DRAFT DISCUSSION DOCUMENT

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This document describes the Borrego Water Coalition's (BWC) two recommended Basin Management Objectives (BMOs):

- **Bring Basin Supply And Demand Into Balance**
- **Protect Water Quality**

The document aims to support public discussion and comment on potential strategies that best advance each BMO.

The document also describes a potential defined methodology and standards for choosing strategies. A methodology is important as there is often a limited amount of resources (time, labor, money) to accomplish objectives. The reason for applying standards is that there is a cost for delay; for assuming perfect information or conditions are necessary before action commences.

The BWC has proposed strategies for discussion that the Borrego Valley (BV) community can move forward with now. These strategies are well-enough understood. These strategies also potentially provide the best outcome value for the resources expended.

MISSION OF RECOMMENDED BASIN MANAGEMENT OBJECTIVES

Water For the Future: Transitioning from Borrego Valley Groundwater Basin (BVGB; Basin) Overdraft to a Sustainable Use of the Basin.[1] Resolving the overdraft of the BVGB is a ***process***. This *process* has physical, legal, environmental, social, and economic ramifications. A sustainable community-wide groundwater system provides for the economy, the community, the desert ecosystem, and equity. There are no panaceas or quick fixes. The Coalition believes that sole reliance and blind faith in *laissez faire* market forces, governmental rescue, future technological fixes and/or legal solutions are misplaced. We understand that solutions by necessity are multifaceted and will only come with the application of human ingenuity and community involvement and effort over time.

THE ROLE OF THE BWC

The BWC is a thought leadership forum whose responsibility is advisory. The BWC has attempted to create a working group that represents all constituencies in the Valley. Each constituency represented by the BWC has a significant stake in the BV that is potentially at risk from the continued overdraft of the BVGB. Members acknowledge that they have no authority to bind their respective constituencies by any decisions or recommendations of the BWC.

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[1] The goal of *sustainability* is "to ensure that natural resources are managed in ways that ensure their efficient but renewable use, and equitable distribution of their benefits." See David L. Feldman, *Water* (Cambridge: Polity Press, 2012), 53.

Members further acknowledge that the BWC's recommendations are in no way meant to abridge the statutory or fiduciary responsibilities of any public regulatory agency.

THE GOALS OF THE BWC[2]

Goal 1: To develop recommendations for managing the BVGB including: what needs to be done, by when, by who, for what cost and what benefits, under what authority, how will results be measured and assessed.

Goal 2: To make certain the analytical basis for choosing basin management strategies to achieve basin management objectives meets the reasonable economic feasibility test. (That is, do we understand in sufficient detail the economic costs and benefits of a particular strategy and are these strategies prioritized as to expected costs and benefits?)

Goal 3: To recommend the means for paying for the implementation of the managed basin plan.

Goal 4: To recommend the best authority to enforce the basin management plan.

PRIORITIZING STRATEGIES: PLANNING & DECISION-MAKING CORE VALUES[3]

1. We will use a broad, stakeholder-based, long-view perspective for Basin management;
2. We will incorporate science, best data, and community knowledge in a documented groundwater management plan (GWMP) update process with public participation.
3. We will determine values for economic, environmental, and social benefits, costs, and tradeoffs for different strategy options for meeting Basin management objectives;
4. We will incorporate future climate variability, economic uncertainties, and risk management options in the decision-making process to prioritize Basin management strategies.

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[2] See Appendix A: "Borrego Water Coalition Memorandum of Understanding" (MOU).

[3] Adapted from *IWM Highlights - Update 2009*, 12B.

PLANNING ASSUMPTIONS

1. There is an overdraft of the BVGB;[4]
2. The overdraft is presently best defined by the work of the United States Geological Survey (USGS) work between 2010 - 2014;[5]
3. It's time to do something to resolve the overdraft.[6] (See Exhibit A: "Cost of Delay: Economics of Managed vs. Unmanaged Basin" and Appendix B: "Economics of Sustainable Groundwater Supply").
4. *Timefulness* is important. Actions taken or delayed all have an economic and/or social consequence. Resolving the overdraft will be a ***process*** that occurs over time.

WHAT HAPPENS IF THE BV COMMUNITY CAN'T AGREE ON A COURSE OF ACTION TO RESOLVE THE OVERDRAFT?

The most likely scenario if the BV community cannot agree on a process to resolve the overdraft now is not many years of more delay. The most likely result is the loss of local control over management of the BVGB. The most probable mechanism for this loss of control would be an adversarial adjudication of the BVGB (see Exhibit B: "Adjudication Explained").

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[4] Approximately $5.645 million in scientifically-based technical work has been produced since 1982 primarily to define the physical characteristics of the overdraft. Of this amount, approximately $2.345 million has been spent primarily on science-based technical work since 2009. There is absolutely no dispute among the experts that overwhelming definitive evidence exists that the BVGB is being overdrafted to the extent that serious economic, social, and environmental harms are likely to occur. See Appendix B: "Economics of Sustainable Groundwater Supply" for some common fallacies that may enter one's thinking in an attempt to dispute scientifically gathered data regarding the Basin overdraft situation.

[5] Despite the expenditure of this $5.645M on scientific studies since 1982, according to the USGS report due out in final form in 2014, the net result has been that the overdraft has more than doubled since 1982; increasing from about 6,000 acre-feet per year (AFY) in 1982 to about 15,000 AFY today (see *http://www.borregowd.org/uploads/ Borrego_USGS_2013.pdf*).

[6] The USGS believes at present withdrawal rates, there is no more than 50-years until the upper aquifer of the Basin will be dewatered (drained of economically extractable water). There is a high probability that water from the middle and lower aquifers of the Basin will be of less quality and more expensive to pump to the surface due to these lower aquifers containing much less water per cubic foot than the upper aquifer. For example, as soon as approximately 30-years from now, water extracted from the Basin may become more expensive for all uses than at present (see Exhibit A: "Cost of Delay: Economics of Managed vs. Unmanaged Basin") primarily due to potentially needing advanced water treatment for some or all uses.

PLANNING TIMEFRAME FOR THE BV COMMUNITY TO AGREE ON A PROCESS TO RESOLVE THE OVERDRAFT

The Coalition is making incremental steps that involve both water pumpers and users giving-up something and being part of an overall solution. The Coalition is building the capacity and relationships to continue to work together over time, in whatever form that takes. The Coalition's intent is to retain local control of the Basin rather than to delegate control to either the County or State government agencies, or the California courts. Even if the BV community doesn't reach agreement on all matters, each item we can agree on is potentially significant as compared to the years when there was little cooperation and virtually no progress on reducing the physical overdraft. Our purpose is to work cooperatively to have water for the future and to have a future community worth living in. In the worst case scenario, the parties would be required to revert to an adversarial adjudication process that would cost the BV community local control, as well as significant money, time, and human resources. The planning objective is to reach agreement on a recommended process to resolve the overdraft by the fall of 2014.

WHERE WILL THE MONEY COME FROM TO IMPLEMENT A PROCESS TO RESOLVE THE BVGB OVERDRAFT?

