SPECIAL JOINT MEETING

BOARD OF DIRECTORS &
ENGINEERING AND OPERATIONS COMMITTEE

Board Room

JANUARY 13, 2011

1:30 p.m.

1. Call to order.

2. Roll call – determination of quorum.

3. Public comment – opportunities for members of the public to address the Committee on matters within the Committee’s jurisdiction.

I. CONSENT CALENDAR

1. Notice of Completion for the ESP - San Vicente Pipeline and Aqueduct Interconnect project.
   Staff recommendation: Authorize the General Manager to accept the San Vicente Pipeline and Aqueduct Interconnect project as complete, record the Notice of Completion, and release funds held in retention to Shea-Traylor Joint Venture in accordance with applicable laws. (Action)

II. ACTION/DISCUSSION

   Staff recommendation: Approve the Water Authority’s Dreissenid Mussel Response and Control Plan which describes the plan for monitoring and controlling the spread of the invasive quagga mussel species. (Action)
2. Lake Hodges projects.
   2-A Presentation on Lake Hodges projects status update. Jeremy Crutchfield

   2-B CLOSED SESSION:
   Conference with Legal Counsel – Consideration of Initiation of Litigation
   Government Code § 54956.9(c) – One Case
   Dan Hentschke

III. INFORMATION

1. Presentation on Emergency Storage Project Operating Plan. Gary Eaton

IV. ADJOURNMENT

Doria F. Lore
Clerk of the Board

Note: All items on the agenda, including information items, may be deliberated and become subject to action. All public documents provided to the committee or Board for this meeting including materials related to an item on this agenda and submitted to the Board of Directors within 72 hours prior to this meeting may be reviewed at the San Diego County Water Authority headquarters located at 4677 Overland Avenue, San Diego, CA 92123 at the reception desk during normal business hours.
January 6, 2011

Attention: Engineering and Operations Committee

Notice of Completion for the ESP - San Vicente Pipeline and Aqueduct Interconnect project.
(Action)

Staff recommendation
Authorize the General Manager to accept the San Vicente Pipeline and Aqueduct Interconnect project as complete, record the Notice of Completion, and release funds held in retention to Shea-Traylor Joint Venture in accordance with applicable laws.

Alternative
Do not accept the project as complete and provide direction to staff relative to issues requiring resolution.

Fiscal impact
There are sufficient funds in the San Vicente Pipeline project budget and the approved fiscal year 2010 and 2011 Capital Improvement Program appropriation to support this action. The rate category for this project is storage.

Background
The Emergency Storage Project is a system of reservoirs, pipelines, and other facilities that will work together to store and move water around San Diego County in the event of an interruption in imported water deliveries. The San Vicente Pipeline is a key component of the Emergency Storage Project’s San Vicente water delivery system. In conjunction with the Dam Raise, Reservoir Interconnect, Moreno-Lakeside Pipeline, San Vicente Pumping Facilities, and the Rancho Peñasquitos Pressure Control/Hydroelectric Facility, the pipeline project will convey untreated water from the San Vicente Reservoir to the Second Aqueduct for distribution to member agencies during an emergency.

The San Vicente Pipeline construction is now complete and we can record the Notice of Completion. With this action, the Water Authority will satisfy the term in our Agreement Between the Water Authority and City for the ESP (Expansion of San Vicente Reservoir) where the City of San Diego’s “temporary ownership of fifty percent (50%) of the Authority’s water storage rights (in Olivenhain Reservoir)…shall terminate upon the completion of the construction of the (San Vicente) pipeline between San Vicente Reservoir and the Authority’s Second Aqueduct”. Therefore, with San Vicente Pipeline now operational and having obtained the balance of the Olivenhain Reservoir storage from Olivenhain Municipal Water District as part of our recent settlement agreement, we have achieved a major ESP construction and storage milestone where the entire capacity of Olivenhain Reservoir, or 24,375 acre-feet, is now part of the Water Authority’s emergency storage system.

Previous Board action: At the April 23, 2009 board meeting the Board accepted Change Orders 52 through 55, 57, and 58 for a credit of $1,138,894 and approved Change Order 60 for the
Reach 1 differing site condition cost impact undisputed amount of $1,562,406, increasing the construction contract amount to $219,698,040.

At the June 23, 2005 board meeting the Board approved a construction contract to Shea/Traylor Joint Venture for $198.4 million for the San Vicente Pipeline and Aqueduct Interconnect.

Discussion
This project consists of an 11-mile long tunnel with a finished diameter of 102-inches and appurtenant facilities. The tunnel project connects the San Vicente Pump Station to the Second Aqueduct at the Rancho Peñasquitos Pressure Control/Hydroelectric Facility at the tunnel’s West Shaft as shown on Figure 1. The pipeline is complete and ready for use.

Since the Board’s last action in April 2009, we processed 29 change orders under staff authority. We executed $982,830 in additional items. The costs were offset by $2,930,999 in credits for a net credit of $1,948,169, as detailed below and summarized in Table 1. A brief explanation is provided below.

Design Modifications:
We executed 40 design modifications at a cost of $225,245 and 11 design modifications for a credit of $288,485, resulting in a net credit of $63,240. Representative design modifications include adding safety enhancements that included modular concrete retaining wall guardrail; access structure guardrails; and the addition of access hatches and work platforms. Other design modifications include additional electrical junction boxes, and a manual transfer switch. The most significant credit item is for the deletion of revegetation, landscaping and irrigation from the project scope. This work has been advertised as a separate construction contract to be considered for award at the upcoming January 27th board meeting, that incorporates community input and the latest project site-specific hydoseed mixes.

Administrative Modifications:
We executed nine items at a cost of $290,294 and 12 items for a credit of $1,971,001 for a net credit of $1,680,707. The most significant credit item is for recovery of the unused raw material price fluctuations included in the bid by the contractor.

Environmental Modifications:
We executed six items at a cost of $158,153 and two items for a credit of $587,632, resulting in a net credit of $429,479. The largest cost item is for monthly materials and operation of the Slaughterhouse Shaft groundwater treatment plant to remove constituents to meet regional water quality standards for discharge. The most significant credit items are for recovery of unused funds for operation of the groundwater treatment plants at Central Shaft and the East Portal.
Design Omissions:
We executed three items for a cost of $3,489 and one item for a credit of $63,712, resulting in a net credit of $60,223. The credit item is for the recovery of the unused allowance to perform weld testing.

Community Accommodations:
We executed three items for a cost of $108,042. One was for the installation of a fence at the West Shaft to match the existing fence at the neighboring Rancho Peñasquitos Pressure Control/Hydroelectric Facility. The second was for changing the standard grey block to colored split-face block retaining wall in accordance with the Mira Mesa community agreement. The third was for modifications to existing landscape and irrigation in the parkway at Central Shaft. This change occurred, because the landscape in the parkway was installed by the developer McMillin prior to the contractor installing the permanent driveway and grading at Central Shaft.

Outside Agency Requirements:
We executed three items for a cost of $85,594. The most significant item is for the installation of electrical connections to SDG&E’s facilities by the contractor rather than SDG&E to avoid potential contract delays resulting from SDG&E’s availability to perform the work.

Contractor Error:
We executed one item for a credit of $20,169. The credit is for loss of value and our designer’s costs to evaluate the impacts of out-of-round pipe.

Differing Site Conditions:
We executed three items for a cost of $107,549. The most significant item is for field investigations, drilling, and filling of a sinkhole that formed near the pipeline alignment within the Interstate 15 right-of-way pursuant to CalTrans’ requirements.

Field Modifications:
We executed two items for a cost of $4,464. One item changed existing electrical pull boxes at the Rancho Peñasquitos Pressure Control/Hydroelectric Facility to larger pull boxes to better accommodate the cables and the other was for moving stockpiles to allow SDGE to install a power pole.

There are some minor change order items that will need to be executed after authorizing the General Manager to accept the project as complete. These items are:

- Recovery of Unused Material Allocations: Currently, approximately $16,000 remains in the raw material cost fluctuation allocations that were in the contract to better define the contractor’s risks and costs. The final raw material costs will not be known until January 2011 when the contractor is scheduled to complete minor roadwork.
• Disputes Review Board: The contract has $51,000 remaining for DRB costs. The DRB is currently evaluating the most recent hearing and preparing their final report. DRB costs will be reconciled after we receive their invoice.

• Weather Days: Excusable delays for inclement weather will be added to the contract time per the contract provisions should they occur prior to filing the Notice of Completion.

• Other Minor Changes: Other minor changes may be authorized as final clean up and contract closeout is completed.

Therefore, the San Vicente Pipeline project is now substantially complete with only minor site work remaining. This memo asks the Board to accept the project, subject to final completion of punchlist items, and authorize the General Manager to file promptly the Notice of Completion. Once the Notice of Completion is filed, staff will make timely final payment in accordance with applicable laws.

Pending final minor change orders described above, the final construction contract price for the San Vicente Pipeline project is $217,720,961, an increase of 9.8 percent of the original contract value. As outlined at previous Special Engineering and Operations Committee meetings, most recently on September 9, 2010, the contractor has submitted several claims for additional compensation and time. General Counsel and staff will continue to update the board as we move through the dispute resolution processes.

The small business participation for this project is 9.2 percent. This information is provided for statistical purposes.

Prepared by: Gary Bousquet, Engineering Manager
Reviewed by: Michael T. Stift, Director of Engineering
Approved by: Frank Belock, Jr., Deputy General Manager

Attachments:
  Figure 1 – Location Map
  Table 1 – Summary of Construction Change Orders
PROJECT: SAN VICENTE TO SECOND AQUEDUCT PIPELINE
SHAFT AND PORTAL LOCATIONS

FIGURE 1

San Diego County Water Authority
CAPITAL IMPROVEMENT PROGRAM

San Vicente Reservoir

San Vicente Portal

Slaughterhouse Shaft

Central Shaft

West Shaft

San Vicente Shaft
### TABLE 1
SUMMARY OF CONSTRUCTION CHANGE ORDERS
SAN VICENTE TO SECOND AQUEDUCT PIPELINE
SPECIFICATION 540

<table>
<thead>
<tr>
<th>Change Order</th>
<th>Item No.</th>
<th>Description</th>
<th>Amount</th>
<th>Time Extension</th>
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<tr>
<td>1</td>
<td>1</td>
<td>Administrative Change - Contract price adjustment for groundbreaking</td>
<td>($3,000)</td>
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<td>2</td>
<td>1</td>
<td>Administrative Change - Corrections to Contract Specifications (Holidays)</td>
<td>$0</td>
<td>0 days</td>
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<td>3</td>
<td>1</td>
<td>Scope Change - Modify tunnel vertical alignment – western section</td>
<td>($60,000)</td>
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<td>4</td>
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<td>Scope Change - Modify Contractor’s requirement to reimburse the Water Authority for inspector overtime</td>
<td>($260,000)</td>
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<td>5</td>
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<td>Administrative Change - Corrections to contract specifications (Regional Water Quality Control Board Orders)</td>
<td>$0</td>
<td>0 days</td>
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<td>5</td>
<td>2</td>
<td>Environmental Change - Dispose of groundwater at Slaughterhouse Shaft</td>
<td>$40,000</td>
<td>0 days</td>
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<tr>
<td>5</td>
<td>3</td>
<td>Environmental Change - Add supplemental water treatment system and install sprinkler system at Slaughterhouse site</td>
<td>$128,984</td>
<td>0 days</td>
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<tr>
<td>6</td>
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<td>Scope Change - Modify contract specifications (temporary power at the San Vicente Portal)</td>
<td>$30,706</td>
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<td>6</td>
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<td>Scope Change - Modify Drawing C-40 to eliminate SDG&amp;E provisions</td>
<td>($11,587)</td>
<td>0 days</td>
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<td>7</td>
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<td>Scope Change - Perform repairs to the Water Authority’s construction management trailers and relocate security guard booths</td>
<td>$4,426</td>
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<td>0 days</td>
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<td>8</td>
<td>1</td>
<td>Administrative Change - Modify allowable blasting hours at Slaughterhouse Shaft and Tunnel Reach 5</td>
<td>($350,000)</td>
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<td>9</td>
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<td>Modify contract specification for site grading (compaction requirements)</td>
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<td>10</td>
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<td>Scope Change - Lower cement content in low density cellular concrete backfill</td>
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<td>Scope Change - Change to tunnel vertical alignment – eastern section</td>
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<td>0 days</td>
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<td>Scope Change - Change to precast concrete tunnel supports</td>
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<td>13</td>
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<td>Scope Change - Changes to contract drawings for West Shaft final surface improvements</td>
<td>$0</td>
<td>0 days</td>
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<td>13</td>
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<td>Scope Change - Change to Contract Drawing M-4 Central Shaft piping crotch plate</td>
<td>$0</td>
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<td>Scope Change - Changes to Contract Drawing M-1 West Shaft piping crotch plates</td>
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<td>4</td>
<td>Scope Change - Correction to Contract Drawing T-11 for</td>
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<td>13</td>
<td>5</td>
<td>Scope Change - Correction to Contract Drawing E-3 Pump Station control panel pilot light lens color</td>
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<td>14</td>
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<td>Administrative Change - Changes to Contract Drawings (survey control points)</td>
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<td>Scope Change - Changes to Contract Specifications (compaction at Central Shaft)</td>
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<td>Scope Change - Changes to Contract Drawings (tunnel alignment horizontal curve No. 17)</td>
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<td>17</td>
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<td>Scope Change – Provide office copy machine</td>
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<td>18</td>
<td>1</td>
<td>Environmental Change - Mobilize Slaughterhouse Shaft supplemental groundwater treatment system</td>
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<td></td>
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<td>18</td>
<td>2</td>
<td>Environmental Change - Operate supplemental Slaughterhouse Shaft groundwater treatment system May 24, 2006 to May 31, 2006</td>
<td></td>
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<td>18</td>
<td>3</td>
<td>Environmental Change - Provide monthly operation and maintenance of supplemental Slaughterhouse Shaft groundwater treatment system from June 2006 to March 2007</td>
<td></td>
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<tr>
<td>18</td>
<td>4</td>
<td>Environmental Change - Supply resin for ion-exchange process for supplemental Slaughterhouse Shaft groundwater treatment system</td>
<td></td>
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<tr>
<td>19</td>
<td>1</td>
<td>Environmental Change - Mobilize San Vicente Portal supplemental groundwater treatment system</td>
<td></td>
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<tr>
<td>19</td>
<td>2</td>
<td>Environmental Change - Provide monthly operation and maintenance of San Vicente Portal supplemental groundwater treatment system from September 2006 to May 2007</td>
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<td>19</td>
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<td>Environmental Change - Supply resin for ion-exchange process for San Vicente Portal supplemental groundwater treatment system</td>
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<tr>
<td>20</td>
<td>1</td>
<td>Scope Change - Credit unused power generation allowance at San Vicente Portal</td>
<td></td>
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<tr>
<td>20</td>
<td>2</td>
<td>Scope Change - Provide treated water connection at West Shaft site</td>
<td></td>
<td></td>
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<td>20</td>
<td>3</td>
<td>Scope Change - Provide temporary power generation at West Shaft</td>
<td></td>
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<td>20</td>
<td>4</td>
<td>Scope Change - Provide Temporary Paving on Alemania Road</td>
<td></td>
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<tr>
<td>21</td>
<td>1</td>
<td>Administrative - Modify allowable blasting hours in Tunnel Reach 3</td>
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<tr>
<td>22</td>
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<td>Scope Change - Modify grout connections in welded steel pipe</td>
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<td>23</td>
<td>1</td>
<td>Administrative Change - Modify allowable work hours at West</td>
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**Change Orders 1-19 Approved at September 2006 Board Meeting**

**Total change order amount:** $1,141,565

**Total time extension:** 0 days

**Original Board authorized contract amount:** $198,366,900

**New contract amount:** $199,508,465
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<td>24</td>
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<td>Scope Change - Modify improvement plans for Alemania Road</td>
<td>$0</td>
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<td>25</td>
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<td>Scope Change - Credit excess raw material cost price fluctuation allowance</td>
<td>($1,500,000)</td>
<td>0 days</td>
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<td>25</td>
<td>2</td>
<td>Scope Change - Credit unused balance of Slaughterhouse Shaft groundwater treatment</td>
<td>($217,084)</td>
<td>0 days</td>
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<td>26</td>
<td>1</td>
<td>Differing Site Condition - Provide site visit by Digger Shield consultants</td>
<td>$2,436</td>
<td>0 days</td>
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<tr>
<td>26</td>
<td>2</td>
<td>Differing Site Condition - Re-design excavator boom on Digger Shield</td>
<td>$17,250</td>
<td>0 days</td>
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<tr>
<td>26</td>
<td>3</td>
<td>Differing Site Condition - Provide long lead time major spares for Digger Shields</td>
<td>$635,060</td>
<td>0 days</td>
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<tr>
<td>26</td>
<td>4</td>
<td>Differing Site Condition - Provide Digger Shield replacement parts to date</td>
<td>$839,639</td>
<td>0 days</td>
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<td>27</td>
<td>1</td>
<td>Scope Change - Supply temporary construction water during Water Authority shutdowns</td>
<td>$12,000</td>
<td>0 days</td>
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<tr>
<td>28</td>
<td>1</td>
<td>Scope Change - Add Standard Drawings SD-30 and SD-33 to contract</td>
<td>$0</td>
<td>0 days</td>
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<tr>
<td>28</td>
<td>2</td>
<td>Scope Change - Modify Specification for unwatering pump</td>
<td>$0</td>
<td>0 days</td>
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<tr>
<td>29</td>
<td>1</td>
<td>Differing Site Condition - Tunnel Reach 4 West interim payment No. 1 for cost impact of differing site condition</td>
<td>$3,200,000</td>
<td>0 days</td>
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**Change Orders 20-29 Approved at July 2007 Board Meeting**

**Total change order amount through Change Order 29:** $4,138,172

**Total time extension:** 0 days

**Original Board authorized contract amount:** $198,366,900

**New contract amount:** $202,505,072

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<th>Description</th>
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<td>30</td>
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<td>Differing Site Condition - Tunnel Reach 4 West interim payment No. 2 for cost impact of differing site condition</td>
<td>$440,000</td>
<td>0 days</td>
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**Change Order 30 Accepted at September 2007 Board Meeting**

**Total change order amount through Change Order 30:** $4,578,172

**Total time extension:** 0 days

**Original Board authorized contract amount:** $198,366,900

**New contract amount:** $202,945,072
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<th>Change Order</th>
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<tr>
<td>31</td>
<td>Differing Site Condition - Provide long lead time major spares for Digger Shield 2</td>
<td>$210,450</td>
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<td>32</td>
<td>Differing Site Condition - Tunnel Reach 4 West interim payment No. 3 for cost impact of differing site condition</td>
<td>$335,000</td>
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<td>33</td>
<td>Differing Site Condition - Tunnel Reach 4-East interim payment No. 1 for cost impact of differing site condition</td>
<td>$1,020,000</td>
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**Change Orders 31-33 Approved at the October 2007 Board Meeting**

