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TECHNICAL MEMORANDUM NO. 2 (TM-2)

To: Jerry Potamis, P.E., Falmouth Wastewater Superintendent
CWMP Review Committee

From: Nathan C. Weeks, P.E., Stearns & Wheler, LLC
Jesse Schwallbaum, Watershed Hydrogeologic, Inc.

Date: October 7, 2010

Re: Assistance to CWMP Review Committee
Task 12-1: Subsurface Investigations and Groundwater Modeling for Five Treated Water Recharge/Discharge Scenarios
S&W No. 8612163
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This memorandum is prepared to summarize subsurface investigations and groundwater modeling for five treated water recharge/discharge scenarios. It is prepared to complete Task 12-1 as detailed in the Task 12 Project Scope attached in Appendix A.

BACKGROUND

The Town of Falmouth initiated a Comprehensive Wastewater Management Planning (CWMP) Project for its South Coastal Watersheds to Little Pond, Great Pond, Green Pond, Bournes Pond, Eel Pond, and Waquoit Bay Watersheds in early 2007. The location map for this Planning Area is illustrated on Figure 1. The following documents have been prepared to date:

- Needs Assessment Report, October 2007
- Alternatives Screening Analysis Report, November 2007
- Environmental Notification Form Document, December 17, 2007 (This document summarizes the main findings of the Needs Assessment Report and Alternatives Screening Analysis Report to initiate the Massachusetts Executive Office of Energy and Environmental Affairs Massachusetts Environmental Policy Act (MEPA) review process as well as the Cape Cod Commission Development of Regional Impact review process.)
- Draft Comprehensive Wastewater Management Plan and Draft Environmental Impact Report (CWMP/DEIR) and Notice of Project Change, December 2009

All of these documents are located on the Town's Wastewater Department website at www.falmouthmass.us/depart.php?depkey=wastewater as well as at the CWMP Project site at www.falmouthwastewaterprojects.org with additional background information.

These documents have summarized the need to remove existing and future wastewater nitrogen loadings to meet the nitrogen Total Maximum Daily Load (TMDL) limits. Figures 2 and 3 illustrate the existing and future wastewater nitrogen removals needed to meet the TMDLs.

In February 2010, the Town's Board of Selectmen formed a CWMP Review Committee to review the Draft CWMP/DEIR. That committee has met several times and has requested additional cost development and technical evaluations as detailed in the Project Scope in Appendix A.

The purpose of this technical memorandum is to summarize the subsurface investigations and groundwater-modeling findings of Task 12-1 for five alternative wastewater management scenarios. The potential treatment and recharge sites which are part of the scenarios are illustrated on Figure 4, and the scenarios are briefly listed below.

- **Scenario 3C** includes the following components:
  - Advanced treatment at the Massachusetts Military Reservation (MMR) site with a treatment performance of less than 1 milligram per liter (mg/L) Total Organic Carbon and 1 mg/L Total Nitrogen on average.
  - Recharge of the treated water through injection wells placed in the Route 151 right-of-way (ROW) to distribute the recharge to the planning area watersheds.
- **Scenario 3D** includes the following components:
  - Enhanced Nitrogen Removal treatment with treatment performance of 3 mg/L Total Nitrogen on average at the MMR site.
  - Discharge of the treated water at an outfall to the Cape Cod Canal.
- **Scenario 2A Modified** includes the following components:
  - Enhanced Nitrogen Removal treatment at the Falmouth Country Club (FCC) site.
  - Subsurface recharge at the following sites:
    - Western portion of Falmouth Country Club site (Site 2B)
    - Southwest portion of Allen Property (Site 4)
    - Dupee Ball Field Property (Site 5)

- **Scenario 1A Modified** which includes the following components:
  - Advanced treatment at Blacksmith Shop Road (BSR) WWTF site to meet a treatment performance of 2 mg/L Total Nitrogen on average and less than 3 mg/L Total Organic Carbon.
  - Recharge of the treated water through injection wells placed at the northern edge of the BSR WWTF site (Site 7) and at the Land Swap Parcel (Site 10) located north of the BSR WWTF site.
- **Scenario 1D** which includes the following components:
  - Enhanced Nitrogen Removal treatment at the BSR WWTF.
  - Discharge of the treated water at an outfall to Vineyard Sound at Nobska Point.

Technical Memorandum No. 1 (October 7, 2010) summarized the technical details, advantages, disadvantages, and cost summary of these five scenarios.