Assuming a plan that is agreeable to the BV community is developed, then there are options to potentially obtain some new public state funding, private foundation funding, existing implementation funding from Proposition 84 bonds, and from the private bond markets. However, none of these known funding sources are presently available to the BV community. That is because, there is no agreed plan to manage the BVGB. Once a plan is in place, there are other funding sources that potentially may become available. However, whatever the funding sources that ultimately become available, it is highly probable that the BV community will be asked to bear a portion of the ultimate cost to resolve the overdraft.

WHY NOT JUST INITIATE AN ADVERSARIAL ADJUDICATION OF THE BASIN NOW?

In an adversarial adjudication, the courts decide what is best for a basin rather than the community. The courts apply a remedy that may or may not be beneficial to the whole community since their obligation is to "balance" water use in the basin. They apply established legal standards that offer little or no flexibility. This surrender of local control to an outside court could have a devastating effect on our community as we know it today.

Even if the community were to go through an adversarial adjudication process right now, it would not resolve the question of how to pay for the needed changes. An adversarial adjudication would most likely eliminate many or all of the above potential funding sources. For example, it is likely that potential state, foundation, and private bond market funding sources would be unwilling to provide funding when the basin's future was unsettled. Also, an adversarial adjudication does not relieve the necessity for developing a plan to resolve the overdraft of the Basin. It just eliminates known funding sources for developing this plan (see Exhibit B: "Adjudication Explained").

BASIN MANAGEMENT OBJECTIVES (BMO)[7]

A. Bring Basin Supply And Demand Into Balance

What this means is that outflow = inflow. There is no longer an overdraft of the Basin (overdraft means that outflow is greater than inflow). This objective does not specify *how* to achieve this objective. That is the job of strategy. Why is this objective important? Not because the Basin will run out of water in the foreseeable future. The problem with dewatering the upper aquifer is that the water will become much more expensive as water levels drop; as the upper aquifer becomes dewatered, and withdrawals occur primarily from the middle and lower aquifers. That is, continued overdraft will affect the *economic extractability* of withdrawals from the Basin.[8]

What is necessary for any objective to be operationally useful is to *quantify* the objective in terms that can be measured so that it is possible to know whether or not the objective is being met; to *qualify* the objective by specifying who is responsible for implementing the strategies to achieve the objective, who is accountable if the objective is not met by a specific date, and what penalties are assessed against whom if the objectives and various milestones along the way are not met by the allotted timeframes.

An important prioritization requirement to operationalize any strategy to meet a basin management objective is *cost*. How much will it cost to achieve this objective? Who pays this cost? The goal for any strategy is to equitably allocate the cost to all stakeholders. The final requirement is an *update process* that can alter the plan, as necessary, by looking at what is

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[7] DWR mandatory groundwater management plan components include: (a) monitoring AND management of groundwater levels within the groundwater basin; (b) monitoring AND management of groundwater quality degradation; (c) monitoring AND management of inelastic land surface subsidence; (d) monitoring AND management of changes in surface flow and surface water quality that directly affect groundwater levels or quality; (e) monitoring AND management of changes in surface flow and surface water quality that are caused by groundwater pumping in the basin; (f) description of how recharge areas identified in the plan substantially contribute to the replenishment of the groundwater basin. Specific and measurable Basin Management Objectives need to be established to cover all the above items. See See R. Hull, "Required technical components of a groundwater management plan," DWR (8/2013).

[8] The overriding issue is not necessarily how much water remains in a basin, but the cost to extract and use whatever water is there. For example, a basin could have 500-years of water in it at present extraction rates, but only 20-years of economically extractable water left for beneficial purposes.

working and what is failing and making adjustments in a timely fashion so that money can be spent most effectively.

B. Protect Water Quality

Protecting and restoring groundwater quality to safeguard public and environmental health and secure water supplies for beneficial irrigation, recreational, and domestic and commercial uses. Why is this important? Presently, water from most areas of the Basin's upper aquifer is of very high quality requiring little treatment for drinking water purposes and is of sufficient quality for irrigation and recreational purposes without treatment. Water from lower in the Basin may require expensive advanced water treatment for drinking water purposes and/or be harmful to use for irrigation purposes without treatment.[9]

A. STRATEGIES[10] FOR BRINGING BASIN SUPPLY AND DEMAND INTO BALANCE[11] (Basin Management Strategies [BMS])[12]

Strategies are best initially prioritized using standard economic analysis methodologies such as ROIC (return on invested capital) or DCF (discounted cash flow) or ROV (real options value) metrics by monetizing the costs/benefits of each strategy.[13] These analytical methods provide

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[9] Two potential future water quality issues in the Basin include dissolved minerals (such as fluoride and arsenic) that may reside in harmful concentrations in the lower portion of the Basin and the potential migration of nitrates in the most upper portion of the Basin as withdrawals in the northern portion of the Basin decrease.

[10] *Strategy* is used here to mean a high level plan to achieve one or more Basin Management Objectives (BMOs) under conditions of uncertainty. Strategy is important because the resources available to achieve these BMOs are limited. Strategy helps to focus appropriate resources on those activities that potentially will provide the best outcome value for the resources expended (Wikipedia).

[11] From *IWM Highlights - Update 2009*, 12C-D

[12] See State of California, California Natural Resources Agency, Department of Natural Resources, *California Water Plan: Integrated Water Management - Update 2009 Volume 2 - Resources Management Strategies* (Bulletin 160-09, December 2009) available at http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v2_all_cwp2009.pdf.

[13] Understanding the costs and benefits of a strategy and how that strategy will be financed is really "creating the architecture for reaching a [Basin Management Objective] - and providing stewardship to protect and preserve the assets needed for the achievement and maintenance of that [BMO]." See Robert J. Shiller, *Finance and the Good Society* (Princeton and Oxford: Princeton University Press, 2012), 7.

the opportunity to prioritize strategies and make informed decisions to allocate limited capital to achieve results.[14]

__________________ Strategy Priorities Ranked Highest Potential ROIC[15] ________________

1. Use and Reuse Water More Efficiently

Use water more efficiently with significantly greater end-use efficiency,[16] water conservation, recycling, and reuse to help meet future water demands and adapt to climate change. For example, increase residential,[17] recreational, and agricultural water use efficiency,[18] implement measures such as conservation and recycling; capture, store, treat, and use storm water runoff: such as small surface basins, residential storm water capture systems; the creation of catchment basins or sumps downhill of development;[19] incorporate and implement low impact

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[14] "Trust is the cornerstone of most relationships in life" (Shiller, 36). The reason trust often enters in to decision making regarding strategy is that the information regarding a strategic choice is almost always less than what one may wish for. Sometimes "the best you can expect is to avoid the worst." See Italio Calvino, *If on a Winter's Night a Traveler* (1979) in William Poundstone, *Prisoner's Dilemma* (New York: Doubleday, 1992), 53.

[15] ROIC = return on invested capital. See Exhibit C: "Standards & Methodology for Establishing Strategic Priorities."

