution to the State's water issues but what is needed is a similar tool for all over-drafted (and ultimately all) basins so there can be a critical analysis of a Basin's water issues and "what if" scenarios can be quickly understood.

Engineers involved in the Mojave case have reviewed the operation of the Instajudicator and suggested its use would hasten the resolution of the Mojave case. The Instadjudicator was offered to the SWRCB with appropriate technical assistance for its use but the offer was rejected. At a contested hearing the

SWRCB refused to force the Monterey County Water Resources Agency to release data by which the instant adjudication of the Salinas Valley could be accomplished. Hearing on Motion to Quash Subpoenas, 6/28/00, Application 30532. A staff member of the SWRCB has suggested there are two problems with the Instadjudicator: A) The name and B) that this office developed it.

6>The office is currently working on an analysis of the leadership in the Water and Sewer industry with prominent People of Color. The purpose of this analysis is to compare the existing leadership of the water industry against the demographic make-up of the State now and forty years from now. The preliminary results of this research indicate that the California's water industry is not reflective of the ethnic demographic make-up of the State now or forty years from now.

Responses to the Questions Posed by the Board

Professor Sax proposes quantifiable criteria by which the water user could determine whether or not it is pumping percolating groundwater. The first problem with the proposed criteria is that they will involve more engineers arguing arcane hydrologic issues. These arcane hydrological issues are irrelevant if there is an unreasonable use of water. More importantly the percolating groundwater and underground surface water classification will change depending on what crop is used and how much water is being pumped in a given basin. What these criteria do is add further confusion rather than bring more definability to water usage in California. From time to time or place to place making the fine distinctions advanced by Professor Sax may be necessary, but only as a component of an overall solution-oriented water management system, not as the starting point. Making the management of California water more complex is not in the State's interest.

People v. Forni

Over thirty years ago adjudication was proposed for the Napa Valley and our vineyard clients decided adjudication would not solve the water problems caused by Frost Protection in the Napa Valley. The clients and their representatives instead worked closely with the staff of the SWRCB led by Ken Woodward, the former Chief of the Division of Water Rights, and the SWRCB to develop the principles which ultimately became People v. Forni. These principles and facts were presented in a highly contested hearing before the SWRCB. The arguments and the facts presented by our clients were the basis for the See decision and from

the See decision the SWRCB developed the regulation challenged in People v. Forni. People ex rel. SWRCB v. Forni (1976) 54 Cal.App.3rd 743; See Decision 1404. Our clients presented these positions because they felt the only way a system for Frost Protection could be developed was if all water sources in the water basin were considered and managed. Under the far-sighted leadership of Chairman Adams and Members Robie and Auer the SWRCB used its Sections 100 and 275 powers and brought stability to the region's water problems and allowed the Napa Valley to prosper. The lesson the SWRCB can learn from Forni is that once it develops a carefully reasoned engineering position it should take an active role in solving a region's water problem before the problem becomes a crisis.

For the last five years another set of clients have advocated a similar solution, the application of Sections 100 and 275 powers to the Salinas Valley's salt water intrusion and nitrate problems and the SWRCB has repeatedly rejected our clients' pleas. The current Chief of the Division of Water Rights has opposed the use of Sections 100 and 275 powers by the SWRCB because "initiating an unreasonable use proceeding would be viewed by the local agency as a 'blind-side' attack, and would probably be considered a back-door adjudication by the agricultural community. Nevertheless, if other efforts fail, this type of action would be preferred over an adjudication because the SWRCB could address administratively rather that in a judicial proceeding in superior court." (Confidential) Memorandum from Harry Schueller on Salinas Valley, June 16, 2000, page 8. The SWRCB's inaction has put in jeopardy the water supply of a major city in California and will likely cost the taxpayers (State and/or local) tens or hundreds of millions of dollars that could have been avoided by forcing a certain limited segment of the agricultural community to use water reasonably in the first place. The SWRCB has the power to solve water problems in this State and most of the issues raised in Professor Sax's Report. It must use the power and not worry about offending local water agencies or limited segments of the agricultural community.

Indefinite Nature of California Water Rights

No one really knows who has water rights in California. All water licenses are subject to vested rights. What those vested rights are is anybody's guess. Probably the most interesting statement made in Professor Sax's Report is found in footnote 122 wherein he cites In re Waters of Long Valley for the proposition that there is no such thing as unexercised riparian water rights in California. Long Valley probably does not say that, but the point is there is no water right in

California if the actual or contemplated water use is unreasonable. The Sax Report is full of references to cases by various California courts over the last century, which apply the reasonableness test to solve a water problem. There are no absolute water rights. A water right disappears in California when the needs of the community demand it.

The most disturbing problem we have in California water issues is that the SWRCB cannot figure out what its position is on most issues and the underflow issue is just a manifestation of the problem. We have staff letters of the SWRCB and Licenses telling the public that certain water rights exist yet frequently in public hearings of all types we have representatives of the SWRCB or other agencies of the State denying the validity of SWRCB's earlier positions. The SWRCB looks like a fool. To the outside world the State of California looks like a fool. In earlier times California could do whatever it pleased. Now, however, we have few major banks or financial institutions left in California and in order to maintain financing for our homes, agriculture and industries we must bring some order and discipline to the State's water system. We have to have more definability in our water system. We cannot reject definability merely because it upsets the sensitivities of certain water agencies or members of the agricultural community. The magic of People v. Forni and other things done in the Napa Valley to define water rights and optimize the region's water resources brought confidence to the investing and lending institutions and helped spur the development of California's wine industry.

Existing Statutory Structure and Actions of the SWRCB

Professor Sax's Report fails to recognize how much the Legislature and the SWRCB has actually done to solve the State's water problem. We direct the SWRCB's attention to Water Code Sections 5100 et seq. and 1010 et seq. and the forms prepared by the SWRCB. STATEMENT (1-00) and ST-SUPPL (2-01). No one knows exactly how to fill out the forms because of the SWRCB's inability to define underflow and consumptive use but at least there is a form. SWRCB has expanded the Section 5100 form dramatically in recent years without legislative approval. The forms should be expanded administratively to require water users to report all types of water sources and use. If the SWRCB does this administratively, there will be no need for the legislative action feared by Professor Sax. Once the forms are filed the data should be put into the existing publicly accessible SWRCB databases defined by USGS basin lines. Then Computer tools

should be developed for each water basin such as an "integrated groundwater and surface water model" throughout the State by which anyone could easily ascertain a reasonable use of water for a given basin.

Such a system would encourage conservation and the orderly transfer of water. Either the SWRCB or somebody else could then stop anybody who is unreasonably using water pursuant to Water Code Sections 100 and 275. Anybody who is using less than a reasonable amount water could transfer water to somebody who has a need for the conserved water. Then the State's water argument will be over reasonable use of water in any given basin not over the application of unclear laws to disputed hydrological facts.

Ultimately if the expanded Section 5100 form is not filled out and filed by a water user, the Legislature could develop legislation establishing a presumption the water user forfeits whatever water rights it has unless the water user can demonstrate good cause for not filing the form. Notwithstanding much of the uncertainty about the present filing system, this office has been active in filing reports for its various clients, relying on various public sources to explain and detail positions where the SWRCB has not provided clarity. This office understands the system to be akin to recording ownership of real property. In other words, if a water user declines to follow the statute and does not file, its claim will be entitled to less weight than any competing claim of a water user who followed procedures and filed reports – similar to that of a property owner who takes title but does not record it. Water users also file Statements with the expectation that this State database will be used by EIR preparers to catalogue and analyze water rights for a given project. Save Our Peninsula Committee v. Monterey County Board of Supervisors (2001) 87 Cal.App.4th 99, 122; Petition for Extension of Time for Permit 5882 (Application 10216) (1999).

California's computer industry deals with much more complex than the State's water issues. The SWRCB should rely on this industry for solutions. The SWRCB's existing data system on water rights should be modified to make all pumping data publicly available and a system of inquiry developed so the public can ascertain a reasonable water use standard for each basin.

Conclusion

The Sax Report offers important statutory history. The SWRCB should carefully consider the Report's generalized recommendations and develop an action plan to pursue the goal of a more defined system of water rights. This will ultimately lead to an overall solution-oriented water management system.

Very truly yours,

Patrick J. Maloney

EXHIBIT B

US007805380B1

(12) **United States Patent**
Hornbeck et al.

(10) **Patent No.: US 7,805,380 B1**
(45) **Date of Patent: Sep. 28, 2010**

(54) **SYSTEMS AND METHODS FOR OPTIMIZED WATER ALLOCATION**

(75) Inventors: **David Hornbeck**, Northridge, CA (US); **Dennis J. Coady**, Oceanside, CA (US); **Patrick J. Maloney**, Alameda, CA (US)

(73) Assignee: **Patrick J. Maloney, Jr.**, Alameda, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 274 days.

(21) Appl. No.: **11/761,896**

(22) Filed: **Jun. 12, 2007**

Related U.S. Application Data

(60) Provisional application No. 60/815,157, filed on Jun. 19, 2006.

(51) **Int. Cl.**
G06Q 50/00 (2006.01)

(52) **U.S. Cl.** **705/315**

(58) **Field of Classification Search** 705/315
See application file for complete search history.

(56) **References Cited**

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Tagami, Ty, "City Flushes Out Old Debtors Untapped Fortune? Atlanta Records Show About $50 Million in Uncollected Water and Sewer Bills," The Atlanta Journal-Constitution, Atlanta, GA, Jan. 5, 2004, p. D.1.*

Business Wire, "QI Systems Inc. Sees Promising Sales Growth in Water Delivery Control Business," New York, Sep. 15, 2005, p. 1.*

Lais, Sami, "Water Trading Site Makes Its Debut; Suggested: Observers Sayexchange Could Create New Water Rights Battle (Company Business and Marketing)," Computerworld, Feb. 14, 2000, p. 16(1).*

Tom Kuhnle, "The Federal Income Tax Implications of Water Transfers," Stanford Law Review (47 Stan. L. Rev. 533), Feb. 1995, 31 pages.

"Assessment of Water Companies and Water Rights," Assessors' Handbook Section 542, California State Board of Equalization, Dec. 2000, 164 pages.

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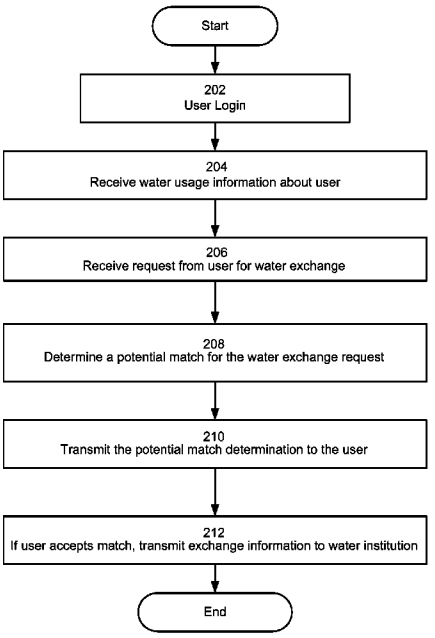
Primary Examiner—John W Hayes
Assistant Examiner—Nathan Erb
(74) *Attorney, Agent, or Firm*—Patent Law Works LLP

(57) **ABSTRACT**

The present invention relates to systems and methods for optimizing water allocation. In particular, the present invention relates to systems and methods for establishing and querying a database of information for projecting and optimizing water distribution within a county, city or state and providing useful output as a result of such queries. The system and method also provide for exchange of water rights and the output of data in a useful form, such as a map, graph, list, summary or chart. The system and method also provide for water planning based on consideration of various parameters.

24 Claims, 19 Drawing Sheets



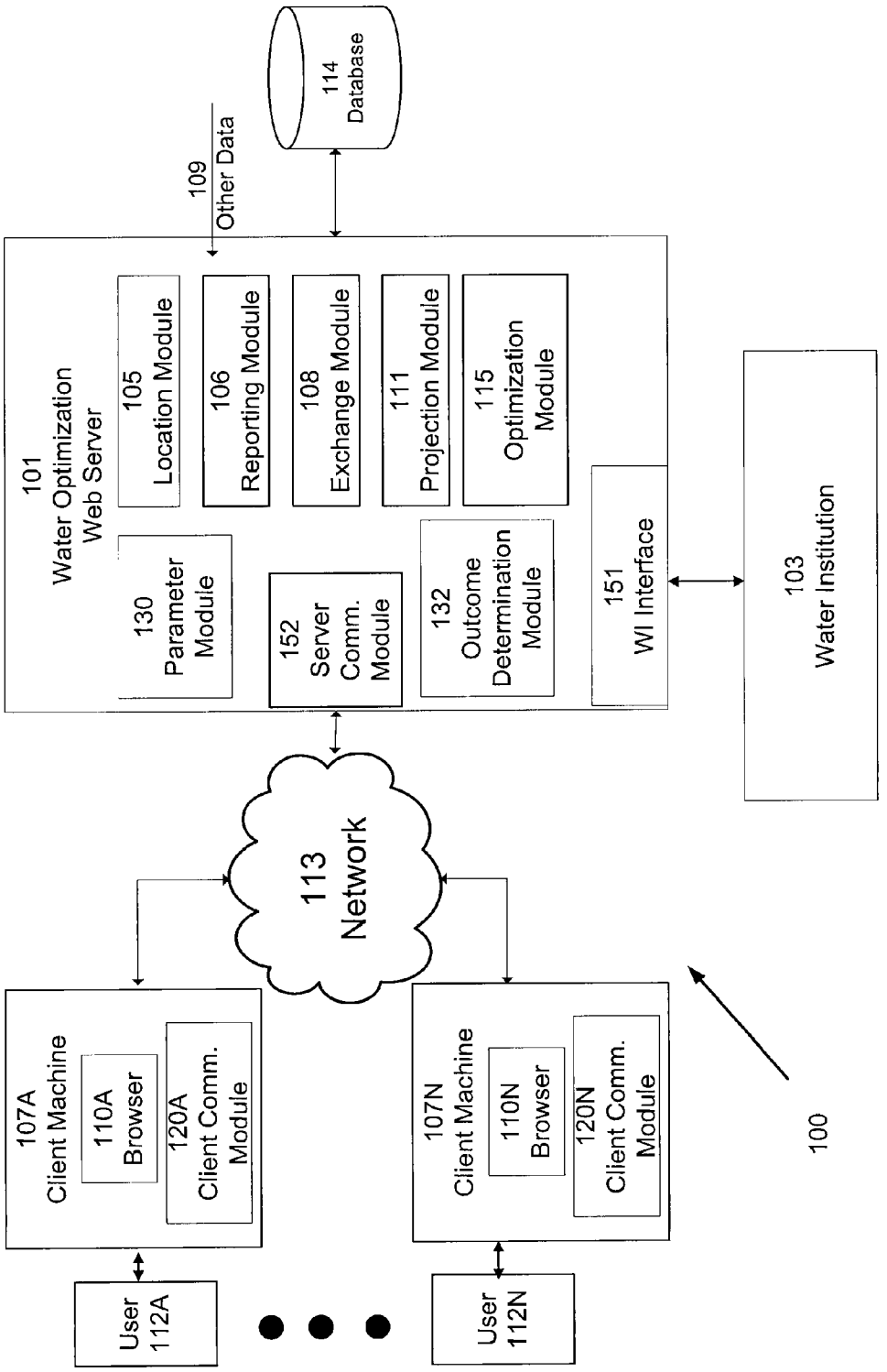

114 Database
109 Other Data
101 Water Optimization Web Server
105 Location Module
106 Reporting Module
108 Exchange Module
111 Projection Module
115 Optimization Module
130 Parameter Module
152 Server Comm. Module
132 Outcome Determination Module
151 WI Interface
103 Water Institution
113 Network
107A Client Machine
110A Browser
120A Client Comm. Module
107N Client Machine
110N Browser
120N Client Comm. Module
User 112A
User 112N
100

Fig. 1

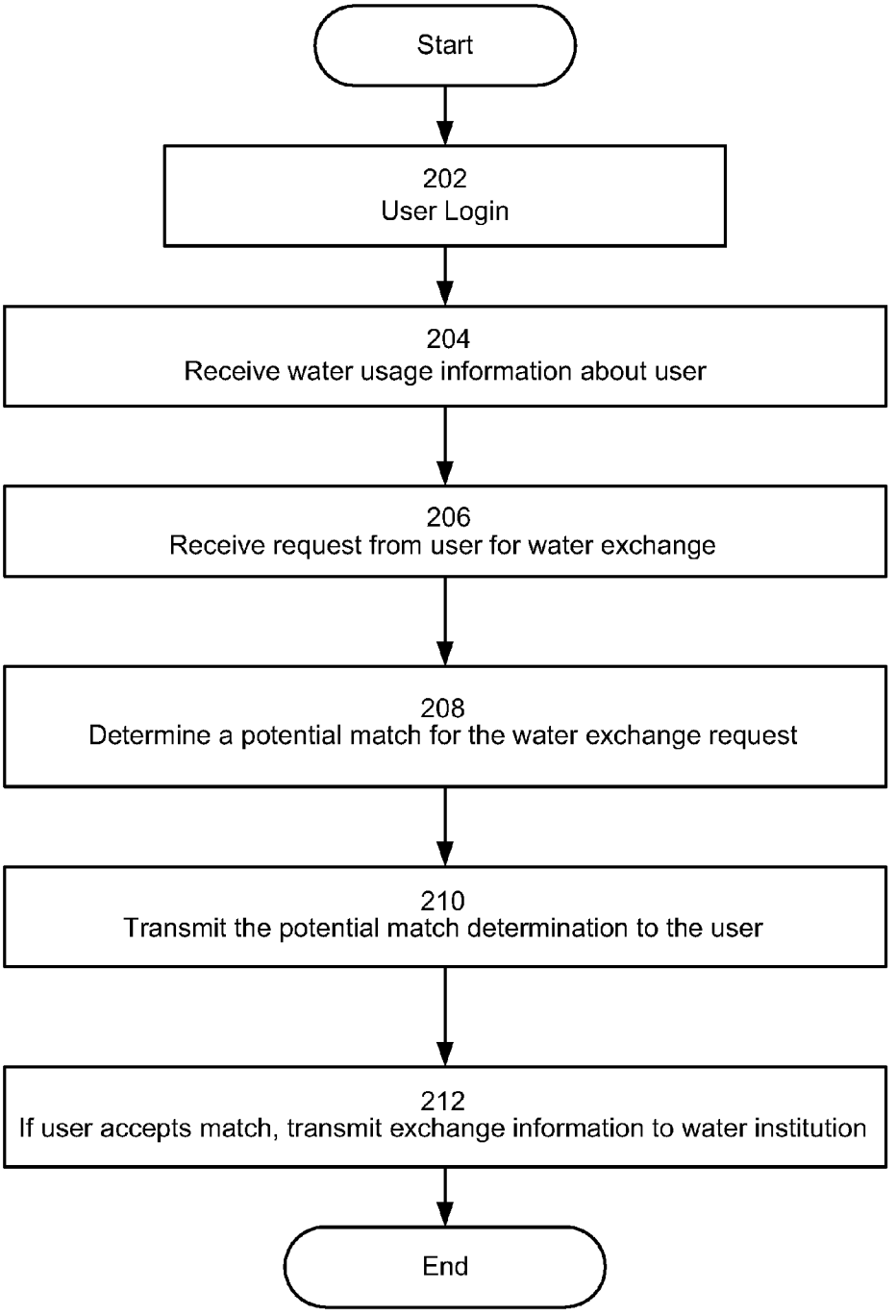

Start
202
User Login
204
Receive water usage information about user
206
Receive request from user for water exchange
208
Determine a potential match for the water exchange request
210
Transmit the potential match determination to the user
212
If user accepts match, transmit exchange information to water institution
End

Fig. 2

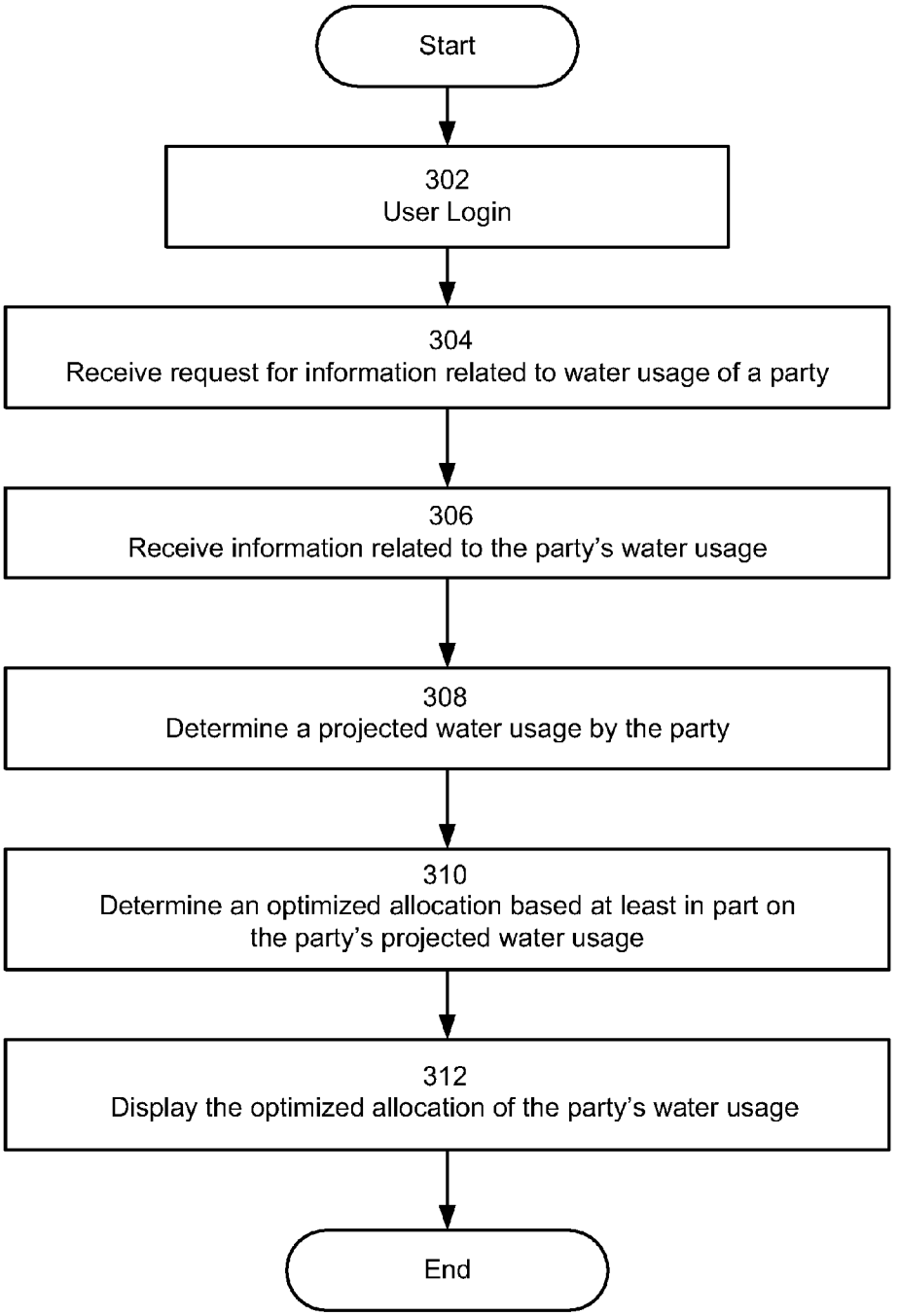

Start
302
User Login
304
Receive request for information related to water usage of a party
306
Receive information related to the party's water usage
308
Determine a projected water usage by the party
310
Determine an optimized allocation based at least in part on the party's projected water usage
312
Display the optimized allocation of the party's water usage
End

Fig. 3

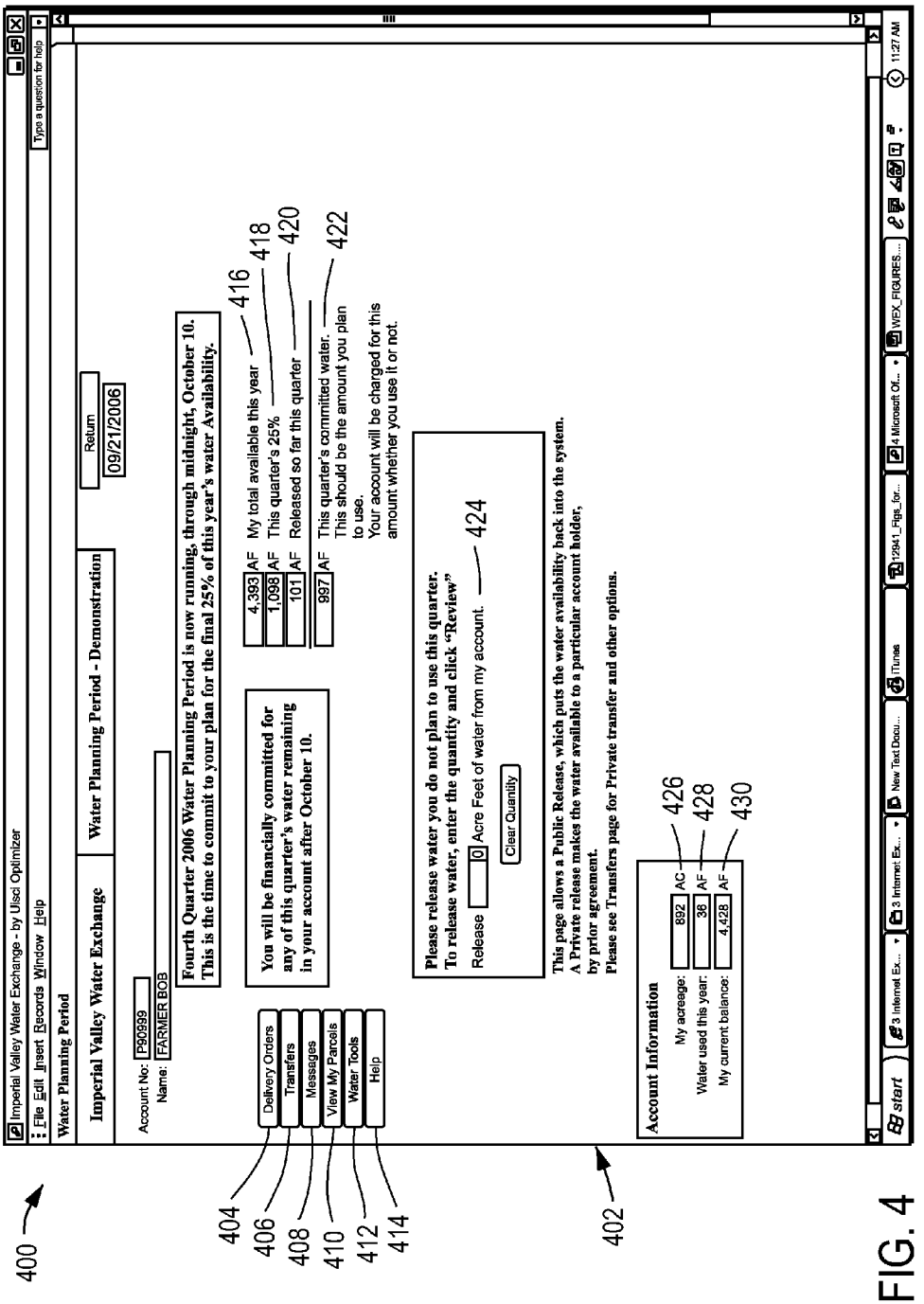

400
Imperial Valley Water Exchange - by Uisci Optimizer
File Edit Insert Records Window Help
Type a question for help
Water Planning Period
Imperial Valley Water Exchange
Water Planning Period - Demonstration
Return
09/21/2006
Account No: P80999
Name: FARMER BOB
Fourth Quarter 2006 Water Planning Period is now running, through midnight, October 10.
This is the time to commit to your plan for the final 25% of this year's water Availability.
You will be financially committed for any of this quarter's water remaining in your account after October 10.
4,393 AF My total available this year
1,098 AF This quarter's 25%
101 AF Released so far this quarter
997 AF This quarter's committed water.
This should be the amount you plan to use.
Your account will be charged for this amount whether you use it or not.
Please release water you do not plan to use this quarter.
To release water, enter the quantity and click "Review"
Release 0 Acre Feet of water from my account.
Clear Quantity
This page allows a Public Release, which puts the water availability back into the system.
A Private release makes the water available to a particular account holder, by prior agreement.
Please see Transfers page for Private transfer and other options.
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
Account Information
My acreage: 892 AC
Water used this year: 36 AF
My current balance: 4,428 AF
404
406
408
410
412
414
416
418
420
422
424
426
428
430
402
start
3 Internet Ex...
3 Internet Ex...
New Text Docu...
iTunes
12941_Figs_for...
4 Microsoft Of...
MEX_FIGURES...
11:27 AM

FIG. 4

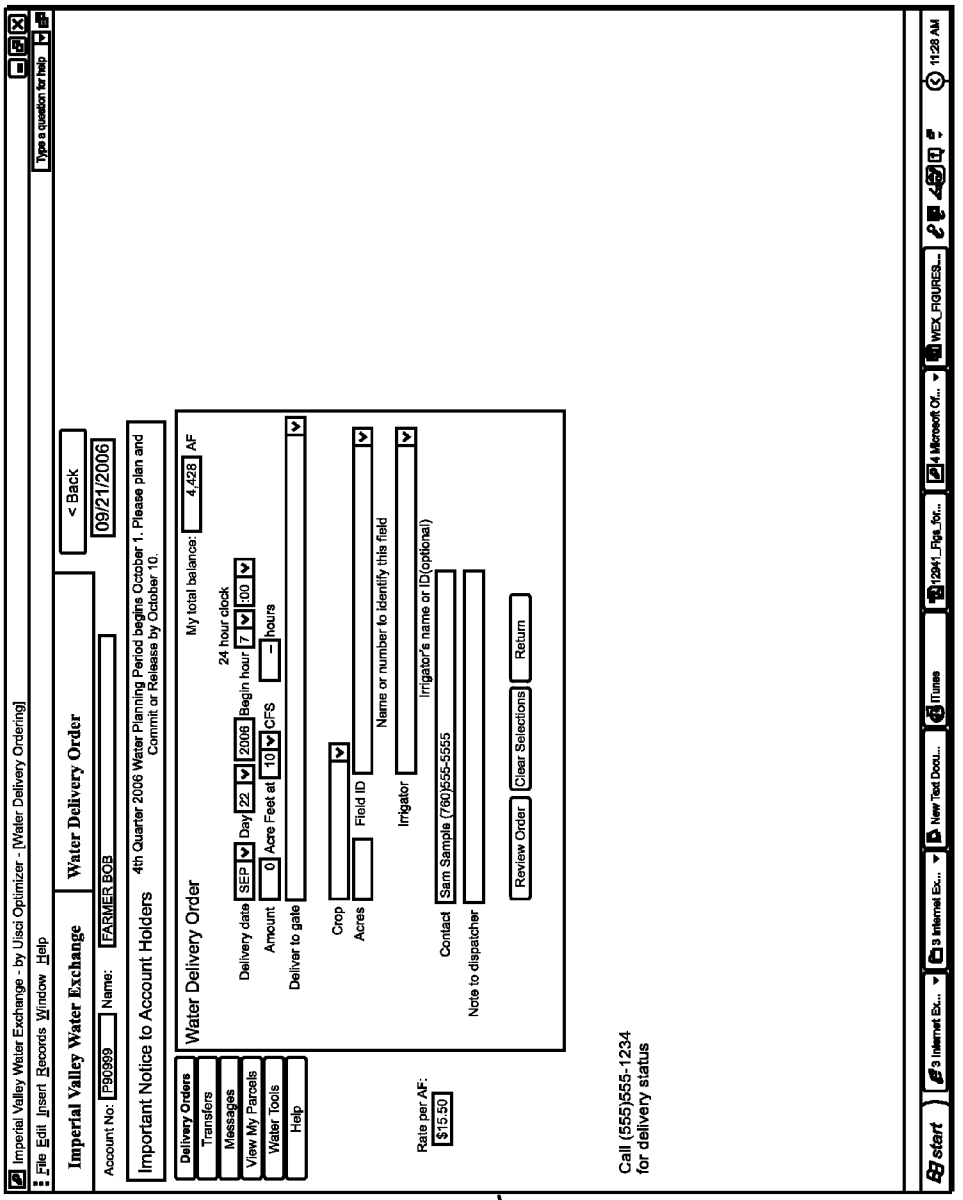

500
502
Imperial Valley Water Exchange - by Usci Optimizer - [Water Delivery Ordering]
File Edit Insert Records Window Help
Type a question for help
Imperial Valley Water Exchange
Water Delivery Order
< Back
Account No: P90999 Name: FARMER BOB
09/21/2006
Important Notice to Account Holders
4th Quarter 2006 Water Planning Period begins October 1. Please plan and Commit or Release by October 10.
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
Water Delivery Order
My total balance: 4,428 AF
24 hour clock
Delivery date SEP Day 22 2006 Begin hour 7 :00
Amount 0 Acre Feet at 10 CFS - hours
Deliver to gate
Crop
Acres
Field ID
Name or number to identify this field
Irrigator
Irrigator's name or ID(optional)
Contact Sam Sample (760)555-5555
Note to dispatcher
Review Order
Clear Selections
Return
Rate per AF: $15.50
Call (555)555-1234 for delivery status
start
3 Internet Ex...
New Text Docu...
iTunes
12941_Fga_for...
4 Microsoft Of...
WEX_FIGURES...
11:28 AM

FIG. 5

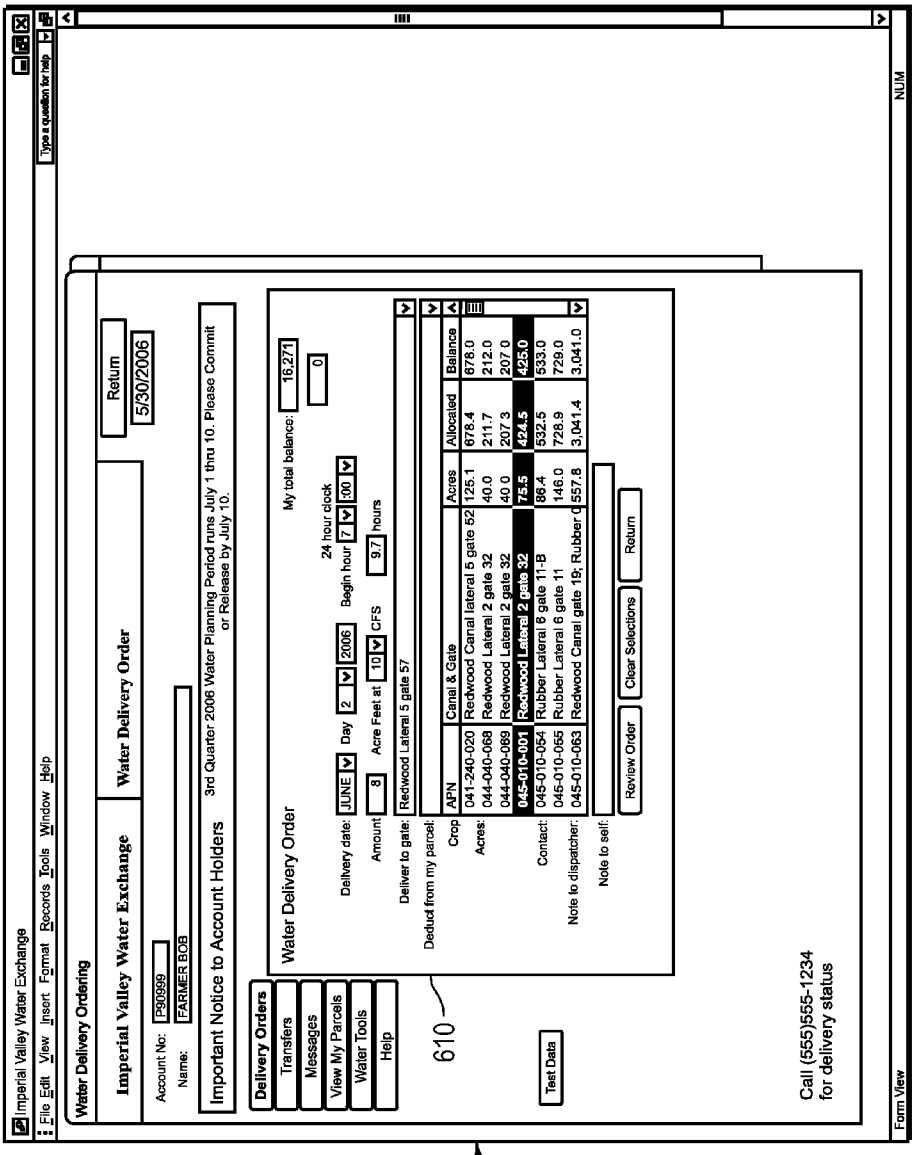

600
602
610
Imperial Valley Water Exchange
File Edit View Insert Format Records Tools Window Help
Water Delivery Ordering
Imperial Valley Water Exchange
Water Delivery Order
Return
5/30/2006
Account No: P00999
Name: FARMER BOB
Important Notice to Account Holders
3rd Quarter 2006 Water Planning Period runs July 1 thru 10. Please Commit or Release by July 10.
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
Test Data
Water Delivery Order
My total balance: 16,271
0
24 hour clock
Delivery date: JUNE Day 2 2006 Begin hour 7 :00
Amount 8 Acre Feet at 10 CFS 9.7 hours
Deliver to gate: Redwood Lateral 5 gate 57
Deduct from my parcel:
Crop
Acres:
Contact:
Note to dispatcher:
Note to self:
APN
041-240-020
044-040-068
044-040-069
045-010-001
045-010-054
045-010-055
045-010-063
Canal & Gate
Redwood Canal lateral 5 gate 52
Redwood Lateral 2 gate 32
Redwood Lateral 2 gate 32
Redwood Lateral 2 gate 32
Rubber Lateral 8 gate 11-B
Rubber Lateral 6 gate 11
Redwood Canal gate 19; Rubber
Acres
125.1
40.0
40.0
75.5
88.4
146.0
557.8
Allocated
678.4
211.7
207.3
424.5
532.5
728.9
3,041.4
Balance
678.0
212.0
207.0
425.0
533.0
729.0
3,041.0
Review Order
Clear Selections
Return
Call (555)555-1234
for delivery status
Form View
NUM

FIG. 6

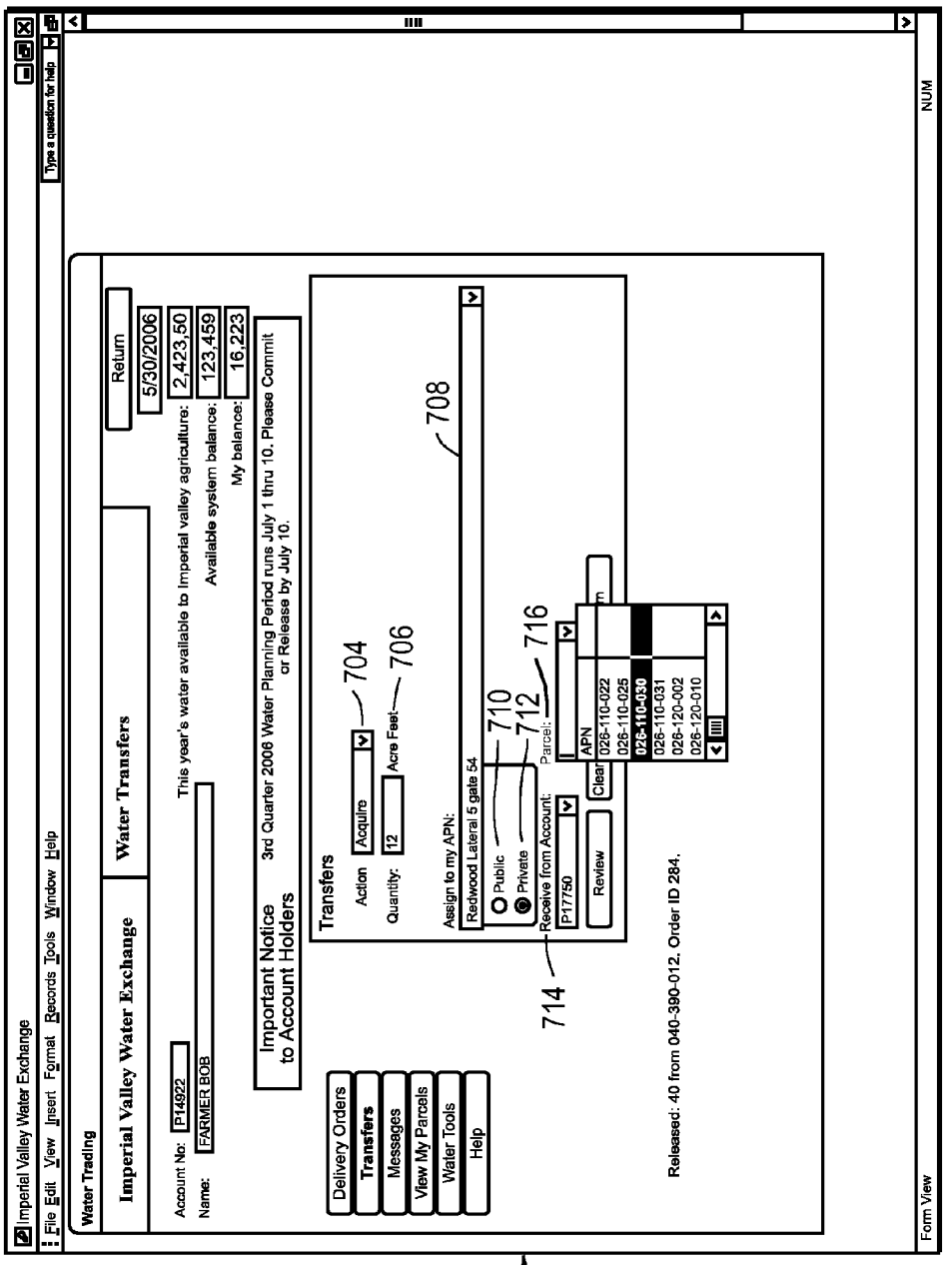

700
702
Imperial Valley Water Exchange
File Edit View Insert Format Records Tools Window Help
Type a question for help
Water Trading
Imperial Valley Water Exchange
Water Transfers
Return
Account No: P14922
Name: FARMER BOB
This year's water available to Imperial valley agriculture: 5/30/2006
2,423.50
Available system balance: 123,459
My balance: 16,223
Important Notice to Account Holders
3rd Quarter 2006 Water Planning Period runs July 1 thru 10. Please Commit or Release by July 10.
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
Transfers
Action
Acquire
704
Quantity:
12
Acre Feet
706
708
Assign to my APN:
Redwood Lateral 5 gate 54
Public
Private
710
712
716
Receive from Account:
P17750
Review
Clear
APN
026-110-022
026-110-025
026-110-030
026-110-031
026-120-002
026-120-010
714
Released: 40 from 040-390-012. Order ID 284.
Form View
NUM

FIG. 7

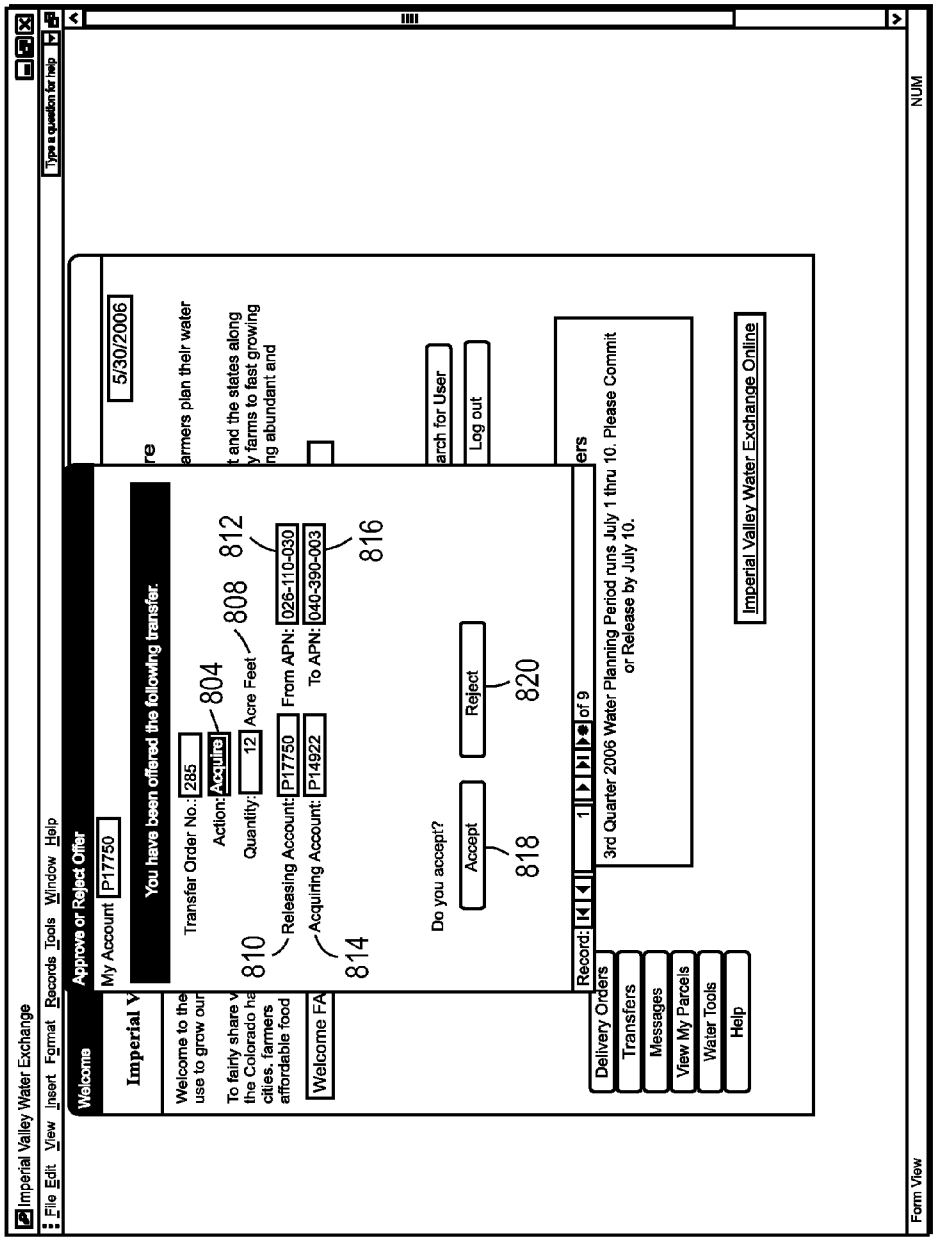

800
Imperial Valley Water Exchange
File Edit View Insert Format Records Tools Window Help
Welcome
Approve or Reject Offer
My Account P17750
You have been offered the following transfer.
Transfer Order No.: 285
Action: Acquire
Quantity: 12 Acre Feet
Releasing Account: P17750
Acquiring Account: P14922
From APN: 026-110-030
To APN: 040-390-003
804
808
812
816
810
814
Do you accept?
Accept
Reject
818
820
5/30/2006
Log out
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
3rd Quarter 2006 Water Planning Period runs July 1 thru 10. Please Commit or Release by July 10.
Imperial Valley Water Exchange Online
Form View
NUM

FIG. 8

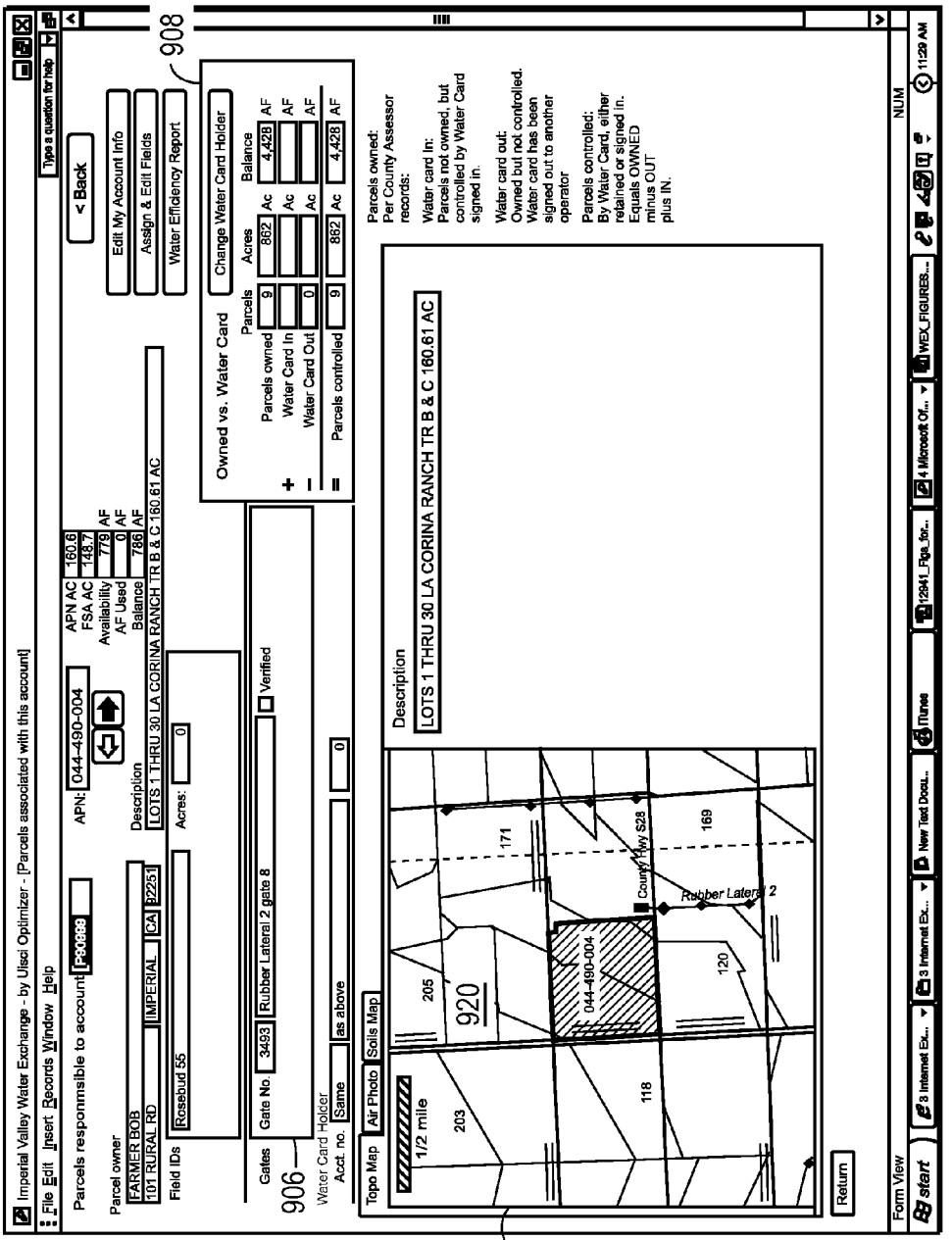

900
904
906
908
Imperial Valley Water Exchange - by Ulsci Optimizer - [Parcels associated with this account]
File Edit Insert Records Window Help
Type a question for help
Parcels responsible to account
APN: 044-490-004
APN AC 160.6
FSA AC 148.7
Availability 779 AF
AF Used 0 AF
Balance 786 AF
< Back
Edit My Account Info
Assign & Edit Fields
Water Efficiency Report
Parcel owner
FARMER BOB
101 RURAL RD
IMPERIAL
CA
92251
Description
LOTS 1 THRU 30 LA CORINA RANCH TR B & C 160.61 AC
Field IDs
Rosebud 55
Acres: 0
Owned vs. Water Card Holder
Change Water Card Holder
Parcels
Acres
Balance
Parcels owned 9 862 Ac 4,428 AF
+ Water Card In 0 Ac AF
- Water Card Out 0 Ac AF
= Parcels controlled 9 862 Ac 4,428 AF
Gates
Gate No 3493 Rubber Lateral 2 gate 8
Verified
Water Card Holder
Acct. no. Same as above 0
Topo Map
Air Photo
Soils Map
Description
LOTS 1 THRU 30 LA CORINA RANCH TR B & C 160.61 AC
Parcels owned:
Per County Assessor records:
Water card in:
Parcels not owned, but controlled by Water Card signed in.
Water card out:
Owned but not controlled. Water card has been signed out to another operator
Parcels controlled:
By Water Card, either retained or signed in.
Equals OWNED
minus OUT
plus IN.
1/2 mile
920
044-490-004
County Hwy S28
Rubber Lateral 2
Return
Form View
NUM
start
11:29 AM

FIG. 9

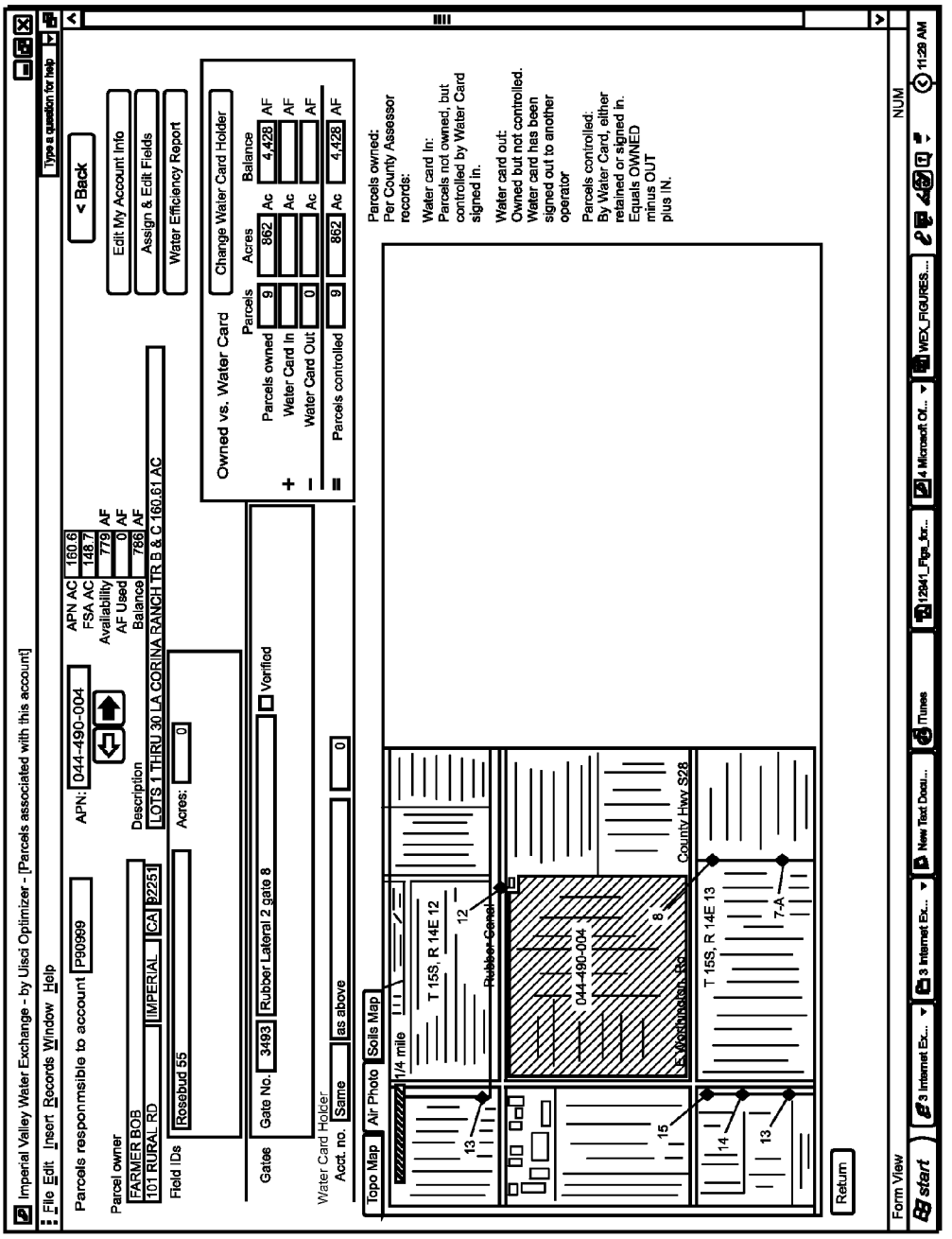
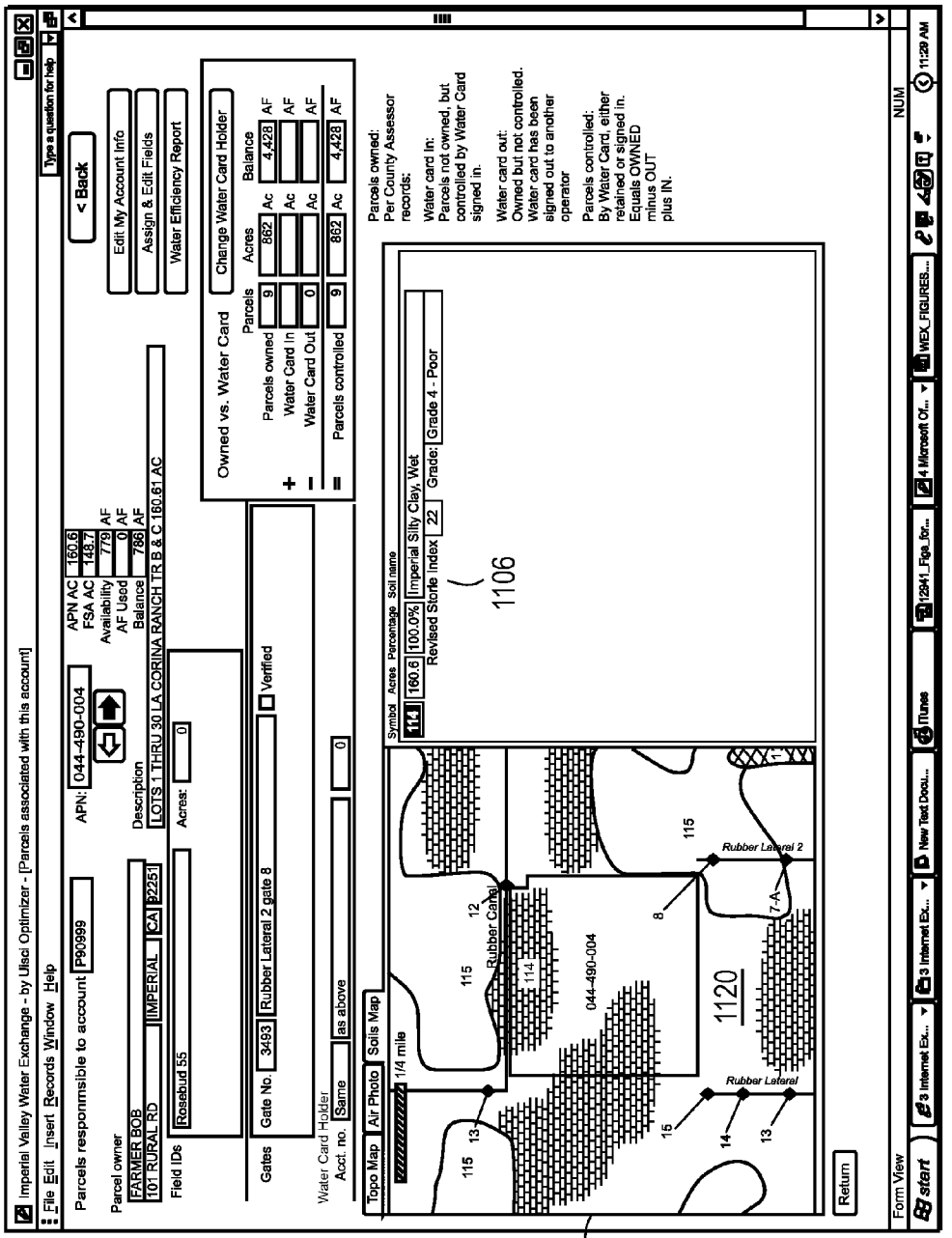

Imperial Valley Water Exchange - by Uisci Optimizer - [Parcels associated with this account]
File Edit Insert Records Window Help
Type a question for help
Parcels responsible to account P90999
APN: 044-490-004
< Back
Parcel owner
FARMER BOB
101 RURAL RD
IMPERIAL CA 92251
Description
LOTS 1 THRU 30 LA CORINA RANCH TR B & C 160.61 AC
APN AC 160.6
FSA AC 148.7
Availability 779 AF
AF Used 0 AF
Balance 786 AF
Edit My Account Info
Assign & Edit Fields
Water Efficiency Report
Field IDs
Rosebud 55
Acres: 0
Owned vs. Water Card
Change Water Card Holder
Parcels
Acres
Balance
Parcels owned 9 862 Ac 4,428 AF
+ Water Card In 0 Ac AF
– Water Card Out 0 Ac AF
= Parcels controlled 9 862 Ac 4,428 AF
Gates
Gate No. 3493 Rubber Lateral 2 gate 8
Verified
Water Card Holder
Acct. no. Same as above 0
Topo Map
Air Photo
Soils Map
1/4 mile
Parcels owned:
Per County Assessor records:
Water card In:
Parcels not owned, but controlled by Water Card signed in.
Water card out:
Owned but not controlled. Water card has been signed out to another operator
Parcels controlled:
By Water Card, either retained or signed in.
Equals OWNED
minus OUT
plus IN.
T 15S, R 14E 12
T 15S, R 14E 13
044-490-004
Rubber Canal
County Hwy S28
Return
Form View
NUM
start
3 Internet Ex...
New Text Docu...
iTunes
1294 1_Fig_for...
4 Microsoft Of...
WEX_FIGURES...
11:29 AM

FIG. 10


Imperial Valley Water Exchange - by Uisci Optimizer - [Parcels associated with this account]
File Edit Insert Records Window Help
Parcels responsible to account P90999
APN: 044-490-004
APN AC 160.6
FSA AC 148.7
Availability 779 AF
AF Used 0 AF
Balance 786 AF
< Back
Edit My Account Info
Assign & Edit Fields
Water Efficiency Report
Parcel owner
FARMER BOB
101 RURAL RD IMPERIAL CA 92251
Description
LOTS 1 THRU 30 LA CORINA RANCH TR B & C 160.61 AC
Field IDs
Rosebud 55
Acres: 0
Owned vs. Water Card
Change Water Card Holder
Parcels
Acres
Balance
Parcels owned 9 862 Ac 4,428 AF
+ Water Card In Ac AF
- Water Card Out 0 Ac AF
= Parcels controlled 9 862 Ac 4,428 AF
Gates
Gate No. 3493 Rubber Lateral 2 gate 8
Verified
Water Card Holder
Acct. no. Same as above 0
Topo Map
Air Photo
Soils Map
1/4 mile
Symbol Acres Percentage Soil name
114 160.6 100.0% Imperial Silty Clay, Wet
Revised Storie Index 22 Grade: Grade 4 - Poor
1106
Parcels owned:
Per County Assessor records:
Water card in:
Parcels not owned, but controlled by Water Card signed in.
Water card out:
Owned but not controlled. Water card has been signed out to another operator
Parcels controlled:
By Water Card, either retained or signed in.
Equals OWNED
minus OUT
plus IN.
Rubber Canal
Rubber Lateral 2
Rubber Lateral
044-490-004
1120
Return
Form View
NUM
start
11:29 AM

