# Groundwater Recharge Feasibility Study
## *Executive Summary*

*May 2007*

RMC

*Innovative Solutions for Water and the Environment*

# Groundwater Recharge Feasibility Study

**Prepared by:**

RMC Water and Environment

**May 2007**

## Acknowledgements

The Groundwater Recharge Feasibility Study was prepared by a core team of the City of Lancaster and RMC Water and Environment staff, with the input of a number of participants and stakeholders that we would like to acknowledge herein.

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# Executive Summary

The Groundwater Recharge Feasibility Study (Study) was prepared by RMC Water and Environment (RMC), as a consultant to the City of Lancaster (City, or Lancaster). The purpose of the Study was to assess institutional, regulatory, technical, and financial opportunities and challenges associated with a groundwater recharge (GWR) project using recycled water (GWR-RW) as one of the water supplies in Antelope Valley (Valley). These opportunities and challenges were studied in sufficient detail to:

1. Evaluate the feasibility of using recycled water as part of a GWR project operation
2. Develop an implementation strategy
3. Provide local officials with the basis for making a decision on if and how the region should move forward with a GWR-RW project as part of the solution to the Valley's water resources management issues

## Background

The Antelope Valley is a thriving area covering over 2,200 square miles of Los Angeles and Kern counties. In addition to benefiting from a historically dynamic farming community, the Valley is expecting its population in City of Lancaster, City of Palmdale, Town of Rosamond, and unincorporated areas to increase from an estimated 400,000 people in 2005 to roughly 740,000 in 2025 based on the 2006 Greater Antelope Valley Economic Alliance report.

The Valley is a desert environment that currently relies mostly on groundwater and surface water imported from other parts of the state through the California Aqueduct as part of the State Water Project (SWP). The Valley is a closed basin in that there is no outlet to the Pacific Ocean.

### Need for Groundwater Recharge Projects

The Valley needs to tackle a number of major water resource issues to sustain its current economy as well as its projected growth. These water resource issues include:

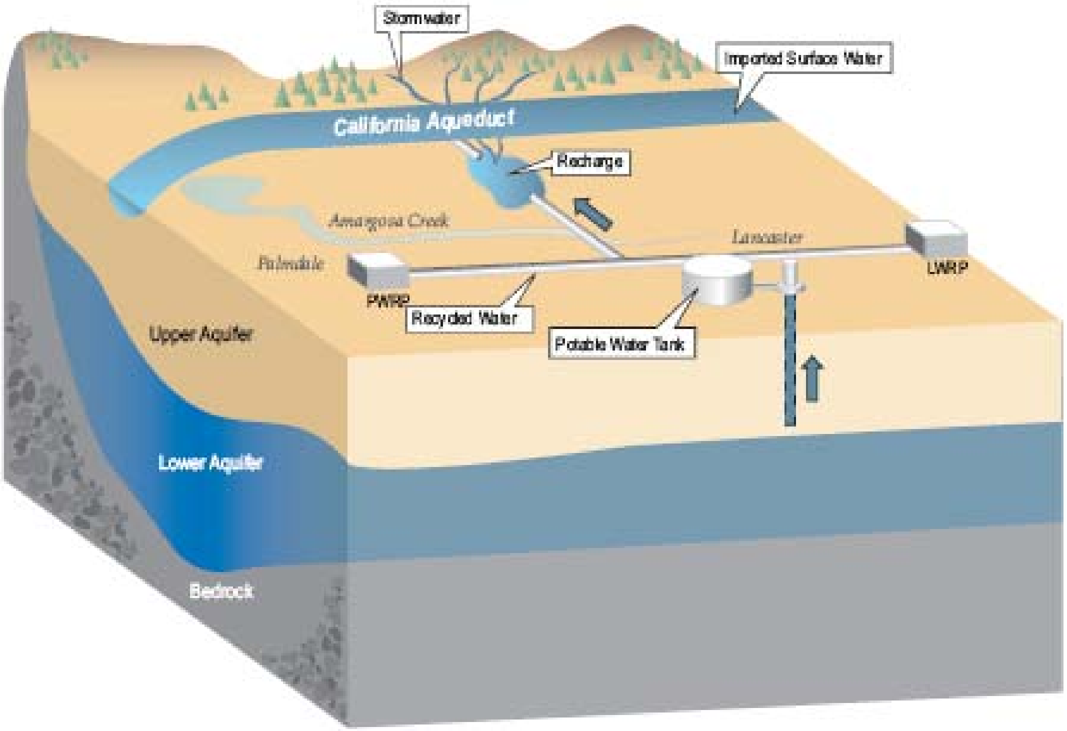
- An overdrafted groundwater basin, which limits the amount of water that can be economically and sustainably pumped in the long-term
- Uncertain future reliability of SWP water supplies due to factors such as climate change, levee breach, earthquake, power outage, or environmental and wildlife protection needs
- Limited local water treatment and conveyance capacity and increasingly stringent potable water quality standards, which will require significant capital improvements in the next 20 years
- Limited effluent management options and increasingly stringent wastewater discharge requirements, which will require significant capital improvements in the next 20 years

The entities in charge of water resources management in the Valley have been working on developing and implementing solutions to address these various issues. The solutions are at different stages of development and implementation; but there appears to be a consensus amongst stakeholders that GWR projects, including GWR-RW, will need to be part of the ultimate solution.

### Why Groundwater Recharge Using Recycled Water?

The technique of using recycled water to replenish groundwater via surface spreading or direct injection has been successfully applied in other areas of the State. In Los Angeles County, the Montebello Forebay GWR Project, which serves the greater Los Angeles metropolitan area, uses roughly 50,000 acre-feet per year (afy) of recycled water for groundwater recharge of the Central Basin. Other examples include the Chino Basin Groundwater Recharge Project in Riverside County, which currently has authorization to use 8,000 afy with plans to ultimately use 22,000 afy of recycled water, and the Orange County Groundwater Replenishment System in Orange County, which plans to recharge 72,000 afy of recycled water starting in 2007. All of these projects use a blend of recycled water, imported water and/or stormwater for recharge. The concept of using recycled water as part of a GWR project is illustrated in **Figure ES-1**.

**Figure ES-1: Concept of Groundwater Recharge Project Using Recycled Water in Antelope Valley**




Implementing a regional GWR project would provide benefits such as avoiding and/or delaying the need for new imported water treatment facilities and provide a more reliable water supply (since water would be stored underground). Some of the key benefits that would result from using recycled water as part of the GWR projects being considered for implementation in the Valley are summarized in **Table ES-1**.

**Table ES-1: Key Benefits of a GWR-RW Project in Antelope Valley**

| Benefit Category | Benefit Description [1] |
|---|---|
| Water Supply Reliability | Provides new source of water supply that is reliable, "drought-proof," and locally controlled |
| | Diversifies regional water portfolio |
| Effluent Management | Provides beneficial use project for winter recycled water flows and reduces recycled water storage needs |
| | Provides alternative effluent management mechanism |
| | Promotes highest beneficial use of recycled water |
| Integration/Synergies with Other Solutions | Supports other solutions being developed to address the limited availability of water supplies, including GWR and groundwater management projects |
| Consistency with State and Federal Goals and Objectives | Upholds State guidelines and policies relative to recycled water, including the California Water Code, Section 13510, and Section 461, and the 2005 California Water Plan Update, which promote diversification of regional water portfolio and encourage the use of recycled water |

Notes:

1. Only identifies benefits of using recycled water as part of a GWR project; does not list all the benefits of implementing a GWR project.