[16] "The primary benefit of improving water use efficiency is the lowering of demand and the ability to cost-effectively stretch existing water supplies. Once viewed and invoked primarily as a temporary source of water supply in response to drought or emergency water shortage situations, water use efficiency and conservation approaches have become viable long-term supply options, saving considerable capital and operating costs for utilities and consumers, avoiding environmental degradation, and creating multiple benefits." See *Resources Management Strategies*, 3-21; and http://www.swrcb.ca.gov/water_issues/hot_topics/20x2020/docs/comment043009/202020_final_report_draft.pdf.

[17] *Urban Water Use Efficiency* - California law (Senate Bill X7 7, November 2009) requires all appropriators of water in the state to reduce end-use consumption of water 20% by December 31, 2020.

[18] *Agricultural Water Use Efficiency* - the use and application of scientific processes to control agricultural water delivery and achieve a cost-beneficial outcome.

[19] *Urban Runoff Management* - Activities to manage both storm water and dry weather runoff. Dry weather runoff occurs when, for example, excess landscape irrigation water flows from the land. For new catchment basins to be valuable for recharge, they must produce a *net* improvement in recharge to the Basin. To date, the advice of experts familiar with the recharge characteristics of this Basin believe that it is unlikely that the development of man-made bio-retention recharge areas would add significant amounts of recharge to the Basin. The majority of recharge occurs within the ABDSP and man-made structures would not be allowed to be constructed on parkland. Also, it is unlikely that the County would approve the construction of publicly funded bio-retention recharge areas. Historically, public flood control structures have ben overwhelmed by periodic flood flows, resulting in County liability for damages to private homes. If bio-retention recharge areas were privately funded, then the owner would become liable for any damages from flood flows.

development (LID) design features, techniques, and practices to reduce landscape irrigation needs and to reduce storm water runoff.[20]

Work Plan Elements

- work with growers to identify Best management practice (BMPs) innovations;
- work with golf course owners to establish a water budget for each course;
    - based on the water budget for each course, estimate the capital needed to invest to achieve this water budget;
    - identify financing alternatives that could meet the business requirements for each course achieving its water budget;
- review commercial BMPs and estimate costs for implementing these best practices;
- discuss with Borrego Water District prospect for a Proposition 218 process to develop a tiered rate structure that will incentivize residential customers to employ BMPs for end use efficiency in water use.

Work Plan Schedule - see Exhibit D: “Proposed 2014 Groundwater Management Planning Process”

2. Expand Environmental Stewardship through Improved Land Use Management[21]

Projects that practice, promote, improve, and expand environmental stewardship to protect and enhance the desert environment. Work with San Diego County Department of Planning and Development Services (DPS) and the California Department of Parks and Recreation (DPR) on improved land use management practices for the Borrego Valley Watershed. Such land use changes may involve:

Desert Lands Stewardship - Working landscapes such as the Anza-Borrego Desert State Park (ABDSP; Park) and agricultural lands in the northern part of the Basin provide critical habitat and sequester carbon. It is likely that difficult decisions will be made in order to

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[20] Source: CWP Update 2009; SWRCB Recycled Water Policy: DWR Sustainability Values from *Integrated Regional Management Grant Program Funded by Proposition 84 and Proposition 1E Draft (March 2010) - Guidelines* available at http://www.water.ca.gov/irwm/docs/prop84/guidelinepsp/GL_drtf_FINAL.pdf.

[21] *Land Use Planning & Management* - Integrating land use and water management consists of planning for the business and economic development needs of a growing population while providing for the efficient use of water, water quality, energy, and other resources. The way in which we use land—the pattern and type of land use and transportation and the level of intensity—has a direct relationship to water supply and quality, flood management, and other water issues.

fulfill the goals of reliable water supplies and functional desert ecosystems both in and outside the boundaries of the Park.[22]

Crop Idling for Water Transfers - Crop idling is removal of lands from irrigation with the aim of returning the lands to irrigation at a later time or the sale of water rights at a later time without losing such rights. Crop idling for water transfers is done to make water available for potential transfer to other uses in the Valley such as ecosystem maintenance and new development.

Irrigated Land Retirement (*fallowing*) - Irrigated land retirement is the removal of farmland from irrigated agriculture. Permanent land retirement is perpetual cessation of irrigation of lands from agricultural production, which is done for water transfer or for solving overdraft-related problems.[23]

Water Transfers - Water transfers are a voluntary change in the way water is distributed among water users in response to water scarcity (by definition, overdraft is a condition of water scarcity). Transfers can be between water districts that are neighboring or across the state, provided there is a means to convey and/or store the water. Water transfers can be a temporary or permanent sale of water or a water right by the water right holder; a lease of the right to use water from the water right holder; or a sale or lease of a contractual right to

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[22] For example, one doesn’t see healthy, well-watered mesquites in the landscaped environment of Borrego Valley dying in droves like we see in the Borrego Sink---Borrego Airport areas of the Valley. Although mesquite has the deepest roots documented for any tree (at least that local botanists have seen references for) they still succumb to drought and severe over-draft. Because a mesquite puts roots 50 meters down into a mine in Kansas doesn't mean it goes that deep everywhere it is found, or that in response to severe overdraft it responds by going deeper--we don't know. USGS stated in the early 2000's that the Southwest was experiencing its worst drought cycle in more than 500 years. As one travels the West it is clear a large percentage of junipers and pinyons have died as a result of severe drought---in some cases 50% of previous coverage---and one scientifically documented result is an upsurge in large-scale wildfires in Utah, Colorado, Arizona, and New Mexico. Mesquite is not immune to drought or overdraft issues, though it is supremely adapted to the desert environment.

[23] “Communities of individuals have relied on institutions resembling neither the state nor the market to govern some resource systems [commonly pooled resources - CPRs] with reasonable degrees of success over long periods of time.” Users of CPRs in many places around the world have managed to sustainably manage those resources through local, self-regulation rather than rely on state regulation or privatization of the commons. See Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990), 1

water supply. Water transfers can also take the form of long-term contracts for the purpose of improving long-term supply reliability.[24]

Ecosystem Restoration - Ecosystem restoration improves the condition of modified natural landscapes and biological communities to provide for their sustainability and for their use and enjoyment by current and future generations. This strategy focuses on restoration of aquatic, riparian and floodplain ecosystems because they are the natural systems most directly affected by water and flood management actions, and are likely to be affected by climate change.

Economic Incentives - Economic incentives include financial assistance, water pricing, and water market policies intended to influence more sustainable groundwater management. Economic incentives can influence the amount of use, time of use, wastewater volume, source of supply and speed at which BMPs (best management practices) are adopted. Examples of economic incentives include low interest loans, grants, and water rates, extraction fees and rate structures. Free services, rebates, and the use of tax revenues to partially fund water services also have a direct effect on the prices paid by water users and the incentive users have to alter water-related practices today rather than at some future date.

Work Plan Elements

- work with San Diego County Department of Planning and Development Services (DPS) to remove land use barriers for fallowing presently irrigated farmland;
- establish formal mechanisms to purchase farmland from those growers wishing to exit the Valley at this time and to permanently retire this irrigated land;
- develop pricing incentives to promote the use of best management practices (BMPs) by agriculture, recreation, commercial, and recreational water users.