1104

FIG. 11

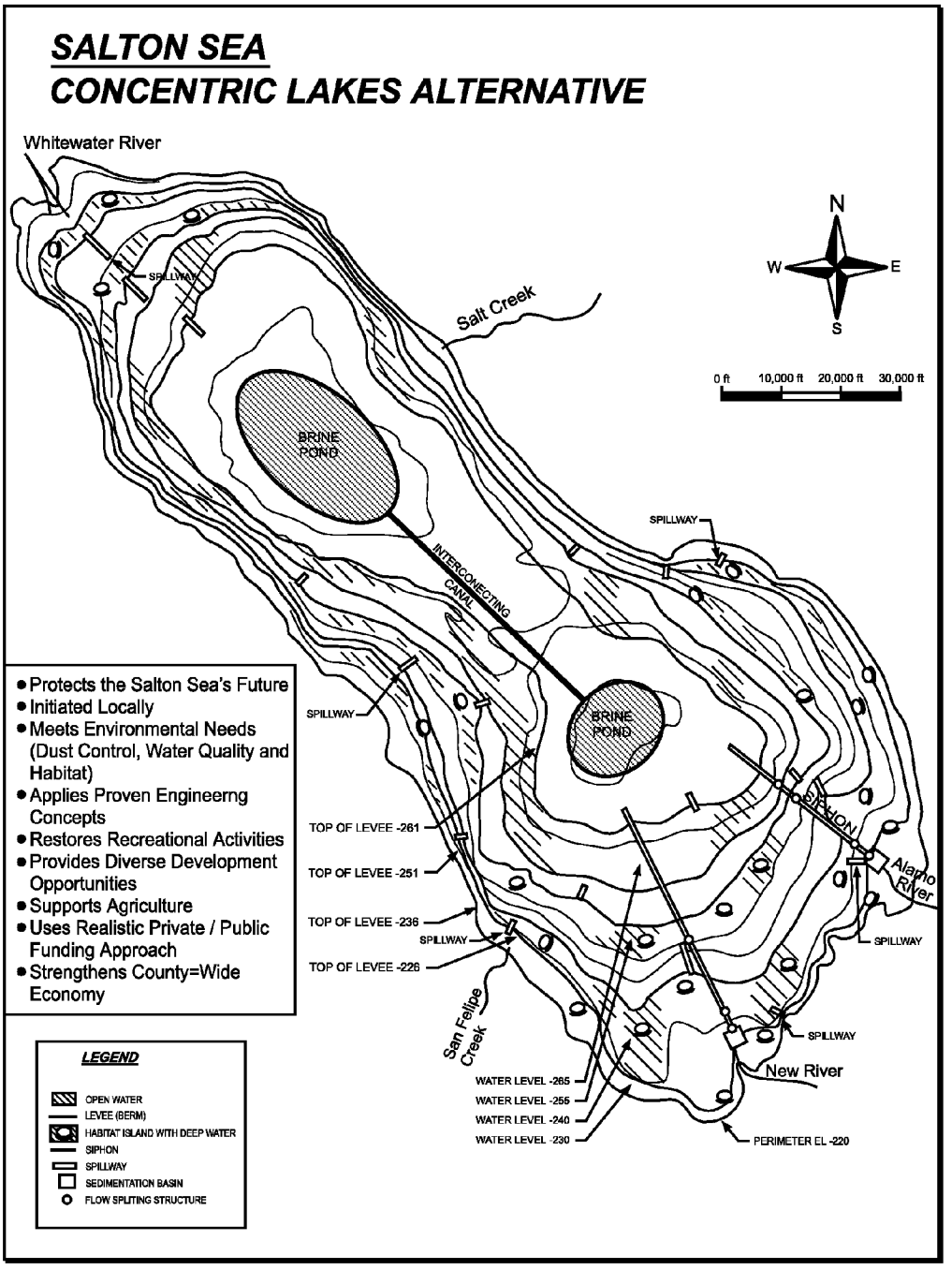

SALTON SEA
CONCENTRIC LAKES ALTERNATIVE
Whitewater River
SPILLWAY
Salt Creek
N
W
E
S
0 ft
10,000 ft
20,000 ft
30,000 ft
BRINE POND
INTERCONNECTING CANAL
SPILLWAY
BRINE POND
SPILLWAY
SIPHON
Alamo River
TOP OF LEVEE -261
TOP OF LEVEE -251
TOP OF LEVEE -236
SPILLWAY
TOP OF LEVEE -226
SPILLWAY
San Felipe Creek
SPILLWAY
New River
WATER LEVEL -265
WATER LEVEL -255
WATER LEVEL -240
WATER LEVEL -230
PERIMETER EL -220
• Protects the Salton Sea's Future
• Initiated Locally
• Meets Environmental Needs (Dust Control, Water Quality and Habitat)
• Applies Proven Engineerng Concepts
• Restores Recreational Activities
• Provides Diverse Development Opportunities
• Supports Agriculture
• Uses Realistic Private / Public Funding Approach
• Strengthens County=Wide Economy
LEGEND
OPEN WATER
LEVEE (BERM)
HABITAT ISLAND WITH DEEP WATER
SIPHON
SPILLWAY
SEDIMENTATION BASIN
FLOW SPLITING STRUCTURE

FIG. 12

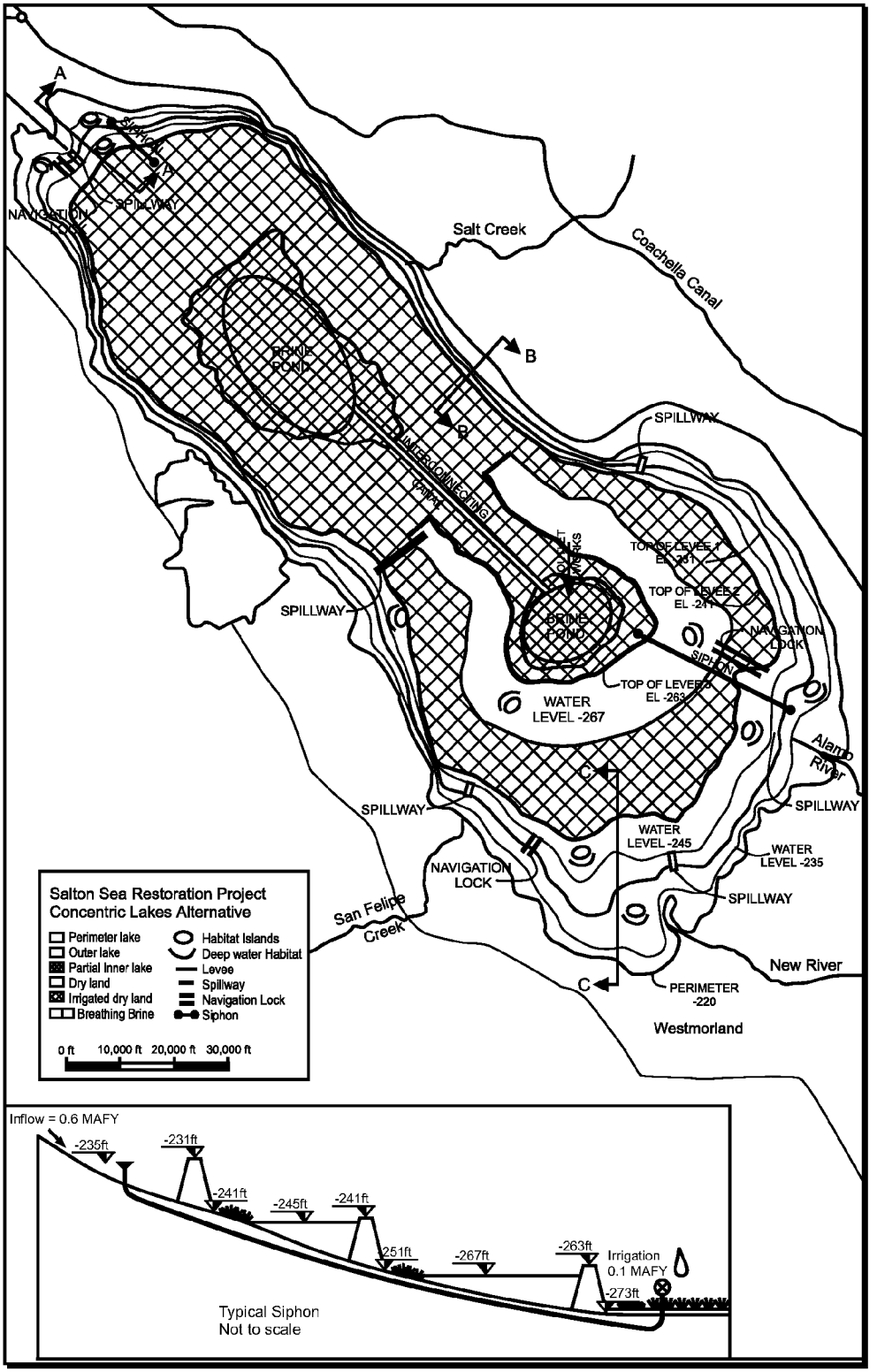

A
A
SPILLWAY
NAVIGATION LOCK
Salt Creek
Coachella Canal
B
B
BRINE POND
INTERCONNECTING CANAL
SPILLWAY
TOP OF LEVEE A EL -231
TOP OF LEVEE B EL -241
SPILLWAY
BRINE POND
NAVIGATION LOCK
SIPHON
TOP OF LEVEE C EL -263
WATER LEVEL -267
C
Alamo River
SPILLWAY
SPILLWAY
WATER LEVEL -245
WATER LEVEL -235
NAVIGATION LOCK
SPILLWAY
San Felipe Creek
New River
C
PERIMETER -220
Westmorland
Salton Sea Restoration Project
Concentric Lakes Alternative
Perimeter lake
Outer lake
Partial Inner lake
Dry land
Irrigated dry land
Breathing Brine
Habitat Islands
Deep water Habitat
Levee
Spillway
Navigation Lock
Siphon
0 ft 10,000 ft 20,000 ft 30,000 ft
Inflow = 0.6 MAFY
-235ft
-231ft
-241ft
-245ft
-241ft
-251ft
-267ft
-263ft
Irrigation 0.1 MAFY
-273ft
Typical Siphon
Not to scale

FIG. 13

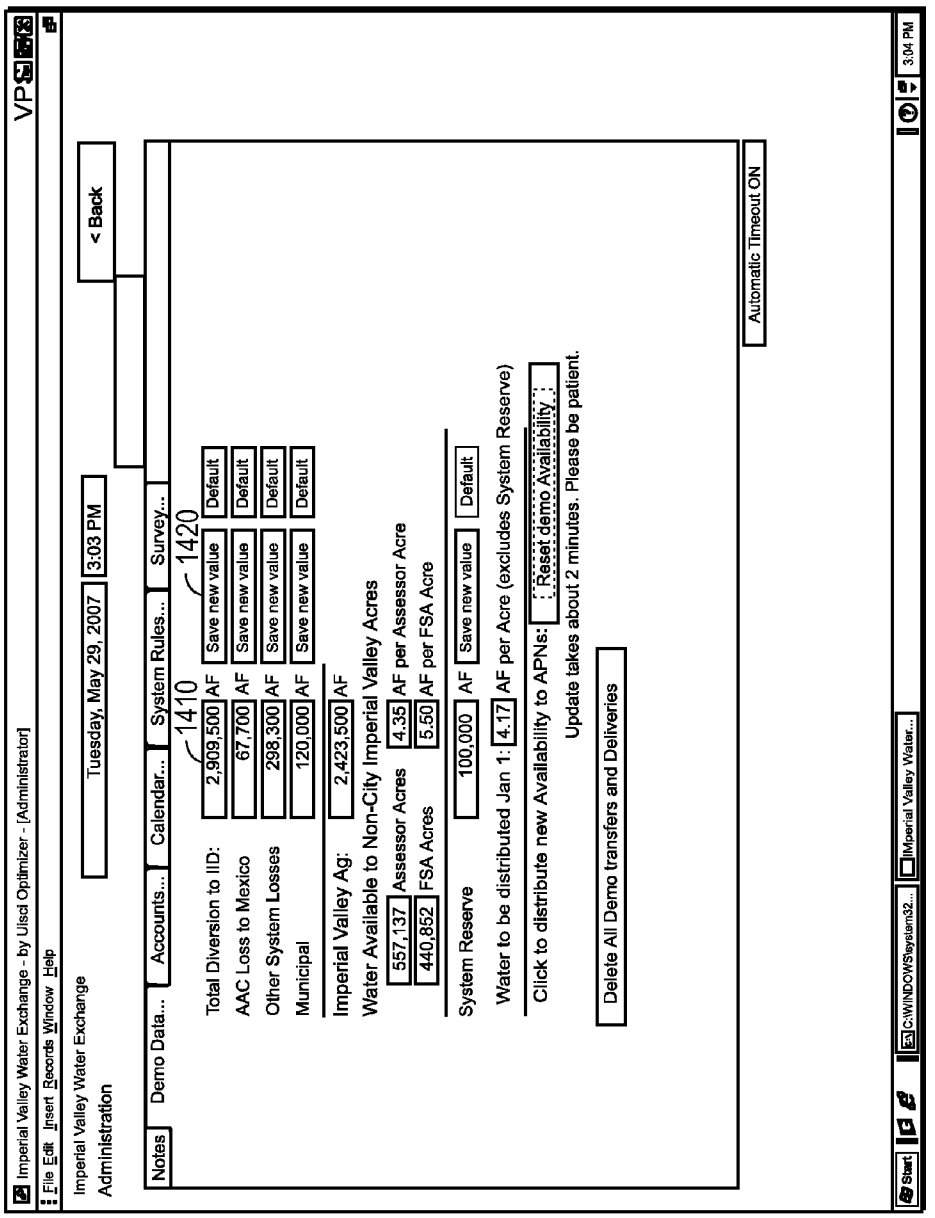

1400
Imperial Valley Water Exchange - by Ulsa Optimizer - [Administrator]
File Edit Insert Records Window Help
Imperial Valley Water Exchange
Administration
Tuesday, May 29, 2007
3:03 PM
< Back
Notes
Demo Data...
Accounts...
Calendar...
System Rules...
Survey...
1410
1420
Total Diversion to IID:
2,909,500 AF
Save new value
Default
AAC Loss to Mexico
67,700 AF
Save new value
Default
Other System Losses
298,300 AF
Save new value
Default
Municipal
120,000 AF
Save new value
Default
Imperial Valley Ag:
2,423,500 AF
Water Available to Non-City Imperial Valley Acres
557,137 Assessor Acres
4.35 AF per Assessor Acre
440,862 FSA Acres
5.60 AF per FSA Acre
System Reserve
100,000 AF
Save new value
Default
Water to be distributed Jan 1: 4.17 AF per Acre (excludes System Reserve)
Click to distribute new Availability to APNs:
Reset demo Availability
Update takes about 2 minutes. Please be patient.
Delete All Demo transfers and Deliveries
Automatic Timeout ON
Start
C:\WINDOWS\system32...
Imperial Valley Water...
3:04 PM

FIG. 14

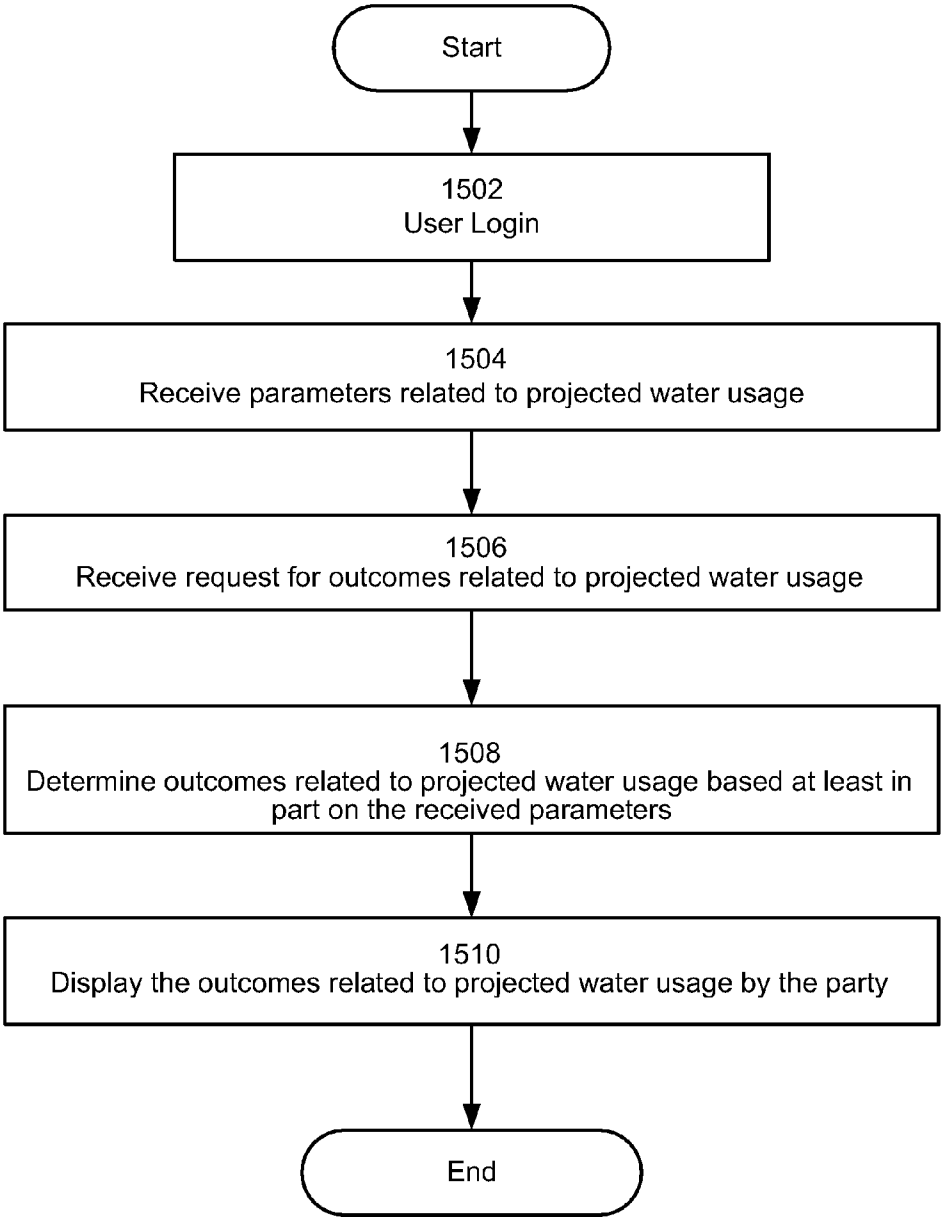

Start
1502
User Login
1504
Receive parameters related to projected water usage
1506
Receive request for outcomes related to projected water usage
1508
Determine outcomes related to projected water usage based at least in part on the received parameters
1510
Display the outcomes related to projected water usage by the party
End

Fig. 15

State of California
State Water Resources Control Board
DIVISION OF WATER RIGHTS
1001 I Street, 14th Floor, Sacramento, CA 95812

P.O. Box 2000, Sacramento, CA 95812-2000
Info: (916) 341-5300, FAX: (916) 341-5400, Web: http://www.waterrights.ca.gov

STATEMENT OF WATER DIVERSION AND USE

(This is not a water right)

This Statement should be typewritten or legibly written in ink and submitted to the address above.
A separate statement should be filed for each point of diversion. A duplicate copy will be returned to your file.

A. Name of person diverting water SAMPLE LAND OWNER NAME
Address SAMPLE ADDRESS
Telephone: (510) 521-4575

B. Water is used under: Riparian claim: ☐ Pre 1914 right: ☐ Other (explain) (see footnote 1)

C. Name of the body of water at the point of diversion
Colorado River (All American Canal)

Tributary to

D. Point of diversion is located within Imperial County on Assessors Parcel # 019-070-015

being within the SE 1/4 of SW 1/4 of Section 24, of Township 12 S, Range 11 E, San Bern. BM.
Name of works Imperial Irrigation District (see footnote 2)

E. Do you own the land at the point of diversion? Yes ☐ NO ☑ The name and address of the owner of the land is:
Land is being held in trust by Imperial Irrigation District (footnote 3)

F. Capacity of diversion works unknown Capacity of storage tanks or reservoir 0 AF

Type of diversion facility: Gravity ☑ Pump ☐

Method of measurement: Weir ☐ Flume ☐ Electric Meter ☐ Estimate ☑ (see footnote 4)

G. Enter the amount (or approximate amount) of water used each month.
Amounts below are shown in: Acre-feet

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Annual
2000 - 2002	23.2	27.8	40.4	49.8	52.4	48.0	53.3	48.3	41.6	37.8	28.6	22.4	473.7

H. Annual water use in recent years: Maximum 474 Acre Feet Minimum 0 AF
Year of first use (nearly as known) 1900 (estimated) (see footnote 5)

I. Purpose of use: What is the water being used for: (example, number of acres and type of crop irrigated, average number of persons served, number of stock watered, etc.) (see footnote 6)

J. General description or location of place of use (example: 40 acres of pasture located 3 miles from Happyville on Alpha Road)
Current water use on 160 acres, about 3/4 mile northwest of Barth Rd and State Hwy 78. See attached map

K. Map: Please locate the point of diversion and place of use on a print of a USGS quad map, or make a sketch on the section grid provided on the reverse side of this form. The sketch should identify the section lines, prominent local landmarks and roads, your point of diversion, and your place of use (your house, acreage irrigated, etc.). (see footnote 7)

L. Please answer only those questions below which are applicable to your project.

Additional copies of this form and water right information can be obtained at www.waterrights.ca.gov.

STATEMENT (12-03) P17614 019-070-015 A

FIG. 16A

1. Conservation of water
   a. Describe any water conservation efforts you may have started: **see footnote 8**

2. Water quality and wastewater reclamation
   a. Are you now or have you been using reclaimed water from a wastewater treatment facility, desalination facility or water polluted by waste to a degree which unreasonably affects such water for other beneficial uses? YES ☐ NO ☑.

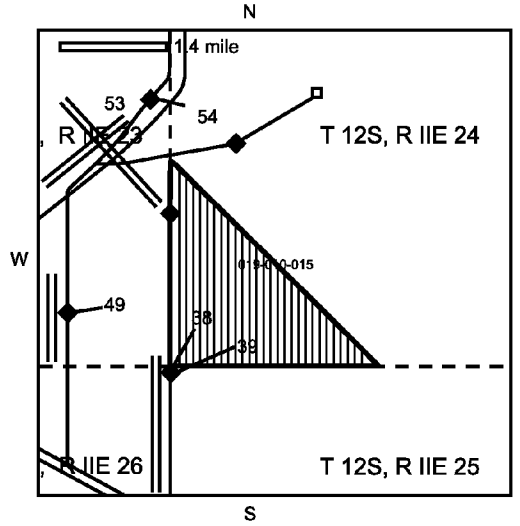
I declare under penalty of perjury that the information in this report is true to the best of my knowledge and belief.

DATE: _____ at _____, California

SIGNATURE: _____

PRINTED NAME: _____
(first name) (middle init.) (last name)

COMPANY NAME: _____



The location of the diversion point and the place of use may be sketched on the section grid provided. If it is used, please enter the section(s), township, range and the base meridian below. Also, show any streams or other landmarks that will assist in identifing the area.

Section(s) **24**

Township **12 S**

Range **11 E**

San Bern. BM

General area of use is within Imperial County and historic San Diego County

GENERAL INFORMATION PERTAINING TO WATER RIGHTS IN CALIFORNIA

There are two principal types of surface water rights in California. They are riparian and appropriative rights.

A riparian right enables an owner of land bordering a natural lake or stream to take and use water on his riparian land. Riparian land must be in the same watershed as the water source and must never have been severed form the source of supply by an intervening parcel without reservation of the riparian right to the severed parcel. Generally, a riparian water user must share the water supply with other riparian users. Riparian rights may be used to divert the natural flow of a stream but may not be used to 1) store water for later use 2) divert water which orginates in a different watershed 3) divert water released from storage, or 4) divert return flows from groundwater use.

An appropriative right is required for use of water on nonriparian land and for storage of water. Generally, appropriative rights may be exercised only when there is a surplus not needed by riparian water users. Since 1914 new appropriators have been required to obtain a permit and license form the State.

Statements of Water Diversion and Use must be filed by a riparian and pre-1914 appropriative water users. The filling of a statement (1) provides a record of water use, (2) enables the State to notify such users if someone proposes a new appropriation upstream from their diversion, and (3) assists the State to determine if additional water is available for future appropriators.

The above discussion is provided for general information. For more specific information concerning water rights, please contact an attorney or write to this office. We have several pamphlets available. They include: (1) Statements of Water Diversion and Use, (2) Information Pertaining to Water Right in California and (3) Appropriation of Water in California.

STATEMENT (12-03)

P17614 019-070-015 A

FIG. 16B

STATEMENT OF WATER DIVERSION AND USE FOOTNOTES

Footnote 1 - CLAIM OF RIGHT:
Claimant(s) relies on predecessor's pre-1914 claims as set forth in the decrees, decisions, and record submitted in Arizona v. California, including the chains of title, admissions of the Imperial Irrigation District, testimony and exhibits therein.

The Seven-Party Agreement -

Claimant(s) relies on the record, admissions, and holdings in Bryant v. Yellen (1980) 447 US 352.

Claimant(s) relies on California law as applicable to irrigation districts, i.e., the Wright Act, as currently codified in the Water Code, including, but not limited to sections 22250 et seq., 22437 and the authority interpreting said statutory and customary law.

Claimant(s) relies on the public policy of the State of California with respect to conservation and optimization of water resources, including but not limited to Water Code section 1011.

Claimant(s) rely on WRO 2002-0013.

With respect to water used or related to power development, claimant(s) rely on Nev-Cal Electric Securities v. IID (1936) 85 F.2d 886, cert denied.

Footnote 2 - POINT(S) OF DIVERSION:
Colorado River at Imperial Dam, Sec 9 Township 15 S Range 24 E SBM as per Permit 7643 point, and the Whitsett Intake at Lake Havasu as a point of diversion. Whitsett Intake is located at N0319200, E3160300 by California Coordinates in Zone 5 and is within Section 28, Township 03 N, Range 27 E, SBB&M.

Footnote 3 - Diversion Points: The primary diversion system is operated by IID for the benefit of landowners pursuant to a Trust established by the landowners. There is re-diversion from IID's system to the landowners system. The diversion point to the Landowner's system is set forth on the attached map.

Footnote 4: This information is under control of IID and we are attempting to obtain said information.

Footnote 5: This is a compilation of the highest uses of water on a monthly basis between 2000-2002. It includes the 100,000-acre feet of water annually diverted to MWD. This calculation is less than the 3.85 MAF annual water to which the landowners are entitled on IID's behalf, i.e., the Seven Party Agreement. The exact entitlement for each parcel will be determined after further information is obtained from IID and then further analysis the Assessor's Records is made.

Footnote 6 - USE OF WATER:
Water is used to irrigate crops including leaching and pre-irrigation and is authorized for related uses, power development, and municipal uses pursuant to the authority stated above.

Footnote 7 - AREAS OF USE:
Imperial County and San Diego County as to pre-1914 rights and additionally the service areas of San Diego County Water Authority and the Coachella Valley Water District, Improvement District No. 1; and Metropolitan Water District, per WRO 2002-0013, and any other Constitutionally permissible area pursuant to the North American Free Trade Agreement and/or Sporhase v. Nebraska, ex rel. Douglas (1982) 458 U.S. 941.

Footnote 8: Diverter and/or diverter's agent(s) utilize a variety of conservation methods depending on variables, including crops grown, soil conditions, and water needs. The methods used and/or available for the diverter include, but are not limited to, crop rotation, fallowing, pump-back systems, sprinklers, drip systems, leveling, and tiling.

FIG. 16C

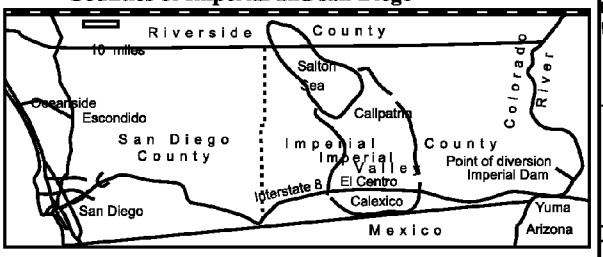
SUPPLIMENTAL MAPS TO STATEMENT OF WATER DIVERSION AND USE

SAMPLE

Name of person diverting water: SAMPLE LANDOWNER

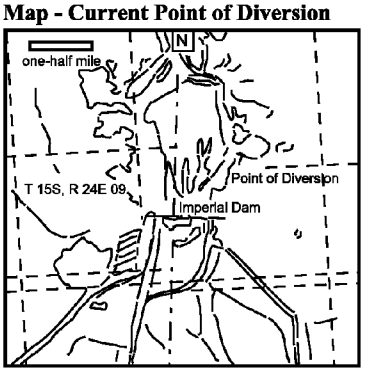
County: IMPERIAL APN: 999-999-999

Map - General Area of Use within California: Counties of Imperial and san Diego



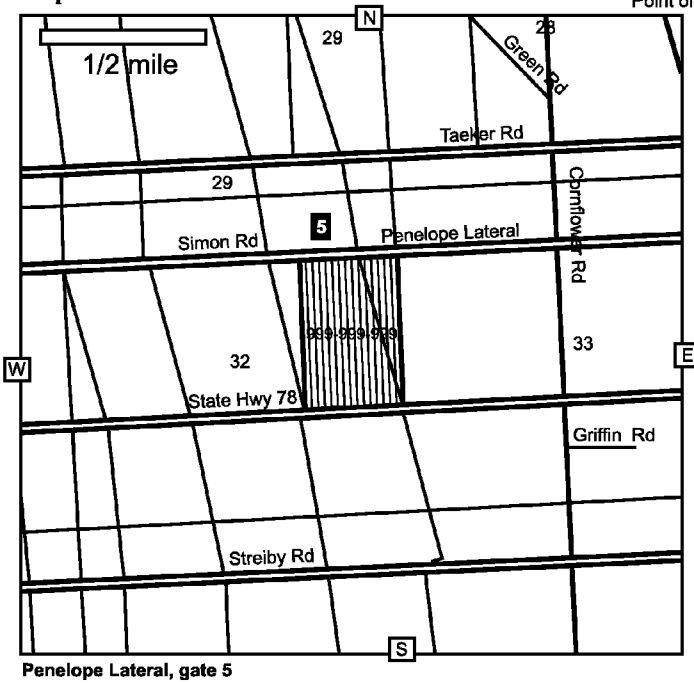
Straightline distance from Point of Diversion to Point of Use: 40 miles

Map - Current Point of Diversion



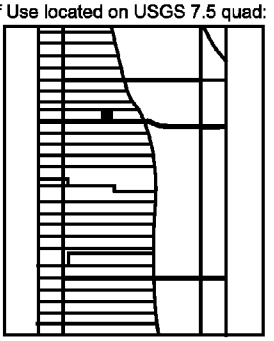
Quad: Yuma West

Map - Detail of Current Area of Use



Penelope Lateral, gate 5

Point of Use located on USGS 7.5 quad:



Holtville NE

SE quarter of NE quarter of
Township: 13 S
Range: 16 E
Section: 32
Baseline: San Bernardino

SUPPLEMENTAL MAPS Note: Item B "Other (explain)" on Page one refers to footnote 1.

APN: 039-120-037

FIG. 16D

SYSTEMS AND METHODS FOR OPTIMIZED WATER ALLOCATION

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. §119(e) to U.S. Provisional Patent Application Ser. No. 60/815,157, entitled "Systems and Methods for Water Optimization," filed Jun. 19, 2006, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to systems and methods for optimizing water distribution. More particularly, the present invention relates to systems and methods for establishing and querying a database of information for optimizing water distribution within a defined geographical area and providing useful output as a result of such queries. The system and method also provide for exchange of water rights and the output of data in a useful form, such as a map, graph, list, summary, or chart. The system and method also provide for water planning based on consideration of specified parameters.

2. Description of the Related Art

Water is a vital natural resource. In addition to the aesthetic pleasantries of green lawns, swimming pools and fountain shows in areas that would otherwise be desert without irrigation, water provides the foundation for agriculture, industries and residences to function.

Currently, public databases of information provide listings of an estimated amount of water used per parcel of land by location. Other resources provide additional information related to land, such as water evaporation, climate, crops grown, crop rotation, soil type, ownership, water rights, financial support, investment, or other factors. However, the databases are of questionable accuracy.

In addition, water planning has been executed in a piecemeal, manual fashion. The additional information needed to create a comprehensive water plan is not integrated and therefore incomplete and/or inaccurate projections result.

With the occurrence of more frequent droughts, burgeoning population increases, and the likelihood of global warming impacting the availability of water, there is a need for a way to optimize the allocation of water and the planning of water usage.

SUMMARY OF THE INVENTION

In one or more embodiments, the present invention provides a method for water exchange comprising receiving information related to water usage of a client; receiving from the client a request for a water exchange; determining a potential match for the water exchange request; and transmitting the potential match determination to the client.

The present invention further provides a method for optimizing allocation of water comprising receiving a request for information related to water usage of a party; receiving information related to the party's water usage; determining a projected water usage by the party; determining an optimized allocation of the party's water usage based at least in part on the projected water usage by the party; and displaying the optimized allocation of the party's water usage.

The present invention further provides a method for water planning comprising receiving parameters related to projected water usage of a party; receiving a request for outcomes related to projected water usage of the party; determining outcomes related to projected water usage by the party based at least in part on the received parameters; and displaying the outcomes related to projected water usage by the party.

The present invention further provides a system for water exchange comprising a water usage module configured to receive information related to water usage; a communication module configured to receive a request for a water exchange; and a water exchange module configured to determine a potential match for the water exchange request.

The present invention further provides a system for optimizing allocation of water, the system comprising a water usage module configured to receive information related to water usage by a party; a water projection module configured to estimate projected water usage by the party; and an optimization module configured to determine an optimized allocation of the party's water usage based at least in part on the projected water usage by the party.

The present invention further provides a system for water planning comprising a parameter module configured to receive parameters related to projected water usage by a party; and an outcome determination module configured to determine outcomes related to projected water usage by the party based at least in part on the received parameters.

The present invention further provides a computer program product for producing a user interface of a system for optimizing allocation of water, the user interface comprising a first display area for listing information related to water usage; a second display area, visually distinguished from and concurrently displayed with the first display area, for receiving criteria related to water usage to be included in the first display area; and a third display area, visually distinguished from and concurrently displayed with the first and second display areas, for displaying a water account balance for the client.

The features and advantages described herein are not all-inclusive, and many additional features and advantages will be apparent to one of ordinary skill in the art in view of the figures and description. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated by way of example, and not by way of limitation in the figures of the accompanying drawings in which like reference numerals are used to refer to similar elements.

FIG. **1** is a block diagram depicting a system architecture for practicing the present invention according to one embodiment.

FIG. **2** is a flowchart depicting a method for practicing the present invention according to one embodiment.

FIG. **3** is a flowchart depicting another method for practicing the present invention according to one embodiment.

FIG. **4** is a graphical representation of a display device depicting an example of a public water release request according to one embodiment.

FIG. **5** is a graphical representation of a display device depicting an example of a water delivery order according to one embodiment.

FIG. **6** is a graphical representation of a display device depicting another example of a water delivery order according to one embodiment.

FIG. **7** is a graphical representation of a display device depicting an example of a water transfer acquisition request according to one embodiment.

FIG. **8** is a graphical representation of a display device depicting an example of a water transfer acquisition request according to one embodiment.

FIG. **9** is a graphical representation of a display device depicting an example of a topographic map of parcels owned and/or controlled by an account holder according to one embodiment.

FIG. **10** is a graphical representation of a display device depicting an example of an air photographic map of parcels owned and/or controlled by an account holder according to one embodiment.

FIG. **11** is a graphical representation of a display device depicting an example of a soils map of parcels owned and/or controlled by an account holder according to one embodiment.

FIG. **12** is an example of how the present invention can address variation in the amount of water supplied to the Salton Sea.

FIG. **13** is another example of how the present invention can address variation in the amount of water supplied to the Salton Sea.

FIG. **14** is a graphical representation of a display device depicting an example of inputting parameters according to one embodiment.

FIG. **15** is a flowchart depicting another method for practicing the present invention according to one embodiment.

FIGS. **16**A-**16**D are examples of forms that have been completed automatically using the present invention according to one embodiment.

One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the invention described herein.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Systems and methods for optimizing the allocation of water are described below. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the invention. It will be apparent, however, to one skilled in the art that the invention can be practiced without these specific details. In other instances, structures and devices are shown in block diagram form in order to avoid obscuring the invention. Furthermore, the particular arrangements of elements in screen shots shown here are illustrative of one embodiment and are not intended to limit the scope of the present invention.

Reference in the specification to "one embodiment," "an embodiment" or "the embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment.

Some portions of the detailed descriptions that follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

The present invention also relates to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general-purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, and magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, or any type of media suitable for storing electronic instructions, each coupled to a computer system bus.

Finally, the algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general-purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear from the description below. In addition, the present invention is not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the invention as described herein.

According to one embodiment, the present invention provides an online tool for assisting users in managing water usage and determining projected water availability. In one embodiment, the online tool uses data received from an agency or institution (such as an irrigation district), combined with user-entered data and/or other data. This combination of data provides more accurate projections of account balances, since it takes into water usage that may not yet be recorded or known to the irrigation district.

By providing users with an accurate picture of their current and projected water account balances, taking into account expected and future transactions and usage, the present invention allows users to better manage their water allocation and to ensure that sufficient water is available for expected needs.

According to another embodiment, the present invention provides a way to estimate optimized water allocation for various users taking into account past, current and projected water usage.

According to another embodiment, the present invention provides a way to plan for different outcomes related to projected water usage based on the consideration of various parameters related to projected water usage.

System

FIG. **1** shows a network **113** connecting a community of users **112**A-**112**N and a water optimization server **101**. FIG. **1** illustrates one embodiment by which a plurality of users **112**A-**112**N can manage and exchange information about water usage.

User **112**A views, inputs and edits information about water usage using a first client machine **107**A. The first client machine **107**A includes software and hardware for interacting with the water optimization server **101**.

In one embodiment, client machine **107**A is a computer of conventional design, and includes a processor, an addressable memory, and other conventional features (not illustrated) such as a display, local memory, input/output ports, and a network interface. In other embodiments one or more of the components of client machine **107**A may be located remotely and accessed via the network **113**. Client machine **107**A interacts with water optimization web server **101** via the network **113** such as the Internet. In one embodiment, the client communication module **120**A of client machine **107**A performs communication operations to enable such interaction via the Internet or some other network **113** such a LAN, a WAN, a MAN, a wired or wireless network, a private network, a virtual private network, or other networks. In various embodiments, client machine **107**A may be implemented as a computer running a Microsoft operating system, Mac OS, various flavors of Linux, UNIX, Palm OS, and/or other operating systems.

Other examples of computing devices will be apparent to one of skill in the art without departing from the scope of the present invention. For example, the first client machine **107**A can also be implemented as a personal digital assistant (PDA), a cellular telephone, or another device with web browsing capability.

The client machines **107**A-**107**N are connected to the network **113**. The network **113** can be implemented as any electronic medium by which content can be transferred. Through the network **113**, the client machines **107**A-**107**N can send and receive data from client machines **107**A-**107**N and the water optimization server **101**.

The present invention also includes software operable on the system of FIG. **1**. The first user communicates with the system using a Web browser **110**A of a conventional type such as Internet Explorer from Microsoft Corp. or Firefox by Mozilla. The Web browser **110**A is used in conventional manner to retrieve and present web pages.

In one embodiment, water optimization web server **101** comprises a water institution interface **151** for communicating with water institution **103** and a server communication module **152** for communicating with client machines **107**A-**107**N.

Water optimization web server **101** may comprise several modules coupled via a system bus (not shown). For example, location module **105**, reporting module **106**, exchange module **108**, projection module **111**, optimization module **115**, parameter module **130**, outcome determination module **132**, water institution interface **151**, and server communication module **152** are coupled together by a system bus, and may send signals to and receive signals from database **114**, other data **109** sources, water institutions **103**, and to client machines **107**A-**107**N.

The location module **105** provides information about a particular attribute concerning a parcel of land in response to inquiries from the client machine **107**A. For example, the location module **105** may provide information regarding geographic location, boundaries, and/or other parcel-related information. The location module **105** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information about the parcels of land, for example, from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The reporting module **106** provides information on a particular parcel of land in response to the attributes determined by the location module **105**, according to one embodiment. The reporting module **106** provides output in a useful form, such as a chart, graph, map, form or the like. The reporting module **106** can be used to automatically enter data into forms, according to one embodiment. The reporting module **106** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The exchange module **108** locates potential matches in response to a water exchange request. In a private exchange, the exchange module **108** automatically searches for one or more users **112**A-**112**N that desire to exchange a requested amount of water, according to one embodiment. In another embodiment, two water users who have agreed "off-line" to a transfer execute the transfer via the exchange module **108**. In a public exchange, the exchange module **108** determines whether the availability of water that has been released to the system is sufficient to satisfy a request or whether the system can accept water from a user, according to one embodiment. The exchange module **108** also provides a way for a user to verify that a potential match is desired by the user, according to one embodiment. After an exchange has been executed, exchange module **108** sends updated account data to water institution **103** via water institution interface **151**. The exchange module **108** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The projection module **111** provides an estimated water usage based on various factors. For example, the projection module **111** may consider current water usage by the user, past water usage by the user, evaporation estimates, soil information, and climate estimates for the user's land. The projection module **111** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The optimization module **115** determines an optimized allocation of a party's water usage based on many factors. In one embodiment, the optimization module **115** considers total available water, estimated usage by another party, current water usage by another party, past water usage by another party, evaporation estimates, salinity information, crop information, soil types, water rights, and climate estimates. The optimization module **115** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

In one embodiment, the initial distribution of water availability is determined as a share of the total water available,

proportional to each member's share of total irrigated acreage. Historically, water usage data has not been collected at a sufficient level to allow accurate analysis at the farm field level. Thus, the initial distribution is based on share of acreage, according to one embodiment.

As additional data about fields and crops are collected by the system, distribution can be enhanced by further analysis of water use efficiency. Administrative decisions can consider soil type, crop mix, efficiency history, and other factors to determine distribution, according to one embodiment. The usage data collected is also incorporated into efficiency planning tools made available to the users.

The parameter module **130** receives parameters related to water usage by a party. For example, the received parameters may include information about total available water in the system; water allocated to the party or to other parties; estimated, current or past water usage; evaporation data or estimates; salinity thresholds; climate data; data for the types of crops that have been or may be grown; crop rotation; soil type; ownership; water rights; financial support; financial investment; and the like. The parameter module **130** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The outcome determination module **132** is configured to determine outcomes related to projected water usage by the party based at least in part on the received parameters. The outcomes related to projected water usage may include, for example, information related to water needs, return on investment, and crop yields. The outcome determination module **132** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The basic operation for the above described system is as follows. First, the user **112**A interacts with the Internet using a Web browser **110**A in the conventional manner. As part of this process, web pages, including content and hypertext links are displayed to the user **112**A. The user **112**A can select a portion of the web page and provide input. This happens automatically with the user **112**A selecting text from a web page being presented and initiates a function provided by the client communication module **120**A. The client communication module **120**A generates a request for a communication channel using the selected information. The client communication module **120**A sends this request to the server communication module **152**. The server communication module **152** processes the request.

Processing of the request includes providing a location to the location module **105**, and having the location module **105** determine various attributes about a parcel of land. Processing the request can also include the generating a query (such as a user driven query or a query constructed by the location module), which may be sent to parameter module **130**, and applying that query to the database **114** to generate a list of information that satisfies the query parameters, such as that determined by outcome determination module **132**.

In addition, processing the request may include using the exchange module **108** to locate matches for water exchanges between users or between a user and the system, using projection module **111** to provide estimated water usage based on various factors, and/or using optimization module **115** to determine an optimized allocation of water usage based on many factors, as described above. Finally, processing the request may also include using the reporting module **106** to generate a map or other information that includes the attributes related to a parcel of land based on the selected input and/or automatically completing forms related to the water transfer. The processed information is then returned to the client communication module **120**A.

The database **114** stores a variety of different types of information about parcels of land, and is responsive to queries from the client machines **107**A-**107**N. There are a variety of parameters that can be set by the user **112**A to expose any portion of the data. The database **114** includes a first data portion that is relatively static in that it changes relatively infrequently. The database **114** includes a second data portion that is relatively dynamic in that the data changes frequently. For example, the second data portion can include information about water usage, climate, crops grown, crop rotation, soil type, ownership, water rights, financial support and/or investment.

The database **114** has software for interfacing one or more data stores. For example, database **114** can receive information from, for example, assessors' offices, irrigation districts, the United States Geological Survey, universities, colleges, almanacs, museums, libraries, bureaus of reclamation, a spatial database within a Graphical Information System ("GIS") and/or farm bureaus.

In one embodiment of database **114**, namely a spatial data model, reality can be represented by four spatial entities. These four elements are point, line, area, volume. In their most simplified form, spatially linked data are information associated with a specific location: for example, the location of a canal gate, or a farmer's crop. While there are an infinite number and variety of spatial data, these four spatial elements can replicate complicated geographic relationships and patterns.

An alternate embodiment of database **114**, a spatial database within a GIS is a collection of spatially referenced data that are combined to reflect reality and can be manipulated, transformed, and analyzed before being displayed on a map. The ways in which the four spatial data types are organized and modeled within a GIS determine to a very large extent its capabilities and functionality.

In another embodiment of database **114**, an object-oriented data model structured as the foundation of a GIS provides the ability to hold spatial data (attributes) in a database and enables the user to perform specific spatial queries. A spatial query seeks to find answers to geographical questions concerning but not limited to "adjacent," "within," "about," "near," "intersect," and "overlay." An object-oriented spatial data model does not organize and retrieve data based on the usual linked tables, but rather on data organized by object and class. In its most basic form, one object contains three classes based on three geographical elements which are all inherited.

According to another embodiment of database **114**, a searchable database, such as a water datamart, is a relational database capable of housing, among other data, location information. The database can be interconnected with existing systems containing parcel and mapping data, and can be pre-populated with critical geographic datasets (i.e. streets and boundaries). The water datamart accepts farm specific location data, such as water distribution points, crops, canals, gates, location, water delivery and associated governmental data. The output resulting from search queries of the database may be, for example, a chart, list, graph, summary, or interactive map.

Another example of database **114** is a private database of water management. This would provide a way to accurately track and manage various factors related to water usage associated with persons or entities.

Water exchange module **108** also allows user **112**A to securely access and manage his or her water accounts, which may include information provided by water institution **103**. Water institution **103** can be one or more institutions, such as irrigation districts, government agencies, private water management agencies, or the like. In one embodiment, password protection and authentication, 128-bit encryption, SHTML, and other security features are used to ensure the security of the user's data. Once user **112**A has been authenticated, exchange module **108** obtains water data including total water availability data and/or allocated water data from water institution **103**, including dates, amounts, and the like.

Water exchange module **108** sends HTML code or other presentation technologies to browser **110** causing browser **110** to present a user interface to user **112**. The user interface allows the user to enter transactions and/or parcel information, as well as to review water account balances and view transaction information.

When user **112**A enters transactions and/or other water-related data, the user-entered data is transmitted via client communication module **120**A to server communication module **152**. Exchange module **108** searches and transmits potential matches. The user **112**A may then accept or reject potential matches, according to one embodiment.

If an exchange is requested, water exchange module **108** determines if sufficient water is available to satisfy the request for transfer between users, or between the system and a user. If the exchange is accepted, according to one embodiment, water exchange module **108** sends information about such exchanges (also known as a "paper" water transfer") to the water institution **103** via water institution interface **151** and/or via a form provided by the water institution **103**, such as those shown in FIGS. **16**A-**16**B. As an example, a Delivery Order may entered by a user **112**A to direct to the water institution **103** to supply the actual "wet water" (also known as a "wet" water transfer) to the transferee user's irrigation gate. If the transferor user's account has sufficient acre feet of water available to be transferred, the system forwards the Delivery Order to the water institution's Water Master, according to one embodiment. The Order for the transfer of water is delivered by, for example, direct data connection, email, mail and/or fax. The Water Master adds the Order to deliver the "wet water" to the delivery schedule, according to one embodiment. The amount of available water can then be determined by subtracting the released amount from the user's water balance or adding the acquired amount to the user's balance.

In one embodiment, water exchange module **108** can provide information to various regulatory bodies to satisfy reporting requirements. For example, to comply with statutory, ordinance and/or regulatory requirements, water exchange module **108** can provide data of various types, such as data concerning water exchanges, usage and availability, to agencies or institutions at the federal, state and/or local levels. Such information can be sent by, for example, direct data connection, email, mail and/or fax. As an example, a user could submit the forms depicted in FIGS. **16**A-**16**D to comply with California Water Code Section 5100 et seq.

In one embodiment, web server **101** projects future water usage balances in light of the user-entered data. Based on user-entered data along with transaction data and/or account balance received from water institution **103** and/or data received from other sources **109**, reporting module **106** presents report **102** including projected balances and other useful information either in the context of HTML web pages or in other formats such as PDF, Microsoft Excel, and the like. In one embodiment, reporting module **106** is augmented by a module for generating a list of transactions that may or may not be interactive. Thus, the term "reporting module **106**" is intended to be illustrative and not limiting. References herein to "reporting module **106**" should be considered to encompass such variations as interactive registers, reports, graphs, charts, maps, forms and the like. Reports including projected balances are provided to browser **110** in HTML, PDF, Excel, or the like, and displayed to user **112**. User **112**A can also save and/or print such reports as desired.

The reporting module **106** is software and data operational on the server to generate representations of land. In one embodiment, reporting module **106** retrieves information from water institution **103**, database **114**, location module **105** and other data **109**. The reporting module **106** generates representations that can be used in presenting results to the user **112**, such as maps, charts, graphs, forms and the like. The reporting module **106** can be used to automatically enter data into forms, according to one embodiment. In one embodiment, the reporting module **106** is a graphics user interface as will be understood by those skilled in the art.

In one embodiment, web server **101** provides information for water planning purposes. The parameter module **130** receives one or more parameters related to water usage of a party. These parameters can include, for example, information about total available water in the system; water allocated to the party or to other parties; estimated, current or past usage by another party; evaporation data or estimates; salinity thresholds; climate data; data for the types of crops that have been or may be grown; crop rotation; soil type; ownership; water rights; financial support; financial investment; and the like. Web server **101** receives a request for outcomes related to projected water usage of the party. The outcome determination module **132** determines outcomes related to projected water usage by the party based at least in part on the received parameters. Outcomes related to projected water usage include, for example, information about water needs, return on investment, and crop yields. The outcomes related to projected water usage by the party are then displayed.

One skilled in the art will recognize that the system architecture illustrated in FIG. **1** is merely exemplary, and that the invention may be practiced and implemented using many other architectures and environments.

Methods

Referring now to FIG. **2**, a flowchart depicts a method for practicing the present invention according to one embodiment. User **112**A logs in **202** and is authenticated. Water optimization web server **101** receives **204** water information usage data about the user **112**, such as transaction data and/or account balance, from water institution **103**. Optionally, exchange module **108** can present a user interface to user **112**, including current balances, transactions, and other account information. In one embodiment, user **112**A is given an opportunity to enter data, such as exchange requests. Water optimization web server **101** also receives this user-entered data **204**.

Optionally, water optimization web server **101** also retrieves data from data store **114**. Data from data store **114** may include, for example, user-entered data that was entered during previous visits to the website and/or data received electronically from the water institution **103** and/or data extracted from previous online sessions and/or other data received from, for example, other users.

Server communication module **152** receives **206** requests from users **112**A-**112**N for a water exchange and sends the requests to water exchange module **218**. Exchange module **108** determines **208** potential matches by searching for avail-

able water in the system database **114**, which would include water that has not been released from users and/or available water released into the system by users. Server communication module **152** then transmits the potential matches **210** to client machine **107**A via client communication module **120**A. In one embodiment, the user can be prompted to indicate whether or not a proposed match is acceptable.

If the exchange is consummated, water optimization web server **101** transmits **212** information about such exchanges to the water institution **103**, according to one embodiment. Water optimization web server **101** can then determine the amount of available water by subtracting the released amount from the user's water balance or adding the acquired amount to the user's balance. In one embodiment, report generation module **106** generates and displays a report, which may include projected balances and/or transactions.

By taking into account user-entered data and data from water institutions **103** and/or other data **109**, report generation module **106** is able to generate projected balances that more accurately reflect user's **112**A projected water usage. Report **102** may be a static report, a dynamic report allowing user interaction, or an input/output screen that allows the user to update, view, modify, and otherwise interact with transaction data. Report **102** may be in the form of a chart, graph, map, form or other useful output.

Referring now to FIG. **3**, a flowchart depicts a method for practicing the present invention according to another embodiment. User **112**A logs in **302** and is authenticated. Water optimization web server **101** receives **304** a request for information related to the water usage by a party. The system receives **306** water information usage data about the party, such as transaction data and/or account balance from water institution **103** or information provided by user **112**A or other data **109**. Optionally, water optimization web server **101** also retrieves data from data store **114**.

Based on the received information, water optimization web server **101** determines **308** a projected water usage by the party. To determine the projected usage, water optimization web server **101** may consider, for example, current water usage by the party, past water usage by the party, evaporation estimates, crop information, soil types, and climate estimates.

Based at least in part on the party's projected water usage, water optimization web server **101** determines **310** an optimized allocation of the party's water usage. To determine the optimized allocation of the party's water usage, water optimization web server **101** may consider a variety of factors. Examples of such factors include information about total available water, estimated usage by another party, current water usage by another party, past water usage by another party, evaporation estimates, salinity information, crop information, soil types, water rights, and climate estimates. The water optimization web server **101** may also determine optimized allocation **310** in view of ground water, underflow, surface water, riparian, and pre-1914 appropriative rights. Water optimization web server **101** provides for display **312** of the optimized allocation of the party's water usage.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine return on investment.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine future usage.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine environmental impact.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine the optimal allocation of water rights.

In another embodiment, the water optimization web server **101** uses optimized allocation to aid in regional land use planning. In this embodiment, the system and methods could assist in the determination of the optimal location for developing land in light of water efficiency (for example, by developing the land least suitable for farming).

Referring now to FIG. **15**, a flowchart depicts another method for practicing the present invention according to one embodiment. User **112**A logs in **1502** and is authenticated. Water optimization web server **101** receives **1504** parameters related to projected water usage. The received parameters may include information about total available water in the system; water allocated to the party or to other parties; estimated, current or past usage by another party; evaporation data or estimates; salinity thresholds; climate data; data for the types of crops that have been or may be grown; crop rotation; soil type; ownership; water rights; financial support; financial investment; and the like.

Water optimization web server **101** receives **1506** a request for outcomes related to projected water usage. Outcomes related to projected water usage include, for example, information about water needs, return on investment, land valuation and crop yields.

Water optimization web server **101** determines **1508** outcomes related to projected water usage, such as estimating projected water requirements and crop yields, by taking into account various "what if" scenarios. An example of a GUI **1400** to allow a user to input such parameters is depicted, for example, in FIG. **14**. After a parameter has been entered, the systems and methods can predict various outcomes, such as water availability, crop yields and usage. Water optimization web server **101** displays **1510** the outcomes related to projected water usage by the party.

In another embodiment, outcome determination module **132** determines outcomes related to projected water usage, which can then be used in error analysis and/or data verification of water usage received from water institutions **103**. The outcomes related to projected water usage can also be used in determining the appropriate asking or purchase price of a parcel of land. In another embodiment, the water optimization web server **101** can estimate how much water will be needed for a parcel of land in an upcoming season.

In another embodiment, the water optimization web server **101** determines evaporation and flow to and from bodies of water. For a particular example, as depicted in FIGS. **12** and **13**, the systems and methods can address variation in the amount of water supplied to the Salton Sea as compared with competing interests. The Salton Sea varies in dimensions and area due to changes in agricultural runoff and rain as well as evaporation. In one embodiment, the systems and methods take into account various factors, such as climate changes, evaporation and water flow.

As an example, if a parameter were input that a body of water would receive an allocation of water to maintain a salinity concentration of 40,000 parts per million, the system could determine whether the amount of water allocated for a particular parcel of land would sustain a particular crop in light of climate estimates, for example.

As another example, by providing for more accurate planning, the present invention would mitigate serious problems if the Salton Sea were otherwise allowed to dry out. For example, without water optimization, air pollution from the fine salts left after the Salton Sea dried out would likely damage crops and adversely affect human health. In addition, many bird species rely on the Salton Sea as their habitat might be harmed if the Salton Sea is not maintained. Further, nearby communities might be subject to windstorm damage, and

salts and odors if water planning to the Salton Sea is not executed accurately. By ensuring that water flows in to and out of the Salton Sea are measured accurately, the allocation of water for the Salton Sea and other potentially competing purposes can be optimized. The examples depicted in FIGS. **12** and **13** show how the system and method can be used to determine an optimized distribution of water in light of specified parameters, such as cost, evaporation, salinity thresholds and/or other variables.

Graphical User Interface

The water optimization web server **101** displays a variety of information related to water usage. The system can present a user interface to user **112**, including a graphical representation of the historical, current, projected and/or optimized data in such forms as a chart, graph, map, report, summary or the like.

Referring now to FIGS. **4-11** and **14**, example graphical user interfaces (GUIs) in accordance with embodiments of the present invention are shown. FIGS. **4-11** and **14** show the GUI in different stages of interacting with the user **112**.

FIG. **4** illustrates one example of the GUI **400** for presenting data from the water optimization web server **101** in accordance with the present invention. As can be seen in FIG. **4**, the right portion of the window **402** includes buttons **404**, **406**, **408**, **410**, **412**, **414** for controlling the different views. In this GUI, the user **112**A can make a public release **424** of water back into the water optimization system **100**. A user **112**A can also receive information about his or her total available water for the year **416**, amount used in the current quarter **418**, amount released in the current quarter **420**, the quarter's committed water **422** (which is the amount the user plans to use and for which the user will be charged regardless of use), total acreage **426**, water used in the year **428** and water balance **430**.

FIG. **5** shows a graphical representation of a window **502** showing another GUI **500** of the present invention. FIG. **5** illustrates one embodiment of a water delivery order. This allows the user to determine the amount, date and time of delivery of water and to which gate, field, and crop it will be delivered. It also allows for the irrigator's name to be associated with the order for the user's accounting purposes. Such an order could be sent to the water institution **103** to direct the water institution to release the water as desired. In addition to providing an effective way of accounting for water usage, the system provides for various data to be stored with each water delivery, providing for increased accuracy in the water projections and optimization calculations, as well as a rich data store for any other use.

While the GUI **500** displayed has been shown with particular locations, color schemes, entry fields, and organization, those skilled in the art will realize that these are provided only by way of example and in alternate embodiments a variety of different display formats, organization schemes and color schemes may be used for this GUI **500** and the other GUIs of the present invention.

FIG. **6** shows a graphical representation of a window **602** showing another GUI **600** of the present invention. FIG. **6** illustrates another embodiment of a water delivery order. This GUI **600** provides a way to specify to which parcel and gate **610** the water should be delivered.

FIG. **7** shows a graphical representation of a window **702** showing another GUI **700** of the present invention. FIG. **7** illustrates an embodiment of a water transfer request. This GUI **700** provides a way to specify a desired water acquisition **704** or release (not shown) by quantity **706**, acquiring APN (Assessor's Parcel Number) **708**, releasing account **714** and APN **716**, and whether the transfer will be public (i.e. with another user) **710** or private (i.e. with the water optimization system) **712**, according to one embodiment.

FIG. **8** shows a graphical representation of a window showing another GUI **800** of the present invention. FIG. **8** illustrates an embodiment of a water transfer confirmation screen. In the embodiment depicted, the user is presented with a potential match for a water exchange, in this embodiment a desired acquisition. The GUI **800** shown displays the requested action (i.e. acquire or release) **804**, the quantity **808**, the releasing account **810** and APN **812**, and the acquiring account **814** and APN **816**. The user may accept **818** or reject **820** the potential match for the water transfer, according to one embodiment.

FIGS. **9-11** are screen shots depicting examples of maps of parcels owned and/or controlled by an account holder according to various embodiments. In these embodiments, a water card holder could assign his or her card to another user. Water Cards are one example of an accounting system used to record temporary transfers of water usage where one person leases land to be farmed by another person. These embodiments also provide for generation of a water efficiency report. In one embodiment, the water efficiency report can be used in determining an optimized allocation of water.

FIG. **9** is a screen shot depicting an example of a topographic map of parcels owned and/or controlled by an account holder. FIG. **10** is a screen shot depicting an example of an air photographic map of parcels owned and/or controlled by an account holder. FIG. **11** is a screen shot depicting an example of a report and soils map of parcels owned and/or controlled by an account holder.

Referring now to FIG. **9**, the GUI **900** also includes a first display region **904** in which one view of a map **920**, chart or graph is presented. A second display region **906** is provided to display and/or receive data and/or parameters. A third display region **908** is provided to display a water balance.

In region **904**, there is shown an example of a map **920** that may be generated by reporting module **106** and presented to user **112**A, according to the techniques of the present invention. One skilled in the art will recognize that the particular characteristics, layout, and elements of map **920** are presented here for illustrative purposes, and that many variations are possible. Map **920** may contain interactive components allowing for user input; one skilled in the art will recognize that such components can be omitted or modified and that in alternative embodiments map **920** can be non-interactive. For example, a user **112**A can indicate that a specific portion of one or more parcels should have water released, which would then be depicted in map **920**.

While the regions **904**, **906** and **908** in FIG. **9** have been shown with particular locations, color schemes and organization, those of ordinary skill in the art will realize that these are provided only by way of example and in alternate embodiments a variety of different display formats, organization schemes and color schemes may be used for this GUI **900** and the other GUIs of the present invention. In another embodiment, the maps, tables or graphs can be used to examine trends associated with the parcels, such as water usage, crop types, or other information.

Referring now to FIG. **11**, user **112**A inputs information about the soil in second display region **1106**, according to one embodiment. This information is then be depicted in map **1120** in the first display area **1104**. The user could also provide information in second display region **1106** regarding the gates for a field; this information is also shown in map **1120** of FIG. **11**.

FIG. **14** provides an example of a GUI **1400** to allow a user to input various parameters for water planning purposes by taking into account various "what if" scenarios. After a parameter has been entered, the systems and methods can predict outcomes related to water usage in light of the new input. In the user interface depicted, a user may enter a value in field **1410** and save it as a new value by selecting button **1420**. As another example, if a parameter were provided that a specified number of acre feet of water would be available for a given user, the system could determine the best crops to be grown on a particular parcel of land in light of climate estimates, according to one embodiment.

FIGS. **16**A-**16**D are examples of forms in which the reporting module **106** has automatically entered data, according to one embodiment. The mapping depicted in FIG. **16**D can be generated by reporting module **106**. In one embodiment, forms, such as those depicted in FIGS. **16**A-**16**D, are signed by the user and sent to water institution **103**. Water institution **103** then directs a water release consistent with the information contained in the forms.

The foregoing description of the embodiments of the present invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the present invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the present invention be limited not by this detailed description, but rather by the claims of this application. As will be understood by those familiar with the art, the present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. Likewise, the particular naming and division of the modules, routines, features, attributes, methodologies and other aspects are not mandatory or significant, and the mechanisms that implement the present invention or its features may have different names, divisions and/or formats. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting, of the scope of the present invention, which is set forth in the following claims.

The invention claimed is:

1. A computer-implemented method for water exchange, the method comprising:

receiving, by a computer, a first request for water exchange from a first user, the first user seeking a release of a first amount of excess water, the release being controlled by a water institution;

receiving, by the computer, information related to water usage and water rights of the first user;

receiving, by the computer, a second request for water exchange from a second user, the second user seeking an acquisition of a second amount of excess water;

determining, by the computer, a potential match between the first request and the second request including optimizing the potential match based on the water rights of the first user, water usage by another party, and a salinity threshold of a body of water in the region of the parties;

transmitting, from the computer, the potential match determination to the second user for approval or rejection;

receiving, from the second user, an approval of the potential match determination; and

in response to receiving the approval of the potential match determination from the second user, transmitting information about the water exchange to the water institution.

2. The method of claim **1**, further comprising:

executing the water exchange; and

displaying, at the computer, the first amount of excess water, the second request for the second amount of excess water, details of the potential match determination and, in response to an approved and executed water exchange, a remaining account balance of the water usage of the first user and water usage of the second user after the first request and the second request have been fulfilled.

3. The method of claim **2**, further comprising:

displaying geographic data related to one or more parcels associated with the water exchange between the first user and the second user.

4. The method of claim **2**, further comprising:

automatically inputting data at the computer into a displayed form using the first amount of excess water and a location.

5. The method of claim **2**, further comprising automatically inputting data at the computer into a displayed form using the second amount of excess water and a location.