Total change order amount through Change Order 33: $6,143,622

Total time extension: 0 days

Original Board authorized contract amount: $198,366,900

New contract amount: $204,510,522

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<th>Days</th>
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<tbody>
<tr>
<td>34</td>
<td>Administrative Change - Extend time of completion three days due to wild fire impacts</td>
<td>$0</td>
<td>3</td>
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<tr>
<td>34</td>
<td>Environmental Change - Credit unused balance of San Vicente Portal ground water treatment</td>
<td>($346,298)</td>
<td>0</td>
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<tr>
<td>34</td>
<td>Environmental Change - Extend monthly operation and maintenance of San Vicente Portal supplemental groundwater treatment system 13 months</td>
<td>$172,363</td>
<td>0</td>
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<tr>
<td>34</td>
<td>Environmental Change - Supply resin for ion-exchange process for San Vicente Portal supplemental groundwater treatment system for additional 13 months</td>
<td>$173,935</td>
<td>0</td>
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<tr>
<td>34</td>
<td>Environmental Change - Revise San Vicente Portal treatment capacity requirement</td>
<td>$0</td>
<td>0</td>
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<tr>
<td>35</td>
<td>Differing Site Condition - Conduct road header excavation trial</td>
<td>$200,000</td>
<td>0</td>
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<tr>
<td>36</td>
<td>Differing Site Condition - Tunnel Reach 4 West interim payment No. 4 for cost impact of differing site condition</td>
<td>$17,000</td>
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<tr>
<td>37</td>
<td>Differing Site Condition - Tunnel Reach 4-East interim payment No. 2 for cost impact of differing site condition</td>
<td>$2,138,000</td>
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**Change Order 34-37 Approved at December 2007 Board Meeting:** $8,498,622

Total time extension: 3 days

Original Board authorized contract amount: $198,366,900

New contract amount: $206,865,522

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<tr>
<td>38</td>
<td>Environmental Change – Add piping provisions for West Shaft groundwater treatment units</td>
<td>$18,400</td>
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<tr>
<td>39</td>
<td>Differing Site Condition - Tunnel Reach 4-East interim payment No. 3 for cost impact of differing site condition</td>
<td>$708,000</td>
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**Change Order 38-39 Approved at January 2008 Board Meeting:** $9,225,022

Total time extension: 3 days

Original Board authorized contract amount: $198,366,900

New contract amount: $207,591,922
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<th>No.</th>
<th>Description</th>
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<tr>
<td>40</td>
<td>Differing Site Condition - Tunnel Reach 4-East interim payment No. 4 for cost impact of differing site condition</td>
<td>$1,005,000</td>
<td>0</td>
</tr>
</tbody>
</table>

**Change Order 40 Approved at February 2008 Board Meeting:**

- Total time extension: 3 days
- Original Board authorized contract amount: $198,366,900
- New contract amount: $208,596,922

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Amount</th>
<th>Days</th>
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</thead>
<tbody>
<tr>
<td>41</td>
<td>Scope Change - Supply temporary construction water during Water Authority 2007/2008 shutdowns</td>
<td>$15,000</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Amount</th>
<th>Days</th>
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</thead>
<tbody>
<tr>
<td>42</td>
<td>Environmental Change - Mobilize Central Shaft supplemental groundwater treatment system</td>
<td>$134,973</td>
<td>0</td>
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</table>

<table>
<thead>
<tr>
<th>No.</th>
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<tbody>
<tr>
<td>42</td>
<td>Environmental Change - Provide monthly operation and maintenance of Central Shaft supplemental groundwater treatment system from September 2006 to May 2007</td>
<td>$115,632</td>
<td>0</td>
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</table>

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<th>Days</th>
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<tbody>
<tr>
<td>42</td>
<td>Environmental Change - Supply resin for ion-exchange process for Central Shaft supplemental groundwater treatment system</td>
<td>$83,484</td>
<td>0</td>
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<thead>
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<tbody>
<tr>
<td>43</td>
<td>Differing Site Condition - Tunnel Reach 4-East interim payment No. 5 for cost impact of differing site condition</td>
<td>$1,474,000</td>
<td>0</td>
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</tbody>
</table>

**Change Orders 41-43 Approved at April 2008 Board Meeting:**

- Total time extension: 3 days
- Original Board authorized contract amount: $198,366,900
- New contract amount: $210,420,011

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<tr>
<td>44</td>
<td>Differing Site Condition - Tunnel Reach 4-East interim payment No. 6 for cost impact of differing site condition</td>
<td>$880,000</td>
<td>0</td>
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**Change Order 44 Approved at May 2008 Board Meeting:**

- Total time extension: 3 days
- Original Board authorized contract amount: $198,366,900
- New contract amount: $211,300,011

<table>
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<th>No.</th>
<th>Description</th>
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<tr>
<td>45</td>
<td>Differing Site Condition - Tunnel Reach 4-East interim payment No. 7 for cost impact of differing site condition</td>
<td>$1,038,000</td>
<td>0</td>
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</table>

**Change Order 45 Approved at June 2008 Board Meeting:**

- Total time extension: 3 days
- Original Board authorized contract amount: $198,366,900
- New contract amount: $212,338,011

<table>
<thead>
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<th>No.</th>
<th>Description</th>
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<th>Days</th>
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</thead>
<tbody>
<tr>
<td>46</td>
<td>Environmental Change – Credit unused balance of groundwater treatment provided in Change Order 34</td>
<td>(128,220)</td>
<td>0</td>
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</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
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<th>Days</th>
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</thead>
<tbody>
<tr>
<td>46</td>
<td>Environmental Change - Extend monthly operation and maintenance of San Vicente Portal supplemental groundwater treatment system 3 months</td>
<td>$64,047</td>
<td>0</td>
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<tr>
<td>#</td>
<td>Type</td>
<td>Description</td>
<td>Amount</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
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</tr>
<tr>
<td>46</td>
<td>Environmental Change</td>
<td>Supply resin for ion-exchange process for San Vicente Portal supplemental groundwater treatment system for additional 3 months</td>
<td>$64,173</td>
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<tr>
<td>46</td>
<td>Field Change</td>
<td>Revise allowable minimum weld bead width in Specification 02653, Steel Pipe</td>
<td>$0</td>
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<tr>
<td>46</td>
<td>Scope Change</td>
<td>Delete storm drain cut-off wall at San Vicente Portal</td>
<td>($3,483)</td>
</tr>
<tr>
<td>47</td>
<td>Differing Site Condition</td>
<td>Tunnel Reach 4-East interim payment No. 8 for cost impact of differing site condition</td>
<td>$1,785,000</td>
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**Change Orders 46-47 Approved at July 2008 Board Meeting:**  
**Total time extension:** 3 days  
**Original Board authorized contract amount:** $198,366,900  
**New contract amount:** $214,119,528

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<tr>
<td>48</td>
<td>Differing Site Condition</td>
<td>Tunnel Reach 4-East interim payment No. 9 for cost impact of differing site condition</td>
<td>$490,000</td>
<td>0</td>
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<tr>
<td>49</td>
<td>Differing Site Condition</td>
<td>Tunnel Reach 4-East interim payment No. 10 for cost impact of differing site condition</td>
<td>$1,500,000</td>
<td>0</td>
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<tr>
<td>50</td>
<td>Differing Site Condition</td>
<td>Long lead time spares for Digger Shield</td>
<td>$356,000</td>
<td>0</td>
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<tr>
<td>51</td>
<td>Environmental Change</td>
<td>De-mobilize San Vicente Portal supplemental groundwater treatment system</td>
<td>$10,753</td>
<td>0</td>
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<tr>
<td>51</td>
<td>Environmental Change</td>
<td>Provide monthly operation and maintenance of San Vicente Portal supplemental groundwater treatment system from October 2008 to August 2010</td>
<td>$540,374</td>
<td>0</td>
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<tr>
<td>51</td>
<td>Environmental Change</td>
<td>Supply resin for ion-exchange process for San Vicente Portal supplemental groundwater treatment system</td>
<td>$552,963</td>
<td>0</td>
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**Change Orders 48 – 51 Approved at September 2008 Board Meeting:**  
**Total time extension:** 3 days  
**Original Board authorized contract amount:** $198,366,900  
**New contract amount:** $217,569,618

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<tr>
<td>56</td>
<td>Differing Site Condition</td>
<td>Tunnel Reach 4-East interim payment No. 11 for cost impact of differing site condition</td>
<td>$1,270,000</td>
<td>0</td>
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<tr>
<td>59</td>
<td>Differing Site Condition</td>
<td>Tunnel Reach 4-East interim payment No. 12 for cost impact of differing site condition</td>
<td>$406,000</td>
<td>0</td>
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**Change Order 56, 59 Approved at January 2009 Board Meeting:**  
**Total time extension:** 3 days  
**Original Board authorized contract amount:** $198,366,900  
**New contract amount:** $219,245,618

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<table>
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<tr>
<td>52</td>
<td>1</td>
<td>Differing Site Condition – Credit for unused fund in allowance for roadheader trial at central shaft performed in December 2007.</td>
<td>($19,573)</td>
<td>0</td>
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<tr>
<td>53</td>
<td>1</td>
<td>Reimbursable Modification - Perform weld tests on root pass welds of tunnel pipes to ensure pipe installation meets design requirements</td>
<td>$270,000</td>
<td>0</td>
</tr>
<tr>
<td>53</td>
<td>2</td>
<td>Scope Modification – Revise Welded Steel Pipe field butt weld joint detail to increase allowable space between joints prior to welding</td>
<td>$0</td>
<td>0</td>
</tr>
<tr>
<td>53</td>
<td>3</td>
<td>Scope Modification – Revise pipe alignment tolerance for installation flexibility</td>
<td>$0</td>
<td>0</td>
</tr>
<tr>
<td>54</td>
<td>2</td>
<td>Environmental Modification - Credit to share cost impacts of excessive nitrogen in discharge water</td>
<td>($36,574)</td>
<td>0</td>
</tr>
<tr>
<td>55</td>
<td>1</td>
<td>Environmental Modification - Credit unused balance of San Vicente Portal groundwater treatment</td>
<td>($50,361)</td>
<td>0</td>
</tr>
<tr>
<td>55</td>
<td>2</td>
<td>Environmental Modification – Credit for excess supply resin for ion-exchange process for San Vicente Portal supplemental groundwater treatment system</td>
<td>($127,386)</td>
<td>0</td>
</tr>
<tr>
<td>57</td>
<td>1</td>
<td>Scope Modification - Supply temporary construction water that is not available to the contractor from aqueducts during Water Authority shutdowns</td>
<td>$20,000</td>
<td>0</td>
</tr>
<tr>
<td>58</td>
<td>1-7</td>
<td>Scope Modification – Credit for unused pre-excavation grouting allowances</td>
<td>($1,195,000)</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>1</td>
<td>Differing Site Condition – Tunnel Reach 1 payment of undisputed amount for differing site condition cost impacts</td>
<td>$1,562,406</td>
<td>0</td>
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</tbody>
</table>

**Change Orders 52 – 55, 57, 58, 60 Approved at April 2009 Board Meeting:** $21,302,230

**Total time extension:** 3 days

**Original Board authorized contract amount:** $198,366,900

**New contract amount:** $219,669,130

<table>
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<th>Description</th>
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<tbody>
<tr>
<td>61</td>
<td>1</td>
<td>Design Modification - Revise access hatches size</td>
<td>$1,338</td>
<td>0</td>
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<tr>
<td>62</td>
<td>1</td>
<td>Administrative Modification - Partnering allowance increase</td>
<td>$12,500</td>
<td>0</td>
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<tr>
<td>63</td>
<td>1</td>
<td>Administrative Modification - Disputes Review Board allowance increase</td>
<td>$65,655</td>
<td>0</td>
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<tr>
<td>64</td>
<td>1</td>
<td>Design Modification - Incorporate revised Contract Drawings C-28 and C-29</td>
<td>0</td>
<td>0</td>
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<tr>
<td>64</td>
<td>2</td>
<td>Design Modification - Install junction boxes and conduits at West Shaft</td>
<td>$12,334</td>
<td>0</td>
</tr>
<tr>
<td>65</td>
<td>1</td>
<td>Design Modification - Replace Specification Section 11102 – Submersible Pumps</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>65</td>
<td>2</td>
<td>Design Modification - Relocate manual transfer switch</td>
<td>$10,940</td>
<td>0</td>
</tr>
<tr>
<td>65</td>
<td>3</td>
<td>Design Modification - Provide waterproof multi-pin plugs</td>
<td>$242</td>
<td>0</td>
</tr>
<tr>
<td>65</td>
<td>4</td>
<td>Design Modification - Delete nine intrusion alarms</td>
<td>($2,317)</td>
<td>0</td>
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<tr>
<td>65</td>
<td>5</td>
<td>Design Omission - Install service power</td>
<td>$1,200</td>
<td>0</td>
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<tr>
<td>66</td>
<td>1</td>
<td>Design Modification - Delete West Shaft lighting panel LP-3</td>
<td>($9,726)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and transformer</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>67</td>
<td>1</td>
<td>Environmental Modification - Credit unused balance of allowance for San Vicente Central Shaft water treatment provided by Change Order 42</td>
<td>(127,386)</td>
<td>0 days</td>
</tr>
<tr>
<td>67</td>
<td>2</td>
<td>Design Omission - Unused balance of allowance to perform liquid penetrant tests on root pass welds of tunnel pipes provided by Change Order 53</td>
<td>(63,712)</td>
<td>0 days</td>
</tr>
<tr>
<td>68</td>
<td>1</td>
<td>Design Modification - Add intrusion alarm in the PLC cabinet at Central Shaft and the RIO cabinet at the Portal</td>
<td>$514</td>
<td>0 days</td>
</tr>
<tr>
<td>68</td>
<td>2</td>
<td>Design Modification - Delete the video camera, multiplexer and T-1 service line at Central Shaft and replace with a 56K network connection, Cisco 2801 Router, and Cisco Integrated V.92 Modem</td>
<td>$3,016</td>
<td>0 days</td>
</tr>
<tr>
<td>68</td>
<td>3</td>
<td>Design Modification - Relocate PLC telephone equipment, Cisco 2801 Router, UPS, power block, and terminal block</td>
<td>0</td>
<td>0 days</td>
</tr>
<tr>
<td>68</td>
<td>4</td>
<td>Design Modification - Delete Human Machine Interface System at Central Shaft</td>
<td>($845)</td>
<td>0 days</td>
</tr>
<tr>
<td>68</td>
<td>5</td>
<td>Design Modification - Add a 6000 BTUH thermal edge air conditioning unit and 20 amp breaker and receptacle to the PLC cabinet</td>
<td>$3,617</td>
<td>0 days</td>
</tr>
<tr>
<td>68</td>
<td>6</td>
<td>Design Modification - Add a 20 amp receptacle for the telecommunication equipment</td>
<td>$320</td>
<td>0 days</td>
</tr>
<tr>
<td>68</td>
<td>7</td>
<td>Outside Agency Requirement - Install 900 feet of electrical conductors from the SDG&amp;E meter location at Stonebridge Parkway to the SDCWA PLC cabinet</td>
<td>$71,983</td>
<td>0 days</td>
</tr>
<tr>
<td>69</td>
<td>1</td>
<td>Administrative Modification - Credit the salvage value and unused allowance balance for Long Lead Digger Shield spare parts by Change Order 26</td>
<td>($186,109)</td>
<td>0 days</td>
</tr>
<tr>
<td>69</td>
<td>2</td>
<td>Administrative Modification - Credit the salvage value and unused allowance balance for Long Lead Digger Shield spare parts by Change Order 31</td>
<td>($66,134)</td>
<td>0 days</td>
</tr>
<tr>
<td>69</td>
<td>3</td>
<td>Administrative Modification - Credit the salvage value and unused allowance balance for Long Lead Digger Shield spare parts by Change Order 50</td>
<td>($45,767)</td>
<td>0 days</td>
</tr>
<tr>
<td>70</td>
<td>1</td>
<td>Design Modification - Modify bulkhead supports at Portal Isolation Vault</td>
<td>($6,775)</td>
<td>0 days</td>
</tr>
<tr>
<td>70</td>
<td>2</td>
<td>Design Modification - Modify grating in the West Shaft Access Structure</td>
<td>($2,875)</td>
<td>0 days</td>
</tr>
<tr>
<td>70</td>
<td>3</td>
<td>Design Omission - Dielectric isolation between dissimilar metals at the West Shaft</td>
<td>$1,404</td>
<td>0 days</td>
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<tr>
<td>70</td>
<td>4</td>
<td>Administrative Modification - Reimburse expenses for Tubos Y Activos Inspection</td>
<td>($7,603)</td>
<td>0 days</td>
</tr>
<tr>
<td>70</td>
<td>5</td>
<td>Design Modification - Delete mortar filled diapers for open cut pipe joints</td>
<td>($5,280)</td>
<td>0 days</td>
</tr>
<tr>
<td>71</td>
<td>1</td>
<td>Design Modification - Dewater existing Surge Control Facility Pipeline and install valves in the test bulkhead at Portal site</td>
<td>$9,631</td>
<td>0 days</td>
</tr>
<tr>
<td>71</td>
<td>2</td>
<td>Administrative Modification - Extend Time of Completion</td>
<td>$0</td>
<td>1 days</td>
</tr>
<tr>
<td>Date</td>
<td>Description</td>
<td>Amount</td>
<td>Days</td>
<td></td>
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<tr>
<td>71</td>
<td>Design Modification - Upgrade uninterruptable power source devices for Central Shaft and Portal</td>
<td>$2,137</td>
<td>0</td>
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<tr>
<td>71</td>
<td>Design Modification - Add electrical receptacle, conduit, and wire for Central Shaft Air Vacuum/Air Release Vault</td>
<td>$1,158</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Administrative Modification - Recover portion of Bid Item 30, Raw Material Cost Price Fluctuations</td>
<td>($1,400,000)</td>
<td>0</td>
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<tr>
<td>72</td>
<td>Administrative Modification - Recover remaining funds for weld testing</td>
<td>($156,888)</td>
<td>0</td>
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<tr>
<td>73</td>
<td>Contractor Error - Reimburse cost for NCR 10 Designer Analysis and Loss of Pipe Value</td>
<td>($20,169)</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Modification - Modify grading</td>
<td>$0</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Modification - Modify Portal Storm Drain Line “B” Alignment</td>
<td>$0</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Modification - Modify Portal Storm Drain Line “B” Structures</td>
<td>$6,493</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Modification - Modify Portal Storm Drain Line “D” Structures</td>
<td>$3,272</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Modification - Delete Portal Storm Drain Line “E”</td>
<td>($9,671)</td>
<td>0</td>
<td></td>
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<tr>
<td>74</td>
<td>Design Modification - Modify Portal lower access road</td>
<td>$1,047</td>
<td>0</td>
<td></td>
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<tr>
<td>74</td>
<td>Design Modification - Modify Portal access roads</td>
<td>$2,631</td>
<td>0</td>
<td></td>
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<tr>
<td>74</td>
<td>Design Modification - Add fall railing to retaining walls and Access Structure</td>
<td>$24,794</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Omission - Add reinforcing to Portal Isolation Vault</td>
<td>$885</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Modification - Add electrical conduit, wiring, and fiber optic cable</td>
<td>$0</td>
<td>0</td>
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<tr>
<td>74</td>
<td>Design Modification - Add camera pole and associated Conduit, wiring, and fiber optic cable</td>
<td>$9,937</td>
<td>0</td>
<td></td>
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<tr>
<td>75</td>
<td>Environmental Modification - Mobilize supplemental water treatment system at Slaughterhouse Shaft site</td>
<td>$3,500</td>
<td>0</td>
<td></td>
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<tr>
<td>75</td>
<td>Environmental Modification - Demobilize supplemental water treatment system at Slaughterhouse Shaft site</td>
<td>$2,042</td>
<td>0</td>
<td></td>
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<tr>
<td>75</td>
<td>Environmental Modification - Provide monthly operation and maintenance of supplemental water treatment system at Slaughterhouse Shaft site</td>
<td>$50,640</td>
<td>0</td>
<td></td>
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<tr>
<td>75</td>
<td>Environmental Modification - Supply resin for ion-exchange process at Slaughterhouse Shaft site</td>
<td>$30,492</td>
<td>0</td>
<td></td>
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<tr>
<td>75</td>
<td>Environmental Modification - Recover funds allocated in Change Order 51 for groundwater metals treatment system at Portal</td>
<td>($460,246)</td>
<td>0</td>
<td></td>
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<tr>
<td>76</td>
<td>Design Modification - Widening limits of Slaughterhouse Shaft access road</td>
<td>$0</td>
<td>0</td>
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<tr>
<td>76</td>
<td>Design Modification - Protect electrical facilities in Slaughterhouse Shaft access road</td>
<td>$0</td>
<td>0</td>
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<tr>
<td>76</td>
<td>Design Modification - Slaughterhouse Shaft access road, reduce Bid Item 406</td>
<td>($37,500)</td>
<td>0</td>
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<tr>
<td>77</td>
<td>Design Modification - West Shaft site</td>
<td>$0</td>
<td>0</td>
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<tr>
<td></td>
<td>Description</td>
<td>Cost</td>
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<td>---</td>
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<td>------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Community Accommodation - West Shaft fence</td>
<td>$48,798</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Design Modification - Drainage channel at West Shaft</td>
<td>$0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Design Modification - Modular concrete retaining wall guardrail</td>
<td>$36,943</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Design Modification - Disintegrated granite at West Shaft Flow Meter Vault</td>
<td>$2,979</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Outside Agency Requirement - Alemania Road gate</td>
<td>$5,828</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Design Modification - Conduit and wiring for irrigation controller at West Shaft</td>
<td>$4,940</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Differing Site Condition - Reach 1 Sink Hole Investigation and Repair</td>
<td>$58,912</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Design Modification - Overhead coiling door</td>
<td>$4,147</td>
<td>0</td>
<td></td>
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<tr>
<td>79</td>
<td>Design Modification - Wicket door lock</td>
<td>$529</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Design Modification - Exterior vault ladders</td>
<td>$5,189</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Field Modification - SDG&amp;E pole placement</td>
<td>$2,000</td>
<td>0</td>
<td></td>
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<tr>
<td>80</td>
<td>Administrative Modification - Disputes Review Board allowance</td>
<td>$22,500</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Design modification - Revegetation, landscaping and irrigation</td>
<td>($161,496)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Environmental Modification - Erosion control measures</td>
<td>$63,776</td>
<td>0</td>
<td></td>
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<tr>
<td>81</td>
<td>Environmental Modification- Irrigation sleeves</td>
<td>$7,703</td>
<td>0</td>
<td></td>
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<tr>
<td>82</td>
<td>Design Modification - West Shaft isolation joint access hatch</td>
<td>$12,027</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Design Modification - West Shaft working platform modifications</td>
<td>$7,262</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Design Modification - Second drain down of SVPS/S Pipeline</td>
<td>$20,580</td>
<td>0</td>
<td></td>
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<tr>
<td>83</td>
<td>Design Modification - Controlled low strength material backfill of Central Shaft 24-inch air vacuum/air release pipe</td>
<td>$9,800</td>
<td>0</td>
<td></td>
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<tr>
<td>83</td>
<td>Design Modification - Hydrostatic test Central Shaft 24-inch air vacuum/air release pipe</td>
<td>$15,200</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Design Modification - Modified leak test</td>
<td>($50,000)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Administrative Modification - Consultant evaluation of field applied cement mortar lining</td>
<td>($10,000)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Administrative Modification - Power fluctuation impacts</td>
<td>$11,253</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Design Modification - San Vicente Portal temporary access road</td>
<td>($2,000)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Administrative Modification - Unwatering pump casing video</td>
<td>($2,797)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Community Accommodation - Colored split face concrete masonry units</td>
<td>$8,019</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Administrative Modification - Recover funds allocated in Change Order 75 for groundwater metals treatment system at Slaughterhouse Shaft</td>
<td>($54,055)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Administrative Modification - Reconcile funds recovered in Change Order 67</td>
<td>$127,386</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>Community Accommodation - Landscape and irrigation modifications at Central Shaft</td>
<td>$51,225</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Change Order</td>
<td>Description</td>
<td>Amount</td>
<td>Days</td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>87</td>
<td>1</td>
<td>Administrative Modification - Disputes Review Board allowance</td>
<td>$51,000</td>
<td>0</td>
</tr>
<tr>
<td>88</td>
<td>1</td>
<td>Administrative Modification - Digger Shield allowance recovery</td>
<td>($17,250)</td>
<td>0</td>
</tr>
<tr>
<td>88</td>
<td>2</td>
<td>Differing Site Condition - West Shaft tie-in corrosion removal and repairs</td>
<td>$1,992</td>
<td>0</td>
</tr>
<tr>
<td>88</td>
<td>3</td>
<td>Administrative Modification - Partnering allowance recovery</td>
<td>($18,712)</td>
<td>0</td>
</tr>
<tr>
<td>88</td>
<td>4</td>
<td>Administrative Modification - Inclement weather days in October &amp; November 2010</td>
<td>$0</td>
<td>3</td>
</tr>
<tr>
<td>89</td>
<td>1</td>
<td>Outside Agency Requirement - Dechlor unwatering pump test water</td>
<td>$7,783</td>
<td>0</td>
</tr>
<tr>
<td>89</td>
<td>2</td>
<td>Design Modification - Chain link gate Central Shaft</td>
<td>$4,400</td>
<td>0</td>
</tr>
<tr>
<td>89</td>
<td>3</td>
<td>Field Modification - J-box at RPPCHF pump power</td>
<td>$2,464</td>
<td>0</td>
</tr>
<tr>
<td>89</td>
<td>4</td>
<td>Administrative Modification - Recover funds left from construction water</td>
<td>($5,686)</td>
<td>0</td>
</tr>
<tr>
<td>89</td>
<td>5</td>
<td>Differing Site Condition - Sink hole Reach 1 DSC additional authorization</td>
<td>$46,645</td>
<td>0</td>
</tr>
<tr>
<td>89</td>
<td>6</td>
<td>Administrative Modification – Inclement weather days in December 2010</td>
<td></td>
<td>5</td>
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<tr>
<td>89</td>
<td>7</td>
<td>Design Modification – West Shaft lower retaining wall foundation</td>
<td>$7,828</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total Change Order Amount 61 – 89**: ($1,948,169)  
**Total time extension Change Orders 61 - 89**: 9 days