This technical memorandum (No. 2) summarizes the subsurface investigation and groundwater-modeling findings of these scenarios that provides greater insight into their feasibility.

SITE VISITS AND PRELIMINARY CONSIDERATIONS ON THE POTENTIAL RECHARGE SITES

On June 4, 2010, Nathan C. Weeks, P.E. met with Jerry Potamis, P.E. to review the sites identified in the Project Scope for treated water recharge evaluations. These sites are illustrated on Figure 4 and discussed below.

Site 5 is the Dupee Ball Field Property, as identified on Figure 5. It is also illustrated on Figure 6 from an aerial photo before the ball fields were developed. We met with Helen Kennedy, Recreation Department Director, and Brian Dale, Park Superintendent/Tree Warden who were interested in our evaluation of the site. They expressed concerns about disturbing the two ball fields that were constructed in 2009 and will be ready for use in the fall of 2010. We discussed three possible locations on the site for subsurface leaching facilities:

- Existing parking lot
- The wooded area (4.6 acres) to the west that could become an additional recreational area if it was cleared and used for subsurface recharge
- Two ball fields

Two locations were staked for test pits, as illustrated on Figure 5.

Site 4 is the Allen Property that was recently purchased for conservation and general municipal purposes, as illustrated in Figure 7. The 14 acres in the southwest corner has been identified for the general municipal use and subsurface leaching facilities. An aerial view of this portion of the property (Site 4) is illustrated in Figure 8. One location at the edge of the powerline right-of-way was staked for a test pit.

Site 6 is the Air Force Center for Environmental Excellence (AFCEE). Infiltration Trench site as illustrated in Figure 9. As discussed in Technical Memorandum No. 1, the site is located in a Water Protection District as illustrated in Figure 10. A permanent municipal recharge at this location would most likely need a variance from the Town's zoning requirements. This trench was designed by AFCEE and their engineers to recharge a flow of 0.86 mgd treated groundwater based on a design infiltration rate of 360 gallons per day per square foot (gpd/sf). This design rate is two orders of magnitude larger than the typical 3 gpd/sf allowed by MassDEP for treated municipal wastewater recharge. This recharge system failed in 2002 and the trench area was expanded to 1,350 feet in length with approximately 6,400 sq ft of leaching area. This area would allow a recharge flow of 0.02 mgd based on MassDEP sizing criteria. MassDEP typically allows increased hydraulic loading after performance testing with the actual treated waters that needs to be infiltrated which could occur during the early years of implementation. Based on this site's location in a Water Protection District and its relatively low capacity based on MassDEP loading criteria, it was not used for cost development as part of Scenario 2A Modified, but it should be considered in the future. No test pits were completed at this site. Information from AFCEE that was received on the infiltration trench is attached in Appendix B. (A hydrogeologic investigation report was also received for this facility.)

Site 2B is the western portion of the Falmouth County Club (FCC) Site that is located in the Green Pond Watershed, as illustrated in Figures 10 and 11. As discussed in Technical Memorandum No. 1, Green Pond Watershed has approximately 12.5 kilograms per day (Kg/d) of nitrogen assimilative capacity at this site after the Phase 1 and 2 sewers are installed. This equates to a recharge flow of 1.1 million gallons per day (mgd) at this site at 3 mg/l total nitrogen. If Phase 3 sewers are extended into the upper portion of the Green Pond Watershed to encompass the FCC site, the assimilative capacity would increase to approximately 19.3 Kg/d, which would accommodate up to 1.7 mgd recharge at 3 mg/l total nitrogen. This flow would require subsurface recharge facilities under nearly all of the site's open space. MassDEP would allow greater loading after performance testing with the actual treated water.

Subsurface investigations have previously been completed for this site, as discussed in the Alternatives Screening Analysis Report starting on pages 5-24 with test pit and hydraulic loading data in Appendices 5-2 and 5-3 of that report. No new test pits were completed at this site.

Site 10 is illustrated on Figures 10 and 12 and is a 7.4-acre “Land Swap” property. It is wooded and surrounded by Town conservation land. Subsurface investigations were previously completed for this site as discussed in the Alternatives Screening Analysis Report starting on page 5-24 with test pit data in Appendix 5-2. Because well injection is now being considered for this site, the existing test pit and perc test information is of limited value.