6. The method of claim **1**, wherein the potential match for the first request and the second request comprises a potential match for water available from the first user in a water exchange system.

7. The method of claim **1**, wherein the information related to the water usage and the water rights comprises information provided by the first user.

8. The method of claim **1**, wherein the information related to the water usage and the water rights comprises information provided by a plurality of other users, and wherein the optimizing of the potential match is also based on the information provided by the plurality of other users.

9. The method of claim **1**, wherein the information related to the water usage and the water rights comprises information provided by a government entity.

10. The method of claim **1**, wherein the information related to the water usage comprises information provided by a water meter.

11. The method of claim **1**, wherein the first request and the second request are for an exchange of water described in a water card setting forth an accounting system used to record temporary transfers of water usage.

12. The method of claim **1**, wherein the potential match determination is dependent on the first amount of excess water being equal to or greater than the second amount of excess water.

13. The method of claim **1**, further comprising transmitting, from the computer, details of the approved water exchange to a water regulatory institution or agency.

14. The method of claim **1**, wherein the water exchange comprises an exchange of water rights.

15. A computer readable storage medium storing computer program code, the computer program code executable by a computer for causing the computer to perform a method for an exchange of water, the method comprising:

receiving a first request for water exchange from a first user, the first user seeking a release of a first amount of excess water, the release being controlled by a water institution;

receiving information related to water usage and water rights of the first user;

receiving a second request for water exchange from a second user, the second user seeking an acquisition of a second amount of excess water;

determining a potential match between the first request and the second request including optimizing the potential match based on the water rights of the first user, water usage by another party, and a salinity threshold of a body of water in the region of the parties;

transmitting the potential match determination to the second user for approval or rejection;

receiving from the second user an approval of the potential match determination; and

in response to the approval of the potential match determination from the second user, transmitting information about the water exchange to the water institution.

16. The computer readable storage medium of claim **15**, wherein the method further comprises:

outputting unique geographic data related to one or more parcels associated with the water exchange between the first user and the second user.

17. The computer readable storage medium of claim **16**, wherein the method further comprises:

inputting the unique geographic data into a form.

18. The computer readable storage medium of claim **15**, wherein the method further comprises:

receiving information provided by a government entity.

19. The computer readable storage medium of claim **15**, wherein the method further comprises:

receiving information provided by the first user.

20. The computer readable storage medium of claim **15**, wherein the method further comprises:

executing the water exchange.

21. The computer readable storage medium of claim **15**, wherein the potential match determination is dependent on the first amount of excess water being equal to or greater than the second amount of excess water.

22. The computer readable storage medium of claim **15**, wherein the method further comprises:

transmitting details of the approved water exchange to water regulatory institutions or agencies.

23. The computer readable storage medium of claim **15**, wherein the water exchange comprises an exchange of water rights.

24. The computer readable storage medium of claim **15**, wherein the water exchange comprises an exchange of a water card that indicates a user has rights.

* * * * *

EXHIBIT C

US008341090B1

(12) **United States Patent**
Hornbeck et al.

(10) **Patent No.: US 8,341,090 B1**
(45) **Date of Patent: *Dec. 25, 2012**

(54) **SYSTEMS AND METHODS FOR OPTIMIZED WATER ALLOCATION**

(76) Inventors: **David Hornbeck**, Northridge, CA (US); **Dennis J. Coady**, Oceanside, CA (US); **Patrick J. Maloney**, Alameda, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 64 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/890,009**

(22) Filed: **Sep. 24, 2010**

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/761,896, filed on Jun. 12, 2007, now Pat. No. 7,805,380.

(60) Provisional application No. 60/815,157, filed on Jun. 19, 2006.

(51) **Int. Cl.**
G06Q 50/00 (2012.01)

(52) **U.S. Cl.** **705/315**

(58) **Field of Classification Search** 705/315
See application file for complete search history.

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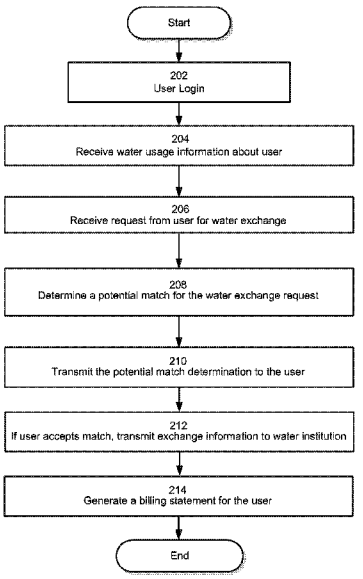
Primary Examiner — Nathan Erb
(74) *Attorney, Agent, or Firm* — Patent Law Works LLP

(57) **ABSTRACT**

The present invention relates to systems and methods for optimizing water allocation. In particular, the present invention relates to systems and methods for establishing and querying a database of information for projecting and optimizing water distribution within a county, city or state and providing useful output as a result of such queries. The system and method also provide for exchange of water rights and the output of data in a useful form, such as a map, graph, list, summary or chart. The system and method also provide for water planning based on consideration of various parameters.

19 Claims, 19 Drawing Sheets



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U.S. Notice of Allowance, U.S. Appl. No. 11/761,896, Aug. 16, 2010, 15 pages.
U.S. Office Action, U.S. Appl. No. 12/549,172, Oct. 12, 2010, 7 pages.

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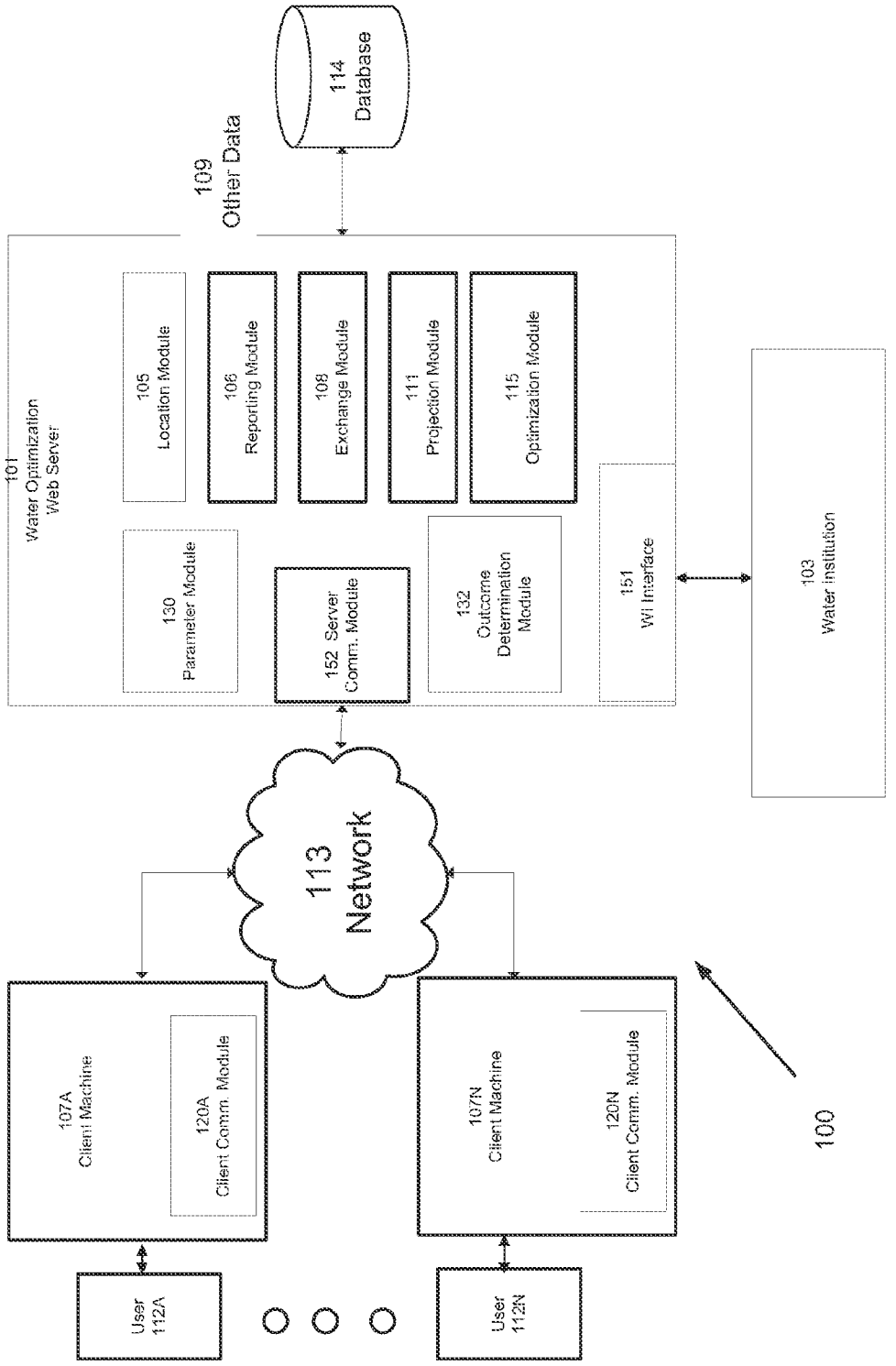

114
Database
109
Other Data
101
Water Optimization
Web Server
105
Location Module
106
Reporting Module
108
Exchange Module
111
Projection Module
115
Optimization Module
130
Parameter Module
152 Server
Comm. Module
132
Outcome
Determination
Module
151
WI Interface
103
Water institution
113
Network
107A
Client Machine
120A
Client Comm. Module
107N
Client Machine
120N
Client Comm. Module
User
112A
User
112N
100

Fig. 1

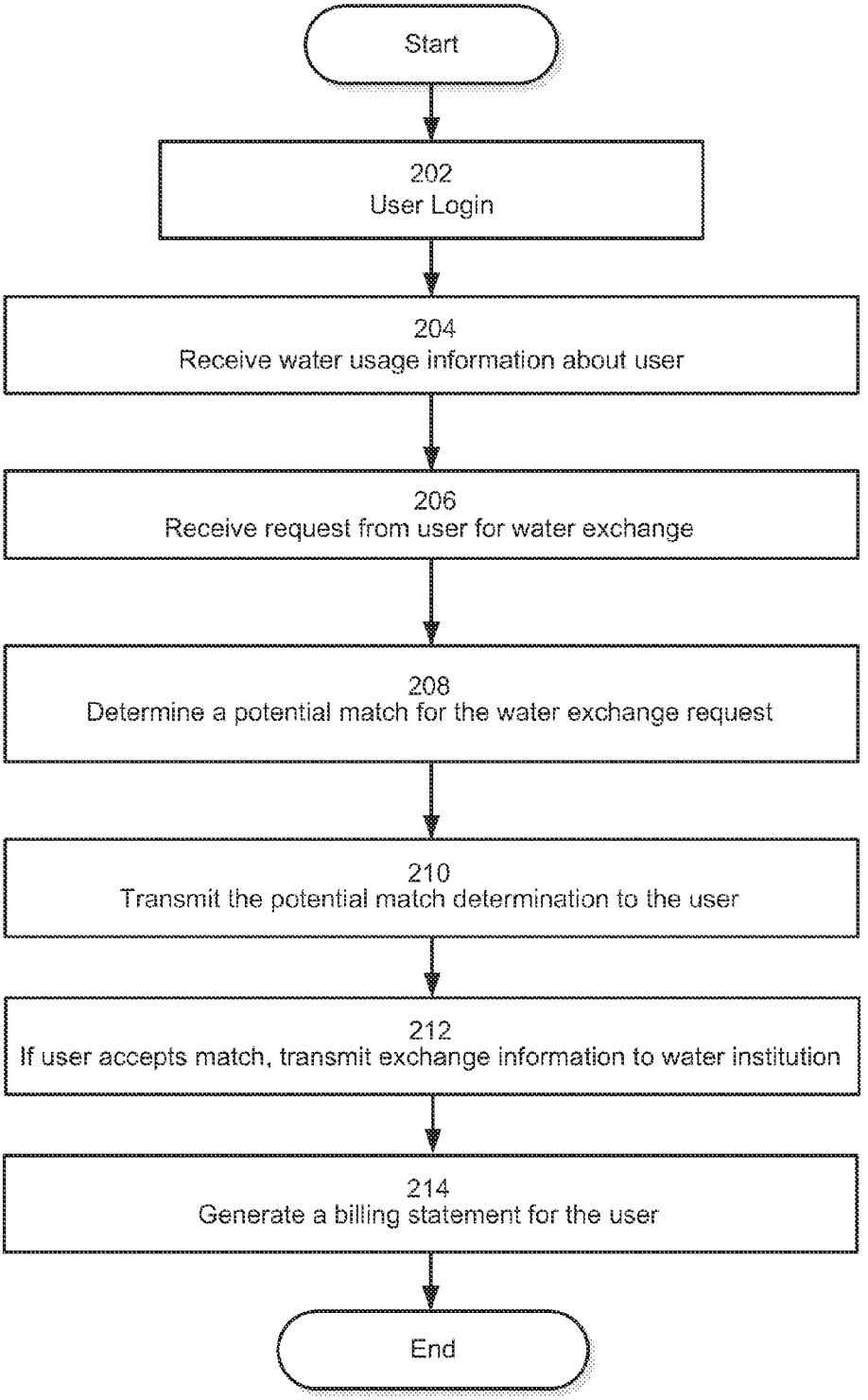

Start
202
User Login
204
Receive water usage information about user
206
Receive request from user for water exchange
208
Determine a potential match for the water exchange request
210
Transmit the potential match determination to the user
212
If user accepts match, transmit exchange information to water institution
214
Generate a billing statement for the user
End

Fig. 2

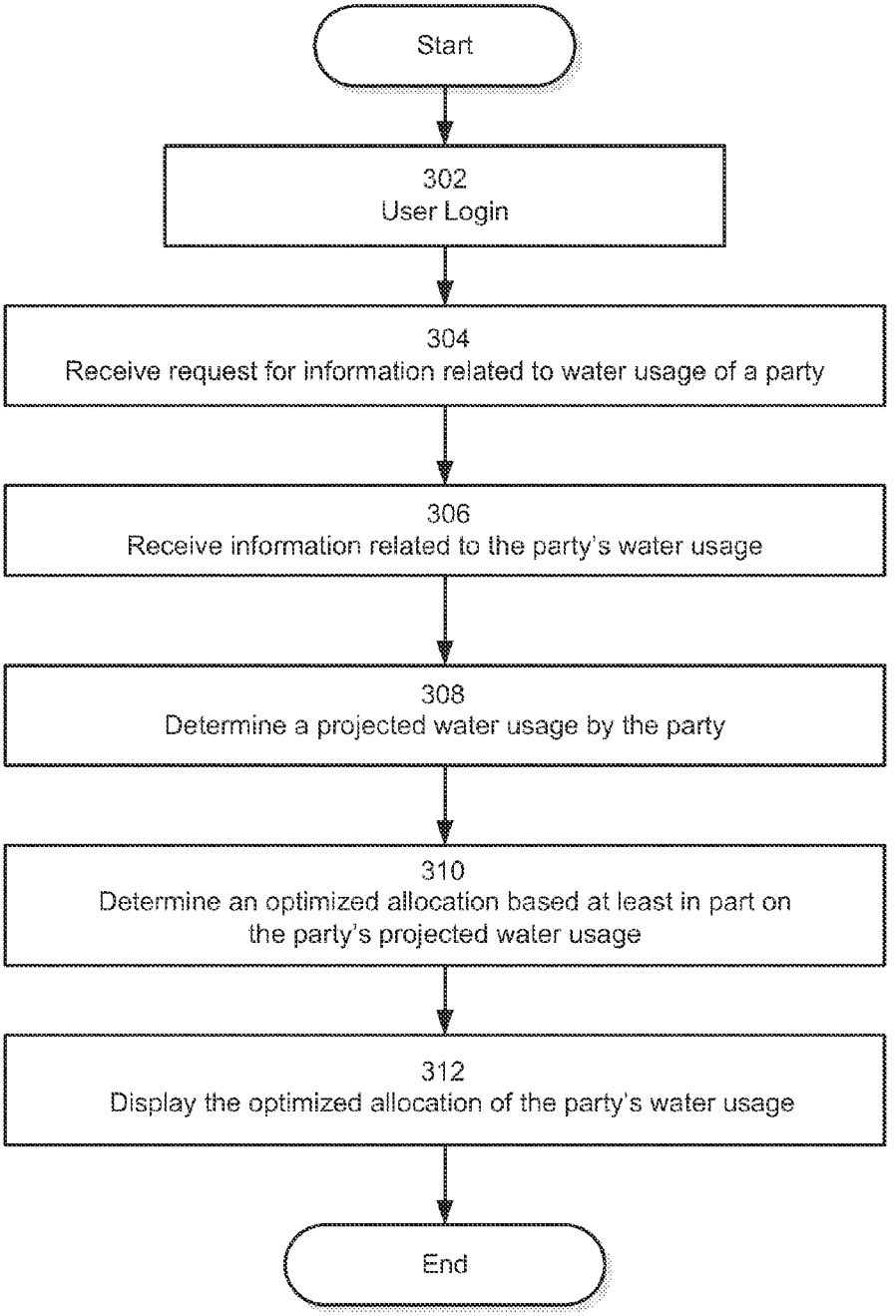

Start
302
User Login
304
Receive request for information related to water usage of a party
306
Receive information related to the party's water usage
308
Determine a projected water usage by the party
310
Determine an optimized allocation based at least in part on the party's projected water usage
312
Display the optimized allocation of the party's water usage
End

Fig. 3

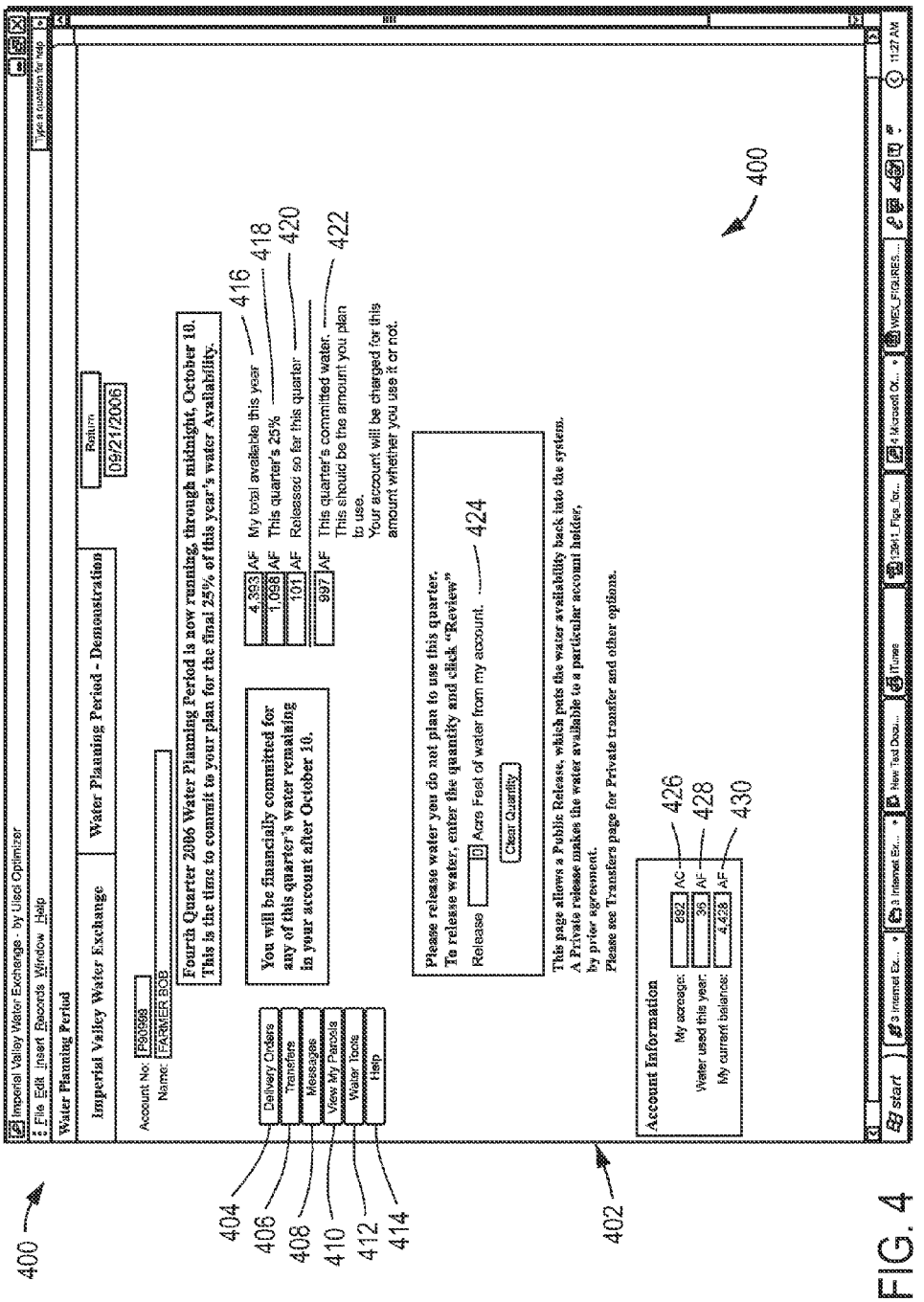

400
Imperial Valley Water Exchange - by Used Optimizer
File Edit Insert Records Window Help
Water Planning Period
Imperial Valley Water Exchange
Water Planning Period - Demonstration
Return
09/21/2006
Account No: F960598
Name: FARMER BOB
Fourth Quarter 2006 Water Planning Period is now running, through midnight, October 18.
This is the time to commit to your plan for the final 25% of this year's water Availability.
You will be financially committed for any of this quarter's water remaining in your account after October 18.
4,393 AF My total available this year
1,098 AF This quarter's 25%
131 AF Released so far this quarter
397 AF This quarter's committed water.
This should be the amount you plan to use.
Your account will be charged for this amount whether you use it or not.
Please release water you do not plan to use this quarter.
To release water, enter the quantity and click "Review"
Release 0 Acre Feet of water from my account.
Clear Quantity
This page allows a Public Release, which puts the water availability back into the system.
A Private release makes the water available to a particular account holder,
by prior agreement.
Please see Transfers page for Private transfer and other options.
Account Information
My acreage: 892 AC
Water used this year: 35 AF
My current balance: 4,438 AF
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
404
406
408
410
412
414
416
418
420
422
424
426
428
430
402
400
start
3 Internet Ex...
3 Internet Ex...
New Text Doc...
iTunes
2941 Figs_for...
4 Microsoft Or...
WEIL FIGURES....
11:27 AM

FIG. 4

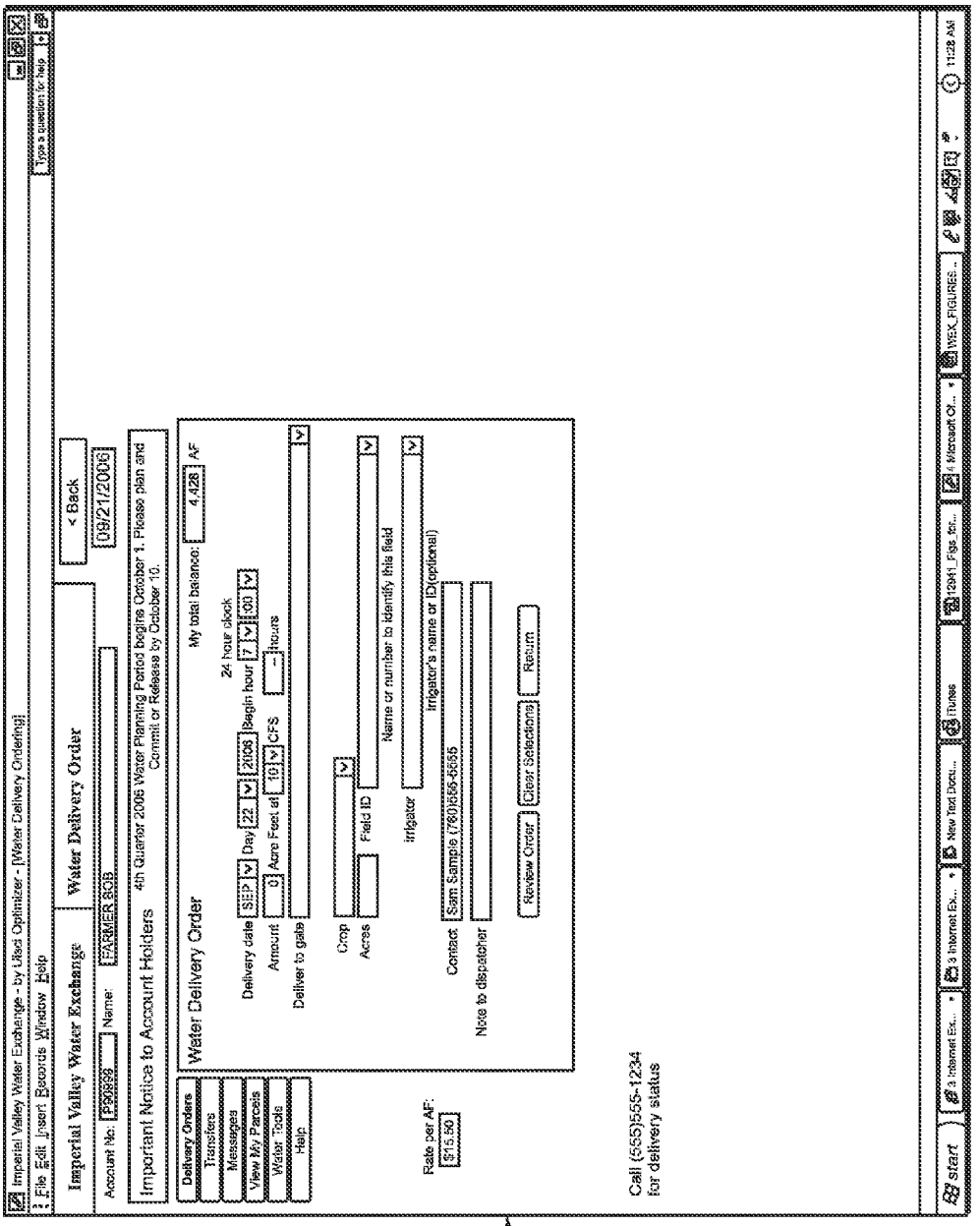

500
502
Imperial Valley Water Exchange - by Ideal Optimizer - [Water Delivery Ordering]
File Edit Insert Records Window Help
Imperial Valley Water Exchange
Water Delivery Order
< Back
Account No. P99999
Name: FARMER BOB
09/21/2006
Important Notice to Account Holders
4th Quarter 2006 Water Planning Period begins October 1. Please plan and Commit or Release by October 10.
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
Water Delivery Order
My total balance: 4,428 AF
24 hour block
Delivery date SEP 22 2006 Begin hour 7 00
Amount 0 Acre Feet at 10 CFS -- hours
Deliver to gate
Crop
Acres
Field ID
Name or number to identify this field
Irrigator
Irrigator's name or ID(optional)
Contact Sam Sample (760)555-5555
Note to dispatcher
Review Order
Clear Selections
Return
Rate per AF: $15.50
Call (555)555-1234 for delivery status
start
3 Internet Ex...
3 Internet Ex...
New Text Docu...
Itunes
12941_Figs_for...
4 Microsoft Of...
WEK_FIGURES ...
11:28 AM

FIG. 5

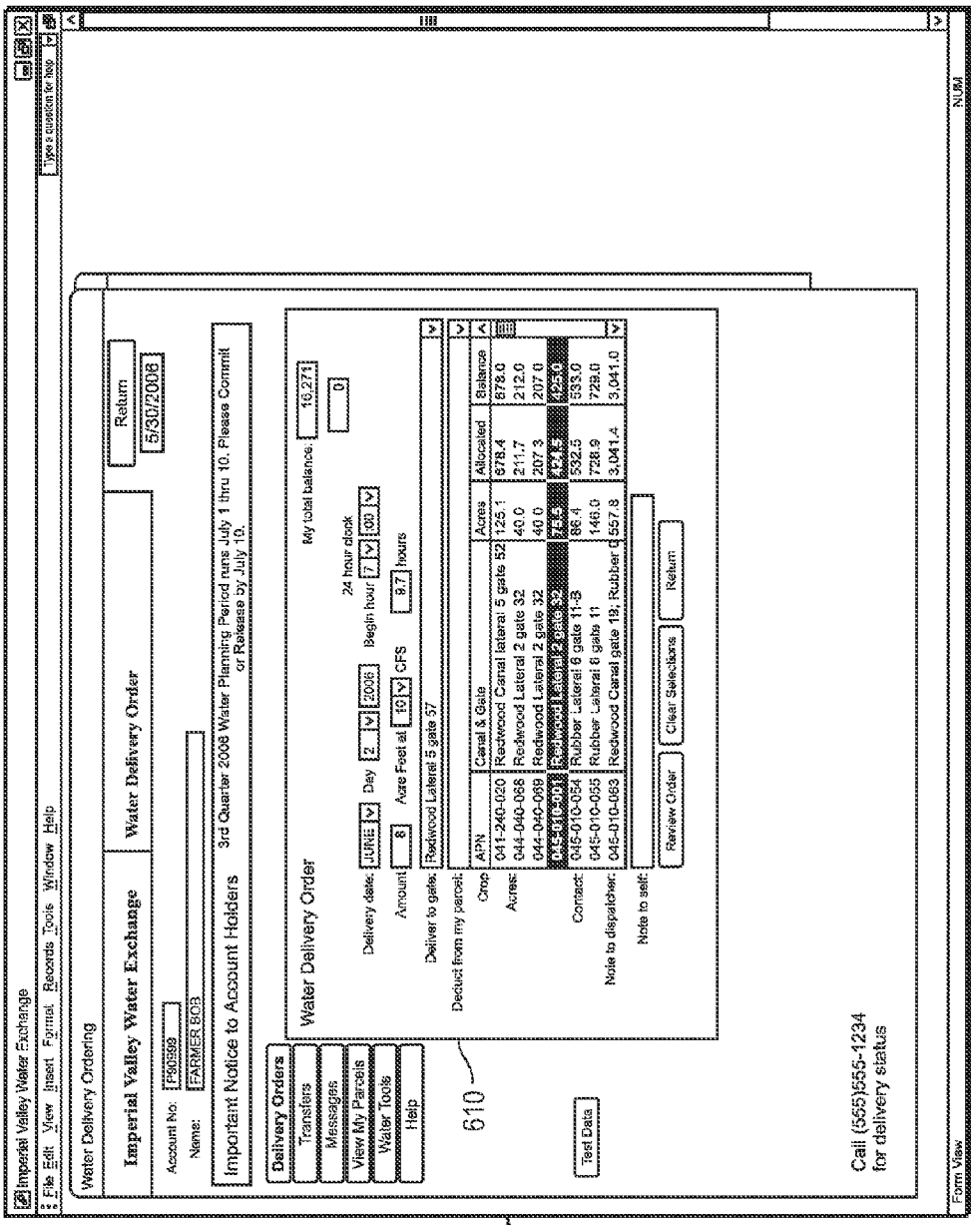

600
602
610
Imperial Valley Water Exchange
Water Delivery Ordering
Water Delivery Order
Return
5/30/2008
Account No:
Name:
FARMER BOB
Important Notice to Account Holders
3rd Quarter 2008 Water Planning Period runs July 1 thru 10. Please Commit or Release by July 10.
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
Test Data
Call (555)555-1234 for delivery status
Delivery date:
Day
Amount
Acre Feet at
GFS
Begin hour
24 hour clock
hours
Deliver to gate:
Redwood Lateral 5 gate 57
Deduct from my parcel:
My total balance:
16,271
Crop
Canal & Gate
Acres
Allocated
Balance
APN
Acres:
Contact:
Note to dispatcher:
Note to self:
Review Order
Clear Selections
Return
Form View
NUM

FIG. 6

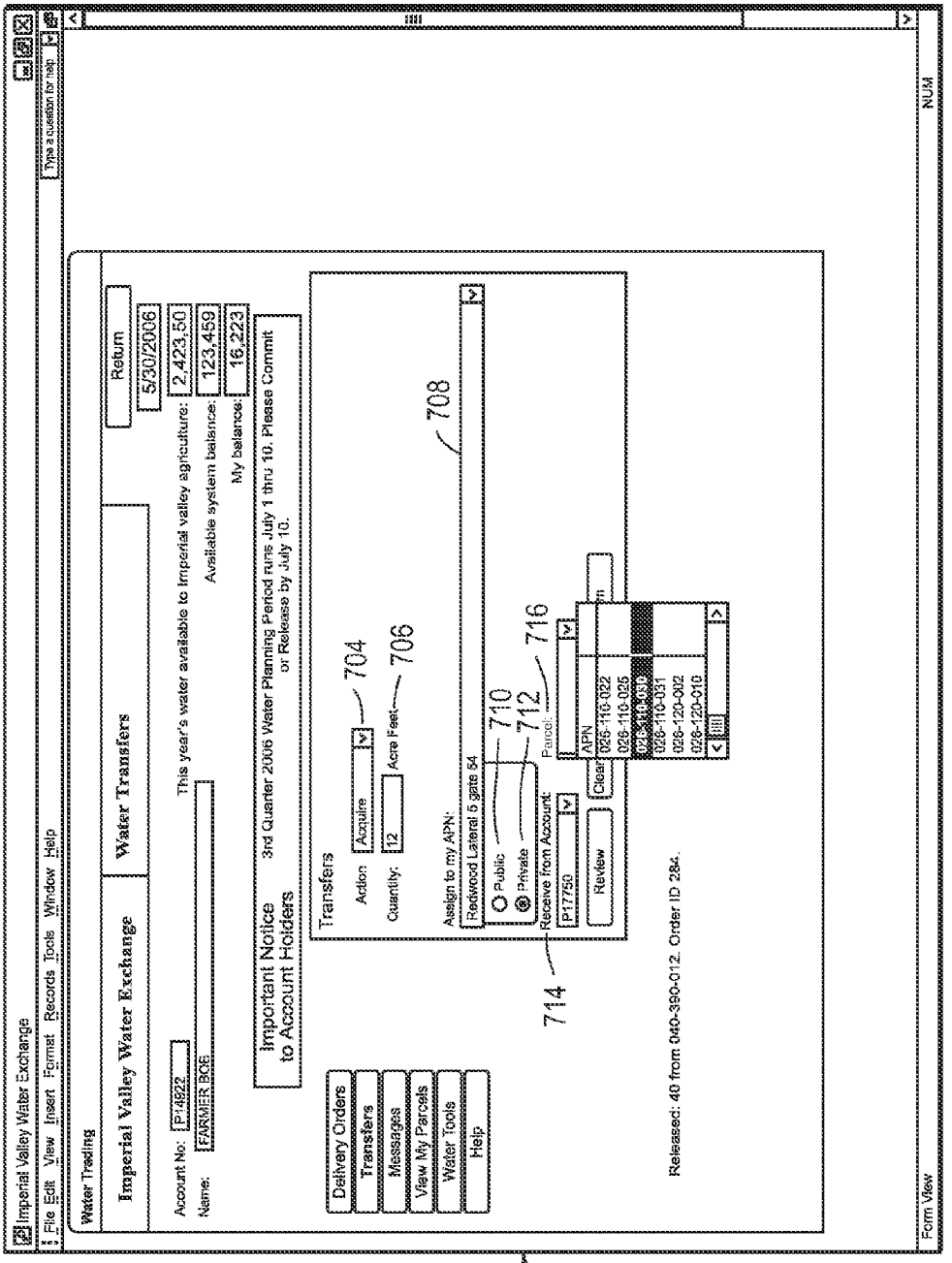

700
702
Imperial Valley Water Exchange
File Edit View Insert Format Records Tools Window Help
Water Trading
Imperial Valley Water Exchange
Water Transfers
Return
Account No: P14922
Name: FARMER BOB
This year's water available to Imperial valley agriculture: 2,423.50
Available system balance: 123,459
My balance: 16,223
5/30/2006
Important Notice to Account Holders
3rd Quarter 2006 Water Planning Period runs July 1 thru 10. Please Commit or Release by July 10.
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
Transfers
Action: Acquire
Quantity: 12 Acre Feet
Assign to my APN:
Redwood Lateral 5 gate 84
Public
Private
Receive from Account:
P17750
Review
Parcel:
APN
026-110-022
026-110-025
026-110-031
026-120-002
026-120-010
Released: 40 from 040-390-012. Order ID 284.
704
706
708
710
712
714
716
Form View
NUM

FIG. 7

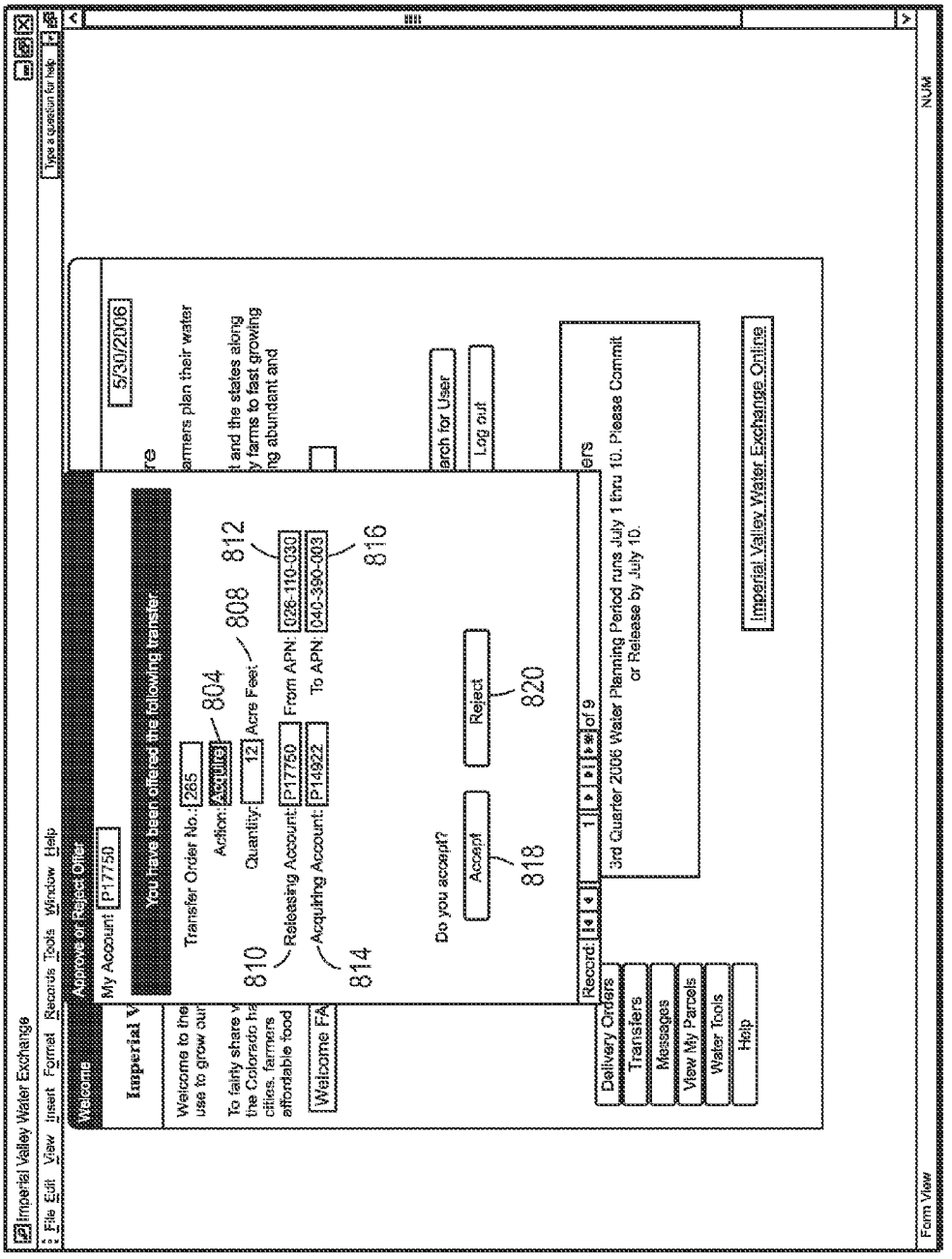

800
Imperial Valley Water Exchange
File Edit View Insert Format Records Tools Window Help
Welcome
Approve or Reject Offer
My Account P17750
Imperial V
You have been offered the following transfer:
Transfer Order No.: 265
Action: Acquire
Quantity: 12 Acre Feet
Releasing Account: P17750
Acquiring Account: P14922
From APN: 026-110-030
To APN: 040-390-003
804
808
812
816
810
814
Do you accept?
Accept
Reject
818
820
Record: 1 of 9
Delivery Orders
Transfers
Messages
View My Parcels
Water Tools
Help
3rd Quarter 2006 Water Planning Period runs July 1 thru 10. Please Commit or Release by July 10.
5/30/2006
Log out
Imperial Valley Water Exchange Online
Form View
NUM

FIG. 8

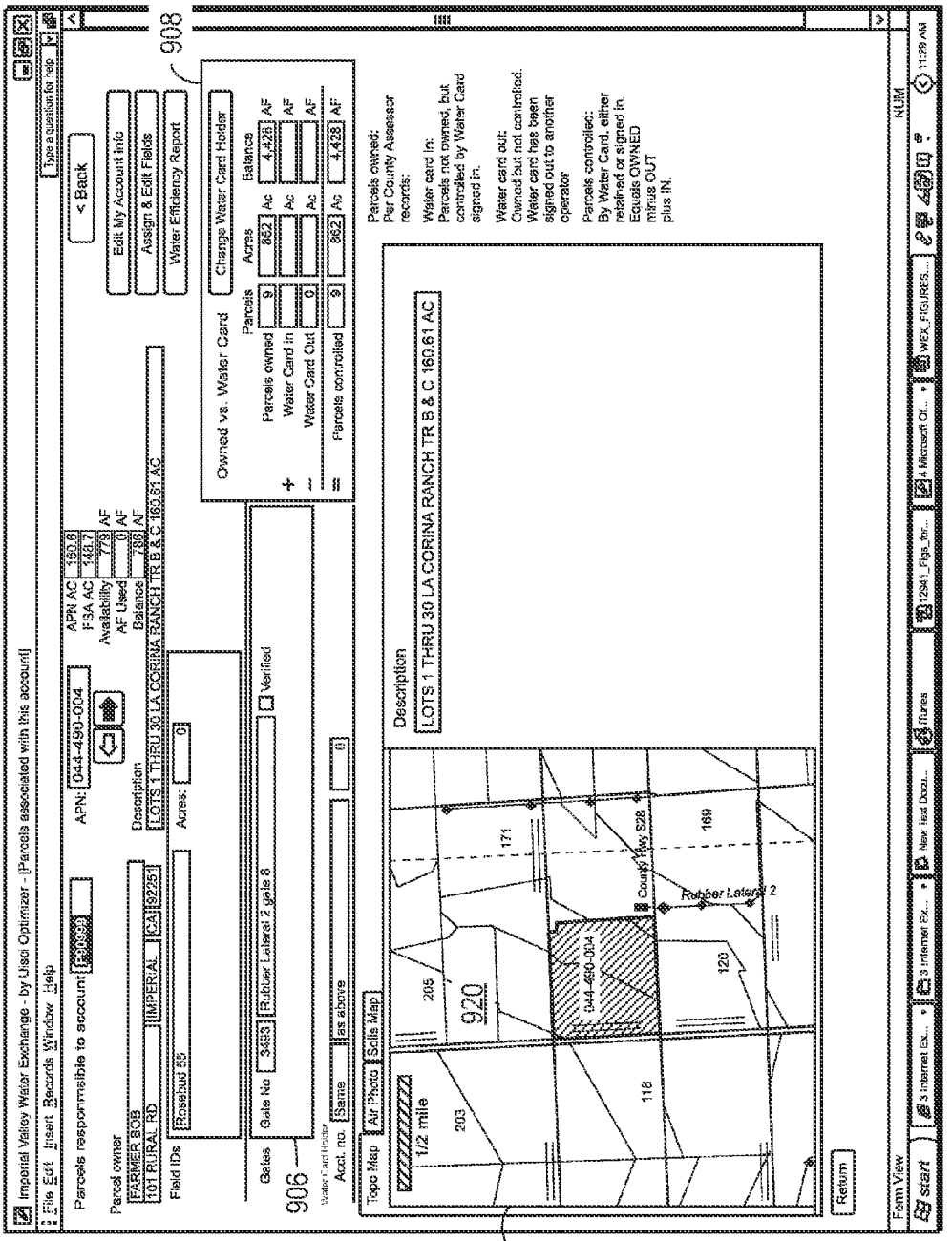

900
904
906
908
Imperial Valley Water Exchange - by Ussi Optimizer - [Parcels associated with this account]
File Edit Insert Records Window Help
Parcels responsible to account
APN:
044-490-004
APN AC
FSA AC
Availability
AF Used
Balance
< Back
Edit My Account Info
Assign & Edit Fields
Water Efficiency Report
Parcel owner
FARMER BOB
101 RURAL RD
IMPERIAL CA 92251
Description
LOTS 1 THRU 30 LA CORINA RANCH TR B & C 160.61 AC
Field IDs
Rosebud 85
Acres:
Owned vs. Water Card
Change Water Card Holder
Parcels
Acres
Balance
Parcels owned
Water Card In
Water Card Out
Parcels controlled
Gates
Gate No.
3483
Rubber Lateral 2 gate 8
Verified
Water Card Holder
Acct. no.
Same
as above
Topo Map
Air Photo
Soils Map
Description
LOTS 1 THRU 30 LA CORINA RANCH TR B & C 160.61 AC
Parcels owned:
Per County Assessor records:
Water card in:
Parcels not owned, but controlled by Water Card signed in.
Water card out:
Owned but not controlled. Water card has been signed out to another operator
Parcels controlled:
By Water Card, either retained or signed in.
Equals OWNED
minus OUT
plus IN.
1/2 mile
920
205
203
171
169
118
120
044-490-004
County Hwy S28
Rubber Lateral 2
Return
Form View
NUM
start
11:29 AM

FIG. 9

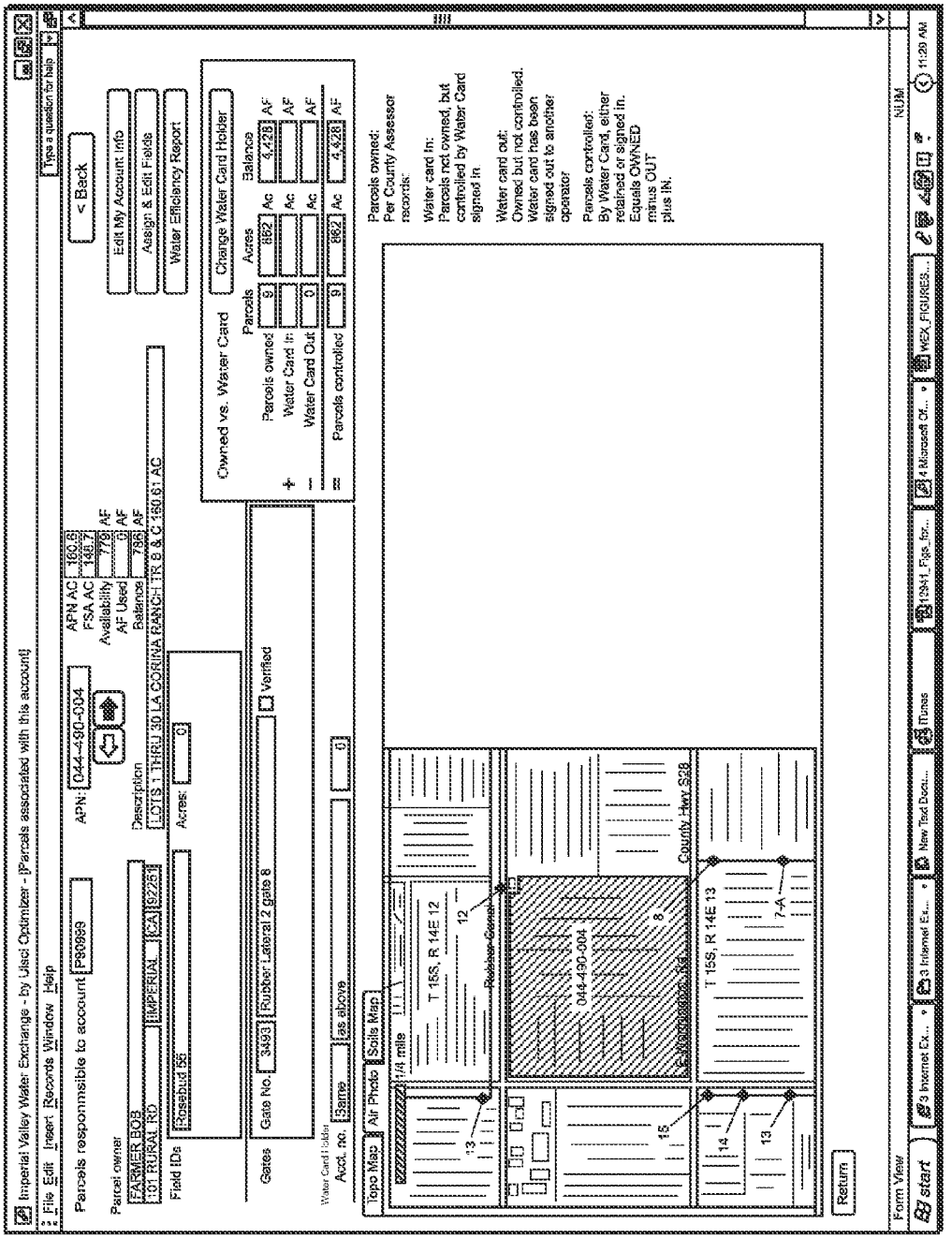
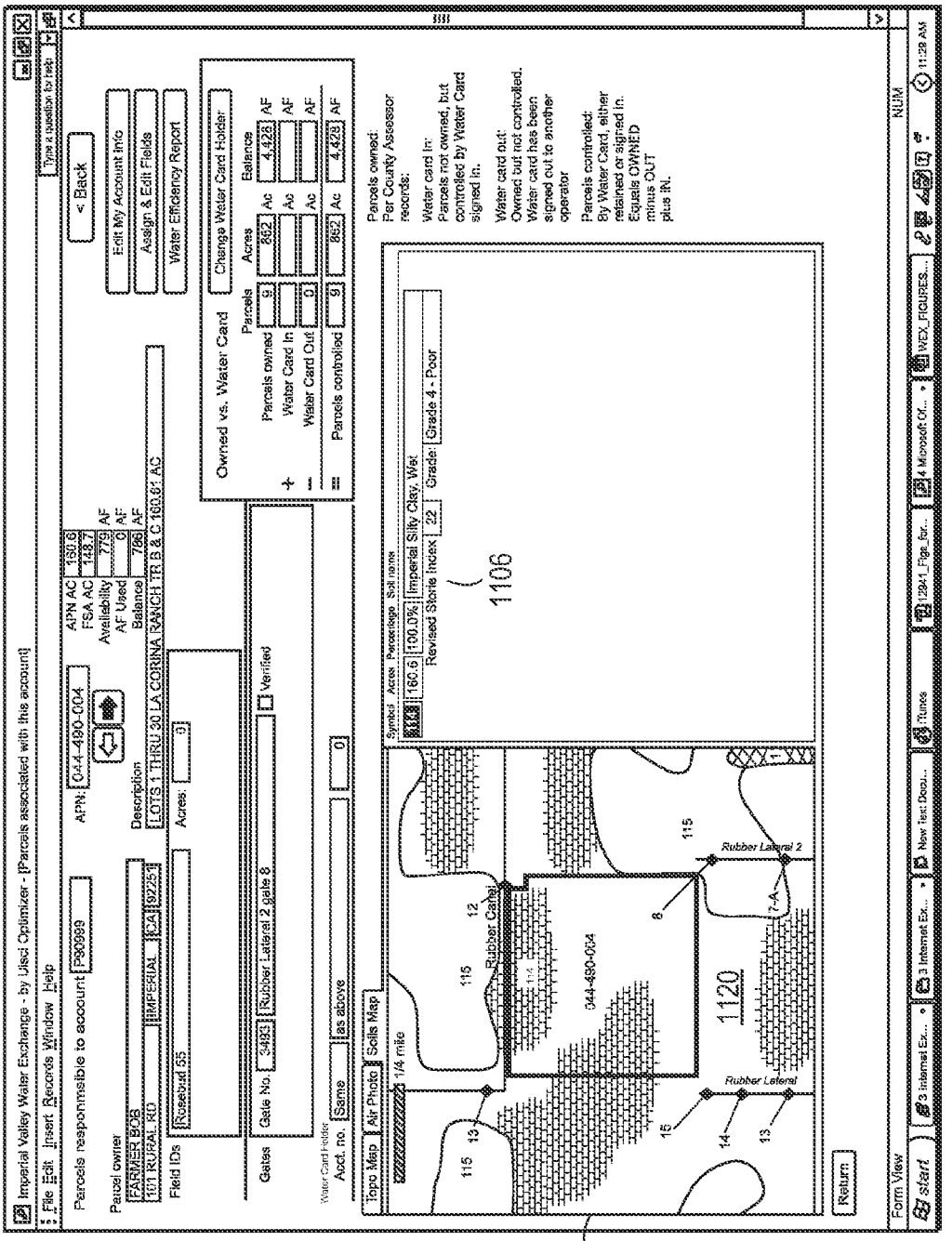

Imperial Valley Water Exchange - by Ussi Optimizer - [Parcels associated with this account]
File Edit Insert Records Window Help
Type a question for help
Parcels responsible to account P80969
APN: 044-490-004
APN AC 160.6
FSA AC 148.7
Availability 776 AF
AF Used 0 AF
Balance 786 AF
< Back
Edit My Account Info
Assign & Edit Fields
Water Efficiency Report
Parcel owner
FARMER BOB
101 RURAL RD
IMPERIAL CA 92251
Description
LOTS 1 THRU 30 LA CORINA RANCH TR & C 160.61 AC
Field IDs
Rosebud 56
Acres: 0
Owned vs. Water Card
Change Water Card Holder
Balance
Parcels
Acres
Parcels owned 9 862 Ac 4,428 AF
+ Water Card In: 0 Ac AF
- Water Card Out 0 Ac AF
= Parcels controlled 9 862 Ac 4,428 AF
Gates
Gate No. 3493 Rubber Lateral 2 gate 8
Verified
Water Card Holder
Acct. no. Same as above 0
Topo Map Air Photo Soils Map
1/4 mile
T 15S, R 14E 12
T 15S, R 14E 13
044-490-004
Redrock Canal
County Hwy S28
Parcels owned:
Per County Assessor records:
Water card In:
Parcels not owned, but controlled by Water Card signed in.
Water card out:
Owned but not controlled. Water Card has been signed out to another operator
Parcels controlled:
By Water Card, either retained or signed in.
Equals OWNED minus OUT plus IN.
Return
Form View
NUM
start
3 Internet Ex...
New Text Docu...
Runas
12941_Figs_for...
4 Microsoft Off...
WEX_FIGURES...
11:09 AM

FIG. 10


Imperial Valley Water Exchange - by Ussi Optimizer - [Parcels associated with this account]
File Edit Insert Records Window Help
Parcels responsible to account P90999
APN: 044-490-004
APN AC 166.6
FSA AC 148.7
Availability 779 AF
AF Used 0 AF
Balance 786 AF
< Back
Edit My Account Info
Assign & Edit Fields
Water Efficiency Report
Parcel owner
FARMER BOB
101 RURAL RD
IMPERIAL CA 92251
Description
LOTS 1 THRU 30 LA CORINA RANCH TR B & C 160.61 AC
Field IDs
Rosebud 55
Acres 0
Owned vs. Water Card
Change Water Card Holder
Parcels
Acres
Balance
Parcels owned 9 862 Ac 4,428 AF
Water Card In 0 Ac AF
Water Card Out 0 Ac AF
Parcels controlled 91 862 Ac 4,428 AF
Gates
Gate No. 3493 Rubber Lateral 2 gate 8
Verified
Water Card Holder
Acct. no. Same as above 0
Parcels owned:
Per County Assessor records:
Water card In:
Parcels not owned, but controlled by Water Card signed in.
Water card out:
Owned but not controlled. Water card has been signed out to another operator
Parcels controlled:
By Water Card, either retained or signed in.
Equals OWNED
minus OUT
plus IN.
Topo Map
Air Photo
Soils Map
1/4 mile
Symbol Acres Percentage Soil name
166.6 100.0% Imperial Silty Clay, Wet
Revised Storie Index 22 Grade Grade 4 - Poor
1106
1120
044-490-004
Rubber Cahal
Rubber Lateral
Rubber Lateral 2
Return
Form View
NUM
start
11:28 AM

1104

FIG. 11

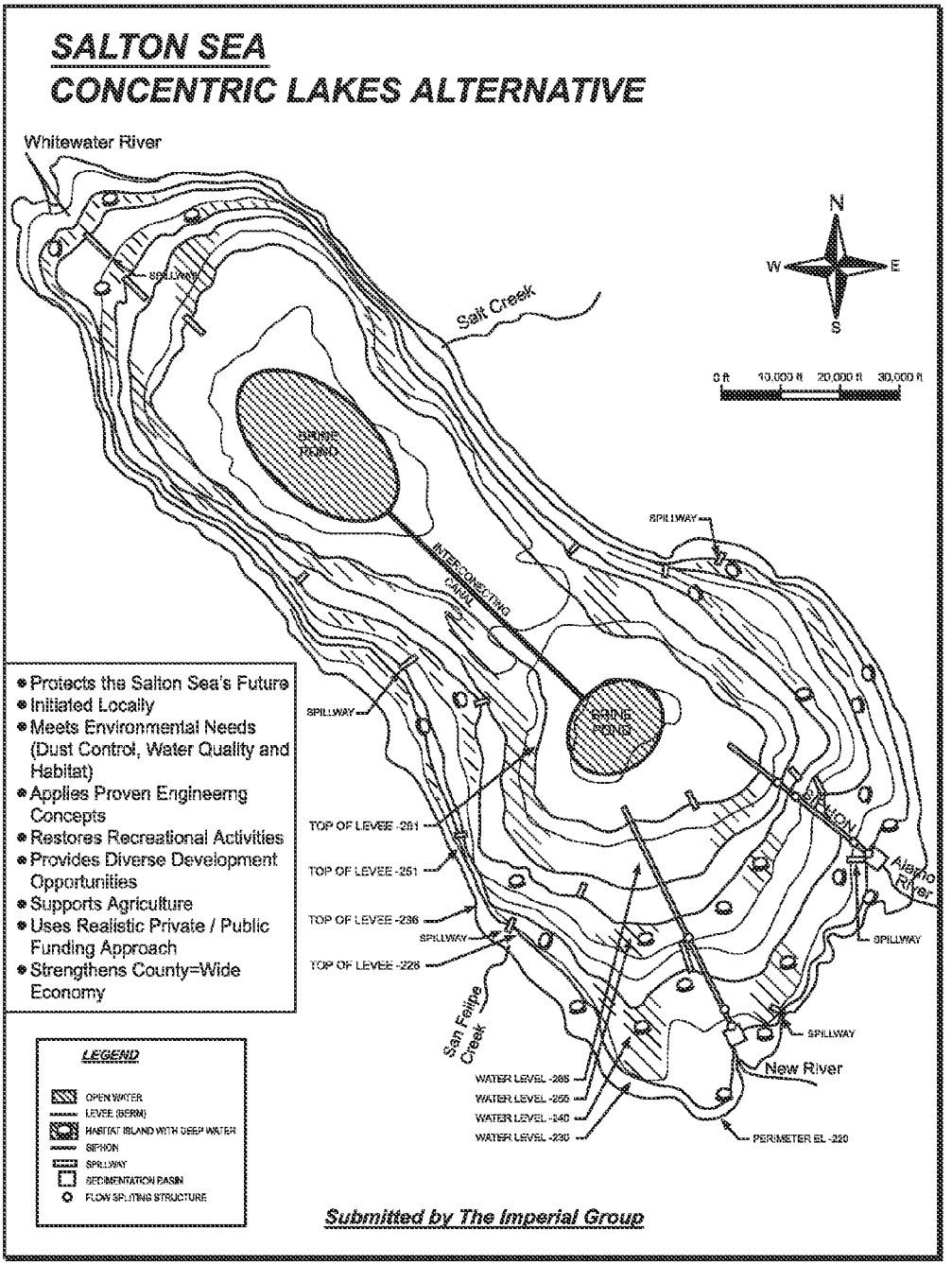

SALTON SEA
CONCENTRIC LAKES ALTERNATIVE
Whitewater River
Salt Creek
N
W
E
S
0 ft
10,000 ft
20,000 ft
30,000 ft
BRINE POND
INTERCONNECTING CANAL
SPILLWAY
SIPHON
Alamo River
New River
San Felipe Creek
TOP OF LEVEE -251
TOP OF LEVEE -251
TOP OF LEVEE -236
TOP OF LEVEE -228
WATER LEVEL -265
WATER LEVEL -255
WATER LEVEL -240
WATER LEVEL -230
PERIMETER EL -220
• Protects the Salton Sea's Future
• Initiated Locally
• Meets Environmental Needs (Dust Control, Water Quality and Habitat)
• Applies Proven Engineering Concepts
• Restores Recreational Activities
• Provides Diverse Development Opportunities
• Supports Agriculture
• Uses Realistic Private / Public Funding Approach
• Strengthens County=Wide Economy
LEGEND
OPEN WATER
LEVEE (BERM)
HABITAT ISLAND WITH DEEP WATER
SIPHON
SPILLWAY
SEDIMENTATION BASIN
FLOW SPLITTING STRUCTURE
Submitted by The Imperial Group

FIG. 12

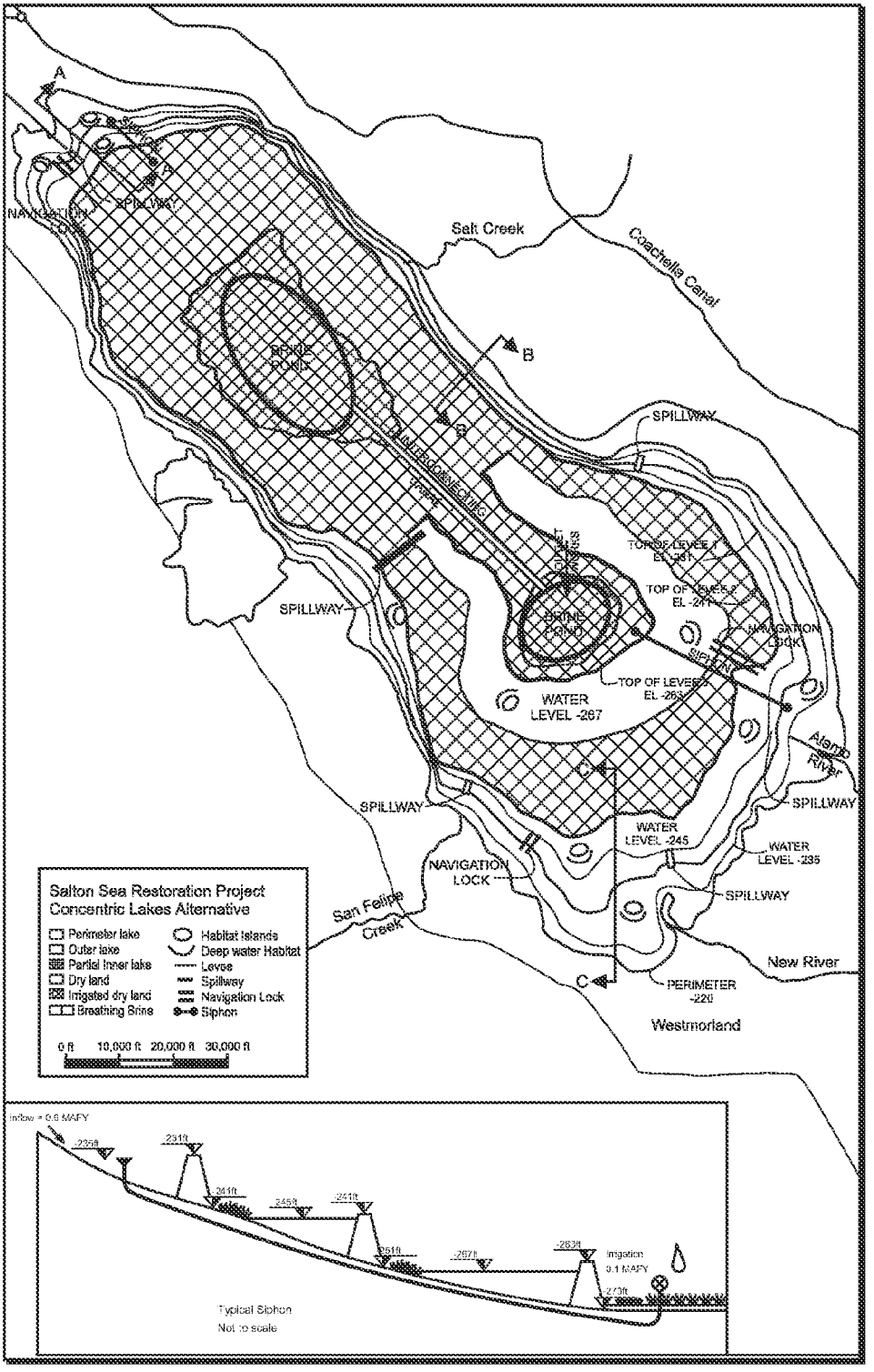

A
B
C
NAVIGATION LOCK
SPILLWAY
Salt Creek
Coachella Canal
SPILLWAY
SPILLWAY
SPILLWAY
SPILLWAY
SPILLWAY
WATER LEVEL -267
WATER LEVEL -245
WATER LEVEL -235
NAVIGATION LOCK
NAVIGATION LOCK
San Felipe Creek
New River
Alamo River
PERIMETER -220
Westmorland
Salton Sea Restoration Project
Concentric Lakes Alternative
Perimeter lake
Outer lake
Partial Inner lake
Dry land
Irrigated dry land
Breathing Brine
Habitat Islands
Deep water Habitat
Levee
Spillway
Navigation Lock
Siphon
0 ft 10,000 ft 20,000 ft 30,000 ft
Inflow = 0.8 MAFY
-235ft
-231ft
-241ft
-245ft
-241ft
-261ft
-267ft
-263ft
Irrigation 0.1 MAFY
-273ft
Typical Siphon
Not to scale