Work Plan Schedule - see Exhibit D: "Proposed 2014 Groundwater Management Planning Process"

3. Improve Data and Analysis for Decision-making

Improve and expand monitoring, data management, and analysis to support decision-making, especially in light of uncertainties, that support groundwater management and flood

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[24] Both using water transfers to establish a recharge basin and/or initiating groundwater banking schemes typically require an adjudication of water rights in order to establish who pays what amounts for the use of water once these mechanisms are in place. See http://www.dpla2.water.ca.gov/publications/waterfacts/water_facts_3.pdf and http://www.water.ca.gov/groundwater/bulletin118/update2003.cfm.

management systems.[25] [See mandatory monitoring requirements in footnote #3 above.] Produce an annual report of progress in Basin health that supports funding requests for GW projects identified by the GWMP.

Work Plan Elements

- review pending DRAFT USGS report;
    - use USGS MODFLOW model to estimate impact of particular strategies on improving the balance of inflows and outflows from the upper aquifer of the Basin;
- review pending DRAFT Reclamation Southeast California Regional Basin Study results. Use results to forecast the economic cost of replacement water for recharging the Basin.

Work Plan Schedule - see Exhibit D: "Proposed 2014 Groundwater Management Planning Process"

__________________ Secondary Strategy Priorities[26] ________________

4. Invest in New Water Technology

Identify and develop creative ways to pay for implementing applied research on emerging, cost-effective water technology for more efficient water use. Also, identify and develop creative ways to pay for implementing advanced technology to reduce energy consumption of water systems and uses (e.g. use of cleaner energy sources to move and treat water).[27]

5. Build Conveyance Systems to Transport Purchased Water to the Valley[28]

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) is scheduled to complete a draft of their Southeast California Regional Basin Study within the next few months. This $900,000 study (50% federal grants; 50% in-kind payments by the Borrego

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[25] *Flood Risk Management* - Flood Risk Management is a strategy specifically intended to enhance flood protection. It includes projects and programs that assist individuals and communities to manage flood flows and to prepare for, respond to, and recover from a flood.

[26] Secondary Strategies will generally only be investigated once strategies believed to possess the highest potential ROIC are fully vetted and if found worthy, funded and implemented.

[27] For example, a clearinghouse for new technology that has worked in other desert environments might help shorten the time to bring new technology to market here.

[28] *Conveyance* - Conveyance provides for the movement of water. Conveyance infrastructure includes natural watercourses as well as constructed facilities like canals and pipelines, including control structures such as weirs.

Water District [BWD]) should provide the economic and practical costs/benefits of this long-standing option to address the overdraft. However, water availability from Colorado River allotments is highly unlikely at this time, based on recent research.[29] It is likely that any imported water used to recharge the Basin would require advanced treatment before it was used for recharge, adding to the cost of this imported water.

6. Expand Conjunctive Management of Groundwater

Advance and expand conjunctive management of existing groundwater sources with groundwater storage to prepare for future droughts, floods, and climate change.[30] This conjunctive use could potentially be for water banking.[31]

B. STRATEGIES FOR PROTECTING WATER QUALITY

__________________ Strategy Priorities Ranked Highest Potential ROIC ________________

1. Monitor Drinking Water Treatment Requirements and Distribution Integrity and Invest in Advanced Water Treatment, If Necessary[32]

[29] The turning point was Tim Barnet and David Pierce, both at Scripps Institution of Oceanography, 2008 paper and their 2009 update to the model where they project that Lake Mead has about a 50/50 chance of reaching dead pool by 2025-2030. Many Colorado Basin water managers now believe that for planning purposes, long term sustainable deliveries from the Colorado River will lie in the range of 11.0 to 13.5 million acre feet (maf) per year, much less than the 17.0 maf presumed by the Colorado River Compact. Thus, the growing impetus is for managers to be thinking about augmented supply from groundwater, and not assuming existing Colorado River allocations can or will be met going forward. For example, see MWD's recent study: .http://http://www.mwdh2o.com/BlueRibbon/pdfs/BRCreport4-12-2011.pdf. Info on SNWA's GW project is at http://www.snwa.com/ws/future_gdp.html

[30] "Conjunctive use" is typically used to describe the practice of storing water in a groundwater basin in wet years and withdrawing it from the basin in dry years. In this Basin, the term is often used to describe the concept of "water banking" (see footnote below).

[31] *Groundwater Banks* - Groundwater banks consist of water that is "banked" during wet or above average years. The water to be banked is provided by the entity that will receive the water in times of need. Although transfers or exchanges may be needed to get the water to the bank and from the bank to the water user, groundwater banks are not transfers in the typical sense. The water user stores water for future use; this is not a sale or lease of water rights. It is typical for fees to apply to the use of groundwater banks.

[32] *Drinking Water Treatment & Distribution* - the reliability, quality, and safety of the raw water supply are critical to achieving the goal of maintaining adequate water treatment and distribution facilities for public water systems. If groundwater quality deteriorates, investment in advanced treatment technology will be necessary.

Drinking water quality standards are presently being revised by almost all states and by the federal government. What these revisions mean is that in the future, treating groundwater extractions from the Basin will become progressively more expensive. Protecting the quality of the groundwater being withdrawn from the Basin is not only good stewardship but the most economically prudent course of action rather than assuming some future advanced water treatment will solve a water quality problem in an affordable fashion.

Work Plan Elements

- *develop an estimate of where BV is currently on the cost curve of an unmanaged basin (see Exhibit A: Cost of Delay: Economics of Managed vs. Unmanaged Basin");*
    - *develop an estimate of the slope of the cost curve the BV is presently on (see Exhibit A: Cost of Delay: Economics of Managed vs. Unmanaged Basin")*;
    - develop a forecast of future water quality degradation and the costs associated with withdrawals primarily from the middle and lower aquifers as the upper aquifer becomes more dewatered at present withdrawal rates. Use results to forecast the economic cost of meeting drinking water standards in future years;
- work with Regional Water Quality Control Board to protect water quality in the BV.

Work Plan Schedule - see Exhibit D: "Proposed 2014 Groundwater Management Planning Process."

2. Manage BVGB Watershed

Example: the acquisition, protection, and restoration of open space and watershed land.[33] Protecting the watershed for a groundwater basin, in case after case across the country, has often proven to be one of the most cost-effective means to assuring future water quality.

Work Plan Elements

- review map of BVGB watershed to determine watershed not within the purview of the Anza-Borrego Desert State Park (ABDSP) that could potentially be purchased or protected;
- continue to work with ABDSP on BMPs for watershed management.

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[33] *Watershed Management* - Watershed management is the process of creating and implementing plans, programs, projects, and activities to restore, sustain, and enhance watershed functions. These functions provide the goods, services and values desired by the community affected by conditions within a watershed boundary. Watershed management is often a key component to protect water quality in some Groundwater Management Plans (GWMPs).

Work Plan Schedule - see Exhibit D: “Proposed 2014 Groundwater Management Planning Process.”