**Total change order amount through Change Order 89**: $19,354,061  
**Total time extension**: 12 days  
**Original Board authorized contract amount**: $198,366,900  
**New contract amount**: $217,720,961
San Diego County Water Authority

January 6, 2011

Attention: Engineering and Operations Committee

Dreissenid Mussel Response and Control Plan (Action)

**Staff recommendation**
Approve the Water Authority’s Dreissenid Mussel Response and Control Plan which describes the plan for monitoring and controlling the spread of the invasive quagga mussel species.

**Alternatives**
Do not approve the Water Authority’s Dreissenid Mussel Response and Control Plan and instruct staff to work with the California Department of Fish and Game to modify the document. Modifying the document would compel staff to re-visit discussions with the Department of Fish and Game.

**Fiscal impact**
Funds in the amount of $12,500 are available within the Operations & Maintenance fiscal years 2010 and 2011 operating budget for quagga mussel monitoring. This item relates to the transportation rate category.

**Background**
In January of 2007, Dreissenid (Quagga) Mussels were discovered in the Colorado River System in Lake Havasu and Lake Mead. Within eight months of the initial findings, the spread of the mussels were confirmed in most lakes within San Diego County.

In October 2007, Assembly Bill 1683 (AB 1683) was adopted. This bill requires agencies to develop plans to monitor and control the spread of the Quagga Mussels. Since passage of AB 1683, the Water Authority has developed operating procedures and methods, including filtration, to control the spread of quagga mussels when performing routine maintenance and aqueduct dewatering activities.

In January 2008, mussel larvae were confirmed throughout the Water Authority’s delivery system, most likely coming from the Colorado River. Water Authority staff has been working with California Department of Fish and Game (DFG) for the past two years to develop a plan which would permit the movement of water between the Olivenhain Reservoir, which has quagga mussels, and Lake Hodges, which does not. These two reservoirs are considered one system and are essential in satisfying requirements of the Emergency Storage Project.

On January 3, 2011, DFG formally approved the Water Authority’s Dreissenid Mussel Response and Control Plan which complies with California Fish and Game Code Section 2301(d) requirements. This allows us to now begin wet-testing of the Lake Hodges Pumped Storage project.
Engineering and Operations Committee
January 6, 2011
Page 2 of 2

Discussion
The Water Authority’s Dreissenid Mussel Response and Control Plan contains the operating procedures required for:

- monitoring and delineation of quagga mussel infestation
- control or eradication of adult mussels and decontamination of water containing larval mussels
- conducting system inspections and coordinating with DFG
- updating or revising control or eradication measures in the approved plan to address future scientific advances in the methods of controlling or eradicating quagga mussels

Operations and Maintenance staff recommend approval of Water Authority’s Dreissenid Mussel Response and Control Plan to control the spread of the quagga mussel.

Prepared by: Joseph Wegand, Operations and Maintenance Manager
Reviewed by: Gary A. Eaton, Director of Operations and Maintenance
Approved by: Frank Belock, Jr., Deputy General Manager

Attachments:
1. Dreissenid Mussel Response and Control Plan
Dreissenid Mussel
Response and Control Plan

December 2010

Approved
By California
Department of Fish and
Game
January 3, 2011
Chief Preparer:
Lisa Prus
Supervising Management Analyst

Contributors:
Joe Wegand
Operations & Maintenance Manager

Larry Purcell
Water Resources Manager

Danny Allison
Operations Supervisor

Approved by:
Frank Belock
Deputy General Manager

Gary Eaton
Director of Operations & Maintenance
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Introduction

Agency Overview
The San Diego County Water Authority (Water Authority) is San Diego County's regional water wholesaler. It was formed in 1944 for the purpose of importing water to the region. The Water Authority’s service area consists of the western third of San Diego County where the majority of the population resides, and extends from Orange and Riverside counties to the border with Mexico as shown in Figure 1. The Water Authority’s mission is to provide a safe and reliable water supply to its 24 member agencies serving the region’s $171 billion economy and its 3 million residents.

The Water Authority’s source water originates from the Colorado River and Northern California’s State Water Project. It is delivered through Metropolitan Water District of Southern California (MWD) facilities at Lake Skinner. Delivery points from MWD are located south of the Riverside/San Diego county line. The Water Authority transmission system has the capacity to deliver up to 925 million gallons per day (MGD) of water. Of this capacity, 420 MGD is available as untreated water for supply to the region’s treatment plants and several reservoirs.

Figure 1 – San Diego County Water Authority Member Agency Map
Though water agencies within the County are not required to report infestations to the Water Authority, we have assembled an infestation matrix to aid in interagency coordination (Table 1). As of September 2010, all agencies and water bodies connected to the Water Authority’s untreated water delivery system are confirmed as infested, with the exception of Lake Hodges and San Dieguito Reservoir.

Table 1. San Diego County Reservoirs Receiving Imported Water

<table>
<thead>
<tr>
<th>Reservoir/Lake</th>
<th>Owner</th>
<th>Access to untreated Colorado River water</th>
<th>Infestation status (Sept. 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dixon</td>
<td>Escondido, City of</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>El Capitan</td>
<td>San Diego, City of</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Hodges</td>
<td>San Diego, City of</td>
<td>Yes</td>
<td>None verified¹</td>
</tr>
<tr>
<td>Jennings</td>
<td>Helix W.D.</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Lower Otay</td>
<td>San Diego, City of</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Miramar</td>
<td>San Diego, City of</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Murray</td>
<td>San Diego, City of</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Olivenhain</td>
<td>San Diego County Water Authority</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Poway</td>
<td>Poway, City of</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Ramona</td>
<td>Ramona M.W.D.</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>San Dieguito</td>
<td>San Dieguito W.D.</td>
<td>Yes</td>
<td>None verified²</td>
</tr>
<tr>
<td>San Vicente</td>
<td>San Diego, City of</td>
<td>Yes</td>
<td>Infested</td>
</tr>
<tr>
<td>Sweetwater</td>
<td>Sweetwater Authority</td>
<td>Yes</td>
<td>Infested</td>
</tr>
</tbody>
</table>

¹. Lake Hodges, owned by the City of San Diego, is connected to the Water Authority’s delivery system via the Olivenhain-Hodges pipeline. The pipeline is fully functional, but will not be in regular use until winter 2010. The reservoir received one positive test result for veligers in April 2008. Monthly tests since that time have yielded negative results.

². San Dieguito Reservoir is indirectly connected to the Water Authority’s untreated water delivery system, as it receives water from Lake Hodges through the 4.5 mile-long Lake Hodges flume. Monthly tests have yielded negative results.

An infestation map and list of reservoirs not connected to the Water Authority’s untreated water delivery system are shown in Appendix A.

Mussel Background

Quagga (Dreissena rostriformis bugensis) and zebra (Dreissena polymorpha) mussels are small freshwater bivalve mollusks from the dreissenid family. Adult dreissenid mussels may release 40,000 eggs in a reproductive cycle and up to one million during a spawning season. During the larval or veliger stage, mussels can float close to the water’s surface for several weeks before settling and attaching to almost any solid or semi-solid surface. Mussels reach reproductive maturity within 10 weeks of life. As mussel populations proliferate, they remove plankton and suspended particles from the water, decreasing food available for fish and other consumers and significantly altering the food chain. Figure 2 shows the life cycle of a zebra mussel.
Figure 2 - Zebra Mussel Life Cycle

Zebra mussels were transported from Europe to the Great Lakes via transoceanic ships in the 1980's and quagga mussels were found shortly thereafter. For approximately 20 years, the dreissenid mussel population remained east of the Continental Divide. In January 2007, quagga mussels were detected in Lakes Mead and Mojave as well as the lower Colorado River system. The San Diego region’s first quagga mussels were found by the City of San Diego at Lake Miramar in August 2007. In January 2008, quagga mussel veligers were found within the Water Authority’s aqueducts and Olivenhain Reservoir. Within the United States and in other areas of the world, these mussels are considered an invasive species with significant impact to the ecosystem.

Of particular concern to water providers, large populations of adult mussels can clog water delivery system components, increasing maintenance costs and disrupting operations related to recreation, hydroelectric power production, and untreated water delivery.

Objectives/Plan Summary
The objectives of the San Diego County Water Authority Dreissenid Mussel Response and Control Plan (Plan) are to: 1) describe actions to be undertaken by the Water Authority in response to the system-wide quagga mussel infestation; and 2) meet control plan development requirements as described under California Fish and Game Code section 2301. (See Appendix B for code text.)

It is important to note that the Water Authority’s entire untreated water transmission system has tested positive for quagga mussel presence. Prevention against infestation within the Water Authority’s system is not possible. Continued source water infestation obligates us to concentrate on population control if we are to fulfill our mission.

This Plan commits to seven management actions that guide the course of the Water Authority’s efforts to manage quagga mussel infestation in our system and minimize the potential spread of the mussel to currently uninfested areas. The Water Authority will do the following:

1. Evaluate system component vulnerability
2. Perform regular system monitoring for quagga/zebra mussels
3. Comply with established reporting requirements
4. Perform outreach activities that promote awareness of quagga/zebra mussels and proactive steps to minimize further spread
5. Participate in selected research projects to improve response and control options
6. Implement best management practices (BMPs) to minimize mussel spread
7. Implement BMPs for mussel population management

This Plan may be expanded to incorporate compliance with future state and federal regulations. It will be reviewed periodically and updated as required.
Infestation Management Actions

Vulnerability and Risk Analysis

Management Action #1: Evaluate system component vulnerability

Awareness is the first step in defining response activities and provides options to decision makers when considering acceptable agency risk. The initial vulnerability analysis also has the benefit of generating a base system status useful for comparison as an infestation progresses. Subsequent physical inspections may alter the validity of earlier analyses and result in modification to risk management decisions and maintenance activities. The Water Authority will analyze system component vulnerability as follows:

1. Review available documentation from industry researchers and others to set basis for analysis.
2. Hold meeting(s) with Water Authority subject matter experts (SMEs) to discuss system components that may be susceptible to damage/failure due to mussel population growth.
3. Establish representative sample sites for physical inspection.
4. Assign staff and schedule inspection.
5. Document current condition of inspected sites, noting areas of concern including:
   a. Component criticality to overall system operation
   b. Likelihood of component damage/failure
   c. Potential liabilities as a result of component failure
   d. Time to repair if damaged/failed
6. Determine whether additional sites should be physically inspected.
7. Consolidate findings, establish re-inspection frequency, and revise monitoring plans.
8. Determine other actions to be taken based on current system conditions and trend analysis.

Progress Update

The Water Authority conducted a preliminary vulnerability analysis in October 2007, prior to documented mussel infestation. Crews physically inspected system components during scheduled preventive and corrective maintenance activities. Priorities were set as follows:

1. Gather knowledge and practices from affected agencies and evaluate applicability to Water Authority system operation.
2. Provide training to staff in mussel identification.
3. Inspect additional system components during preventive and corrective maintenance activities.

In May and June 2008, system operations and maintenance SMEs met and discussed facility types, system components, and operating conditions and indicated level of concern over mussel fouling. At the time, the system had tested positive for veliger stage mussels and a small number of adult mussels had been found in Olivenhain Reservoir.

SMEs prepared a list of system components believed to be susceptible to mussel inhabitance (Table 2). Due to the number of facilities and components within the system, a limited number of each facility type was inspected.
Table 2 – System components

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Quantity in System</th>
<th>Responsible</th>
<th>What to inspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Control Facilities</td>
<td>104 active, 21 inactive</td>
<td>Maintenance &amp; Electrical/Electronics Technicians</td>
<td>Instrumentation (Differential Pressure (DP), Venturi) Airpots Bypass valves Drain ports (easiest way to check)</td>
</tr>
<tr>
<td>Air Vac/Blow Offs</td>
<td>~1600</td>
<td>Maintenance</td>
<td>No dismantling; observation only during shutdown or regular maintenance.</td>
</tr>
<tr>
<td>Weir &amp; Flow Regulatory Structure (FRS)</td>
<td>5</td>
<td>Operations &amp; Water Quality</td>
<td>Concrete Inlet/Outlet</td>
</tr>
<tr>
<td>Reservoir &amp; Dam</td>
<td>1</td>
<td>Operations</td>
<td>Fish screens Intakes Gates Trash racks Carpi liner</td>
</tr>
<tr>
<td>Pump Stations</td>
<td>6</td>
<td>Maintenance &amp; Electrical/Electronics Technicians</td>
<td>Wet wells Pump cans Hydraulic valves Sample/Inst. Lines Bypass lines (quick check) Cooling systems</td>
</tr>
<tr>
<td>Hydroelectric Facilities</td>
<td>2</td>
<td>Operations</td>
<td>Cooling lines</td>
</tr>
</tbody>
</table>

As a result of the analysis, the Water Authority did not invalidate the perceived vulnerability of any of the above facilities and components. Neither did we find adult dreissenid mussel populations at Water Authority facilities other than Olivenhain Reservoir and pipeline. We will continue to inspect components during routine maintenance activities and periodically gather and evaluate new information or new system components as warranted.
Monitoring

Management Action #2: Perform regular system monitoring for quagga and zebra mussels

A monitoring program includes ongoing observation to establish the presence or absence of veliger and adult dreissenid mussels, as well as population data over time. The Water Authority will use the following monitoring methods for this purpose:

- Substrate monitoring using “coupons” – picture documentation
- Plankton tows at reservoir and storage facilities – evaluated using polymerase chain reaction (PCR) and microscopy methods
- Remotely operated vehicle (ROV) inspection – video documentation
- Other physical monitoring of population – picture documentation

Substrate Monitoring

Substrate monitoring provides a sample of adult population growth within a water body or water storage facility without the need for expensive equipment or processes. The Water Authority will place substrate monitoring “coupons” in Twin Oaks FRS (system north), Olivenhain Reservoir (system north-center), Slaughterhouse Weir (system center), and Otay Weir (system south) and document population growth on a regular basis (see Figure 4). Documentation typically consists of photographs with strategically placed measuring devices such as coins and rulers.