FIG. 13

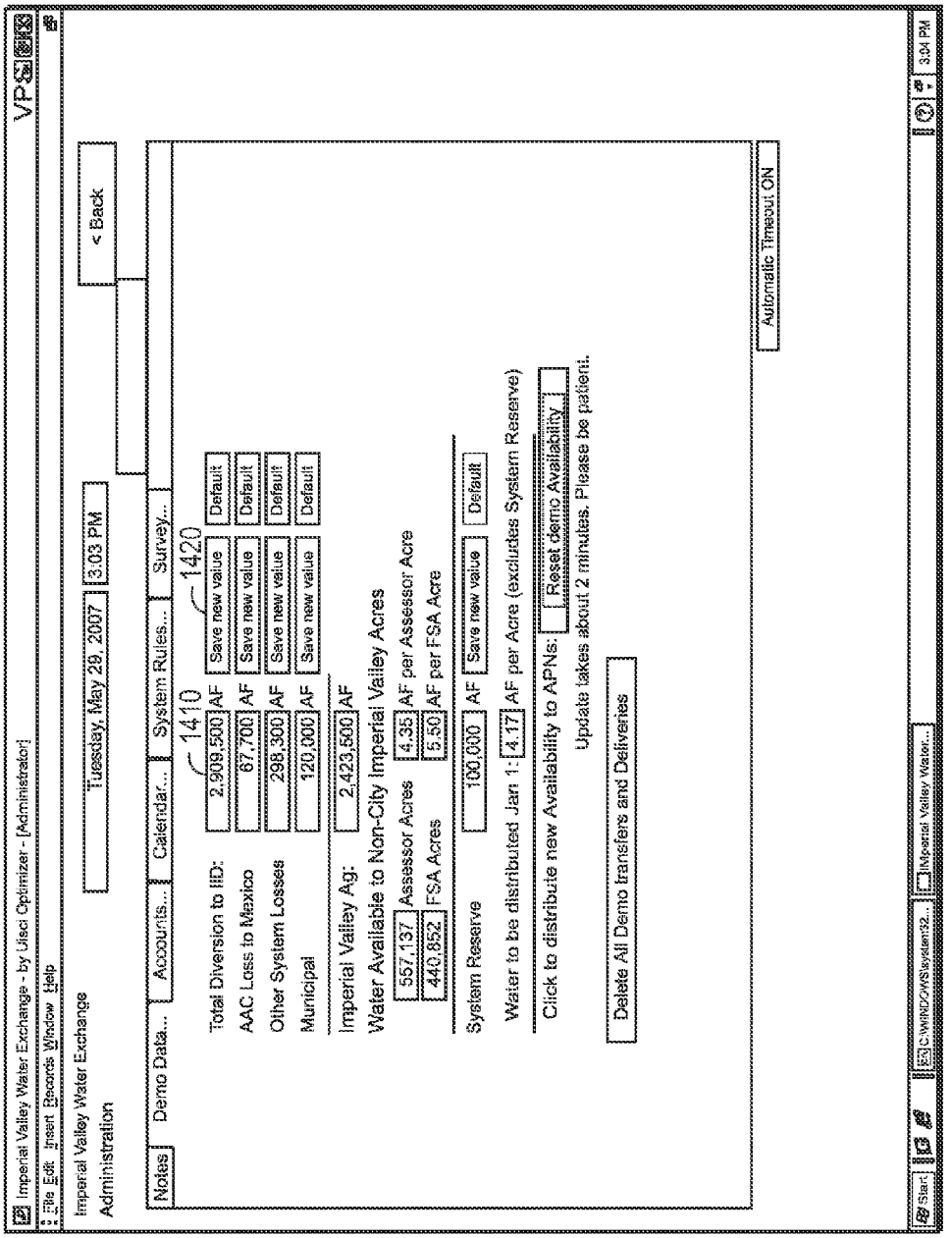

1400
Imperial Valley Water Exchange - by Ulaci Optimizer - [Administrator]
File Edit Insert Records Window Help
Imperial Valley Water Exchange
Administration
Tuesday, May 29, 2007
3:03 PM
< Back
Notes
Demo Data...
Accounts...
Calendar...
System Rules...
Survey...
1410
1420
Total Diversion to IID:
2,909,500 AF
Save new value
Default
AAC Loss to Mexico
67,700 AF
Save new value
Default
Other System Losses
298,300 AF
Save new value
Default
Municipal
120,000 AF
Save new value
Default
Imperial Valley Ag:
2,423,500 AF
Water Available to Non-City Imperial Valley Acres
557,137 Assessor Acres
4.35 AF per Assessor Acre
440,852 FSA Acres
5.50 AF per FSA Acre
System Reserve
100,000 AF
Save new value
Default
Water to be distributed Jan 1: 4.17 AF per Acre (excludes System Reserve)
Click to distribute new Availability to APNs:
Reset demo Availability
Update takes about 2 minutes. Please be patient.
Delete All Demo transfers and Deliveries
Automatic Timeout ON
Start
C:\WINDOWS\system32...
Imperial Valley Water...
3:04 PM

FIG. 14

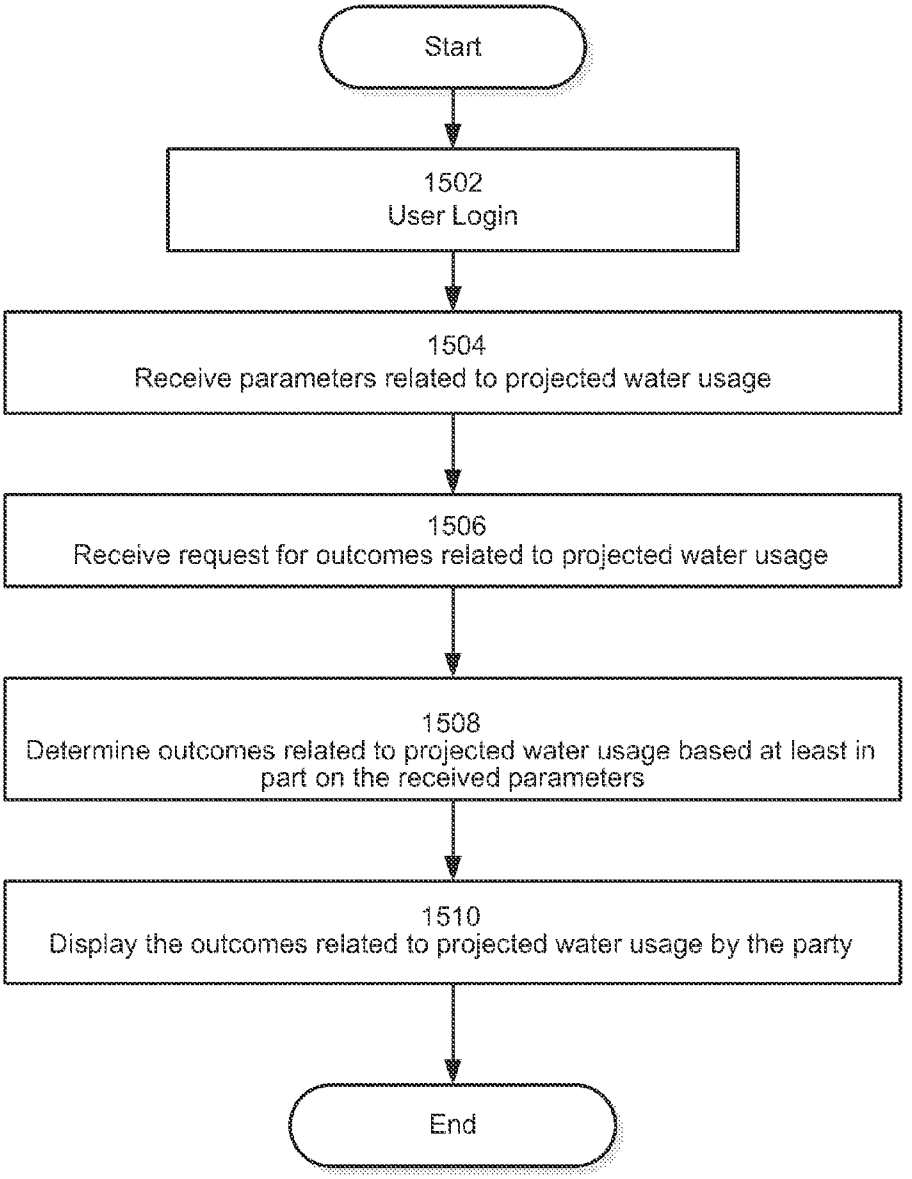

Start
1502
User Login
1504
Receive parameters related to projected water usage
1506
Receive request for outcomes related to projected water usage
1508
Determine outcomes related to projected water usage based at least in part on the received parameters
1510
Display the outcomes related to projected water usage by the party
End

Fig. 15

State of California
State Water Resources Control Board
DIVISION OF WATER RIGHTS
1001 I Street, 14th Floor, Sacramento, CA 95812

P.O. Box 2000, Sacramento, CA 95812-2000
Info: (916) 341-5300, FAX: (916) 341-5400, Web: http://www.waterrights.ca.gov

STATEMENT OF WATER DIVERSION AND USE

(This is not a water right)

This Statement should be typewritten or legibly written in ink and submitted to the address above.
A separate statement should be filed for each point of diversion. A duplicate copy will be returned to your file.

A. Name of person diverting water SAMPLE LAND OWNER NAME
Address SAMPLE ADDRESS
Telephone: (510) 521-4575

B. Water is used under: Riparian claim: ☐ Pre 1914 right: ☐ Other (explain) (see footnote 1)

C. Name of the body of water at the point of diversion
Colorado River (All American Canal)

Tributary to

D. Point of diversion is located within Imperial County on Assessors Parcel # 019-070-015

being within the SE 1/4 of SW 1/4 of Section 24, of Township 12 S, Range 11 E, San Bern. B.M.
Name of works Imperial Irrigation District (see footnote 2)

E. Do you own the land at the point of diversion? Yes ☐ NO ☑ The name and address of the owner of the land is:
Land is being held in trust by Imperial Irrigation District (footnote 3)

F. Capacity of diversion works unknown Capacity of storage tanks or reservoir 0 AF

Type of diversion facility: Gravity ☑ Pump ☐

Method of measurement: Weir ☐ Flume ☐ Electric Meter ☐ Estimate ☑ (see footnote 4)

G. Enter the amount (or approximate amount) of water used each month.
Amounts below are shown in: Acre-feet

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total Annual
2000 - 2002	23.2	27.8	40.4	49.8	52.4	48.0	53.3	48.3	41.6	37.8	28.6	22.4	473.7

H. Annual water use in recent years: Maximum 474 Acre Feet Minimum 0 AF
Year of first use (nearly as known) 1900 (estimated) (see footnote 5)

I. Purpose of use: What is the water being used for: (example, number of acres and type of crop irrigated, average number of persons served, number of stock watered, etc.) (see footnote 6)

J. General description or location of place of use (example: 40 acres of pasture located 3 miles from Happyville on Alpha Road)
Current water use on 160 acres, about 3/4 mile northwest of Barth Rd and State Hwy 78. See attached map

K. Map: Please locate the point of diversion and place of use on a print of a USGS quad map, or make a sketch on the section grid provided on the reverse side of this form. The sketch should identify the section lines, prominent local landmarks and roads, your point of diversion, and your place of use (your house, acreage irrigated, etc.). (see footnote 7)

L. Please answer only those questions below which are applicable to your project.

Additional copies of this form and water right information can be obtained at www.waterrights.ca.gov.

STATEMENT (12-03) P17614 019-070-015 A

FIG. 16A

1. Conservation of water
   a. Describe any water conservation efforts you may have started: see footnote 8

2. Water quality and wastewater reclamation
   a. Are you now or have you been using reclaimed water from a wastewater treatment facility, desalination facility or water polluted by waste to a degree which unreasonably affects such water for other beneficial uses? YES ☐ NO ☑

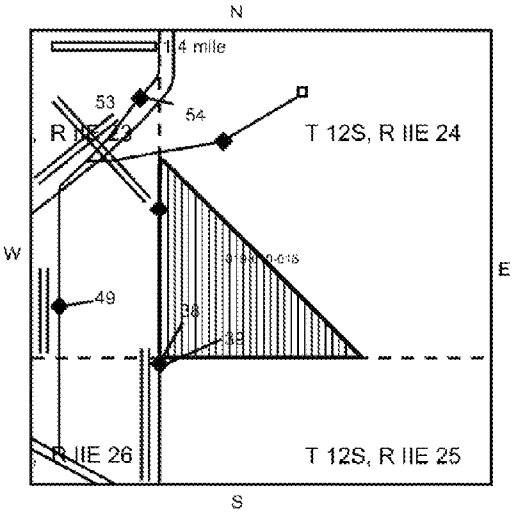
I declare under penalty of perjury that the information in this report is true to the best of my knowledge and belief.

DATE: _____ at _____, California

SIGNATURE: _____

PRINTED NAME: _____
(first name) (middle init.) (last name)

COMPANY NAME: _____



The location of the diversion point and the place of use may be sketched on the section grid provided. If it is used, please enter the section(s), township, range and the base meridian below. Also, show any streams or other landmarks that will assist in identifing the area.

Section(s): 24

Township 12 S

Range 11 E

San Bern. BM

General area of use is within Imperial County and historic San Diego County

GENERAL INFORMATION PERTAINING TO WATER RIGHTS IN CALIFORNIA

There are two principal types of surface water rights in California. They are riparian and appropriative rights.

A riparian right enables an owner of land bordering a natural lake or stream to take and use water on his riparian land. Riparian land must be in the same watershed as the water source and must never have been severed from the source of supply by an intervening parcel without reservation of the riparian right to the severed parcel. Generally, a riparian water user must share the water supply with other riparian users. Riparian rights may be used to divert the natural flow of a stream but may not be used to 1) store water for later use 2) divert water which originates in a different watershed 3) divert water released from storage, or 4) divert return flows from groundwater use.

An appropriative right is required for use of water on nonriparian land and for storage of water. Generally, appropriative rights may be exercised only when there is a surplus not needed by riparian water users. Since 1914 new appropriators have been required to obtain a permit and license from the State.

Statements of Water Diversion and Use must be filed by a riparian and pre-1914 appropriative water users. The filing of a statement (1) provides a record of water use, (2) enables the State to notify such users if someone proposes a new appropriation upstream from their diversion, and (3) assists the State to determine if additional water is available for future appropriators.

The above discussion is provided for general information. For more specific information concerning water rights, please contact an attorney or write to this office. We have several pamphlets available. They include: (1) Statements of Water Diversion and Use, (2) Information Pertaining to Water Right in California and (3) Appropriation of Water in California.

STATEMENT (12-03)

P17614 019-070-015 A

FIG. 16B

STATEMENT OF WATER DIVERSION AND USE FOOTNOTES

Footnote 1 - CLAIM OF RIGHT:
Claimant(s) relies on predecessor's pre-1914 claims as set forth in the decrees, decisions, and record submitted in Arizona v. California, including the chains of title, admissions of the Imperial Irrigation District, testimony and exhibits therein.

The Seven-Party Agreement -

Claimant(s) relies on the record, admissions, and holdings in Bryant v. Yellen (1980) 447 US 352.

Claimant(s) relies on California law as applicable to irrigation districts, i.e., the Wright Act, as currently codified in the Water Code, including, but not limited to sections 22250 et seq., 22437 and the authority interpreting said statutory and customary law.

Claimant(s) relies on the public policy of the State of California with respect to conservation and optimization of water resources, including but not limited to Water Code section 1011.

Claimant(s) rely on WRO 2002-0013.

With respect to water used or related to power development, claimant(s) rely on Ney-Cal Electric Securities v. IID (1936) 85 F.2d 886, cert denied.

Footnote 2 - POINT(S) OF DIVERSION:
Colorado River at Imperial Dam, Sec 9 Township 15 S Range 24 E SBM as per Permit 7643 point, and the Whitsett Intake at Lake Havasu as a point of diversion. Whitsett Intake is located at N0319200, E3160300 by California Coordinates in Zone 5 and is within Section 28, Township 03 N, Range 27 E, SBB&M.

Footnote 3 - Diversion Points: The primary diversion system is operated by IID for the benefit of landowners pursuant to a Trust established by the landowners. There is re-diversion from IID's system to the landowners system. The diversion point to the Landowner's system is set forth on the attached map.

Footnote 4: This information is under control of IID and we are attempting to obtain said information.

Footnote 5: This is a compilation of the highest uses of water on a monthly basis between 2000-2002. It includes the 100,000-acre feet of water annually diverted to MWD. This calculation is less than the 3.85 MAF annual water to which the landowners are entitled on IID's behalf, i.e., the Seven Party Agreement. The exact entitlement for each parcel will be determined after further information is obtained from IID and then further analysis the Assessor's Records is made.

Footnote 6 - USE OF WATER:
Water is used to irrigate crops including leaching and pre-irrigation and is authorized for related uses, power development, and municipal uses pursuant to the authority stated above.

Footnote 7 - AREAS OF USE:
Imperial County and San Diego County as to pre-1914 rights and additionally the service areas of San Diego County Water Authority and the Coachella Valley Water District, Improvement District No. 1; and Metropolitan Water District, per WRO 2002-0013, and any other Constitutionally permissible area pursuant to the North American Free Trade Agreement and/or Sporhase v. Nebraska, ex rel. Douglas (1982) 458 U.S. 941.

Footnote 8: Diverter and/or diverter's agent(s) utilize a variety of conservation methods depending on variables, including crops grown, soil conditions, and water needs. The methods used and/or available for the diverter include, but are not limited to, crop rotation, fallowing, pump-back systems, sprinklers, drip systems, leveling, and tiling.

FIG. 16C

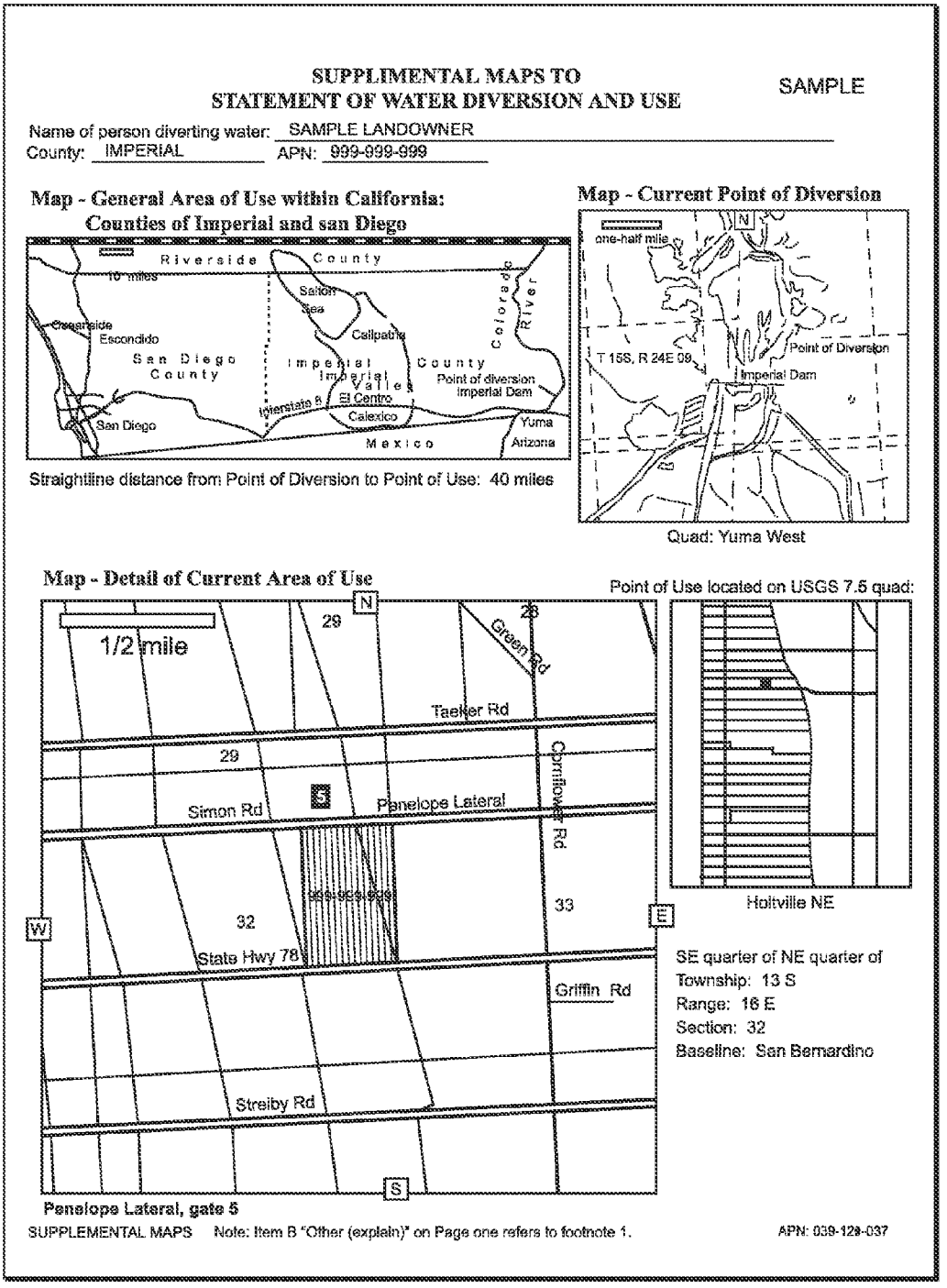

SUPPLIMENTAL MAPS TO
STATEMENT OF WATER DIVERSION AND USE
SAMPLE
Name of person diverting water: SAMPLE LANDOWNER
County: IMPERIAL APN: 999-999-999
Map - General Area of Use within California:
Counties of Imperial and san Diego
Riverside County
10 miles
Salton Sea
Colorado River
Oceanside
Escondido
San Diego County
Imperial Valley
Imperial County
Point of diversion Imperial Dam
Interstate 8
El Centro
Calexico
San Diego
Mexico
Yuma
Arizona
Straightline distance from Point of Diversion to Point of Use: 40 miles
Map - Current Point of Diversion
N
one-half mile
T 15S, R 24E 08
Point of Diversion
Imperial Dam
Quad: Yuma West
Map - Detail of Current Area of Use
Point of Use located on USGS 7.5 quad:
N
1/2 mile
29
28
Green Rd
Taeker Rd
29
Simon Rd
Penelope Lateral
Ciprianower Rd
33
W
E
32
State Hwy 78
Griffin Rd
Streiby Rd
S
Holtville NE
SE quarter of NE quarter of
Township: 13 S
Range: 16 E
Section: 32
Baseline: San Bernardino
Penelope Lateral, gate 5
SUPPLEMENTAL MAPS Note: Item B "Other (explain)" on Page one refers to footnote 1.
APN: 039-129-037

FIG. 16D

SYSTEMS AND METHODS FOR OPTIMIZED WATER ALLOCATION

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation in part of application Ser. No. 11/761,896, entitled "Systems and Methods for Optimized Water Allocation," filed Jun. 12, 2007, which claims priority under 35 U.S.C. §119(e) to U.S. Provisional Patent Application Ser. No. 60/815,157, entitled "Systems and Methods for Water Optimization," filed Jun. 19, 2006, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to systems and methods for optimizing water distribution. More particularly, the present invention relates to systems and methods for establishing and querying a database of information for optimizing water distribution within a defined geographical area and providing useful output as a result of such queries. The system and method also provide for exchange of water rights and the output of data in a useful form, such as a map, graph, list, summary, or chart. The system and method also provide for water planning based on consideration of specified parameters.

2. Description of the Related Art

Water is a vital natural resource. In addition to the aesthetic pleasantries of green lawns, swimming pools and fountain shows in areas that would otherwise be desert without irrigation, water provides the foundation for agriculture, industries and residences to function.

Currently, public databases in some states provide listings of an estimated amount of water used per parcel of land by location. Other resources provide additional information related to land, such as water evaporation, climate, crops grown, crop rotation, soil type, ownership, water rights, financial support, investment, or other factors. However, the databases are of questionable accuracy.

In addition, water planning has been executed in a piecemeal, manual fashion. The additional information needed to create a comprehensive water plan is not integrated and therefore incomplete and/or inaccurate projections result.

With the occurrence of more frequent droughts, burgeoning population increases, and the likelihood of global warming impacting the availability of water, there is a need for a way to optimize the allocation of water and the planning of water usage.

SUMMARY OF THE INVENTION

In one or more embodiments, the present invention provides a method for water exchange comprising receiving information related to water usage of a client; receiving from the client a request for a water exchange; determining a potential match for the water exchange request; and transmitting the potential match determination to the client.

The present invention further provides a method for optimizing allocation of water comprising receiving a request for information related to water usage of a party; receiving information related to the party's water usage; determining a projected water usage by the party; determining an optimized allocation of the party's water usage based at least in part on the projected water usage by the party and water quality; and displaying the optimized allocation of the party's water usage.

The present invention further provides a method for water planning comprising receiving parameters related to projected water usage of a party; receiving a request for outcomes related to projected water usage of the party; determining outcomes related to projected water usage by the party based at least in part on the received parameters; and displaying the outcomes related to projected water usage by the party.

The present invention further provides a system for water exchange comprising a water usage module configured to receive information related to water usage; a communication module configured to receive a request for a water exchange; and a water exchange module configured to determine a potential match for the water exchange request.

The present invention further provides a system for optimizing allocation of water, the system comprising a water usage module configured to receive information related to water usage by a party; a water projection module configured to estimate projected water usage by the party; and an optimization module configured to determine an optimized allocation of the party's water usage based at least in part on the projected water usage by the party.

The present invention further provides a system for water planning comprising a parameter module configured to receive parameters related to projected water usage by a party; and an outcome determination module configured to determine outcomes related to projected water usage by the party based at least in part on the received parameters.

The present invention further provides a computer program product for producing a user interface of a system for optimizing allocation of water, the user interface comprising a first display area for listing information related to water usage; a second display area, visually distinguished from and concurrently displayed with the first display area, for receiving criteria related to water usage to be included in the first display area; and a third display area, visually distinguished from and concurrently displayed with the first and second display areas, for displaying a water account balance for the client.

The features and advantages described herein are not all-inclusive, and many additional features and advantages will be apparent to one of ordinary skill in the art in view of the figures and description. Moreover, it should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated by way of example, and not by way of limitation in the figures of the accompanying drawings in which like reference numerals are used to refer to similar elements.

FIG. **1** is a block diagram depicting a system architecture for practicing the present invention according to one embodiment.

FIG. **2** is a flowchart depicting a method for practicing the present invention according to one embodiment.

FIG. **3** is a flowchart depicting another method for practicing the present invention according to one embodiment.

FIG. **4** is a graphical representation of a display device depicting an example of a public water release request according to one embodiment.

FIG. **5** is a graphical representation of a display device depicting an example of a water delivery order according to one embodiment.

FIG. **6** is a graphical representation of a display device depicting another example of a water delivery order according to one embodiment.

FIG. **7** is a graphical representation of a display device depicting an example of a water transfer acquisition request according to one embodiment.

FIG. **8** is a graphical representation of a display device depicting an example of a water transfer acquisition request according to one embodiment.

FIG. **9** is a graphical representation of a display device depicting an example of a topographic map of parcels owned and/or controlled by an account holder according to one embodiment.

FIG. **10** is a graphical representation of a display device depicting an example of an air photographic map of parcels owned and/or controlled by an account holder according to one embodiment.

FIG. **11** is a graphical representation of a display device depicting an example of a soils map of parcels owned and/or controlled by an account holder according to one embodiment.

FIG. **12** is an example of how the present invention can address variation in the amount of water supplied to the Salton Sea.

FIG. **13** is another example of how the present invention can address variation in the amount of water supplied to the Salton Sea.

FIG. **14** is a graphical representation of a display device depicting an example of inputting parameters according to one embodiment.

FIG. **15** is a flowchart depicting another method for practicing the present invention according to one embodiment.

FIGS. **16**A-**16**D are examples of forms that have been completed automatically using the present invention according to one embodiment.

One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the invention described herein.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Systems and methods for optimizing the allocation of water are described below. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the invention. It will be apparent, however, to one skilled in the art that the invention can be practiced without these specific details. In other instances, structures and devices are shown in block diagram form in order to avoid obscuring the invention. Furthermore, the particular arrangements of elements in screen shots shown here are illustrative of one embodiment and are not intended to limit the scope of the present invention.

Reference in the specification to "one embodiment," "an embodiment" or "the embodiment' means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment.

Some portions of the detailed descriptions that follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

The present invention also relates to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general-purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, and magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, or any type of media suitable for storing electronic instructions, each coupled to a computer system bus.

Finally, the algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general-purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear from the description below. In addition, the present invention is not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the invention as described herein.

According to one embodiment, the present invention provides an online tool for assisting users in managing water usage and determining projected water availability. In one embodiment, the online tool uses data received from an agency or institution (such as an irrigation district), combined with user-entered data and/or other data. This combination of data provides more accurate projections of account balances, since it takes into account water usage that may not yet be recorded or known to the irrigation district.

By providing users with an accurate picture of their current and projected water account balances, and taking into account

expected and future transactions and usage, the present invention allows users to better manage their water allocation and to ensure that sufficient water is available for expected needs.

According to another embodiment, the present invention provides a way to estimate optimized water allocation for various users taking into account past, current and projected water usage.

According to another embodiment, the present invention provides a way to plan for different outcomes related to projected water usage based on the consideration of various parameters related to projected water usage.

System

FIG. **1** shows a network **113** connecting a community of users **112**A-**112**N and a water optimization server **101**. FIG. **1** illustrates one embodiment by which a plurality of users **112**A-**112**N can manage and exchange information about water usage.

User **112**A views, inputs and edits information about water usage using a first client machine **107**A. The first client machine **107**A includes software and hardware for interacting with the water optimization server **101**.

In one embodiment, client machine **107**A is a computer of conventional design, and includes a processor, an addressable memory, and other conventional features (not illustrated) such as a display, local memory, input/output ports, and a network interface. In other embodiments one or more of the components of client machine **107**A may be located remotely and accessed via the network **113**. Client machine **107**A interacts with water optimization web server **101** via the network **113** such as the Internet. In one embodiment, the client communication module **120**A of client machine **107**A performs communication operations to enable such interaction via the Internet or some other network **113** such a LAN, a WAN, a MAN, a wired or wireless network, a private network, a virtual private network, or other networks. In various embodiments, client machine **107**A may be implemented as a computer running a Microsoft operating system, Mac OS, various flavors of Linux, UNIX, Palm OS, and/or other operating systems.

Other examples of computing devices will be apparent to one of skill in the art without departing from the scope of the present invention. For example, the first client machine **107**A can also be implemented as a personal digital assistant (PDA), a cellular telephone, or another device with web browsing capability.

The client machines **107**A-**107**N are connected to the network **113**. The network **113** can be implemented as any electronic medium by which content can be transferred. Through the network **113**, the client machines **107**A-**107**N can send and receive data from client machines **107**A-**107**N and the water optimization server **101**.

The present invention also includes software operable on the system of FIG. **1**. The first user communicates with the system using a Web browser **110**A of a conventional type such as Internet Explorer from Microsoft Corp. or Firefox by Mozilla. The Web browser **110**A is used in conventional manner to retrieve and present web pages.

In one embodiment, water optimization web server **101** comprises a water institution interface **151** for communicating with water institution **103** and a server communication module **152** for communicating with client machines **107**A-**107**N.

Water optimization web server **101** may comprise several modules coupled via a system bus (not shown). For example, location module **105**, reporting module **106**, exchange module **108**, projection module **111**, optimization module **115**, parameter module **130**, outcome determination module **132**, water institution interface **151**, and server communication module **152** are coupled together by a system bus, and may send signals to and receive signals from database **114**, other data **109** sources, water institutions **103**, and to client machines **107**A-**107**N.

The location module **105** provides information about a particular attribute concerning a parcel of land in response to inquiries from the client machine **107**A. For example, the location module **105** may provide information regarding geographic location, boundaries, and/or other parcel-related information. The location module **105** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information about the parcels of land, for example, from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The reporting module **106** provides information on a particular parcel of land in response to the attributes determined by the location module **105**, according to one embodiment. The reporting module **106** provides output in a useful form, such as a chart, graph, map, form or the like. The reporting module **106** can be used to automatically enter data into forms, according to one embodiment. The reporting module **106** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The exchange module **108** locates potential matches in response to a water exchange request. In a private exchange, the exchange module searches for one or more users **112**A-**112**N that desire to exchange a requested amount of water. In a public exchange, the exchange module **108** determines whether the availability of water that has been released to the system is sufficient to satisfy a request or whether the system can accept water from a user. The exchange module **108** also provides a way for a user to verify that a potential match is desired by the user, according to one embodiment. After an exchange has been executed, exchange module **108** sends updated account data to water institution **103** via water institution interface **151**. The exchange module **108** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The projection module **111** provides an estimated water usage based on various factors. For example, the projection module **111** may consider current water usage by the user, past water usage by the user, and expected water usage from the user based on the user's intended purpose for the water. The intended purpose can be divided into the following three categories: agricultural use, industrial use and power production. Agricultural use takes into account evaporation estimates, soil information, and climate estimates for the user's land. The projection module **111** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The optimization module **115** determines an optimized allocation of a party's water usage based on many factors. In one embodiment, the optimization module **115** considers total available water, estimated usage by another party, current water usage by another party, past water usage by another party, projected future usage, evaporation estimates, salinity information, crop information, soil types, water rights, climate estimates, and water quality. The optimization module **115** sends data to and receives data from client machines

107A-107N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

In one embodiment, the initial distribution of water availability is determined as a share of the total water available, proportional to each member's share of total irrigated acreage. Historically, water usage data has not been collected at a sufficient level to allow accurate analysis at the farm field level. Thus, the initial distribution is based on share of acreage, according to one embodiment.

As additional data about fields and crops are collected by the system, distribution can be enhanced by further analysis of water use efficiency. Administrative decisions can consider soil type, crop mix, efficiency history, and other factors to determine distribution, according to one embodiment. The usage data collected is also incorporated into efficiency planning tools made available to the users.

The parameter module **130** receives parameters related to water usage by a party. For example, the received parameters may include information about total available water in the system; water allocated to the party or to other parties; estimated, current or past water usage; evaporation data or estimates; salinity thresholds; climate data; data for the types of crops that have been or may be grown; crop rotation; soil type; ownership; water quality; water rights; financial support; financial investment; and the like. The water rights include the right to use water from different sources including a water body, surface water, ground water, etc. The different systems for determining water rights include, but are not limited to, riparian rights, groundwater, underflow, surface water, and pre-1914 appropriative rights.

The parameter module **130** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The outcome determination module **132** is configured to determine outcomes related to projected water usage by the party based at least in part on the received parameters. The outcomes related to projected water usage may include, for example, information related to water needs, return on investment, and crop yields. The outcome determination module **132** sends data to and receives data from client machines **107**A-**107**N via server communication module **152**. It also receives information from database **114**, other data **109** sources, and water institution **103** via water interface **151**.

The basic operation for the above described system is as follows. First, the user **112**A interacts with the Internet using a Web browser **110**A in the conventional manner. As part of this process, web pages, including content and hypertext links are displayed to the user **112**A. The user **112**A can select a portion of the web page and provide input. This happens automatically with the user **112**A selecting text from a web page being presented and initiates a function provided by the client communication module **120**A. The client communication module **120**A generates a request for a communication channel using the selected information. The client communication module **120**A sends this request to the server communication module **152**. The server communication module **152** processes the request.

Processing of the request includes providing a location to the location module **105**, and having the location module **105** determine various attributes about a parcel of land. Processing the request can also include the generating a query (such as a user driven query or a query constructed by the location module), which may be sent to the parameter module **130**, and applying that query to the database **114** to generate a list of information that satisfies the query parameters, such as that determined by outcome determination module **132**.

In addition, processing the request may include using the exchange module **108** to locate matches for water exchanges between users or between a user and the system, using projection module **111** to provide estimated water usage based on various factors, and/or using optimization module **115** to determine an optimized allocation of water usage based on many factors, as described above. Finally, processing the request may also include using the reporting module **106** to generate a map or other information that includes the attributes related to a parcel of land based on the selected input and/or automatically completing forms related to the water transfer. The processed information is then returned to the client communication module **120**A.

The database **114** stores a variety of different types of information about parcels of land, and is responsive to queries from the client machines **107**A-**107**N. There are a variety of parameters that can be set by the user **112**A to expose any portion of the data. The database **114** includes a first data portion that is relatively static in that it changes relatively infrequently. The database **114** includes a second data portion that is relatively dynamic in that the data changes frequently. For example, the second data portion can include information about water usage, climate, crops grown, crop rotation, soil type, ownership, water rights, financial support and/or investment.

The database **114** has software for interfacing one or more data stores. For example, database **114** can receive information from, for example, assessors' offices, irrigation districts, the United States Geological Survey, universities, colleges, almanacs, museums, libraries, bureaus of reclamation, a spatial database within a Graphical Information System ("GIS") and/or farm bureaus.

In one embodiment of database **114**, namely a spatial data model, reality can be represented by four spatial entities. These four elements are point, line, area, volume. In their most simplified form, spatially linked data are information associated with a specific location: for example, the location of a canal gate, or a farmer's crop. While there are an infinite number and variety of spatial data, these four spatial elements can replicate complicated geographic relationships and patterns.

An alternate embodiment of database **114**, a spatial database within a GIS is a collection of spatially referenced data that are combined to reflect reality and can be manipulated, transformed, and analyzed before being displayed on a map. The ways in which the four spatial data types are organized and modeled within a GIS determine to a very large extent its capabilities and functionality.

In another embodiment of database **114**, an object-oriented data model structured as the foundation of a GIS provides the ability to hold spatial data (attributes) in a database and enables the user to perform specific spatial queries. A spatial query seeks to find answers to geographical questions concerning but not limited to "adjacent," "within," "about," "near," "intersect," and "overlay." An object-oriented spatial data model does not organize and retrieve data based on the usual linked tables, but rather on data organized by object and class. In its most basic form, one object contains three classes based on three geographical elements which are all inherited.

According to another embodiment of database **114**, a searchable database, such as a water datamart, is a relational database capable of housing, among other data, location information. The database can be interconnected with existing systems containing parcel and mapping data, and can be pre-populated with critical geographic datasets (i.e. streets

and boundaries). The water datamart accepts farm specific location data, such as water distribution points, crops, canals, gates, location, water delivery and associated governmental data. The output resulting from search queries of the database may be, for example, a chart, list, graph, summary, or interactive map.

Another example of database **114** is a private database of water management. This would provide a way to accurately track and manage various factors related to water usage associated with persons or entities.

Water exchange module **108** also allows user **112**A to securely access and manage his or her water accounts, which may include information provided by water institution **103**. Water institution **103** can be one or more institutions, such as irrigation districts, government agencies, private water management agencies, or the like. In one embodiment, password protection and authentication, 128-bit encryption, SHTML, and other security features are used to ensure the security of the user's data. Once user **112**A has been authenticated, exchange module **108** obtains water data including total water availability data and/or allocated water data from water institution **103**, including dates, amounts, and the like.

Water exchange module **108** sends HTML code or other presentation technologies to browser **110** causing browser **110** to present a user interface to user **112**. The user interface allows the user to enter transactions and/or parcel information, as well as to review water account balances and view transaction information.

When user **112**A enters transactions and/or other water-related data, the user-entered data is transmitted via client communication module **120**A to server communication module **152**. Exchange module **108** searches and transmits potential matches. The user **112**A may then accept or reject potential matches, according to one embodiment.

If an exchange is requested, water exchange module **108** determines if sufficient water is available to satisfy the request for transfer between users, or between the system and a user. If the exchange is accepted, according to one embodiment, water exchange module **108** sends information about such exchanges (also known as a "paper" water transfer") to the water institution **103** via water institution interface **151** and/or via a form provided by the water institution **103**. As an example, a Delivery Order may entered by a user **112**A to direct to the water institution **103** to supply the actual "wet water" (also known as a "wet" water transfer) to the transferee user's irrigation gate. If the transferor user's account has sufficient acre feet of water available to be transferred, the system forwards the Delivery Order to the water institution's Water Master, according to one embodiment. The Order for the transfer of water is delivered by, for example, direct data connection, via email, or fax. The Water Master adds the Order to deliver the "wet water" to the delivery schedule, according to one embodiment. The amount of available water can then be determined by subtracting the released amount from the user's water balance or adding the acquired amount to the user's balance.

In one embodiment, water exchange module **108** can provide information to various regulatory bodies to satisfy reporting requirements. For example, to comply with statutory, ordinance and/or regulatory requirements, water exchange module **108** can provide data of various types, such as data concerning water exchanges, usage and availability, to agencies or institutions at the federal, state and/or local levels. Such information can be sent by, for example, direct data connection, email, mail and/or fax. As an example, a user could submit the forms depicted in FIGS. **16**A-**16**D to comply with California Water Code Section 5100 et seq.

In one embodiment, web server **101** projects future water usage balances in light of the user-entered data. Based on user-entered data along with transaction data and/or account balance received from water institution **103** and/or data received from other sources **109**, reporting module **106** presents report **102** including projected balances and other useful information either in the context of HTML web pages or in other formats such as PDF, Microsoft Excel, and the like. In one embodiment, reporting module **106** is augmented by a module for generating a list of transactions that may or may not be interactive. Thus, the term "reporting module **106**" is intended to be illustrative and not limiting. References herein to "reporting module **106**" should be considered to encompass such variations as interactive registers, reports, graphs, charts, maps, forms and the like. Reports including projected balances are provided to browser **110** in HTML, PDF, Excel, or the like, and displayed to user **112**. User **112**A can also save and/or print such reports as desired.

The reporting module **106** is software and data operational on the server to generate representations of land. In one embodiment, reporting module **106** retrieves information from water institution **103**, database **114**, location module **105** and other data **109**. The reporting module **106** generates representations that can be used in presenting results to the user **112**, such as maps, charts, graphs, forms and the like. The reporting module **106** can be used to automatically enter data into forms, according to one embodiment. In one embodiment, the reporting module **106** is a graphics user interface as will be understood by those skilled in the art.

In one embodiment, web server **101** provides information for water planning purposes. The parameter module **130** receives one or more parameters related to water usage of a party. These parameters can include, for example, information about total available water in the system; water allocated to the party or to other parties; estimated, current or past usage by another party; evaporation data or estimates; salinity thresholds; water quality; climate data; data for the types of crops that have been or may be grown; crop rotation; soil type; ownership; water rights; financial support; financial investment; and the like. Web server **101** receives a request for outcomes related to projected water usage of the party. The outcome determination module **132** determines outcomes related to projected water usage by the party based at least in part on the received parameters. Outcomes related to projected water usage include, for example, information about water needs, return on investment, and crop yields. The outcomes related to projected water usage by the party are then displayed.

One skilled in the art will recognize that the system architecture illustrated in FIG. **1** is merely exemplary, and that the invention may be practiced and implemented using many other architectures and environments.

Methods

Referring now to FIG. **2**, a flowchart depicts a method for practicing the present invention according to one embodiment. User **112**A logs in **202** and is authenticated. Water optimization web server **101** receives **204** water information usage data about the user **112**, such as transaction data and/or account balance, from water institution **103**. Optionally, exchange module **108** can present a user interface to user **112**, including current balances, transactions, and other account information. In one embodiment, user **112**A is given an opportunity to enter data, such as exchange requests. Water optimization web server **101** also receives this user-entered data **204**.

Optionally, water optimization web server **101** also retrieves data from data store **114**. Data from data store **114**

may include, for example, user-entered data that was entered during previous visits to the website and/or data received electronically from the water institution **103** and/or data extracted from previous online sessions and/or other data received from, for example, other users.

Server communication module **152** receives **206** requests from users **112**A-**112**N for a water exchange and sends the requests to water exchange module **218**. Exchange module **108** determines **208** potential matches by searching for available water in the system database **114**, which would include water that has not been released from users and/or available water released into the system by users. Server communication module **152** then transmits the potential matches **210** to client machine **107**A via client communication module **120**A. In one embodiment, the user can be prompted to indicate whether or not a proposed match is acceptable.

If the exchange is consummated, water optimization web server **101** transmits **212** information about such exchanges to the water institution **103**, according to one embodiment. Water optimization web server **101** can then determine the amount of available water by subtracting the released amount from the user's water balance or adding the acquired amount to the user's balance.

In one embodiment, report generation module **106** generates and displays a report, which may include projected balances and/or transactions. The report generation module **106** also generates **214** a billing statement for each user. The statement for the water seller shows how much money the user earned. The billing statement for the purchaser shows how much the user owes. All this information is also sent to the water institution in the form of financial summaries.

By taking into account user-entered data and data from water institutions **103** and/or other data **109**, report generation module **106** is able to generate projected balances that more accurately reflect user's **112**A projected water usage. Report **102** may be a static report, a dynamic report allowing user interaction, or an input/output screen that allows the user to update, view, modify, and otherwise interact with transaction data. Report **102** may be in the form of a chart, graph, map, form or other useful output.

Referring now to FIG. **3**, a flowchart depicts a method for practicing the present invention according to another embodiment. User **112**A logs in **302** and is authenticated. Water optimization web server **101** receives **304** a request for information related to the water usage by a party. The system receives **306** water information usage data about the party, such as transaction data and/or account balance from water institution **103** or information provided by user **112**A or other data **109**. Optionally, water optimization web server **101** also retrieves data from data store **114**.

Based on the received information, water optimization web server **101** determines **308** a projected water usage by the party. To determine the projected usage, water optimization web server **101** may consider, for example, current water usage by the party, past water usage by the party, evaporation estimates, climate estimates and the intended purpose for the water. The intended purpose can be divided into the following three categories: agricultural use, industrial use and power production. Agriculture will take into account factors like crop information and soil types. Industrial will take into account the type of application, whether the water is resusable, etc. Water used for power production includes, water used in conjunction with solar power, geothermal power, water used at a refinery and supplying water to algae that in turn produce energy, such as oil.

Based at least in part on the party's projected water usage, water optimization web server **101** determines **310** an optimized allocation of the party's water usage. To determine the optimized allocation of the party's water usage, water optimization web server **101** may consider a variety of factors. Examples of such factors include information about total available water, estimated usage by another party, current water usage by another party, past water usage by another party, evaporation estimates, salinity information, water quality, crop information, soil types, water rights, climate estimates and intended use of the water.

The water optimization web server **101** may also determine optimized allocation **310** in view of the following types of water defined by applicable State and Federal law, including but not limited to: ground water, underflow, surface water, riparian, and pre-1914 appropriative rights. Thus, in one embodiment of the invention, the optimization web server **101** identifies groundwater and surface water rights as components of the allocation. Once the optimized allocation is determined, water optimization web server **101** provides for display **312** of the optimized allocation of the party's water usage.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine return on investment.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine future usage.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine environmental impact.

In another embodiment, the water optimization web server **101** uses optimized allocation to determine the optimal allocation of water rights.

In another embodiment, the water optimization web server **101** uses optimized allocation to aid in regional land use planning. In this embodiment, the system and methods could assist in the determination of the optimal location for developing land in light of water efficiency (for example, by developing the land least suitable for farming.).

Referring now to FIG. **15**, a flowchart depicts another method for practicing the present invention according to one embodiment. User **112**A logs in **1502** and is authenticated. Water optimization web server **101** receives **1504** parameters related to projected water usage. The received parameters may include information about total available water in the system; water allocated to the party or to other parties; estimated, current or past usage by another party; evaporation data or estimates; salinity thresholds; water quality; climate data; data for the types of crops that have been or may be grown; crop rotation; soil type; ownership; water rights; financial support; financial investment; and the like.

Water optimization web server **101** receives **1506** a request for outcomes related to projected water usage. Outcomes related to projected water usage include, for example, information about water needs, return on investment, land valuation and crop yields.

Water optimization web server **101** determines **1508** outcomes related to projected water usage, such as estimating projected water requirements and crop yields, by taking into account various "what if" scenarios. An example of a GUI **1400** to allow a user to input such parameters is depicted, for example, in FIG. **14**. After a parameter has been entered, the systems and methods can predict various outcomes, such as water availability, crop yields and usage. Water optimization web server **101** displays **1510** the outcomes related to projected water usage by the party.

In another embodiment, outcome determination module **132** determines outcomes related to projected water usage, which can then be used in error analysis and/or data verifica-

tion of water usage received from water institutions **103**. The outcomes related to projected water usage can also be used in determining the appropriate asking or purchase price of a parcel of land. In another embodiment, the water optimization web server **101** can estimate how much water will be needed for a parcel of land in an upcoming season.

In another embodiment, the water optimization web server **101** determines evaporation and flow to and from bodies of water. For a particular example, as depicted in FIGS. **12** and **13**, the systems and methods can address variation in the amount of water supplied to the Salton Sea as compared with competing interests. The Salton Sea varies in dimensions and area due to changes in agricultural runoff and rain as well as evaporation. In one embodiment, the systems and methods take into account various factors, such as climate changes, evaporation, water quality and water flow.

As an example, if a parameter were input that a body of water would receive an allocation of water to maintain a salinity concentration of 40,000 parts per million, the system could determine whether the amount of water allocated for a particular parcel of land would sustain a particular crop in light of climate estimates, for example.

As another example, by providing for more accurate planning, the present invention would mitigate serious problems if the Salton Sea were otherwise allowed to dry out. For example, without water optimization, air pollution from the fine salts left after the Salton Sea dried out would likely damage crops and adversely affect human health. In addition, many bird species rely on the Salton Sea as their habitat might be harmed if the Salton Sea is not maintained. Further, nearby communities might be subject to windstorm damage, and salts and odors if water planning to the Salton Sea is not executed accurately. By ensuring that water flows in to and out of the Salton Sea are measured accurately, the allocation of water for the Salton Sea and other potentially competing purposes can be optimized. The examples depicted in FIGS. **12** and **13** show how the system and method can be used to determine an optimized distribution of water in light of specified parameters, such as cost, evaporation, salinity thresholds and/or other variables.

In yet another embodiment, the water optimization web server **101** determines outcomes related to the water quality. The water quality includes levels of microorganisms, such as viruses and bacteria; inorganic contaminants, such as salts (e.g. nitrates, selenium and sulfates) and metals; pesticides and herbicides; organic chemical contaminants; and radioactive contaminants.

Graphical User Interface

The water optimization web server **101** displays a variety of information related to water usage. The system can present a user interface to user **112**, including a graphical representation of the historical, current, projected and/or optimized data in such forms as a chart, graph, map, report, summary or the like.

Referring now to FIGS. **4-11** and **14**, example graphical user interfaces (GUIs) in accordance with embodiments of the present invention are shown. FIGS. **4-11** and **14** show the GUI in different stages of interacting with the user **112**.

FIG. **4** illustrates one example of the GUI **400** for presenting data from the water optimization web server **101** in accordance with the present invention. As can be seen in FIG. **4**, the right portion of the window **402** includes buttons **404**, **406**, **408**, **410**, **412**, **414** for controlling the different views. In this GUI, the user **112**A can make a public release **424** of water back into the water optimization system **100**. A user **112**A can also receive information about his or her total available water for the year **416**, amount used in the current quarter **418**, amount released in the current quarter **420**, the quarter's committed water **422** (which is the amount the user plans to use and for which the user will be charged regardless of use), total acreage **426**, water used in the year **428** and water balance **430**.

FIG. **5** shows a graphical representation of a window **502** showing another GUI **500** of the present invention. FIG. **5** illustrates one embodiment of a water delivery order. This allows the user to determine the amount, date and time of delivery of water and to which gate, field, and crop it will be delivered. It also allows for the irrigator's name to be associated with the order. For the user's accounting purposes. Such an order could be sent to the water institution. **103** to direct the water institution to release the water as desired. In addition to providing an effective way of accounting for water usage, the system provides for various data to be stored with each water delivery, providing for increased accuracy in the water projections and optimization calculations, as well as a rich data store for any other use.

While the GUI **500** displayed has been shown with particular locations, color schemes, entry fields, and organization, those skilled in the art will realize that these are provided only by way of example and in alternate embodiments a variety of different display formats, organization schemes and color schemes may be used for this GUI **500** and the other GUIs of the present invention.

FIG. **6** shows a graphical representation of a window **602** showing another GUI **600** of the present invention. FIG. **6** illustrates another embodiment of a water delivery order. This GUI **600** provides a way to specify to which parcel and gate **610** the water should be delivered.

FIG. **7** shows a graphical representation of a window **702** showing another GUI **700** of the present invention. FIG. **7** illustrates an embodiment of a water transfer request. This GUI **700** provides a way to specify a desired water acquisition **704** or release (not shown) by quantity **706**, acquiring APN (Assessor's Parcel Number) **708**, releasing account **714** and APN **716**, and whether the transfer will be public (i.e. with another user) **710** or private (i.e. with the water optimization system) **712**, according to one embodiment.

FIG. **8** shows a graphical representation of a window showing another GUI **800** of the present invention. FIG. **8** illustrates an embodiment of a water transfer confirmation screen. In the embodiment depicted, the user is presented with a potential match for a water exchange, in this embodiment a desired acquisition. The GUI **800** shown displays the requested action (i.e. acquire or release) **804**, the quantity **808**, the releasing account **810** and APN **812**, and the acquiring account **814** and APN **816**. The user may accept **818** or reject **820** the potential match for the water transfer, according to one embodiment.

FIGS. **9-11** are screen shots depicting examples of maps of parcels owned and/or controlled by an account holder according to various embodiments. In these embodiments, a water card holder could assign his or her card to another user. Water Cards are one example of an accounting system used to record temporary transfers of water usage where one person leases land to be farmed by another person. These embodiments also provide for generation of a water efficiency report. In one embodiment, the water efficiency report can be used in determining an optimized allocation of water.

FIG. **9** is a screen shot depicting an example of a topographic map of parcels owned and/or controlled by an account holder. FIG. **10** is a screen shot depicting an example of an air photographic map of parcels owned and/or controlled by an account holder. FIG. **11** is a screen shot depicting

an example of a report and soils map of parcels owned and/or controlled by an account holder.

Referring now to FIG. **9**, the GUI **900** also includes a first display region **904** in which one view of a map **920**, chart or graph is presented. A second display region **906** is provided to display and/or receive data and/or parameters. A third display region **908** is provided to display a water balance.

In region **904**, there is shown an example of a map **920** that may be generated by reporting module **106** and presented to user **112**A according to the techniques of the present invention. One skilled in the art will recognize that the particular characteristics, layout, and elements of map **920** are presented here for illustrative purposes, and that many variations are possible. Map **920** may contain interactive components allowing for user input; one skilled in the art will recognize that such components can be omitted or modified and that in alternative embodiments map **920** can be non-interactive. For example, a user **112**A can indicate that a specific portion of one or more parcels should have water released, which would then be depicted in map **920**.

While the regions **904**, **906** and **908** in FIG. **9** have been shown with particular locations, color schemes and organization, those of ordinary skill in the art will realize that these are provided only by way of example and in alternate embodiments a variety of different display formats, organization schemes and color schemes may be used for this GUI **900** and the other GUIs of the present invention. In another embodiment, the maps, tables or graphs can be used to examine trends associated with the parcels, such as water usage, crop types, or other information.

Referring now to FIG. **11**, user **112**A inputs information about the soil in second display region **1106**, according to one embodiment. This information is then be depicted in map **1120** in the first display area **1104**. The user could also provide information in second display region **1106** regarding the gates for a field; this information is also shown in map **1120** of FIG. **11**.

FIG. **14** provides an example of a GUI **1400** to allow a user to input various parameters for water planning purposes by taking into account various "what if" scenarios. After a parameter has been entered, the systems and methods can predict outcomes related to water usage in light of the new input. In the user interface depicted, a user may enter a value in field **1410** and save it as a new value by selecting button **1420**. As another example, if a parameter were provided that a specified number of acre feet of water would be available for a given user, the system could determine the best crops to be grown on a particular parcel of land in light of climate estimates, according to one embodiment.

FIGS. **16**A-**16**D are examples of forms in which the reporting module **106** has automatically entered data, according to one embodiment. The mapping depicted in FIG. **16**D can be generated by reporting module **106**. In one embodiment, forms, such as those depicted in FIGS. **16**A-**16**D, are signed by the user and sent to water institution **103**. Water institution **103** then directs a water release consistent with the information contained in the forms.

The foregoing description of the embodiments of the present invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the present invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the present invention be limited not by this detailed description, but rather by the claims of this application. As will be understood by those familiar with the art, the present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. Likewise, the particular naming and division of the modules, routines, features, attributes, methodologies and other aspects are not mandatory or significant, and the mechanisms that implement the present invention or its features may have different names, divisions and/or formats. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting, of the scope of the present invention, which is set forth in the following claims.

The invention claimed is:

1. A computer-implemented method for water exchange, the method comprising:

receiving, by a computer, a first request for water exchange from a first user, the first user seeking a release of a first amount of excess water, the release being controlled by a water institution;

receiving, by the computer, from the water institution, a first set of information related to water usage and water rights of the first user;

receiving, by the computer, a second request for water exchange from a second user, the second user seeking an acquisition of a second amount of excess water;

determining, by the computer, a potential match between the first request and the second request including optimizing the potential match;

transmitting, from the computer, the potential match determination to the second user for approval or rejection;

receiving, from the second user, an approval of the potential match determination;

in response to receiving the approval of the potential match determination from the second user, transmitting a second set of information describing the water exchange to the water institution, the water institution scheduling water delivery to the second user based at least in part on the second set of information;

generating a report including projected water balances and transactions for the first user and the second user, wherein the projected water balances reflect projected water usage;

determining outcomes related to the projected water usage including information about water needs and return on an investment; and

applying the outcomes in an error analysis and verifying the first set of information related to water usage received from the water institution.

2. The method of claim **1**, wherein optimization is based on the water rights of the first user.

3. The method of claim **2**, wherein the water rights include groundwater rights and surface water rights and the optimization includes identifying the groundwater rights and the surface water rights under State and Federal law.

4. The method of claim **1**, wherein optimization is based on the water usage.

5. The method of claim **1**, wherein optimization is based on water quality.

6. The method of claim **1**, wherein optimization is based on an analysis of a best way to use the water.

7. The method of claim **1**, wherein optimization is based on whether the water is intended for at least one of agricultural use, industrial use and power production.

8. The method of claim **1**, further comprising the step of generating a billing statement for the second user.

9. The method of claim **1**, further comprising displaying the report including projected water balances and transactions for the first user and the second user.

10. The method of claim **9**, wherein the projected water balances are determined based at least in part on one or more

of data from the water institution and data entered by one of the first user and the second user.

11. The method of claim **1**, wherein the first set of information related to water usage and water rights of the first user comprises information received from the water institution and the first user.

12. A non-transitory computer readable storage medium storing computer program code, the computer program code executable by a computer for causing the computer to perform a method for an exchange of water, the method comprising:

receiving, by a computer, a first request for water exchange from a first user, the first user seeking a release of a first amount of excess water, the release being controlled by a water institution;

receiving, by the computer, from the water institution, a first set of information related to water usage and water rights of the first user;

receiving, by the computer, a second request for water exchange from a second user, the second user seeking an acquisition of a second amount of excess water;

determining, by the computer, a potential match between the first request and the second request including optimizing the potential match;

transmitting, from the computer, the potential match determination to the second user for approval or rejection;

receiving, from the second user, an approval of the potential match determination;

in response to receiving the approval of the potential match determination from the second user, transmitting a second set of information describing the water exchange to the water institution, the water institution scheduling water delivery to the second user based at least in part on the second set of information;

generating a report including projected water balances and transactions for the first user and the second user, wherein the projected water balances reflect projected water usage;

determining outcomes related to the projected water usage including information about water needs and return on an investment; and

applying the outcomes in an error analysis and verifying the first set of information related to water usage received from the water institution.

13. The computer readable storage medium of claim **12**, wherein optimization is based on the water rights of the first user.

14. The computer readable storage medium of claim **13**, wherein the water rights include groundwater rights and surface water rights and the optimization includes identifying the groundwater rights and the surface water rights under State and Federal law.

15. The computer readable storage medium of claim **12**, wherein optimization is based on the water usage.

16. The computer readable storage medium of claim **12**, wherein optimization is based on water quality.

17. The computer readable storage medium of claim **12**, wherein optimization is based on an analysis of a best way to use the water.

18. The computer readable storage medium of claim **12**, wherein optimization is based on whether the water is intended for at least one of agricultural use, industrial use and power production.

19. The computer readable storage medium of claim **12**, further comprising the step of generating a billing statement for the second user.

* * * * *

EXHIBIT D

eWRIMS Application Search Results

Displaying Water Rights where Source = Salinas river.