3. Protect Existing Groundwater Recharge Areas[34]

Example: the acquisition, protection, and restoration of lands that serve as natural recharge areas for the Basin. The objective of this strategy is to make certain that the largest amount of water of the highest quality occurs to recharge the Basin during normal recharge events. With the advent of abrupt climate change, recharge events are expected to be more variable than historical values. That is, average annual recharge is expected to be more variable than during recent historical periods (e.g. over the past 200 years), with increased and more severe flood events, as well as longer and more severe periods of drought. In a closed basin like the BVGB, under present conditions of increased variability of natural recharge, the protection of natural recharge areas is a high priority. Fortunately, the majority of natural recharge areas for the BVGB fall within the boundaries of the ABDSP.

Work Plan Elements

- review map of BVGB recharge areas to determine areas not under the purview of the Anza-Borrego Desert State Park (ABDSP) that could potentially be purchased or protected;
- continue to work with ABDSP on BMPs for recharge areas.

Work Plan Schedule - see Exhibit D: “Proposed 2014 Groundwater Management Planning Process.”

__________________ Secondary Strategy Priorities[35] ________________

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[34] *Recharge Areas Protection* - Recharge areas are those areas that provide the primary means of replenishing groundwater. Protection of recharge areas requires a number of actions based on two primary goals. These goals are (1) ensuring that areas suitable for recharge continue to be capable of adequate recharge rather than covered by urban infrastructure, such as buildings and roads; and, (2) preventing pollutants from entering groundwater to avoid expensive treatment that may be needed prior to potable, agricultural, or industrial beneficial uses. Fortunately, the majority of natural recharge areas for the BVGB are located within the ABDSP boundaries.

[35] Strategies ranked lowest potential ROIC will generally only be investigated once strategies with highest potential ROIC are fully vetted and if found worthy, funded and implemented.

4. Monitor and Reduce Sources of Nonpoint[36] Source Pollution[37]

Whatever toxins or pollutants are placed on the land will almost invariably, somehow, someday end up in the aquifer. Over time, even a small amount of toxins and pollutants can contaminate a very large portion of the aquifer. The least costly management strategy is to prohibit non-point pollution at the outset rather than assuming some inexpensive means to remediate an aquifer will be found in the future. Remediating an aquifer that has become polluted is an expensive undertaking and the most cost-efficient approach is proactive control of contaminants.

5. Remediate Groundwater and Aquifer to Protect the Basin from Expensive Future Water Quality Issues.[38]

Sometimes, the only option is to remediate the portion of the aquifer that is polluted before the entire aquifer is polluted or lost to production. Often, once data is available concerning the polluted sate of a portion of the aquifer, it is least costly to begin remediation in a timely fashion before the pollutant has migrated to other areas of the aquifer and the remediation cost increases by magnitudes, or the opportunity for any cost-effective remediation is foregone. Additionally, updating any County and local ordinances and permitting processes or new wells and processes for well destruction may be useful for protecting the Basin's groundwater from future contamination and overuse.

6. Match Water Quality To Use.

Sometimes the water quality problem is best characterized by a mismatch of use. For example, depending on the pollutant, water that was unsuitable for drinking water use without treatment may be used for irrigation and recreational purposes without treatment. Sometimes, even irrigation quality water can be used for some crops, but not others, or used on turf, but not for crops destined for human consumption. Blending higher quality water with lower quality

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[36] Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

[37] *Pollution Prevention* - Pollution prevention can improve water quality for all beneficial uses by protecting water at its source and therefore reducing the need and cost for other water management and treatment options. An important pollution prevention strategy is implementation of proper land use management practices to prevent sediment and pollutants from entering the source water.

[38] *Groundwater and Aquifer Remediation* - Portions of the upper aquifer of the Valley's groundwater Basin already has degraded water quality that may not support beneficial use of groundwater for all purposes. Groundwater remediation is necessary to improve the quality of degraded groundwater for beneficial use. Drinking water supply is the beneficial use that typically requires remediation when groundwater quality is degraded.

water sometimes can be used to bring the final water up to certain standards for beneficial use. Public education programs may be helpful in enabling the public to better understand the value of protecting the groundwater from overuse and pollution.

7. Practice Integrated Flood Management

Projects that promote and implement integrated flood management to provide multiple benefits including: better emergency preparedness and response, improved flood protection, more sustainable flood and water management systems, enhanced floodplain ecosystems, LID techniques that store and infiltrate runoff while protecting groundwater quality.[39] Examples: storm water capture, storage, clean-up, treatment, and best management practices.

C. ONE STRATEGY THAT WE HAVE REJECTED TO MEET BMOs - DO NOTHING OPTION

Waiting beyond a critical point in time to decide on managed solutions to a community's water supply problems can be expensive (see Exhibit A: "Cost of Delay: Economics of Managed vs. Unmanaged Basin"). That is because, often an economic point-of-no-return is reached beyond which any proposed solution is either unaffordable or unobtainable at a reasonable cost.[40]

For example, waiting for market collapse (e.g. dewatering of the upper aquifer that potentially renders the groundwater from lower aquifers uneconomic to extract) to occur before making adjustments in regulatory structure and/or directed capital flows to water markets is likely to be a higher economic cost than addressing the overdraft in a timely fashion.

The classical economic theory of "automatic stabilization" due to changing *laissez faire* market-based pricing signals has been repeatedly shown not to work well for situations of depleting natural resources. While pricing and markets are absolutely necessary to resolve a groundwater overdraft situation, there is little data, either historical or current, from anywhere in the world, that supports a *laissez fair* approach to resource depletion. *Laissez faire* typically

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[39] Source CWP Update 2009 from *Integrated Regional Management Grant Program Funded by Proposition 84 and Proposition 1E Draft (March 2010) - Guidelines* available at http://www.water.ca.gov/irwm/docs/prop84/guidelinepsp/GL_drtf_FINAL.pdf.

[40] See http://www.scribd.com/doc/22163392/Consequential-Catastrophic-Risks.

does not lead to "automatic stabilization," but often to dis-economic (wealth-destroying) system collapse.[41]

Note 1: If a plan is silent on procedures to *update* the implementation project list, the applicant is limited to projects contained in the plan at the time of adoption.[42]