Coupons may be constructed of PVC/ABS pipe or plates, wire mesh, concrete blocks, wood, etc. A sample process for substrate evaluation is included in Appendix C.

Plankton Tows

The Water Authority will also collect samples at Olivenhain Reservoir, Twin Oaks FRS, Slaughterhouse Weir, and Otay Weir using a plankton tow technique (Appendix C). Plankton tows concentrate significant volumes of water into a manageable size for transport. These samples will be analyzed within a laboratory to quantify veliger population density and characterize spawning cycles on a regular basis.

Figure 4 - Standard Sampling Locations
San Diego County Water Authority
Quagga Mussel Response and Control Plan

Lab testing consists of evaluation by polymerase chain reaction (PCR), which provides a presence or absence result and delineates dreissenid subspecies, or microscopy, which allows non-specific dreissenid identification and population quantification.

ROV Inspection
ROV inspection is preferred for monitoring adult infestations in areas that are difficult or impractical to drain for inspection. Most ROV systems are capable of capturing time, depth, and temperature readings and may have the capability to collect samples for closer inspection using a grab arm. Olivenhain Reservoir is a good candidate for inspection using this method. Other portions of the Water Authority’s infrastructure may be identified for ROV inspection at a later date.

Other Physical Monitoring
Physical monitoring is also conducted during maintenance activities. The Water Authority regularly schedules pipeline and facility maintenance and inspections each year. As infrastructure components are drained, crews trained in mussel identification will note presence or absence of adult mussels and quantify populations. Actions may be taken to reduce populations if deemed harmful to system operation and will be evaluated on a case-by-case basis. See the “Maintenance Planning” section for more information on these activities.

For open water bodies, such as Olivenhain Reservoir, the Water Authority will also observe other indicators of mussel growth by inspecting rocks and loose materials at water’s edge or noting changes in water clarity during routine water quality sampling activities.

Progress Update

Substrate Monitoring
Coupons are viewed on a regular schedule (approximately monthly) and photographs are stored electronically in our archives.

Plankton Tows
In January 2008, the Water Authority contracted with UCSD – Scripps Institution of Oceanography to analyze water samples using PCR and microscopy. This contract is valid through January 2011. The contract is also available to other public agencies within the State of California through a public agency clause.

Sampling results indicate that veliger populations are sparse in December, January and February (Appendix A). Because PCR and microscopy focus on the veliger stage, sampling during this period may result in very low to no veligers detected, even if adults are present. The Water Authority will conduct this type of sampling monthly from March through November. Substrate monitoring will continue to occur during months when plankton tows are not taken in order to document adult mussel growth patterns.

Periodically, the Water Authority may also arrange for a limited number of samples to be tested at MWD for comparison and quality assurance.

ROV Inspection
The Inlet/Outlet (I/O) tower and dam at Olivenhain Reservoir were initially inspected using ROV technology in February 2009. Subsequent inspections took place in June 2009 and October 2009 and included the I/O tower and dam as well as the tunnel and trash racks near the Olivenhain-Hodges headworks connection. The reservoir level was temporarily lowered in September 2008 and again in January, February and May 2009 resulting in adult mortality visible during subsequent ROV inspections.
**Other Physical Monitoring**

Maintenance inspections of Water Authority facilities regularly occur during the course of normal business. As maintenance crews perform preventative or corrective maintenance at a facility, they may disassemble components of the delivery system, perform inspections and note any infestation present. Large scale maintenance inspections occur during aqueduct shutdowns. Shutdowns provide staff with an opportunity to inspect untreated pipeline sections and larger facilities that are difficult to inspect even with ROV technology. With the exception of Olivenhain Dam, Reservoir and untreated water pipeline, all inspected Water Authority system components have little to no adult mussel presence.
Reporting

Management Action #3: Comply with established reporting requirements

Several reporting requirements exist related to quagga mussels and general water releases.

Sighting Reports
The Water Authority will report new discoveries of dreissenid mussel populations (adult or veliger) in Water Authority facilities to the California Department of Fish and Game (CDFG) via e-mail to the Region 5 representative and using the online reporting form. We will also report new infestation locations to the United States Geological Survey (USGS). A notification flow chart including contact information can be found in Appendix B.

Water Release Reports
The Water Authority will report planned and unplanned water releases per regulatory requirements of CDFG and the San Diego Regional Water Quality Control Board (RWQCB).

Annual CDFG Reports
The Water Authority will prepare an annual report on quagga related activities and submit to the Region 5 CDFG representative. The report will include items such as veliger sampling, pipeline dewatering and maintenance, and activities pertaining to the handling of potentially dreissenid contaminated equipment and water. At the request of CDFG, the reporting schedule and content may be modified.

Interagency Working Group Reports
Periodic updates on infestation status will be provided to the San Diego Regional Quagga Mussel Working Group (working group) which is an information sharing consortium consisting of Water Authority member agency representatives and other interested parties in San Diego and southern Riverside counties. We will maintain an e-mail contact list for ease of communication.

Progress Update

Sighting Reports
The Water Authority reported a system-wide quagga mussel infestation in January 2008 when all four monitoring sites tested positive for quagga veligers via PCR and microscopy. If zebra mussels are discovered within the Water Authority’s system, a new report will be filed.

Water Release Reports
The Water Authority reports water releases to RWQCB as required by terms within permits, such as NPDES.

Annual CDFG Reports
CDFG issued a Maintenance Activity Letter Permit to the Water Authority on November 12, 2009. It authorizes trained Water Authority staff to collect and transport quagga and/or zebra mussels during routine maintenance activities and requires an annual report of activities be submitted to the Regional CDFG representative. A copy of the letter permit is located in Appendix B. An annual report has been prepared for November 2009 through November 2010. Annual reports are scheduled to be completed each November.

Interagency Working Group Reports
The working group held meetings on a quarterly or more frequent basis during preparation of a regional planning guide. The guide was issued in June 2008. In August 2008, the group determined e-mail communication along with semi-annual meetings was appropriate to maintain information sharing. The
Water Authority gathers regional information and reports pertinent information to the group on a periodic basis. The next working group meeting is planned for April 2011.
Outreach

Management Action #4: Perform outreach activities that promote awareness of quagga/zebra mussels and proactive steps to minimize further spread

Staff Outreach
The Water Authority will present periodic updates to general staff on the current regional infestation status. Field staff will receive more frequent informational updates as well as periodic training in inspection methods and control measures to be used during untreated water system maintenance activities. The O&M department will post updated status, links to publications, and other related items on the Water Authority’s intranet site.

Customer Outreach
The Water Authority’s “customers” are our 24 member agencies. Water Authority Member Agency Operating Heads meetings provide a monthly forum to discuss dreissenid mussel issues at an operational level. The Regional Quagga Mussel Working Group will meet semi-annually to discuss infestation status, regulatory issues, training, information sharing, and other items of interest. Information updates will also be distributed to both groups via e-mail.

Public Outreach
The Water Authority will promote awareness of quagga and zebra mussels, including personal prevention activities, by providing pamphlets, posters, and other available publications supplied by CDFG and others at public events where outreach activities are planned. Since no boating or other water related activities are allowed at the Olivenhain Reservoir, the Water Authority’s sole reservoir, outreach to boaters will be incidental. Outreach for recreational water bodies within the County is conducted by each reservoir owner.

The Water Authority will cooperate with local environmental groups who are monitoring area waterways that periodically receive water originating from the Colorado River Aqueduct, such as from water discharged during shutdown activities.

Progress Update

Staff Outreach
General staff updates have been conducted, annually or as warranted, via presentation during agency-wide meetings. Status updates for O&M staff are provided monthly during department meetings. Updates to Engineering and other field staff are provided during department or special meetings as pertinent information becomes available.

Thus far, O&M staff training consists of

- Component inspection techniques during preventive and corrective maintenance, including distribution of a mussel identification sheet
- Communicating standard methods for sample collection by Operators
- Procedures for evaluating filtration needs during drainage activities
- Monitoring and control techniques during planned untreated water drainage activities.

A few of the available staff training/informational materials are shown in Appendix C. Field staff updates are made in the form of presentations as well as written procedures. Updates are typically provided monthly at O&M department meetings and training is refreshed annually prior to the start of shutdown season in early fall.
Customer Outreach
The Water Authority’s outreach activities have been focused on relaying information to our member agencies. In August 2007, the Water Authority formed the San Diego Regional Quagga Mussel Working Group (working group). The working group primarily concentrated on sharing available information and culminated in the preparation of a regional planning guide in June 2008. The guide was intended to aid agencies as each developed their agency specific action plan.

Public Outreach
The Water Authority maintains a stock of outreach materials as provided by CDFG and distributes these to member agencies upon request. Member agencies and recreational reservoir owners conduct boater outreach and interact directly with the public at each reservoir. The Water Authority makes these items available to the public at community outreach events where the Water Authority has a booth or other information distribution point.

Water Authority staff gave a quagga mussel overview presentation at the San Diego Waterworks Group in March 2008 and participated in an AwwaRF panel discussion of quagga mussel control activities in April 2008.
Research and Development

*Management Action #5: Participate in research projects to improve response and control options*

The Water Authority will monitor research activities being conducted by other agencies (MWD, USBR, SNWA, etc.) and participate where practical. Because the Water Authority has no dedicated facilities or staff for research, opportunities for original research are very limited.

Activities that the Water Authority may participate in include, but are not limited to, the following:

1. Participate with MWD in viability and population characterization tests by providing samples and test data.
2. Coordinate with MWD to allow installation of a bio-box at Twin Oaks Valley WTP inlet piping (MWD will monitor adult population growth for understanding of effects of residual chlorine on population settlement).
3. Monitor ongoing research on coatings, bacterial biopesticides, ultraviolet light treatment, filtration systems, etc., being conducted by USBR, MWD and others. Evaluate for applicability in Water Authority system.
4. Evaluate use of impressed current cathodic protection at Olivenhain reservoir as a possible mussel control method.

New projects, partnerships, or funding sources for research and development will be explored by monitoring websites, attending working group meetings, soliciting staff input, etc.

Progress Update

1. MWD is developing a procedure and seeking regulatory approval to conduct a mussel viability study which will evaluate potential recovery of veliger stage mussels after reduction in chlorine residual. The Water Authority may participate in this project by providing test data from plankton tows and will, when requested, provide water samples to MWD for further evaluation.
2. A bio-box was installed by MWD staff on September 17, 2009. The purpose of this test is to document the downstream effects of the chlorine application on mussel settlement. Chlorine is applied at Lake Skinner, which is approximately 40 miles north of the bio-box location at Twin Oaks Valley WTP. Chlorine residuals measured at the nearby FRS are minimal.
3. Water Authority staff are in contact with operations, water quality, and research personnel at MWD, US Bureau of Reclamation (USBR), and Southern Nevada Water Authority (SNWA). We continue to gather information regarding ongoing testing and trials. As new facilities are designed, we will continue to evaluate reasonable and cost effective steps we can take to better protect them using the experience of these agencies. For example, the Water Authority is actively monitoring developments in coatings and evaluating potential for use at the San Vicente Dam (owned by City of San Diego) as part of the Water Authority’s San Vicente Dam Raise project. We are also monitoring progress in the EPA approval of Zequanox™ and are working with the California Department of Public Health, Drinking Water Division to develop the potential to use this product in California reservoirs, once EPA registration is attained. Drinking water regulations are a significant concern and will take time to address if any of the materials currently under evaluation are proposed for implementation.
4. At Olivenhain Reservoir, the Water Authority is evaluating the effects of cathodic protection and impressed current on mussel settlement. An impressed current cathodic protection system was installed at Olivenhain Dam during original construction. We will be evaluating existing current densities and whether increased protection against mussel settlement is available by varying the current. A preliminary test of impressed current for cathodic protection shows some promise. Additional evaluation may be conducted as resources become available.
Maintenance Planning

Water Release Controls

Management Action #6: The Water Authority will implement best management practices (BMPs) to minimize mussel spread.

As a result of continued source water infestation, delivered through the Colorado River Aqueduct by MWD, quagga mussels are present throughout the Water Authority’s untreated water delivery system. During shutdowns, service outages, and other maintenance activities, the Water Authority discharges water that may enter streams or other non-connected waterways not documented as infested. This is the Water Authority’s sole prevention opportunity.

The Water Authority has developed a process to aid in determining whether filtration or other control method is appropriate to implement during drainage/maintenance activities. This process is summarized below.

1. Document untreated water drainage locations, volumes, water conditions, timing constraints, and anticipated weather conditions to determine if conditions support live mussels.
2. Print appropriate GIS maps and mark drainage locations, noting proximity to active water bodies.
3. Evaluate potential for discharged water to enter active waterways based on anticipated site conditions.
4. Select filtration method, if deemed necessary.
   a. Mechanical filtration: 25 microns or smaller without chlorination
   b. Mechanical filtration: 150 microns or smaller when using chlorine/de-chlorination in conjunction with filters (see Figure 6). "Using chlorine" indicates that levels are being increased by at least 0.5 ppm at the dosing point.
5. Notify regulatory bodies of discharge, as required.
7. Submit summary of discharges to CDFG annually. See “Reporting” for more information.

The detailed process and standard evaluation forms as well as mechanical filtration product information are located in Appendix C.

Figure 6 - Mechanical Filtration using Vacuum Dewatering Box
System Maintenance Options  
*Management Action #7: The Water Authority will implement BMPs for mussel population management.*

Scheduled Maintenance  
As the infestation progresses, the Water Authority will make choices about which system components require additional scheduled maintenance and establish site specific recommendations for population control. These decisions will require evaluation of delivery system constraints and consider effect of an outage on the Water Authority’s ability to accomplish its mission and meet contractual and regulatory requirements.

Some more typical methods that may be implemented to repair or reverse the effects of mussel infestation on system components are:

- Reservoir or pipeline draw down for mussel desiccation
- Spot super-chlorination (isolated instances)

Other methods, geared towards limiting mussel settlement in critical areas, include:

- Increased component exercise frequency, where a track or guide is involved, to eliminate clumped or established populations that could interrupt flow or component operation
- Physical removal of mussels including pressure washing and scraping

As research and development yields applicable information, changes may be made to standard practices for scheduled maintenance.

Design Considerations  
Designing new facilities and facility retrofits will be a new challenge in selecting components that will be resistant to damage from infestation. In addition, we must ensure that contractors are committed to spread prevention activities.

The Water Authority is in the early stages of developing a comprehensive asset management program. This will include developing a process to evaluate existing infrastructure and the design of proposed new components. Long term measures to address quagga and zebra mussel effects on system performance will need to be included to avoid excessive physical maintenance and decreased component longevity. During the planning and design process, practical and proven control measures will be considered for implementation.

To ensure control is implemented as necessary during construction of Water Authority capital projects, staff will consider addition of mussel control requirements to our General Conditions and Standard Specifications (GCSS), also known as the White Book. The White Book informs contractors of general requirements they will be expected to meet during the construction and testing of Water Authority facilities.

Progress Update  

Water Release Controls  
The Water Authority has used filtration as a control method during planned water releases since February 2008. Testing conducted by CDFG in select areas of the San Diego River, one of the waterways affected by the Water Authority’s releases, has not resulted in any positive identifications. The Water Authority intends to use this method as its primary control for non-infested waterway protection. The annual report, submitted to CDFG, will include a summary of all planned, untreated water releases.
**System Maintenance Options**

**Scheduled Maintenance**
The primary focus for system maintenance has been at Olivenhain Dam and Reservoir. Refer to “Specific Component/Location” section for more information.

**Design Considerations**
The most recent example of this effort is in the design of control measures for use at the San Vicente Dam. The San Vicente Dam is being raised by the San Diego County Water Authority and will be owned and operated by the City of San Diego.

Some examples of recent recommendations include:

- Use of metal seated valves, where practical, to avoid damage to rubber components, such as valve seats, and increase likelihood of mussel destruction when exercising valves
- Installation of injection ports to increase access and allow potential for chemical or other injection
- Allowance for high pressure wash systems and cleanouts

Recently, USBR released a Facility Vulnerability Assessment Template for identifying at-risk components and structures. This template and the associated appendices may be useful to designers when developing plans for new untreated water facilities. It is currently under consideration by the Water Authority’s Engineering Department.
Specific Component/Location Activities

The Water Authority may periodically develop activity plans associated with a particular system component or location due to its unique attributes. One such location is the Olivenhain Dam and Reservoir.

Olivenhain Dam and Reservoir

Background

The Water Authority owns and manages one reservoir, the Olivenhain Reservoir. Planning for the reservoir began in the early 1990’s as part of the Water Authority’s Emergency Storage Project (ESP). The ESP is a complex connection of reservoirs, pipelines and other facilities designed to facilitate water delivery within the County during an extended MWD supply outage. It is more fully described in Appendix D.

The Olivenhain Dam was completed in 2003 and the Olivenhain Reservoir became operational in 2004. Water is not regularly transmitted to/from this reservoir for distribution within the County due to its designation as an emergency supply. Boating, fishing and other recreational water activities are not allowed at this reservoir.

The Olivenhain Reservoir tested positive for the presence of quagga veligers in January 2008 and adult quagga mussels were found in March 2008. Quagga mussels were introduced into the reservoir through water deliveries originating from the Colorado River. The Water Authority monitors and performs maintenance at the reservoir in an attempt to stem the growth of quaggas on critical water delivery system components.

Monitoring, Maintenance and Control Practices

The Water Authority continues to monitor industry progress to improve methods to control the quagga mussel population in Olivenhain Reservoir. At this time, the following monitoring, maintenance, and control measures are planned or currently in practice:

Table 3. Quagga Monitoring, Maintenance and Control Practices

<table>
<thead>
<tr>
<th>Measure</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Monitor coupons and test plankton tows</td>
<td>Monthly</td>
</tr>
<tr>
<td>2. Exercise fish screens to remove quaggas from guide tracks</td>
<td>Bi-monthly</td>
</tr>
<tr>
<td>3. Exercise Inlet/Outlet tower gates to clean gate shafts</td>
<td>Bi-monthly</td>
</tr>
<tr>
<td>4. Conduct ROV inspection of critical facility components</td>
<td>3 times/year</td>
</tr>
<tr>
<td>5. Spot super-chlorination</td>
<td>As required</td>
</tr>
<tr>
<td>6. Lower reservoir level for mussel desiccation</td>
<td>As required</td>
</tr>
<tr>
<td>7. Remove quagga mussels from critical facility components</td>
<td>As required</td>
</tr>
</tbody>
</table>

1. **Monitor coupons and test plankton tows – Monthly**
   The Water Authority currently monitors substrates within the Olivenhain Reservoir for quagga mussel population growth. Operations staff also collect plankton tow samples near the Inlet/Outlet (I/O) tower on a monthly basis from March to November. Plankton tows are tested at UCSD-Scripps Institution of Oceanography to determine number of veligers per liter sampled.
2. **Exercise fish screens to remove quaggas from guide tracks – Bi-monthly**
   During recent ROV inspections, it was noted that quagga mussels are populating fish screen guide tracks. Exercising the fish screens every two months should enable continued function of the fish screens.