### Why Now?

Over 10 million gallons per day (mgd) of tertiary treated recycled water is anticipated to become available by 2010 as a result of the planned upgrades at the County Sanitation Districts of Los Angeles County's (LACSD's) Lancaster Water Reclamation Plant (LWRP). Additional tertiary treated recycled water should become available in 2010 as a result of the planned upgrades at LACSD's Palmdale Water Reclamation Plant (PWRP). Tertiary treated recycled water will also become available in the short term as a result of planned upgrades at the Rosamond Community Services District Wastewater Treatment Plant (RWWTP). The potential project partners must decide now how to optimize the use of this recycled water as well as imported water, which is the most likely blend supply.

## Study Scope

Alternative strategies to achieve GWR-RW in the Valley were evaluated, taking into consideration related regional initiatives (including the GWR projects using imported water, the agriculture and urban use recycled water projects, and the wastewater treatment plant upgrades), regulatory approval pathways, water rights and other institutional issues, and cost implications.

The Study outcomes include a GWR-RW feasibility study for the Lancaster area, and an implementation plan that delineates how the baseline project could be built and how long it would take. The implementation plan serves as the documentation of the recommendations relative to if and how the region should move forward with using recycled water as one of the water supplies for GWR projects.

In developing the baseline project, six key assumptions were made that impact the project definition and implementation plan:

- **Lancaster Area vs. Palmdale Area Project** – This Study focuses on using recycled water from LWRP. PWD is currently conducting a study looking into GWR-RW from PWRP but the timing and more limited scope of that study is such that the results could not be simply integrated into this Study to develop one single regional GWR-RW project. The project considered in this Study is the Lancaster Area GWR-RW Baseline Project (baseline project).
- **"Preferred" vs. "Baseline" GWR-RW Project** – The objective of this Study is to develop a baseline project (as opposed to *the* preferred project) so that budgetary cost estimates and a detailed implementation plan can be developed. When a decision is made to move forward with a GWR-RW project, the "baseline" project should be refined during a subsequent facility planning phase to identify the preferred project for implementation.
- **Baseline vs. No Project Alternatives –** Implementing a GWR-RW project is one potential element of the overall solution to address the Valley's water resources issues. Other potential elements of the overall solution include developing GWR projects using water supplies other than recycled water only (such as imported water or stormwater), purchasing additional imported water, using recycled water for agricultural irrigation or urban uses such as park irrigation, and promoting water conservation.[1] These other elements should be considered by local officials prior to making a final decision on whether the region should move forward with a GWR-RW project. The current Integrated Regional Water Management Plan (IRWMP) process could be the forum for making this decision. This Study provides the information necessary to make an informed decision. It demonstrates that using recycled water is technically feasible and economically viable in comparison to a No Project alternative (i.e., GWR project that would solely rely on imported water).

[1] These elements are considered in various documents, including *AVEK 2005 UWMP (AVEK, 2005), 2005 Integrated UWMP for the Antelope Valley (KJ, 2005), Antelope Valley Facilities Planning Report Recycled Water (KJ, 2005), Palmdale Water District 2005 UWMP (Carollo, 2005), LWRP 2020 Facilities Plan and EIR (ESA, 2004), PWRP 2020 Facilities Plan and EIR (LACSD, 2004), and City of Lancaster Recycled Water Facilities and Operations Master Plan (RMC, 2006).*

- **Regional vs. Local GWR Project** – The baseline project focuses on a large/regional project in the Lancaster area (as described in the previous bullet). Smaller/local projects (e.g., pilot project within Lancaster city limits) could be considered as a potential next step in the implementation plan.
- **LWRP Available Recycled Water Flows –** The baseline project was developed assuming that a "baseline" amount of 10,000 afy of recycled water would be available for GWR from the LWRP. This approach was used to provide local officials with one data point to compare the different elements of the solution to address the Valley's water resources issues and make a decision on whether to move forward with a GWR-RW project. This number should be refined during the facility planning phase.
- **Incidental vs. Planned Recharge –** The baseline project is a planned recharge project[2] rather than an incidental recharge project.[3] This approach was based on an evaluation of the potential advantages and disadvantages of incidental recharge and planned recharge conducted in response to stakeholder input. The evaluation concluded that incidental recharge did not appear to provide any significant advantage over planned recharge in the Lancaster area.

## Stakeholder Involvement

A key objective of this Study was to meaningfully engage local agencies and stakeholders to obtain a broad spectrum of input and information transfer on a GWR-RW project. The Study was structured around a series of workshops that were attended by 20 to 30 stakeholders representing a wide array of socio-economic interests as illustrated in **Table ES-2**. Members of the public and stakeholders who were not directly contacted were also encouraged to ask questions at any time during the Study, although no extensive outreach was conducted. Increased public involvement is anticipated and recommended in subsequent phases of the project.

[2] Project in which a sponsor applies for a permit to use recycled water for a project that has been designed, constructed, and is operated for the purpose of recharging a groundwater basin (by infiltration or injection) that is used as a source of domestic water supply.

[3] "Incidental" recharge occurs when water is added to a groundwater aquifer due to human activities, such as excess irrigation water or wastewater discharged to land or surface water. In the Antelope Valley setting, an incidental recharge project would consist of the discharge of recycled water to the dry bed of an intermittent stream or to disposal ponds. Some examples of incidental recharge include the Victor Valley Wastewater Reclamation Authority Regional Wastewater Treatment Plant that discharges treated effluent to percolation ponds and the unlined Mojave River, which provides incidental recharge to the Mojave Groundwater Basin, and the Santa Clarita Valley Sanitation District's Valencia and Saugus WRPs that discharge to Reaches 5 and 6 of the Santa Clara River in the Eastern Sub-basin. The Santa Clara River provides incidental recharge to the Piru Sub-basin, which underlies Reach 4 of the Santa Clara River. It should be noted that these discharges are regulated under the NPDES program.

**Table ES-2: Stakeholder Involvement**

| Public Agencies | Regulatory Agencies |
|---|---|
| Antelope Valley - East Kern Water Agency | California Department of Health Services |
| City of Lancaster | Lahontan Regional Water Quality Control Board |
| City of Palmdale | Los Angeles County Department of Health Services |
| County Sanitation Districts of Los Angeles County | State Water Resources Control Board |
| Edwards Air Force Base | **Businesses** |
| Littlerock Creek Irrigation District | Agricultural Companies (e.g. Bolthouse) |
| Los Angeles County Department of Public Works | Los Angeles County Farm Bureau |
| Palmdale Water District | UC Cooperative Extension, High Desert Ag. Div. |
| Quartz Hill Water District | Unaffiliated Agricultural Representatives |
| Rosamond Community Services District | Water Companies (e.g. Sundale MWC) |
| **Elected Officials** | |
| County Supervisor - Michael D. Antonovich (Representative Attended) | Cities' Council Members/Agencies' Board Members/Officials |

## Lancaster Area GWR-RW Baseline Project

The Antelope Valley GWR setting was evaluated in terms of the regional hydrogeology, the expected recycled water availability and quality, the blend (diluent) water reliability and quality, and the current regional initiatives (including GWR projects using imported water). The current regulatory setting prescribed by the California Department of Health Services (DHS) and the Lahontan Regional Water Quality Control Board (RWQCB) was assessed, and constraints and potential regulatory pathways for a GWR-RW project were identified. These evaluations served as the basis for developing and analyzing potential GWR-RW project alternatives and selecting the Lancaster Area GWR-RW Baseline Project recommended herein for further evaluation.