Application ID	Permit ID	License ID	DB ID	Water Right Type	Status	Holder Name	Organization Type	Date	Description	Face Amt	County	Watershed	Source
A000231	261	11114	30	Appropriative	Licensed	ATASCADERO MUTUAL WATER COMPANY	Corporation	1/13/16	Migrated data from old WRIMS system.	3,070.00	San Luis Obispo		SALINAS RIVER UNDERFLOW
A004421	2267	847	786	Appropriative	Licensed	DEBRA RETTIG-GALLANT	Individual	5/3/29	Migrated data from old WRIMS system.	253.1	San Luis Obispo		SALINAS RIVER
A008276	4649	4786	1675	Appropriative	Licensed	WILLOW RANCH, A GENERAL PARTNERSHIP	Individual	3/8/35	Migrated data from old WRIMS system.	26.4	San Luis Obispo		SALINAS RIVER
A010211	5881		2214	Appropriative	Revoked	U S ARMY CORPS OF ENGINEERS	Corporation	8/7/95	Migrated data from old WRIMS system.	0	San Luis Obispo		SALINAS RIVER
A010216	5882		2217	Appropriative	Permitted	CITY OF SAN LUIS OBISPO	Government	#####	Migrated data from old WRIMS system.	53,977.30	San Luis Obispo		SALINAS RIVER
A010294	5956		2233	Appropriative	Permitted	CITY OF EL PASO DE ROBLES	Government	4/17/42	Migrated data from old WRIMS system.	4,600.00	San Luis Obispo		SALINAS RIVER
A011745	7253		2799	Appropriative	Revoked			10/7/99	Migrated data from old WRIMS system.	0	San Luis Obispo		SALINAS RIVER
A012285	7287	4426	3040	Appropriative	Licensed	DAVID B WEYRICH	Individual	1/30/48	Migrated data from old WRIMS system.	273.7	San Luis Obispo		SALINAS RIVER
A012526	8964		3128	Appropriative	Permitted	TEMPLETON COMMUNITY SERVICES DISTRICT	Government	5/28/48	Migrated data from old WRIMS system.	500	San Luis Obispo		SALINAS RIVER UNDERFLOW
A013225	11043		3413	Appropriative	Permitted	MONTEREY COUNTY WATER RESOURCES AGENCY	Government	7/11/49	Migrated data from old WRIMS system.	168,538.00	Monterey		SALINAS RIVER
A013690	8766	4829	3650	Appropriative	Licensed	TEMPLETON COMMUNITY SERVICES DISTRICT	Government	4/14/50	Migrated data from old WRIMS system.	102.1	San Luis Obispo		SALINAS RIVER, Salinas River
A016124	10137	7543	4833	Appropriative	Licensed	MONTEREY COUNTY WATER RESOURCES AGENCY	Government	11/4/54	Migrated data from old WRIMS system. Amended license on 9/5/2008 to add a point of rediversion and change the place of use. Order WR 2008-0037-DWR	350,000.00	Monterey, San Luis Obispo		NACIMIENTO RIVER, Salinas River
A016761	12261	12624	5163	Appropriative	Licensed	MONTEREY COUNTY WATER RESOURCES AGENCY	Government	12/2/55	Migrated data from old WRIMS system. Added point of rediversion and changed place of use on 9/5/2008. Order WR 2008-0037-DWR	220,000.00	Monterey		SAN ANTONIO RIVER, Salinas River
A017182	10903	7070	5451	Appropriative	Licensed	EDWARD ALLRED	Individual	8/20/01	Migrated data from old WRIMS system.	120	San Luis Obispo		SALINAS RIVER UNDERFLOW

A017367	10904	6458	5566	Appropriative	Licensed	GAVINO VILLA	Individual	#####	Migrated data from old WRIMS system.	223.6	San Luis Obispo		SALINAS RIVER UNDERFLOW
A017381	10978	6253	5576	Appropriative	Licensed	JOHN GIACONE	Individual	12/6/56	Migrated data from old WRIMS system.	421.5	San Luis Obispo		SALINAS RIVER UNDERFLOW
A024365	16727	11158	9934	Appropriative	Licensed	MOREHART LAND CO, INC	Government	5/9/73	Migrated data from old WRIMS system.	13	San Luis Obispo		SALINAS RIVER
A025199	18727	12295	10527	Appropriative	Licensed	DAVIS BROTHERS RANCH LLC	Corporation	#####	Migrated data from old WRIMS system.	98	San Luis Obispo		ROCKY CANYON, SALINAS RIVER
A030299	20785		13895	Appropriative	Permitted	TEMPLETON COMMUNITY SERVICES DISTRICT	Government	3/28/95	Migrated data from old WRIMS system.	133.7	San Luis Obispo		SALINAS RIVER UNDERFLOW
A030532	21089		14037	Appropriative	Permitted	MONTEREY COUNTY WATER RESOURCES AGENCY	Government	3/25/96	Migrated data from old WRIMS system. Permit amended 9/5/2008 to add a point of rediversion and change place of use. Order WR 2008-0037-DWR	27,900.00	Monterey, San Luis Obispo		NACIMIENTO RIVER, Salinas River
A031115			14358	Appropriative	Pending	DANIEL ENCELL	Individual	#####	Migrated data from old WRIMS system.	47	San Luis Obispo		SALINAS RIVER
S008285			31953	Statement of	Claimed	ATASCADERO MUTUAL WATER COMPANY	Corporation	1/1/74	Migrated data from old WRIMS system.	0	San Luis Obispo		SALINAS RIVER
S009101			32560	Statement of	Inactive			3/10/05	Migrated data from old WRIMS system.	0	San Luis Obispo		SALINAS RIVER
S013532			36403	Statement of	Inactive			3/14/00	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014254			37104	Statement of	Claimed	BASSETTI FARMS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014255			37105	Statement of	Claimed	BASSETTI FARMS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014257			37107	Statement of	Claimed	BASSETTI FARMS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014258			37108	Statement of	Claimed	BASSETTI FARMS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014259			37109	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014260			37110	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014261			37111	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014262			37112	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014263			37113	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER
S014264			37114	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER

S014265			37115	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014266			37116	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	10	Monterey		SALINAS RIVER	
S014267			37117	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014268			37118	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014269			37119	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014270			37120	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014271			37121	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014272			37122	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014273			37123	Statement of	Claimed	MARGARET DUFLOCK	Individual	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014274			37124	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014275			37125	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014276			37126	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014277			37127	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014278			37128	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014279			37129	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014280			37130	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014281			37131	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014282			37132	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014283			37133	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014284			37134	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014285			37135	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014286			37136	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014287			37137	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	

S014288			37138	Statement of	Inactive			9/17/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014304			37154	Statement of	Inactive			8/6/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014305			37155	Statement of	Inactive			8/6/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014306			37156	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	1/20/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014307			37157	Statement of	Claimed	SAN BERNARDO RANCHO	Corporation	1/20/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014329			37179	Statement of	Claimed	SAN ARDO WATER DISTRICT	Corporation	2/17/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014330			37180	Statement of	Claimed	SAN ARDO WATER DISTRICT	Corporation	2/17/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014331			37181	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	21.9	Monterey		SALINAS RIVER	
S014332			37182	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	734.1	Monterey		SALINAS RIVER	
S014333			37183	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014334			37184	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014335			37185	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014336			37186	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014337			37187	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014338			37188	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014339			37189	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	410.2	Monterey		SALINAS RIVER	
S014340			37190	Statement of	Claimed	MATT WILLIAMS RANCH LLC	Corporation	3/3/95	Migrated data from old WRIMS system.	16.7	Monterey		SALINAS RIVER	
S014342			37192	Statement of	Inactive	CHUNN RANCH LLC	Corporation	5/19/08	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014343			37193	Statement of	Inactive	CHUNN RANCH LLC	Corporation	5/19/08	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014347			37197	Statement of	Inactive			4/12/00	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014348			37198	Statement of	Inactive	FERRINI RANCH	Corporation	3/12/99	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014349			37199	Statement of	Inactive			4/12/99	Migrated data from old WRIMS system.	60	Monterey		SALINAS RIVER	
S014350			37200	Statement of	Inactive			4/12/99	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	

S014359			37209	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014360			37210	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	152	Monterey		SALINAS RIVER	
S014361			37211	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014362			37212	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014363			37213	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014364			37214	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014365			37215	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014366			37216	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014367			37217	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014368			37218	Statement of	Claimed	MISSION RANCHES	Corporation	3/27/95	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014421			37271	Statement of	Inactive	CALIFORNIA ORCHARD COMPANY	Corporation	8/13/01	Migrated data from old WRIMS system.	1,032.00	Monterey		SALINAS RIVER	
S014422			37272	Statement of	Inactive	CALIFORNIA ORCHARD COMPANY	Corporation	5/22/06	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014423			37273	Statement of	Inactive	CALIFORNIA ORCHARD COMPANY	Corporation	5/22/06	Migrated data from old WRIMS system.	2,266.00	Monterey		SALINAS RIVER	
S014424			37274	Statement of	Inactive	CALIFORNIA ORCHARD COMPANY	Corporation	5/22/06	Migrated data from old WRIMS system.	2,266.00	Monterey		SALINAS RIVER	
S014425			37275	Statement of	Claimed	CALIFORNIA ORCHARD COMPANY	Corporation	01/01/15	Migrated data from old WRIMS system.	18.9	Monterey		SALINAS RIVER	
S014426			37276	Statement of	Inactive	CALIFORNIA ORCHARD COMPANY	Corporation	5/22/06	Migrated data from old WRIMS system.	2,266.00	Monterey		SALINAS RIVER	
S014427			37277	Statement of	Claimed	CALIFORNIA ORCHARD COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	502	Monterey		SALINAS RIVER	
S014428			37278	Statement of	Claimed	CALIFORNIA ORCHARD COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	2,008.00	Monterey		SALINAS RIVER	
S014429			37279	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	1,011.00	Monterey		SALINAS RIVER	
S014430			37280	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	1,269.00	Monterey		SALINAS RIVER	
S014431			37281	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	711	Monterey		SALINAS RIVER	
S014432			37282	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	928.5	Monterey		SALINAS RIVER	
S014434			37284	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	1,051.00	Monterey		SALINAS RIVER	

S014435			37285	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	1,068.00	Monterey		SALINAS RIVER	
S014436			37286	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	1,738.00	Monterey		SALINAS RIVER	
S014437			37287	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	818.7	Monterey		SALINAS RIVER	
S014438			37288	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	1,738.00	Monterey		SALINAS RIVER	
S014439			37289	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	672	Monterey		SALINAS RIVER	
S014440			37290	Statement of	Inactive	SALINAS LAND COMPANY	Corporation	5/22/06	Migrated data from old WRIMS system.	672	Monterey		SALINAS RIVER	
S014441			37291	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	728	Monterey		SALINAS RIVER	
S014442			37292	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	1,835.00	Monterey		SALINAS RIVER	
S014443			37293	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	660	Monterey		SALINAS RIVER	
S014444			37294	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	856	Monterey		SALINAS RIVER	
S014445			37295	Statement of	Claimed	SALINAS LAND COMPANY	Corporation	7/19/95	Migrated data from old WRIMS system.	872	Monterey		SALINAS RIVER	
S014450			37299	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	757	Monterey		SALINAS RIVER	
S014451			37300	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	523	Monterey		SALINAS RIVER	
S014452			37301	Statement of	Claimed	BOB MARTIN	Individual	8/2/95	Migrated data from old WRIMS system.	94.8	Monterey		SALINAS RIVER	
S014453			37302	Statement of	Claimed	PATRICK J MALONEY	Individual	9/2/95	Migrated data from old WRIMS system.	79.4	Monterey		SALINAS RIVER	
S014454			37303	Statement of	Inactive	RIO FARMS	Corporation	9/15/03	Migrated data from old WRIMS system.	572	Monterey		SALINAS RIVER	
S014455			37304	Statement of	Claimed	RIO FARMS	Corporation	9/2/95	Migrated data from old WRIMS system.	575	Monterey		SALINAS RIVER	
S014456			37305	Statement of	Claimed	RIO FARMS	Corporation	9/2/95	Migrated data from old WRIMS system.	150	Monterey		SALINAS RIVER	
S014457			37306	Statement of	Claimed	RIO FARMS	Corporation	9/2/95	Migrated data from old WRIMS system.	565	Monterey		SALINAS RIVER	
S014458			37307	Statement of	Claimed	RIO FARMS	Corporation	9/2/95	Migrated data from old WRIMS system.	571	Monterey		SALINAS RIVER	
S014461			37310	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	2,193.00	Monterey		SALINAS RIVER	
S014462			37311	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	3,169.00	Monterey		SALINAS RIVER	
S014463			37312	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	2,864.00	Monterey		SALINAS RIVER	

S014464			37313	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	784	Monterey		SALINAS RIVER	
S014467			37316	Statement of	Claimed	JOHN LOMBARDI	Individual	8/18/95	Migrated data from old WRIMS system.	690	Monterey		SALINAS RIVER	
S014468			37317	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	65.7	Monterey		SALINAS RIVER	
S014475			37324	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014476			37325	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014477			37326	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014478			37327	Statement of	Inactive			9/15/03	Migrated data from old WRIMS system.	798.3	Monterey		SALINAS RIVER	
S014490			37339	Statement of	Inactive			9/15/01	Migrated data from old WRIMS system.	814	Monterey		SALINAS RIVER	
S014491			37340	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	955	Monterey		SALINAS RIVER	
S014492			37341	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	116	Monterey		SALINAS RIVER	
S014493			37342	Statement of	Inactive	THE PRUDENTIAL INSURANCE COMPANY OF AMERICA	Corporation	9/16/03	Migrated data from old WRIMS system.	252	Monterey		SALINAS RIVER	
S014494			37343	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	419	Monterey		SALINAS RIVER	
S014495			37344	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	111	Monterey		SALINAS RIVER	
S014496			37345	Statement of	Inactive			01/01/15	Migrated data from old WRIMS system.	439	Monterey		SALINAS RIVER	
S014497			37346	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	556	Monterey		SALINAS RIVER	
S014498			37347	Statement of	Claimed	ORRADRE RANCH COBURN	Corporation	9/16/03	Migrated data from old WRIMS system.	170	Monterey		SALINAS RIVER	
S014499			37348	Statement of	Claimed	ORRADRE RANCH COBURN	Corporation	9/16/03	Migrated data from old WRIMS system.	467	Monterey		SALINAS RIVER	
S014500			37349	Statement of	Claimed	ORRADRE RANCH COBURN	Corporation	9/16/03	Migrated data from old WRIMS system.	90.2	Monterey		SALINAS RIVER	
S014501			37350	Statement of	Claimed	ORRADRE RANCH COBURN	Corporation	9/16/03	Migrated data from old WRIMS system.	0.1	Monterey		SALINAS RIVER	
S014502			37351	Statement of	Claimed	ORRADRE RANCH COBURN	Corporation	9/16/03	Migrated data from old WRIMS system.	897	Monterey		SALINAS RIVER	
S014503			37352	Statement of	Inactive	THE PRUDENTIAL INSURANCE COMPANY OF AMERICA	Corporation	6/16/08	Migrated data from old WRIMS system.	623	Monterey		SALINAS RIVER	
S014504			37353	Statement of	Claimed	ORRADRE RANCH COBURN	Corporation	9/16/03	Migrated data from old WRIMS system.	699	Monterey		SALINAS RIVER	

S014516			37365	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	692	Monterey		SALINAS RIVER	
S014518			37367	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	769	Monterey		SALINAS RIVER	
S014519			37368	Statement of	Inactive			9/16/03	Migrated data from old WRIMS system.	556	Monterey		SALINAS RIVER	
S014573			37421	Statement of	Claimed	ALLAN D GIUDICI	Individual	5/13/96	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014574			37422	Statement of	Claimed	ALLAN D GIUDICI	Individual	5/13/96	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014575			37423	Statement of	Claimed	ALLAN GIUDICI	Corporation	5/13/96	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014576			37424	Statement of	Claimed	ALLAN GIUDICI	Corporation	5/13/96	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014577			37425	Statement of	Claimed	ALLAN GIUDICI	Corporation	5/13/96	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S014868			37708	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014869			37709	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014870			37710	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014871			37711	Statement of	Claimed	TANIMURA & ANTLE INC	Corporation	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014872			37712	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014873			37713	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014874			37714	Statement of	Claimed			1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014875			37715	Statement of	Claimed	TANIMURA & ANTLE INC	Corporation	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014876			37716	Statement of	Claimed	TANIMURA & ANTLE INC	Corporation	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014877			37717	Statement of	Claimed	TANIMURA & ANTLE INC	Corporation	1/21/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014878			37718	Statement of	Claimed	T. Yuki Farms, LPII	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014879			37719	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014880			37720	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014881			37721	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014882			37722	Statement of	Claimed	Robert tanimura 1980 IrrevocableTrust; et al	Trust	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	

S014883			37723	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014884			37724	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014885			37725	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014886			37726	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014887			37727	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014888			37728	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014889			37729	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014890			37730	Statement of	Claimed	Tanimura Land Company, LLC	Limited Liabi	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014892			37732	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014893			37733	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014894			37734	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014895			37735	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014896			37736	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014897			37737	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014898			37738	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014899			37739	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S014900			37740	Statement of	Claimed	Tanimura & Antle Partnership; et al	Limited Partr	1/22/98	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER UNDERFLOW	
S015136			37977	Statement of	Claimed	FRANK J OSTER	Individual	4/26/01	Migrated data from old WRIMS system.	92.7	San Luis Obispo		SALINAS RIVER	
S015152			37993	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015153			37994	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015154			37995	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015155			37996	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015156			37997	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	

S015158			37999	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015159			38000	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015160			38001	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015161			38002	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015162			38003	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015163			38004	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015164			38005	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015165			38006	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015166			38007	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015167			38008	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015169			38010	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015170			38011	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015171			38012	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015172			38013	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015173			38014	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015174			38015	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015175			38016	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015176			38017	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015177			38018	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015178			38019	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015179			38020	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015180			38021	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015181			38022	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	

S015182			38023	Statement of	Claimed	SAN BERNABE VINEYARDS	Corporation	#####	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015565			38396	Statement of	Claimed	ORRADRE RANCH	Corporation	#####	Migrated data from old WRIMS system.	3.4	Plumas		SALINAS RIVER SUBTERRANEAN	
S015595			38426	Statement of	Claimed	PARRIS VALLEY RANCH	Corporation	3/11/02	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S015596			38427	Statement of	Claimed	PARRIS VALLEY RANCH	Corporation	3/11/02	Migrated data from old WRIMS system.	0	Monterey		SALINAS RIVER	
S016921			47699	Riparian Clain	Claimed	Rio Farms LLC	Corporation	6/30/10		645.5	Monterey		SALINAS RIVER	
S016923			47701	Riparian Clain	Claimed	American Farms LLC	Corporation	6/30/10		93.1	Monterey		SALINAS RIVER	
T030237	20659		38716	Temporary Pe	Revoked			7/15/93	Migrated data from old WRIMS system.	0	San Luis Obispo		SALINAS RIVER	

CALIFORNIA
Water Boards
Contact: DIVISION OF WATER RIGHTS
E-mail: ewrims@waterboards.ca.gov
Phone: 916.341.5300

OFFICE OF PUBLIC AFFAIRS FACTSHEET

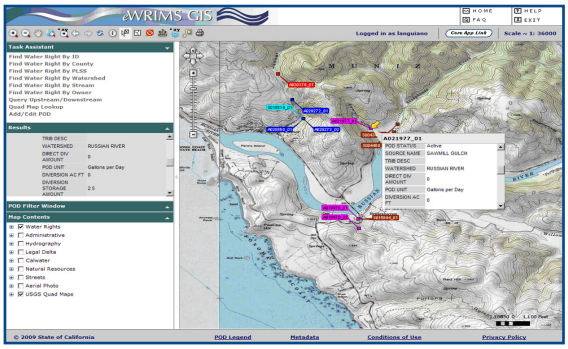
eWRIMS

APRIL | 2010

STATE WATER RESOURCES CONTROL BOARD | 1001 I Street, Sacramento, CA 95814 | Mailing Address: P.O. Box 100, Sacramento, CA 95812-0100 | www.waterboards.ca.gov

WHAT IS eWRIMS?

The Web-based Enhanced Water Right Information Management System (eWRIMS) was developed by the State Water Board to track information on water rights in California. eWRIMS contains information on water right permits and licenses issued by the State Water Board and other claimed water rights. eWRIMS is also a module of the State Water Board's California Integrated Water Quality System (CIWQS) program. eWRIMS provides the public and staff internet access to California's water rights information by combining a tabular database with a Geographic Information System (GIS) database system.



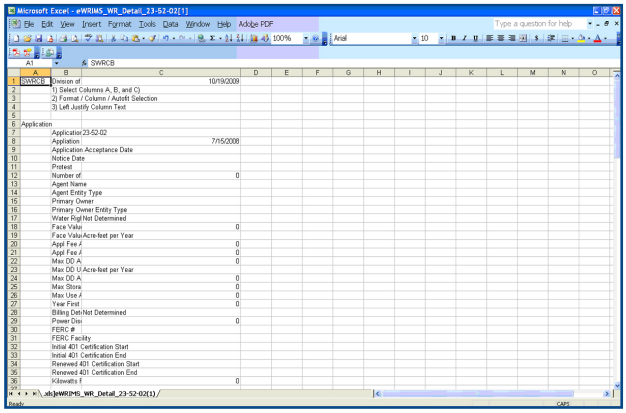
THE BIRTH OF eWRIMS

The enhanced water right system went live September of 2007, and throughout the past two years eWRIMS has been used by staff, management, and the public. eWRIMS provides information on water right holders, location of water rights and other information mandated by state law. eWRIMS supports GIS functionality, online reporting functions, and annual fee billing processes. It also provides the public with copies of water right permits, licenses, registrations and revocations.

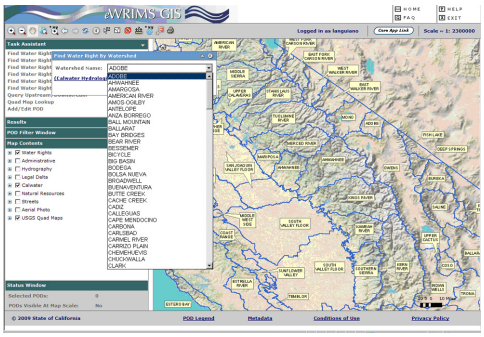
OTHER FUNCTIONS OF eWRIMS

eWRIMS is used for calculating and billing the water right annual fees. The State Water Board's Division of Water Rights works with the Board of Equalization (Equalization) to accurately access water right fees for each water right. eWRIMS also provides the water right's face value amount to allow water right holders to check the accuracy of the billing. The State Water Board and Equalization exchange data through a secured FTP site.

All public users or stakeholders have access to eWRIMS data and can download information pertaining to water rights into an excel spreadsheet.



Enhancements to eWRIMS will continue based upon public demand and available resources.



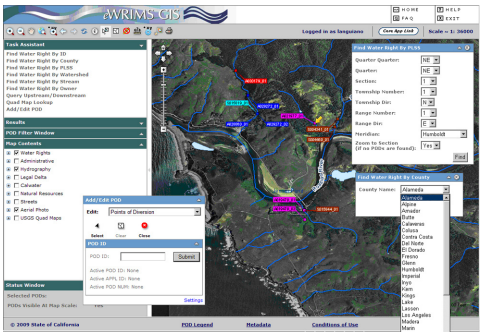
HOW THIS SYSTEM HELPS STAFF STREAMLINE BUSINESS PROCESSES:

- tracks workflow and end product
- determines and tracks annual water right fee bills
- combines formerly separate databases into one
- tracks inspection and complaint information

WHAT THE WEB-BASED SYSTEM DOES:

Public and staff can search for details about water rights by:

- water right status
- water right type
- primary owner
- water right ID; (application, permit or license number)
- watershed, county, or source of the water



HOW WATER RIGHTS CAN BE SEEN ON GIS:

GIS staff within the Office of Information Management Analysis (OIMA) has maintained the GIS application providing critical maintenance support as well as enhancements. The eWRIMS GIS application is served out by one of the most advanced GIS enterprise architecture in California.

The eWRIMS Web-based GIS displays real-time data by:
•providing a printable graphic display of Points of Diversion (PODs)
•moving between the data application and mapping functions for easy searches
•mapping for upstream and downstream POD searches
•displaying fully-appropriated streams to determine if water is available
•providing usgs quadrangle and aerial photograph layers

Further information can be found by going to our website at:

http://www.waterboards.ca.gov/ewrims
Or contact us by emailing us at
ewrims@waterboards.ca.gov
or call (916) 341-5300.

EXHIBIT E

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board

NOV 13 2012

In Reply Refer
To:KDM:~~A007482~~ incorrect
KMRWRA
266.001
Maloney/IID Statement

Mr. Thomas S. Virsik
Law Offices of Patrick J. Maloney
2425 Webb Avenue, Suite 100
Alameda Island, CA 94501-2922

Dear Mr. Virsik:

STATEMENTS OF WATER DIVERSION AND USE – COLORADO RIVER WATER USERS

This letter is regarding the Statements of Water Diversion and Use (statements) filed in 2006 on behalf of approximately 350 landowner/farmers in Imperial Valley who have a right to receive their water from the Imperial Irrigation District (IID).

The State Water Resources Control Board issued water right Permit No. 7643 to IID on January 6, 1950. Permit 7643 authorizes IID to divert a maximum of 10,000 cubic feet per second from the Colorado River from January 1st to December 31st of each year for irrigation and domestic use on 992,548 acres of land. IID diverts Colorado River water at Imperial Dam, thence into a canal system for distribution to its agricultural water users. IID also holds a pre-1914 appropriative water right and has a contract with the Secretary of Interior for the delivery of Colorado River water.

The statement filers are relying upon IID's pre-1914 right. California Water Code section 5101, subdivision (b) provides that a statement need not be filed if the diversion is covered by a permit. The statement filers receive water deliveries from IID, using IID facilities. The Division has received no information to document that the farmers divert water in excess of IID Permit 7643 at Imperial Dam. Thus, water diverted by IID at Imperial Dam under Permit 7643 to collectively serve its agricultural water customers need not be covered by statements filed by IID or others.

The statement filers filed the statements for water delivered from the IID canal system, stating that the turnouts are points of rediversion. Permit 7643 does not list any points of rediversion. Points of rediversion are not necessary in the permit because water diverted at Imperial Dam is

placed into a canal system and does not rejoin a stream system for subsequent rediversion from a surface stream.

Statements of water diversion and use are not required to be filed for the diversion of water from a water body other than a surface or subterranean stream. (See Wat. Code, §§ 5100, subd. (c), 5101.) The farm turnouts are not points of diversion within the meaning of the statute, nor are they points of rediversion. Also, as noted above, it appears that all of the water is accounted for in Permit 7643. Accordingly, the statements are not accepted. If you would like the statements returned to your firm, please advise the Division accordingly within 30 days of the date of this letter. After that date, the Division will destroy the statements in accordance with its records retention policy.

Katherine Mrowka is the senior staff person assigned to this matter. Ms. Mrowka can be contacted at (916) 341-5363 or by email at kmrowka@waterboards.ca.gov if you require further assistance. Written replies should be addressed as follows: State Water Resources, Division of Water Rights, Attn: Katherine Mrowka, P.O. Box 2000, Sacramento, CA 95812-2000.

Sincerely,

James W. Kassel

James W. Kassel, Assistant Deputy Director
Division of Water Rights

cc: Enclosed Mailing List

NOV 1 3 2012

Petition for Modification List -- not Statement of Water Diversion Mailing List

Mailing List

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Brownstein, Hyatt, Farber, Shreck
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bherrema@bhfs.com

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RWF Family Partners & FLG Family Partners
Foster Feed Yard Inc.
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Brawley, CA 92227

EXHIBIT F

REVIEW OF THE LAWS ESTABLISHING THE SWRCB'S PERMITTING AUTHORITY OVER APPROPRIATIONS OF GROUNDWATER CLASSIFIED AS SUBTERRANEAN STREAMS AND THE SWRCB'S IMPLEMENTATION OF THOSE LAWS.

SWRCB No. 0-076-300-0

Joseph L. Sax
Project Director

FINAL REPORT

JANUARY 19, 2002

ACKNOWLEDGMENTS

I would like to express my special appreciation to the policy and technical advisory committees who assisted me in developing this Report, though they bear no responsibility for the conclusions or proposals made here, nor of course for any errors I have committed. I wish also to thank those members of the State Water Resources Control Board staff – Erin Mahaney, Andy Sawyer, Paul Murphey, and Lewis Moeller – who generously responded to my many questions, and who went far beyond the call of duty in answering my numerous requests for documents and for information about Board practices.

Members of the Technical Advisory Committee: Carl Hauge, Karen Burow, David Purkey, Steve Bachman, Kit Custis, and Jerold Behnke.

Members of the Policy Advisory Committee: Nancee M. Murray, Anne Schneider, Art Littleworth, Carl Hauge, and Hap Dunning.

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Appendices

There will always be great difficulty in fixing a line, beyond which the water in the sand and gravels over which a stream flows and which supply or uphold the stream, ceases to be a part thereof and becomes what is called percolating water.

Hudson v. Dailey, 156 Cal. 617, 627-28 (1909)

INTRODUCTION

1. A Brief Description of Groundwater: The Law and the Reality

The law in California requires that water be identified as in one of three categories: surface water, percolating groundwater, and "subterranean streams flowing through known and definite channels" (subterranean streams).[1] For purposes of this Report, the significance of these categories is the following: Only surface water and subterranean stream water are within the permitting jurisdiction of the State Water Resources Control Board (the Board or SWRCB).[2] Appropriation of those waters requires a Board permit, and is subject to various permit conditions.[3]

To put the matter as simply as possible, the above categories do not accord with scientific understanding of the occurrence and distribution of water on and in the earth. To hydrogeologists, water is a continuum. The same water may sometimes be found on the surface of the earth and at other times underground. Water moves by the force of gravity, and whether it is surface water or groundwater at any particular moment depends on the slope (known as gradient) and direction of the medium through which it is moving at a given moment, on obstacles it encounters, and on the topography of the land. Moreover, from a technical perspective, the distinction between percolating groundwater and subterranean streams is meaningless, or nearly so. Water that actually flows like a surface stream beneath the earth's surface, as in lava tubes or limestone caverns, is very rare in California. Virtually all underground water percolates through the ground. It may move more or less rapidly; it may be moving parallel or perpendicular to a surface stream; it may be narrowly confined or broadly diffused underground. From a geological perspective, these factors are simply crude and partial descriptions of the enormously varied behavioral characteristics of subsurface water, depending on a variety of factors, such as the varied

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[1] When the term "subterranean stream" is used in this Report, it will generally be shorthand for the statutory phrase in Water Code § 1200: "subterranean streams flowing through known and definite channels."

[2] The term jurisdiction, or permitting jurisdiction, used throughout the Report requires a cautionary note. Water Code § 1200 defines the scope of Board authority for those provisions in Part II of the Water Code that require Board approval of diversions from a stream, lake, or other body of water. Insofar as there is controversy involving the Board's authority to impose conditions on groundwater in connection with other activities within its authority (e.g., approvals under Water Code § 1211 where percolating groundwater was a source of some of the treated waste water), nothing in this Report is intended to suggest a position on such matters.

[3] There are other important distinctions, but they are not within the scope of this Report, e.g., riparian uses require no permit (Water Code § 1201), and percolating groundwater is not subject to statutory adjudications (Water Code § 2500).

transmissivity of the material in which it is found, the varied obstacles it encounters, and the diverse gradients over which it travels in its movement through the earth. In addition, at various points in time or space, groundwater may be in hydraulic connection with a surface stream, or it may be confined, at least for some distance, beneath a quite impermeable layer. Water underground may, at one place, or during one season, seep into a river through its banks (a gaining river), and at another place or time seep out from the banks into the underground (a losing river). It all depends on whether the saturated area of the ground is above or below the river bank at that point.

The categories that statutes and judicial opinions use, such as "underflow,[4]" "subflow,"

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[4] The term "underflow", though commonly used – and thus necessarily employed repeatedly in this Report – is an unfortunate usage, for several reasons. First, and foremost, it is not a technical term of art used by hydrogeologists. They understand groundwater and surface water to be part of a continuum (at times interrupted), and there is no hydrological line of demarcation between groundwater that is, for example, percolating toward a stream, and groundwater that has become part of the stream as "underflow". As the Arizona Department of Water Resources has explained, "[i]n the ideal, subflow [or underflow] can be visualized as just another part of the stream that lies out of view below the surface. As part of the stream, it also has distinct bed and banks which define its extent. This ideal concept of subflow does exist in narrow bedrock canyon streams where both the surface and subsurface components of the stream are contained within hardrock boundaries. But as these bedrock canyons descend from the mountains, the valleys become alluvial valleys between mountain ranges, where the subterranean component of streams becomes unbounded." Technical Assessment of the Arizona Supreme Court Interlocutory Appeal Issue No. 2 Opinion, In Re The General Adjudication of the Gila River System and Source, Arizona Department of Water Resources (December 15, 1993) (typescript), at 38.

In addition, as noted hereafter in the text, the term has been commonly picked up from a headnote in *Los Angeles v. Pomeroy*, 124 Cal. 597, 57 P. 585 (1899), writ of error dis. sub nom. *Hooker v. Los Angeles*, 188 U.S. 314, 23 S.Ct. 395, 47 L.Ed. 487 (1903) and is often cited in a way that gives an inaccurate sense both of the trial judge's instructions, and the Supreme Court's decision, in that case.

As a legal term, underflow has been defined in various ways. It is said to be water in the soil, sand and gravel immediately below the bed of the open stream (*Verdugo Canon Water Co. v. Verdugo*, 152 Cal. 655, 663, 93 P. 1021 (1908)), which supports the surface stream in its natural state or feeds it directly (*Huffner v. Sawday*, 153 Cal. 86, 92, 94 P. 424 (1908); *San Bernardino v. Riverside*, 186 Cal. 7, 14, 198 P. 78 (1921)). *Pomeroy* is cited for the view that underflow requires that the surface and subsurface be in contact and that the subsurface flow shall have a definite direction corresponding to the surface flow, 124 Cal. 597, 617, 636-37, 57 P. 585 (1899). A commonly cited definition of underflow is taken from Wells A. Hutchins, The California Law of Water Rights (1956), at 422: "The underflow or subflow of a surface stream consists of water in

(continued...)

"subterranean streams," and "percolating groundwater," bear little if any relationship to these geological realities. Indeed, these water law terms are geographic conceptions fundamentally at odds with science's understanding of water's movements. The legal categories seem to assume, for example, that there is a fixed space within which water is the "underflow" of a stream, and beyond that space the water is something else. From a hydrogeological perspective, such geographic categories are dubious at best. From a scientific perspective, efforts to fit water into the law's categories by using these technical-sounding classifications give the enterprise a somewhat daffy air. Is the water moving parallel to the stream, or perpendicular to it? Is the aquifer more like a lake in shape, or more like a river? Is water percolating through the ground rapidly enough to be treated as "flowing" water?

How then does one intelligently examine a statutory provision like Water Code § 1200? This Report is founded on a simple premise. It is that the provision was enacted to achieve some legislative purpose, and that however unscientific or outdated the statutory language may be, it is nonetheless likely that the legislators had some real problem in mind that they were seeking to address. As we shall see, those who drafted the legislation that became the Water Commission Act were not ignorant of the interactive relationship between groundwater and surface water. They knew perfectly well that much "percolating groundwater" was on its way to or from a surface stream, and they knew that water appeared, disappeared and reappeared on the surface as streams flowed. It was, after all, 1913 and not 1319 in which they were drafting legislation. So it seems appropriate to pose the following as the basic question: what were the drafters of § 42 of the Water Commission Act,[5] the original version of today's Water Code § 1200, trying to do, and how might their goal best be accomplished today? Whether that goal remains a desirable one today is a separate question – a question for today's legislature.

2. Questions Addressed in this Report

Six specific questions have been posed as the scope of work for this Report. They are:

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[4](...continued)
the soil, sand, and gravel immediately below the bed of the open stream, which supports the surface stream in its natural state or feeds it directly. To constitute underflow, it is essential that the surface and subsurface flows be in contact and that the subsurface flow shall have a definite direction corresponding to the surface flow. The underflow may include the water moving not only in the loose, porous material that underlies the bed of the surface stream, but also the lateral extensions of the water-bearing material on each side of the surface channel. But it must be moving in a course and confined within a space reasonably well defined, so that the existence and general direction of the body of water moving underground may be determined with reasonable accuracy."

[5] The relevant sentence reads: "Whenever the terms stream, stream system, lake or other body of water or water occurs in this act, such term shall be interpreted to refer only to surface water, and to subterranean streams flowing through known and definite channels."

1. What is the scope of the State Water Resources Control Board's (SWRCB) water right permitting authority over groundwater?

2. What is the current legal test for determining whether groundwater is subject to the SWRCB's permitting authority?

3. Under this legal test, what physical characteristics should the SWRCB evaluate in distinguishing subsurface waters subject to the SWRCB's permitting authority from subsurface waters that are percolating groundwater?

4. What factors has the SWRCB considered in its past decisions regarding groundwater classifications?

5. Should the legal test for determining what subsurface waters are subject to the SWRCB's permitting authority be changed? If so, what legal test would be appropriate?

6. Can quantifiable criteria be established to implement the legal test? What are the quantifiable criteria?

The bulk of this report consists of underlying data and analysis that inform the answers offered to questions 1, 2, 3 and 4. That material is divided into three parts: Part I consists of a review of the judicial decisions that dealt with subsurface water, and that formed the case law background to the Water Commission Act of 1913. Part II comprises a legislative history of the 1913 Act, and reference to subsequent legislation dealing with Board jurisdiction over groundwater. Part III discusses the Board's interpretation of the subterranean stream language of Water Code § 1200 and its predecessor provisions from the beginning to the present time.

Question 5 calls for judgment about a question that must ultimately be resolved legislatively. Part IV of this Report discusses approaches that have been taken in some other western states to deal with the integration of surface water and subterranean water management, and to suggest some changes that the California legislature may wish to consider. Part V discusses other opportunities to manage subsurface water that may be available under existing law and that may be pursued in the absence of legislative change. Part VI is a response to Question 5.

Question 6 asks whether quantifiable criteria can be articulated to implement the subterranean stream provision of the law. Based on the conclusions drawn in this report about the meaning of the provision, an effort has been made to provide such criteria. The proposed criteria have been developed following consultation with the Technical Advisory Committee appointed by the Board. But they do not implement (and there was not) a Committee recommendation. The proposed criteria are mine.

3. Responses to the Questions Posed by the Board

1. What is the scope of the State Water Resources Control Board's (SWRCB) water right permitting authority over groundwater?

Water Code § 1253 grants the SWRCB permitting authority over unappropriated water. Water subject to appropriation is defined in Water Code § 1201 as "[a]ll water flowing in any natural channel" except water that is or may be needed for use upon riparian land or water that is otherwise appropriated.[6] Unappropriated water is defined in Water Code § 1202. The term "water" as utilized in the preceding cited provisions is limited by Water Code § 1200 to "surface water, and to subterranean streams flowing through known and definite channels." Thus the Board's permitting authority over groundwater extends only to the water of unappropriated subterranean streams flowing through known and definite channels, except as it is or may be reasonably needed for useful and beneficial purposes upon lands riparian to the channel through which it is flowing, that is, to use on land overlying a subterranean stream.[7]

2. What is the current legal test for determining whether groundwater is subject to the SWRCB's permitting authority?

The California Supreme Court has not provided a judicial interpretation of the statutory definition of groundwater subject to the Board's permitting jurisdiction. While the Board looks to the decision in *Los Angeles v. Pomeroy*, which distinguished between subterranean streams and percolating groundwater, as authority, that case is not a judicial interpretation of Water Code §1200, or of its predecessor statutory provision.

The current legal test, as articulated by the Board in its 1999 decision in the *Garrapata Creek* case,[8] requires the following physical conditions to exist in order for groundwater to be classified as a subterranean stream flowing through a known and definite channel, and thereby to be subject to the Board's permitting authority: (1) a subsurface channel must be present; (2) the channel must have relatively impermeable bed and banks; (3) the course of the channel must be known or capable of being determined by reasonable inference; and (4) groundwater must be flowing in the channel.

In the *Garrapata Creek* decision, the Board also stated that while a subterranean stream includes "underflow" (which is not a statutory term, though it is commonly used), it is not necessary that

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[6] There is an exemption for small domestic appropriations, which are acquired by registration, Water Code § 1228, et seq.

[7] See note 264, *infra*.

[8] D. 1639 (1999). Board decisions are referred to in this report by the capital letter D., followed by the decision number and the date.

groundwater be underflow to establish the existence of a subterranean stream flowing through a known and definite channel. Underflow was described as having the following physical characteristics: (1) underflow must be in connection with a surface stream; (2) underflow must be flowing in the same general direction as the surface stream; and (3) underflow must be flowing in a watercourse and within a space relatively well defined.[9]

The Board noted both some differences, and some common elements, between a subterranean stream and underflow. A subterranean stream, it said, need not be interconnected with a surface stream. Both a surface stream and underflow, however, must flow in a watercourse. A watercourse must consist of a bed, banks or sides, and water flowing in a defined channel.

Some elements of the current legal test utilized by the Board are more fully defined than others. The standard of "relatively impermeable bed and banks" of a channel is described as material "sufficiently impermeable at the point of diversion to prevent the transmission of all but relatively minor quantities of water through the channel boundary." The Board does not utilize a quantitative measure of difference in permeability. The test is not that the bed and banks be "absolutely impermeable."

There is no similarly spelled-out definition of what constitutes a "channel," of what is required for a channel to be "known and definite," or of how it is determined whether water is "flowing" in a channel. At least some of these criteria have been the subject of considerable controversy in other cases, notably the so-called *Pauma and Pala* case (In the Matter of Application 30038 et al.), in which a Draft Decision was issued on October 25, 1999, as well in some earlier cases noted in the body of this Report. However, the Board's current interpretation of these elements remains to be fully spelled-out. Concern has been expressed that the Board may be taking an excessively broad view of what constitutes a channel and of the existence of flow; and that by focusing as much as it does on the presence of bed and banks, though they may be distant from a stream, the Board may be moving toward a too expansive definition of a subterranean stream. It has been suggested that these interpretations, or proposed interpretations, are at odds both with the statutory mandate and with long-standing Board practice.

3. Under this legal test, what physical characteristics should the SWRCB evaluate in distinguishing subsurface waters subject to the SWRCB's permitting authority from subsurface waters that are percolating groundwater?

I understand this question to ask for an analysis of meaning of the subterranean stream provision of Water Code § 1200; and, based on that analysis, to propose an appropriate test for

[9] This definition actually comes from Instructions XVI and XVII of the trial judge's instructions in *Pomeroy,* and is not characterized there as a definition of "underflow," a term which appears only once in *Pomeroy,* in connection with the Court's comment on Instruction X, see 124 Cal., at 630.

implementing the subterranean stream provision of Water Code § 1200. As spelled out in detail in Part II of this Report, analysis of the background of the 1913 Water Commission Act, and in particular the evolution of the subterranean stream provision of that Act, indicates that evaluation of "physical characteristics" is not the key to a proper interpretation of the statutory provision.

My analysis reveals that the legislative purpose was to protect the integrity of the permitting agency's jurisdiction over surface stream appropriations by preventing unpermitted taking of groundwater that appreciably and directly affects surface stream flows. The concern was essentially to close a loophole that would have been left if any taking of water from a subsurface location would leave the permitting agency powerless in the face of wells or tunnels that were effectively underground facilities for withdrawing stream water. At the same time, it is clear that the legislation was not intended to create permitting jurisdiction over all groundwater whose pumping would in any way, or at any time, affect surface streams. The statute was without doubt meant to leave much tributary groundwater as part of a separate legal regime outside the permit system that was being established. While the "subterranean stream" language in the Water Commission Act was almost certainly intended to focus on areas that were very proximate to the surface stream (the subterranean aspects of surface streams), such as what is called underflow or subflow, it should be kept in mind that modern-day high-powered pumps were not extant at that time. The central concern was impact, however, not proximity.

My conclusion is that the legislation was designed to create an impact test (impact of pumping on surface stream flows), rather than seeking to identify a physical entity with a specific shape, despite the conventional "subterranean stream" language the law picked up from the old treatises. I conclude that a test designed to identify appreciable and direct impact of groundwater diversion on a surface streams represents a more faithful implementation of the legislative purpose than any catalog of physical characteristics.[10]

While any test of impact necessarily involves a judgment about the boundaries of inclusion and exclusion, so does any test based on geography or on physical characteristics, whether it involves flow direction, permeability of an asserted bed and banks, identification of a channel, or whether certain groundwater is or isn't "underflow." Since the groundwater and surface water within a watershed essentially constitute a continuum, any test intended to separate one part of the groundwater from another ("percolating" vs. "flowing"), or to distinguish groundwater from surface water, inescapably requires a judgment that reflects a purposive goal, rather than reflecting a technical line of demarcation that hydrogeologists or other scientific experts utilize and for which there is a technically accepted definition. Indeed, even in states where groundwater and surface water management is fully integrated, policy-dominated judgments must be made

[10] Insofar as such a test would enlarge Board jurisdiction somewhat, it raises the perplexing question of how to deal with longstanding uses, formerly considered outside the Board's jurisdiction, but now deemed to be jurisdictional. As to "grandfathering" existing uses, see text at notes 211, *infra.*

about the point at which pumping impacts on surface streams are sufficiently attenuated in time or impact that they should not be considered.[11]

The response to Question 6, below, offers a suggested approach for the Board in drawing the required line distinguishing subsurface waters subject to the SWRCB's permitting authority from subsurface waters that the law classifies as percolating groundwater.

4. What factors has the SWRCB considered in its past decisions regarding groundwater classifications?

Two factors have been found wherever the Board has taken jurisdiction of what is determined to be a subterranean stream: a finding of (1) bed and banks; and (2) water flowing along the line of a surface stream (though sometimes very slowly). A third factor – the presence or absence of a channel – has been a subject of controversy from the beginning. In addition, in almost all cases where the Board took jurisdiction, hydraulic connectivity showed that the pumping would impact a surface stream. Connectivity is a factor that is always taken account of, and appears to be influential, though the Board has not articulated surface stream impact as itself a test of jurisdiction. There are, however, cases where the Board has taken jurisdiction where there was no finding of such connectivity and impact, and cases where it has declined jurisdiction where that element was present.

The classic case for finding jurisdiction is where subsurface water is pumped from a narrow alluvial valley enclosed by a steep rocky canyon, and where the subsurface water is moving along a closely confined path paralleling the line of a surface stream. The 1926 *Sheep Creek* case exemplifies such circumstances,[12] and one can find similar cases down through the decades.[13] Described as the underflow of the surface stream, the subsurface flow in that case was "very slow", but it was said to be definite, and was within a channel – a closely confined path – formed by the walls of a canyon that ranged from ¼ mile to 1 mile in width. Though the decision contains no finding of relative impermeability, it quotes the language of "impervious sides and bed" from the *Pomeroy* headnotes as describing the setting in the case. As to impact, it also quotes the *Pomeroy* headnotes, which speak of "caus[ing] the water of the stream to leave its bed to fill the void caused by such [groundwater] diversion."

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[11] See text at notes 235, 263, *infra*.

[12] Decision No. 3883, D. 119 (1926), discussed text at note 173, *infra*.

[13] E.g., Stony Creek (Colusa County), Order WR 80-11 (1980), discussed in text at note 177, *infra*; Laguna Creek (Santa Cruz County), Memo from Charles NeSmith, Associate Engineering Geologist, Files 262.0 (44-16-01), Water Rights Complaint – California Department of Fish and Game vs. Stephenson Ranch (Santa Cruz Biotechnology) Regarding Diversions from Laguna Creek in Santa Cruz Country (August 23, 2001).

The most troublesome cases for the Board seem to have been those where the claim is that there is no "channel," though the other factors – bed and banks, and flow, as well as impact on a surface stream – have been present. The record of the very first subterranean stream case, in 1924, contains a staff report recommending against taking jurisdiction because the groundwater is in a broad valley described by the staff as "an underground lake." The Board did, however, assert jurisdiction, perhaps because neither side objected (indeed, it seems the two contending sides wanted the Board to resolve their conflict).

In 1938, a case involving the San Luis Rey River again raised the question whether the fact that the subsurface water was found within a broad valley that was not channel-like, i.e., narrowly confined, was jurisdictionally disqualifying.[14] The Board held that it was not. The Board took jurisdiction, stating, "while the underground water is concluded to be a definite stream, yet the bottoms along the river constitute reservoirs of some magnitude just as are found in a surface stream in its wide, deep and slow moving reaches."[15] The Board took special note of the hydraulic connection, or impact factor, noting that the "stream and the underground water function as a closely related unit."

The issue arose again in 1960, in the *Cache Creek* case, where doubts were raised about the width of the asserted channel and the resulting asserted lack of flow.[16] The Board formally rested its finding of no jurisdiction on the slowness of the flow and the breakup of the canyon walls by side canyons. In the course of its decision, the Board asked, "[w]hen is a given area a stream, and when is it an underground basin? Does the word 'flowing' include water that is moving very slowly? When a given area containing slowly moving water has impermeable sides and bottom, must those impermeable sides and bottom be construed as the bed and banks of a stream...?"[17] In that case, the answer was "no". The circumstances suggested that the pumping was not impacting the surface stream, which may have influenced the decision against jurisdiction.

Hydraulic connection between the subsurface water and the surface stream, such that pumping is seen as significantly impacting the surface stream, is commonly an indication that the Board will find jurisdiction in an otherwise marginal case – as in the 1938 case noted above involving the San Luis Rey River; or in the more recent *Carmel River* case (though the jurisdictional finding there was uncontested);[18] and it may be explanatory of the 1999 Draft decision in the *Pauma and Pala*

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[14] D. 432 (1938), discussed in text at note 195, *infra*.

[15] D. 432, at 14-15.

[16] D. 968 (1960), discussed in note 178, *infra*.

[17] *Id*., at 3.

[18] Order No. WR 95-10 (1995), discussed in text at note 189, *infra*.

case.[19]

On the other hand, the Board has taken jurisdiction of cases where there was no evidence of hydraulic connection (the pumping was from a confined aquifer), and where the presence of anything ordinarily thought of as a channel was doubtful.[20] And it has denied jurisdiction for lack of a "known and definite channel," even where pumping might be depleting the stream.[21] The common explanatory element in these two cases is "bed and banks." In the former case, bed and banks were found; and in the latter there was nothing that could qualify as bed and banks. If there is a single dominating factor in the Board's current jurisdictional decisions, it seems to be a focus on the presence or absence of a bed and banks. The presence of something that qualifies as a bed and banks seems to generate a rather generous attitude toward finding a channel, and the presence of flow. The presence of a hydraulic connection between the subsurface water and a surface stream appears as an added factor in favor of a jurisdictional finding.

5. Should the legal test for determining what subsurface waters are subject to the SWRCB's permitting authority be changed? If so, what legal test would be appropriate?

In theory, there is no doubt that hydraulically connected groundwater and surface water ought to be managed in a single integrated system, and that has been the general direction in which many states have moved. There are several models that offer California useful ideas.[22] But this State has a long and deep history of resistance to such integration, and the prospects of achieving legislative change that wouldn't be piecemeal or riddled with destructive exceptions seems very dim within the foreseeable future. In addition, California's exception of riparian uses (which cases indicate includes overlying applications of groundwater) from its permitting system provides another reason to doubt the prospects of full integration of administration under a Board permitting system.[23] For these practical reasons, I suggest that efforts at improving management of groundwater be directed elsewhere than at legislation to enlarge the Board's permitting jurisdiction over what is now called percolating groundwater.

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[19] Discussed in text following note 158, *infra*.

[20] D. 1589 (1982), Chorro and Morro Creeks.

[21] Pilarcitos Creek, San Mateo County, SWRCB letter of Jan. 9, 2001 (363:CLC:262.0(41-08-03)), at 2. Earlier, the Board refused jurisdiction of a well within 18 feet of a creek pumping tributary water, because the groundwater was seeping, not flowing with the stream. It told the protestant it would have to go to court to protect its stream rights against the pumping. Decision A. 6017, D. 225 (1929) (Metcalf Creek, San Bernardino County).

[22] Nebraska, Oregon, and Colorado, discussed in text following note 250, *infra*, offer a variety of promising examples.

[23] See note 264 and Part VI, *infra*.

Instead, I suggest a three-prong approach: (1) Improvement of the existing method for implementing Water Code § 1200, along the lines proposed in this Report; (2) Active use by the Board of its existing jurisdiction under Water Code § 275 to deal with waste, unreasonable use, unreasonable methods of use, and implementation of the public trust, which offers considerable authority to protect surface resources from groundwater diversions;[24] and (3) Additional attention to basin-wide management, using as a model the more successful managed Southern California basins.[25] Comprehensive basin management comprehends not only regulation of groundwater and surface water, but other techniques that are becoming increasingly important, such as conjunctive use, control of subsidence and saltwater intrusion, aquifer quality control, pump taxes or other fees to limit use and support importation of new supplies, etc. While recognizing the difficulty and cost of settling rights within an entire basin, the successful precedents established in some California basins seem to offer the best hope for achieving genuine comprehensive management in this State, taking account of California's historic experience with efforts at groundwater law reform.

6. Can quantifiable criteria be established to implement the legal test? What are the quantifiable criteria?

Perhaps. As was noted above, and will be explained in detail in the body of the Report, the legislative purpose underlying the subterranean stream language of Water Code §1200 was to protect the surface stream permitting jurisdiction from subversion by those who might directly benefit from the stream without having to obtain a permit like other surface diverters, while not subjecting all groundwater, or even all tributary groundwater, to the permitting system they were establishing. The legislative goal was to pose the question, when should a well be treated as essentially a subterranean component of a surface stream; that is, which wells are appreciably and directly (both in place and time) impacting the surface stream?[26] That is not a question technical experts can answer, though experts can tell us what we are likely to include or exclude within any line that we draw in an effort to be true to the legislative intent.

In an effort to find workable criteria that would approximate the legislative goal as closely as

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[24] See, however, note 287, *infra.*

[25] See generally William Blomquist, Dividing the Waters: Governing Groundwater in Southern California (1992).

[26] Because I conclude that this was the legislative intent, the so-called "bed and banks" test of jurisdiction is inappropriate, nor can legislative intent be implemented by efforts to define what constitutes a "definite channel[]," or when groundwater water is "flowing" through such a channel, notwithstanding the literal language of the statute. It should be emphasized that the literal terms of a statute sometimes simply do not describe legislative intent. See *Andrus v. Charlestone Stone Products Co.,* 436 U.S. 604 (1978) (holding that groundwater is not a "valuable mineral" within the meaning of the General Mining Law of 1872, 30 U.S.C. § 22).

possible, experts on the Technical Advisory Committee were consulted. The following does not represent their recommendations, either individually or collectively. Indeed, there was no single view taken by the Committee, which is perhaps a reflection of the difficulty in this context of sorting out technical from interpretive and policy perspectives.

It may well be that no shorthand criteria will prove generally applicable in a satisfactory manner. Technical Advisory Committee members often emphasized how various stream conditions can be from place to place, and from season to season; and how much difference it makes whether there are few or many wells in an area, etc. As one member put it, any simple test must confront the fact that "there is a significant problem in studying surface water-groundwater interactions because the evidence is not readily visible, the hydraulics are complex and dynamic, the impacts can be felt over a broad area with no single point of diversion from the stream, and because of the time delay between pumping and impact."[27]

What follows – with all due cautions – are criteria I suggest for the use of presumptions to assist in determining jurisdiction.[28] No doubt they will benefit from refinements based on experience, and from adaptations reflecting conditions in differing river systems.[29] They are not entirely quantitative, in particular the terms such as "thickness" or "substantial" used below. The purpose of these terms is to provide guidance to the Board as it seeks to implement the legislative will. It may find, based on its experience, or with further technical assistance, that in some river systems or areas it can appropriately utilize a numerical value as a guide, and thus evolve toward a more fully quantitative test of presumptive jurisdiction.[30] Ultimately, however, as noted above, and as will be discussed more fully in the body of the Report, the legislative purpose was to protect its permitting authority over surface stream waters from subversion, that is, to identify those

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[27] Memo from Kit H. Custis, DOC-Division of Mines and Geology, Dec. 28, 2001, at 2.

[28] I received a number of helpful memos from Technical Advisory Committee Members, both suggesting how to determine certain measures (e.g., a stream recharge area), noting concerns with various suggested quantitative criteria, and offering alternative criteria. These memos are reprinted in Appendix E.

[29] The occurrence, movement, and availability of groundwater are all determined by the availability of a water supply and by the rock types that constitute the local geology. In California the available water supply from precipitation and surface runoff, and the geology vary considerably from place to place within the state. This variation in water supply and geology requires that any consideration of groundwater issues must include a detailed understanding of both the local water supply and the local geology. A technical approach used to determine the relationship between groundwater extraction and stream flow must be suitably designed to fit the local groundwater hydrology and the local geology.

[30] My assumption is that if the Board pursues this approach it will implement it through formal regulations, following appropriate public processes.

groundwater diversions that in some "substantial" way undermine that authority. No magic number can do that job.

1. A well 1,000 feet or less from a designated surface stream recharge area is presumptively within the Board's jurisdiction,[31] if either (a) a substantial percentage of the well's annual flow is extracted from the stream recharge area (determined by using the Jenkins method or some similar reproducible method); or (b) the well produces substantial stream depletion determined as of the period of the most critical flows of the stream system it impacts. The Board shall bear the burden of making these determinations.

2. If either (a) the well is screened below a clay layer of such thickness, and where conditions denote lateral continuity, indicating lack of well impact on the stream; or (b) the well does not create a measurable drawdown at the edge of the stream recharge area, indicating lack of hydraulic influence from the stream, the presumption of jurisdiction shall be rebutted. A party opposing a presumption of jurisdiction shall bear the burden of rebutting the presumption.

3. Whenever a well is found to be presumptively jurisdictional, any well owner may have individual pump tests performed to determine actual well impacts, for the purpose of rebutting any of the foregoing presumptions. Such tests shall be of reasonable duration and intensity. The costs of any such tests shall be borne by the party ordering the tests.

4. Whenever a well is found to be presumptively non-jurisdictional, the Board (within the scope of its ability under existing law to gather information)[32] or any protestant may have individual pump tests performed to determine actual well impacts, for the purpose of rebutting any of the foregoing presumptions. Such tests shall be of reasonable duration and intensity. The costs of any such tests shall be borne by the party ordering the tests.

5. Following any such tests, and after considering the evidence before it, the Board shall make a final determination of jurisdiction.

6. The jurisdictional presumptions of ¶ 1, above, shall not apply in cases of

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[31] According to technical experts I consulted, in water table situations when setting observation wells in pump tests, drawdown is near zero at that distance, an experience that has been confirmed by modelling. Drawdown, or changes in the water table adjacent to the stream recharge area, is an indicator of hydraulic influence of the well's pumping.

[32] See note 287, *infra.*

long-standing hydrological disconnection.[33]

It should be noted that a determination that a well is jurisdictional does not mean that it is in fact adversely affecting uses of the surface stream. It only means that the well is sufficiently within the impact-orbit of the stream, that the Board has jurisdiction to consider well impacts in the same way that it considers impacts from proposed surface diversions.

PART I:

THE LEGAL BACKGROUND OF THE WATER COMMISSION ACT

1. The *Pomeroy* Case

If there is any point about which all sides in the debates over subterranean streams agree, it is that one has to look to the decision in *Los Angeles v. Pomeroy*[34] for legal guidance in deciding whether certain subsurface waters are, or are not, a subterranean stream under California law.[35] Before turning to that much-cited case, a few preliminary comments are in order. First, the *Pomeroy* decision is not a legally binding precedent. It was decided prior to the enactment of the governing statute[36] and its predecessor provision,[37] and therefore it does not represent the

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[33] See text at note 211, *infra*.

[34] 124 Cal. 597, 57 P. 585 (1899), writ of error dis. sub nom. *Hooker v. Los Angeles*, 188 U.S. 314, 23 S.Ct. 395, 47 L.Ed. 487 (1903).

[35] For example, in a statement at a public workshop held by the SWRCB on April 24, 2000, the Department of Water Resources stated that "the appropriate legal test to be applied in distinguishing between percolating water and subterranean streams was set forth by the California Supreme Court in *Los Angeles v. Pomeroy* more than 100 years ago." Statement of the Department of Water Resources, State Water Resources Control Board Workshop, 24 April 2000, at 1. See also *Id*., at 6: "In determining the legal classification of groundwater, the Board and its predecessors have relied on the California Supreme Court's 1899 decision in *Los Angeles v. Pomeroy* which established the distinction between subterranean streams and percolating groundwater."

[36] Water Code § 1200. See also §1221: "This article shall not be construed to authorize the board to regulate groundwater in any manner." As this provision makes clear, under the Water Code a "subterranean stream flowing through known and definite channels" is not legally

(continued...)

Supreme Court's interpretation of the legislature's intent in enacting the Water Commission Act in 1913. Second, it may well be that *Pomeroy* has been more often plucked for its quotable language than studied for its meaning and context (many commentators quote the language of its headnotes rather than the text of the opinion), and that at least some of what has been attributed to it over the years may be misleading. Third, any effort to ascertain the significance of *Pomeroy* to the 1913 law needs to take account of subsurface water law developments in the California Supreme Court between 1899 and 1913. Fourth, and finally, it is important to understand what the legislature was trying to do when it enacted the statutory provision in question, rather than just assuming it meant to codify the *Pomeroy* opinion. The following pages explore each of these matters.

Pomeroy was an eminent domain valuation case. In order to improve its municipal water supply system, Los Angeles had condemned a narrow strip of land comprising 315 acres, averaging some ¼ mile in width,[38] adjacent to the Los Angeles River just above where it passes through the narrows out of the San Fernando Valley, between the eastern extremity of the Cahuenga Mountains and the Verdugo hills. The question in the case was how to value the land taken. It was determined that Los Angeles had a paramount pueblo right to the water of the Los Angeles River. If the water beneath the condemned land was water of the Los Angeles River, the City was entitled to it and the condemnation award could not include the sales value of the water under the land for use elsewhere. Notably, the case had nothing to do with state regulatory jurisdiction over groundwater. The question was simply whether the water beneath the defendants' land was part of the Los Angeles River (Los Angeles wins), or whether it was part and parcel of the condemned land (defendants win).

The physical situation in the case was that the water of the Los Angeles River had its source in the mountains surrounding the San Fernando Valley, water that went underground into the alluvium of the Valley, and then by gravity flow found its way to the River. The Court acknowledged that all, or virtually all, the groundwater from the San Fernando Valley watershed found its way into the Los Angeles River. The defendants' land lay on both sides of the River, and the subsurface water beneath it was "in intimate contact" with the surface flow, and flowing in the same direction

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[36](...continued)
considered "groundwater".

[37] The original statute read: "Whenever the terms stream, stream system, lake or other body of water or water occurs in this act, such term shall be interpreted to refer only to surface water, and to subterranean streams flowing through known and definite channels." Statutes 1913, ch. 586, § 42 (Approved June 16, 1913, in effect August 10, 1913).

[38] 124 Cal., at 604, 606.

at a rate about 1/1000 the rate of the surface stream.[39] The Court held that the evidence sustained a finding that this subsurface flow was a subterranean stream. The bulk of the Court's opinion examines the question whether the law with respect to subterranean streams was correctly stated in the trial judge's instructions to the jury.

The narrow question in the case was whether the subsurface water in question was part of the surface stream of the Los Angeles River. For that reason the instructions speak to evidence relating to the question whether the water in question was an immediate subsurface element of the surface stream, that is, what is usually called underflow.[40] For example, the trial judge told the jury that if it found the water moving underground was "in the same general direction as the surface stream and in connection with it,"[41] then the water should be considered as part of the watercourse. That instruction, and its approval by the Supreme Court, does not decide one way or another whether the presence of subsurface water flowing in the same direction as the surface stream is a necessary element of any subterranean stream.[42] There is, however, at least one thing the Court does make clear. Nothing in the case is intended as a determination that all tributary

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[39] The court said the surface stream flowed 2-3 feet/second, and the subsurface flow was 14-17 miles/year. *Id*., at 617. This was probably a misstatement, see Statement of Dennis E. Williams, State Water Resources Control Board Workshop, 24 April 2000, transcript, at 58 ("...Pomeroy...estimated...groundwater was flowing...200 to 250 feet per day....Groundwater flows a few feet per day").

[40] In defining "underflow," reference is usually made to the elements mentioned in Instruction XVI in the *Pomeroy* decision: groundwater must be connected to the surface stream, flow in the same direction as the surface stream, be confined to a reasonably well-defined space, and be moving in a course. *Los Angeles v. Pomeroy*, 124 Cal., at 623-624.

[41] 124 Cal., at 624.