3. **Exercise I/O tower gates to clean gate shafts – Bi-monthly**
   During recent ROV inspections it was noted that quagga mussels are populating I/O gate shafts. Exercising the gates every two months should enable continued ability to open valves effectively and alleviate potential for damage to motor components from the increased resistance provided by the shells.

4. **Conduct ROV inspection of critical facility components – 3 times per year**
   ROV inspection is proposed to occur in February, June and October. Inspection of the I/O tower, trash racks, Carpi liner and other components will support the ability to make informed decisions about what maintenance is required, as well as document population fluctuations over time.

   A June 2009 remotely operated vehicle (ROV) inspection showed that mussels on the dam were concentrated between 25 and 100 feet below the water surface (el. 1053 – 978). Mussels are present down to the reservoir floor. Results from each inspection are compared to determine adult population growth rate and identify areas of concern.

5. **Spot super-chlorination – As required**
   Operations staff will evaluate the feasibility of super-chlorinating the I/O tower and other critical components to reduce mussel population within those areas. Because of regulatory constraints, this measure will likely only be used in isolated instances and not as a regular control method.

6. **Lower reservoir level for mussel desiccation – As required**
   Based on periodic ROV inspection results or as a result of seasonal delivery plans, the Water Authority may reduce reservoir levels to kill mussels located on the dam and exposed surfaces of the reservoir. Considerations must be given to the cost for pumping to/from the reservoir and required emergency storage levels when exercising this option.

   In late July through September 2008, the reservoir was held at a 1045 elevation to desiccate quagga mussels at upper levels. This process was successful in eliminating mussels lodged in rocks and crevices above the water line.

7. **Remove quagga mussels from critical facility components – As required**
   Based on periodic ROV inspection results, the Water Authority may determine that physical removal of mussels is required. Mussel removal may be done in conjunction with lowering reservoir levels, through use of ROV collection tools, or through use of divers. Because each of these methods is cost and time intensive, a cost benefit analysis will be done before this measure is enacted.
Olivenhain-Hodges Interconnect Pipeline

Background
As part of the Water Authority’s Emergency Storage Program, the Olivenhain Reservoir will deliver water to Lake Hodges through the Olivenhain-Hodges interconnect pipeline, which was completed in 2007. The Olivenhain-Hodges pipeline will begin regular deliveries upon completion of the Lake Hodges Pump & Hydroelectric facility. Facility testing is scheduled to begin in Winter 2010.

Lake Hodges is a non-contact recreational water body owned by the City of San Diego. It currently receives water through local runoff from rainfall. The reservoir is listed as an impaired water body with the State Water Resources Control Board and Environmental Protection Agency (EPA) under Clean Water Act section 303(d). A 303(d) listed water body is one that does not meet water quality standards that states, territories, and authorized tribes have set, even after point sources of pollution have installed the minimum required levels of pollution control technology. Lake Hodges is 303(d) listed for the following constituents: color, manganese, nitrogen, pH, phosphorus, and turbidity.

The City of San Diego has contractual obligations to supply water from Lake Hodges to Santa Fe Irrigation District and San Dieguito Water District. Water for both agencies is delivered from Lake Hodges to San Dieguito Reservoir through the Hodges Flume. The San Dieguito Reservoir is effectively a forebay to the R.E. Badger Filtration Plant (Badger FP). Water from San Dieguito Reservoir is blended with water supplied from the Water Authority’s transmission system at the San Dieguito/Santa Fe 3,4,5 Flow Control Facility and treated at Badger FP. Existing poor water quality in Lake Hodges is untreatable at certain times of year. Amounts delivered from Lake Hodges to San Dieguito Reservoir may vary for this reason. The Water Authority does have capacity to provide the full amount required to run the 40 MGD Badger FP through existing untreated water connections, but currently only supplements this operation. The amount of untreated water delivered by the Water Authority is determined by each member agency as they weigh acquisition costs of local and imported supplies.

Industry-wide, other than eliminating the connection, effective measures to prevent the spread of quagga mussels to interconnected water bodies have not yet been discovered. Because the Olivenhain-Hodges interconnection is integral to the Water Authority’s ability to deliver drinking water to the San Diego region’s more than three-million residents, we have attempted to find a practical way to control mussel transfer while enabling regular operation. Since 2008, the Water Authority has collaborated with regional representatives from CDFG on this issue and has evaluated a number of proven and available control technologies. These technologies include, but are not limited to, chlorination, desiccation, mechanical filtration, percolation, ultraviolet disinfection, turbidity, and natural system controls. Details of each of these methods and applicability to movement of water through the Olivenhain-Hodges Interconnect Pipeline can be found in Appendix A. Control technologies to be implemented include:

Table 4. Mussel Control Technologies

<table>
<thead>
<tr>
<th>Method</th>
<th>Locations</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desiccation</td>
<td>• Olivenhain Reservoir</td>
<td>MWD has used desiccation in conjunction with inducing anoxic conditions on one of their reservoirs each year. Desiccation provides mussel kill above the water line, while anoxia can result in mussel death in deeper water. Conditions are maintained for approximately one month during the summer. This exercise is secondary to the delivery of water and may be aborted should water demands require it. Mussels can recover if the process is aborted early and new settlement occurs rapidly after conclusion due to source water infestation. Water quality is temporarily affected by this activity.</td>
</tr>
<tr>
<td></td>
<td>• Lake Hodges</td>
<td>The Water Authority uses desiccation for mussel kill annually at Olivenhain Reservoir. Olivenhain Reservoir does not currently exhibit anoxia at any time, so mussel kill is limited to the</td>
</tr>
</tbody>
</table>
drawdown area. Draw down does not typically exceed 1045 feet in elevation, which means that mussel kill is limited to the first 33 feet of depth along the shoreline.

Lake Hodges does exhibit anoxia at certain times of year in portions of the reservoir. The Water Authority will coordinate with the City of San Diego as needed to accomplish desiccation where possible. The likely opportunity would be late summer/early fall as the reservoir is drawn down to prepare for winter rains.

Conclusion: While this method will not eliminate the mussels or prevent their transfer, it will be used as a control measure to inhibit their uncontrolled growth.

<table>
<thead>
<tr>
<th>Natural: Anoxia</th>
<th>Lake Hodges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anoxia is observed in portions of Lake Hodges and is expected to provide localized population control. Mortality rate increases with duration. After 4 weeks, expect total kill in anoxic zones.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Natural: Low pH</th>
<th>Olivenhain Reservoir, Lake Hodges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low pH is naturally observed on occasion and may increase mussel mortality in both Olivenhain Reservoir and Lake Hodges. In summer 2010, low pH occurred below 990 feet elevation in Olivenhain Reservoir for several weeks. This is the first time a pH under 7 has been observed in the reservoir. Using ROV inspection, we will continue to monitor how effective these events are in controlling quagga mussels at those depths.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical removal</th>
<th>Olivenhain Reservoir, Lake Hodges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on results of ROV or other physical inspections, divers, ROV, or other means may be used to remove mussels from heavily infested components</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Turbulence</th>
<th>Olivenhain-Hodges Pipeline, Hodges Pumped Storage, Lake Hodges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to water turbulence has been shown to contribute to substantial damage or outright mortality in veligers (Rehmann et al 1999, Horvath and Crane 2010). The Olivenhain/Hodges water supply system consists of a 1.25 mile pipeline flowing at an average of 315,000 gallons per minute that originates at Olivenhain Reservoir and drops in elevation by 700 feet before entering two electrical generating turbines below the shoreline at Hodges Reservoir. An analysis using methodologies developed by others concludes that hydrodynamic forces generated in the Olivenhain/Hodges system results in 100% mortality in all mussel size classes.</td>
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</tbody>
</table>

Based on the cooperative evaluation of theoretical control measures by the Water Authority and CDFG, the most significant control will be realized through turbulence associated with high water velocity and pressures during transit through the Olivenhain-Hodges Interconnect Pipeline and turbines at the Hodges Pumped Storage facility. These forces are anticipated to result in total mortality to veligers entering the system. The Water Authority continues to explore additional methods of control and will continue to cooperate with CDFG to evaluate new, proven scientific methods that can be applied at this site.
General Operating Information
The Olivenhain Reservoir receives water from the Second San Diego Aqueduct through Pipeline 5 and is capable of holding over 24,000 acre-feet (AF) of water. Emergency storage agreements require 18,000 AF of stored water be maintained until the San Vicente Dam Raise project is completed in 2014. An operating building at the southwest portion of the reservoir contains a gate shaft that allows water to be delivered from Olivenhain Reservoir into Lake Hodges via a tunnel and interconnect pipeline. The tunnel invert elevation is 964 feet above sea level. Water enters Lake Hodges at the invert, at an elevation of 250 feet. The interconnect pipeline has a maximum capacity 760 cfs when both turbines of the Lake Hodges Pumped Storage Facility are operating. Lake Hodges has a capacity of 30,250 AF at an elevation of 315 feet.

Figure 8 - Olivenhain - Hodges Interconnect Facilities

Maintenance and Control Plan – Inter-Reservoir Operation
Upon successful completion of the Lake Hodges Pumped Storage projects, water will be transferred between reservoirs on a routine basis. Maintenance will be performed in Olivenhain Reservoir by the Water Authority. The City of San Diego (City) will perform maintenance as required in Lake Hodges (with costs shared equally between the Water Authority and City). Olivenhain maintenance activities are described in the Olivenhain Reservoir section of this document. Maintenance for the Lake Hodges Pump and Hydroelectric Facility is described later in this document.

Monitoring and Sampling
The Water Authority will implement a system of monitoring and sampling to detect quagga mussels. Monitoring is already being conducted by the Water Authority at Olivenhain Reservoir, and by the City of San Diego at Lake Hodges. With this project’s implementation, the Water Authority will add additional monitoring stations at multiple locations within the pump house (before and after the turbines) to detect quaggas. Additional monitoring stations will be installed at the inlet-outlet structures of both Olivenhain and Lake Hodges. This system will ensure monitoring will be conducted at critical points along the delivery system, including locations before the water enters the turbines, and immediately after the water exits the turbines and discharges into Lake Hodges. The monitoring will include evaluation of veliger survival.

The Water Authority will file quarterly monitoring reports to the Department of Fish and Game, or under a revised schedule as mutually agreed to by the Water Authority and the Department.
Lake Hodges Pumped Storage
The Lake Hodges Pumped Storage Facility is a combined pump station and 40 MW hydroelectric facility located along the shore of Lake Hodges at the base of the Olivenhain-Hodges Interconnect Pipeline. All water running through that pipeline must first pass through the Pumped Storage Facility prior to entering Lake Hodges. There are certain controls that may be possible within the facility to protect it against severe mussel fouling, which would cripple operations.

Vulnerability Analysis
A preliminary vulnerability analysis has been completed. We have assigned priorities for control in the following components:

- Cooling system
- Fire suppression system
- Other small diameter pipes

A more in depth vulnerability analysis is scheduled for completion by June 2011.

Control Options
The Water Authority is currently evaluating options for reducing likelihood of mussel settlement in various small pipe systems within the Lake Hodges Pumped Storage Facility. Some of these options include:

- Inline filtration
- Pipeline pigging/mechanical cleaning
- Spot chlorination
- Ultraviolet disinfection
- Anoxia

Each of these will be evaluated further to determine applicability, frequency, cost, and timing for implementation.
Other Specific Component/Location Activities
Special considerations or activities for specific infrastructure components or locations may be added at a later date at the discretion of Water Authority management or at the request of a regulating agency.
# Appendix

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Appendix A: Maps & Data

Regional Infestation Map

Figure A 1 Infestation Status
Reservoirs without Direct Access to Water Authority Transmission System

Area reservoirs not receiving untreated water from the Water Authority or not currently connected to the Water Authority’s delivery system are as follows:

Table A-1 – Reservoirs without Direct Access to the Water Authority Transmission System

<table>
<thead>
<tr>
<th>Reservoir/Lake</th>
<th>Owner</th>
<th>Source Water</th>
<th>Infestation status (Sep 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrett</td>
<td>San Diego, City of</td>
<td>Natural runoff, upstream releases</td>
<td>None reported</td>
</tr>
<tr>
<td>Cuyamaca</td>
<td>Helix W.D.</td>
<td>Natural runoff</td>
<td>None reported</td>
</tr>
<tr>
<td>Henshaw</td>
<td>Vista I.D.</td>
<td>Natural runoff</td>
<td>None reported</td>
</tr>
<tr>
<td>Loveland</td>
<td>Sweetwater Authority</td>
<td>Natural runoff</td>
<td>None reported</td>
</tr>
<tr>
<td>Morena</td>
<td>San Diego, City of</td>
<td>Natural runoff</td>
<td>None reported</td>
</tr>
<tr>
<td>Sutherland</td>
<td>San Diego, City of</td>
<td>Natural runoff</td>
<td>None reported</td>
</tr>
<tr>
<td>Turner</td>
<td>Valley Center M.W.D.</td>
<td>Treated water</td>
<td>None reported</td>
</tr>
<tr>
<td>Wohlford</td>
<td>Escondido, City of</td>
<td>Natural runoff, upstream releases</td>
<td>None reported</td>
</tr>
<tr>
<td>Beck</td>
<td>Rainbow M.W.D.</td>
<td>Treated water</td>
<td>None reported</td>
</tr>
<tr>
<td>Maerkle</td>
<td>Carlsbad M.W.D.</td>
<td>Treated water</td>
<td>None reported</td>
</tr>
<tr>
<td>Morro Hill</td>
<td>Rainbow M.W.D.</td>
<td>Treated Water</td>
<td>None reported</td>
</tr>
<tr>
<td>Red Mountain</td>
<td>Fallbrook P.U.D.</td>
<td>Treated water</td>
<td>None reported</td>
</tr>
</tbody>
</table>
Microscopy Test Results

Microscopy test results are as follows:

Figure A-2 - Microscopy Test Results
Methods & Calculations

Several approved methods were evaluated to determine their ability to prevent or control the spread of quagga mussels from the Water Authority’s transmission system to the City of San Diego’s Lake Hodges. These methods, as well as any available calculation estimates are contained in the following pages.

Desiccation

Desiccation is achieved by drawing down upper levels of the reservoir and allowing mussel die off over a period of several weeks.

MWD has used desiccation in conjunction with inducing anoxic conditions on one of their reservoirs each year. Desiccation provides mussel kill above the water line, while anoxia can result in mussel death in deeper water. Conditions are maintained for approximately one month during the summer. This exercise is secondary to the delivery of water and may be aborted should water demands require it. Mussels can recover if the process is aborted early and new settlement occurs rapidly after conclusion due to source water infestation. Water quality is temporarily affected by this activity.

The Water Authority uses desiccation for mussel kill up annually at Olivenhain Reservoir. Olivenhain Reservoir does not currently exhibit anoxia at any time, so mussel kill is limited to the drawdown area. Draw down does not typically exceed 1045 feet in elevation, which means that mussel kill is limited to the first 33 feet of depth along the shoreline.

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Storage (AF)</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,078</td>
<td>24,276</td>
<td>Normal fill</td>
</tr>
<tr>
<td>1,060</td>
<td>20,874</td>
<td>Pump to fill (turn on pumps to top off reservoir)</td>
</tr>
<tr>
<td>1,050</td>
<td>19,130</td>
<td>Pump to drain (gravity drain down to this elevation, then pump to drain further)</td>
</tr>
<tr>
<td>1,045</td>
<td>18,298</td>
<td>Emergency pool</td>
</tr>
<tr>
<td>1,040</td>
<td>17,489</td>
<td>Gate 1</td>
</tr>
<tr>
<td>1,020</td>
<td>14,488</td>
<td>Gate 2</td>
</tr>
<tr>
<td>997</td>
<td>11,425</td>
<td>Normal minimum operating pool</td>
</tr>
<tr>
<td>990</td>
<td>10,563</td>
<td>Gate 3</td>
</tr>
<tr>
<td>970</td>
<td>8,261</td>
<td>Centerline for Hodges Headworks piping</td>
</tr>
<tr>
<td>964</td>
<td>7,616</td>
<td>Invert of Hodges Headworks Pipeline</td>
</tr>
<tr>
<td>960</td>
<td>7,197</td>
<td>Gate 4</td>
</tr>
<tr>
<td>900</td>
<td>2,064</td>
<td>Gate 5</td>
</tr>
<tr>
<td>840</td>
<td>43</td>
<td>Gate 6</td>
</tr>
</tbody>
</table>

Lake Hodges does exhibit anoxia at certain times of year in portions of the reservoir. The Water Authority will coordinate with the City of San Diego as needed to accomplish desiccation where possible. The likely opportunity would be late summer/early fall as the reservoir is drawn down to prepare for winter rains.

Conclusion: This method, does not eliminate mussels, and is therefore used as a control measure rather than a prevention tool.
Physical Removal
Through the use of divers or ROVs, mussels that have become concentrated in specific or sensitive locations can be physically removed. This control measure would be focused on locations where, for reasons of ease of settling, have become concentrated and their removal is necessary. This may be done at locations that are environmentally sensitive or where infrastructure appurtenances are being impacted. Physical removal will be conducted using methods similar to those that have been used in other water bodies and water infrastructure appurtenances where quaggas have settled.

Natural System Controls
Natural system controls encompasses evaluating such naturally occurring events such as low pH and anoxia as well as elevated temperatures. It also considers normal facility operating conditions and their ability to aid in control. These can be used as a control either alone or in conjunction with another method.

Low pH is naturally observed on occasion and may increase mussel mortality in both Olivenhain Reservoir and Lake Hodges. In summer 2010, low pH occurred below 990 feet elevation in Olivenhain Reservoir for several weeks. This is the first time a pH under seven has been observed in the reservoir. Using ROV inspection, we will continue to monitor how effective these events are in controlling quagga mussels at those depths.

Anoxia is observed in portions of Lake Hodges and is expected to provide localized population control, but will not eliminate mussels altogether. To date, Olivenhain Reservoir does not exhibit anoxic conditions.

The temperature within either reservoir is consistently suitable to support mussels at all life history stages. There is no opportunity to heat the water to a level sufficient to kill quagga mussels.

Turbulence
Turbulence can also be considered a natural system control. As water moves between Olivenhain and Hodges reservoirs, it passes through the Hodges Pumped Storage Facility. The elevation change between Olivenhain Reservoir and Lake Hodges puts this water under pressure (approximately 700 feet of head). Prior to entering Lake Hodges, the water travels through turbines to generate electricity.

Methods and Results
Previous laboratory studies have suggested quagga mussel veligers are susceptible to damage and eventual mortality due to turbulent forces in the water from rapids, spillways, falls, and other hydrodynamic forces (Rehmann et al 2003, Horvath and Crane 2010). These studies determined a relationship between veliger size and the intensity of the turbulence, and quantified this relationship in a dimensionless unit “d*”, which is the ratio of the veliger shell size and Kolmogorov scale. Basically, the studies concluded that water eddies that are smaller than the veliger diameter can provide sufficient dynamic shear and/or pressure forces to injure or kill a veliger.