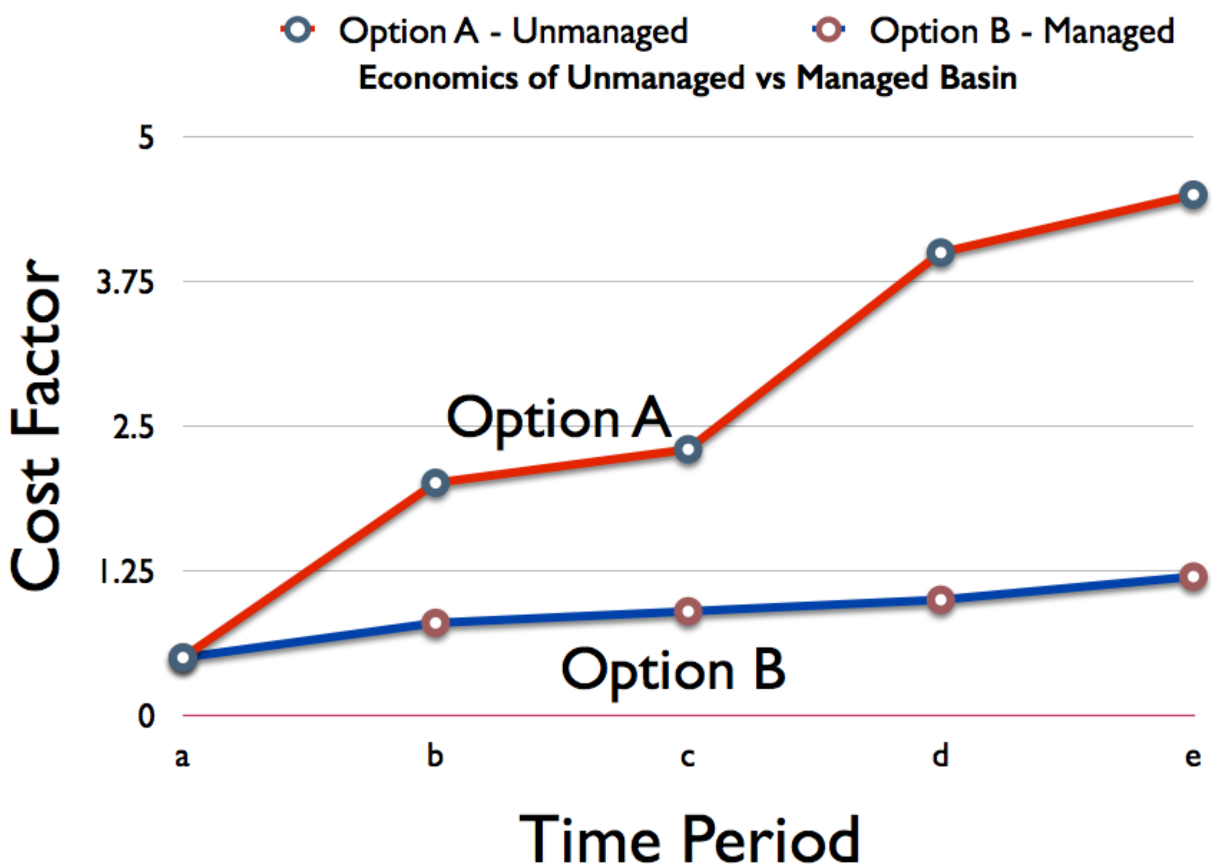
[41] An example of this "tipping point" principle, is the failure of the levees surrounding New Orleans post-Katrina resulting in ~$20 billion in damages to the city's economy, the 2008-2010 meltdown of Wall Street financial institutions that cost investors ~$50 trillion in lost economic value, the BP Gulf oil spill that is estimated to cost the Gulf communities ~$50 billion in lost economic value, the Fukushima nuclear industrial accident that some estimates indicate may cost the Japanese economy ~$100 billion in lost economic value, etc.

In each of these cases, markets failed to adequately price the systemic risk of a knowable, calculable risk. Each case represents the pernicious results of the myth of *laissez faire* that pits "free markets" over government "interference" in markets to resolve economic externalities or probabilistic cost forecasts related to the real economy. In each case, no classical economic theory of the automatic, self-equilibration of markets is operative or useful. *Laissez faire* for depleting natural resources often does not lead to "automatic stabilization," but to system collapse; collapse that is much more costly than managing the situation in the first place. Promoting l*aissez faire* in such cases represents the economic fallacy of *confirmation bias* (see Appendix B: "Economics of Sustainable Water Supply").

[42] See *Integrated Regional Management Grant Program Funded by Proposition 84 and Proposition 1E Draft (March 2010) - Guidelines* p. 15 available at http://www.water.ca.gov/irwm/docs/prop84/guidelinepsp/GL_drtf_FINAL.pdf.

Exhibit A: CONCEPTUAL PICTOGRAPH OF THE COST OF DELAY:

ECONOMICS OF MANAGED VS UNMANAGED BASIN



Note: The above conceptual pictograph illustrates the idea of potential costs over time in a situation where *laissez faire* markets ("do nothing") prevails In Option A. Option B describes a situation where a plan to manage the basin exists. This pictograph does not illustrate specific prices or timeframes for the Borrego Valley Groundwater Basin. We know that the Borrego Basin is somewhere on the Option A curve. But, we do not know where. That is because, to date, no economic work has been done for forecasting prices under a "do nothing" (laissez faire) scenario. Option B curve has been realized in other basins where human intervention and planning has been successfully implemented.

Exhibit B: ADJUDICATION EXPLAINED

An adjudication process provides a formal process to establish a managed basin. An adjudication of a groundwater basin is only one method for regulating groundwater extraction when an overdraft exists. The purpose of each method is threefold: (a) to develop an agreed upon written plan to bring the basin into balance (withdrawals = recharge); (b) to establish an authority to enforce the plan implementation; and (c) to establish a funding mechanism to pay for implementing the plan. Below are some of the mechanisms available in California to establish a managed basin:

Adjudication. Adjudication is the legal process by which a court in California reviews evidence and argumentation set forth by parties using groundwater to come to a decision which determines rights and obligations among the parties involved:

- *Adversarial Adjudication*. A court-directed adjudication process can be lengthly and costly when adversarial. For example, this adversarial process could cost as much as $4 million and take as long as 8-years in the case of the BVGB. If the adjudication is adversarial, often the local community loses control over the basin. The courts take control by appointing a *Watermaster* to oversee the implementation of the managed basin plan, to collect fees to pay for the implementation of the plan, and to exact penalties for non-compliance..
- *Stipulated Agreement Adjudication*. If the parties can agree on a plan to manage the basin, then the courts can *stipulate* (legally approve) this plan. The stipulation would create the authority to implement the plan and the funding mechanism to pay for its implementation. This process could take a few months and cost no more than a few hundred thousand dollars once the plan is agreed to by the BV community. If the adjudication is the result of a negotiated settlement that the courts then stipulate, local stakeholders often retain control over the basin.

Legislative. An alternative to the courts is the California State Legislature enacting laws that can be used to manage the BVGB. There are two types of legislative initiatives: (a) asking the legislature to enact a new law specially for the BV; and (b) using existing laws to manage the Basin:

- *New Legislation*. The legislature can create a groundwater management authority for the Borrego Valley by law. This is a difficult and expensive process that can take two or more years, cost more than $200,000 and require significant local human resources to pull off. However, because this is the potential result of a political process, the probability of the legislature approving such legislation, even with the expenditure of time, money, and human resources is low (estimate is 10%-30% probability, depending on the composition of the legislature).

- **Existing Legislation**. More compelling due to its lower risk and lower cost than new legislation is the potential use of existing groundwater management legislation. In the BV, the Borrego Water District (District) is the management authority of the Basin under Assembly Bill 3030 (see http://www.water.ca.gov/groundwater/gwmanagement/ab_3030.cfm). The District adopted a groundwater management plan (GWMP) under AB 3030 in 2002. In October 2013, the District's Board passed a resolution to update the 2002 GWMP. The District has broad authority, through the AB 3030 process, to manage a groundwater basin. Water Code section 10753.9(c) gives the District the authority to limit or suspend groundwater extractions in the area covered by the groundwater management plan if the District has determined, after appropriate study, that "groundwater replenishment programs or other alternative sources of water supply have proved insufficient or infeasible to lessen the demand for groundwater." Water Code section 10754.2 authorizes the District to impose "equitable annual fees and assessments for groundwater management" within the area covered by the groundwater management plan. The area covered by the GWMP is the District's boundaries, which encompasses more than 90% of the BVGB. Under AB 3030, a plan to manage the basin must be developed with community support and acceptance. That is, an approved GWMP cannot be developed by fiat by a board of the District.