[42] *Pomeroy* quoted from Kinney's first edition, published in 1894, Clesson S. Kinney, A Treatise on the Law of Irrigation (1894), § 48, 69-70. Kinney had a rather formal and elaborate conception of subterranean streams, which he spelled out at length in his second edition (Clesson S. Kinney, A Treatise on the Law of Irrigation, vol. II (1912), at § 1161, pp. 2106-07). He included known and unknown, dependent and independent, subterranean streams. Underflow is the classic example of what he calls a known, dependent subterranean stream. While what Kinney had primarily in mind were simply the subsurface elements of more-or-less perennial surface streams, according to him a subterranean stream may also be entirely independent of any surface stream, so long as it ascertainably has the channel-like characteristics of surface streams. Such flows, which Kinney calls "independent [of surface] streams" may be identified by "the topographical features of the country." Kinney, 2d ed., at § 1165, at 2117. Kinney cites for this point *McClintock v. Hudson*, 141 Cal. 275, 74 P. 849 (1903).

underground water should be classified as a subterranean stream.[43]

Taken all in all, *Pomeroy* can be read broadly or narrowly, and neither reading can be said definitively to be right or wrong. The case itself deals only with the underflow of a gaining stream,[44] but it purports to set out more generally "the proper definition of a subterranean stream ", which it does by quoting from Clesson Kinney's treatise on the law of irrigation.[45] In so doing, it employs terms that are capable of variable interpretations, but which the Court either does not define, or defines ambiguously. For example, the Court does not indicate what sort of movement is required for subsurface water to be "flowing," a matter of some importance since virtually all groundwater is in motion to some extent. It says a channel must be "defined," and defined means

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[43] 124 Cal., at 631-32. As the issue is sometimes raised whether the legal definition of a subterranean stream might embrace the whole of the Central Valley or any other broad alluvial valley enclosed by mountains and thus arguably having a bed and banks, the instructions in *Pomeroy* are striking: Having just described a "watercourse," as above, the trial judge goes on to say that "[w]ater moving by force of gravity in a valley or basin of wide extent,...and moving generally through the whole or through a large portion of the basin...composed of alluvial or other deposit lying throughout the entire basin...do not constitute a watercourse...." *Id*., at 627. The Supreme Court underlines this point, noting that the trial judge "was not giving, or intending to give, a definition which would make the whole San Fernando basin a subterranean stream. The instructions...are applicable...exclusively to the comparatively narrow outlet of the valley...between the rocky and comparatively impervious mountain sides on either hand... [including] water moving in a definite direction...[and] sides and bed to the channel in which it is moving..." *Id*., at 631-32. Well before *Pomeroy*, California court cases had already decided to reject integrated management of surface and groundwater, even where knowledge of the hydrological impact was clear and undisputed, *Gould v. Eaton*, 111 Cal. 639, 645, 44 P. 319 (1896), and despite a view that such a rule was not required by precedent, and was unwise. *Southern Pacific Railroad Co. v. Daffier*, 95 Cal. 615, 619-20, 30 P. 783 (1892). Explicit reference to these precedents in *Pomeroy* makes clear that the *Pomeroy* Court was not seeking to use the subterranean stream category to bring about integration of surface rights with uses of tributary groundwater.

[44] There seem to be no early cases finding a subterranean stream that involved anything other than underflow. For example, only a few months after the *Pomeroy* decision, the Court held that the subterranean flow in the bed of the San Gabriel River was underflow constituting a subterranean stream, and not percolating water that belonged to the owner of the soil. *Vineland Irrigation Dist. v. Azusa Irrigating Co.*, 126 Cal. 486, 494, 58 P. 1057 (1899).

[45] See note 42, *supra*.

"contracted and bounded,"[46] but it does not further define those terms. Whatever contracted and bounded means, the Court acknowledged that in the *Pomeroy* case the "contracted and bounded" area was as much as two and a half miles in width,[47] which is hardly what most people would think of as a contracted channel. Moreover, one is left unsure whether it is essential to the decision that within such a channel "there was a subsurface flow corresponding with the surface flow...."[48] If so, that would significantly narrow the potential for a broad area of an alluvial valley to qualify as a bounded and contracted channel. As to the "sides and bed" to the channel,[49] the Court describes them as "comparatively impervious,"[50] giving no further definition to that characterization.

The plain fact is that while the outcome in *Pomeroy,* in favor of Los Angeles, made good sense, the decision's legal effort to define a part of the groundwater continuum as a "subterranean stream" was both a hydrogeological and a public policy fiasco. Virtually everyone acknowledges this. What is less often noted is that the *Pomeroy* test was soon abandoned by the California Supreme Court. In fact, it is almost certainly the case that the *Pomeroy* court itself realized that the subterranean stream category it had fashioned was an unfit tool for water management. After all, the judges in the *Pomeroy* case were perfectly well aware that the water in the Los Angeles River, and its underflow, and all the rest of the surface and subsurface water in the San Fernando Valley, was part of single, continuous system. The *Pomeroy* Court acknowledged that fact explicitly. It knew full well that the "percolating" water outside of the acreage in the case was on its way to those lands where it would be magically transformed into "subterranean stream" water. Why, then, did it write the opinion it did? After all, unlike today's Board and courts, it had no subterranean stream language in a statute that it was bound to interpret and implement. It was making law in the common law tradition.

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[46] 124 Cal., at 633.

[47] *Id.,* at 632.

[48] *Id.,* at 634.

[49] *Id*., at 632.

[50] *Ibid.* Despite the common use of the word "impermeability" in discussions of the *Pomeroy* case rule, neither the instructions, nor the Supreme Court opinion uses that word. The Supreme Court, attributes to the trial court a standard of "a well-defined channel with impervious sides and banks" *Id*., at 631 (emphasis added), though the word "impervious" never appears in the trial court's instructions. The trial court said only that the sides and banks "may consist of any material which has the effect of confining the waters within circumscribed limits." *Id.*, at 623 (Instruction XV). In any event, in the very next paragraph the Supreme Court describes the channel as being the "comparatively impervious mountain sides on either hand." *Id*., at 632. See note 146, *infra*.

2. The *Pomeroy* Case in its Historical Context

The traditional common law definition of subterranean streams was very narrow and essentially limited to flows in limestone regions.[51] Why didn't the Court in *Pomeroy* leave it at that, and instead adopt a common sense test based on whether the water in question was tributary to the surface river, and whether its pumping would adversely affect the rights Los Angeles held in the river? That would have been a straightforward, hydrologically and legally rational approach, and would have avoided the need to wrestle with the obviously unwieldy concept of a "subterranean stream."

We now know the answer. It was provided a few years later by the trial judge in *Pomeroy*, Lucien Shaw. Shaw subsequently became a Justice of the California Supreme Court, and wrote several important groundwater opinions, including the decision in *Katz v. Walkinshaw.*[52] The explanation is ironic in the extreme, because the justification for what the Court did in *Pomeroy*, and for the rule it fashioned – which still dominates California groundwater law a century later – was repudiated by the California Supreme Court in 1903. Why did the Court do what it did, and what happened next? The answer is fascinating.

In 1899, when *Pomeroy* was decided, it was still widely believed that the common law doctrine of absolute ownership was the law governing groundwater in California.[53] Under that doctrine, a landowner could pump and bear no responsibility for the impact on other pumpers, however great the damage to them, so long as he was not actuated by malice.[54] Indeed, the trial judge in *Pomeroy* drew on the decision in *Hanson v. McCue*[55] in his instructions, a California case that cited absolute ownership as the governing rule for groundwater. If that was the law, then a landowner overlying such water, so long as not actuated by malice, could pump and use the water without regard to its impact on others. Under the rule stated in the *Hanson* case in 1871, only if the landowner was pumping from a subterranean stream could he be restrained from harming

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[51] The conventional cases spoke of those genuine underground flows "in limestone regions." And the courts recognized that "[u]nderground currents of such a description are exceptional in their nature....." *Haldeman et al v. Bruckhart*, 45 Pa. 514, 518 (1863).

[52] 141 Cal. 116, 74 P. 766 (1903).

[53] *See City of San Bernardino v. City of Riverside*, 186 Cal. 7, 14, 198 P. 784 (1921).

[54] The English common law rule for groundwater is generally traced back to the 1843 decision in *Acton v. Blundell* 12 M. & W. 324 (Meeson and Welsby), reprinted in CLII The English Reports 1223 (Exchequer Division VIII, 1915). There was recognized a subterranean stream exception to this rule, *Chasemore v. Richards*, 7 H.L. Cas. 349, 1 Engl. Rul. Cas. 729, 754 (1859), but the presence of such streams was considered quite exceptional.

[55] 42 Cal. 303, 10 Am.Rep. 299 (1871).

another who had a right to the water with which his pumping interfered. The *Hanson* case seems to be the first California decision to use the sort of formulation that appeared in *Pomeroy* and then later showed up in California statutory law: "a subterranean stream of a defined character, and flowing in a defined channel".[56]

Under the absolute ownership legal rule articulated in the *Hanson* case, if the water under the defendants' land in *Pomeroy* was percolating groundwater, the landowner could pump it no matter that it was draining water from the Los Angeles River. If absolute ownership was the law in California, it was essential to determine if the water in question was, or was not, percolating groundwater. Only if it was not, and was instead "subterranean stream" water, could Los Angeles be secure in its rights in the Los Angeles River. The assumption that absolute ownership was the law governing groundwater is thus what created the need for a subterranean stream doctrine.[57] The irony of *Pomeroy* is that absolute ownership wasn't the law in California after all.

Though the *Pomeroy* Court understood the hydrological realities in the case before it, it accepted the premise that underlay Judge Shaw's instructions, which was that percolating groundwater was subject to the absolute ownership rule. On that premise, either Los Angeles had to lose a case that the Court undoubtedly believed that the city deserved to win, or the Court had to look to a legal theory that solved the immediate problem before it, but created a hydrologically untenable distinction among groundwater at different stages of its voyage down through the San Fernando Valley. The *Pomeroy* Court chose to decide in favor of a result that protected Los Angeles' treasury at the expense of a coherent legal theory. Since *Pomeroy* did not actually involve a dispute over water, it left to another day the question how much protection Los Angeles would be given against pumpers generally in the San Fernando Valley, that is, how much tributary groundwater would be found to be "subterranean stream" water.

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[56] 42 Cal., at 308. It is perhaps worth noting that in its characterization of subterranean streams, the Court in *Hanson* seems to have had in mind something much more like a true river underground: "Underground currents of water... are known to exist in considerable volume, particularly in limestone regions." *Ibid*. But "limestone in California is insignificant as a water-bearing formation." California's Ground Water, Dept. of Water Resources Bulletin No. 118 (Sept. 1975), at 15. "[D]efinite underground streams are few and of rare occurrence," Samuel C. Wiel, II Water Rights in the Western States (3d ed., 1911), § 1077, at 1011-12.

[57] To be sure, any jurisdiction that had separate legal regimes for groundwater and surface water (even if absolute ownership was not the groundwater rule), had to have some way to draw a line between what was groundwater and what was surface water. It was early recognized that some water, though physically beneath the surface of the earth, was functionally so much part and parcel of the surface stream that it was prudent, not to say essential, to manage it integrally with the surface stream. But, as we shall see, that did not mean one needed the artifice of a "subterranean stream" doctrine such as that fashioned by Kinney.

3. Doing the Job Pomeroy Failed to Do: *Katz v. Walkinshaw* and *Los Angeles v. Hunter*

Only four years after the *Pomeroy* decision, a far more famous case was decided by the California Supreme Court, *Katz v. Walkinshaw*.[58] The facts were simple enough. Plaintiff was pumping groundwater and using it on his overlying land. Defendant was pumping groundwater from under his nearby land, and taking it off the overlying land for use. Plaintiff claimed that defendant's pumping dried up his wells, and that he was entitled to relief. The defendant asserted that California followed the absolute ownership doctrine of groundwater law, that "each landowner owns absolutely the percolating waters in his land, with the right to extract, sell, and dispose of them as he chooses, regardless of the results to his neighbor...."[59] Plaintiff denied that absolute ownership was the law in California, but he had a second theory as well. He also claimed that they were both pumping from an underground stream, and so, in any event the law governing percolating groundwater, even if it was absolute ownership, didn't apply.

What makes the case especially significant for our purposes is that the Court found it need not decide whether the water in question was a subterranean stream or percolating groundwater, because absolute ownership wasn't the law of percolating groundwater in California. Thus the defendant would lose whether the water in question was percolating water or the water of a subterranean stream. Of course everyone today knows that *Katz v. Walkinshaw* is the case that declared the correlative rights doctrine as the law governing competing groundwater pumpers.[60] What is not so well remembered is that the decision broke sharply with tradition and precedent, rejecting claims that absolute ownership must be the law of percolating groundwater because that was the common law rule, because California had adopted the common law, and because a previous Supreme Court decision (*Hanson v. McCue*) had said it was the law (though in dictum). The rejection of the common law absolute ownership rule in *Katz* was at the time considered "novel and of the utmost importance"[61] and the case was decided by the Court upon rehearing, following exhaustive briefing.

The relevance of the groundbreaking decision in *Katz* is that it made the doctrinal gymnastics of the *Pomeroy* case unnecessary, and reduced the subterranean stream category to a virtual

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[58] 141 Cal. 116, 74 P. 766 (1903).

[59] 141 Cal., at 121.

[60] Perhaps not everyone. One still finds people quoting the absolute ownership language that appeared in Instruction XII in *Pomeroy*, which the Supreme Court expressly disavowed as the law in *Katz v. Walkinshaw*, 141 Cal., at 132. See letter to State Water Resources Control Board from William H. Baber III, for the Subterranean Streams...Workshop (April 18, 2000), at 2.

[61] 141 Cal., at 120.

irrelevance. If landowners pumping groundwater – even percolating groundwater – must respect the rights of other water-rights holders whom their pumping injures, then it makes no difference in a case like *Pomeroy* whether the water in question was a subterranean stream or percolating water. Since Los Angeles had a paramount right to the waters of the Los Angeles River, any diversion of groundwater that impaired that right would be a violation of Los Angeles' right under the rule of *Katz v. Walkinshaw.*

Essentially what *Katz* did was to determine that the resolution of conflict between contending water users should be based on the impact of one use upon another, rather than upon some *ex-ante* classification of the source. This change was calculated to bring the legal rules into congruence with the hydrological realities; and in doing so to eliminate the legal fiction that groundwater movement was unknowable in favor of case-specific factual inquiries: was the water's movement known or practically determinable? If so, what were the impacts? And if there were impacts, were they legally redressable?

If the *Katz* decision had preceded *Pomeroy*, the subterranean stream concept in California law might well have faded into the mists of legal history. As the Court put it in *Katz*, "averment[s] that ...water constitute[s] part of an underground stream may be regarded as surplusage."[62] That statement is especially notable because the author of the *Katz* opinion was none other than Lucien Shaw, who had been the trial court judge in *Pomeroy*. It was Judge Shaw's instructions that were the subject of the decision in *Pomeroy*. And it was Shaw who relied on the absolute ownership doctrine from *Hanson v. McCue* in his instructions,[63] which may have been the very thing that led the *Pomeroy* Court to rely on the subterranean stream finding, and to equivocate about the status of all the rest of the percolating, tributary groundwater in the San Fernando Valley. Yet four years later it was this same Lucien Shaw, now a Justice (and later Chief Justice) of the California Supreme Court, who wrote the opinion in *Katz v. Walkinshaw* stating that the "subterranean stream" category was effectively "surplusage." Indeed, in a law review article he wrote many years later, Shaw restated the holding of *Pomeroy* in terms that brought it into line with *Katz* and subsequent decisions. That case, he said, stood for the proposition that "persons having rights in a natural stream were threatened with injury by extraction of the percolating [!] water which sustained and supported the stream in its flow."[64]

Why, then, did Shaw give the instruction he did in *Pomeroy*, which made the distinction between a subterranean stream and percolating ground water so important? Shaw gave the explanation in his opinion in *Katz.* Speaking of himself, he said: "Inasmuch as the writer of this opinion [in *Katz*] was also the writer of the instruction under consideration [in *Pomeroy*], it may be proper to say

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[62] *Id*., at 121.

[63] Instruction No. XII, at 124 Cal., at 622 ("absolute owners").

[64] Lucien Shaw, The Development of the Law of Waters in the West, 10 Cal. L. Rev. 443, 458 (1922) (exclamation added).

that he did not give the instruction because he approved that part of it restating the doctrine of *Hanson v. McCue*. The instruction was given because [it] had been requested by the appellants in the case, and [Los Angeles] consented that that part should be given in substance rather than take the chances of a reversal of the case, should the supreme court hold its refusal to be erroneous [that is, should the supreme court approve the absolute ownership doctrine]."[65] In short, Los Angeles was worried that absolute ownership might be held to be the law of percolating groundwater in California, and if it were, then Los Angeles could only prevail if the water under the land being condemned was not percolating groundwater, but was part of a subterranean stream. To be on the safe side, it agreed to the instruction, and the *Pomeroy* Court, unwilling or unready to repudiate the absolute ownership doctrine, assumed its validity, and was thus obliged to draw the subterranean stream/percolating groundwater distinction.

It wasn't until Shaw's opinion in *Katz* that the Court decisively repudiated absolute ownership. Any doubt that the subterranean stream issue was no longer considered significant to groundwater litigation in California was removed in subsequent Supreme Court decisions. In a case decided less than a month after *Katz,* Justice Shaw wrote: "The case of *Katz v. Walkinshaw*...establishes a rule with respect to waters percolating in the soil, which makes it to a large extent immaterial whether the waters in this land were or were not a part of an underground stream, provided the fact be established that their extraction from the ground diminished to that extent, or to some substantial extent, the waters flowing in the stream."[66] Then in 1909, in another groundwater case, the Court said: "There is no rational ground for any distinction between such percolating waters and the waters in the gravels immediately beneath and directly supporting the surface flow, and no reason for applying a different rule to the two classes,...if, indeed, the two classes can be distinguished at all."[67]

That same year the Court decided *City of Los Angeles v. Hunter*.[68] *Hunter* dealt with the question raised but left in limbo in *Pomeroy*: What right did landowners in the San Fernando Valley further

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[65] 141 Cal., at 131.

[66] *McClintock v. Hudson,* 141 Cal. 275, 281, 74 P. 849 (1903). The Court made this statement in response to a claim by a surface riparian user that a neighboring landowner was unlawfully interfering with the plaintiff's right by pumping and taking water offsite for use, because the groundwater being pumped was a "subterranean stream" drawing from the surface stream.

[67] *Hudson v. Dailey*, 156 Cal. 617, 628, 105 P. 748 (1909). The category had not wholly disappeared, it seems. See *Arroyo Ditch & Water Co. v. Baldwin*, 155 Cal. 280, 100 P. 874 (1909), though the *Arroyo Ditch* decision's use of the subterranean stream category is at odds with the great weight of California Supreme Court opinions of that era.

[68] 156 Cal. 603, 105 P. 755. Notably the decision in the *Hunter* case was written by Justice Frederick W. Henshaw, who participated in both *Pomeroy* and *Katz.*

from the stream than those in *Pomeroy* (though still within the several-miles-wide banks area identified in *Pomeroy*), have to pump tributary groundwater that diminished flows in the Los Angeles River? The facts were these: Los Angeles brought suit against owners of some 5,000 acres in the San Fernando Valley who were pumping water asserted to be tributary to the Los Angeles River, to quiet title to its paramount right to use of the waters of the River. The principal claim of the defendants was "[t]hat the waters are strictly percolating waters, not belonging to the subterranean flow of the stream, but if concededly on the way to join and swell such flow, still percolating waters, to the use of which, as owners of the land, they have an absolute indefeasible right."[69]

The Court rejected this claim, holding it was immaterial whether the waters in question were considered percolating or not. Since "[t]hese waters percolate...in the sense that they form a vast mass of water confined in a basin filled with detritus, always slowly moving downward to the outlet [which is the Los Angeles River]," [70] then insofar as Los Angeles has paramount rights to the use of all the waters of the River, "none of these so-called percolating waters may be withdrawn to the invasion and injury of such right."[71] It was held unnecessary, as in *Katz* and *McClintock*, to classify the water either as percolating or as a subterranean stream.

When Kinney, on whose 1894 treatise the *Pomeroy* Court had relied, published his second edition in 1912 he acknowledged the change that had occurred. Citing the more recent California cases, such as *Los Angeles v. Hunter*, he explained that only a limited class of percolating waters, "diffused percolating waters," "are considered as a part of the very soil itself and belong to the realty in which they are found." Picking up the test of *Hunter*, he explained that "these [percolating] waters are those which, as far as known, do not contribute or <u>are not tributary</u> to the flow of any definite stream or body of surface or subterranean waters."[72] Though unwilling to let loose of the old terminology, Kinney acknowledged that the groundwater question was becoming a matter of evidence based on the ability to determine hydrological relationships, rather than a formal classification based on the geography of the water's movement:[73]

> It is plain to see that, as the years go by, the class of diffused percolating waters will be growing smaller and smaller. This is due the scientific investigations of the movements of percolating waters through the ground, and also to the discoveries which are constantly

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[69] *Id*., at 605.

[70] *Id*., at 607.

[71] *Id*., at 608.

[72] Clesson S. Kinney, A Treatise on the Law of Irrigation, vol. II (1912). See 2 Kinney § 1188, pp. 2152 (emphasis added).

[73] *Id.*, at 2153.

> being made that certain waters which were once considered mere percolations flowed in defined subterranean channels which have become known....In time, if the courts are as active in establishing new rules governing subterranean waters within the next few years as they have been in the past ten years, which rules have but kept pace with the scientific investigations upon the subject, this class of subterranean waters will pass from the class of those flowing in unknown courses to those flowing in known courses, and the "secret incomprehensible influences," and "practical uncertainties" will become comprehensible influences and practical certainties.

The newer California judicial approach that Kinney acknowledged, which focused on whether groundwater was known to be contributing to a surface stream, as the line of demarcation, continued into modern times. In 1943, in *Los Angeles v. Glendale*,[74] the Supreme Court stated unequivocally that Los Angeles' pueblo right in the Los Angeles River extended to all the groundwater in the San Fernando Valley upon which the flow of the River depended; and it made clear, by citing *Hunter* as authority, that it did not view that case as limited to groundwater in the southeast corner of the Valley within the bed and banks area described by *Pomeroy*. The Court said:[75]

> It has long been established that as successor to the pueblo of Los Angeles, the city of Los Angeles has a right, superior to that of a riparian or an appropriator, to satisfy its needs from the waters of the Los Angeles River [omitting citations]. Because the flow of the river is dependent on the supply of water in the San Fernando Valley, it has also been held that the pueblo right includes a prior right to all of the waters in the basin. (Los Angeles v. Hunter, 156 Cal. 603 [105 P. 755]).

In 1975, in *Los Angeles v. San Fernando*,[76] the Supreme Court reaffirmed *Glendale* explicitly. But it did something else as well. It made clear that the scope of Los Angeles' pueblo right grew out of the scope of the waters of the Los Angeles River, and that the scope of the Los Angeles River was determined by the extent of the groundwater that was tributary to the River. In other words, for determining pueblo rights, the Los Angeles River consists of its surface flow and the groundwater tributary to it. The Court decided that the subterranean extent of the Los Angeles River is measured by the tributary nature of the groundwater in the San Fernando Valley, the very thing that Pomeroy said it was *not* deciding. Revealingly, both the *Glendale* and *San Fernando* cases cite *Hunter*, not *Pomeroy*, as authority for the expansive view of the subterranean extent of

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[74] 23 Cal.2d 68, 142 P.2d 289 (1943).

[75] *Id.*, at 73 (emphasis added).

[76] 14 Cal.3d 199, 537 P.2d 1250 (1975).

the Los Angeles River.[77] It is important in this respect to note that *Glendale* and *San Fernando* do *not* simply say that pueblo rights extend to groundwater beneath the pueblo boundaries. The Court conceived of the pueblo right as including within the surface stream its tributary groundwater – the "waters of the Los Angeles River and the waters supplying it."[78] The cases are about "rights in the Los Angeles River,"[79] "the river to which the pueblo right attaches."[80] That, of course, is a fundamentally different view from that inherent in the 1894 Kinney classification of waters, and in the boundary that the Court in *Pomeroy* was at pains to identify, when it said that its decision was not meant to embrace the entire San Fernando Valley.

But – and this is the most important "but" in this Report – as it turned out, the legislation upon which Water Code § 1200 rests did not follow in the path that Justice Shaw and the California Supreme Court's subsequent pueblo rights cases set out for it. Instead, by a circuitous path, the legislature was led back to the distinction and the formulation that the *Pomeroy* Court had used. How that happened is the subject of the next section of this Report.

PART II:

THE STATUTORY RESPONSE

1. The Water Commission Act of 1913

Prior to 1911, all appropriation rights to surface water were acquired under sections 1410 to 1422 of the Civil Code, which essentially was a law requiring filing of a notice of appropriation. Failure to comply made appropriators vulnerable to subsequent claimants who had complied. There was no state administration of water rights. Groundwater was simply pumped by overlying landowners without any state administration or regulation. In 1911 the legislature established a State Conservation Commission to make a study of the need of laws for the preservation and control of the use of the natural resources of the State (one of which was water), to report to the Governor and to recommend measures to the legislature.[81] George C. Pardee, a progressive Republican,

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[77] 23 Cal.2d, at 73. See also 14 Cal.3d, at 248.

[78] 14 Cal.3d, at 212.

[79] *Id.*, at 241, n. 23.

[80] *Id.*, at 251.

[81] Ch. 408, Statutes of 1911 (April 8, 1911). At the same time the legislature established a State Board of Control (the next year its work was taken over by the State Water Commission), (continued...)

who had been Governor of California in 1903-07, was appointed chairman of the Commission. The other two members were Francis Cuttle and J.P. Baumgartner. The Report of the Commission, transmitted on January 1, 1913,[82] and its legislative proposal for water, was the source for the bill that ultimately became the Water Commission Act. Section 42 of that Act is, with very slight changes, today's Water Code § 1200. The inspiration for the enactment of a comprehensive water law was an extraordinary document, Report of Irrigation Investigations in California, done under the direction of Elwood Mead.[83]

The original legislative draft prepared by the Conservation Commission explicitly provided a permit system both for surface and for underground waters, and the two categories were dealt with in separate, similar[84] sections of the draft bill. Just as the bill recognized riparian uses of surface water, and did not subject them to permitting, so it recognized the right of overlying landowners to use underground water on overlying land without permitting. But it did require those seeking either surface stream appropriations, or groundwater appropriations for use off the overlying land, to obtain appropriation permits. In addition, the bill specifically granted the Commission authority to protect those with surface stream rights against off-tract underground pumpers "where it is claimed that such development and carrying away of water is diminishing the supply of water of such riparian owner or appropriator of water from the streams of water or underground water."[85]

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[81](...continued)
which had authority to accept applications for the use of water for power purposes, which could grant term licenses for 25 (later extended to 40) years. Ch. 41, Extra Session, 39th Legislature (Jan. 2, 1912). See Report of the State Water Commission of California, Published April 1, 1914 (Sacramento, State Printing Office, 1914), at 7.

[82] Report of the Conservation Commission of the State of California, January 1, 1913, Transmitted to the Governor and the Legislature January 1, 1913 (1912), at 19-42. No official version of the Commission's legislative recommendation is extant. A version found in the Charles David Marx Papers, at Stanford University, SC 161, Series VIII, Box 1, and reproduced here as Appendix A, is undoubtedly the Commission's bill, as explained more fully below.

[83] Bulletin No. 100, U.S. Department of Agriculture, Report of Irrigation Investigations in California (Washington, D.C., Government Printing Office, 1901). Elwood Mead, a pioneer in western water law, was the first state engineer of Wyoming, and later Commissioner of the Federal Bureau of Reclamation.

[84] There was some odd lack of parallelism. While the bill required registration of proposed riparian uses and abolished unused surface riparian rights after four years of nonuse, no such limitations were imposed on overlying uses of groundwater.

[85] Sec. 17.

In short, the Commission bill sought to get rid of distinctions between groundwater and surface water legal regimes, and to institute integrated, parallel systems. But because it still recognized underground water and surface water as distinct categories, it had not really rid itself of the question, what is groundwater, and what is surface water, despite its attempt to do so.[86] Section 8 of the bill, which provided "Underground water, for the purpose of this act, is defined as any water that occurs or is found beneath the surface of the ground," generated a lengthy and fascinating discussion in hearings held by the Commission. The predictable question was, if a surface stream moves underground for a certain distance, and then again rises to the surface, may one put a pump in the below-surface area and then be subject to the underground water provisions of the act, rather than the surface water provisions?[87] The Commission debated the question, is there water that "occurs or is found beneath the ground" that should <u>not</u> be treated as underground water, but as surface water?

The following excerpts from a hearing held on the Commission's original bill on May 28, 1912, are exceptionally revealing of how those involved in the development of the 1913 legislation were thinking about the issue at the time:

The Chair of the Commission, former Governor George Pardee, was going through the Commission's draft bill section by section, and read out Section 8: "Underground water, for the purpose of this Act, is defined as any water that occurs or is found beneath the surface of the ground."

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[86] Samuel Wiel, a prominent San Francisco attorney and writer on water law, was in active consultation with the Commission, and had suggested, unsuccessfully, a "consolidated" system. Wiel says that his "suggestions were not acted upon by the Commission and form no part of the bill presented to the legislature, nor of the statute passed." Samuel C. Wiel, A Short Code of Underground Water, 2 Cal. L. Rev. 25 (1914). Wiel's notion was that "[a] definite body of water upon the surface, and the underground water proximately connected therewith in natural occurrence, constitute a consolidated underground and surface water-supply" and that rights should "extend to the whole and every part of a consolidated surface and underground water-supply...without distinction between the surface part and the underground part." *Id.*, at 26.

[87] It is not clear what exactly the differences in result would have been, since in general the bill sought to integrate the two sources, but the bill seems to have anticipated at least one difference: Under § 17 of the bill, groundwater appropriators making off-tract uses are made subordinate to surface-stream riparians whose supply their appropriations diminish. However, there is nothing in the bill that makes surface-stream appropriators subordinate to overlying on-tract users of groundwater when the surface-stream appropriations diminish their supply, though groundwater appropriators appear to be thus subordinated under § 15(a).

MR. KEECH:[88]....The sub-surface stream is deemed to be part of the stream; one minute it is in the open and another minute it is below the surface. The vested rights in a stream under the riparian law is the stream consisting of the running open water on the surface and also of the sub-surface water in the same bed.
MR. BAUMGARTNER: As we have handled "Stream flow" in the Bill, does it interfere with the sub-surface stream?
MR. KEECH: You have handled "stream" so far under the term of riparian rights only, and the riparian rights include that sub-surface flow and is sustained by the courts, and sustained by constitutional provision. Now you propose to take out and destroy it as a stream flow and put in and classify underground water with sub-surface flow.
MR. Pardee: How would this do: [Underground water...is defined as any water that occurs or is found beneath the surface of the ground] outside limits of defined stream.
....
MR. CUTTLE: All I seek is to determine what is underground stream and what is percolating water.
MR. KEECH: ...This sub-surface flow is an all important matter and it is so radical a departure from the law that I do not think it would stand. I think you have attempted to incorporate riparian law in accordance with the decisions of the courts, but now you take that underground flow right out of the rule and class it with water with which it has never been classed; and since you provide for both kinds of water, why have you made that radical change?
MR. PARDEE: Put right at the end of the sentence "exterior to banks of streams."
["Underground water, for the purpose of this Act, is defined as any water that occurs or is found beneath the surface of the ground exterior to banks of streams."]

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[88] Hearing of May 28, 1912, 2 p.m., beginning at 8, see Appendix D, *infra*. Stenographic transcripts of these hearings were found in Oakland in the Pardee Home Museum Papers, Water Conservation, Box 29. They are attached in full here (including those portions that deal with matters other than groundwater) as Appendix D.

The cast of characters in the hearings is as follows: Pardee is the Chair of the Conservation Commission, and, as noted above, Francis Cuttle and J.P. Baumgartner were the other two Commission Members. E.E. Keech was a lawyer practicing in Santa Ana, who represented water users in San Bernardino, Riverside, and Los Angeles Counties. Samuel Wiel, as noted above, was a very prominent San Francisco lawyer and a prolific writer on water law. Frank H. Short of Fresno was a prominent water lawyer who represented Central Valley agricultural interests. Mr. Tait was probably C.E. Tait, who was senior irrigation engineer, in the office of public roads and rural engineering, at the U.S. Department of Agriculture. He was a member of a Commission that issued a report on the utilization of the Mojave River for irrigation in Victor Valley in 1917. I have not been able to identify Mr. Lane. He might have been Franklin K. Lane, who was Secretary of the Interior in President Wilson's Cabinet, and previously a water lawyer in San Francisco. However, Lane was a member of the Interstate Commerce Commission, and in D.C. from 1905-1913, when he became Interior Secretary.

> MR. KEECH: I should say [except] "Sub-stream flow." You have not defined stream flow, but nevertheless it is defined under the law. You have not defined stream, but that is a term known to the law. Either would be satisfactory to me.
> MR. PARDEE: You want it confined to the banks of a stream?
> MR. KEECH: Yes, that is all right.....
> [It was then suggested that confining sub-stream flow to the banks of the stream was too narrow a definition, narrower than the Court had already determined in *Los Angeles v. Pomeroy*].
> MR. KEECH: What would you say?
> MR. SHORT: I would say stream flow and nothing more.
> ...
> MR. TAIT: I would say just [...water that occurs or is found beneath the surface of the ground] "other than stream flow".
> MR. CUTTLE: Would not this difficulty crop up of determining what is underground stream flow or percolating water?
> MR. SHORT: You cannot get rid of this difficulty. The rights of one kind of water is of one nature, and of the other kind of water of another nature. You want to leave the stream unimpaired and call all the other kind of water underground water.
> ...
> MR. WIEL: I suggest this Bill have two or three chapters, underground water and stream flow, –and provide that no water that directly effects a surface flow shall be affected by this [underground] chapter....
> MR. SHORT: My suggestion would be that the Act, the general scope, should apply to all waters now unappropriated as stream flow, and to all underground waters other than stream flow. When you say that you have done the best you can.

It is clear from this colloquy that the men who drafted the Conservation Commission's bill understood that any line separating groundwater from surface water was a human construct made for some managerial purpose, rather than a line separating two distinct hydrological entities. Notably, no one made reference to the formalism of Kinney, or to traditional conceptions of "subterranean streams." They seem to have understood perfectly well that water was a continuum. They conceived their task as drawing a functionally useful, if hydraulically arbitrary, line at what was effectively part of the stream flow. Their purpose was to define what uses would come within the bill's provisions dealing with "underground water" (such as § 13), and which with "appropriators of waters from the streams" (such as § 17). As Samuel Wiel (the leading water law authority of his day, and a participant in the above-quoted colloquy), put it, for that purpose what was needed was a definition sufficient to protect streams against pumping that "directly effects a surface flow."[89]

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[89] Wiel personally opposed drawing any distinction between ground and surface water, though that was never the position of the Commission. In this same colloquy Wiel said, "I would

(continued...)

Both the Commission's original bill, and the above discussion, demonstrates that these water experts, as of 1913, did not at all think that groundwater was too mysterious in its ways to be subject to legal control. The commonly heard notion that people back then still believed groundwater was too occult and mysterious to be managed is simply wrong.[90] As we shall see shortly, the legislative reluctance to institute integrated management was fundamentally based on legal reservations, not technical or managerial ones.

By the time the Commission's bill was introduced in the Assembly some seven months later, it had been extensively revised.[91] Though we have the bills themselves, and the votes on various amendments, the full history of the legislation's development during the legislative session is lost (or at least has not yet been found), though we do have numerous newspaper reports on the bill's progress through the legislature. Most importantly, we have the bill originally drafted by the Commission, and a full transcript of the hearings (from which the above excerpts were taken) in which many – probably most – of the most influential figures participated. It appears that there was another somewhat modified version that appeared between the time of the Commission draft and the first introduced bill, and there is a law review commentary discussing it in some detail,[92] but the draft itself has not been found. From the commentary, it appears to have been very similar to the bill introduced in the Assembly. As can best be gleaned from the law review text, that draft contained nothing new or significant relating to groundwater.

No explicit evidence of authorship has been found as to any of the bill drafts or amendments, but an undated document supporting the law, written just prior to the time it was submitted to a public referendum in 1914, has been found among Governor Pardee's papers. That document says "This Water Commission Law was drawn by the State Conservation Commission, aided by a

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[89](...continued)
not make any distinction between stream flow and underground water, make no distinction whatever, but take water supply. If water supply is partially underground and partially on the surface, there is no reason why people should not enjoy it whether underground [or] in the stream. There should be a right in the supply regardless of whether underground or surface." pp. 12-13. To which Mr. Keech replied, that such a proposal "...is a departure from this Bill and is a radical construction." p. 13.

[90] The usual source for this belief is an 1850 Connecticut case, in which the court said groundwater influences "are so secret, changeable and uncontrollable, we cannot subject them to the regulation of law, nor build upon them a system of rules, as has been done with streams upon the surface." *Roath v. Driscoll*, 20 Conn. 533, 541 (1850).

[91] The original Commission bill, and the bill as first introduced, are set out in full as Appendices A and B-1.

[92] A.E. Chandler, The Water Bill Proposed by the Conservation Commission of California, 1 Cal. L. Rev. 148 (1913).

number of prominent attorneys, among whom may be mentioned Judge Curtis H. Lindley, of San Francisco; Judge Farraher, of Siskiyou; E.E. Keech, of Santa Ana." In Pardee's hand there is an insert at this point saying "Mention any others you may think of."[93]

Assembly Bill No. 642, was introduced on January 23, 1913, by Assemblyman W.A. Johnstone.[94] The bill seems to follow Wiel's advice given in the hearings (though not his more general groundwater proposals in his 1914 law review article).[95] The bill makes no distinction between surface water and ground water, but simply covers "water" generally. It establishes a permit system for the appropriation of all water which has never been appropriated or applied to riparian use,[96] recognizes existing appropriations, and abolishes unused riparian rights after five years from the time the bill is enacted.[97] In result this is not different in substance from what the original Commission bill sought to do, as it would have created an appropriation permit system for both groundwater and surface water, though unlike the original Commission draft, it did not take up groundwater and surface water in separate provisions. By creating a unified system of appropriation applicable to all water, the bill as introduced avoided the need to define or to distinguish surface water from underground water, the issue that had so troubled the Commission members and their advisors during the hearing quoted above. Section 42 of the introduced bill simply says "The word 'water' in this act shall be construed as embracing the term 'or use of water'; and the term 'or use of water' in this act shall be construed as embracing the word 'water'".

That approach did not last for long. The very first amendment to the bill, dated April 2, added the following sentence to Section 42: "Whenever the terms stream, stream system, lake or other body of water occurs in this act [and those were the operative terms for water in the bill], such term shall be interpreted to refer only to surface water." Surprisingly, this significant change from both

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[93] A copy of the letter is on file with Joseph Sax. A book by Franklin Hichborn, Story of the Session of the California Legislature of 1913 (San Francisco, Press of the James H. Barry Company, 1913), at 153, also says "Francis Cuttle...had much to do with the framing of the measure." (Hichborn covered the legislature for the Sacramento Bee).

[94] Johnstone became Chair of the State Water Commission in 1915, succeeding Professor Charles David Marx of Stanford University. Johnstone and Pardee knew each other, and some correspondence between them (though not on this subject) is among the Pardee papers.

[95] See note 86, *supra*.

[96] In what is probably an unintended omission, it does not explicitly recognize overlying on-tract uses of groundwater, the analogue of riparian rights on a stream. But the bill never mentions groundwater, underground water, or subsurface water in any form. It is simply implicitly incorporated in the overall definition of water.

[97] §§ 11, 34.

the Commission draft and the bill as introduced, sweeping away governance of groundwater, appears to have generated no controversy, and to have been acceptable to the supporters of the bill.[98] The most likely reason is that they had been persuaded that subjecting groundwater to the same permitting system as surface water exceeded the state's authority. And thereby hangs a most significant tale.[99]

While I have found nothing documenting the thinking of those who drafted the amendment, there is some highly revealing material in the Commission's hearings during the previous year, and no doubt those who participated in the Commission's hearings also participated in the development of the bill as it moved through the legislature. On the same day that the colloquy excerpted above took place, there was also a discussion of the scope of legislative permitting authority over groundwater. The Commission's discussion had moved on from § 8 to § 11 of the bill. That section, dealing with groundwater, provided:[100] "Owners of overlying land shall have the right to use such underground water on such overlying land only, and such use shall be for useful and beneficial purposes only, and may be had without appropriating the same or filing notice of appropriation." Section 13 said: "The right to appropriate underground water for use on other than overlying land may be acquired by filing application for appropriation of such underground water with the said Water Commission...and complying with all conditions required from appropriation of water from streams of water...." And § 27 of the bill gave the Water Commission broad discretion to impose conditions through adoption of rules and regulations that limited the extent and purposes for which appropriations could be made.

These provisions generated a lively discussion about the nature of a landowner's existing property right to use groundwater. All agreed that beneficial overlying uses should be recognized, and that any uses had to respect the rights of others, as *Katz v. Walkinshaw* had held. The question was whether the legislature had the authority to subject non-overlying uses to a discretionary permit system parallel to that which would apply to surface streams. The claim effectively was that there was an important legal difference between the status of surface streams, whose unappropriated water belonged to the public, and underground water in which – though subject to correlative rights – the overlying owner held a property interest. If there was a pre-existing property right

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[98] Hichborn, *supra* note 93, at 150, notes that amendments proposed by the Conservation Committee were adopted "without difficulty."

[99] One bit of evidence in support of the view that the concern was about the scope of state authority is that when this amendment was adopted, the title of the bill was also changed. A sentence was added to the beginning of the title saying "To Regulate the Use of Water Which Is Subject to Such Control by the State of California, and in That Behalf."

[100] During the hearing Governor Pardee suggested the following change: "Owners of overlying land shall have the right to use such underground water on such overlying land only, and such use shall be for useful and beneficial purposes only, provided such use is for domestic purposes only." Hearing, 2 p.m. (May 28, 1912), at 17.

(even though it was not the absolute ownership of the common law, and was correlative with other rights as per *Katz)*, then arguably the effort to give a Commission fully discretionary permitting authority – to deny a permit for some reason other than to protect another's water rights – was at odds with the landowner's property interest in groundwater beneath his land.

Wiel started the discussion, saying "[i]f you give somebody the right to appropriate water you assume the right to take it away from them."[101] And Frank Short added, "Here [in the bill] it says they cannot take water from land and put it upon other land. Now [under existing law], they have the unrestricted right to take water from any land and put it upon any other land...."[102] Then, following some further discussion of this point, Short made the following statement:[103]

> MR. SHORT: ... A man has as much right to extract water as coal[,] oil or any other part of the substance of this land, and the only limitation in the doing of that is he must not take it in such a way as to injure his neighbor. That is the settled right in property. Over the water percolating the ground he has the power the same as over other property; it is no more a jurisdiction over the underlying, percolating water than it is over any other substance in the ground. ...
>
> MR. LANE: ...The only question is, would it be unconstitutional as restricting the use of property, if it required the owner of lot A to get a permit before he could transport it to lot C. That goes to the constitutionality and not to the question of policy.[104]
>
> ...
>
> MR. PARDEE: Who owns the water underground?[105]
>
> MR. SHORT: The land owner.
>
> MR. PARDEE: The ownership of the corpus of the water?
>
> MR. SHORT: Sure, yes sir. When you say that something which is now permitted by law cannot be done, and do say that something different can be done in a different way, it seems to me the Legislature would have no authority to do that.
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> ...

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[101] Hearing, 2 p.m. (May 28, 1912), at 18.

[102] *Id.*, at 19.

[103] *Id.*, at 21.

[104] *Id.*, at 21-22.

[105] *Id.*, at 26-27.

MR. SHORT: If the law gives the right, as the law now is, we would not object to restriction possibly, but to say it is unlawful without appropriation to take water from overlying land to some other land, it would prohibit the use of underground water.

...

MR. SHORT: What we object to is that we cannot use water where we now have the right to its use, and this law would do away with a right that now exists.[106]

MR. CUTTLE: Write a section for that.

MR. SHORT: All right, I will do that.[107]

...

This discussion suggests that Short, who was an influential representative of Central Valley agricultural interests, had raised doubts in the minds of the legislation's supporters about the constitutionality of imposing a discretionary permit system on the use of groundwater on non-overlying land.[108] Of course, the Commission had never intended to require a permit for use on

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[106] *Id.*, at 28-29.

[107] *Id.*, at 29. While no documentation of Short as a draftsman has been found, Short did write a letter to the Commission several months after the hearings, in which he again indicated his concern about the underground water provisions: "What I especially wish to impress, however, is that there appears to be no sufficient or controlling reason for attempting to change the laws with respect to subterranean or underground waters at all, as at present decided, it is perfectly well understood, clearly definite and sufficient for all purposes...and I wholly fail to see that anything further is desirable. I have given this subject considerable thought and study since the proceedings before the Commission, and I am more than ever convinced that the proposed legislation as to underground waters, except in so far as it relates merely to the exercise of public authority thereover [he had elsewhere distinguished authority to regulate to protect others' rights, for example, versus discretionary permitting to determine whether water could be taken at all] should be entirely eliminated as wholly unnecessary and hurtful." Letter dated July 18, 1912, Frank H. Short to State Water Commission, at 4-5, in Pardee Home Museum Papers, Water Conservation, Box 29 (copy on file with Joseph Sax).

[108] Short's view drew on language that percolating water belongs to the owner of the soil, common in cases decided when absolute ownership was still thought to be the rule in California; e.g., *Gould v. Eaton*, 111 Cal. 639, 644 (1896). It appears to have been taken as authoritative, despite the decision in *Katz v. Walkinshaw*, note 58 *supra*, and even though in 1911 (two years previously) California had amended Section 1410 of the Civil Code to read: "All water or the use

(continued...)

overlying land (which was considered a parallel to riparian uses of surface water).[109] Therefore, it was not surprising that an amendment to limit the coverage of the bill to surface waters[110] was proposed during the legislative debate. There seems to have been no controversy over this amendment,[111] suggesting that Short's legal argument was persuasive. It should be emphasized that Short's claim was a limited one. He did not assert that there was no regulatory authority over non-overlying uses of groundwater, or that such uses could not be integrated with surface water rights. He was simply objecting to giving a permitting agency discretionary authority to deny altogether such a use, except where it was necessary to protect some other right in that water, such as a correlative right by another groundwater user.[112] Short was thus apparently making a claim that the plenary power and proprietary interest in surface waters (which belonged to the people of the State) did not extend to groundwater; and that property rights in groundwater were, though not absolute, nonetheless an extant incident of landownership. Though such a claim would hardly be likely to prevent a grant of discretionary permitting authority under contemporary understanding of state legislative authority,[113] it apparently was persuasive to legislators back in 1913.[114] And it seems to explain why California decided to grant permitting jurisdiction over

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[108](...continued)
of water within the State of California is the property of the people of the State of California, ..." Cal. Stats. 1911, c. 407, p. 821. See Cal. Water Code § 102.

[109] They certainly knew the recent decision in *Hudson v. Daily*, 156 Cal. 617, 628, 105 P. 748 (1909), in which that very issue arose.

[110] The amendment read: "Whenever the terms stream, stream system, lake or other body of water occurs in this Act, such term shall be interpreted to refer only to surface water." Assembly Bill No. 642, amendment of April 12, 1912, § 42.

[111] Hichborn, *supra* note 93, at 150. Regarding the April 30th amendment, see note 116, *infra*.

[112] While § 15 of the water bill, as introduced, gave the commission discretion ("The...commission may in its discretion allow...the appropriation of unappropriated water..."), the enacted version omitted discretion even over surface water appropriations ("The...commission shall allow...the appropriation of unappropriated water...").

[113] Since a version of the language that appears today as Water Code § 102 had been enacted in 1911, Short may have been pressing the point a bit far even back then..

[114] A review of contemporary newspaper accounts in the Fresno Republican, Oakland Enquirer, Sacramento Bee, San Francisco Daily News, and San Francisco Call, has turned up no indication of any controversy over changes in the bill regarding groundwater coverage. For example, the Oakland Enquirer of April 21, 1913, p. 6, has an article entitled "Conservation Bill
(continued...)

surface water, but not over groundwater.[115]

In any event, the result of the legislative decision created the need to distinguish groundwater from surface water, again raising the problem that had come up during the discussion of the Commission's original draft. What, if any, water beneath the surface of the earth should be included in the term "surface water," and subject to permitting jurisdiction? Certainly, no one wanted a user to be able to circumvent the law simply by diverting from a reach of a surface stream where the water sank below the surface before emerging again, or by sinking a well in a riverbank. This issue was addressed on April 30, when the following underscored language was added to Section 42: "Whenever the terms stream, stream system, lake or other body of water or water occurs in this act, such term shall be interpreted to refer only to surface water, and to subterranean streams flowing through known and definite channels."[116]

This, of course, is the *Pomeroy* language that was ultimately enacted as the Water Commission Act of 1913, and that remains today, with only insubstantial change, as Water Code § 1200. Strikingly, the subterranean stream language appeared for the first time at a late stage in the evolution of the law. It never came up in the Commission's report, in its original bill, in any of three Commission hearing sessions on the bill, or in the bill as first introduced in the Assembly, even though, as we have seen above, efforts to distinguish surface water and underground water

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[114](...continued)
Amended and Strengthened". It says "[t]here was a preliminary hearing given to the elaborate measure in the Assembly a few days ago, but there was a continuance of the subject granted for the purpose of making changes which were considered advisable. The committee worked Saturday as also last night on the subject, with the result that it was the opinion of some of the assemblymen who had opposed certain features when the bill was before the Assembly, the measure had been strengthened in a satisfactory manner and that a number of the features which had not appealed favorably to some of the members of the lower house had been so rewritten as to satisfy the most insistent of the critics. The amendments were ordered printed and the measure, as amended, will come up for passage in a few days...." Similarly, *id.*, April 22, 1913, p. 3: "...the amendments proposed yesterday...were of a minor character, none of them touching any of the main features of the proposed enactment." Of course the bill was still too strong for its opponents, *id.*, April 27, 1913, p. 19; April 29, 1913, p. 1.

[115] While the legal concern expressed was limited to discretionary permitting authority (that is, e.g., a right to deny an appropriation altogether in the public interest), the legislative result, of course, was to deny any permitting jurisdiction at all over (percolating) groundwater, and that has remained the law.

[116] Though the language was offered by Assemblyman Henry Ward Brown of San Mateo (California Assembly Journal, 40th Sess., 1913, April 30, 1913, p. 2336), an opponent of the bill, it appears to have generated no objection, either by proponents or opponents. Brown was a lawyer, and a graduate of Hastings College of the Law.

engaged the bill's drafters at some length in the May 28th hearings the previous year. None of the suggested phrasing put forward in that hearing, such as "surface water and sub-stream flow" or "surface water and subsurface water within the banks of streams" or "surface water and underground stream flow" appeared in the final bill as enacted.

Why did the bill's draftsmen use the *Pomeroy*/Kinney language, rather than one of the formulations that had been suggested in the previous year's hearings? No documentation has been found to answer this question, or to explain the reasoning for any of the other amendments made to § 42 of the bill.[117] The likeliest explanation is that rather than seeking to devise their own language to identify the subsurface water that should be included within the surface water system (and recognizing from the previous year's hearing the difficulty of fashioning satisfactory language), they simply plugged in familiar language that was already a part of water law terminology, "subterranean stream [etc.]." The use of that language – so patently inapt and inept to us today – seems to have generated not a word controversy in a bill that was otherwise so controversial and divisive that it only became law by virtue of a public referendum.[118]

There is nothing to suggest that the draftsmen intended to codify the *Pomeroy* case, or any particular reading of it. Nor, it seems, did they concern themselves with the geologic perplexities they were creating in treating groundwater and surface water as separate entities. Most likely, once they were persuaded that there were constitutional problems in creating an integrated system (which is what the Commission and the Johnstone bill had originally sought), they simply reconciled themselves to a bifurcated system, and sought to make sure that they had prevented the most egregious opportunities for people to subvert the surface water permitting system. The subterranean stream language of *Pomeroy* was the only established verbal tool for doing so, as it clearly covered what had been described in the hearings as "sub-surface flow" of surface

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[117] A (highly opinionated) discussion of the controversy over the bill can be found in Hichborn, *supra*, note 93 at 137-73, but it deals almost exclusively with the maneuvering of various factions, rather than with the specifics of the amendment process. Hichborn says there were two legislative meetings on the bill (pp. 145, 165). No transcript or other record of them has been found, but there is a lengthy report in the Sacramento Bee of March 19, 1913 (at 1) of the first meeting, held on March 18, 1913. A letter from Assemblyman Johnstone to Governor Pardee, dated April 4, 1914, gives the final votes on the bill and a brief discussion of two proposed Senate amendments (not dealing with groundwater), commenting "[t]hese are interesting to indicate hidden influences in the consideration of the measure." Pardee Papers, Pardee House Museum, Water Conservation, box 29 (copy on file with Joseph Sax).

[118] See Amendments to Constitution and Proposed Statutes with Arguments Respecting the Same, to be Submitted to the Electors of the State of California at the General Election on Tuesday, November 3, 1914 (State Printing Office, 1914)

streams[119], or what Wiel had earlier described as a line that would protect streams against pumping that "directly effects a surface flow."

In short, all the evidence we have indicates that the legislative language was designed to exclude groundwater generally, except for that which was functionally part and parcel of a surface stream – in the sense of pumping that directly affected surface flow. Probably – though there is no evidence one way or another – the legislators would also have meant to include true subterranean streams, such as flows in limestone caverns or lava tubes, which would be "independent" subterranean streams under Kinney's classification. But even in 1913, it was clear that such features were few and of rare occurrence in California.

The Water Commission legislation was extremely controversial, though not on the subterranean stream issue. Its far more significant provisions sought to control monopolization of water by riparian landowners (a matter that would ultimately be resolved by a Constitutional Amendment several decades later),[120] and to get rid of unused riparian rights (a provision held unconstitutional,[121] but ultimately effectively achieved by California Supreme Court interpretation).[122] The bill passed the Assembly by a vote of 44-30, and the Senate version by 28-6. The Assembly then concurred on a 41-10 vote (41 votes being required for passage). The bill was signed by the Governor on June 16, 1913, but then was subjected to a referendum following an all-out effort by the law's opponents. It was approved by the people on November 3, 1914 by a margin of 50.7% to 49.3%,[123] and became effective on December 19, 1914.

2. Subsequent Legislative Developments

Almost as soon as the Water Commission law was enacted, proposals emerged to revise it and to create an integrated management system for surface and groundwater. As early as 1916, the report of a legislatively created Water Problems Conference recommended that groundwater be

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[119] Hearing, 2 p.m. (May 28, 1912), at 8 et seq.

[120] California Constitution, Art. X, Section 2. See *Herminghaus v. Southern California Edison Co.*, 200 Cal. 81, 252 P. 607 (1926).

[121] *Tulare Irr. Dist. v. Lindsay-Strathmore Irr. Dist.*, 3 Cal.2d 489, 531, 45 P.2d 972, 989 (1935).

[122] *In re Waters of Long Valley Creek Stream System*, 25 Cal.3d 339, 158 Cal.Rptr. 350, 599 P.2d 656 (1979).

[123] A Study of Ballot Measures: 1884-1986, Compiled by the Office of the Secretary of State, March Fong Eu, Sacramento, CA (n.d.).

made appropriable and "placed under the control of the State Water Commission."[124] In 1917, the State Water Commission's annual report cited "the need of ground water legislation," and opined that "surface and ground water supplies are so intimately related physically that one can not be completely regulated and administered without similar control of the other....[T]he fact that the water passes beneath the surface and is for a time hidden from view to again reappear farther down the stream, does not offer a logical reason for its exemption from control and regulation."[125]

In 1957, the State Water Plan observed that "[w]hile it is not an immediate problem, it is evident that effective administration of the development and utilization of ground water resources, either by the State or by local agencies, or by both, will become mandatory as the stage of full water development is approached. When it becomes necessary to operate the major ground water basins for import-export purposes as envisioned under The California Water Plan, requisite authority to do so must exist....The following items are suggested for consideration in this connection: ... The requirement of permits and licenses for the appropriation of ground water."[126]

In 1971, the Chair of the Assembly Committee on Water made two very modest legislative proposals: including groundwater in the existing statutory adjudication procedures, and requiring pumpers statewide (and not just in four southern counties)[127] to file statements of the amounts they were pumping. His suggestions did not get enacted. Two years later, Ronald Robie, a respected water law expert who became Director of the Department of Water Resources (and later a judge), gave an address in which he said, "...'ad hoc' solutions are not satisfactory. I find it curious that although regulation of surface waters is properly a responsibility of the State, groundwater regulation is somehow viewed as a 'local' concern....The result is uncoordinated

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[124] Report, State Water Problems Conference, November 25, 1916, at 65. The Report said "[t]he conference therefore has recommended legislation which will recognize the doctrine of prior appropriation as applied to underground water, so that the one who first develops it shall be entitled to so much water as is necessary for the beneficial use of the project to which it is applied....[T]he appropriation of underground water, like the appropriation of surface water, should be placed under the control of the State Water Commission, but...no owner of land of 160 acres or less, should be compelled to apply to the Water Commission for permission to develop the water lying under his own land for use upon that land...." *Id*., at 65-66.

[125] Report of the State Water Commission of California, Published January 1, 1917 (Sacramento, State Printing Office, 1917), at 74.

[126] Bulletin No. 3, The California Water Plan, State of California, Department of Water Resources, Division of Resources Planning (May 1957), at 221.

[127] Water Code § 5000(c). Carley V. Porter, What's in the Legislative Cards for Ground Water, Proceedings of the 8th Biennial Conference on Ground Water, University of California Water Resources Center (1971), at 63, 65-66.

administration of interrelated resources."[128]

Four years later, the background study for the Governor's Commission to Review California Water Rights Law posed the question, "Should permits be required for new wells where critical groundwater problems exist or are threatened? For new wells in all basins? For all wells, new and existing, where critical groundwater problems exist or are threatened? For all wells in all basins?"[129] The Commission itself, however, acknowledged what had become the political reality when it came to groundwater law reform. After noting that "[m]ost other western states have integrated groundwater into state-level appropriation permit systems," it noted that "California's experience with groundwater management...differs from that of other western states." It therefore concluded "that local management, if it is properly undertaken, offers the best opportunity for workable and effective control," and to make clear that it was not calling for anything like a general permitting system, it said "the Commission...intends that proposed legislation not require any unnecessary management actions in areas without critical long-term overdraft, subsidence, or water quality problems."[130]

The Governor's Commission correctly read the California legislative situation. No pleas for integrated management of surface and groundwater generated statutory change. In a progress update ten years later, attorney Kevin O'Brien reported "[t]he California Legislature has flirted with the concept of ground water management during the past several legislative sessions. To date, no comprehensive ground water management legislation has been adopted."[131]

On the contrary, the legislature made clear its disinclination to enact comprehensive legislation or to expand the Board's permitting jurisdiction over groundwater.[132] The subterranean stream

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[128] Ronald B. Robie, Carley Porter Memorial Luncheon Address, in Proceedings, Ninth Biennial Conference on Ground Water, University of California, Water Resources Center (1973), at 146.

[129] Governor's Commission to Review California Water Rights Law, Anne J. Schneider, Groundwater Rights in California, Background and Issues (Staff Paper No. 2, July, 1977), at 96.

[130] Final Report, Governor's Commission to Review California Water Rights Law (December 1978), at 166, 167.

[131] Kevin M. O'Brien, The Governor's Commission Revisited: Ten Years of Not So Benign Neglect in California Ground Water Law, in Johannes J. DeVries, ed., Sixteenth Biennial Conference on Ground Water, University of California, Water Resources Center (1988), at 50 (citations omitted)..

[132] A useful, succinct review of legislative activity appears in Anne J. Schneider, Groundwater Management Options – Vision vs. Reality, in, Water Rights, Water Wrongs:

(continued...)

provision of Water Code § 1200 remains virtually unchanged from what it was in 1913. Indeed, in a variety of statutory provisions as well as legislative studies, the legislature's posture toward statewide groundwater management has been set down unambiguously:

- In 1962, an Assembly Interim Committee Report, concluded: "In most areas of the State, the key to the solution of ground water problems lies in local attitudes and political feasibility....Water agencies expressed a strong desire to solve their problems themselves and to manage ground water basins locally. The committee agrees that local management is desirable and ...provides simplified solutions to many of the ground water basin management problems."[133]

- In 1984, in legislation granting area-of-origin rights to a variety of water systems as against future export projects initiated after a certain date, the legislation was careful to distinguish between surface water appropriations dated by the time of "applications [before the Board] to appropriate," and groundwater appropriations, dated by the time they are "initiated" [outside of any permitting process].[134]

- Because the Article containing the area-of-origin law was codified in the midst of a chapter of the Water Code that deals with the Board's administrative responsibilities, the legislature added § 1221, stating "This article shall not be construed to authorize the board to regulate groundwater in any manner."

- The provision that grants the Board authority over general adjudications of stream systems specifically excludes "an underground water supply other than a subterranean stream flowing through known and definite channels."[135]

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[132](...continued)
Learning From the Past, Looking to the Future, Forum Sponsored by the San Francisco Estuary Project, the Water Education Foundation, the Commonwealth Club of California and Friends of the San Francisco Estuary, Nov. 2, 1999, at 41-46.

[133] Assembly Interim Committee on Water, California Legislature, Ground Water Problems in California (vol. 26, Assembly Interim Committee Reports No. 4, Dec. 1962), at 8, 46.

[134] Water Code §§ 1215, 1216.

[135] Water Code § 2500.

- In one instance where it did give authority to adjudicate a river, the Scott River, including interconnected groundwater, the legislature specified that the decision was "necessary...for a fair and effective judgment of ...rights" in that particular river, but declared it "necessary that the provisions of this section apply to the Scott River only."[136] Ironically, the studies that led to the Scott River legislation demonstrate that the legislature has been fully and unambiguously informed of the inadequacies of the bifurcated (groundwater and surface water) system it had created.[137]

- Even where the legislature has wanted the Board to act generally as to groundwater – as with water quality adjudications – it has been careful to require it to go to court,[138] and to defer to local public agencies.[139]

- Where the legislature wants to include "percolating groundwater" within the coverage of a statute, it does so explicitly, as in a law requiring recordation of certain groundwater extractions. In that law, the definition section says "'[g]round water' means water beneath the surface of the ground whether or not flowing through known and definite channels."[140]

- Finally, the legislature has made clear its view that its preferred way of dealing with groundwater is through local, basin-specific management, a

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[136] Water Code § 2500.5.

[137] "...[P]umping of groundwater as well as underflow reduces the surface flow of the various streams and the main stem of Scott River....It became apparent...that underground water was an important part of the water supply problem in the stream system and that in order to properly determine the rights to water from the stream system, interconnected underground water should be included." State Water Resources Control Board, Division of Water Rights, Report of Investigation Pursuant to Petition for Adjudication, Scott River, Siskiyou County (December 1971), at 5-6. See also California State Water Resources Control Board, Report on Hydrogeologic Conditions, Scott River Valley, Scott River Adjudication (November 1975).

[138] Water Code § 2100.

[139] Water Code § 2101(b).

[140] Water Code § 5000(a); see also Water Code § 1005.4. Water Code § 12922 expresses the public interest in protecting groundwater basins from critical conditions of overdraft depletion, sea water intrusion or degraded water quality, but it is just a declaration of the public interest, not a grant of jurisdiction to the Board.

position it has held quite consistently over many years.[141]

This brief review makes clear that the legislature has repeatedly been made aware of the Board's limited jurisdiction over groundwater under Water Code § 1200, and has shown no inclination to expand that jurisdiction beyond the legislative goals that led to the language in the 1913 statute.

PART III:

THE BOARD'S CURRENT IMPLEMENTATION OF THE LAW GOVERNING SUBTERRANEAN STREAMS FLOWING THROUGH KNOWN AND DEFINITE CHANNELS

As noted at the beginning of this Report, in answer to Question 2, the Board's interpretation of Water Code § 1200,[142] treats the decision in *Los Angeles v. Pomeroy*[143] as stating the governing

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[141] Water Code §§ 10750-10756; Assembly Interim Committee on Water, California Legislature, Ground Water Problems in California (vol. 26, Assembly Interim Committee Reports No. 4, Dec. 1962), at 47-48.