Several field studies examining mortality due to turbulence determined veliger survivability in live-streams (Horvath and Lamberti 1999, Jessopp 2007). These studies concluded that bivalve veligers appear to be highly susceptible to damage and increased mortality from physical forces such as experienced during turbulent tidal or stream transport. Recently, a study for Denver Water developed a mussel veliger transport model between two reservoirs (AMEC 2009). This study evaluated a number of factors affecting the potential for quagga transport from Tarryall Reservoir to Cheesman Reservoir in Colorado. Of particular relevance to the Water Authority, the study examined mortality resulting from spillway release and subsequent live-stream transport of veligers. The study compared the impacts of short duration, high intensity turbulence and low intensity, longer duration turbulence on veliger survivability. This work correlated the findings from several previous studies and developed a relationship between d* and chance of veliger survival for one hour post turbulence. This relationship can be used to determine potential mortality of various size veligers after exposure to turbulence at various intensities.
The model results presented by AMEC were based on open channel flow in a natural stream. The Olivenhain-Hodges Pumped Storage Facility is a closed conduit system with two reversible 600 rpm Francis turbines. The Water Authority hired Frank De Fazio to apply the turbulence principles in the AMEC report to calculate the $d^*$ for the Olivenhain-Hodges system. The Department of Water Resources also performed independent calculations to determine $d^*$ for the Olivenhain-Hodges system.

The methodology used the Reynolds number and relative pipe roughness to calculate the Darcy friction factor. The friction factor was then used in combination with the water velocity to determine the energy loss to friction, and eventually the energy dissipation rate. This rate was then used in the calculation developed in previous studies to establish $d^*$. This methodology for developing the energy dissipation rate was compared to other methods for calculating this rate, and they were determined to be equivalent. The calculations were then shared between the Water Authority and DWR engineers, and they concluded the results and methodology was similar.

The calculations for the Olivenhain-Hodges system applied this methodology for developing $d^*$ at three discrete locations. These locations are identified in the attached Drawing Number DS-11 and in Appendix A and are referred to as 1) the Olivenhain to Hodges Tunnel, 2) the Discharge from Hodges Turbine, and 3) the Hodges Discharge Tunnel. The energy loss was then converted to a unit length to determine the rate of energy dissipation for turbulent kinetic energy. The dimensionless number $d^*$ was then calculated for various sizes of veligers (a representative calculation for veliger of size 89 µm is presented in Appendix A).

The $d^*$ results were then applied to Figure 15 in the AMEC report (reproduced below) to determine the survivability rate for specific sized veligers at the 3 locations previously identified. Note that a $d^*$ of 2.5 or greater indicates 100% mortality within one hour of exposure to turbulence.

![Figure 15. Relationship between $d^*$ and the Hourly Chance of Survival](image.png)

Source: AMEC 2009
The cumulative d* impacts were then determined based on the travel path of the veligers through the system between the reservoirs. The results based on normal operating conditions are depicted below.

<table>
<thead>
<tr>
<th>Veliger Life Stage</th>
<th>Olivenhain to Hodges Tunnel</th>
<th>Discharge from Hodges Turbine</th>
<th>Hodges Discharge Tunnel</th>
<th>Cumulative Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D*</td>
<td>Survival</td>
<td>D*</td>
<td>Survival</td>
</tr>
<tr>
<td>Trochophore 57µm</td>
<td>0.95</td>
<td>95%</td>
<td>3.80</td>
<td>0%</td>
</tr>
<tr>
<td>Trochophore 89µm</td>
<td>1.48</td>
<td>60%</td>
<td>5.76</td>
<td>0%</td>
</tr>
<tr>
<td>D-shaped veliger 115µm</td>
<td>1.92</td>
<td>35%</td>
<td>7.67</td>
<td>0%</td>
</tr>
<tr>
<td>Veliconcha 200µm</td>
<td>3.33</td>
<td>0%</td>
<td>13.33</td>
<td>0%</td>
</tr>
<tr>
<td>Pediveliger 235µm</td>
<td>3.92</td>
<td>0%</td>
<td>15.67</td>
<td>0%</td>
</tr>
<tr>
<td>Plantigrade 329µm</td>
<td>5.48</td>
<td>0%</td>
<td>21.93</td>
<td>0%</td>
</tr>
</tbody>
</table>

D* calculated with turbine at maximum flow, which is the normal operating condition.

Summary Conclusions

The Water Authority’s analysis is based on methodology developed by AMEC for Denver Water. The AMEC study consolidated prior scientific laboratory and field studies to establish a relationship between veliger survival and exposure to turbulence. Both the RNT Inc. and Water Authority engineers concur with the methodology for calculating d*. As the table above shows, hydrodynamic forces generated in the Olivenhain-Hodges system result in 100% mortality in all mussel size classes.

The additional turbulence information above, along with the measures contained in the previously submitted plan, further demonstrates the Water Authority’s commitment to control or eradicate quagga mussels in the water delivery and supply system as required by Fish and Game Code Section 2301. With this paper, the Water Authority believes all DFG concerns related to plan approval have been satisfied.

References


Boat Inspections

Lake Hodges is owned and operated by the City of San Diego. In addition to its pivotal role in the region’s water supply system, the lake is utilized for recreation, including boating. Boat inspections are an important component in the process to control the spread of quaggas. The Water Authority will coordinate with, encourage and support the City of San Diego in conducting a boat inspection program that seeks to ensure that all water is drained, and any vegetation is removed from boats leaving Lake Hodges.
Appendix B: Regulatory

Dept. of Fish & Game Code section 2301

2301. (a) (1) Except as authorized by the department, a person shall not possess, import, ship, or transport in the state, or place, plant, or cause to be placed or planted in any water within the state, dreissenid mussels.

(2) The director or his or her designee may do all of the following:

(A) Conduct inspections of conveyances, which include vehicles, boats and other watercraft, containers, and trailers, that may carry or contain adult or larval dreissenid mussels. Included as part of this authority to conduct inspections is the authority to temporarily stop conveyances that may carry or contain adult or larval dreissenid mussels on any roadway or waterway in order to conduct inspections.

(B) Order that areas in a conveyance that contain water be drained, dried, or decontaminated pursuant to procedures approved by the department.

(C) Impound or quarantine conveyances in locations designated by the department for up to five days or the period of time necessary to ensure that dreissenid mussels can no longer live on or in the conveyance.

(D) (i) Conduct inspections of waters of the state and facilities located within waters of the state that may contain dreissenid mussels. If dreissenid mussels are detected or may be present, the director or his or her designee may order the affected waters or facilities closed to conveyances or otherwise restrict access to the affected waters or facilities, and shall order that conveyances removed from, or introduced to, the affected waters or facilities be inspected, quarantined, or disinfected in a manner and for a duration necessary to detect and prevent the spread of dreissenid mussels within the state.

(ii) For the purpose of implementing clause (i), the director or his or her designee shall order the closure or quarantine of, or restrict access to, these waters, areas, or facilities in a manner and duration necessary to detect and prevent the spread of dreissenid mussels within the state. No closure, quarantine, or restriction shall be authorized by the director or his or her designee without the concurrence of the Secretary of the Resources Agency. If a closure lasts longer than seven days, the department shall update the operator of the affected facility every 10 days on efforts to address the dreissenid infestation. The department shall provide these updates in writing and also post these updates on the department's Internet Web site in an easily accessible manner.

(iii) The department shall develop procedures to ensure proper notification of affected local and federal agencies, and, as appropriate, the Department of Boating and Waterways, the Department of Water Resources, the Department of Parks and Recreation, and the State Lands Commission in the event of a decision to close, quarantine, or restrict a facility pursuant to this paragraph. These procedures shall include the reasons for the closure, quarantine, or restriction, and methods for providing updated information to those affected. These procedures shall also include protocols for the
posting of the notifications on the department's Internet Web site required by clause (ii).

(iv) When deciding the scope, duration, level, and type of restrictions, and specific location of a closure or quarantine, the director shall consult with the agency, entity, owner, or operator with jurisdiction, control, or management responsibility over the marina, boat launch facility, or other facility, in order to focus the closure or quarantine to specific areas and facilities so as to avoid or minimize disruption of economic or recreational activity in the vicinity.

(b) (1) Upon a determination by the director that it would further the purposes of this section, other state agencies, including, but not limited to, the Department of Parks and Recreation, the Department of Water Resources, the Department of Food and Agriculture, and the State Lands Commission, may exercise the authority granted to the department in subdivision (a).

(2) A determination made pursuant to paragraph (1) shall be in writing and shall remain in effect until withdrawn, in writing, by the director.

(c) (1) Except as provided in paragraph (2), Division 13 (commencing with Section 21000) of the Public Resources Code does not apply to the implementation of this section.

(2) An action undertaken pursuant to subparagraph (B) of paragraph (2) of subdivision (a) involving the use of chemicals other than salt or hot water to decontaminate a conveyance or a facility is subject to Division 13 (commencing with Section 21000) of the Public Resources Code.

(d) (1) A public or private agency that operates a water supply system shall cooperate with the department to implement measures to avoid infestation by dreissenid mussels and to control or eradicate any infestation that may occur in a water supply system. If dreissenid mussels are detected, the operator of the water supply system, in cooperation with the department, shall prepare and implement a plan to control or eradicate dreissenid mussels within the system. The approved plan shall contain the following minimum elements:

(A) Methods for delineation of infestation, including both adult mussels and veligers.

(B) Methods for control or eradication of adult mussels and decontamination of water containing larval mussels.

(C) A systematic monitoring program to determine any changes in conditions.

(D) The requirement that the operator of the water supply system cooperate with the department to update or revise control or eradication measures in the approved plan to address scientific advances in the methods of controlling or eradicating mussels and veligers.

(2) Paragraph (2) of subdivision (a) does not apply to the operation of water delivery and storage facilities for the purposes of providing water supply if the operator of the facilities has prepared and implemented a plan to control or eradicate dreissenid mussels in accordance with paragraph (1). The department may require the operator of a facility to update its plan, and if the plan is not updated or revised as described in subparagraph (D) of paragraph (1), the department may engage in the actions described in paragraph (2) of subdivision (a).
(e) Any entity that discovers dreissenid mussels within this state shall immediately report the discovery to the department.

(f) (1) In addition to any other penalty provided by law, any person who violates this section, any verbal or written order or regulation adopted pursuant to this section, or who resists, delays, obstructs, or interferes with the implementation of this section, is subject to a penalty, in an amount not to exceed one thousand dollars ($1,000), that is imposed administratively by the department.

(2) A penalty shall not be imposed pursuant to paragraph (1) unless the department has adopted regulations specifying the amount of the penalty and the procedure for imposing and appealing the penalty.

(g) The department may adopt regulations to carry out this section.

(h) This section shall remain in effect only until January 1, 2012, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2012, deletes or extends that date.
Notifications and Contact Information

Quagga/Zebra Mussel Test Result Notification

1. Secure Sample for Testing/Identification (Water Authority/Initiator)
2. Complete Lab (Veliger) or Observational (Adult) Testing of Sample (Lab or other trained personnel)
3. Notify Water Authority of Negative Results (Lab or other trained personnel)
4. Quagga or Zebra Mussel? (Yes/No)
   - Yes: Notify Initiator and Water Authority of Positive Results (Lab or other trained personnel)
     - Lisa Frus: lfrus@sdcwa.org or (760) 233-3252
     - Dan Allison: dallison@sdcwa.org or (760) 233-3279
   - No: Notify CDFG of Positive Results and Provide Requested Detail (Water Authority)
     - Dwayne Maxwell: (562) 342-7152
     - Dominique Norton: (916) 654-4267
5. New Infestation Inconvinent? (Yes/No)
   - Yes: Complete USGS Form for New Infestation Sites (Water Authority)
   - No: Notify Member Agency Operating Heads, Quagga Working Group & MWD (Water Authority)
Unplanned Water Release Notification

Uncontrolled Untreated Water Release Occurs (Water Authority/Initiator)

- Proceed with Drainage. No Special Notification Required.

Release Likely to Reach Uninfested Waterway?

- Yes
  - Can Drainage into Waterway be avoided?
  - Yes
    - Determine Volume of Water Released and Affected Waterway(s) (Water Authority)
  - No
    - Notify CDFG within 24 Hours of Release (Water Authority)

- No
  - File Documentation and Include in Annual Report

Dwayne Maxwell: (562) 342-7152
Dominique Norton: (916) 654-4267
November 12, 2009

Lisa Prus
Supervising Management Analyst
San Diego County Water Authority
610 West 5th Avenue
Escondido CA 92025

Subject: Maintenance Activity Letter Permit Request - Quagga

Dear Ms. Prus:

The Department of Fish and Game (Department) has reviewed your request for a letter permit approving collection and transport of quagga and/or zebra mussels (mussels) during routine maintenance activities for San Diego County Water Authority (SDCWA) staff. SDCWA provides water to San Diego County residents and reliable delivery is essential. Mussels pose a potentially large problem for water delivery in the area. We appreciate the proactive steps and resources that SDCWA has devoted thus far to deal with potential mussel issues.

SDCWA work crews handle contaminated equipment and water during routine maintenance activities. SDCWA staff also samples water to determine presence or absence and densities of mussel veligers in waterways.

The Department approves the following activities for trained SDCWA staff:

1. Water sampling and transport for analysis;
2. Routine maintenance, handling, and disposal of equipment that is potentially contaminated;
3. Other essential, non-research oriented activities placing trained staff in contact with potentially contaminated water and equipment.

SDCWA staff shall be trained and take all precautions available to ensure mussels are not spread as a result of their activities. The SDCWA’s Operations manual shall detail proper identification of mussels and containment and decontamination measures for crews coming into contact with mussel-contaminated equipment and water. Any contractor enlisted by SDCWA shall also be provided with proper decontamination guidelines. Containment and decontamination measures shall include quarantine of all potentially contaminated equipment including water in a secured facility and desiccation or decontamination before disposal. All water samples and contaminated equipment shall be isolated from unfested waters during handling. The Department shall be notified as soon as possible in the event that any operations activities may have contaminated previously unfested waters.

SDCWA shall submit an annual report describing all activities related to veliger sampling, pipeline dewatering and maintenance, and all other activities pertaining the handling of potentially contaminated equipment and water. Provided that SDCWA staff follows the above-listed guidelines.

Conserving California’s Wildlife Since 1870
Lisa Prus
November 12, 2009
Page 2 of 2

for containment, this letter approves the activities listed above for a two-year period from the date of this letter.

Please feel free to contact Daniel Schrimsher at (858) 467-6926 regarding any questions related to this letter.

Sincerely,

[Signature]
Edmund Pert
Regional Manager
South Coast Region

cc: Dan Schrimsher, San Diego
Martha Volkoff, Sacramento
Dwayne Maxwell, Los Alamitos
Appendix C: Processes & Procedures

Mussel Identification Field Guide

The following quagga mussel identification sheet is made available to all field staff.

**QUAGGA MUSSEL IDENTIFICATION**

**Adult Color pattern & size**
- Black cream, or white bands
- Pale or completely white
- Dark concentric rings; paler in color near the hinge
- 1/2 inch to 1 1/2 inch

**Young**

When you rub hand over surface, the young feel like sunflower seed or small pebble.

**Pre shell & Adult Colony**

**Young populations**

Appear single or in small clusters and low densities (1 mussel per foot)

**Not Clams**

The Asian Clam, pictured here, is not an invasive species, although there are plenty of them in our waters.

**QUAGGA MUSSEL IDENTIFICATION**

Look for Quagga mussel adults in a variety of habitats and attached to hard and soft surfaces. They tend to settle in quieter waters, not where the flow is strong. Look for the adults in discontinuities from mainstream flow, for example: diversions, gates, transitions, drain lines, sand traps, cracks, dams and rock faces, valves, screens, and stop logs. Adult mussels are most likely to be found in the following areas:

- Sand traps
- Drain pipes
- Turnouts
- Transitions
- Surge chambers
- Quiescent water
- Fish traps
- Undersea of rocks
- Blind flange
- Bulkhead pipe

Caution: Adult Quagga mussels are sharp and can cause injury.

You need the following equipment:

- Gloves, waterproof
- Knife or other scraping tool
- Ziplock bags/Labels
- Permanent marker pen (Sharpie)
- Camera
- Ruler, include in photo

- Collect adult samples by scraping and removing the mussel as intact as possible and placing in a sealable plastic bag.
- Label bag with date, site, exact location, size of colony, and your name.
- Take photos and use ruler, wherever possible and label with date, location, and your name.
- Carefully wash off equipment (knife and gloves) to avoid carrying the species to a new location.
- Bring sample to Supervisor for identification.
Zebra Mussel and Quagga Mussel Distinguishing Characteristics

The following distinguishing characteristics chart is made available to all field staff.

Quagga mussels and Zebra mussels can be easily confused, and appear similar in microscopic tests. Distinguishing characteristics of the adult mussels are shown in Table D-1 below.

<table>
<thead>
<tr>
<th></th>
<th>ZEBRA MUSSEL</th>
<th>QUAGGA MUSSEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shell</strong></td>
<td>Triangular shape, byssal (ventral) side flat, bilaterally symmetrical. Obvious ridge between side and bottom.</td>
<td>Rounder sides, byssal side rounded, ridge lacking. Will not sit flat on vertical surface.</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>Variable colors and patterns, usually dark</td>
<td>Pale near hinge, dark concentric rings on the shell</td>
</tr>
<tr>
<td><strong>Byssal</strong></td>
<td>Large groove in middle of flat side; allows tight hold on rocks</td>
<td>Small byssal groove near the hinge</td>
</tr>
<tr>
<td><strong>Depth in Lake</strong></td>
<td>3 to 98 feet (1-30 m), rarely found below 50 feet (15 m)</td>
<td>3 to 351 feet (1-107 m), commonly found down to 98 feet (30 m)</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>32° to 86°F (0° to 30°C)</td>
<td>32° to 86°F (0° to 30°C)</td>
</tr>
<tr>
<td><strong>Tolerance</strong></td>
<td>54° to 68°F (12° to 20°C) preferred</td>
<td>39° to 68°F (4° to 20°C) preferred</td>
</tr>
<tr>
<td><strong>Reproductivity</strong></td>
<td>Young present at 57° to 68°F (14° to 20°C)</td>
<td>Young present as low as 46°F (8°C)</td>
</tr>
</tbody>
</table>

Quagga mussels tend to colonize over top of the Zebra mussel, smothering them, and eventually reduce or eliminate the Zebra mussel colony.

Credits:
- USGS Species Fact Sheet
- Seagrant Pennsylvania and Penn State Erie, The Behrend College, Aquatic Invasive Species of Pennsylvania
- United States Department of Agriculture, National Agricultural Library, National Invasive Information Center
Substrate Evaluation
A variety of substrate assemblies (coupons) exist for monitoring dreissenid mussel presence and population growth. PVC and ABS materials are used extensively within the industry as they are lightweight, easily manipulated, and attractive to both quagga and zebra mussels. Other attractive materials include rubber tires, concrete, untreated wood, steel, and stainless steel. Regardless of the coupon material chosen, the following procedures will be followed by Water Authority staff:

Considerations for Placement
Juvenile settlement is affected by substrate type, substrate texture, depth, light, water currents, proximity to other mussels or adjacent surfaces, and ionic concentrations. Juveniles prefer dark areas, such as the undersides of suspended substrates, with currents that will transport food organisms.

Inspection
Pull coupon rope to surface using a slow, smooth hand over hand motion, let excess water drip off, and place coupon in empty bucket prior to evaluation. Allow substrate layers to partially dry and then rub fingers over surfaces to feel for the sandpaper-like presence of quagga mussel shells.

Inspect coupons monthly, recording number or density and sizes of settled mussels in writing and with photographs. Include a ruler or other measuring device in photos for size reference. Return coupon to original location.