Sites 11 and 12 are potential sites along Route 28 north ROW and along the westerly end of Thames B. Landers Road and Route 28A, as identified in the Project Scope in Appendix A. These sites were visited on June 4, 2010 and it was decided that recharge at the Route 28 ROW has low potential of being approved by Mass Highway who controls the site. The intersection area of Route 28A and Thames B. Landers Road has a very small ROW area and is very near the northern end of the BSR WWTF site. Due to these considerations, it is believed that the northern end of the BSR WWTF site would be a more practical location for injection wells, particularly if the groundwater modeling indicated that groundwater recharge from that site does not flow to West Falmouth Harbor. This replacement site is discussed below.

Site 7 is the northern end of the BSR WWTF site (illustrated in figure 12) that is located outside of the West Falmouth Harbor Watershed and is used as a practical replacement for Sites 11 and 12, as discussed above. Subsurface investigations were previously completed at this site, as discussed in the Alternatives Screening Analysis Report starting on page 5-24. Because well injection is being considered for this site, the test pit and perc test data is of limited value.

TEST PIT COMPLETION AT SITES 4 AND 5 AND CONSIDERATIONS FOR WELL INJECTION SITES

Test pit locations were staked at Site 4 and 5, as identified above. The sites were cleared through Dig Safe and test pits were completed on June 14, 2010 using a backhoe and operator supplied by the Town’s Water Department, and a certified soil evaluation from BSC Group. Test pit results are attached in Appendix C and the following items are noted:

- These areas are in the outwash plan and have sandy soils and the deep perc tests were less than 2 minutes per inch.
- Site 5 has a relatively tight soil layer about 1 foot thick that is approximately 2 to 3 feet below the ground surface. A perc test was completed in this layer at TP-2 to provide better understanding of this layer and its perc rate was approximately 7 minutes per inch. It is believed that this layer would need to be removed from this site to be used at a high hydraulic loading rate. Further tests would be needed during design to determine the extent of this layer at the site.

As discussed for Sites 10 and 7, and as applicable for the Route 151 corridor, test pits and perc tests are of limited value to determine the feasibility of well injection at these sites. Deep soil borings will be needed to understand the soil types where the treated water would be injected. Also, it is believed that performance testing will be needed in the early stages of implementation to demonstrate feasibility and to fine tune injection rates.

GROUNDWATER MODELING AND DEVELOPMENT OF MODELING SCENARIOS

Introduction. Four sets of groundwater model scenarios were simulated, each with several different assumed rates of recharge. The scenarios have been designated 1A, 2A, 3C and 1D/3D. Each of these scenarios, and the model runs associated with them, are described below.

It is necessary to note that the United States Geologic Survey (USGS) model of the Sagamore Lens of the Cape Cod Aquifer is based on a generalized conceptual model of the aquifer. With respect to the injection well simulations, there is relatively sparse data at the depths of the proposed wells and certainly no site-specific data. This means that there are some uncertainties about site-specific geological conditions and this leads to a degree of uncertainty in the model results. Additional data collection and model revision would be necessary to fully evaluate these potential deep well injection systems. Nevertheless, the modeling that has been conducted provides useful insights on the potential effects of the proposed injection wells, as well as the proposed subsurface leaching facilities.

Scenario 1A – Injection Wells Near Existing Blacksmith Road WWTF. This scenario assumes that 10 deep injection wells will be installed at two parcels (Sites 7 and 10) near the existing WWTF on Blacksmith Road. Five injection wells were simulated on each parcel. The wells are assumed to be completed at a depth of approximately 200 feet with slotted screens at the bottom 70 feet. The proposed total rates of recharge are assumed to be evenly distributed among the injection wells.

Two steady state average annual recharge rates were simulated - 1.8 and 2.5 mgd. In addition, two maximum month rates were simulated at 3.3 and 4.5 mgd at the well injection sites. These groundwater model scenarios were coupled with particle track analyses to determine the ultimate fate of water and nitrogen originating from the wells.

The discharge from the existing BSR WWTF and recharge to the existing sand infiltration beds was assumed to be 1 mgd with a maximum month flow of 1.8 mgd. These recharges were run to understand possible interactions between the existing sand bed recharges and the well injection recharges.

Scenario 2A – Subsurface Leaching Systems at Sites 2B, 4, and 5. Three potential sites for subsurface leaching systems have been identified for Scenario 2A. These are designated Site 2B (Falmouth Country Club Site), Site 4 (Allen Property) and Site 5 (Dupee Field Site).