Regulation.

- *County Ordinances*. Some aspects of basins in California are managed under county ordinances. However, there are presently no counties in California who have enacted ordinances that include the full range of provisions required to manage a basin including: a written plan to balance the basin, the creation of an authority to implement the plan, and a mechanism to pay for the implementation of the plan. The majority of county ordinances are much more limited in their intent.
- *State Agency Intervention*. Presently, there exists no statewide regulatory authority that is able to "take-over" a basin from local control, if local control fails in its responsibilities to address an overdraft situation in a timely fashion. However, this situation is likely to change in the near future. When, is unknown at present. Groundwater has currently become a hot topic in Sacramento, as the economic importance of existing groundwater resources in California is becoming more widely understood.

Exhibit C: STANDARDS & METHODOLOGY FOR ESTABLISHING STRATEGIC PRIORITIES

Standards:

- *Forward progress*. We cannot afford to be caught in "analysis paralysis" by waiting for perfect information (which never exists) and perfect solutions. We need to keep moving forward as time is our enemy.
- *Pareto's Law (80/20 rule)*. We need to focus on the biggest bang for the buck and not over-optimize. We don't have the time or resources to over-optimize. This needs to consider the backdrop of timing. What do we need to know "now" to take the next step vs. what will we need to fine-tune over time.
- *Timing*. When, in what order, and to what degree often determines the economic and social cost/benefits of any strategy. Thus, it is important to consider the timing and timeframe for implementation of a strategy.

Methodology:

A high level, first-cut approach using available information at hand will be adequate in most instances to choose a strategy. Both for a first-cut approach and those special instances where additional information is necessary to move forward on a particular strategy, the methodology shall include the following parameters:

- *Physical Benefit*. How much water will be added to the upper aquifer (by capturing, saving/reducing withdrawals, or adding/importing water) with this strategy?
- *Economic Costs and Benefits*. Economically, how much money will this strategy cost? What are the first order benefits from this strategy? Are the economic benefits greater than the costs?
- *Social Costs and Benefits*. Socially, who benefits; who loses? Are the social benefits from the strategy greater than the social costs?
- *Feasibility*. What are the chances of success? For example, are we proposing a strategy that has rarely been tired before or a strategy that has been used successfully by others in the past?
- *Risk*. What is the risk if the strategy is unsuccessful? For example, are we putting all of our eggs in one baskets by pursuing a particular strategy? What are the trade-off's and white/black swans regarding this strategy that may emerge?

Use:

Matrix. Side-by-side comparison of analytically determined values, where available and affordable to determine, for differing strategies.

Ranking: Using return on invested capital (ROIC), discounted cash flow (DCF), and/or real options analysis (ROA) metrics to choose strategies potentially producing the best value for the resources invested to implement this strategy.

Exhibit D: PROPOSED 2014 BASIN MANAGEMENT PLANNING PROCESS

October 23, 2013: District: Public Hearing to adopt a resolution of intention to draft a GWMP

Review of timeline for GWMP update process

Review required technical components of the Plan update

October 24, 2013: District: Provide copy of the signed resolution to DWR

Staff to begin revision process of 2002 GWMP update document

Staff to setup web page for GW background studies

November 7, 2013: Coalition: Adopt Basin Management Objectives (BMOs)

Prioritize Basin Management Strategies (BMSs) to meet these BMOs

November 20, 2013: District: GWM agenda item for discussion at monthly Board workshop

Preliminary outline sections requiring revisions based on new data

Discuss BMOs from Coalition meeting

Discuss GWMP Stakeholders' Committee membership

December 5, 2013: Coalition: Adopt scope of work for BMS priorities

Provide DRAFT BMO document for District GWMP update process

Develop talking points for January 14th public meeting

December 18, 2013: District: GWM agenda item for monthly Board workshop

Report on status of update progress

Discuss DRAFT Coalition BMO document

Finalize GWMP Stakeholders' Committee membership

<u>2014</u>

January 9, 2014: Coalition: Discuss DRAFT USGS Report and USBR Basin Study

UCI presentation regarding technical assistance for GWMP update process

Public meeting talking points practice

Finalize BMSs

Finalize talking points for public meeting on January 14th

January 14, 2014: District: Meeting to discuss DRAFT USGS Report and USBR Basin Study

Set Annual Town Hall Meeting Date

Discussion of Water Quality Program

	Discussion of groundwater flow/water level monitoring Discussion of surface water flow/quality and identify recharge areas
(map)	
January 14, 2014	Coalition: 4:30 – 6:30 PM Public Meeting
February 6, 2014	Coalition: Update BMO document based on feedback at public meeting Begin discussing reduction-sharing formula
February 18, 2014:	District: Prepare agenda for Town Hall Meeting Finalize Report of the GWMP Stakeholders' Committee Discussion of land surfaced subsidence and monitoring plan Begin graphic design/review Review required technical components of the Plan (second time) Discussion of Basin Management Objectives
March 6, 2014	Coalition: Discussion of BMO document Continue development of reduction-sharing formula Discussion of financing options for implementing strategies Discussion of alternatives for a Basin management authority Providing District with most recent BMO document
March 18, 2014:	District: Finalize preparation for Town Hall Meeting Discussion with County and Park personnel (flood, planning,
environmental)	
	Final review of GWMP Stakeholder's Committee Discussion of Basin Management Objectives

Town Hall Meeting (date yet to be determined)

April 3, 2014	Coalition: Update BMO document based on feedback at public meeting Adopt final reduction-sharing formula Further discussion of financing options for implementing strategies Further discussion of alternatives for a Basin management authority Provide District with most recent BMO document Review agenda and talking points for May 22ned public meeting
April 15, 2014:	District: Review of Town Hall Meeting Final discussion of Water Quality Program Final discussion of surface water flow/quality and identify recharge areas

Final discussion of land subsidence and monitoring plan

May 1, 2014 meeting — Coalition: Update BMO based on stakeholder feedback at District

Apply final reduction-sharing formula to final GMSs
Review draft financing plan and implementation timeline
Continue discussion of monitoring and performance metrics
Finalize agenda and talking points for May 22nd public meeting
Provide status update for authority recommendations

May 20, 2014: District: Discussion of monitoring protocols for the Plan
Review graphic design and document layout of the Plan
Review required technical components of the Plan (third and final time)
Discussion of incorporating GWMP into Integrated Regional Water Management Plan (IRWMP)

May 22, 2014 Coalition: Public Meeting

June 5, 2014 meeting — Coalition: Update BMO based on stakeholder feedback at public

Debrief May 22nd public meeting feedback
Adopt final strategy applications of reduction-sharing formula recommendations
Adopt final financing plan and implementation timeline recommendations
Adopt final monitoring and performance metrics recommendations
Convey Coalitions recommendations to District's Board