Inspections performed at less than two week intervals may deter mussel settlement due to repeated coupon disturbance.

Reporting Procedures
Follow reporting procedures indicated in Appendix B and under the Reporting section of the main plan.
Operations and Maintenance Department

Operations Policies, Practices, and Procedures (PPP)

Section: 452.7  Page: 1 of 3
Subject: Plankton Tow Sampling
Date: 12/22/09  Revision: 00
Approved by:

Purpose
This PPP establishes the procedures for collecting and processing plankton tow samples for dreissenid mussel population presence and quantification.

Policy
The Operations and Maintenance Department complies with State regulations regarding invasive species spread control.

Strategic Goals:
The procedures described below support the Operations and Maintenance Department strategic goals.

Goal 1: Water Delivery System and Facilities Safety and Reliability

Regulations
California Fish & Game Code Division 3, Chapter 3.5, Section 2301.

Discussion
Plankton tows concentrate significant volumes of water into a manageable size for transport. Samples collected using this method will be analyzed in a laboratory to quantify veliger population volumes and characterize spawning cycles within the Water Authority’s delivery system. Samples are collected monthly from March through November of each year. Plankton tows are collected at Olivenhain Reservoir, Twin Oaks FRS, Slaughterhouse Weir, and Otay Weir. Sites may be added or removed at the discretion of Water Authority management.

Lab testing consists of evaluation by polymerase chain reaction (PCR) method, which provides a presence or absence result and can delineate quagga or zebra mussel type, or by microscopy, which allows non-specific dreissenid identification and population quantification.

Safety
Safety is the responsibility of everyone. The following are minimum requirements.
- Equipment is checked prior to mobilization for operation and safety.
- Acetic acid (Vinegar at 5% dilution) is corrosive. Review the MSDS and use caution when handling.
- Wear protective eyewear. Avoid breathing in fumes.
- Exercise boat safety.
- Personal Protective Equipment (PPE) is available and in servicable condition.

Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Notify lab of expected delivery date and time prior to sampling date</td>
<td>Operations</td>
</tr>
</tbody>
</table>
| 2.   | Prepare and inspect the following equipment prior to departure:  
- Plankton net (simple, conical plankton-tow net or Franklin type net, 63 μm pore size, 0.25 m diameter net opening, removable, weighted cod-end piece)  
- Line for deploying the net (at least 25 feet long)  
- Sample container (polyethylene material, 50 to 500 mL volume, screw lid)  
- Field sheets and pens/pencils  
- Chain of custody  
- Tweezers or small spatula  
- Measuring tape or ruler  
- Permanent marker | Operators |
| 3.   | At each site, collect a minimum of four vertical plankton tows and combine into one sample container. More than four plankton tows may be collected to increase the likelihood of collecting veligers. Collect each plankton tow in a different area of the site to further increase the likelihood of collecting veligers.  
a. Prepare the net by securing the cod-end piece to the end of the net. Securely attach the tow line to the top ring of the plankton net and secure the other end of the line to the boat.  
b. Lower the net 6.1 m (20 ft) below water surface, or to 1 m above the sediment and/or thermocline. Record the depth the net is lowered.  
c. Keep net at this depth for 60 seconds and then manually retrieve using a hand-over-hand technique at a rate of 0.5 m/s (1.5 ft/s). Slow and steady retrieval is the key to collecting a good plankton tow. Retrieval to the surface should take approximately 10 seconds. | Operators |
d. Rake the net by raising it so that the cod end of the net is at the water surface. Raise organisms into the cod end of the net by lowering the net back into the water, keeping the opening above the water surface. Repeat this procedure several times to ensure that all the organisms inside the net are in the cod end.

e. A squirt bottle, filled with either tap water or water from the lake or river, can be used to squirt down the sides of the net. Spray the outside of the net starting at the mouth to rinse organisms into the cod end.

f. Carefully remove the cod-end piece without spilling collected water and plankton. Condense the sample as much as possible by swirling the cod-end piece. You may need to use tweezers or a spatula to gently clear the mesh netting in the cod-end piece to allow the water to filter through.

g. Lower the cod-end piece (separated from the plankton net) into the water, keeping the opening above the water surface. Condense the sample again and pour into the sample container. Repeat this procedure until the cod-end piece appears clean.

h. It is important to record the number and length of tows so that the quantity of water sampled can be determined.

i. The quantity of water sampled is determined using the formula below, assuming a net filtering efficiency of 100% (i.e., no clogging). If clogging occurs, a pressure wave develops, and water will be forced to the surface prior to the net emerging from the water. If clogging occurs, first try reducing the depth of the tow. If it still occurs, estimate the net filtering efficiency and multiply the corresponding percent by the maximum volume of water filtered (e.g., 80% filtering efficiency means 0.80 x V).  

Maximum volume of filtered water, $V_m = \pi * r^2 * d$

Where:
- $r$ = radius of the net opening (0.30 m)
- $d$ = depth to which the net is lowered (6.1 m)

1. Before leaving each site, field equipment must be decontaminated to prevent transfer of organisms. Clean the plankton net, cod-end piece and rope assembly by washing with fresh water and then decontaminating with 5% acetic acid solution (white vinegar). The clean sampling equipment should be rinsed and dried prior to reuse.

5. Complete chain of custody for samples.
   - Claim of custody should list “microscopy” and “quantification” test methods for all samples from known infested sites.
   - List “PCR” and “microscopy” for non-infested sites.

6. Transport samples to lab within 24 hours.

7. Upon receipt of lab results, document findings in historical graph located at L:\OM\DeptOnly\0125_PP\432_PPP\Published\432.7_Plankton_Tow.docx and
   - File results electronically and hard copy under 1275.14.
   - Report findings as per notification chart.

Responsibility: Operations Supervisor, Operators, Supervising Management Analyst

Forms: Chain of custody
<table>
<thead>
<tr>
<th>Date Collected</th>
<th>Number of Samples</th>
<th>Quagga Sample Collection Data</th>
<th>Plankton Tow Sampling</th>
<th>Temperature (°C)</th>
<th>Depth (m)</th>
<th>Time (Local)</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Time</td>
<td></td>
</tr>
</tbody>
</table>

**Source of Site**
- TOLP North Basin
- Operations Reservoir
- 10° Tower
- SD-1 Weir
- SDS Weir

**Requested Analyses**
- PCR
- No. Microscopy

**Column Description**
- **Remark**: Additional notes or comments.
- **Print Name**: The name of the person responsible for the record.
- **Signature**: Signature of the person responsible.
- **Received By**: The name of the person receiving the data.
- **Reinquished By**: The name of the person reinquishing the data.

**System Operations Manager**

**Director of Operations and Maintenance**

**Revision**: 00

**Date**: 12/22/09

**Subject**: Plankton Tow Sampling

**Section**: 431.7
### Operations and Maintenance Department


**Purpose**

This PPP establishes the procedures for documenting Dreissena Mussel (quagga and zebra) control decisions during planned water releases in connection with annual shutdowns or other maintenance activities.

**Policy**

The Operations and Maintenance Department complies with regulations associated with water releases to surface water, storm drains, or other conveyance systems.

**Strategic Goals**

The procedures described below support the Operations and Maintenance Department strategic goals:

**Regulations**

California Fish & Game Code, Division 3, Chapter 3.5, Section 2301.

**Discussion**

The Water Authority regularly schedules water releases in connection with annual shutdowns and other maintenance activities. Shutdowns and other maintenance activities are required to continue safe and reliable operation of the Water Authority’s delivery system and facilities. Water releases occur at multiple blowoff and pumping well sites for each shutdown.

During untreated water releases, quagga or zebra mussels may be released that have the potential to reach live, non-infested waterways or water bodies. The mussels should be physically removed or rendered inactive through chemical treatment, filtration or other methods to avoid mussel transfer. This is the Water Authority’s sole prevention opportunity.

**Procedure**

When work will involve discharging water from pipelines and structures, staff must complete a report which consists of the Mussel Control Evaluation Form for each water discharge site and the Mussel Control Summary. The steps are:

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Make a copy of the Mussel Control Evaluation Form, located at L:\OM\DeptOnly\1275_WaterQuality\1275_14_QuaggaMussel\forms\Mussel Control Evaluation Form.docx and shown in Figure 1 below, for each site where water will be discharged. If it is known that a group of sites will not meet all “Water conditions”, list on a single form. Complete the form as follows:</td>
<td>Operations Supervisor/Maintenance Supervisor</td>
</tr>
<tr>
<td></td>
<td>a. <strong>Event type</strong> - Indicate the Event type or name, for example, Shutdown - Total Untreated Water Shutdown of Pipelines 3 and 5.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. <strong>Drainage site(s)</strong> - List the blow off, pumping well, or other drainage site by station number.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. <strong>Date(s)</strong> - Indicate date(s) that the drainage will occur.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. <strong>Water volume</strong> - Indicate approximate volume of water to be drained at each site in acre feet (AF).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. <strong>Drain time allowed</strong> - Estimate the number of hours available to complete the drainage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>f. <strong>Flow rate</strong> - Estimate the drainage site flow rate in gallons per minute (gpm).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>g. <strong>Weather conditions</strong> - Indicate the anticipated weather conditions during the drainage date(s) for this event based on NWS or other recognized weather forecasting tool.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>h. <strong>Water conditions</strong> - Most untreated water within the Water Authority’s delivery system will meet all water conditions listed in this section. Under some special circumstances, one or more of the water conditions may not be met. In this case, place an X over the box indicating that the condition is not met. An X over any one of the above water conditions means no filtration is necessary at the drainage location. If all Water conditions are met, continue to step 2. If any are not met, skip to step 5.</td>
<td></td>
</tr>
</tbody>
</table>
2. a. Print GIS map(s) of the drainage site and surrounding area. Mark drainage site on the map.
b. Highlight location of nearby waterway(s) in blue (active or not).
   c. Highlight anticipated drainage path in yellow.
   d. Indicate whether the drainage path intersects with one or more waterways/water bodies by circling Yes or No.
   e. Indicate whether any nearby waterway/water body is active or anticipated to be active on the drainage date(s) by marking Yes or No.
   - Waterways/water bodies connected to a nearby waterway should also be considered here.

   If “Yes” in d. or e., continue to step 3. Otherwise, skip to step 5.

3. a. List all waterways or water bodies identified in step 2.
   b. Enter the approximate distance from the drainage site.
   c. Based on dry weather conditions, indicate by circling the number whether the water being drained.
      - 4 = will certainly reach the waterway/water body
      - 3 = is likely to reach the waterway/water body
      - 2 = somewhat likely to reach the waterway/water body
      - 1 = will likely not reach the waterway/water body
   d. Indicate if wet weather will change the rating assigned for dry weather.

   If ratings for wet and dry weather are 1, skip to step 5. For all other ratings, consider weather conditions from step 1 and proceed to step 4.

4. Indicate the filtration/control method to be implemented.
   a. Mechanical filtration of 25 microns or less should be chosen if no additional chlorination will be done or if the site conditions require a smaller footprint unit to be used.
   b. Mechanical filtration of 150 microns or less is to be used only if additional chlorine (0.5 ppm typical added dose) is applied at Skimmer for
      i) 24 hours prior to discharge if north of Mira Mar
      ii) 48 hours prior to discharge if south of Mira Mar
   c. If another method, not currently listed, will be used to filter the discharged water, describe the method under “Other”. Notify CDFG prior to using an unlisted method.

   If no control methods will be implemented, provide comments under step 5 or attach additional documentation to support the decision.

5. Complete step 5 as follows:
   a. Provide comments
   b. Prepared by – print preparer’s name
   c. Title – list title of preparer
   d. Signature – preparer’s signature
   e. Date – indicate date signed

Once all individual forms are completed, assemble the Mussel Control Evaluation report as follows:

1. Make a copy of the Mussel Control Evaluation Summary located at
   \L:\OM\DeptOnly\1275_WaterQuality\1275.14_Quagga_Mussels\forms\Mussel Control Evaluation Summary.docx and shown in Figure 2.

2. Assemble all documents prepared for the Event type name and compile the information on the Mussel Control Evaluation Summary.

3. Scan entire package and file electronically at
   \L:\OM\DeptOnly\1275.14_Quagga_mussels\Documentation\Drainage\.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Notify Supervising Management Analyst that evaluation is complete.</td>
</tr>
<tr>
<td>5.</td>
<td>Update master list of drainage sites and date evaluated for future reference. Supervising Management Analyst</td>
</tr>
<tr>
<td>6.</td>
<td>Prepare annual report of sites evaluated and provide to regional Department of Fish &amp; Game representative.</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Operations Supervisor, Maintenance Supervisor</td>
</tr>
<tr>
<td>Forms</td>
<td>Mussel Control Evaluation Form</td>
</tr>
<tr>
<td></td>
<td>Mussel Control Event Summary</td>
</tr>
</tbody>
</table>
# Mussel Control Evaluation Form

1. **Event type/name**
   - Drainage site(s) (PPL/Staff)
   - Date(s)

2. **Water volume (AF)**
   - Drain time allowed (hours)
   - Flow rate (gpm)

3. **Weather conditions**
   - Water conditions:
     - Untreated supply
     - Temperature:
       - 88°F (29°C)
     - pH between 7.2 and 9.5
     - Calcium above 15 mg/L
     - Dissolved oxygen above 0
     - Salinity below 5 ppt

   An X over any one of the above water conditions means no filtration is necessary at the drainage location. Skip to step 5.

2. **GIS maps**
   - Attach GIS map(s) of drainage site
   - Highlight location of nearby waterway(s) in blue
   - Highlight anticipated drainage path in yellow

   Does drainage path intersect with waterway(s)?
   - Yes / No

   Are any nearby waterways active or anticipated to be active during drainage?
   - Yes / No

3. **Waterway name**
   - Approx. Distance
   - Water likely to reach waterway (4 very likely; 3 likely; 2 not likely)
   - Wet weather rating change?

<table>
<thead>
<tr>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

   If likely to reach waterway is 1, then no filtration is necessary at this drainage site. Skip to step 5.

   All others proceed in step 4.

4. **Indicate filtration method**
   - Mechanical filtration: 25 microns or smaller without chlorination
   - Mechanical filtration: 150 microns or smaller when using chlorine/de-chlorination in conjunction with filters
   - Other* (Please specify) ____________________________

5. **Comments**
   - ____________________________________________
   - ____________________________________________
   - ____________________________________________

   Prepared by ____________________________
   Signature ____________________________

   Title ____________________________
   Date ____________________________

* Notify CDFG prior to using an unlisted method.
# Mussel Control Evaluation Summary

<table>
<thead>
<tr>
<th>Event type/name</th>
<th>Total number of drainage sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drainage date(s)</th>
<th>Total volume drained (AF)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of waterways potentially affected by drainage:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very likely (4)</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of filtration sites:</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 micron or less</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>-----------</td>
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<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Prepared by</th>
<th>Title</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Mechanical Filtration Product Information

Usage guidelines are available from the provider for reference.

<table>
<thead>
<tr>
<th>Unit Type 1</th>
<th>20 or 25-CY Vacuum sealed dewatering unit with filter blanket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx flow rate</td>
<td>Approx. 2 MGD (1400 GPM) using 150 micron filter media</td>
</tr>
</tbody>
</table>
| Dimensions | Height 69” to 86”  
Width 92” to 98”  
Length 238” to 284” |
| Provider* | Baker Corporation |
| Est. Lead time | 3 days |

<table>
<thead>
<tr>
<th>Unit Type 2</th>
<th>Model BF-1000 Bag filtration unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx flow rate</td>
<td>1000 GPM using 25 micron filter media</td>
</tr>
</tbody>
</table>
| Dimensions | Height 63”  
Width 48”  
Length 48” |
| Specifications | See [http://www.rainforrent.com/products/Filters/bf1000.htm](http://www.rainforrent.com/products/Filters/bf1000.htm) |
| Provider* | Rain for Rent (The unit pictured above is manufactured by Filter Specialists, Inc.) |
| Est. Lead time | 1 week |

*Note: Additional providers may be available.*
Appendix D: ESP General Information

The Emergency Storage Project (ESP) is designed to protect the San Diego region from potential disruptions to the water delivery system by increasing the amount of water stored locally. With approximately 90% of the region’s water coming from outside the county, this infrastructure is critical to regional sustainability. The ESP is a system of reservoirs, interconnected pipelines and pumping stations designed to make water available to the San Diego region in the event of an interruption in imported water deliveries, such as an earthquake.

The San Diego County Water Authority began preparing planning documents for the ESP in the early 1990’s. An EIR/EIS for the ESP was certified in 1996 and Record of Determination (ROD) was issued in 1997. Construction of the first facilities began in 2000 with the Olivenhain Dam and Reservoir. The Olivenhain Dam was completed in 2003 and the reservoir became operational in 2004. The first three phases of construction are anticipated to be completed by 2014.

The Lake Hodges Projects are part of the second phase of the ESP. The Lake Hodges Projects connect the city of San Diego’s Hodges Reservoir, also called Lake Hodges, to the Water Authority’s Olivenhain Reservoir. The connection provides the ability to store 20,000 acre-feet of water in Hodges Reservoir for emergency use. The connection also allows water to be pumped back and forth between Hodges Reservoir and Olivenhain Reservoir. From Olivenhain Reservoir, water can be distributed throughout the region by the Water Authority’s transmission system.

When water is transferred downhill from Olivenhain Reservoir into Hodges Reservoir, it will generate up to 40-megawatts of peak hydroelectric energy. During the generation period water will flow at a rate of up to 760 cubic feet per second (491 million gallons per day). The energy created during regularly scheduled operation will provide approximately $5.4 million in revenue each year to offset operating costs. The hydroelectric facility is operated pursuant to a contractual agreement with San Diego Gas & Electric (SDG&E) and can include regularly scheduled energy production as well as peak demand production.

The third phase of the ESP involves construction of the San Vicente Pipeline and raising the San Vicente Dam. The Dam Raise project is the largest component increase of storage for the region. It will add 152,000 AF of regional capacity and further protect San Diego County from water shortages.

Fact sheets for the Emergency Storage Project, Olivenhain Dam and Reservoir, and Lake Hodges Projects follow.
Preventing for a Water Emergency
Up to 90 percent of the water used by San Diego County residents and businesses travels hundreds of miles from Northern California and the Colorado River. Prolonged drought or earthquake damage could disrupt the delivery of imported water into the San Diego region.

Faults Cross Our Pipelines
The pipeline that brings imported water to the San Diego region crosses earthquake faults on the way. Earthquake damage is one example of how our water supply could be jeopardized.

New Storage and Distribution Facilities
The Emergency Storage Project will protect the San Diego region from potential disruptions in the water delivery system by increasing the amount of water stored locally. New water storage and pipeline connections will distribute water throughout the region if imported water supplies are cut off. The Emergency Storage Project is expected to meet the county’s emergency water needs through 2038.

Construction of the first facilities began in 2000, and the last will be complete in 2012. To minimize water rate impacts, the project cost slightly over $1 billion in spread over several decades.