Two steady state average annual rates were simulated with total discharges of 1.8 and 2.9 mgd. The 1.8 mgd flow would be distributed between Site 2B (1.7 mgd) and Site 4 (0.1 mgd). The 2.9 mgd flow would be distributed between Site 2B (1.7 mgd), Site 4 (0.8 mgd) and Site 5 (0.4 mgd). These groundwater model scenarios were coupled with particle track analyses to determine the ultimate fate of water and nitrogen originating from the recharges.

Two maximum month flows were also evaluated. The assumed rates are 3.2 and 5.2 mgd. The 3.2 mgd flows would be distributed between Site 2B (3.0 mgd) and Site 4 (0.2 mgd). The 5.2 mgd flows would be distributed between Site 2B (3.0 mgd), Site 4 (1.4 mgd) and Site 5 (0.8 mgd). The maximum month scenarios were conducted in order to calculate the maximum groundwater mound height beneath the recharge areas.

Scenario 3C – Injection Wells Along Route 151. This scenario assumes that 12 deep injection wells would be spaced along the right of way of Route 151 in Falmouth. The simulated wells were spread relatively evenly across the right of way from just east of the intersection of Route 151 with Boxberry Hill Road to Ashumet Road. The final locations for the injection wells would need to be confirmed by test well investigations and pumping tests.

The wells are assumed to be completed at a depth of approximately 200 feet with slotted screens at the bottom 70 feet. The proposed total rates of discharge are assumed to be evenly distributed among the injection wells.

Two steady-state average recharge scenarios were simulated assuming annual average recharge rates of 1.8 and 2.7 million gallons per day (mgd). These groundwater model scenarios were coupled with particle track analyses to determine the ultimate fate of water and nitrogen originating from the wells. In addition to the injection wells, it was assumed that recharge of treated water would at the existing wastewater treatment facility (WWTF) at a rate of 1 mgd.

Two additional groundwater flow scenarios were run to simulate the maximum month recharges of 3.3 mgd and 5.1 mgd at the injection wells and 1.8 mgd at the BSR WWTF site. These are relatively short term maximum discharges. The purpose of these scenarios was to determine the groundwater mound at the injection wells.

Scenario 1D/3D – Ocean Outfall. This scenario does not include any new water recharges to the groundwater system. It is assumed that the discharge will occur at an ocean outfall. The purpose of this scenario was to evaluate the potential impact of eliminating the wastewater flows from existing septic systems in the areas to be sewered. This was accomplished by running the USGS model of the Sagamore Lens with a reduction in recharge in the sewered areas that is equivalent to the captured wastewater.

Modeling Method. The ultimate basis for all of the modeling scenarios is the USGS groundwater flow model of the Sagamore Lens of the Cape Cod Aquifer (Walters and Whelan, 2004). This model was developed using the USGS three-dimensional groundwater flow model MODFLOW (2000). The input and output model files for the Sagamore Lens Model (the portion of the Cape Cod Model that covers the Town of Falmouth) were obtained directly from the USGS.

Scenario 1D/3D was conducted using the entire Sagamore Model domain. Scenarios 3C, 2A and 1A were conducted using a sub-regional version of the Sagamore Lens Model that included only the southwestern portion of the Sagamore Lens - the Town of Falmouth and surrounding areas. The sub-regional model was generated using a technique known as telescopic mesh refinement. The sub-regional model area is extracted from the larger model and the new boundaries are represented by constant head nodes that are equivalent to the water levels at those nodes in the original model. The model domain and boundary conditions are shown in Figure 13. (The development of the sub-regional model is also described in the Alternatives Screening Analysis Report starting on page 2-10 with detailed information contained in Appendix 2-2.)

The sub-regional model further revised the USGS regional model by tightening the grid spacings in the areas of interest. The original Sagamore Model had uniform grid sizes of 400 by 400 feet. In the sub-regional model, the grids were revised to 200 by 200 feet. This also required modifying some of the boundary conditions, particularly the stream nodes. The MODFLOW stream package requires that stream nodes be numbered sequentially without gaps or duplications. The sub-regional model was then run without changes and compared to the original Sagamore Model. Minor changes in the stream conductivities were required to better match the water levels and water budget to the original model, but a satisfactory calibration was obtained without any significant modifications. The calibrated water table elevations are shown in Figure 13.