### Project Description & Operational Strategy

The baseline project would recharge 50,000 afy of blend water, on average, at a 4:1 ratio. The blend water would initially consist of 40,000 afy of imported water from the SWP and 10,000 afy of recycled water from LWRP. Up to 64,000 afy of imported would be recharged in wet years to take advantage less expensive water but the 5-year running average of imported water deliveries would be 40,000 afy. The blend might later include stormwater but this component is not part of the current project definition. The 4:1 blend ratio was constrained by DHS requirement included some key assumptions; particularly total organic carbon (TOC) removal through soil aquifer treatment (75% reduction) and initial TOC concentrations in recycled water (8 to 10 mg/L).

The baseline project would extract 48,000 afy[4] of recharged water, on average, via a new well field and deliver the water to wholesaler/retailer distribution system(s) and private agricultural users. **Table ES-3** summarizes the primary components of the baseline project. And, for comparison, Table ES-3 includes the "No Project alternative," which is a regional GWR project that recharges 50,000 afy, on average, of imported water only. **Figure ES-2** presents facilities locations, which were located to develop a detailed baseline project description for comparison with a regional GWR project, and, consequently, should be refined as project details are better defined. **Figure ES-3** presents the operational schematic. The baseline project assumes all facilities within the "Project Scope" area on Figure ES-3 would be owned and operated (and, perhaps, contracted) by a Groundwater Recharge Joint Powers Authority[5] (GWRJPA). This assumption should be refined as project planning progresses.

[4] The baseline project assumes 2,000 afy of blend water is lost to evaporation while in the recharge basins.
[5] The Antelope Valley State Water Contractors Association (AVSWCA) is the most likely organization to fulfill the role of a GWRJPA. Information on the AVSWCA can be found at www.avswca.org.

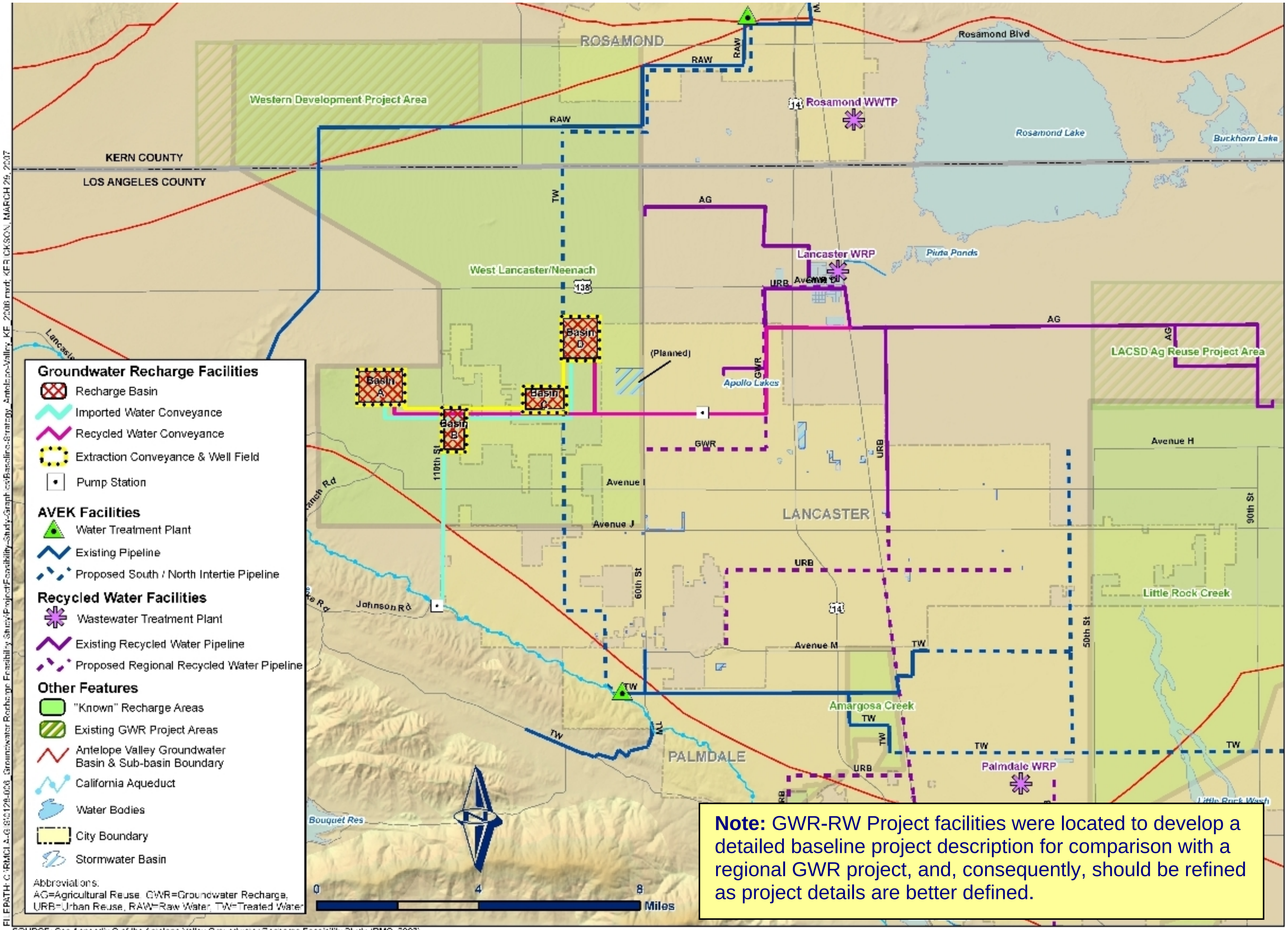
**Table ES-3: Baseline Project - Concept & Facilities**

| Project Component | Concept | Operational Period | Flows: Annual Average | | Flows: Peak Day | Facilities [1] |
|---|---|---|---|---|---|---|
| **Lancaster Area GWR-RW Baseline Project** | | | **afy** | **mgd** | **mgd** | |
| Recycled Water Facilities [2] | • No advanced treatment; 4:1 blend with imported water<br>• New conveyance system<br>• Opportunity for direct delivery to agricultural users | Jan – Dec | 10,000 | 9 | 21 | • 14 miles of 15" to 30" pipeline<br>• 1,800 hp booster pump station along pipeline |
| Imported Water Facilities [3] | • 4:1 blend with recycled water<br>• New conveyance system<br>• Opportunity for direct delivery to agricultural users | Nov – Mar | 40,000 | 86 | 139 | • 11 miles of 36" to 66" pipeline<br>• 6,400 hp pump station at California Aqueduct |
| Recharge Basins [4] | • West Lancaster area<br>• Opportunity to use planned City stormwater basin(s) | Jan – Dec | 50,000 | 36 | 160 | • 4 basins over 1,100 acres<br>• Infiltration rate of 0.5 ft/day |
| Extraction Facilities [5] | • New well field and conveyance facilities<br>• Same as regional GWR project except for DHS well location requirements<br>• Opportunity for direct delivery to agricultural users | Apr – Oct | 48,000 | 25 | 45 | • 6 miles of 30" to 48" pipeline<br>• 50 wells @ 560 hp/well |
| **Regional GWR Project / No Project Alternative (for comparison with GWR-RW Baseline Project)** | | | | | | |
| Imported Water Facilities | • No blending required<br>• New conveyance system but larger than GWR-RW project | Jan – Dec | 50,000 | 107 | 174 | • 11 miles of 39" to 72" pipeline<br>• 8,300 hp pump station at California Aqueduct |
| Recharge Basins | • Same area (West Lancaster) as GWR-RW project but larger basin acreage | Jan – Dec | 50,000 | 36 | 174 | • 1,200 acres<br>• Same infiltration rate |
| Extraction Facilities | • Same as regional GWR project without DHS well location requirements | Apr – Oct | 48,000 | 25 | 45 | • 6 miles of 30" to 48" pipeline<br>• 50 wells @ 560 hp/well |