The Water Authority is addressing the environmental impacts of constructing the Emergency Storage Project by creating new wetlands, restoring habitat at project sites, and preserving sensitive habitat at other locations.

www.sdcwa.org
Emergency Storage Project – Key Facilities

Olivenhain Dam/Reservoir, Pipeline and Pump Station
- 318-foot-tall new dam adding 18,100 acre-feet of emergency water storage (completed 2002)
- Pipeline connecting Olivenhain Reservoir to the Water Authority's Second Aqueduct and water transfer pump station (pipeline completed 2002, pump station completed 2005)

Lake Hodges Pipeline and Pump Station
- Pipeline connecting Olivenhain Reservoir to Hodges Reservoir, providing ability to store 20,000 acre-feet of emergency water in Hodges Reservoir (completed 2007)
- Pump station to generate power and move water between Hodges and Olivenhain reservoirs (under construction through 2010)
- Electrical substation and line to deliver power locally (completed 2008)

San Vicente Pipeline and Pump Station
- 11-mile pipeline to connect San Vicente Reservoir to the Water Authority's Second Aqueduct (under construction through 2010)
- Pump station and surge control facility to move water from San Vicente Reservoir to the Water Authority's Second Aqueduct (under construction through 2009)

San Vicente Dam Raise
- An additional 117 feet added to San Vicente Dam providing 52,000 acre-feet of water stored for emergency use, plus 100,000 acre-foot of storage available for use when needed (construction scheduled 2009-2012)

Water Conservation – Urgent and Ongoing
The completion of the Emergency Storage Project will not change the fact that San Diego County has a semiarid climate and relies on imported water for the majority of its water needs.

Years of drought in the regions that supply imported water to San Diego have reduced supplies. Regulatory restrictions in response to environmental concerns have further limited water deliveries. Conservation is needed now and must be ongoing.

The San Diego County Water Authority urges residents and businesses to increase their water conservation efforts. Water-saving tips, incentive programs, water-smart landscaping ideas, and other resources are available at www.20gallonchallenge.com.

For more information about the San Diego County Water Authority's Emergency Storage Project, please call toll-free (877) 428-2010, email ESPlno@sdcwa.org, or visit our website at cip-ssp.sdcwa.org.

San Diego County Water Authority

Emergency Storage Project
Investing In Water Reliability

The Olivenhain Dam and Reservoir is the San Diego region's first major new dam and reservoir in 50 years. It is the cornerstone of the San Diego County Water Authority's Emergency Storage Project, helping to protect the region from severe water supply shortages.

Up to 90 percent of the water used by San Diego County residents and businesses is imported from hundreds of miles away. A prolonged drought or earthquake damage could prevent imported water from reaching us, threatening our lifestyles and businesses.

The Emergency Storage Project creates new emergency water storage at the Olivenhain, San Vicente, and Hodges reservoirs. New pipelines will connect these reservoirs to the Water Authority's pipeline distribution system, so water can continue to flow throughout the region even if the imported water supply is disrupted. Construction of the Olivenhain Reservoir and its connecting pipelines are now complete and are the first Emergency Storage Project components to be operational.

An Engineering Marvel

The Olivenhain Dam is an impressive engineering accomplishment. It was the first roller-compacted concrete dam built in California. At 318 feet high, the Olivenhain Dam stands taller than any other roller-compacted concrete dam in North America. The Olivenhain Dam was designed to both withstand and remain fully functional during and after an earthquake, to keep water flowing to the region.

At 318 feet high, the Olivenhain Dam stands taller than any other roller-compacted concrete dam in North America.

A new connection between Olivenhain and Hodges reservoirs will move 20,000 acre-feet of Hodges' water available to the region when needed.
**Dam Facts**

- Weighs 3 million tons
- Stands 318 feet tall and 2,552 feet long
- Covers 200-acre surface area
- Holds 24,000 acre-feet of water

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**Roller-Compacted Concrete Saved Time and Money**

The Olivenhain Dam, constructed using roller-compacted concrete, is as strong as a conventional concrete dam but was less expensive because it was built in about half the time required for a traditional dam. Roller-compacted concrete is mixed with less water than traditional concrete. Having the consistency of wet gravel, it was transported by dump trucks and then placed in one-foot layers. The layers were compacted with vibratory rollers similar to those used in road building. Olivenhain Dam crews worked 24 hours a day, six days a week to facilitate bonding of the layers. The granite used for the roller-compacted concrete was quarried and processed into rocks and sand right on the construction site. Eliminating the need to haul gravel to the site saved money and significantly reduced the amount of traffic traveling through the nearby rural community.

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**From Breaking Ground to Topping Off**

Starting in fall 2000, the contractor blasted and excavated approximately 700,000 cubic yards of material to form the foundation of the dam. In late 2001, dam construction began. More than 13,000 cubic yards of roller-compacted concrete was placed every 24 hours. After just one year, the dam was topped off at its complete height of 318 feet. The stair-stepped downstream face (dry side) of the dam was stained to blend with the natural surroundings of the area. Standing taller than the dam, the inlet-outlet tower controls the water flowing in and out of the reservoir.

Water first poured into the Olivenhain Reservoir in 2003. The dam and reservoir now stand ready to help ensure our region is protected from a water emergency. A small portion of water in Olivenhain Reservoir is dedicated to Olivenhain Municipal Water District’s operational use.

A photographic online tour of the dam’s construction is available at the following web address: [www.sdcwa.org/lifea/esp-olivenhainphototour.shtml](http://www.sdcwa.org/lifea/esp-olivenhainphototour.shtml)

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**Preserving Our Resources**

The new reservoir is nestled within the Elfin Forest Recreational Reserve, a spectacular 756-acre open space park and recreational area. The reserve is owned by the Water Authority and operated and managed by the Olivenhain Municipal Water District. The wildlife and natural resources on this reserve are all closely monitored and will be preserved for generations to come.

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**For more information about the San Diego County Water Authority’s Emergency Storage Project or the Olivenhain Dam and Reservoir, please call toll free (877) 426 2010, email ESInfo@sdcwa.org, or visit our website at cip-esp.sdcwa.org.**

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**Photography © 2003 by Ted Bialosky and John W. Arendt**

February 2009
Improving Water and Energy Reliability

Over the years, the San Diego County Water Authority has imported up to 90 percent of the county's water supplies to meet the region's needs. The Lake Hodges Projects will help keep water flowing throughout the region in catastrophic events such as an earthquake or prolonged drought when water deliveries from other sources would be cut off.

The Lake Hodges Projects will connect the city of San Diego's Hodges Reservoir with the Water Authority’s Olivenhain Reservoir. The connection will provide the ability to store 20,000 acre-feet of water at Hodges Reservoir for emergency use. The connection will also allow water from Hodges, which can currently serve only the Santa Fe Irrigation and San Dieguito Water districts, to be made available for use throughout the region.

Additionally, the projects will help keep Hodges Reservoir at a more consistent level during dry seasons, and provide the ability to capture water before it spills over the Hodges Dam during rainy seasons.

During the transfer of water from Olivenhain Reservoir downhill to Hodges Reservoir, the Lake Hodges Projects will also generate 40 megawatts of peak hydroelectric energy—enough power to annually sustain nearly 25,000 homes.

Project Benefits

- Provides emergency water storage for up to 40,000 homes
- Makes water from Hodges Reservoir available for distribution throughout the county
- Annually generates enough electricity for 26,000 homes

Construction Components

Construction of the Lake Hodges Projects began in 2005 and is anticipated to be complete in late 2010. The projects’ components include an underground pipeline, a pump station, an electrical switchyard, and an inlet-outlet structure.

Completed in spring 2007, the pipeline tunnel is 1.25 miles long and contains a 10-foot diameter steel pipeline that rises 770 feet in elevation from Hodges Reservoir to Olivenhain Reservoir.

www.sdcwa.org
The Hodges Pump Station will extend 10 stories underground. It will house two 28,000 horsepower pump turbines that will generate 40 megawatts of electricity as water flows down the pipeline from Otay Reservoir into Hodges Reservoir. The energy created will provide approximately $5.4 million in revenue each year, defraying operating costs at the Hodges Reservoir facilities and of other Water Authority programs that ensure a reliable water supply for the county. Electricity generated by the pump turbines will be transmitted to an outdoor switchyard, then to a 66 kilovolt power line that will connect to the existing local transmission system.

Once the construction projects are complete, community input will be incorporated to restore the native landscape on the project site.

The Hodges Inlet Outlet Structure will be located below the surface of Hodges Reservoir. Linked to the pump station through a 290-foot-long tunnel, it will draw or discharge water back and forth between the reservoir and the pump station.

Avoiding and Minimizing Impacts

The Water Authority strives to avoid and minimize impacts to the environment and the community. Once the construction projects are complete, a landscape architect will incorporate community input in a landscape plan to restore the land temporarily impacted by the construction project.

The Water Authority will also monitor the site for up to five years after construction is complete to preserve the valuable habitat of sensitive plants and wildlife species. The Water Authority also works with recreational users and communities surrounding Hodges Reservoir to provide information on the project and respond to questions and concerns. The Water Authority uses newsletters, community meetings, and mailings to update stakeholders.

If you would like to be added to the Water Authority’s mailing list, please call the project information line at (877) 426-2010 or email ESPinfo@sdwaa.org.

For more information about the San Diego County Water Authority’s Emergency Storage Project or the Lake Hodges Projects, please call toll free (877) 426-2010 email ESPinfo@sdwaa.org, or visit our website at cip-esp.sdwaa.org.
Investing in Water Reliability

Raising the height of San Vicente Dam is the last major component of the San Diego County Water Authority’s forward-thinking, Emergency Storage Project, helping to ensure that water is available to the San Diego region even if access to our imported water is interrupted. The San Vicente Dam Raise will help protect the region’s economy, job base, and quality of life by increasing the amount of water available for use within the county during emergencies.

Raising San Vicente Dam

San Vicente Dam, which is owned and operated by the city of San Diego, currently stands at 220 feet. The Water Authority will raise the dam an additional 117 feet – the tallest dam raise in the United States and the tallest of its type in the world. The raised dam will store an additional 152,000 acre-feet of water, more than doubling the reservoir’s water storage. This will be the greatest single increase in water storage capacity in San Diego County’s history.

This new water storage will serve two purposes. About two-thirds of the additional storage will capture surplus water during wet seasons for use in subsequent dry years. The other third of the new reservoir capacity will store water for use in an emergency if the San Diego region’s imported water supply is cut off.

Construction Begins at the Base

The San Vicente Dam Raise construction is scheduled from 2010 to 2012 and is split into several distinct construction phases. The first construction phase, foundation excavation, is expected to last about one year. This work will not affect the integrity of the existing dam, and it will be closely monitored throughout construction.

This phase includes all the preparation work before concrete can be applied to raise the dam. The contractor will excavate down to the...
existing dam's foundation and will pour "dental" concrete in any crevices. Similar to filling a cavity in teeth, crews will fill any cavities so the foundation for the dam is smooth and level.

The contractor will also remove about two to three inches of the dry side of the dam to create a good bonding surface for the new concrete. Other work in the first phase includes installing new pipelines and other components near and inside the existing dam.

The next phase of construction will raise the dam with roller-compacted concrete and is anticipated to begin in 2010. Roller-compacted concrete takes less time, water, and money than conventional concrete, but is just as strong. The downstream side of the existing dam will be completely covered by roller-compacted concrete and will have a new, stair-stepped appearance. The dam will be built to remain operational in the event of a major earthquake.

Additional phases of the project include a new marina, a replacement pipeline and site restoration activities. The project is expected to be completed in 2012.

**Reservoir Closed for Construction**

San Vicente Reservoir is closed to all recreation, including boating and fishing, because the water in the reservoir needed to be significantly lowered for construction. Once the dam raise is complete and the reservoir is refilled, the reservoir will reopen to recreation. This is anticipated between 2014 and 2017, depending on rainfall and supply and demand for water.

When the reservoir is reopened, the public will enjoy a number of enhancements, including an improved access road to the reservoir, an expanded boat ramp and parking area, and new shade trees and picnic areas. For information about water recreation alternatives in the meantime, please visit the City of San Diego’s website at www.sandiego.gov/water/recreation.

**San Vicente Dam Facts**

- **Current height:** 220 feet
- **New dam height (after raise):** 317 feet
- **Current storage capacity:** 90,000 acre-feet
- **New storage capacity (after raise):** 242,000 acre-feet

**San Vicente Reservoir**

Raising San Vicente Dam will significantly expand the reservoir’s current 90,000 acre-foot capacity. An acre-foot of water is equal to 335,900 gallons and is the approximate amount two families of four use in one year.

**Emergency Storage Project**

For more information about the San Diego County Water Authority’s Emergency Storage Project or the San Vicente Dam Raise, please call toll free (877) 426-2010, email ESPinfo@sdcwa.org, or visit our website at cip-esp.sdcwa.org.
References/Links
References used in development of this plan have been noted throughout. Additional references include:


100th Meridian Columbia River Basin Team has developed an interagency invasive species response plan. It shows containment, control and eradication options that may have been referenced within this plan. The plan can be viewed at http://100thmeridian.org/ActionTeams/Columbia/CRB%20Dreissenid%20Rapid%20Response%20Plan%20OCTOBER%202008.pdf

Web Links
Web links used in the development of this plan or containing useful supplemental information include:

100th Meridian Initiative is a cooperative effort between state, local, and federal agencies to 1) prevent the spread of Zebra mussels and other aquatic nuisance species into the western United States and 2) monitor and control zebra mussels and other aquatic nuisance species. More information about the 100th Meridian Initiative is available on the http://100thmeridian.org/ website. The website has features such as suggested watercraft drying times based on geographic location and time of year, printable posters, and information pamphlets.


Army Corps of Engineers Zebra Mussel Research Program website http://el.erdc.usace.army.mil/zebra/ contains technical reports, a zebra mussel information system (ZMIS) and other useful references.

California Department of Fish and Game website www.dfg.ca.gov/invasives/quaggamussel contains information including the scientific advisory report, brochures and posters, and Quagga mussel response across the state.

California Department of Food and Agriculture website http://www.cdfa.ca.gov/invasives/# contains presentations and information regarding invasive plant and animal species.

California Department of Water Resources (DWR) website http://www.water.ca.gov/. Of special interest may be the link to DWR’s Water Data Library http://www.wdl.water.ca.gov/

Cornell University website has a section within their environmental impact statement for lake source cooling which covers maintenance procedures such as pipeline pigging, manual cleaning, and use of coatings at http://www.utilities.cornell.edu/util_lscs_mussels.html.

San Diego Regional Water Quality Control Board (RWQCB) is in the process of reissuing the National Pollutant Discharge Elimination System (NPDES) general permit for San Diego County. The most recent general permit was issued in 2002. Text of the 2002 permit can be found at http://www.swrcb.ca.gov/rwqcb9/orders/order_files/2002%20order%20files/R9-2002-0020/2002-0020.html.

Seagrant Non Indigenous Species website contains research papers and publication links on zebra and quagga mussels. http://www.sgnis.org/index.htm


U.S. Bureau of Reclamation website http://www.usbr.gov/mussels has references to past, present and future quagga mussel research projects and activities, as well as access to documents and templates that may be useful to water and power providers combating dreissenid mussel infestations.

U.S. Fish and Wildlife Service website http://www.fws.gov/invasives/ has references to standard operating procedures in use by other states and agencies. It also includes a link to a development wizard for creating a Hazard Assessment Critical Control Plan (HACCP) A particularly good reference available at this site is the decontamination protocol prepared by the State of Oklahoma http://haccp-nrm.org/documents/okwrb.pdf.
Glossary

Acronyms

ABS  Acrylonitrile Butadiene Styrene  
AF  Acre-Feet (of water)  
BMP  Best Management Practices  
CDFG  California Department of Fish and Game  
cfs  Cubic Feet per Second  
CY  Cubic Yard  
EPA  US Environmental Protection Agency  
ESP  Emergency Storage Project  
FRS  Flow Regulatory Structure  
GCSS  General Conditions and Standard Specifications  
GIS  Geographic Information Systems  
HACCP  Hazard Assessment and Critical Control Points  
I/O  Inlet/Outlet  
MGD  Million Gallons per Day  
MWD  Metropolitan Water District of Southern California  
NAS  Non-indigenous Aquatic Species  
NPDES  National Pollutant Discharge Elimination System  
O&M  Operations and Maintenance  
PCR  Polymerase Chain Reaction  
PVC  Polyvinyl Chloride  
ROV  Remotely Operated Vehicle  
RWQCB  Regional Water Quality Control Board  
SDCWA  San Diego County Water Authority (Water Authority)  
SME  Subject Matter Expert  
USBR  US Department of the Interior, Bureau of Reclamation  
USGS  United States Geological Survey  
WTP  Water Treatment Plant

Terms

303(d) - Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. (Ref: EPA website)

Anoxia – An oxygen deficiency reaching the tissues of the body/organism of such severity as to result in permanent damage.

Coupon – A substrate assembly used to establish mussel presence or quantify infestation by weight or measure mussels within a defined area.

Dreissena – A genus of bivalve shells, including the marine mussels, in which the two adductor muscles are very unequal. (Ref: Webster's Revised Unabridged Dictionary)

Dreissena polymorpha – (D. polymorpha) Scientific name for the zebra mussel.

Dreissena rostriformis bugensis – (D. bugensis) Scientific name for the quagga mussel.
Eradication – The complete absence of the dreissena mussel, in any life stage, at a particular location over a defined period of time. In other areas of the country, it is signified by an absence exceeding one mussel's life cycle. Eradication parameters have not yet been defined within the San Diego region.

Elevation – The height above sea level.

Hypoxia – A state of oxygen deficiency which is sufficient to cause an impairment of function.

Microscopy - Evaluation under a microscope. Cross polarization techniques are used for purposes of identifying specific traits evident in dreissena mussels. This method can be used prior to initial confirmation of mussel presence; however, it is most useful when evaluating progress of a known infestation.

Pediveliger – The first post-veliger larval stage of the mussel associated with development of a “foot” marking a change in behavior that allows the animal to both swim and crawl on surfaces. Dreissenid pediveligers range in size from approximately 231 to 462 microns.

Plankton Tow Method – A method of sample gathering most often used in a reservoir or other large body of water. The process involves filtering volumes of water to obtain a concentrated sample which can then be evaluated using PCR or microscopy.

Point source - As defined in CFR122.2, a point source is any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

Pollutant - As defined in CFR122.2, a pollutant is dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water. It does not mean:
(a) Sewage from vessels; or
(b) Water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil and gas production and disposed of in a well, if the well used either to facilitate production or for disposal purposes is approved by authority of the State in which the well is located, and if the State determines that the injection or disposal will not result in the degradation of ground or surface water resources.

Polymerase Chain Reaction (PCR) – A technique in molecular biology by which a small fragment of DNA can be rapidly cloned, or duplicated, to produce multiple DNA copies. PCR is most useful prior to initial confirmation of mussel presence. Mussel identification is made by comparison against specific genetic markers.

Secchi disk – The Secchi disk is used to measure water clarity. It is lowered into the lake until the observer loses sight of it. The disk is then raised until it reappears. The depth of the water where the disk vanishes and reappears is the Secchi disk reading. The depth level reading on the measuring tape at the surface level of the lake is recorded to the nearest foot. Instructions for making a secchi disk are at http://dipin.kent.edu/makedisk.htm.

Thermocline - A distinct layer within a body of water where the temperature changes rapidly with depth. This is typically a transition zone between water layers with different oxygen carrying capacity and movement.

Veliger – An early planktonic larval stage mollusk that has developed the velum, a ciliated swimming organelle. Dreissena veligers range in size from approximately 97 microns to 347 microns.
January 6, 2011

Attention: Engineering & Operations Committee and Board of Directors

CLOSED SESSION:
Conference with Legal Counsel – Consideration of Initiation of Litigation
Government Code § 54956.9(c) – One Case

Purpose
This memorandum is to recommend that the Board by motion hold a closed session, pursuant to Government Code §54956.9(c) to discuss the above-referenced matter at the June 13, 2011, Board meeting.

Prepared by: Daniel S. Hentschke, General Counsel