Particle tracking was conducted using the USGS particle tracking code MODPATH (Pollock, 1994) which interfaces directly with the MODFLOW outputs.

GROUNDWATER MODELING RESULTS

Results of Scenario 1A. The projected water levels and particle traces for the 1.8 and 2.5 mgd average annual discharge simulations for Scenario 1A are illustrated in Figure 14 and 15 respectively. The particles are spread across West Falmouth from north of Herring Creek to south of West Falmouth Harbor. A summary of the ultimate fate of the water and nitrogen recharged from the injection wells for both simulations are summarized in Table 1. A distinction is made between recharges to estuaries, which are simulated in the USGS model as drain nodes, and the bay beyond the estuaries, which are simulated in the USGS model as general head boundaries.

For both of the above scenarios, the recharge at the existing WWTF was simulated at a rate of 1.0 mgd. The effluent-impacted groundwater entered either West Falmouth Harbor (87 to 90 percent) or entered the bay beyond or north of West Falmouth Harbor (10 to 13 percent).

TABLE 1

Scenario 1A Fate of Nitrogen as Percent of Recharge from Injection Wells

Ultimate Recharge Site	1.8 mgd	2.5 mgd
Wing Pond	37.1%	36.8%
Herring Brook	17.5%	13.6%
Bay North of Herring Brook	3.2%	2.9%
Bay Between Herring Brook and West Falmouth Harbor	34.3%	33.2%
West Falmouth Harbor	5.1%	7.1%
Bay Beyond West Falmouth Harbor	2.8%	6.4%

Two additional groundwater flow model simulations were conducted to estimate groundwater mounding resulting from the maximum month recharge of treated water into the deep injection wells proposed for Scenario 1A. The assumed maximum month recharges were 3.3 and 4.5 mgd. Normally this type of analysis is done to ensure that a surface or subsurface recharge meets the requirement for a 4-foot separation between the bottom of the discharge structure and the top of the water table. However, this does not apply to an injection well in which the water is introduced deep into the aquifer. Rather, the scenario was conducted simply to ensure that the rise of groundwater near the well as a result of the injection does not reach ground surface. The model-predicted maximum monthly groundwater levels for the 3.3 and 4.5 mgd scenarios are illustrated in Figures 16 and 17, respectively.

A finite difference groundwater model, such as MODFLOW, does not provide precise water levels at individual wells. A finite difference model is based on estimating water levels at nodes that are generally considerably larger than a well. The model nodes in the USGS Sagamore Model are 400 by 400 feet. These have been reduced to 200 by 200 feet in the sub-regional model. The water level at each node represents an average water level within the area of the node.

Therefore, it was necessary to calculate the water level in the immediate vicinity of the injection wells using a technique described by Anderson and Woesner (1992). This entails a modified form of the Theim equation for unconfined conditions. The equation is presented below:

hw = square root [ho2 + Q/πK ln(re/rw)]
where

hw = the calculated water level at the well

ho = the observed water level at the model node

Q = the injection rate

re = effective well block radius

rw = well radius

Based on this equation and the water levels obtained from the groundwater flow model for the maximum month flows of 3.3 and 4.5 mgd, the maximum water level at the 10 injection wells was estimated to be 41 feet (the highest model-predicted level at an injection well node at either of the two sites was 35.7 feet). Therefore, the elevation of the ground surface at the proposed injection wells should be greater than 41 feet. The existing surface topography at these sites is greater than 41 feet, with the exception of one low area at Site 7 of 40 feet. Any subsequent well siting processes will need to avoid this one localized low elevation area.

The groundwater model predicts that the maximum predicted groundwater mound height at the existing sand infiltration beds at the WWTF with a maximum monthly discharge of 1.8 mgd will be approximately 29 feet which is well below the surface elevations of the beds.

Results of Scenario 2A. The projected groundwater levels and particle traces for the 1.8 and 2.9 mgd recharge simulations for Scenario 2A are illustrated in Figure 18 and 19. A summary of the ultimate fate of the water recharged from the injection wells for both simulations are summarized in Table 2.