Notes:

1. Pipelines were sized based on a maximum velocity of 10 feet per second.
2. Recycled water is proposed to be delivered from LWRP to four recharge basins. Available flows vary from approximately 5 mgd in the summer to the peak of 21 mgd in the winter based on the following assumptions: 1) committed flows to Piute Ponds and Apollo Lakes continue; 2) planned urban uses are implemented through 2010; 3) LACSD agricultural reuse project is developed through 2010; and 4) all remaining flows could be made available for GWR-RW. Water quality goals from regulatory requirements will be met through a 4:1 blend with imported water (20 percent recycled water and 80 percent imported water) and no supplemental tertiary treatment from LWRP. Recycled water will be received at 120 psi from the LACSD Recycled Water Transmission Line and delivered to the recharge basins at atmospheric pressure.
3. Imported water from SWP is proposed to be delivered from the California Aqueduct to four recharge basins. Delivery flows vary based on hydrologic (wet/average/dry) year with above average deliveries in wet years and below average deliveries in dry years. Imported water will be delivered to the recharge basins at atmospheric pressure.
4. Recharge basins are proposed to be spread across a 20-square mile area to prevent mounding of recharge water. Limiting factors in design of the recharge basin were infiltration rate and getaway capacity. For this Study, the infiltration rate was based observations at an adjacent project (in an adjacent groundwater sub-basin) and getaway capacity was based on analytical modeling. Both values should be refined as site-specific data is collected.
5. Extraction facilities consist of wells to extract the recharge water and pipelines to deliver the water to AVEK's South/North Intertie (treated water) Pipeline, which will convey water to municipal and industrial customers. Wells will be required (by draft DHS GWR regulations) to be a minimum of 500 feet and six months travel time from the recharge basins. Depending on the basin size, 10 to 20 wells will surround each recharge basin to extract recharge water as it flows concentrically away from the recharge areas.

**Figure ES-2: Baseline Project - Facilities Location**




SOURCE: See Appendix C of the Antelope Valley Groundwater Recharge Feasibility Study (RMC, 2006)

## Figure ES-3: Baseline Project - Operational Schematic

**① LWRP – RECYCLED WATER**

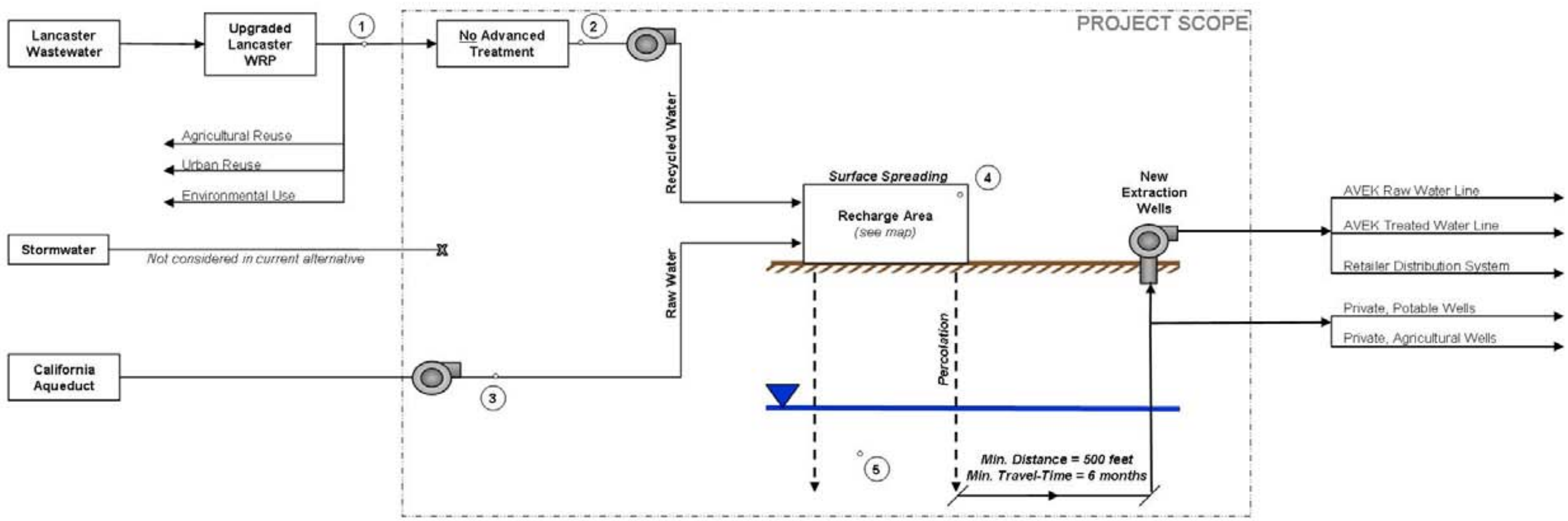
**Water Quantity**
- •Annual Volume = 10,000 afy
- •Peak Flow = 20.7 mgd

**Water Quality (typical)**
- •TOC = 10 mg/L
- •TDS = 570 mg/L (on average)
- •Nitrate (N) = 9 mg/L
- •THMs =Not Available

**② RECYCLED WATER FOR RECHARGE**

**Water Quantity**
Same as ①

**Water Quality**
Same as ①




**③ AVEK – IMPORTED RAW WATER**

**Water Quantity**
- •Annual Volume = 40,000 afy
- •Peak Flow = 139 mgd

**Water Quality (typical)**
- •TOC = 4 mg/L
- •TDS = 230 mg/L
- •Nitrate (N) = 1 mg/L
- •THMs = Not Available

**④ BLENDED WATER FOR RECHARGE**

**Water Quantity**
- •Annual Volume = 50,000 afy
- •Peak Flow = 160 mgd

**Water Quality (estimated)**
- •TOC in RW = Not Applicable
- •TDS = 300 mg/L (on average)
- •Nitrate (N) = 2.6 mg/L
- •THMs = Not Available

**⑤ RECHARGE WATER AFTER PERCOLATION**

**Water Quality (estimated)**
- •TOC = 0.5 mg/L
- •TDS = 300 mg/L
- •Nitrate (N) = 1.7 mg/L
- •THMs = Not Available

## Budgetary Cost Estimate

**Table ES-4** summarizes the estimated costs for the baseline project. These estimates are budgetary cost estimates and should be refined as project planning progresses. Most of the capital and operating and maintenance (O&M) costs are associated with facilities that would be part of the regional GWR project currently under development (recharge basins, imported water conveyance facilities, and extraction and delivery facilities). For comparison, the estimated cost for the No Project alternative (i.e., a regional GWR project using 50,000 afy of imported water, on average) is included in Table ES-4.