[142] Over the years, the Board guidance document, with titles that are variations of "General Information Pertaining to Water Rights," has had a provision dealing with "Appropriation of Underground Water," but that provision has never sought to define the scope of the statutory construct "subterranean stream" in any detail, nor does it give much hint of how the Board approaches uncertain cases. The 1923 version says "...attention is called to the fact that the jurisdiction of this office is limited by the following sentence in section 42 [now section 1200] of the ...Act: [quoting]....It is therefore unnecessary to apply if the waters to be developed are merely percolating waters." (p. 27). In 1925, it added: "... the Division does not encourage the filing of applications to appropriate from springs or wells upon one's own land, unless there is a possibility that someone else may...establish an adverse claim." (p. 30-31). By 1956, the following language, appeared: "Whether underground water is moving in 'subterranean streams...' is determined by the facts in each case. Where this is the case, such water is subject to appropriation under the Water Code....If it is proposed to use ground water on nonoverlying land, and the source of the water is a subterranean stream...an application...is required." (p. 40). The current version, dated January 2000, has changed yet again, omitting reference to case-by-case analysis, but adding reference to "ground water basin." It states that "jurisdiction...is limited...to 'subterranean streams... ', and explains that "[u]nderground water not flowing in a subterranean stream, such as water percolating through a ground water basin, is not subject to the SWRCB's (continued...)

law.[144] It reads that decision as requiring the following physical conditions to exist for groundwater to be classified as a subterranean stream flowing through a known and definite channel:[145]

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[142](...continued)
jurisdiction. Applications to appropriate such water, regardless of use, should not be submitted." (p. 8).

[143] 124 Cal. 597, 57 P. 585 (1899), writ of error dis. sub nom. *Hooker v. Los Angeles*, 188 U.S. 314, 23 S.Ct. 395, 47 L.Ed. 487 (1903).

[144] In fact that case was decided before the first statute, the predecessor to Water Code § 1200, was enacted, and *Los Angeles v. Pomeroy* was not a statutory interpretation case, so strictly speaking it is not a binding interpretation of the statute. Technically, the Board recognizes this and says in its *Garrapata* decision (*supra* note 8, at 3) that the decision in *Los Angeles v. Pomeroy* sets forth "the distinction between subterranean streams and percolating groundwater," and thus is relied on to define the requirements for finding a "subterranean stream...." under the statute. It may seem surprising that no Supreme Court case after 1914 has authoritatively interpreted the subterranean stream language of the Water Code. One theory is that since the Court has shown itself willing to protect surface stream rights against groundwater pumping, and *vice versa*, the scope of Board permit jurisdiction over groundwater has simply not loomed large in terms of protecting rights. See, e.g., *Eckel v. Springfield Tunnel & Dev. Co.*, 87 Cal.App. 617, 262 P. 425 (3d Dist. Ct. App. 1927); *McClintock v. Hudson*, 141 Cal. 275, 74 P. 849 (1903); *Miller v. Bay Cities Water Co.*, 157 Cal. 256, 107 P. 115 (1910).

[145] D. 1639 (1999) (*Garrapata*). This statement of the Board's interpretation of Water Code § 1200 is repetitive of the material responding to Question 2, text at note 8 *supra*. It is included here so that the main body of the Report can stand alone.

While interpretation of its jurisdiction over groundwater is based on the Board's understanding of the mandate of Water Code § 1200, it was for some time Board policy to accept a permit application for groundwater that did not meet the Water Code standard for a subterranean stream if the applicant affirmatively wished to have a permit. The Board explained this policy many years ago: "Applications are occasionally received for waters to be developed from wells or other works drawing from a body of broadly diffused percolating water. In such instances, if the applicant desires, the application is allowed in order to establish a public record of the initiation of the use of the water." Third Biennial Report of the State Water Commission of California, 1919-1920 (Sacramento, California State Printing Office, 1921), at 17. As it explained in its Rules as early as 1925, note 142, *supra*, this could be a means to prevent others from obtaining adverse possession rights. Though there is no current written policy on this matter, Board staff reports that – depending on available resources – the Board would take a look at the facts, and would not accept an application that clearly involves percolating groundwater. As a practical matter, resources are not usually available to make field examination of unprotested

(continued...)

- A subsurface channel must be present.
- The channel must have relatively impermeable bed and banks.
- The course of the channel must be known or capable of being determined by reasonable inference.
- Groundwater must be flowing in the channel.

The Board also takes the position that while in *Los Angeles v. Pomeroy* the Court stated that the bed and banks of a subterranean stream must be impermeable,[146] it should recognize that all geologic materials are permeable to some extent. Therefore, the Board interprets the law so that if the rock forming the bed and banks is relatively impermeable compared to the aquifer material filling the channel, it infers that a subterranean stream exists.

In addition, underflow is not considered coextensive with the definition of subterranean stream, but only as one category thereof.[147] The Board notes that underflow was defined in *Los Angeles v. Pomeroy* as having the following physical characteristics:

- Underflow must be in connection with a surface stream.
- Underflow must be flowing in the same general direction as the surface stream; and
- Underflow must be flowing in a water course and within a space reasonably well defined.

Under these definitions, according to the approach the Board takes, all underflow constitutes a subterranean stream within the meaning of *Los Angeles v. Pomeroy*, but something can qualify as a subterranean stream without being underflow. Thus, underflow is viewed as a subset of a subterranean stream flowing in through a known and definite channel. Under, the Board's interpretation of the law it is not necessary that groundwater be underflow to establish the

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[145](...continued)
applications.

[146] The Board is aware that the term actually used in *Los Angeles v. Pomeroy* is "impervious," not impermeable, but it treats them as synonymous, and uses impermeable because it is used more commonly in scientific literature. Draft Decision, In the Matter of Applications 30038 [et al.], Waste Management, Inc., et al., Applicants; Yuima Municipal Water District, Protestant; Pauma Valley Water Co., Interested Party (Nov. 23, 1999), at 6 n.2 (*Pauma and Pala* case). As is noted in the discussion of *Los Angeles v. Pomeroy*, it is doubtful that the Court intended to impose a test of impervious or impermeable. In fact it only found the channel there to be "comparatively impervious." See note 50, *supra.*

[147] *Garrapata*, *supra* note 8, at ¶ 3.3.1. This position had been set out the previous year in a Memo from the Office of the Chief Counsel, Memo dated Sept. 18, 1998, from Barbara J. Leidigh, Senior Staff Counsel, to Ed Dito, Division of Water Rights, regarding permitting of underground water in the Russian River Valley, at 4.

existence of a subterranean stream flowing through a known and definite channel. However, a review of many cases reveals that the most frequently encountered groundwater cases in which the Board takes jurisdiction are in fact "underflow" cases,[148] and that, at least in early cases, if groundwater (though tributary to a stream) didn't flow along it as underflow, jurisdiction was denied.[149]

1. Recent Board Decisions

a. Garrapata Creek

The 1999 *Garrapata* decision[150] is illustrative of a contemporary case in which the Board determines whether a subterranean stream is present.

In non-technical terms, the physical situation in the case was the following. Garrapata Creek is a perennial surface stream near the coast that empties into the Pacific Ocean. The stream drains a watershed about 10 miles square that consists of a rather steep canyon rising on both sides of the stream. The canyon consists of solid rocky walls that meet below the bottom of the Creek in a sort of U-shape. In the canyon bottom adjacent to the stream is an area of relatively flat land that experts describe as "an unconsolidated deposit of cobbles, gravel, sand and clay," or technically "alluvium." The source of this alluvium is material eroded from the rocky canyon and carried down by the Creek. The area of the alluvium represents the meandering course that the river has taken over time, and at flood stages, laying down a river valley above the bedrock.

Compared to the rocky canyon walls, this alluvium, which is about 50 feet thick in the Garrapata Creek watershed, is highly permeable, so that a well drilled into the alluvium below the water table produces water when pumped. Such a well was drilled into the alluvium near Garrapata Creek.

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[148] Illustratively, a case involving shallow wells near, and within the floodplain of, the Big Sur River in Monterey County, was one where "The Division [of Water Rights] conducted a field investigation of the complaint [by the Department of Parks and Recreation asserting adverse impacts to public trust resources in the river and lagoon areas] and found that [an individual's] wells divert from the underflow of the Big Sur River," and that therefore an application to appropriate was required for uses on nonriparian lands. Letter dated Jan. 17, 2001, from Harry M. Schueller, Chief, Division of Water Rights, SWRCB, to Mr. James Hill, ref. no. 363:CLC:262.0(27-06-01), at 1. The case is also typical in that the wells were found to be impacting the River. A hydrologic investigation report "concluded that water pumped by the ...wells is induced river seepage. Therefore, [the] wells are hydrologically connected to the Big Sur River." Letter dated Dec. 27, 2000, from Lewis Moeller, Chief, Hearing Unit, to Mr. James J. Hill, re: Water Right Application 30166 of James Hill (El Sur Ranch)...," at 1.

[149] Decision A. 6017, D. 225 (1929) (Metcalf Creek, San Bernardino County).

[150] *Garrapata*, *supra* note 8.

The real question of interest in the case was whether, and to what extent, such a well impacted flows in the surface stream, but the prior question for the Board was whether it had jurisdiction over the pumping at all, and that question turned on whether the groundwater being pumped came from a "subterranean stream" within the meaning of Water Code § 1200.

To determine its jurisdiction, the Board said it had to answer four questions: (1) is there a subsurface channel; (2) if so, does it have relatively impermeable bed and banks; (3) is the course of the channel known or capable of being determined by reasonable inference; and (4) is groundwater flowing in the channel. Interestingly, only questions 1, 3, and 4 are drawn from the statutory language of Water Code § 1200 – channel, known and definite, and flowing. The second question – relating to bed and banks – is derivative. The definition of a channel requires that it be confined, the source of the bed and banks requirement. That requirement in turn produces the need for a judgment about how "impermeable" a bed and banks has to be.

As to three of the four questions posed by the Board in *Garrapata*, there was no dispute.[151] Both sides in the case apparently agreed that the narrow area of alluvium at the bottom of the canyon paralleling the Creek was a channel. They agreed as well that groundwater was flowing in the channel, and that the groundwater was flowing "toward the ocean, in the same fashion as the surface stream...though flowing with much less velocity than the surface stream."[152]

The principal point of contention in the case was whether the alluvium from which the well was pumping had "relatively impermeable" bed and banks, which the Board defined as follows: "is the [material comprising the bed and banks] sufficiently impermeable at the point of diversion to prevent the transmission of all but relatively minor quantities of water through the channel boundary....[T]he test is not that the bed and banks be absolutely impermeable, but rather, relatively impermeable compared to the alluvium filling the channel." The Board conceded this was a subjective test, as no appellate court or Board decisions have quantified differences in permeability.[153] The Board concluded that the relative impermeability test was met because "the

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[151] *Id*., at ¶ 3.3.2..

[152] *Ibid.*

[153] There is at least one case in which a court treated the juncture of older (less permeable) and younger (more permeable) alluvium as the determinant of a bed and banks. *United States v. Fallbrook Public Utility Dist.*, 347 F.2d 48, 56 (9 Cir. 1965). Notably, technical experts agree that "the diversity of California's geology make the use of a 'young' versus 'old' formation type distinction inappropriate in a statewide application." Memo from Kit Custis, Senior Engineering Geologist, to Department of Fish and Game, Sept. 14, 2001 (on file with Joseph Sax); "...whether the sediments surrounding the stream are younger or older alluvium is irrelevant in my mind." Memo from Karen R. Burow, U.S.G.S. to Technical Advisory Committee, Aug. 31, 2001 (on file with Joseph Sax); "...the assumption...that there is an erosional inner alluvial valley in most basins

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alluvium was recharged principally through the shallow percolation of rainfall through the zone of weathered bedrock, colluvium and soil, and through infiltration from surface flow in Garrapata Creek," and not from openings in the bedrock constituting the canyon walls and bottom."

The test of impermeability of bed and banks would seem to be a further refinement of the question whether there is a channel, or what the statute calls a "known and definite channel." However, nothing in the statute itself requires a measure of impermeability. The Board seems to have adopted a stepped analysis: the law requires a channel; a channel must have bed and banks;[154] bed and banks are defined by capacity to confine flow.

The Board's seeming emphasis on "bed and banks" and on relative impermeability as the standard for testing the statutory requirement of a channel may be highly significant. The central controversy over the scope of "subterranean stream" in the statute centers on whether the Board is likely to take jurisdiction over groundwater pumping in broad alluvial valleys where it has not ordinarily exercised its jurisdiction in the past, rather than taking jurisdiction only over pumping in the near vicinity of surface streams.[155] If the Board were to take the view that a channel must fit

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[153](...continued)
that is filled with 'younger alluvium'. California streams and rivers do not necessarily follow this assumption." Memo from Dr. Steven Bachman, to Joseph Sax, Aug. 15, 2001 (on file with Joseph Sax).

The Board in *Garrapata* utilized several tests to support its finding of "relative" impermeability: (1) evidence that the type of rock in question that comprised the bed and banks was of low permeability, as little as 1% or 2% compared to sand and gravel, which ranged around 20%; (2) sampling of the actual rock in the watershed which was found to have little faulting, and of the faulting found much of it was filled with clay, indicating little capacity for water to permeate through it; (3) well tests into the bedrock demonstrated very low pumping capacity, another measure of relative impermeability (being several orders of magnitude lower than a well in the alluvium); (4) modeling suggesting that water reaching the surface stream did not come through the bedrock, but from the alluvium; (5) consideration of chemical differences between well water and water in the surface stream was not indicative that stream water came from some other source than the alluvium (i.e., through fractures in the bedrock). *Garrapata*, *supra* note 8, at ¶ 3.3.2.

[154] *Hutchinson v. Watson Slough Ditch Co.*, 16 Idaho 484, 488, 101 P. 1059, 1061 (1909): "water flowing in a definite channel, having a bed and sides or banks ...."

[155] In *United States v. Fallbrook Public Utility Dist.*, 347 F.2d 48, 56 (9 Cir. 1965), the court distinguished a case involving the Santa Ana River system (*Orange County Water Dist. v. City of Riverside*, 173 Cal.App.2d 137, 174, 343 P.2d 450 (4th Dist. Ct. App. 1959)) in which "the basins were huge subterranean lakes" that were "relatively stationary," and where it was determined they did not constitute a jurisdictional subterranean stream, as contrasted with the
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the definition of being like "a trench, furrow, or groove" or "a tubular passage"[156] – that is, something essentially long and narrow – it would doubtless be drawn toward the more restricted view of its jurisdiction that some urge, sticking to the immediate confines of the channels of surface streams. On the other hand, if a channel can be quite broad and un-furrow-like, so long as it is enclosed by relatively impermeable beds and banks, subterranean stream jurisdiction could be quite extensive.

Garrapata, however, is not a very good test case, for two reasons: First, there was no dispute over the presence of a channel and flow; and second, and more importantly, it is the type of case that engenders the least controversy about the meaning and application of Water Code § 1200. There is general agreement that where a stream is contained within a narrow bedrock canyon in which the streambed occupies most of the canyon bottom, a so-called "bed and banks" test is an appropriate measure of jurisdiction, because the presence of a "channel" is indisputable. The understanding is that the relatively narrow band of alluvium within the highly impermeable canyon walls and bottom is (1) essentially the buried portion of the stream, where the subterranean water in the alluvium is moving with the stream (usually relatively rapidly down a fairly steep gradient); (2) is in hydraulic contact with the stream; and (3) pumping of such water is likely to have a direct impact on the surface stream.

In such circumstances, assuming a highly impervious enclosure, the subsurface water fits everyone's legal definition of a "subterranean stream flowing through known and definite channels," and satisfies even those who claim that the "subterranean stream" definition should be limited to what is called the underflow of surface streams. The groundwater in such situations is seen as constituting the immediate subterranean component of the surface stream (even though it is understood that water constitutes a continuum and technically speaking there are no such distinct boundaries). In addition, so long as the pumping is within the alluvium, and the alluvium is essentially isolated by the bedrock from all water sources except the stream, the pumping is likely to be immediately impacting the surface stream, which creates the strongest claim for regulatory intervention.

In such situations, it is generally accepted that the Board need only ask two questions: (1) is the alluvium within "bed and banks" that essentially isolate it? and (2) is the pumping from this isolated alluvium?[157] Controversy begins when the Board is seen as limiting its inquiry to these questions

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[155](...continued)
coastal basin of the Santa Margarita River system. The court noted also that its finding of a subterranean stream was supported by hydraulic connectivity, stating that the "wells...lie not on the fringes of the Coastal Basin but within or closely adjacent to the river itself." 347 F.2d, at 56.

[156] American Heritage Dictionary (3rd ed., 1992), at 320.

[157] Another recent narrow bedrock canyon case, still at the staff decisional level, contains a
(continued...)

when it deals with cases other than those set in narrow bedrock canyons, and something other than underflow is involved.[158] That is exactly what happened in the hotly-disputed *Pauma and Pala* case.

b. Draft Decision, Pauma and Pala Basins

A draft decision issued in 1999, and still not made final, is illustrative both of the interpretive difficulty that Water Code § 1200 can present, and of the fractious disputes it can generate over the way in which the Board should be exercising its jurisdiction. The Board received applications from several mutual water companies to appropriate water from a subterranean stream in the upper part of the San Luis Rey River in San Diego County. The applications were protested both by a water district and a water company which divert water in that same area, but which never applied for appropriative water rights. The protestants contended that they were pumping percolating groundwater, and that the water the applicants sought to pump was percolating groundwater as well.

The *Pauma and Pala* case presented a factual situation that differs at least in degree from the great majority of subterranean stream cases that have come before the Board during the past three-

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[157](...continued)
report by the staff geologist stating, "in accordance with...*Garrapata Creek*, the beds and banks of a subterranean stream are determined by a sufficient difference in the permeability of local rock materials such that the subterranean stream is reasonably confined to the known and definite channel." Memo from Charles NeSmith, Associate Engineering Geologist, Files 262.0 (44-16-01), Water Rights Complaint – California Department of Fish and Game vs. Stephenson Ranch (Santa Cruz Biotechnology) Regarding Diversions from Laguna Creek in Santa Cruz Country (August 23, 2001), at 5.

[158] The notion that underflow is just one category of subterranean stream is not new, however. See D. 968 (1960) (Cache Creek Tributary), at 3-4.

The issue whether surrounding mountain ranges other than in a narrow canyon could qualify as "bed and banks" was being explored within the Board Staff in the year preceding preparation of the *Pauma and Pala* draft decision. Memo from the Office of the Chief Counsel, *supra* note 147, at 5. It had presumably been noted that there were many permits for groundwater diversions in the Russian River Valley. The Memo reported that while there were hundreds of groundwater permits on the main stem of the Russian River, 70 to 80 percent were for underflow, and that there had been no controversy about the propriety of groundwater permitting in the Russian River Valley. The Memo concluded with a statement of "... reasons why permits are necessary. First, the characteristics of much of the Russian River are similar to the Los Angeles River as described in *Pomeroy*. There are mountains along the sides of the valley that contribute runoff and may represent the bed and banks...." *Id.*, at 4-5. The Memo concludes that under *Pomeroy*, "the bed and banks can be established by reasonable inference, and may consist of the surrounding mountain ranges...." *Id.*, at 6.

quarters of a century. It was neither a conventional underflow-type case,[159] nor did it involve subsurface water moving through a long and narrow alluvial valley enclosed by steep canyon walls, and constituting channel flow in the conventional sense of the term.

The case arose when Waste Management of California, Inc. filed an application to appropriate groundwater for use at a proposed solid waste landfill. The point of diversion was to be a well located some 50 to 100 feet from the San Luis Rey River. While the applicant believed that the water beneath the proposed site may be percolating water, it filed for a permit to preserve its priority of right in the event the proposed diversion was found to be from a subterranean stream within the meaning of Water Code § 1200. A number of other applications were also filed to appropriate water from wells in the Pala and Pauma Basins. The applications were protested by other water users who had not sought permits for their diversions, who asserted that the water applied for was percolating groundwater.

The water-bearing alluvial areas in the Pauma and Pala Basins along the San Luis Rey River are 6.5 to 7.5 miles long and from 0.5 to 3.0 miles wide,[160] with narrows at both their upstream and downstream ends. The basins have several other unusual features as well. Because the downstream movement of the subsurface water was partially blocked by a rise in the underlying bedrock (presumably the reason for the lateral spread), the movement of the water within the basin was particularly slow, making it appear – in the view of some protestants in the case – more like an underground lake or reservoir than a stream.

The protestants focused on these unusual features in concluding that the Pauma Basin could not qualify as a subterranean stream within the meaning of Water Code § 1200. Essentially their legal points were: (1) that the water was too slow-moving to constitute flow (sometimes not moving downstream at all when pumping lowered the water table); (2) that the shape of the basin meant it

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[159] The Board geologist's memorandum recommendation to the Board concluded, however, that "the groundwater in the alluvial aquifer of the Pala basin is...underflow of the San Luis Rey River " based on a finding that "the subterranean channel is a flow boundary, groundwater in the alluvium is confined to a well defined space and is moving in a course... and [] the direction of groundwater flow is generally in the same direction as the... River." Memorandum to files of Julie Laudon, Associate Engineering Geologist, re: Application 30038 (January 21, 1992).

[160] A U.S. Geological Survey Report shows the Pauma Basin as approximately 7-7.5 miles long, 50% of which is about 1 mile wide and with alluvium 650-750 feet thick; and 50% of which is 2-2.5 miles wide and between 400-450 feet thick. The Pala Basin is approximately 6.5 miles long, 50% of which is 1.5-2 miles wide and 250-500 feet thick; 35% of which is .5-.75 miles wide and about 250 feet thick; and 15% of which is 2.5-3 miles wide and about 200 feet thick. Hydrologic – and Salt – Balance Investigations...Lower San Luis Rey River Area, San Diego County, California, U.S. Geological Survey Water-Resources Investigations 24-74 (October, 1974) (the "Moreland" Report).

wasn't a stream flowing through a channel – that is, that it wasn't longish and narrowish enough to be a channel; (3) that the enclosing bedrock was not sufficiently impermeable (they used the term "absolutely impermeable") to constitute a channel's bed and banks; and (4) that the water within the asserted channel was not all moving parallel to the stream.

The Board's draft decision found nonetheless that there was groundwater flowing in a known and definite channel. It said that "[a]s with surface streams, which may include deep lakes impounded by a rim of bedrock or other obstructions, there may be constrictions in a channel or wider and deeper areas in the channel of a subterranean stream."[161] The fact that the watercourse is wide or narrow, or balloons out at points, was not deemed determinative.[162] What seems to have been crucial was evidence that water was moving along a particular path, though that path need not have had any particular form, nor been narrowly confined.

While the flow of the water within the basin was not uni-directional, it ultimately moved downstream. There was testimony that "at the margins of the valley, groundwater is flowing roughly perpendicular to the bed of the channel, but that as it reaches the middle of the valley, the direction of the groundwater flow turns and flows downstream."[163] The draft decision concluded that "[t]he net groundwater flow direction is downstream,"[164] as part of its finding that there was water flowing through a known and definite channel. There were also some clay layers within the basin that partially confined some of the water in the alluvium, which one expert witness suggested

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[161] Draft Decision (Nov. 23, 1999), at 26. This was the position taken by the Board in an earlier decision dealing with the Bonsall Basin on the same river downstream of the Pauma Basin, where the subterranean stream question had arisen and been decided in favor of jurisdiction despite evidence that the bedrock of the narrows had partially obstructed underground flow. D. 432 (1938), reaffirmed in Order of the State Water Rights Board, dated June 26, 1962. The case is discussed in text at note 195, *infra*.

[162] Cf. the 9th Circuit's *Fallbrook* decision, *supra* note 155, distinguishing the Santa Ana (*Orange County Water Dist.*) case on precisely this ground, 347 F.2d, at 56.

There is language in a number of cases – such as *Pomeroy,* 124 Cal. at 631-32; *Los Angeles v. Hunter*, 156 Cal. at 607; and *Eckel v. Springfield Tunnel & Dev. Co.*, 87 Cal.App. 617, 622 (3d Dist. Ct. App. 1927); as well as the pre-rehearing opinion of Justice Temple in *Katz v. Walkinshaw*, 141 Cal. at 139-140, indicating that water in a lake-like basin is percolating water, though the precise question of the significance of size and shape of a basin has never been before the California Supreme Court.

[163] Draft Decision, at 31.

[164] *Ibid.*

made it "a quiescent basin"[165] rather than a stream, but the draft found a subterranean stream nonetheless, noting that the clay layer was not continuous and that there was continuity between the alluvium above and below it.

The draft then concluded that the bedrock in the hills enclosing the valley constituted the bed and banks of the channel. The standard the draft applied was that there must be a bed and banks that are "relatively impermeable compared to the overlying aquifer material."[166] While there was considerable testimony about the permeability of the crystalline rock that constituted the bedrock as a result of fractures in it, the draft decision concluded that as a whole it was not water bearing despite local fracturing, and that it passed the "relative impermeability" test.

One may look at the concerns of the protestants in two different ways. One perspective would focus on their concern about a perceived expansiveness in the interpretation of the terms "flowing" and "channels" in Water Code §1200: a very generous test of flow; the sufficiency of a finding that the "net groundwater direction is downstream," as opposed to a claimed requirement that the hydraulic gradient of any water flow be parallel to the surface flow of the stream; and the application of the bed and banks test to a rather broad alluvial valley, rather than just a "narrows" type area.

Another perspective on the dispute is that the protestants believed the pumping was not significantly affecting the surface stream, and that the Board was deviating from its actual functional approach, which was to employ the subterranean stream definition only to protect surface streams from pumping that immediately and directly affects them. Focus on such impact seems not to have been central to the *Pauma and Pala* analysis, at least for the Board's geologist, who testified as follows:[167]

> Water rights professionals often use the term 'underflow' as jargon for a subterranean stream. However, the two terms can indicate different physical conditions. The most important difference between a subterranean stream and underflow is that interconnection with a surface stream is not a defining characteristic of a subterranean stream, but it is for underflow. Thus, not all subterranean streams constitute the underflow of surface streams.

A confined aquifer in the vicinity of a surface stream, otherwise meeting the subterranean stream standard, but the pumping of which has no direct impact on the stream, would, under this view, come within the Board's permitting jurisdiction.(The deeper underlying issue may be a difference

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[165] *Id.*, at 32.

[166] *Id.*, at 23.

[167] Quoted in the Legal Brief of the Division of Water Rights in the *Pauma and Pala* case, at 6 (December 1, 1997).

of view about how to deal with cases of long-standing hydrological disconnection, where decades of pumping have dramatically changed the groundwater/surface water relationships, an issue noted at the very end of Part III of this Report, below).

While contemporary connection to a surface stream is not a factor under the language of Water Code § 1200, it appears to have been an element in every subterranean stream case in California I have been able to find,[168] going all the way back to *Pomeroy*. Thus, while the Board staff was – strictly speaking – correct in saying, as it does in a proposed amendment to the draft decision, that

> ...this decision follows established precedent, does not change existing law, does not expand the test regarding what constitutes a subterranean stream, and does not expand the permitting authority of the SWRCB[169]

in practice the position taken in the *Pauma and Pala* draft embraces a more inclusive view of subterranean streams than the Board has utilized in the past.

What the protestants see in the *Pauma and Pala* case is the prospect of the Board administratively expanding its *de facto* jurisdiction in a way that could lead to its regulating groundwater pumping quite broadly (how broadly no one can say, as the fears are about something that might happen, not something that has happened), utilizing a Pauma-and-Pala-like expansive definition of a "flow[] through [a] known and definite channel." The Board, on the other hand, says it is just implementing the statute, and that (contemporary) connectivity with a surface stream is simply not an element of a subterranean stream under the terms of the statutory provision. Both positions are right! They are simply right about different things.

The *Pauma and Pala* draft opines that underflow is a subcategory of subterranean streams, but that underflow does not exhaust the category of subterranean streams. The significance of this view, it would seem from reading the draft decision, is that a subterranean stream need not be "in connection with" a surface stream,[170] need not be flowing in the same direction as a surface stream, and need not be "within a space reasonably well defined."[171]

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[168] See, e.g., D. 1585 (1982), at 34 (Salinas River), Order WR 82-12 (1982). A possible exception is D. 1474 (1977), at 13, 1977 WL 22457 at 6. See also D. 1474, at 7,10, 1977 WL 22457 at 3,5.

[169] Draft amendment to the draft decision (dated Jan. 24, 2000, from Assistant Chief Counsel Andrew H. Sawyer).

[170] Presumably this is what hydrogeologists mean when they speak of hydraulic continuity.

[171] Insofar as the draft decision purports to rely on *Pomeroy*, it should at least be noted for the record that *Pomeroy* never *says* that underflow is only one subset of a subterranean stream;

(continued...)

All this is only to suggest that it is not unreasonable to claim that the *Pauma and Pala* draft decision involves an interpretive expansion of the Board's longstanding approach to Water Code § 1200.

2. Older Board Decisions

Most older subterranean stream cases involved streams in narrowly constricted canyons, or (similarly to *Pomeroy*) groundwater under a narrow strip of land at the entry or exit of a broad alluvial valley, where the groundwater was moving parallel to the stream.[172] While the Board has never set down a standard for determining whether water is "flowing" within a channel, or for the shape of the channel, nonetheless, in all but one case, the channel in the case before the Board was more "riverlike" than "lakelike," and the flow of the water seems to have been essentially unimpeded through relatively coarse younger alluvium. The one notable exception is a downstream portion of the same river involved in the *Pauma and Pala* case, the San Luis Rey River in San Diego County. The channel-shape issue also arose in an old case involving the Tia Juana River, discussed below. In general, however, older subterranean stream cases involve water within the immediate orbit of a surface stream.

While the following discussion in the text focuses on only a handful of illustrative cases, numerous other related decisions are identified and noted in the footnotes.

a. Sheep Creek, San Bernardino County

A 1926 decision, involving Sheep Creek in San Bernardino County, is typical of many of the older cases.[173] The subsurface water in question was described by the Board as "underflow" (a term

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[171](...continued)
and the trial judge's instructions never *say* that without the three elements of underflow, subsurface water can still be a subterranean stream. See 124 Cal., at 624, Instructions XVI and XVII.

[172] While movement parallel to the stream was mentioned as a supportive evidentiary fact in *Pomeroy*, it was not stated as a requirement.

[173] Decision No. 3883, D. 119 (1926). Examples of typical cases are D. 1142 (1963) ("applicant...to drill a well adjacent to the Russian River"); D. 1110 (1963) ("[t]he remainder of the supply to the well is derived from the underflow of the...Russian River ... and it is to this extent only that the appropriation is within the Board's jurisdiction."); D. 1337 (1969) ("the Board...finds that the applicant's well does not draw upon the underflow of either...River...and that the source is not within the jurisdiction of the Board.") See also Staff Memo from Lewis Moeller to Files, re: Report of Investigation Big Sur River in Monterey County, April 12, 1992 ("Staff concludes that both the...[w]ells are pumping from the underflow of the Big Sur River and (continued...)

found in many Board decisions).[174] It was underground water moving through an area about 660 feet wide, and 200 feet in depth, under and along the line of the surface stream, down a gradient of about 300 feet per mile, within a canyon ranging from ¼ mile to 1 mile in width and 4 miles in length. Though the Board made no finding about permeability, it concluded that "the underground flow passes through a known and definite channel and although the rate of the flow may be very slow and may be said to 'percolate' through the gravels, it is nevertheless flowing toward the desert through a definite channel formed by the walls of the canyon on either side."[175]

The features which make this seem a familiar subterranean stream case are that the subsurface water is moving parallel and proximate to a surface stream within a rather narrow valley of highly permeable younger alluvium that is relatively long and narrow (channel-like).[176] The groundwater is following the lines of former surface channels created by the river's historic meandering as it exited a canyon, which lines are broadly parallel to the stream across the alluvial fan, so that the dominant groundwater movement is parallel to the surface stream course through the valley, and moves downgradient with the stream. These are places where abundant groundwater is found, and as pumping continues and the water table declines, the river becomes a losing stream, to the detriment of downstream surface water uses.

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[173](...continued)
not from percolating groundwater."), p. 4.

[174] A Memo from the Office of Chief Counsel, *supra*, note 147, says "the SWRCB has been issuing permits to appropriators of water from the underflow of the Russian River...since the 1920's...70 percent to 80 percent are for underflow...[though] it appears that there was no controversy [as to whether the water was a subterranean stream]." Memo, at 4. The Memo, *id.*, also cites cases that "refer to the underground portion of a stream as 'underflow:' (See *Anaheim Union Water Co. v. Fuller* (1907) 88 P. 978...; *Hudson v. Dailey* (1909)105 P. 748; *Perry v. Calkins* (1911)113 P. 136 ; *Larsen v. Apollonio* (1936) 55 P.2d 196." In fact neither *Hudson* nor *Larsen* use the term "underflow".

[175] D. 119, *supra* note 173, at 11.

[176] E.g., Lagunitas Creek, in Marin County: a well 50 feet from the edge of a creek in alluvial deposits at the lower end of a relatively narrow valley, in sand and gravel with high permeability and hydraulic connections with the surface waters. See Order WR 95-17, In the Matter of Fishery Protection [etc.], Order Amending Water Rights [etc.], at 28-29. Other examples are San Simeon Creek and Santa Rosa Creek in San Luis Obispo County, coastal streams narrowly confined, where applications were filed to appropriate underflow, and the Board took jurisdiction, though without any explicit finding of a subterranean stream, D. 1624 (1989) (Santa Rosa Creek) and D. 1477 (1977) (San Simeon Creek). See also Santa Ynez River, D. 1486 (1978) (application to appropriate underflow).

b. Stony Creek, Colusa County

Stony Creek in Colusa County was involved in a court case that was referred to the Board as referee by the Superior Court in 1978. The referee report,[177] adopted by the Board, is considerably more detailed than most Board decisions, and it describes a case exactly like the situation mentioned above: a surface stream exiting a narrows into a valley from ½ to 1 mile wide where the alluvial fan containing younger and highly permeable alluvium is enclosed by considerably less permeable, older alluvium surrounded by bedrock. A well drilled into the recent alluvium some 1,300 feet from the stream channel is determined by pumping tests and chemical analysis of the water to be getting its recharge directly out of the sides of the surface stream, and with little if any influence from other sources. The physical setting comfortably fits the legal understanding of a California subterranean stream – subsurface water moving along a known and definite, closely confined path. It also is conformable to a hydrological standard for integrating management of subsurface pumping that directly impacts surface flows with the management of the affected surface stream, and could be read as indicating that a test of whether water is jurisdictional is whether the surface stream is directly contributing to the water being pumped.[178]

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[177] Order WR 80-11, Order Adopting Report of Referee, in *County of Colusa v. Westcamp* (Superior Court, County of Colusa, No. 14932) (State Water Resources Control Board, June 19, 1980).

[178] Impact alone, however, is not understood to be sufficient, where there is nothing that can be characterized as a channel. For example, in a recent situation where a complaint was filed and a staff investigation was made (Pilarcitos Creek, San Mateo County), the Board staff recommended declining jurisdiction. In that situation, the alluvial land flanking the stream was not enclosed by a rocky canyon or bowl. Instead, the river flowed down from mountains on the east and emptied into the Pacific Ocean. Over the years the river had meandered north and south and created a fairly broad alluvial plain which sloped down toward the ocean. The claim was that pumping from the alluvium caused water from the surface stream to move out from its bed into the alluvium to replace the pumped water, and as a result flows in the stream declined, causing, among other things, damage to the fishery resources in the stream. The staff concluded that jurisdiction should be declined on the ground that inasmuch as "the alluvial aquifer in the area of the ...well field is not bound by a known and definite channel, water extracted from the aquifer is not subject to the Board's permitting jurisdiction." It noted that subsurface water must be "bound by definable beds and banks" to sustain jurisdiction, and that no information was submitted by the complainants to support such a finding. Memo from Cori Condon, SWRCB, to Joseph Sax, Feb. 9, 2001, at 13 (on file with Joseph Sax).

See also D. 968 (1960), involving an underground source tributary to Cache Creek in Kern County. Plainly the source was tributary to the surface stream, but the Board found no jurisdiction because of the slowness of the flow ("substantially less than 100 feet a day") (*note*:100 feet a day is actually very rapid movement for groundwater, groundwater typically moves about 1,000 feet per year, so this may be a misprint. See note 39, *supra*); the width of the

(continued...)

In its decisions in cases such as this one, the Board does not expressly attach any significance to the width of the canyon; as in *Pomeroy* itself, one is left to wonder whether rocky hills miles apart. enclosing a significantly wider alluvial valley, are to be understood to be the banks of a subterranean stream.[179] The Board seems not to have taken such an expansive view of its jurisdiction, as the decisions appear in fact (if not in theory) to give considerable weight to a well's capacity to have a direct and essentially immediate impact on the surface stream, rather than simply following out the expansive implications of the "bed and banks" formulation.[180]

c. Chorro and Morro Creeks, San Luis Obispo County

Though impact of pumping on a stream seems to be present (and important) in most cases where

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[178](...continued)
canyon (1,600-3,000 ft); and the breakup of the canyon walls by side canyons. In its decision, the Board asked, "[w]hen is a given area a stream, and when is it an underground basin? Does the word 'flowing' include water that is moving very slowly? When a given area containing slowly moving water has impermeable sides and bottom, must those impermeable sides and bottom be construed as the bed and banks of a stream...?" In this matter, the answer was "no," and the Board did not examine the asserted impact on the surface stream at all.

[179] See text at note 47, *supra.*

[180] D. 1595 (1983) (Springs Tributary to the Klamath River), at 9. The Board took jurisdiction upon finding that the flow "contributes to the [surface] River," even though "[t]he [subsurface] channel is not pronounced." It did not make an analysis either of the presence of bed and banks, or of relative permeability.

Even in the case involving what may be its most expansive interpretation of a subterranean stream, the San Luis Rey River below Monserate Narrows (see D. 432, at 10, discussed in text at note 195, *infra*), the functional relationship between pumping and the surface stream seems to be paramount. For example, the 1962 Board Order in that case noted: "The conclusion is inescapable that during periods of normal rainfall and runoff the stream and underground water function as a closely related unit with the effects of surface flow extending from bank to bank." In the matter of Permit 5227 et al., Order Extending Time to Complete Application of Water to Beneficial Use Under Permits 5228 and 5229, State Water Rights Board, June 26, 1962, at 13 (emphasis omitted).

That also seems to have been the understanding of the courts in the early days. Though not a Board jurisdictional case, *City of San Bernardino v. City of Riverside*, 186 Cal. 7, 14, 198 P. 784 (1921), has interesting language. The Court, citing *Pomeroy, inter alia*, says: "When a stream runs over porous material saturated with water, and the underground waters support the stream, either by upward or lateral pressure, or feed it directly, persons having rights in the stream will be protected against a depletion thereof by adverse diversions of such underground waters, if they are injured thereby. There may be a point of distance from the stream at which a diversion of such underground water will have so little effect on the stream that it will not be actionable."

the Board takes jurisdiction, there are exceptions where the Board has taken jurisdiction despite the absence of hydrological connection. For example, in a 1982 case, involving Chorro and Morro Creeks in San Luis Obispo County, the staff finding was that the Board should take jurisdiction because "the extent and direction of underflow can be readily defined within the...watershed" and "the bed and banks can be ascertained ...," even though it seemed doubtful that the wells were impacting the surface stream because the area from which they were pumping was overlain by a thick layer of low permeability silts and clays.[181] As the report put it, "[l]ocal water level data indicate that these silts and clays hydraulically separate the basal aquifer from the surficial channel deposits of" the surface stream.[182] The report concluded that "[t]here is no definitive information pertaining to whether subsurface water in that area may be found in direct hydraulic continuity with surface flows of the river."[183] Subsequently the Board took jurisdiction on the ground that there was a subterranean stream flowing through known and definite channels.[184]

Though finding that the subsurface flow was within well-defined beds and banks of rocks, the Board did not indicate the distance between the banks. One expert witness described the width of the recent alluviums as ranging from 1,000 to 3,000 feet.[185] A map included as Figure 1 in the subsequent substantive decision in the case indicates (with what precision is unknown) that the watershed boundaries were about .5 miles on one side of certain of the wells in question, and perhaps as much as 2.5 miles on the other side.

d. Tia Juana River, San Diego County

An unsigned memorandum by an attorney for the Board's predecessor, the Division of Water Rights, Department of Public Works, prepared on January 16, 1924 in regard to what was

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[181] Internal Memo from Gil Torres to Mr. Walt Pettit, Division of Water Rights, regarding "Applications 24239 [et al.], Chorro and Morro Creeks, City of Morro Bay, San Luis Obispo County" (Jan. 7, 1977), at 1, 2. In the substantive decision in the case, however, it was determined that at least some of the wells were causing a direct reduction of streamflow of about 0.1 cfs in Chorro Creek from pumping a well at 0.53 cfs. D. 1633 (1995), at 11. The Board made clear that though the term "underflow" was used in the case it was not meant to have a restrictive meaning, but was used to refer to the broader category of subterranean stream flowing through known and definite channels, *Id*., at 2, n.1.

[182] Internal Memo, *supra* note 181, at 1.

[183] *Ibid*.

[184] D. 1589 (1982).

[185] Transcript of testimony of John F. Mann, Jr., Before the State Water Resources Control Board, Division of Water Rights, In the Matter of Applications 24239 [et al.], Chorro and Morro Creeks, Jan. 12-13, 1977, at 76.

described as the first application received for a permit to appropriate underground water, urged the Board to take a limited view of its jurisdiction, focusing on the actual facts of *Pomeroy* for guidance, rather than the more inclusive language in some of the headnotes. He said that it was inappropriate to use the general words in headnotes 15 and 16 of *Pomeroy* to justify taking jurisdiction over "a catchment basin, a detritus filled valley, or an underground reservoir or lake constituted of water filling a porous formation of gravels....[S]uch basins or reservoirs are not subterranean streams merely because they have a bottom and sides and contain a water bearing formation through which the water moves, percolates or flows in a definite general direction, that is toward the lower end of the basin....Nor does the court indicate in [*Pomeroy*] that it considered the entire area covered by the narrows, which was in places from 2 ½ to 3 miles wide, a subterranean stream....[I]t is deemed conclusive that the Division of Water Rights can not under the guise of an expanded definition of 'a subterranean stream...' bring within its jurisdiction the waters of typical underground basins, reservoirs or lakes."[186] Despite the attorney's strong memo urging the Division to decline jurisdiction, a permit was granted for what was described in one brief as "an underground lake, a natural reservoir...where a great natural dam or plug of adobe fills the mouth of the river...."[187] The case may be of little precedential importance, since neither side urged the Division to decline jurisdiction; only the Division's attorney appears to have been concerned about setting a bad precedent.[188]

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[186] Memorandum re Jurisdiction Over Applications To Appropriate Underground Water, at 4, unsigned and undated signature line for "Attorney for Division," stapled to Personal Memorandum (Do not file) re Application Number 1851, Reference to Memo. date of Jan. 16, 1924, re jurisdiction over applications to appropriate underground water, dated January 17, 1924, also with unsigned signature line for Attorney for Division. The dated memo refers in the text to the Tia Juana River Valley application of the Coronado Water Company. The January 17th memo is initialed SEB, undoubtedly referring to Spencer Burroughs who was attorney for the Division at that time.

[187] The quote is from the "Brief of Protestor Herbert Peery" in re Application No. 1851, stamped received by the Dept. of Public Works, March 5, 1923, at 1. The permit is No. 1724, granting application 1851 by the Coronado Water Company to appropriate groundwater in the Tia Juana River Valley. The permit was abandoned by the successor permit holder, California Water and Telephone Co., in February 1962.

[188] A private water company wanted to install wells in the valley where existing farmers' alfalfa was being root-irrigated by the existing high water table, which they feared would be drawn down. Their claim was that overlying uses should be protected against export appropriations. (Of course they should. The real question was whether they were entitled to have the "natural" level of the water table maintained. This controversy arose in 1923, prior to the constitutional amendment that is now Article X, § 2). In any event, both sides apparently wanted the State to take jurisdiction and to give its stamp of approval to their position, rather than litigating the question privately. The attorney who wrote the memo urged (in addition to his legal

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e. Carmel River, Monterey County

In this case, testimony offered that the subsurface flow of the Carmel River was a subterranean stream was not contested, and "accordingly" – without drawing any conclusions of its own – the Board found it to be a subterranean stream and subject to Board jurisdiction.[189] The case, therefore, is of no precedential importance. It is nonetheless interesting because it illustrates the tension created when a setting that does not have the geographic elements of a conventional subterranean stream case[190] is combined with strong concerns about the impact of pumping on a stream. The alluvial valley in question was about 15 miles long and .5 to 1 mile wide, the valley floor consisting all of younger alluvium ranging in thickness from about 1 foot to 200 feet near the river mouth. The river channel itself ranged from 20-150 feet in width. Pumping impacts on the stream were a central concern.[191] The case is also illustrative of the disagreement commonly found in cases over the presence of confined or partially-confined aquifer conditions. The highly various and complex conditions within different aquifers can generate diverse conclusions from technical experts as to whether, and to what extent, pumping from beneath more-confining layers within an aquifer is impacting a surface stream.[192]

The following is from a memo to the Board from the Chief of the Division of Water Rights in the Carmel River case:[193]

> It can be concluded that a classification of the basin as underflow or as groundwater would be a very close call. Litigation might be necessary to finally settle the question, and the burden of proof would fall on the Board, were we to find the

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[188](...continued)
argument) the State not to become implicated in this essentially private fight.

[189] Order No. WR 95-10, at 12-13, 1995 WL 464902 at 5 (1995).

[190] I.e., a physical-proximity/underflow type case.

[191] See G.M. Kondolf, et al., Effects of Bank Storage and Well Pumping on Base Flow, Carmel River, Monterey County, 91 J. Hydrology 351 (1987).

[192] See, e.g., Carmel River Watershed Management Plan, Working Paper Number Six, Legal Status of Carmel Valley Groundwater, prepared for the California Department of Fish and Game by the Monterey Peninsula Water Management District, John Williams, Resource Analyst, September 1983, at 31-34.

[193] Quoted in Carmel River Watershed Management Plan, *supra*, at 33. Note the use of "underflow" here as a synonym for the statutory subterranean stream definition; and the Board's recent insistence that underflow is only one subcategory of subterranean stream. It is hardly surprising that outsiders have been confused.

water to be underflow and attempt to require the company to file water right applications. The presumption would be that the water is in a groundwater basin and not part of a flowing stream.

f. Sacramento River Groundwater Transfer, Yolo County

This was the only decision found that can be read to conclude openly that the fact of "direct surface stream impact" from pumping is irrelevant to the Board's jurisdiction over groundwater, though the jurisdictional question is only adverted to in an aside. The matter arose in the context of the 1977-78 drought, and involved a proposed pumping operation that would have created a cone of depression whose effect would likely have drawn a good deal of water out of the surface flow of the Sacramento River. The decision suggests that such impact does not trigger jurisdiction under Water Code § 1200. "In reviewing this program," it said, "we have been mindful of our limited jurisdiction over percolating groundwaters and recognize that no application for a permit to appropriate percolating groundwater is required by law....It should be noted that the Governor's Commission to Review California Water Rights Law is studying the issue of groundwater rights. To the extent that such review may lead to approaches to coordinate surface and groundwater rights, problems such as those raised by the instant proposal could be resolved in a more orderly manner."[194]

g. San Luis Rey River, San Diego County (Mission and Bonsall Basins)

While most "direct impact" cases seem to fit into conventional subterranean stream settings – such as wells in the alluvium of a narrow coastal river canyon, or wells so proximate to the river that they easily qualify as underflow – occasionally more perplexing cases arise. In such instances, while pumping clearly threatens a "direct impact" on surface stream interests, the river valley is fairly broad and the wells aren't pumping what is commonly understood to be underflow. Perhaps the most notable example of such a case is a 1938 decision of the State Engineer,[195] reconsidered and reaffirmed in 1962,[196] dealing with the status of groundwater in the downstream reaches of the San

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[194] D. 1474 (1977), at 13, 1977 WL 22457 at 6. See also D. 1474, at 7,10; 1977 Westlaw 22457 at 3,5.

[195] D. 432 (1938).

[196] In the Matter of Permit 5227 et al. (Order Extending Time to Complete Application of Water to Beneficial Use Under Permits 5228 and 5229 (State Water Rights Board, June 26, 1962)). As a result of substantial pumping and a series of dry years (15 or more years), the factual situation had changed (at least for the time). It was apparently alleged that the ground water table was much lower, and groundwater direction had shifted, so it was urged the Board should relinquish jurisdiction. See Memorandum [to the Files?], regarding Permits 5227, 5228 and 5229 (continued...)

Luis Rey River,[197] the same river that was at issue in the 1999 *Pauma and Pala* draft decision. Basically the question was whether proposed municipal pumping projects for growing north San Diego County communities sought by Fallbrook, Oceanside, and Carlsbad would interfere with existing downstream irrigators, and risk infiltration of seawater into the aquifer. The Board found there would likely be such interference. It took jurisdiction of the proposed wells on the ground that they pumped from a subterranean stream, and the Board limited operation of the wells in order to protect existing surface water rights.

The area in question was defined by a river that widened and then constricted as it went through several narrows on its way to the ocean. Above the narrows the water spread underground in basins averaging about one mile wide,[198] with water rising to the surface as it reached the narrows, then sinking underground again at the downstream end of the narrows, and into another basin.

This was plainly not a narrow alluvial valley with a well in the immediate physical environs of a river; but rather a substantial well field across a rather broad alluvial plain. Fallbrook, for example, proposed to drill ten wells in the valley bottomlands. The 1938 decision strongly suggested the Board's appreciation that this was not the usual subterranean stream case. For example, it said, "while the underground water is concluded to be a definite stream, yet the bottoms along the river constitute reservoirs of some magnitude just as are found in a surface stream in its wide, deep and

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[196](...continued)
(Applications 8156, 8205 and 8418), from Charles M. Harris, Associate Engineer, Water Resources, concurred in by Lee W. Carter, Senior Engineer, Water Resources (Jan. 3, 1962), at 14-15.

[197] Permits 5228 and 5229 dealt with the Mission Basin, and Permit 5227 dealt with the Bonsall Basin. The Board considered them together in 1961 because "the physical characteristics of Bonsall and Mission Basins appeared to be similar." Order Extending Time [etc.], *supra* note 196, at 2. Interestingly, the Board says that in 1938 the State Engineer concluded that the Bonsall, Mission, *and* Pala sectors and their connecting narrows constituted an underground channel with known and definite banks and bottom. *Id.*, at 9.

[198] In the 1938 decision, D. 432, the Board said the areas in question were bottoms in three sectors, one of which averaged a maximum width of 3,800 feet in an area six and one-quarter miles long; another with a maximum width of 6,500 feet and five miles long; and a third was about 600-700 feet wide and five miles long. The average depth of the alluvium ranged from under 100 to about 200 feet. All through this area the alluvium was "most of the time full of water to or near the surface." D. 432 at 11. See Order Extending Time, *supra* note 196, at 13.

slow moving reaches."[199] Then it added, while the "[m]ovement downstream is very slow"[200] underground water was appearing on the surface at several narrows, evidencing the presence of an "underground channel...too narrow to carry the flow which is moving through the wider and deeper channels above and below."[201] While this description depicted a setting quite different from the sort of "underflow" that had been involved in the *Pomeroy* case, the Board found there was "an underground stream in a definite channel." The channel's width varied considerably from a few hundred feet to a maximum of more than a mile. Nonetheless, the Board found it had the necessary bed and banks consisting of "bedrock hills of granite or other material descending sharply to the trough and definitely marking the banks...[and] [t]he same bedrock would be found to continue across the bottom."[202]

That the decision was unconventional is evidenced by the fact that the same areas of the San Luis Rey River that were discussed in the 1938 decision (the downstream Mission and Bonsall Basins) came before a Superior Court in 1959, and again before the Board in 1962.[203] The trial judge had concluded in a memorandum opinion "that ground water in the Mission Basin does not constitute a subterranean stream flowing in a known and definite channel."[204] The Board, however, reaffirmed the 1938 decision. It again noted that movement of the subterranean water was slow,[205] but it did not find that fact disqualifying. It said all the elements were necessary to find a subterranean stream within the meaning of § 1200 of the Water Code. During normal years when the water table was high, and ignoring changes in water movement brought about by pumping's cones of depression, it said, there was frequent contact between the subsurface water and the surface flow, and the direction of movement was the same in both instances, moving downgradient with the stream. As to the existence of a channel, it noted that the width of the banks in *Pomeroy* was 1½ to 2 miles, and in another Supreme Court case,[206] 700 to 1800 feet in width, while here it was on average

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[199] D. 432, at 14, 15.

[200] *Id.*, at 13.

[201] *Ibid.*

[202] *Id.*, at 12.

[203] Order Extending Time, *supra*, note 196. The case is cited in the order as *San Luis Rey Water Conservation District v. Carlsbad Mutual Water Company*, San Diego Superior Court No. 184855, memorandum opinion dated November 18, 1959.

[204] Order Extending Time, *supra* note 196, at 2.

[205] About one-third of a mile per year *(Id*., at 7).

[206] *Verdugo Canon Water Co. v. Verdugo*, 152 Cal. 655, 659 (1908).

"only about one mile wide."[207] It then announced (in the single sentence it underscored in its opinion) what was apparently a strong influencing factor for it: "The conclusion is inescapable that during periods of normal rainfall and runoff the stream and underground water function as a closely related unit with the effects of surface flow extending from bank to bank."[208]

That underscored sentence suggests that though it did not track the usual physical shape of subterranean stream cases, in fact the 1938 Bonsall Basin case was functionally an underflow case, that is, one where pumping the wells anywhere within the basin ("from bank to bank") was directly impacting the surface stream,[209] and that therefore the subterranean waters were effectively a subterranean element of the surface stream. In that respect the Bonsall Basin case was within the mainstream of Board decisions both before and after it.

The 1962 decision also posed an extremely important question that has not often been considered, but becomes crucial if stream impact is acknowledged as the determinant of jurisdiction. That question is whether a well should be viewed as pumping from a subterranean stream if the qualifying criteria are not presently being met, but were being met under earlier conditions before there was extensive pumping. An example would be where pumping has lowered the water table, changed the direction of flow, and several hydrological connectivity which previously existed and would be restored if pumping were substantially constrained. This is not a matter that has been settled, either in Board or judicial decisions, but there is a staff expression of opinion dealing with the variant situation where an extended drought, along with pumping, has dramatically changed natural conditions in the basin. A staff report prepared for the 1962 consideration of Board jurisdiction over groundwater in the Mission Basin reads as follows:[210]

> Therefore, in re-examining the analysis leading to Decision #432 in the light of present conditions, it is concluded that the basic natural factors have not been altered, but that a prolonged period of very low precipitation combined with steady pumping has caused a temporary overdraft condition which could and probably will be corrected upon resumption of normal rainfall and runoff....Such a situation would cause a recurrence of the factors necessary to a complete legal definition of an underground channel. As a result of these considerations, it is believed that the Board would be remiss in its responsibilities were it to relinquish jurisdiction.

There are a number of places in California where widespread pumping over the years has lowered

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[207] Order Extending Time, *supra* note 196, at 13. Mission Basin is about 9 miles long.

[208] *Id*., at 13 (emphasis in original).

[209] "...it is clear that the ground water table would be affected directly by surface flows in the river and vice versa when the ground water table is near the surface..." *Id.*, at 13.

[210] Memorandum [to the Files?], *supra* note 196, at 15.

the water table and reversed the gradient that existed before pumping began.[211] Continuation of that pumping may have no current adverse impact on surface stream flows. But if that pumping were to cease or cut back, eventually the water table would rise and contribute significantly to surface stream flows, which have been historically diminished by pumping. Thus the question of "hydraulic connection" has temporal and cumulative elements to it. From a legal perspective, the question is whether and to what extent longstanding uses should be accepted, under "grandfathering," in order to minimize disruption of established human communities and economies.[212] These perplexities, among others, lead to the suggestions, made earlier in response to Question 6 that jurisdictional decisions should not be used to reverse long-standing situations of hydrological disconnection; and also to the proposal made below in Part VI,[213] suggesting comprehensive basin management, rather than legislatively expanded permitting jurisdiction, is the preferred long-term solution to overpumping.

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[211] E.g., *United States v. Fallbrook Public Utility Dist*., 193 F.Supp. 342, 353 (S.D. Cal. 1961), rev'd in part on other grounds, 347 F.2d 48 (9 Cir. 1965). The impacts of such sustained pumping are noted and described in G. Mathias Kondolf, Surface-Ground Water Interactions: Some Implications for Sustain ability of Ground Water Resources, Proceedings of the 19th Biennial Ground Water Conference, JJ DeVries, J. Woled, eds., Water Resources Center Report No. 84, Univ. of Cal., Davis (1994), at 135.

[212] If the Board adopted an expanded view of its jurisdiction, affecting some existing pumpers who had never applied for permits, there would – it seems – be some ability to prefer existing users to new applicants, notwithstanding application date, and perhaps to grant priorities to existing pumpers who are new applicants that reflect their actual relative date of beginning pumping. "Water Code Section 1450 states that any application properly made gives to the applicant a priority of right as of the date of the application until such application is approved or rejected. The SWRCB has the authority, however, to modify the relative priority of applications. (Water Code Section 1257)." D. 1632 (1995) (New Los Padres Project of Monterey Peninsula Water Management District, Carmel River, Monterey County), at 43, 1995 WL 464946. Such authority, however, would not help those making unpermitted diversions from subterranean streams as against those with already permitted or licensed rights. See also note 303, *infra.*

[213] See item 6 in response to Question 6, following note 30, *supra;* and point (3), text at note 306, *infra.*

PART IV:

GROUNDWATER LAW IN OTHER STATES[214]

1. Arizona

Arizona's experience deserves extended consideration both because it is the only other state with a statute like California's,[215] and because its courts and Department of Water Resources have dealt extensively and recently with the definition of subterranean streams (which their statute calls "underground channels," and which their courts call "subflow"). In contrast to the experience in California, Arizona's Supreme Court interpreted its statutory provision in major decisions on several occasions, starting in 1931,[216] and then again in 1993[217] and 2000.[218] The Court's decisions

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[214] For related literature on groundwater law in other states, see Robert Jerome Glennon & Thomas Maddock, III, The Concept of Capture: The Hydrology and Law of Stream/Aquifer Interactions, in Forty-Third Annual Rocky Mountain Mineral Law Institute (1997), at 22-1 – 22-89; Herman Bouwer & Thomas Maddock III, Effects of Groundwater Pumping on Streamflow: Legal and Hydrologic Aspects, Proceedings of the 21st Biennial Ground Water Conference, University of California Water Resources Center Report No. 95 (1998) 9; Robert J. Glennon & Thomas Maddock, III, In Search of Subflow: Arizona's Futile Effort to Separate Groundwater from Surface Water, 36 Ariz. L. Rev. 567 (1994); John D. Leshy & James Belanger, Arizona Law Where Ground and Surface Meet, 20 Ariz. St. L.J. 657 (1988); Douglas Grant, The Complexities of Managing Hydrologically Connected Surface Water and Groundwater Under the Appropriation Doctrine, 22 Land and Water L. Rev. 63, 64 (1987); Frank J. Trelease, Conjunctive Use of Groundwater and Surface Water, 27 Rocky Mtn. Min. L. Inst. 1853, 1857-58 (1982); Barbara Tellman, My Well v. Your Surface Water Rights: How Western States Manage Interconnected Groundwater and Surface Water, U. AZ Water Resources Res. Center, Issue Paper No. 15 (June 1994); David H. Getches, Water Law in a Nutshell, at 272 et seq. (3d ed. 1997).

[215] A.R.S. § 45-141(A): "The waters of all sources, flowing in streams, canyons, ravines or other natural channels, or in definite underground channels...are subject to appropriation..."

[216] *Maricopa County Municipal Water Conservation Dist. No. 1 v. Southwest Cotton Co.*, 39 Ariz. 65, 4 P.2d 369 (1931) (hereafter *Southwest Cotton*).

[217] *In re the General Adjudication of...The Gila River System*, 175 Ariz. 382, 857 P.2d 1236 (1993) (hereafter *Gila River II*).

[218] *In re the General Adjudication of...The Gila River System* (hereafter Gila River IV), (continued...)

have also been the subject of extensive law review discussion,[219] and of an unusually detailed and candid analysis by the Arizona Department of Water Resources (ADWR).[220]

The Arizona experience is especially interesting because its recent judicial decisions arose out of an effort to develop workable, objective criteria to be used in deciding what groundwater wells should be treated as pumping from "definite underground channels," the statutory provision that parallels California's subterranean stream definition in Water Code § 1200.

By way of introduction, it should be noted that since the 1931 decision in the state's leading case, *Southwest Cotton*, Arizona seems to have essentially abandoned any search for subterranean streams as such, and limited the application of its statute to those underground waters that constitute what it calls "subflow."[221] It is not entirely clear why it has done this. *Southwest Cotton* itself was a subflow case, and that may be the only sort of subterranean stream issue that has come before the Arizona courts. In any event Arizona has concluded that a broad alluvial valley cannot meet the definition of an underground channel,[222] a proposition that it notes is supported by *Pomeroy's* view of the San Fernando Valley.[223]

The history of judicial interpretation of Arizona's statute is instructive. Arizona's bifurcated system applies appropriation law to surface water and a different rule to groundwater. What underground water, then, if any, should be managed under the appropriation system? The leading case that addresses that question, *Southwest Cotton*, can be read as both sophisticated and naïve. In one

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[218](...continued)
198 Ariz. 330, 9 P.3d 1069 (2000), cert. denied sub. nom. *Phelps Dodge Corp. v. United States*, ___ U.S. ___, 121 S.Ct. 2576, 150 L.Ed.2d 739 (2001) (asserting that judicial interpretations of subflow in the 1993 and 2000 decisions of the Arizona Supreme Court constituted a sudden and unpredictable departure from prior precedent and thus constituted an unconstitutional taking without compensation).

[219] Glennon & Maddock, (1994), *supra* note 214. Glennon & Maddock (1997), *supra* note 214. Bouwer & Maddock (1998), *supra* note 214.

[220] Preliminary Report on Proposed Criteria to Identify Stream Subflow, Arizona Department of Water Resources (November 5, 1993) (typescript); Technical Assessment of the Arizona Supreme Court Interlocutory Appeal Issue No. 2 Opinion, In re The General Adjudication of the Gila River System and Source, Arizona Department of Water Resources (December 15, 1993) (typescript).

[221] *Southwest Cotton*, 39 Ariz., at 96.

[222] *Id.*, at 89-90.

[223] *Id.*, at 97-98.

respect, it seems to take a very contemporary and hydrologically informed position. The Court's answer is that those waters which are "as a matter of fact...part of the surface stream"[224] should be managed under appropriation. The way to determine the identity of such waters, the Court said, is by asking, does "drawing off the subsurface water tend to diminish appreciably and directly the flow of the surface stream? If it does, it is subflow, and subject to the same rules of appropriation as the surface stream itself."[225]

In other words, the Court interpreted its subterranean stream category as designed to protect the integrity of its surface stream appropriation system. Thus, it concluded, all uses that appreciably and directly affect surface streams should be managed integrally with the surface stream system. Thus understood, the court's interpretation seems both rational (it approaches the issue functionally rather than definitionally), and workable (though the system is a continuum throughout the watershed, one need only manage for significant interference, rather than for any and every impact, however remote in quantum and time).

To this point, *Southwest Cotton* seems to have taken a thoughtful, functional approach to the problem – embracing within the surface water system only pumping that "appreciably and directly" affects the flow of surface waters, and defining such pumping as "subflow." But then the Court took a turn in another direction. Drawing on the formalistic treatise writer Kinney, the Court added that subflow may be defined as "the bed of the stream, or the lands under or immediately adjacent to the stream."[226] By adding a locational element to its conception of subflow, the Court shifted from a functional definition to a geographical one. While one need not necessarily read the opinion that way (for example, the Court said "in <u>almost all cases</u> the so-called subflow is found within, or immediately adjacent to, the bed of the surface stream itself," suggesting that proximity is simply a guide to answering a functional question, rather than a requirement in and of itself[227]), that *is* the way the subsequent Arizona Supreme Court has read it, assuring that what might have been a hydrologically and administratively workable standard, would become a more formalistic, geographically driven test.[228]

Because of its geographic-test interpretation of *Southwest Cotton*, in 1993 the Arizona Supreme Court rejected a carefully developed trial-court-fashioned test that was designed to be functional (asking whether the pumping was appreciably and directly diminishing the surface stream), on the ground that it used an impact test, rather than the geographical one that *Southwest Cotton*, in its

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[224] *Id*, at 96.