TABLE 2

Scenario 2A Fate of Nitrogen as Percent of Recharge

Ultimate Discharge Site	1.8 mgd	2.9 mgd
Coonamessett River	0.7%	20.0%
Cranberry Bogs Above Green Pond	93.1%	74.4%
Green Pond	6.2	5.6%

The groundwater mounds that could occur from the maximum month flows of 3.2 and 5.2 mgd are illustrated in Figures 20 and 21, respectively. The ground elevation at the site is approximately 10 feet higher**.**

Results of Scenario 3C. The projected groundwater levels and particle traces for the 1.8 and 2.7 mgd recharge simulations for Scenario 3C are illustrated in Figure 22 and 23 respectively. The particles are spread across Falmouth from West Falmouth to Waquoit Bay. A summary of the ultimate fate of the nitrogen and water recharged from the injection wells for both simulations are summarized in Table 3. A distinction is made between recharges to estuaries, which are simulated in the USGS model as drain nodes, and recharges to the rivers and cranberry bogs associated with these estuaries, which are simulated in the USGS model as general head boundaries. It is noted that the model predicts that most of the groundwater flowing to the Coonamessett River and the Coonamessett Well will first flow through Coonamessett Pond. This will provide nitrogen attenuation. In addition, the predicted groundwater travel times to the Coonamessett Well are greater than four years.

It is also noted that there is a greater level of uncertainty in the particle tracking analysis for those particle tracks with very long groundwater travel times. Flows from the injection wells to ponds and rivers generally take less than 30 years. Flows from the injection wells to the estuaries are generally greater than 50 years. These time factors need to be taken into account when determining potential impacts of nitrogen in estuaries. In particular, the impacts of removing the nitrogen in the Phase 1, 2 and 3 sewer areas will be apparent in the estuaries decades before the full affects of discharging nitrogen at the injection wells.

Figures 22 and 23 also indicate that all of the recharge from the existing WWTF will flow toward West Falmouth Harbor. For both of the steady state average discharge scenarios the model predicts that between 82 percent and 85 percent of the groundwater originating at the existing facility will flow to West Falmouth Harbor. The remainder will flow to the bay north of or beyond West Falmouth Harbor.

TABLE 3

Scenario 3C Fate of Nitrogen as Percent of Recharge

Ultimate Recharge Site	1.8 mgd	2.7 mgd
Herring Brook/Wings Pond	2.6%	3.0%
Ocean Near Herring Brook	3.6%	3.3%
Ocean Near West Falmouth Harbor	2.1%	2.1%
Coonamessett River	54.0%	51.6%
Long Pond	0.3%	0.6%
Great Pond	1.8%	0.9%
Coonamesset Well	0.6%	3.6%
Green Pond Via Cranberry Bogs	16.7%	16.7%
Green Pond	1.5%	1.8%
Bournes Pond Via Cranberry Bogs	1.8%	3.5%
Bournes Pond	6.5%	4.1%
Childs Brook	0.7%	3.2%
Waquoit Bay near Child's Brook	7.8%	5.6%

Calculations were made with respect to the potential mounding at the injection wells using the same formula as was applied for Scenario 1A. For the highest maximum monthly discharge rate of 4.5 mgd at the potential injection wells, the maximum groundwater mound was calculated to be 51.5 feet (the highest model-simulated water level for the 200 by 200 foot injection well nodes was 46.0 feet). Therefore, the elevation of the ground surface at the proposed injection wells should be greater than 51.5 feet. The ground elevation along Route 151 is in the 70-foot to 80-foot range, which is well above the 52-foot elevation calculated.

The projected water table elevations for the 3.3 and 4.5 mgd maximum month discharges are shown in Figures 24 and 25, respectively.

Results of Scenario 1D/3D - Ocean Outfall. The purpose of this model scenario was to evaluate the potential impacts to groundwater from the total removal of septic system recharge within the proposed areas to be sewered without having the groundwater returned to the aquifer. Two average annual scenarios were simulated - 2.8 and 3.5 mgd. In addition, two maximum month scenarios assuming total capture of 5.1 and 6.3 mgd were simulated. The 2.8 and 5.1 mgd scenarios assume the removal of septic system recharge to the Phase 1 and 2 areas, south of Route 28. The 3.5 and 6.3 mgd scenarios also include the Phase 3 areas north of Route 28.

The model simulated reduction in groundwater elevation from the four scenarios is illustrated in Figures 26, 27, 28, and 29, respectively.

These reductions are all relatively low at 0.5-foot maximum reduction. There is no indication that significant groundwater elevation impacts would occur due to the ocean outfalls. It is noted that this groundwater reduction indicates the groundwater rise that is currently occurring from the imported water supply being discharged at these areas through individual septic systems.

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