**Table ES-4: Budgetary Cost Estimates**

| Baseline Project Components | GWR-RW Project Cost | No Project Alternative Cost |
|---|---|---|
| | ($ Million; 2006 dollars) [1] | |
| Recharge Basins | $30 M | $30 M |
| Recycled Water Treatment Facilities | - | - |
| Recycled Water Conveyance Facilities | $30 M | - |
| Imported Water Conveyance Facilities | $70 M | $80 M |
| Extraction and Delivery Facilities | $70 M | $70 M |
| Capital Cost Subtotal | $200 M | $180 M |
| Annualized Capital Cost [2] | $15.0 M/yr | $13.2 M/yr |
| Operational & Maintenance Cost [3] | $22.0 M/yr | $23.6 M/yr |
| **Total Annual Cost** | **$37.0 M/yr** | **$36.8 M/yr** |

Notes:

1. The cost estimate is based on a combination of recent local bid information, planning costs for other Southern California GWR projects, and generic unit costs for pipelines and pump stations. It includes a planning level contingency of 25 percent and a 20 percent contingency for planning, design, environmental documentation, administration costs. Capital and O&M costs are rounded the nearest ten million and hundred thousand, respectively.
2. Annualized at 6 percent over 30 years (A/P Factor = 0.073).
3. Includes the purchase price of imported water. The purchase price of recycled water was not included because negotiations are currently underway between LACSD and potential customers. The price could be up to $100 per af (RMC, 2006), which is equivalent to $1.0 million per year in incremental costs.

## Benefits and Avoided Costs

**Table ES-5** presents the major incremental costs and benefits (expressed as avoided costs) associated with the baseline project as compared to the No Project alternative.

The project would provide benefits beyond those identified in Table ES-5, such as diversifying the regional water portfolio or promoting highest beneficial use of recycled water. These benefits are listed in Table ES-1 but were not quantified.

**Table ES-5: Major Incremental Costs vs. Avoided Costs [1]**

| Project Component | Benefit / Impact | Incremental Cost ($ M / year) | Avoided Cost ($ M / year) |
|---|---|---|---|
| **Capital Costs [2]** | | | |
| Recycled Water Conveyance | New pipeline and pump stations | $2.6 | |
| Imported Water Conveyance | Reduced size of pipeline and pump station | | $0.8 |
| Recharge Basins [3] | Avoided acreage (100 ac) required for recharge | | $0.2 |
| LACSD Agricultural Reuse Project [4] | Avoided storage ponds, equipment, roads, etc. | | $2.5 |
| **O&M/yr Costs** | | | |
| Recycled Water Conveyance [5] | New pumping costs and recycled water purchase | $1.2 to 2.2 | |
| Imported Water Conveyance [6] | Avoided pumping costs and imported water purchase | | $2.8 to 7.3 |
| LACSD Agricultural Reuse Project [4] | Avoided agricultural operations and lost revenue | $2.5 | $1.7 |
| Well Mitigation [7] | New water supply and/or well replacement/relocation | $0.5 | - |
| Access to New Water Supply | New water supply available for use in proximity of pipelines | Not Quantified [8] | |
| **Total** | | **$6.8 to 7.8** | **$8.0 to 12.5** |

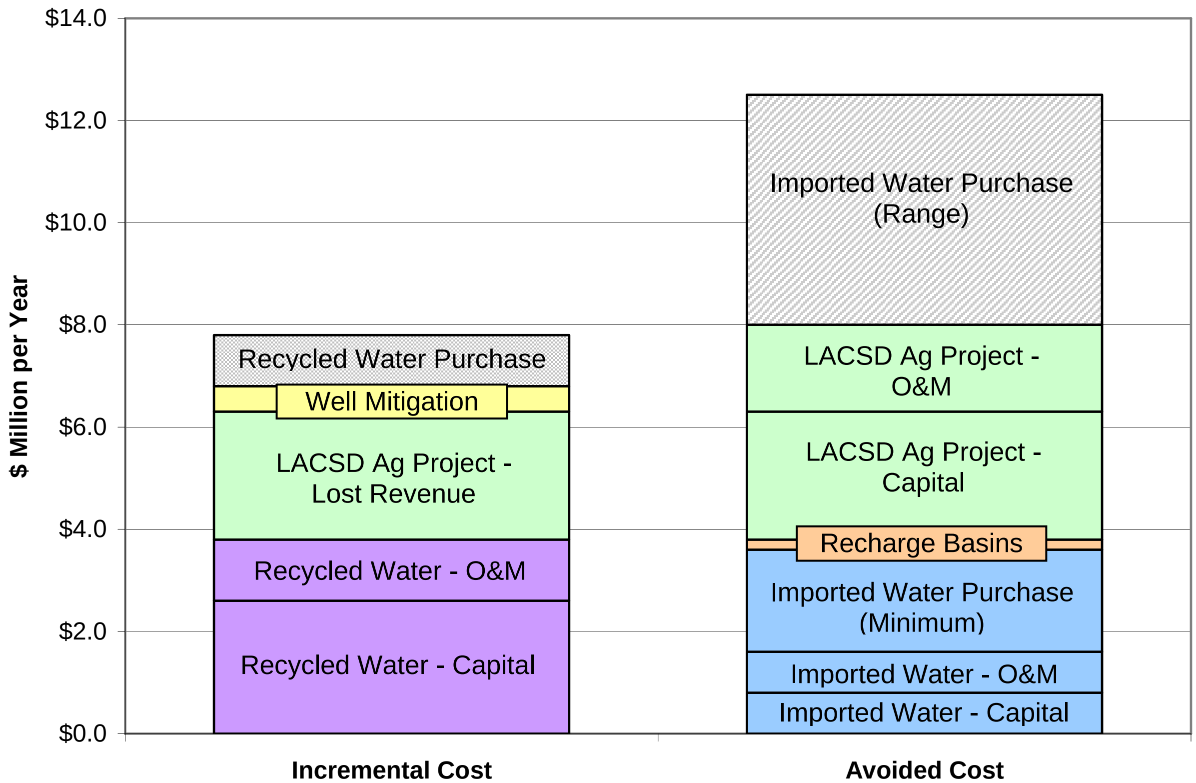
Notes:

1. GWR-RW project key incremental costs and avoided costs are in comparison to the No Project alternative (i.e., a 50,000 afy regional GWR project using imported water only).
2. Capital costs were annualized based on an interest rate of 6 percent over 30 years (A/P Factor = 0.073).
3. The GWR-RW project would require 100 less acres of recharge than a regional GWR project due to a lower blend water peak flow. The lower peak flow results from delivery of recycled water over the full year instead of imported water over five months during the wet season.
4. The incremental cost for the agricultural reuse project is based on the loss of $250/af of projected annual revenue once the project is operational. Avoided costs for the project are $33.8 million for the avoided construction of storage ponds, agricultural operation equipment, and roads/fences/culverts ($27.5, $2.6, and $3.7 million, respectively). Avoided costs also include $1.7 million per year of avoided O&M costs for agricultural operations. (Source: LACSD, personal communication, 2006 and 2007)
5. Recycled water O&M includes the purchase price of recycled water, which was not included in the baseline project because negotiations are currently underway between LACSD and potential customers for urban uses. Recycled water purchase price for GWR is typically less expensive than urban uses due to wet season storage avoidance benefits. To be conservative, the price could be up to $100 per af, which is equivalent to $1.0 million per year in incremental costs. The potential range of recycled water purchase price results in a range of incremental costs.
6. Imported water O&M includes the purchase price of imported water, which was assumed to be $200 per af based on current AVEK GWR rates but delivery of imported water via purchase of an entitlement could cost over $650 per af. The potential range of imported water purchase price results in a range of avoided costs.
7. Well mitigation assumes one well per recharge basin would need to be relocated and/or a new water supply would be provided to well owner.
8. Agricultural users in the vicinity of the imported water and recycled water pipeline alignment would have access to non-potable water for agricultural uses. This benefit is not quantified but could be significant in dry years if access to groundwater is limited due to adjudication.