[225] *Id*., at 97 (emphasis omitted).

[226] *Id.*, at 96.

[227] *Id*., at 97 (emphasis added).

[228] *Gila River II*, 175 Ariz., at 390-91.

view, required.

The trial court had determined that wells withdrawing water from the younger alluvium within the stream basin should be presumed to be pumping appropriable subflow if:[229]

> As to wells located in or close to that younger alluvium, the volume of stream depletion would reach 50% or more of the total volume pumped during one growing season for agricultural wells or during a typical cycle of pumpage for industrial, municipal, mining, or other uses, assuming in all instances and for all types of use that the period of withdrawal is equivalent to 90 days of continuous pumping for purposes of technical calculation.

The Supreme Court rejected that test, holding that location, not impact, was decisive. It said, "*Southwest Cotton*...did not purport to identify subflow in terms of an acceptable amount of stream depletion in a given period of time. It sought to identify subflow in terms of whether the water at issue was part of the stream or was percolating water on its way to or from the stream."[230] The Court thus ruled that the trial judge must be guided by the language in *Southwest Cotton* stating "that subflow is found within or immediately adjacent to the stream bed."[231]

In a report issued following the Supreme Court's 1993 decision, designed to guide the trial court on remand in fashioning a legally acceptable definition of subflow, the ADWR identified a number of respects in which the Supreme Court had perpetuated "the arbitrary nature of the bifurcated system" in Arizona, and imposed legal concepts "at odds with hydrological reality."[232] What is arbitrary about the decision, the ADWR said, is the notion that there is such a thing as water "more closely associated with the stream than with the surrounding alluvium,"[233] which is how the Court defined subflow. As the Report gently put it, "[h]ydrologists generally agree that in perennial and intermittent stream environments water is interrelated and interconnected."[234]

In other words, if one wants to make distinctions about water within a single interrelated system such as a stream and the watershed of which it is a part, the recommended way to do so is to draw lines based on hydrological distinctions, such as impact of pumping on streamflow measured over

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[229] *Id.*, at 385 (quoting trial court).

[230] *Id.*, at 391-92.

[231] *Id.*, at 391.

[232] Preliminary Report, *supra* note 220, at 1.

[233] *Id.*, at 4 (quoting *Gila River II*, 175 Ariz., at 391, 144 Ariz. Adv. Rep., at 23).

[234] *Id.*, at 1.

specified time periods. As the Report indicates, while any such approach incorporates a policy decision, cutting off consideration of impacts at some selected point – the hydrologic system being essentially a continuum – using impact over time at least draws the line in terms of managerial realities that reflect hydrological significance, rather than a merely arbitrary geographic line. Some such policy decision must be made in every water management system.[235]

In an unmistakable, though diplomatic, rebuke to the Court, the Report says,

> the Court establishes the legal concept that the imaginary line between percolating groundwater and appropriable subflow is a geographic line, rather than a geologic line, by rejecting the younger alluvium test. In the Court's own words, subflow is water that is 'more closely associated with the stream than with the surrounding alluvium.' DWR can only interpret this to mean that subflow is the physical presence of water in a certain geographic location at a particular moment in time....Developing a set of criteria based on these guidelines negates the need to use the aquifer parameters of transmissivity and storage coefficient because these are only useful in determinations that calculate a specific volume of water depleted from the stream after a certain period of time, a specific rate of depletion after a certain period of time, or the location of the boundary between older and younger alluvium.[236]

Following the ADWR Report, the case returned to the trial court for a revised decision consistent with the Supreme Court's opinion. Obliged to draw a geographic rather than a geologic line (to find which wells are "more closely associated with the stream than with the surrounding alluvium"), the trial judge fashioned, and the Supreme Court has now validated, a geographic definition of subflow that probably includes most of the wells that have the greatest impact on the stream. While abjuring any direct measure of impact (such as the rejected 50%/90 day test), it

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[235] See Technical Assessment, *supra* note 220, at 36: "In other states that have a unified water law system, in which both groundwater and surface water are appropriable, there is still a need to establish streamflow interference thresholds for the conjunctive management of groundwater and surface water rights. States such as Colorado and New Mexico recognize that wells located some distance from the stream have an effect. Those states use a time based maximum interference test to identify which wells need to be actively administered in the prior appropriation system. Oregon uses a distance based approach, declaring wells within specified proximity to the stream to be within the law of appropriation. Whether Arizona has a bifurcated or unified system of water law, there is still the need to establish a test for identifying wells which significantly effect [sic] streamflow. That test must of necessity incorporate some type of arbitrary factor within its criteria."

[236] Preliminary Report, *supra* note 220, at 4 (citations omitted).

defines subflow as the "saturated floodplain Holocene [younger] alluvium."[237] To this the Court added several other criteria to provide "more certainty and reliability."[238] It noted that the geologic unit must be saturated because of the need for a hydraulic connection between the stream and the subflow. The water which makes up the saturation must flow substantially in the same direction as the stream, and the effect of any side discharge from tributary aquifers and basin fill is overcome or is negligible. In addition:[239]

1. the water level elevation of the subflow zone must be relatively the same as the stream flow's elevation.
2. the gradient of these elevations for any reach must be comparable with that of the levels of the stream flow.
3. there must be no significant difference in chemical composition that cannot be explained by some local pollution source which has a limited effect.
4. where there are connecting tributary aquifers or floodplain alluvium of ephemeral streams, the boundary of the subflow zone must be at least 200 feet inside of that connecting zone so that the hydrostatic pressure effect of the side recharge of this tributary aquifer is negligible and the dominant direction of flow is the stream direction.
5. where there is a basin-fill connection between saturated zones of the floodplain Holocene alluvium and a saturated zone of basin fill, the boundary of the subflow zone must be 100 feet inside of the connecting zone so that the hydrostatic pressure effect of the basin-fill's side discharge is overcome and the predominant direction of flow of all of the subflow zone is the same as the stream's directional flow.

The irony of the Arizona situation is that its Supreme Court in 1921, often condemned for backwardness, basically understood the importance of managing water functionally, while the same Court 72 years later – in a misplaced effort to defer to earlier precedent – turned the clock back to the formalism of an earlier time. The functional approach described by the ADWR reports was

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[237] Holocene is a period of time covering the most recent 10,000 years. It should be noted that the Technical Advisory Committee appointed by the Board to assist the author of this Report concludes that "anything in the Arizona [Report] that discusses this younger alluvium...[is] probably not applicable to the general case in California." The reason is that "In California, many river systems are constructional – that is the river deposits have built-up on top of previous sediments. Good examples of this are the areas in California where levees are required to control higher flows in the streams, because the streams are very close to surrounding surface elevations." Memorandum, Dr. Steven Bachman, to Joseph Sax, August 15, 2001, at 1 (on file with Joseph Sax).

[238] Gila River IV, 198 Ariz., at 337-38 (quoting trial court).

[239] *Ibid*.

long ago understood by the California Supreme Court, as evidenced by decisions like *Katz v. Walkinshaw*[240] and *Los Angeles v. Hunter*.[241] And, as an earlier section of this Report indicates, there is good reason to conclude that the California legislature knew it as well, and intended to legislate it in 1913.

2. Other Western States

How do other western states deal with the groundwater/surface water intersection, and what have any of them done that might be of interest to California, either in modifying its administration of the law as it currently stands, or in considering changes in the legal test it now employs?[242] While categorization of groundwater as either percolating water, or as subterranean stream water, was once common in many western states, it has been rejected as a scientific anachronism almost everywhere for many years. To take just a few examples, Utah got rid of it in 1935,[243] Kansas did so in 1945,[244] and North Dakota in 1955.[245] It remains as a legally significant category only in Arizona and California.

In general, western states may be categorized as falling in one of four categories:[246]

1. At one extreme is Oklahoma, which rigidly separates surface water and groundwater, and treats as groundwater any water under the surface of the earth outside the cut bank of a definite stream. Though prior appropriation governs both surface water and groundwater, the two sources are managed separately without integration. Texas – which still follows an absolute ownership rule for

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[240] 141 Cal. 116, 74 P. 766 (1903).

[241] 156 Cal. 603, 105 P. 755 (1909).

[242] Several excellent, modern articles are available dealing with the very questions posed in this study – essentially the problems and opportunities for integrating groundwater and surface water management – and the following draws significantly upon them, with thanks. Among those upon which I especially relied are: Glennon & Maddock (1994), *supra* note 214; Glennon & Maddock (1997), *supra* note 214; Grant, *supra* note 214.

[243] See Robert W. Swenson, A Primer of Utah Water Law: Part II, 6 Energy L.& Pol'y. 1, 25 (1985).

[244] Kans. Laws 1945, ch. 390, § 25.

[245] See *Baeth v. Hoisveen*, 157 N.W.2d 728, 730 (N.D. 1968).

[246] Where not otherwise cited, references to state statutes and cases cited can be found in Glennon & Maddock (1997), *supra* note 214.

groundwater – also provides no integrated management of groundwater and surface water (though it has been under strong pressure, because of an Endangered Species Act problem in the Edwards Aquifer, to do so).[247]

2. At the other extreme are those states that have a fully integrated system, under which all water is within the appropriation system, and seniority and juniority is recognized without regard to whether one is using groundwater or surface water.[248] Nebraska has moved somewhat toward integration, giving local districts authority (but not an obligation) to designate groundwater management areas and to develop plans for integrated use of groundwater and surface water.

3. Oregon and Colorado treat groundwater and surface water as separate systems (though appropriation applies to both), but have a specific method for integrating uses, founded on whether there is impact by a user of one source on a user from the other source. These methods are usually called "bright-line rules."

4. California and Arizona separate groundwater and surface water, drawing a line between them by a statutory category.[249] The statutory characterizations are almost certainly meant to be the same, though the phrasing of the laws differ somewhat.

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[247] For a review of the Texas situation generally, see *Sipriano v. Great Spring Waters of Am., Inc*., 1 S.W.3d 75 (Tex. 1999).

[248] E.g., Washington, Kansas, New Mexico, Nevada, North Dakota, Utah, Wyoming, Idaho.

[249] This seems to be the case in Texas as well, though the statutory situation in Texas is rather confused. Tex. Water Code Ann. §§ 52.001(4) (repealed in 1995), defined underground water as "water percolating below the surface of the earth...but does not include defined subterranean streams or the underflow of rivers." That definition still appears in Tex. Water Code Ann. § 64.003(12), which deals with import authorities, but a new statute dealing with groundwater conservation says only "'Groundwater' means water percolating below the surface of the earth," without qualification, Tex. Water Code Ann. § 36.001(5). In any event, the Texas courts thus far have rigorously applied the Kinney Treatise of 1912 as authority: "[f]or...water to qualify as surface water, the subterranean water course must have all the characteristics of surface water courses, such as beds, banks forming a channel, and a current of water," citing as authority, Kinney, §1155, at 2099, *A.H. Denis, III v. Kickapoo Land Company*, 771 S.W.2d 235, 236 (Ct. App. Texas, 1989), writ of error denied Oct. 25, 1989. Moreover, a designation of the Edwards Aquifer as a subterranean watercourse was found void by a state district court, and declared not an underground river in legislation in 1993, though litigation in a suit attempting to adjudicate water rights in the Edwards Aquifer on the theory that it is an underground river is still pending at this time. These issues were discussed by Douglas G. Caroom in an April 8, 1999 presentation at a Local Government Seminar, available at http://www.bickerstaff.com/articles/groundwater.htm.

> While California's law defines the jurisdiction of its administrative permitting agency, the Arizona law is utilized to determine whether or not the water in question is subject to appropriation, or is governed by the groundwater reasonable use system.

It would lengthen this Report unduly to describe in detail all the variants, intricacies and implementation issues encountered in each of the states mentioned above. The states on the two extremes – those that do not integrate administration at all, and those that totally integrate – have little if anything to offer California under its current law.

3. Nebraska

Nebraska's approach will doubtless be of interest to water interests in California. Until quite recently, surface streams and aquifers had been dealt with under separate legal regimes, and there was no law governing groundwater withdrawals that affect surface water rights. However, in 1996 a law was enacted stating that where groundwater and surface water are physically interrelated, they should be managed as one source,[250] but the question who was to govern was controversial for reasons that would be entirely familiar to Californians. The new law gives to local natural resource districts (NRDs) authority to resolve surface/groundwater conflicts by designating groundwater management areas and developing management plans for conjunctive use in what are called integrated management areas.[251] The State DWR (which like the Board here has surface water jurisdiction) was given only very limited authority to act where the NRDs fail to act (where interstate compacts are involved). The incentive for the new law was a particular problem, pumping in Nebraska that affected its ability to meet its compact obligations under the Republican River Compact.

Inquiries in Nebraska reveal that at least one NRD has initiated an integrated management plan (North Platte NRD, for Pumpkin Creek) to control groundwater impacts on stream flows. A moratorium was instituted on new well drilling, while existing wells are measured for pumping rates over the next few years to determine use. No limits on existing uses have been imposed at this time. Groundwater users have sued to challenge the NRD Management Plan, while surface water users have filed suit against the State seeking damages for its alleged failure to regulate

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[250] See Stephen D. Mossman, Whiskey is for Drinkin' But Water is for Fightin' About: A First-Hand Account of Nebraska's Integrated Management of Ground and Surface Water Debate and the Passage of L.B. 108, 30 Creighton L. Rev. 67 (1996).

[251] The NRDs are given authority to limit the total amount of groundwater withdrawn, institute a system of rotating groundwater use, requiring well spacing, and requiring a reduction in the number of irrigated acres.

groundwater use. The details of the plan can be accessed on the North Platte NRD website.[252] Another plan is said to be in the offing for Lodgepole Creek in the South Platte NRD. Then there is the Platte River Cooperative Agreement, which involves three-state negotiations, a Supreme Court interstate water case, and the Endangered Species Act, which presents a sort of ultimate legal, economic, and political test of a state's capacity to integrate management of hydrologically connected ground and surface water.[253]

4. Oregon

Oregon and Colorado have also employed techniques that might be of interest here: efforts to implement so-called "bright line" tests for determining when pumping impacts on surface streams should no longer be taken into account because they are too remote. Oregon regulates groundwater appropriation in order to prevent "substantial interference with surface water supplies"[254] (which includes both appropriators and instream flow rights). This is somewhat the same as the impact test proposed by the trial court in Arizona, discussed above. The Oregon administrative standard is the following:

1. Is the aquifer hydraulically connected to the surface water source?[255] If yes, then a well producing water from that aquifer is presumed to be a cause of substantial interference, if any of the following conditions exists:

    a. The well is less than .25 mile from the surface water source; or

    b. The rate of appropriation is greater than 5 c.f.s. and the well is less than 1 mile from the surface water source; or

    c. The rate of appropriation is greater than 1% of the minimum perennial

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[252] http://www.npnrd.org

[253] See J. David Aiken, Balancing Endangered Species Protection and Irrigation Water Rights: The Platte River Cooperative Agreement, 3 Great Plains Nat. Res. J. 119 (1999).

[254] Or. Admin. R. § 690-09-040. Washington State does not require a substantial impact. It regulates pumping that "affects, even if minutely, the river's flow...," *Hubbard v. Washington Dept. of Ecology*, 86 Wash.App. 119, 124, 936 P.2d 27, 29 (Wash. Ct. App. 1997).

[255] Or. Admin. R. § 690-09-040(1). While Oregon does not define hydraulic connection, there is a definition in a recent Washington State Pollution Control Board decision: "[i]f the evidence demonstrates that any of the water extracted from the ground at the place, and depth, in question would otherwise have contributed to a particular surface water, then hydraulic continuity between that groundwater and that surface water is established." *In re Appeals from Water Rights Decisions of the Department of Ecology*, at 1996 WL 514630, at 12.

streamflow or instream water right with a senior priority date, or greater than 1% of the discharge that is equaled or exceeded 80% of the time, and the well is less than 1 mile from the surface water source; or

d. The well pumping would result, after a continuous 30 day period, in depleting the stream by more than 25% of the rate of appropriation, and the well is less than 1 mile from the surface water source.

The above criteria, if met, create a presumption of interference. The administrative agency is also permitted to demonstrate substantial interference by evidence, and apparently one way of making that showing is by demonstrating a potential for "a cumulative adverse impact" on surface flows.[256] If a similar approach were to be utilized in California, the Board, by utilizing a version of such bright-line rules, might establish a presumption of the presence of a subterranean stream, and thus of jurisdiction. It would alternatively have the opportunity to establish jurisdiction analytically, that is, by site-specific evidence of the impact presumed to exist under the various bright-line tests.

An alternative approach would be to adopt a simplified version of the Oregon standard. One might, for example, create a presumption that pumping from any well within a fixed distance and pumping above a specified minimum, is pumping a statutory "subterranean stream." The question, when such methods are used, is both (1) how much sophistication one is willing to forego, e.g., in terms of actual impact on the stream in making a jurisdictional decision; and (2) how justifiable any such presumption is, in terms of the facts it purports presumptively to demonstrate. Notably, three of the four Oregon presumptions include no accounting for the actual hydrological relationship between the well and the stream. Only standard (d.) requires that factor to be determined analytically.

The Oregon system is also hydrologically incomplete in its use of specified distances such as .25 mile or 1 mile, which necessarily fail to account for impacts that will be felt over longer periods of time,[257] though some standard to account for attenuation of impact is inevitable in any system, a point that the California Supreme Court has expressly acknowledged.[258]

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[256] Or. Admin. R. § 690-09-040(5).

[257] Both Colorado and Idaho have statutes that require accounting for future loss: Colo. Rev. Stat. § 37-92-502(2) ("is causing or will cause material injury"); Idaho Code § 42-237a(g) (would adversely affect "the present or future use of any prior surface or ground water right").

[258] *City of San Bernardino v. City of Riverside*, 186 Cal. 7, 14, 198 P. 784 (1921): There "may be a point of distance from the stream at which a diversion of...underground water will have so little effect on the stream that it will not be actionable."

5. Colorado

Like Oregon, Colorado has also adopted a "bright line" approach that sets a standard for inclusion and exclusion from the regulatory system. That standard is whether "the withdrawal... will... within one hundred years, deplete the flow of a natural [surface] stream...at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal."[259] While 100 years seems an extraordinarily long time, and .001 a very small quantum, used as managerial standards, the attractiveness of some sort of time-sensitive standard is that it bases jurisdiction on the hydraulic realities of the specific case, rather than building in simplifying assumptions.[260] It also acknowledges the significance of long-term impacts on the water supply in the system.[261] Its weakness is that it is unlikely to take account of other variables that might intervene to diminish the need for the water, such as a run of unusually wet years.[262]

It should be noted again that any standard based on impact (that is, on the degree of hydrologic relationship between the groundwater use and surface water resources) – whatever the legal regime may be – necessarily calls for a policy judgment about the point at which impacts should no longer be accounted for, either because they are too slight, too difficult to ascertain, or too expensive to manage. Notably this problem arises as much in a state with a fully integral system for groundwater and surface water administration as it does in a state with a system like California's.[263]

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[259] Colo. Rev. Stat. § 37-90-103(10.5).

[260] "In the Scott River adjudication [in California], the ...Board staff report applied a time factor in deciding to include...only pumping which affected the surface flow of the Scott River within a single irrigation season." Anne J. Schneider, Are Our Ground Water Laws Adequate?, in Proceedings of the 19th Biennial Ground Water Conference, JJ DeVries, J. Woled, eds., Water Resources Center Report No. 84, Univ. of Cal., Davis (1994), at 50.

[261] Fashioning an appropriate remedy to account for impacts that won't be felt for many years is a challenging task. In theory, it is simply a discounting problem, like providing enough money today to assure an individual she will have $1,000 in 25 or 40 years based on an assumed rate of interest. In practice, with water supply, the problem is a good deal trickier. New Mexico's approach is discussed in Glennon & Maddock, *supra*, note 214, at 22-41 – 22-42. Colorado's augmentation plan system is discussed in Lawrence J. MacDonnell, Colorado's Law of "Underground Water"; A Look at the South Platte Basin and Beyond," 59 U. Colo. L.Rev. 579, 589 (1988).

[262] Possible practical approaches to this problem are discussed in Grant, *supra* note 214, at 75-77.

[263] An interesting dispute over the question how little is too little arose recently in

(continued...)

PART V:

MANAGEMENT OF GROUNDWATER OUTSIDE WATER CODE § 1200

In considering the limitations on Board jurisdiction imposed by Water Code § 1200, it is useful to keep in mind two matters: (1) Even if the definition of a subterranean stream were very expansively interpreted, the Board's permitting jurisdiction would still not embrace uses of that water on overlying land; and (2) There are other potentially available sources of Board authority over the use of subsurface water, outside of Water Code § 1200's permitting jurisdiction.

1. Overlying Uses of Groundwater

Land overlying a subterranean stream is considered riparian to that stream,[264] and the Board's understanding is that "[a] riparian is entitled to pump and use water on a parcel which overlies a subterranean stream" just like a riparian on a surface stream, without seeking a permit from the Board.[265]

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[263](...continued)
Washington State, which has an integrated system. See *Hubbard v. Washington Dept. of Ecology*, 86 Wash.App. 119, 936 P.2d 27 (1997). The court found that the Department of Ecology had not abused its discretion in restricting pumping when river flows fell below a specified minimum even though there was evidence that the impact of pumping could have accounted for as little as a .004 percent reduction in streamflow during low flows. See Jeffrie Minier, Conjunctive Management of Stream-Aquifer Water Rights: The *Hubbard* Decision, 38 Nat. Res. J. 651 (1998); Douglas L. Grant, *supra* note 214.

[264] "An overlying right, [is] analogous to that of the riparian owner in a surface stream," *City of Barstow v. Mojave Water Agency*, 23 Cal.4th 1224, 1240, 5 P.3d 853, 863, 99 Cal.Rptr. 294, 304 (2000). See also *Prather v. Hoberg*, 24 Cal.2d 549, 50 P.2d 405 (1944); Wells A. Hutchins, The California Law of Water Rights (1956), at 421. All the usual limits on riparian diversion and use presumably apply to subterranean stream riparians as to those riparian to a surface stream – use is limited to natural flows, must be within the watershed, and no seasonal storage is permitted. As to the extent of overlying rights, it is "the owner's right to take water from the ground underneath for use on his land within the basin or watershed." *City of Barstow, supra.*

[265] See D. 1632 (1995), at 35, 1995 WL 464946. Riparian pumpers of percolating groundwater don't even have to file the statements of diversion and use to which surface riparians (continued...)

While there is no authoritative source of data as to how much groundwater is used on overlying riparian land, and how much being applied to non-overlying land, there is little doubt that a considerable percentage of groundwater is being used on riparian overlying land, and thus would be outside the Board's permitting jurisdiction, no matter how expansively the statutory category of "subterranean streams flowing through known and definite channels" was applied. Some rough sense of the scope of the issue may be gleaned from the following estimates provided by the Association of California Water Agencies (ACWA) in response to an inquiry by the author of this Report:[266]

> For example, in Ventura County, the total groundwater pumping is about 70% agricultural and 30% municipal and industrial (M&I). It can be assumed that essentially all the M&I usage is not overlying....Assuming that some of the agricultural pumping is not overlying, then the total non-overlying usage could rise to at least 50%....Of course, this will vary considerably by county. It's likely that a county in the northern Sacramento Valley could have the highest percentage of overlying use whereas urban counties such as Los Angeles or Orange could have the lowest percentage. Again, this is all very theoretical and conditions could dramatically vary for each and every country in California.

Whatever the actual numbers, it is significant that concerns about non-regulation of groundwater use are not attributable solely to restrictions imposed under interpretations of Water Code § 1200, and that expanded interpretation of that statutory provision would primarily affect M&I users of groundwater, rather than agricultural pumpers.

2. Other Sources of Authority Over Use of Groundwater

a. Constitution Article X, § 2, Water Code § 100, The Public Trust, and Water Code § 275

While Water Code § 1200 limits the Board's permitting jurisdiction over groundwater, it does not limit other sources of authority that may be available to the Board to regulate uses of groundwater. A lively current question is whether, and to what extent, the Board may restrict pumping of percolating groundwater that is adversely affecting surface instream benefits, such as fish populations and riparian values. The Board's attorneys are of the view that the Board has authority to control such uses where they either (1) violate the prohibition of the Constitution and the Water Code on waste and on unreasonable use and methods of use; or (2) violate the public trust.

Both jurisdictional and substantive issues questions are presented. In terms of jurisdiction, there

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[265](...continued)
are subject under Water Code § 5101. See the definition of diversion in Water Code § 5100(b).

[266] Letter from Stephen K. Hall, Executive Dir., ACWA to Joseph Sax, October 31, 2001, at 1 (on file with Joseph Sax).

are two distinct issues: (1) Does the Board have authority to take jurisdiction itself, and to issue remedial orders against users water users over whom it has no permitting authority?[267] (2) May the Board go to court and seek judicial relief? Substantively, the questions are (1) What constitutes waste and unreasonable use, in the context of groundwater use that affects surface stream values? (2) Does the public trust extend to groundwater uses at all?[268] Since this Report deals only with the Board's permitting jurisdiction, the following discussion is limited to that issue, not with the questions what constitutes waste and unreasonable use, or what constitutes a violation of the public trust.[269]

Assuming that a substantive violation exists, there is no doubt[270] that the Board, through the Attorney General,[271] can institute litigation to control groundwater use that (1) constitutes waste or unreasonable use or method of use within the meaning of Article X, § 2 of the California Constitution, and Water Code § 100;[272] or (2) that violates the public trust.[273] There may still be

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[267] While the question here relates to users of percolating groundwater, a parallel question arises as to riparian surface water users, and pre-1914 appropriators.

[268] Cf. *In the Matter of the Water Use Permit Applications* (Waiahole Ditch case), 94 Haw. 97, 9 P.3d 409 (2000) (public trust extends to groundwater). An unresolved question in California is whether pumping of tributary groundwater that affects public trust values in navigable waters would be treated like tributary surface water under *National Audubon Society v. Superior Court*, 33 Cal.3d 419, 189 Cal.Rptr. 346, 658 P.2d 709 (1983).

[269] The scope of the Board's public trust authority is currently a subject of considerable dispute. See, e.g., David R.E. Aladjem, Is Water Ripe for the Taking? The SWRCB's Lower Yuba River Decision and the Public Trust Doctrine, 11 California Water Law & Policy 261 (July 2001), criticizing D. 1644 (2001) (Lower Yuba River) (petitions for reconsideration and petitions for writ of administrative mandamus pending). See generally Gregory S. Weber, Articulating the Public Trust: Text, Near-Text and Context, 27 Ariz.St.L.J. 1155, 1173 (1995).

[270] See *Environmental Defense Fund v. East Bay MUD*, 26 Cal.3d 183, 200, 605 P.2d 1, 10, 161 Cal.Rptr. 466, 475 (1980) (*EDF II*) and *People ex rel. State Water Resources Control Board v. Forni*, 54 Cal.App.3d 743, 126 Cal.Rptr. 851 (1st Dist. Ct. App. 1976). Courts may require the parties to accept a physical solution to resolve a waste problem. *City of Lodi v. East Bay MUD*, 7 Cal.2d 316, 341, 60 P.2d 439 (1936).

[271] Water Code § 275. Also the Attorney General can bring an action for equitable relief "for the protection of the natural resources of the state from pollution, impairment, or destruction." Cal. Govt. Code § 12607 (West 1980). For definition of "natural resources" see Cal. Govt. Code § 12605.

[272] *People ex rel. SWRCB v. Forni*, 54 Cal.App.3d 743, 753, 126 Cal.Rptr. 851 (1st Dist.

(continued...)

some question whether the Board can assert its own jurisdiction to adjudicate and remedy complaints about these matters where it otherwise has no jurisdiction over the respondent,[274] though the California Supreme Court has said that claims of unreasonable uses of water or of harm to the public trust "may be brought in the courts or before the Board."[275]

Board jurisdiction in such situations is said to be founded primarily on Water Code § 275,[276]

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[272](...continued)
Ct. App. 1976) (Board sues under Water Code § 275 to enjoin riparian uses as unreasonable). The prohibition on unreasonable and non-beneficial use applies to groundwater as well as surface water use. *Peabody v. Vallejo*, 2 Cal.2d 351, 372, 40 P.2d 486, 494 (1935); *Joslin v. Marin Mun. Water Dist.*, 67 Cal.2d 132, 138, 429 P.2d 889, 893, 60 Cal.Rptr. 377, 381 (1967).

[273] Under *Marks v. Whitney*, 6 Cal.3d 251, 261, 98 Cal.Rptr. 790, 491 P.2d 374 (1971) "members of the public" have standing to bring an action to restrain violations of the public trust. See also *In re Waters of Hallett Creek*, 44 Cal.3d 448, 472, 243 Cal.Rptr. 887, 749 P.2d 324, 338 n.16 (1988), cert. denied 488 U.S. 824 (1988). The State acting through the Board has a continuing responsibility and authority under the public trust doctrine to consider the effect of water diversions upon public trust resources and to avoid or minimize harm to those resources to the extent feasible. *National Audubon Society v. Superior Court*, 33 Cal.3d 419, 427, 189 Cal.Rptr. 346, 365, 658 P.2d 709 (1983) (a duty of continuing supervision). Preservation and enhancement of fish and wildlife resources, and recreation, as well as the public interest in water, are statutory responsibilities of the Board. Water Code §§ 1243, 1253.

A recently filed case in Arizona asserts that the State water agency has an affirmative duty to use the public trust to protect the state's watercourses from adverse affects of groundwater pumping. Center for Biological Diversity v. Joseph C. Smith, Dir., Arizona Dept. of Water Resources, No. CV2002-000171, Superior Court, Maricopa County, filed Jan. 7, 2002.

[274] It may be important to distinguish the Board's ability to go to court from its ability to assert jurisdiction itself, and to issue orders restraining groundwater use. Sometimes the term "jurisdiction" seems to be used without making this distinction explicit. See, e.g., Barton H. Thompson, Jr., Legal Disconnections Between Surface Water and Ground Water, in Making the Connections: Proceedings of the Twentieth Biennial Conference on Ground Water, University of California, Water Resources Center Report No. 88, June 1996, at 21.

[275] *In re Waters of Hallett Creek, supra* note 273, at 749 P.2d 324, 338 n.16.

[276] "The department and board shall take all appropriate proceedings or actions before executive, legislative, or judicial agencies to prevent waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water in this state."

secondarily on Water Code § 174,[277] and perhaps on substantive provisions Article X, § 2 of the Constitution which is self-executing, and on its statutory parallel, Water Code § 100. There is one court decision, in a district court of appeal case, directly on point, though it did not involve groundwater.

In *Imperial Irrigation District v. State Water Resources Control Board* (*IID II*),[278] the issue was whether the Board could take jurisdiction over pre-1914 surface water appropriations in order to determine whether the water was being unreasonably used in violation of Article X, § 2 of the Constitution, or whether a complainant would have to go to court to raise and adjudicate such a claim. The argument was that the Board had no pre-existing jurisdiction over IID's pre-1914 appropriations; and that the statutory provision upon which the Board relied was not a grant of jurisdiction to it, but simply an authorization to the Board to go to court to seek relief. The provision in question was Water Code § 275. IID claimed that this provision was a restriction on the Board – directing it to petition other agencies to grant relief for violations – rather than a grant of jurisdiction to act on its own. (Even if such a claim were to prevail, however, courts have broad authority to refer any and all issues to the Board).[279]

The court expressly rejected that claim, and said it saw no distinction between the *IID* case and an earlier case in the California Supreme Court (known as *EDF I*)[280] which sustained Board jurisdiction over a claim of waste and unreasonable use under Water Code § 275. However in that case, the Board already had jurisdiction over the water user, which was one of its permittees;[281]

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[277] "The [l]egislature hereby finds and declares that in order to provide for the orderly and efficient administration of the water resources of the state it is necessary to establish a control board which shall exercise the adjudicatory and regulatory functions of the state in the field of water resources." See also Water Code §§ 104, 105.

[278] 225 Cal.App.3d 548, 275 Cal.Rptr. 250 (4th Dist. Ct. App. 1990).

[279] "...in any lawsuit for a determination of rights to water, 'the court may order a reference to the Board, as referee, of any or all issues' (Wat. Code, § 2000), or, alternatively, 'may refer the suit to the board for investigation or and report upon any or all of the physical facts involved.' (Wat. Code, § 2001.)." *In re Waters of Hallett Creek*, *supra* note 273, at 749 P.2d 324, 338 n.16.

[280] *Environmental Defense Fund v. East Bay MUD*, 20 Cal.3d 327, 572 P.2d 1128, 142 Cal.Rptr. 904 (1977) (*EDF I)*. See also *EDF II*, *supra*, note 270.

[281] The *EDF v. EBMUD* case, where the court held that the Board has jurisdiction to determine whether a water user's failure to reclaim water violated the Water Reclamation Law, dealt not only with the use of water held under a Board permit, but with a statute that expressly granted the Board jurisdiction to regulate reclamation and use of waste water. Such cases

(continued...)

similarly, in the *National Audubon* (Mono Lake)[282] case (which began in a court) Los Angeles was already within the Board's jurisdiction before the public trust claim arose.

The *IID I* decision says: "[n]o case has construed section 275 as a limitation on the Board's adjudicatory power. In fact, *EDF I*, which holds the Board had *exclusive* adjudicatory jurisdiction...cites section 275 in support of its conclusion the Board's 'powers extend to regulation of water quality and prevention of waste.'"[283] The court in *IID I* also relied on the so-called Racanelli decision,[284] which also cited § 275 as authority for the proposition that the Board has "the separate and additional power to take whatever steps are necessary to prevent unreasonable use or methods of diversion."[285] The court in *IID I* concluded that "section 275 is not to be construed as a limitation on the Board's adjudicatory authority, but rather as a statute granting separate, additional power to the Board."[286]

Though the Supreme Court has not yet expressly addressed the question whether Water Code § 275 provides an independent source of jurisdiction over pumpers of percolating groundwater, the holding of the *IID* case, along with the language of *EDF I*, and the Racanelli decision, are significant authority in favor of the claim that the Board can assert jurisdiction over percolating groundwater pumping to adjudicate and remedy claims that come within the scope of waste and unreasonable use covered by Water Code § 275. Such jurisdiction could be a powerful tool to deal with pumping that impairs instream flows needed to protect fish and riparian values, one of the major issues underlying complaints urging the Board to take a broadened view of its jurisdiction

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[281](...continued)
essentially raise primary jurisdiction, or concurrent jurisdiction, issues, rather than dealing with the question whether there is Board jurisdiction at all. The Board and the courts have concurrent jurisdiction. *EDF II*, *supra* note 270.

[282] *National Audubon Society v. Superior Court*, 33 Cal.3d 419, 189 Cal.Rptr. 346, 658 P.2d 709 (1983); D. 1635 (1996), at ¶ 4.1, 1996 WL 904701 at 12.

[283] 186 Cal.App.3d 1160, 1169 (4th Dist. Ct. App. 1986).

[284] *United States v. State Water Resources Control Board*, 182 Cal.App.3d 82, 142, 129-30, 227 Cal.Rptr. 161, 195-96, 187 (1st Dist. Ct. App. 1986). While there is language in the Racanelli decision that is very broad – the court says the Board has independent jurisdiction to implement the Constitutional provision against unreasonable use – this statement was made in the context of a party holding a Board permit, and the Board was only amending the permit terms. It did not seek to use an unreasonable use claim to create jurisdiction where it did not otherwise exist.

[285] 186 Cal.App.3d., at 1170, quoting 182 Cal.App. 3d at 142.

[286] *Id*, at 1170.

under Water Code §1200.[287]

Of course *IID* is a District Court of Appeals case, not a Supreme Court decision, and it deals with surface water. It remains to be seen if the Supreme Court's language in *EDF I* will be applied to cases like groundwater, where there is no pre-existing Board jurisdiction. No doubt the claim will be made that percolating groundwater is a special case, and that the legislature has taken special pains to restrict Board jurisdiction over groundwater, specifying those (few) instances in which it believes such jurisdiction may be exercised.[288] In anticipation of any such claim, however, it should be recalled that back in 1912 and 1913 the only expressed objection to jurisdiction over groundwater was to a discretionary permitting system that might deny a landowner appropriation of water despite an adequate supply. It was acknowledged even then that when groundwater pumping adversely affected other water rights it was amenable to regulation and restriction.

The question of the scope of Board jurisdiction over groundwater to protect instream values is currently pending in the *North Gualala Water Company* case.[289] In that matter the Board had jurisdiction over a surface appropriation, which was conditioned by a bypass flow provision. The permittee then sought a permit (out of an abundance of caution?) to change the point of diversion to a well, while simultaneously asserting that the well did not pump subterranean stream water, and that it was not being recharged by the stream anyway. The Board nonetheless insisted on maintaining the bypass flow condition on the well, while declining to adjudicate the subterranean stream question, saying that issue was not properly before it.

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[287] It should be noted that the Board's limited ability to gather information or perform monitoring, or to require diverters to report and monitor, significantly constrains its practical capacity to implement Water Code § 275 and the public trust. Broad substantive authority may be undermined by ability to obtain sufficient evidence to sustain a claim. Improving the Board's information-gathering capacity is certainly an issue that deserves to be on the legislative agenda.

[288] See text at notes 132 et seq., *supra*, citing various Water Code provisions.

[289] *North Gualala Water Company v. State Water Resources Control Board*, No. SCUK CVG 01 86 109, Superior Court, Mendocino County, filed July 19, 2001. The case has a complicated history. See SWRCB Orders WR 2001-14, WR 99-011, and WR 99-09-DWR. On June 21, 2001, the Board issued an Order Denying Reconsideration, in the *North Gualala Water Company* case, Order WR 2001-14. The Order deals with the procedural failings of the petition for reconsideration. But the Order notes that the Company claims its pumping is not affecting the surface flow, as well as that it is not pumping from a subterranean stream. If there is no hydraulic connection between the pumping and the surface flows, then the case would become moot (there would be no need to apply streamflow maintenance standards to these wells). If, however, there is a connection, and if it is determined that the Company is not pumping from a subterranean stream – an issue that the June 21 Order leaves open for later consideration – the question remains whether, and how, the Board would seek to control the pumping in order to protect instream flows.

The Board has, however, made clear its understanding that it has jurisdiction whether or not the well in question is pumping subterranean stream water.[290] As noted above, the applicant has now filed suit in Superior Court seeking a determination that it is not pumping subterranean stream water and that the Board has no jurisdiction over its well. The case potentially presents this issue: If the facts showed that the new point of diversion, the well, was pumping tributary groundwater with virtually the same impact on instream values as the previous surface diversion, but that legally the well is pumping percolating groundwater, has the Board now lost jurisdiction over the diversion? If so, can it take jurisdiction anew under Water Code § 275? This case, or one like it, will doubtless eventually work its way through the courts and clarify the scope of the Board's asserted independent authority over percolating groundwater that threatens surface stream values in violation of the values protected under Water Code § 275.

b. Remedies for Impairment of Water Rights

While California does not have an integrated permit system for administering surface and groundwater use, the Courts have protected surface stream rights against groundwater pumping, and *vice versa*, at the behest of the injured party, for nearly a century.[291] For example, in a 1904

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[290] The Board's Order says the following: "...Under Article X, Section 2 of the California Constitution and Water Code Section 100, all diversion and use of water in California is subject to reasonable use restrictions and a prohibition on unreasonable diversion or method of diversion. Adverse impacts to fish and wildlife are among the factors that provide a basis for determining that a water diversion may be unreasonable. (*United States v. State Water Resources Control Board* (1986) 182 Cal.App.3d 82, 129-130 [227 Cal.Rptr. 161, 187]; SWRCB Order WR 95-4, p. 17). Water Code Section 275 directs the SWRCB to take all appropriate actions to prevent waste or unreasonable use and unreasonable methods of diversion. The SWRCB's authority to regulate water use to comply with the reasonable use and diversion requirements of the California Constitution and Water Code extends to water use under all types of rights. *[Imperial Irrigation District v. State Water Resources Control Board*, 225 Cal.App.3d 548, 275 Cal.Rptr. 250 (4th Dist. Ct. App. 1990).] Thus, the SWRCB's authority to require the operator of a well to prepare a water supply contingency plan to avoid or reduce impacts on public trust resources is not limited to situations where the well is deemed to be under the SWRCB's permitting authority." Order WR-99-011, at 7-8, n.3. Elsewhere in the Order, the Board, citing *National Audubon* (note 273, *supra)*, says the Board "has the continuing responsibility and authority under the public trust doctrine to consider the effect of water diversions upon public trust resources and to avoid or minimize harm to those resources to the extent feasible." *Id.*, at 5. It should be noted, incidentally, that since salmon in the river were listed under the federal Endangered Species Act, the pumpers might have been liable for a "take" under that law (16 U.S.C. § 1538(a)(1)(B)) whether or not the Board had jurisdiction over them.

[291] *Eckel v. Springfield Tunnel & Dev. Co.*, 87 Cal.App. 617, 262 P. 425 (3d Dist. Ct. App. 1927); *McClintock v. Hudson*, 141 Cal. 275, 281, 74 P. 849 (1903); *Miller v. Bay Cities Water*

(continued...)

case, *Cohen v. La Canada Land & Water Company*,[292] the Court protected a prior appropriator from a surface stream against a subsequent appropriator of tributary percolating groundwater. Similarly in *City of Lodi v. East Bay M.U.D.*,[293] the Court protected a prior appropriator of percolating groundwater against a subsequent appropriator of surface stream water.

In a 1903 decision, a riparian surface stream user was protected against an appropriator of percolating groundwater.[294] Similarly, the Court protected Los Angeles' paramount pueblo rights in the Los Angeles River against diminution by pumping of tributary percolating groundwater.[295] Still another early case applied the correlative rights doctrine as between a riparian user of a surface stream and an overlying user of tributary groundwater.[296]

The effective result of all these cases has been to implement integrated management of water rights in hydraulically connected groundwater and surface stream water, through the medium of private litigation.[297] Indeed, it may be that the determination of the California Supreme Court to

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[291](...continued)
Co., 157 Cal. 256, 107 P. 115 (1910) (mandated injunctive relief no longer the law, cited in *City of Lodi v. East Bay M.U.D.*, 7 Cal.2d 316, 338, 60 P.2d 439 (1936)).

[292]142 Cal. 437, 76 P. 47 (1904). The Court's legal posture in this case is not entirely clear, as it does not describe the defendant (pumper of percolating groundwater used off the overlying land) as simply an appropriator, junior to the plaintiff (surface steam appropriator), but says that a use other than on the pumper's own land is "not for a reasonable use" (142 Cal. at 439).

[293] 7 Cal.2d 316, 60 P.2d 439 (1936).

[294] *McClintock v. Hudson*, 141 Cal. 275, 281, 74 P. 849 (1903).

[295] *Los Angeles v. Hunter*, 156 Cal. 603, 608, 105 P. 755 (1909).

[296] *Hudson v. Dailey*, 156 Cal. 617, 105 P. 748 (1909). The Court made clear that correlative rights would apply whether the groundwater was percolating or was a subterranean stream (156 Cal. at 628). Followed in *Eckel v. Springfield Tunnel & Dev. Co.*, 87 Cal.App. 617, 623, 262 P. 425 (3d Dist. Ct. App. 1927).

[297] See *United States v. Fallbrook Public Utility Dist.*, 165 F.Supp. 806, 847 (S.D. Cal. 1958), citing numerous California cases to the effect that: "...a percolating groundwater supply, although not part of the flow of a stream, may nevertheless be hydrologically connected with it, with the result that the extraction of water from either source diminishes the amount of water in the other....In such a situation, the percolating groundwater and the stream are regarded as one common water supply...and in considering the respective rights of those who secure water from
(continued...)

integrate groundwater and surface water rights in litigation explains at least in part how California law has been able to endure the "non-administration" of groundwater under Water Code § 1200 for so many decades.

Nor need all such cases be remitted to private litigation. The Board clearly has authority to protect groundwater uses when it has jurisdiction over permit applications to appropriate surface water,[298] and it does so. Groundwater users dependent on recharge from surface streams are protected by a determination whether surface water is available for appropriation.[299] The Board also has authority to condition surface stream appropriation permits so as to protect groundwater rights.[300] The courts, of course, can also afford such protection in private litigation.[301]

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[297](...continued)
the two interconnected sources, it is 'immaterial whether the (underground) waters...were or were not part of an underground stream, provided the fact be established that this exaction from the ground diminished to that extent, or to some substantial extent, the water flowing in the stream.'" Needless to say, the courts also integratively manage surface water rights with subterranean stream water uses, for example, protecting a senior surface appropriator against a junior pumper. *Larsen v. Apollonio*, 5 Cal.2d 440, 55 P.2d 196 (1936); *Barton Land & Water Co. v. Crafton Water Co.*, 171 Cal. 89, 152 P. 48 (1915).

[298] Water Code §§ 1253, 1255, 1257.

[299] E.g., the permits for the Solano Project (Putah Creek), Order WR 81-11 (1981), 1981 WL 40368, and Cachuma Project (Santa Ynez River), D. 1486 (1978), 1978 WL 21156, among others, have permit conditions designed to protect prior rights to divert from percolating groundwater (in both cases Condition 11). In a decision involving a stream tributary to Pismo Creek in San Luis Obispo County, the Board said: "In order to issue a permit, the Board must find that unappropriated water is available to supply the applicant....Unappropriated water includes water that has not been either previously appropriated or diverted for riparian use....The owner of land overlying a groundwater basin, which is fed by percolation from a surface watercourse, possesses rights analogous to a riparian owner (Peabody v. Vallejo (1935) 2 Cal.2d 351, 372, 40 P.2d 486. Consequently, water is not available for appropriation from a watercourse which feeds a groundwater basin if the appropriation would materially damage the rights of the overlying landowners (see Id. at 374; Lodi v. East Bay Municipal Utility Dist. (1936) 7 Cal.2d 316, 339, 60 P.2d 439)." D. 1627 (1990), at 3.

[300] E.g., *City of Lodi v. East Bay M.U.D.*, 7 Cal.2d 316, 323, 60 P.2d 439 (1936): "In the permits of the District...it was specifically provided that the District was under the responsibility of not injuring the underground water users, downstream from the dam."

[301] E.g., *Miller v. Bay Cities Water Co.*, 157 Cal. 256, 107 P. 115 (1910) (the court prohibited an appropriation of surface waters where the appropriation would have reduced
(continued...)

PART VI:

SHOULD THE LEGAL TEST BE CHANGED?

Should the legal test for determining what subsurface waters are subject to the SWRCB's permitting authority be changed? If so, what legal test would be appropriate?

To answer these questions, one must first decide what is really being asked? If the question is whether Water Code § 1200 is suited to resolve California's 21st Century water problems, or is a law that would or should be enacted today, the answer is certainly "no".[302]

If, however, the question is whether proposing legislation to expand the Board's permitting jurisdiction over subsurface waters is the most promising approach to today problems for California, the answer – in this observer's opinion – is also "no." The reasons are many, and they are more practical than theoretical:

> A great deal of subsurface water has been pumped for a long time, and any comprehensive permitting system would have to address existing uses. To do so presents complex problems of fairness to those dependent on existing uses, and perplexing questions of implementation. Illustratively, would a pumper of tributary groundwater since 1980 be integrated as of that date with appropriators from the stream, or be treated as a new appropriator, as

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[301](...continued)
groundwater recharge necessary to support the use of an overlying user of percolating groundwater).

[302] Every authority agrees that the "right" system is one that integrates management of hydrologically connected ground and surface waters. "Where...the stream and the groundwater are so closely connected that the use of one affects the other, the same law must be applied to both sources," Frank J. Trelease, Conjunctive Use of Groundwater and Surface Water, 27 Rocky Mtn. Min. L. Inst. 1853, 1856 (1982), quoted in John D. Leshy & James Belanger, Arizona Law Where Ground and Surface Water Meet, 20 Ariz. St. L.J. 657, 658-59 (1988). See also National Water Commission, Water Policies for the Future 233, Recommendation 7-1 (1973): "State laws should recognize and take account of the substantial interrelation of surface water and ground water. Rights in both sources of supply should be integrated, and uses should be administered and managed conjunctively. There should not be separate codifications of surface water law and ground water law; the law of waters should be a single, integrated body of jurisprudence."

of the date of a newly required permit application?[303] What if 1980 surface stream appropriators are subject to bypass flow limits in their permits? Would such limits be newly imposed on pumpers of tributary water? Or should there be recognition of longstanding existing uses through some form of "grandfathered rights" (an approach that presents its own fairness problems)?

Numerous such questions would arise under new legislation if it extended Board jurisdiction over existing uses, such as the application of permit requirements to situations such as adjudicated groundwater rights, and to established groundwater banking programs.

As noted above, a considerable percentage of pumped groundwater is used on overlying land and is thus riparian. It would therefore be outside any revised permitting system, unless riparian groundwater use was to be treated differently from riparian surface water use. Excluding overlying uses would at best be an incomplete form of regulatory management.

Experience shows the reluctance of the legislature to provide for comprehensive regulation of groundwater, even in the context of local control, as illustrated by the limitations in recent groundwater management legislation.[304] The prospects for comprehensive legislative reform are therefore unpromising. (I do, however, wish to reiterate the observation made above[305] that legislation improving the Board's information-gathering capacity, so that it can effectively fulfill responsibilities it already has under the Article X, § 2 of the Constitution, and Water Code § 275, should unquestionably be on the legislative agenda).

The issues described in the preceding paragraphs are only some of those that legislative rewriting of Water Code § 1200 at this late stage would generate. In acknowledgment of such practical concerns, and in light of the history of proposed legislative groundwater reform in California, I

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[303] While priority is ordinarily based on the date of filing of a permit application (Water Code §§ 1225, 1450, 1455), the Board has authority to adjust the priorities of water right applicants, *United States v. SWRCB,* 182 Cal.App.3d 82, 132, 227 Cal. Rptr. 161, 189 (1st Dist. Ct. App. 1986), and it has adjusted priorities in the public interest where junior applicants had longstanding claims and uses within the groundwater basin (e.g., D. 1632 (1995), *supra* note 265 at 35, 41-45; Order WR 95-10, *supra* note 189 at 38-39). Nonetheless, settling priorities would be a deeply troublesome issue. See note 212, *supra.*

[304] E.g., Water Code §§ 10753.8(b); 10750.4.

[305] In note 287, *supra.*

suggest an alternate approach, a three-point strategy for dealing with the problem of groundwater/surface water management in California:

(1) Adoption by the Board of clear criteria to implement the existing statutory purpose, by taking jurisdiction henceforth over groundwater uses that diminish appreciably and directly the flow of a surface stream; and

(2) Proactive use by the Board of its authority under Water Code § 275 and any other sources of jurisdiction it has, to implement the constitutional prohibitions on waste, unreasonable use, and unreasonable methods of use; to protect the public trust; and to safeguard established rights in surface stream flows; and

(3) Where serious basin-wide problems are presented, comprehensive basin management (as with the most successful adjudicated/managed Southern California basins)[306] is the most promising tool to achieve genuine integration of surface water and groundwater administration in California. This suggestion is made in full recognition of the cost, duration and complexity usually associated with settling rights generally within a basin.[307] Nonetheless, that approach seems the most promising way for this state to position itself to address contemporary issues. Unlike proposals for expanding regulatory jurisdiction, basin management offers the possibility of employing the full range of needed management tools, such as professional administration, pumping assessments, importation of new supplies, replenishment programs, achievement of sustainable use, allocation of groundwater storage capacity, quality control, and conjunctive use.

-end of report-

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[306] See generally William Blomquist, Dividing the Waters: Governing Groundwater in Southern California (1992).

[307] A task that has not been made easier by the recent decision in *City of Barstow v. Mojave Water Agency*, 23 Cal.4th 1224, 1240, 5 P.3d 853, 863, 99 Cal.Rptr. 294, 304 (2000).

Appendix A:
Draft of the Proposed Water Commission Bill

Appendix B1:

Assembly Bill No. 642 (1913) (as introduced Jan. 23, 1913)

Appendix B2:

Assembly Bill No. 642 (1913) (as amended in Senate May 10, 1913)

Appendix C:
Water Commission Act of 1913

Appendix D:

Transcripts of Hearings on Proposed Water Commission Bill

Appendix E:
Memos from Technical Advisory Committee Members

-end of appendices-

EXHIBIT G

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September 16, 2010

Dr. Thomas Harter, Project Director
The Regents of the University of California,
University of California, Davis
1850 Research Park Dr. Suite 300
Davis, CA 95618-6153

Re: Comments on SB X2 1 (Water Code Section 83002.5) Nitrate Project Interagency Task Force Meeting

Dear Dr. Harter:

This office represents one or more parties interested in the above matter. We are deeply appreciative of your willingness to let the general public participate in the Interagency Task Force process and offer these comments only as constructive suggestions. This office has long supported seeking real, data-based collaborative solutions that are beneficial to all parties (discussed below). We also believe the only way one can understand the farming practices of a region is to talk to farmers and have them explain how they use the water to grow crops. Since the fact-based engineering/economic study outlined in presentations at the August 17, 2010 Nitrate Pilot Project ITF meeting is generally aligned with our approach to developing water resource solutions, we gladly offer to contribute information and experience. We submit the comments in this letter: 1) in an attempt to clarify that the scope of the study does not inadvertently omit integrative solutions and important economic considerations and 2) to discuss some of the challenges and opportunities to obtain the data necessary for the study to meaningfully contribute to real solutions. If you or any of your staff have any questions about these comments, please free to contact our office.

This office has worked on similar water projects, litigation and problems in the following jurisdictions: Napa, Solano, Monterey, Kern, Imperial, Mendocino, Alameda, Riverside, Contra Costa, Amador, Placer, Nevada, Santa Barbara, Kern and San Luis Obispo Counties. In our experience, the best approach is for agriculture, public agencies and other stakeholders to work together to see if they can resolve disputes for the benefit of all parties. This approach depends on all parties sharing all data so that engineers/economists can determine exactly what the facts are about the use of water and when it is needed. In using this approach, we have found there are many myths about water and how it is used. Once the facts surrounding the use of water and

when it is needed are understood by all parties involved, the myths can be set aside and major water issues can be resolved for the benefit of all.

Retired UC Davis Law School professor Harrison Dunning can discuss this type of approach and would be a great resource for this study with his vast reservoir of experience in the relevant water law issues discussed below and as Director of Governor Brown's Water Study Commission almost thirty years ago.

Determination of a cost-effective, politically feasible solution

To achieve a successful outcome that protects public health, the recommended policy must be both cost effective and politically feasible.

The work of Dr. Lund on alternative water supplies cost, the work of Dr. Jensen on drinking water remediation cost, and the work of Dr. Howitt on nitrate mitigation cost need to be integrated to determine the least-cost combination of approaches for society to address potential nitrate health problems. Present value cost analysis can determine in which of these three areas expenditures of societies resources will be most effective in achieving health goals.

Since, as Dr. Howitt discussed, distributional effects play a large role in political feasibility, we urge the Davis Report to consider a wide range of policy approaches to identify an approach that will be both politically feasible and cost effective. We further urge the Davis Report give due consideration to testing and monitoring costs needed to assess and enforce all policy alternatives, as testing and monitoring costs may add significantly to overall costs in some policy alternatives. For thoroughness, the Davis Report should also review the physical effectiveness of existing proposals, such as well protection methods to reduce nitrate pathways to the aquifer, as well as the associated cost effectiveness of these methods to reduce nitrate concentrations.

Data

Open data regarding the quantity of water pumped, fertilizer and chemical inputs to farming is in the interest of all Californians and required under the Constitution. Given the importance of both the existing nitrate content in pumped groundwater and irrigation method on resulting nitrate leachate, the Davis Report should reinforce the concept that there must be full disclosure at the farm level of all water usage and the chemicals added to the water, which data must be made public. Farmers should also report nitrate levels in well water. Without testing well water for nitrate, farmers cannot be satisfying basic nitrate application management because they cannot know how much nitrate to add to that existing in the pumped water to satisfy crop needs.

When such data is publicly made available positive action might be taken in response to the publication of the data:

1. The agricultural community will be able to compare other farmers' practices including but not limited to irrigation, fertilizer and pesticide application against their own. The proprietary information argument is offset by the State's obligation under the State Constitution to make sure that the State's water is put to reasonable and beneficial use.

2. The State and any other interested party will be able to determine how much of the nitrate content in surface runoff derives from the water source (pumped or surface) as opposed to nitrate added to the water on the property.

3. The rate of any denitrification of surface and underground sources of water by pumping, application, and absorption of the nitrate content by crops can be determined.

The collection of water data including but not limited to water quality and fertilizer and chemical applications is of limited value unless it is collected in a consistent manner across the State and the data is publicly available. It makes no sense to allow each individual water district or agency or regional board to develop its own water database and determine what part of the database will be availability to the public.

Consistent data collection is the only way to develop a statewide policy to deal with the nitrate issue. The State has strengthened Water Code sections 5100 et seq in SBX 8 enacted in 2009. This office continues to believe that the rigorous use of Water Code Section 5100 would be a significant benefit to the State of California. The law has already developed a statutory procedure under the jurisdiction of the SWRCB with Water Code Sections 5100 et seq. to collect monthly diversion data from "...surface stream or subterranean stream..." water users beginning in 2012. This existing process should be used to collect all water data and if amendments are needed to expand the scope of Water Code Section 5100 then the Davis Report should so recommend.

Ground water and surface water definition

There is a continuing controversy in California as to the definitions of ground and surface water, in particular, the ambiguous distinction between groundwater and river underflow. This controversy could be a hindrance to or an opportunity for the collection of water pumping data. This historical dispute was described in the so-called Sax Report issued in 2002 pursuant to a process of the SWRCB. A copy of the Sax Report is attached and marked Exhibit A. This office commented on the Sax Report and suggested that the SWRCB use the powers granted it in Water Code sections 5100 et seq to obtain the appropriate data on all water usage in California. A copy of this office's letter to the SWRCB dated April 2, 2002 is attached and marked Exhibit B. No action was taken by the SWRCB on the Sax Report.

The confusion on this issue in the State of California is amply demonstrated by looking at the SWRCB'S eWRIMS database for the Salinas River and its tributaries. The SWRCB eWRIMS website has the following information:

1. Licenses and Permits show the SWRCB has issued licenses for surface as well as the underflow of the Salinas River and its tributaries.

2. The Statements of Water Diversion show water users have filed Statements of Water Diversion and Use for surface as well as the underflow of the Salinas River and its tributaries.

3. eWRIMS Salinas River database and eWRIMS factsheet are attached hereto as Exhibit C.

There are conflicting definitions of ground water and surface water throughout the statutory and case law of California. Under Article 10 Section 2 of the California Constitution, the State has the responsibility to guarantee that the water of the State of California is put to reasonable and beneficial use. Any report to the Legislature that separates ground water from surface water will not address the overall nitrate issue because these water sources are inter-related. In order to meet the project objectives the Report must discuss the interrelationship between ground water and surface water and the impact this interrelationship has on nitrates.

Finally, the accuracy of water measurements will be a significant issue. There is a serious measurement problem in connection with water use in California agriculture. The accuracy levels vary from a low of plus or minus three percent to a high of plus or minus forty percent. Improvement and consistency in measurement techniques is needed. If after 2012 the measuring technology requirements of Section 5100 only apply to some sources of applied water and not to others, then incomparable data introduces a flaw that can be exploited by opponents to change.

Cost allocation experience

During the public presentation, comments were made about the cost allocation process and a presentation was given by Dr. Lund on an "Alternative Water Supply." The Cost Allocation Process is of immense value for the following reasons:

1. It aids in determining responsibility if there is damage

2. It helps determine the consequences of different behavior

3. It may suggest it is in the interest of the farmer to change her/his farming practices, and

4. Most importantly it drives a solution

The Farmers in the Salinas Valley dealt extensively with cost allocation in connection with Salt Water Intrusion and an initial nitrate education program. This process is described in part at http://www.mcwra.co.monterey.ca.us/welcome_svwp_n.htm. If you need more information about the actual process itself we are willing to make all the information that we developed for the process available to you. The cost allocation process worked in the Salinas Valley in connection with salt water intrusion because there was parity of data and careful technical examination of the causes of salt water intrusion by a modeling committee made up of sophisticated hydrogeologists representing the public as well as various farming interests.

However, the cost allocation procedure for the small nitrate program attached to the project to address salt water intrusion ignored publicly available data from UC Agriculture Extension demonstrating wide variation in applied nitrates by crop type and thus region, and created a uniform per acreage charge despite this variation. Given the potential magnitude of cost for any new nitrate program, a detailed technical/economic analysis has to be made on nitrates before any cost allocation process can start, otherwise any program will disintegrate at the cost

allocation phase. The importance of this type of technical process should be discussed in detail in the Report to the Legislature.

Professor Lund with his presentation on "Alternative Water Supply" demonstrated an example of such careful independent analysis at the workshop. The presentation showed how to develop criteria to determine the impact of the nitrates on the health of individuals. Professor Lund carefully pointed out that his work was not complete but this is the type of careful analysis of the nitrate issue that must be part of any Report to the Legislature. Then once issues are technically understood further investigation can be made as to costs to remediate any existing or potential damage caused by the nitrates in the water. The Legislature will not be well served if the Report is prepared that does not offer a viable economic solution to deal with the issue.

Historical Issues

The history of nitrate usage in the regions covered by the Davis Report may be the most important information that can come out the process. There are a significant number of technical reports on water usage, land development and nitrate usage in the region as well as the State.[1] There is some evidence that different parts of the agricultural industry in the Salinas and Turlock areas have determined that less nitrates are necessary to maintain the same level of crop production. If in fact there has been a recent reduction in the application of nitrates, the Davis Report should carefully analyze the effect of this reduction on current and future nitrate concentrations. Such information would help identify future options and improve estimation accuracy for reducing nitrate concentrations. In addition, when including the economic consequences of salt water intrusion, low value crops during certain times of the year should not be grown.[2] A similar analysis may apply to low value, high nitrate using crops.

Dredging Experience

When one looks at the charge of the Davis study, it may be appropriate for the Report to consider making recommendations for changes in the existing statutory and regulatory system to manage water issues as they presently exists in the Federal Clean Water Act and the Porter Cologne Act.

Under the existing statutory and regulatory system, the United States, California and the Port of Oakland faced what appeared to be an insurmountable problem with the Dredging issue in the San Francisco Bay in the nineteen eighties The nature of these problems was more particularly described in the articles prepared by Prof. Kagan at UCB. Copies of the articles are attached and marked Exhibits D and E. This problem was in part dealt with by Statutory changes at the Federal level. The nitrate issue has the potential for degenerating into the same types of conflicts that occurred with dredging in the SF Bay and could affect the well being of many

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[1] See State Water Resources Control Board Reports: Nitrate in Drinking Water Report To the Legislature Report No 88-11WQ Division of Water Quality October 1988, State Water Resources Control Board Division of Water Quality Nonpoint Source Program Nonpoint Management Source Plan November 1988, California Report on Water Quality Prepared as Required in Clean Water Act Section 305(b) California Water Resources Control Board July 1992

[2] Based on contribution to salt water intrusion and net revenue per acre foot data from Agland Investment Services, "Monterey County Water Conservation Alternatives: An Analysis," July 1995.

people and the environment. The study should consider all options including potential legislative changes at both the State and National levels so the goals of the study can be accomplished.

We deeply appreciate the opportunity to comment on the Task Force work to date and if we can be any further help as a collaborative colleague please contact us.

Sincerely,

Patrick J. Maloney

Enclosures

Exhibit A – Sax Report
Exhibit B – PJM to SWRCB letter dated April 2, 2002
Exhibit C – eWRIMS Salinas River database and factsheet
Exhibit D – Dredging Oakland Harbor: Implications for Ocean Governance
Exhibit E – Adversarial Legalism and American Government

c. Jeffrey S. Young, Chair, California Regional Water Quality Control Board
Senator Tony Strickland
Senator Sam Blakeslee
Senator Elaine Alquist
Senator Jeffery Denham
Assembly Member Anna M. Caballero
Assembly Member Pedro Nava
Assembly Member William W. Monning
Charles R. Hoppin, Chair, SWRCB
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