A range of incremental costs and avoided costs were presented due to the range of future conditions, particularly regarding the cost and availability of imported water and benefits/costs for the LACSD Agricultural Reuse Project.

As shown in Table ES-5 and presented in **Figure ES-4**, the avoided costs associated with the baseline project are estimated to outweigh the incremental costs.

**Figure ES-4: Comparison of Incremental Costs vs. Avoided Costs**




***Based on the favorable comparison of avoided and incremental costs, the baseline project is estimated to be economically feasible in addition to being technically feasible. Hence, it is recommended that the baseline project be further investigated and that the stakeholders move forward with the implementation plan presented below***.

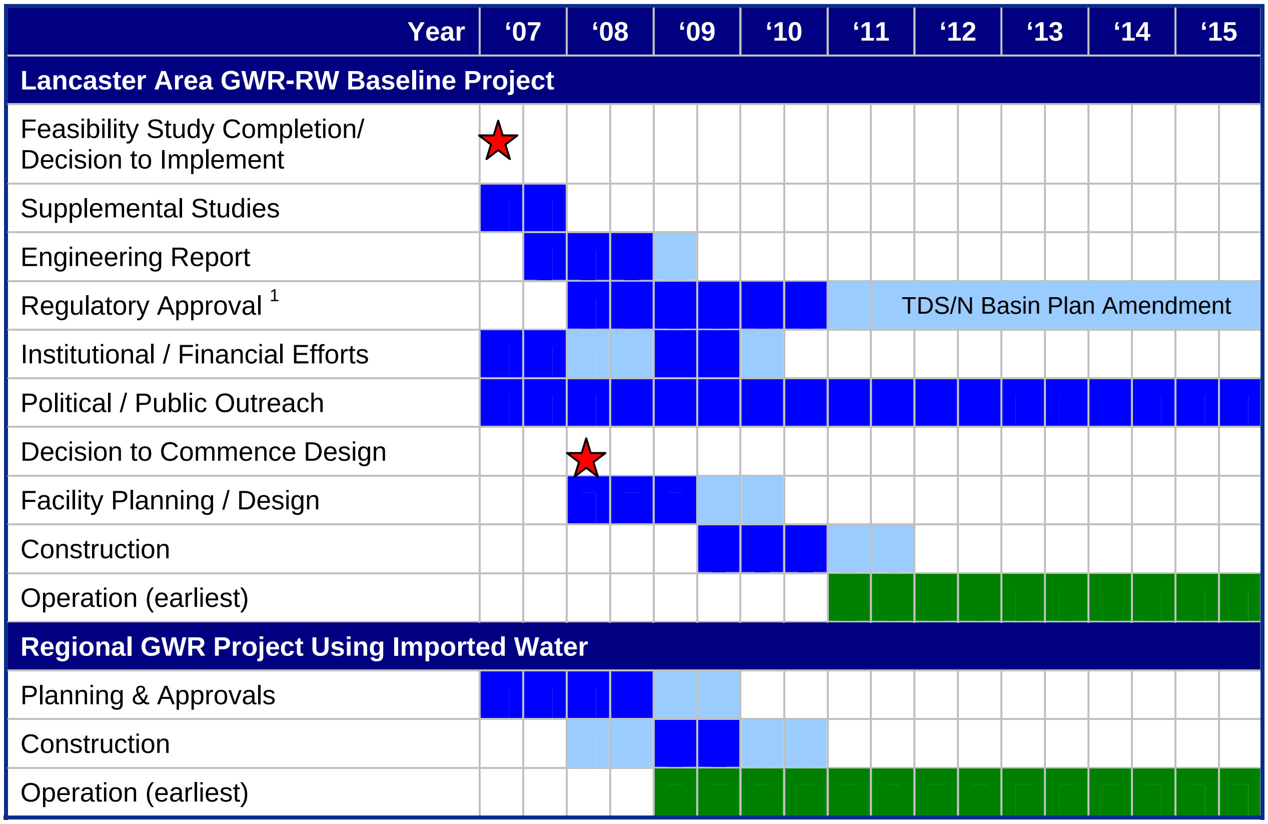
## Implementation Plan

**Figure ES-5** summarizes the recommended implementation activities for the baseline project and associated timeline. It also illustrates how the project implementation timeline would relate to the regional GWR project using imported water being developed by the GWRJPA, and highlights key decision points.

The timeline shows that it would take <u>four to nine years</u> after this Study is complete to start using recycled water as part of a GWR project operation.

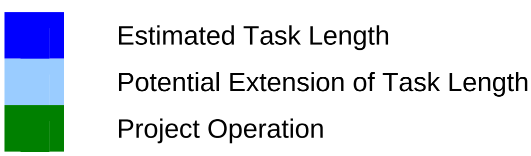
The timeline assumes that a project champion/lead agency responsible for implementing the plan in coordination with all the stakeholders is identified immediately after this Study is complete. In the interim, the project champion/lead agency is assumed to be the GWRJPA.

**Figure ES-5: Implementation Timeline**




Note:

1. The duration of this task is dependent on many factors, particularly the magnitude of recycled water included in the initial phase(s) of the GWR-RW project and the related scope of an anti-degradation analysis. Also, a Salt / Nitrogen Basin Plan Amendment may be developed, which could take many years, but a GWR-RW project could be implemented in the interim.




Specific strategies and activities were developed for the five key implementation activities that should be initiated prior to moving forward with project design. These strategies are briefly summarized below. A number of the recommended activities would also be required as part of the regional GWR project using imported water. Implementation activities for the regional GWR project using imported water and the baseline project should therefore be closely coordinated and/or merged.

## Supplemental Studies

**Table ES-6** summarizes the main recommendations for technical work recommended in the near-term to better define the baseline project and refine the budgetary cost estimate and implementation timeline.

**Table ES-6: Primary Technical Recommendations**

| Project Component | Primary Technical Implementation Recommendations |
|---|---|
| Recycled Water Conveyance Facilities | • Evaluate use of recycled water between urban, agricultural, and groundwater recharge to identify highest beneficial use to the Valley through IRWMP process and/or update to Regional Recycled Water Master Plan |
| Recycled Water Treatment / Blending Assumptions | • Track progress of DHS draft GWR regulations and incorporate into project planning<br>• Track progress of draft and final WRRs and WDRs from Lahontan and other RWQCBs and be prepared to incorporate into project planning<br>• Solicit input at public meetings to determine preferred recycled water treatment alternative<br>• Collect water quality samples for DHS and RWQCB regulated constituents from new LWRP treatment facilities to verify Study estimates |
| Imported Water Conveyance Facilities | • Coordinate design of regional GWR imported water system to ensure that the design does not exclude a GWR-RW project<br>• Conduct imported water quality sampling for DHS and RWQCB regulated constituents that are not currently evaluated |
| Recharge Basins | • Conduct groundwater sampling in the area(s) of recharge<br>• Conduct vadose zone monitoring via column testing, field tests at recharge sites, or other means<br>• Conduct site-specific, hydrogeologic testing to determine range of infiltration rates and getaway capacities |
| Extraction Facilities | • Coordinate design of regional GWR extraction system to ensure that the design does not exclude a GWR-RW project<br>• Confirm underground retention time estimates to support design suggestions for extraction system |

## Regulatory Strategy

The project to obtain regulatory approval includes three components: DHS / RWQCB Process; environmental documentation; and Salt / Nitrogen Basin Plan Amendment (TDS/N BPA).

It is recommended that the lead agency continue involving DHS and RWQCB in the project planning activities, a process that was started with this Study. It is also recommended that the lead agency initiate the regulatory process described below as soon as the technical information becomes available:

1. **Project Sponsor Submits Engineering Report (0.5 to 1.5 years):** All recycled water projects must submit engineering reports for DHS and RWQCB review. The specific topics that impact the timeline for completion of an engineering report are:
    - Hydrogeologic Characterization
    - Groundwater Quality Monitoring
    - Diluent Water Characterization
    - Contingency Plan
    - Long-Term Monitoring Plan
    - Vadose Zone Monitoring
    - Impact and Mitigation Analysis
2. **DHS and RWQCB Review Engineering Report (0.5 to 1.0 year):** There are no statutory or regulatory deadlines for when DHS and RWQCB must complete a review of an engineering report. In addition, for DHS, the review and subsequent revision of a report is typically a multiple

step process, with time gaps between providing comments to the project sponsor, the project sponsor revising and re-submitting the report, and the project sponsor receiving additional DHS feedback.

3. **DHS Holds Public Hearing (0.3 to 0.5 year):** Upon completion of the engineering report, DHS schedules and holds a public hearing prior to making a final determination on the public health aspects of a project.
4. **DHS Issues Findings of Facts/Conditions (0.3 to 0.5 year):** After the completion of the public hearing, DHS issues "Findings of Fact and Conditions." Project sponsors have found that this process can be expedited if they volunteer to produce a draft document for DHS to use as a starting point for their own document production.
5. **RWQCB Holds Permit Hearing (0.5 to 2 years):** Once the "Findings of Fact and Conditions" have been finalized by DHS, the next step in the process is to obtain Waste Discharge Requirements (WDRs) and/or Water Recycling Requirements (WRRs) from the RWQCB. The project sponsor must submit a Report of Waste Discharge to the RWQCB.
6. **RWQCB Prescribes WDR or WRR (up to 1 year):** If there are no disputes over the permit after the RWQCB public hearing, the permit goes into effect almost immediately and no further approval is needed. However, the process would be extended if the permit is petitioned by the sponsor or an opponent.

The environmental (California Environmental Quality Act / National Environmental Policy Act) process could be conducted concurrently with the regional GWR project review process. It is recommended that a review under NEPA be conducted in addition to a CEQA review so that federal funding can be pursued.

It may be beneficial for all stakeholders to consider pursuing and funding a regional approach for salt and nitrogen management similar to the TDS/N BPA adopted by the Santa Ana RWQCB in 2004.[6] This BPA took almost nine years to develop and approve, and included the formation of a stakeholder Task Force and the completion of multi-million dollar studies. A comparable endeavor taking place in the Antelope Valley might require 6 to 10 years to complete and, therefore, it is recommended that efforts begin directly.

## Institutional Arrangements

Currently there are several entities that either contribute to the volume of water in the basin or draw from it. An adjudication process began in 1999; however, there is no clear indication on what the result may be, and there may not be a conclusion for many years. Hence, agreements between stakeholders will need to be developed so that the project partners and/or participants can claim project benefits and implement GWR in the absence of conclusion to the adjudication process.

For this discussion, it is assumed that the GWRJPA will take the lead in developing and implementing a regional GWR program. GWRJPA would be responsible for conducting an inclusive process to address the issues of all stakeholders and developing policies for development, such as management of water volume, water quality, and monitoring. The specifics for policies will become clearer as the IRWMP process proceeds and other analytical work, such as groundwater monitoring and pilot studies, provide data.

Then, a set of criteria should be developed against which to measure any proposals for GWR or other project that would affect the quantity or quality of water in the basin. For a GWR-RW project, management of water quality and monitoring should be emphasized since use of recycled water instead of

[6] Santa Ana RWQCB Resolution R8-2004-0001: Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate an Updated TDS and Nitrogen Management Plan for the Santa Ana Region Including Revised Groundwater Sub-basin Boundaries, Revised TDS and Nitrate-Nitrogen Quality Objectives for Groundwater, Revised TDS and Nitrogen Wasteload Allocations, and Revised Reach Designations, TDS and Nitrogen Objectives and Beneficial Uses for Specific Surface Waters. Available at: http://www.waterboards.ca.gov/santaana/pdf/04-01.pdf

imported water could raise concerns regarding water quality impacts. Finally, interagency agreements will be prepared to document the policies and criteria. Examples of these agreements include between:

- GWRJPA and AVEK/PWD/LCID for purchase of imported water
- GWRJPA and LACSD for purchase of recycled water
- GWRJPA and wholesalers/retailers for storage and/or purchase of recharge water
- GWRJPA and agricultural users for direct delivery of imported, recycled, and/or extracted water

## Financial Approach

The first step in approaching financing is for the lead agency to work with project participants to determine the project costs and benefits to the participants. Preliminary benefits and costs were developed in this Study; but benefits and costs must be refined and the participation by the various agencies agreed upon. Based on the preliminary benefits and costs assessment, it is anticipated that key participants would be AVSWCA and LACSD. This step is closely related to the development of institutional arrangements and should therefore be completed simultaneously.

A second step will be for the lead agency and key participants to develop a funding strategy for their share of the project that would combine outside sources of capital funding and local funding:

- Several outside sources of capital funding could be available, which would be best pursued by the lead agency. Given the timing of the project, the most promising source of state or federal dollars is Proposition 84 dollars through the IRWMP process. The lead agency should therefore incorporate the project through the current IRWMP process. The lead agency should also start working with all water resources agencies in the Valley to develop a single federal funding request for water resources projects. The funding could come through Title XVI or direct appropriation.

- Realistically no outside source of funding would cover the entire capital cost and some form of local capital funding, such as a bond or certificates of participation, will be needed. The debt from local capital funding as well as O&M costs will likely be paid through revenue sources, which typically fall into the categories of connection fees, water availability standby charges, system charges, commodity rates, and property taxes. AVEK has been collecting development fees for projects identified in their 10-Year Capital Facilities Program. Some of the projects within this program relate to a regional GWR project. Many banking programs charge a volumetric (commodity) fee per af of storage per year; this is another option that the participants could consider. It is recommended that the lead agency and participants start developing a financial plan, which would establish the most appropriate source of local funding.

## Public Acceptance Strategy

Successful GWR-RW projects such as the Orange County Water District Groundwater Replenishment Program and the Scottsdale [Arizona] Water Campus project have incorporated extensive public relations campaigns. These and other projects were case studies used in the preparation of the recommendations in the WateReuse Foundation study *Best Practices for Developing Indirect Potable Reuse Projects, Phase 1 Report*[7] and the related web site[8]. The recommended project, which is outlined below in three steps, is modeled on the recommendations of the aforementioned *Best Practices Report* and web site. Key recommendations include:

1. Understand and Support Policy Makers
    - Collaborate with Policy Makers

[7] Best Practices for Developing Indirect Potable Reuse Projects: Phase 1 Report (WateReuse Foundation, 2004). Available at: www.watereuse.org/Foundation/researchreport.htm

[8] www.watereuse.org/Foundation/resproject/WaterSupplyReplenishmt/index.htm

  - Develop Foundation of Written Support
  - Develop Political Champions
2. Build Strong Relationships
  - Define Priority Relationships
  - Identify Early Supporters
  - Create Water Quality Confidence
  - Turn Conflict and Opposition into Assets
3. Communicate with Purpose and Diligence
  - Adopt a Collaborative Communication Style
  - Lead a Meaningful Dialog
  - Pay Attention to the Media
  - Understand Public Sentiments

The lead agency should immediately develop and implement a public outreach program building upon these recommendations. Outreach activities to be defined as part of the program are anticipated to include a 6-month to 1-year public outreach campaign on water resources issues to establish the need for solutions/projects. This campaign should take place immediately. The campaign would then evolve to focus on the solutions, including GWR-RW projects.

## Pilot GWR-RW Program

Although large-scale GWR-RW within Antelope Valley shows high potential, timing of implementation depends on two processes unknowns: timing of large-scale groundwater banking and resolution of the groundwater adjudication process. Since it is important to move forward with the general concept of GWR-RW, a logical first step towards implementation could be the development of a local pilot GWR-RW program.

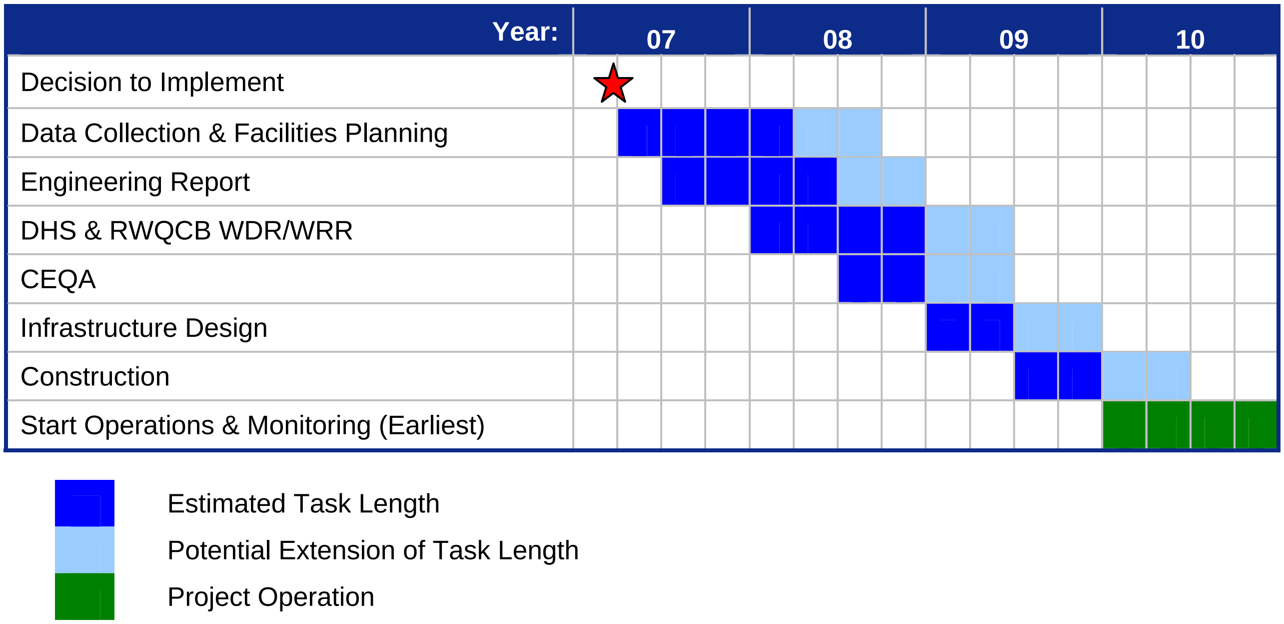
Site selection and design of the pilot program could incorporate stormwater basins that are used for recharge of stormwater. Recycled water could be available from LACSD (such as from the 1 mgd MBR facility that recently began operation at LWRP) and could be conveyed via existing or planned recycled water pipelines serving the urban areas with possible extensions to the recharge basin. Imported water could supplement stormwater as the blend supply.

Implementation of a pilot GWR-RW program would provide similar benefits and avoided costs to the program partners but on a smaller scale than a regional project. The pilot program would enhance the feasibility of implementing the regional GWR-RW project by:

- Providing water quality and reliability data that will help optimize the regional project definition
- Demonstrating attainment of regulatory requirements, while avoiding basin-wide issues such as salt and nitrogen management and Basin Plan Amendment
- Providing a forum to resolve institutional issues surrounding the regional project with a reduced number of partner agencies
- Providing a forum for public review

The total process should take three to four years, as shown in **Figure ES-7,** and could begin operations by 2009-2010 or 2010-2011 wet season.

**Figure ES-7: Pilot GWR-RW Program Timeline**




## Immediate-Term Tasks

In summary, the interim lead agency (assumed to be the GWRJPA) should work with the participants and other stakeholders to complete the following tasks in 2007-2008:

- Confirm project champion/lead agency that will be responsible for implementing the plan, including incorporating the GWR-RW baseline strategy into the regional GWR project and promote GWR-RW project benefits relative to other water resource solutions in the Valley.
- Use the IRMWP process (or other planning processes) to refine the amount of recycled water that should be recharged (the baseline project assumes 10,000 afy).
- Complete technical tasks that will support pilot program implementation and allow refinement of the baseline project definition:
    - Document regional GWR project components, such as imported water supply plan and facilities recharge sites, and extraction facilities.
    - Collect water quality data for constituents not currently analyzed but required for an ADA, such as total nitrogen.
    - Commence hydrogeologic characterization for key attributes, such as groundwater quality, infiltration rate, getaway capacity, and underground retention time in preparation for development of an Engineering Report.
    - Identify ideal recharge basin sites and begin negotiations with land owners to determine willingness to sell development rights[9] and/or ownership of sites.
- Continue engaging with DHS and RWQCB regarding GWR projects in the Valley and determine if a regional TDS/N Management Plan would be beneficial to GWR-RW project implementation.

[9] Purchase of development rights of agricultural land would allow for continued agricultural operations on a majority of the tract while using a portion to operate recharge basins. The recharge basin locations could be rotated in conjunction with rotating agricultural use of the land. This approach could foster a partnership between groundwater recharge proponents and the agricultural community by supporting continued agricultural operations in the Antelope Valley and provide an alternative revenue source for agricultural operators.

- Start developing a detailed financing plan. Incorporate the project into the current IRWMP process to position the project for Prop 84 grant funds. Start working with all water resources agencies in the Valley to develop a single federal funding request for water resources projects.
- Develop a long-term political/public outreach program. Conduct a 6-month to 1-year public outreach campaign on water resources issues to establish the need for solutions/projects.

As noted previously, a number of these tasks would also be required as part of a regional GWR project using imported water. These tasks should therefore be closely coordinated and/or merged with tasks associated with a regional GWR project implementation.

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