June 17, 2014: District: Discussion with County and Park personnel (flood, planning, environ)

Determine monitoring protocol for groundwater level and water quality

June 26, 2014 Coalition: Public Meeting

July 15, 2014: District: Finalize all components of GWMP to meet DWR standards
Incorporate feedback from Coalition public meeting

August Break

September 16, 2013: District: Review of finalized plan

October 14, 2014: District: Public Hearing to adopt 2014 Groundwater Management Plan Update

Appendix A: BORREGO WATER COALITION MEMORANDUM OF UNDERSTANDING

[see http://borregowatercoalition.org]

Appendix B: ECONOMICS OF SUSTAINABLE GROUNDWATER SUPPLY

Nothing is more useful than water;
but it will purchase scarce anything;
scarce anything can be had in exchange for it."[43]

DEFINITIONS

Acre-feet/year (af/y): a unit of measuring water usage over time corresponding to covering one acre of land with one foot of water over the course of one year. An acre-foot of water equals 43,560 cubic-feet of water or 325,851.4 U.S. gallons. A football field is about 1.1 acres. One cubic-foot contains 7.48 gallons of water.

Adjudication: see Exhibit B.

Appropriator: the pumpers of the groundwater basin that resell water for use by other parties.

Aquifer: the underground geologic formation where water is stored within the groundwater basin. The Valley's groundwater basin is comprised of three aquifers: upper, middle, and lower aquifers. The upper aquifer of the basin contains high quality, potable water. The middle and lower aquifers contain water of lesser quality that would require in some cases tertiary water treatment to render this water potable or suitable for irrigation.

Conjunctive Use: the storage of water in a groundwater basin for use at a later time.

Dewatering: the extraction of water from one or more aquifers that comprise the groundwater basin. As an aquifer is dewatered, pore space in a deep aquifer can collapse, rendering the aquifer no longer useful for storing water. Thus, if the aquifer becomes dewatered to the extent that pore space collapses, "even if pumping stopped, such fossil water cannot be replaced" (*American West at Risk*, 236).

Groundwater: water beneath the surface of the ground below the water table in which soil is saturated with water.

Groundwater Basin: an area underlain by one or more permeable formations capable of furnishing water supply.

Overdraft: a condition wherein the total annual production from a groundwater basin exceeds the safe yield thereof. In the long run, rates of ground water extraction cannot exceed rates of recharge.

Overlying Parties: owners of land that overlies the groundwater basin and who have exercised overlying water rights to pump wherefrom.

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[43] Adam Smith, *The Wealth of Nations* quoted in Steven Solomon, *Water: The Epic Struggle for Wealth, Power, and Civilization* (New York: HarperCollins Publishers, 2010), 379. Adam Smith was musing about the "diamond-water paradox." "Why was water, despite being invaluable to life, so cheap, while diamonds, though relatively useless, so expensive?"

Overlying Water Rights: the rights, limitations, and responsibilities of overlying parties to the groundwater in the groundwater basin.

Recharge: the amount of water falling on the land from all sources that reaches the aquifer. Typically, the maximum safe yield is equal to no more than the annual recharge rate. Recharge is slow. Deeper aquifers take hundreds to thousands of years to recharge. "Withdrawing excessive groundwater amounts (i.e. over-drafting) from deep aquifers is the same as mining a nonrenewable resource, like petroleum" (*American West at Risk*, 236).

Safe Yield: the maximum quantity of water that can be produced annually from a groundwater basin under a given set of conditions without causing a gradual lowering of the groundwater level leading eventually to depletion of supply.

Sustainable Yield: the maximum quantity of water that can be produced annually from a groundwater basin under a given set of conditions without causing damage to existing ecosystems within the basin. The sustainable yield is almost always lower than the safe yield.[44]

Sustainability (broad definition): Sustainability, as used here is the re-engineering of complex economic support systems that enable these existing systems to transition from high Energy Return on Energy Invested (EROEI) sources to systems capable of operating at lower thermodynamic states without experiencing disruptive non-linearities or collapse.[45]

Sustainability (water definition): the maximum economically extractable withdrawals from the basin during any defined period that does not exceed the sustainable yield of the basin. The

[44] Surface waters and groundwater are interconnected. They may be thought of as a single resource. Over-pumping groundwater can impact surface flows, reducing the water available to support the fauna and flora of the Park's desert ecosystem. T.C. Winter et. al. *Ground Water and Surface Water, a Single Resource* (U.S. Geological Survey Circular 1139, 1999) in Howard G. Wilshire, Jane E. Nielson, and Richard W. Hazlett, *The American West at Risk: Science, Myths, and Politics of Land Abuse and Recovery* (Oxford & New York: Oxford University Press, 2008), 231, 236, 534 footnote #17.

[45] In 1930, EROEI of oil, natural gas and coal was 100:1; today EROEI of oil, gas, wind is 15:1; large hydropower 11:1; conventional coal 10:1; newly found oil, photovoltaic solar 8:1; *clean* coal 5:1 (better carbon emissions control through carbon capture and sequestration but coal ash and heavy metals pollution); fuel cell, geothermal, nuclear 4:1 (nuclear's carbon footprint is ~ 66 gCO2e/kWh, less than 960 gCO2e/kWh for conventional coal but for every dollar spent on nuclear, 5X-6X more carbon could be reduced with end-use efficiency, or renewables); oil shale and Alberta tar sands 3:1 (Athabasca Valley tar sands have largest carbon footprint of any oil production); LNG 2:1; ethanol (from corn) 1.3:1; hydrogen 0.8:1; nuclear fusion (unknown). See, Charlie Hall, "Balloon Graph;" The Oil Drum (www.theoildrum.com); Thomas Homer-Dixon, *The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization* (Washington, DC, Island Press, 2006).

permeability of the aquifer, water quality in the aquifer, and the cost of energy for withdrawals primarily determine whether the water is economically extractible for use.[46]

Water Budget Deficit: the amount of water on an annual basis withdrawn that exceeds the safe yield. This total equals the *overdraft*.

Withdrawals: the amount of extraction of groundwater from the groundwater basin.

CONSTRAINTS:

The primary and overdetermining causal claim of basin overdraft is based on ignoring and distorting the value of groundwater. This has resulted in groundwater being overused, degraded, and misallocated. Without price signals or other indicators of value to help guide policy, too little attention and funding for resource management and protection of ground water has occurred.[47]

Essentially, in California the state *owns* the water, which is assumed to have no market value (water in the basin is a *commons*). The overlyers and appropriators may have *claims* to withdraw water from the basin for beneficial use (*rights* must be established by court adjudication) for the cost of pumping, treating, and transporting this withdrawn water for beneficial use. But, the water itself is *free*.

This colossal underpricing of water's full economic and environmental worth unfortunately sends perverse, insidious, and often illusory economic signals "that water supply is endlessly plentiful, prompting wasteful use on wasteful purposes" with dis-economic (wealth-destroying) returns. The Twentieth Century's most egregious example of discounting the full economic and environmental worth of water is the former Soviet Union's destruction of central Asia's Aral Sea

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[46] Water systems are the largest single category user of electricity in the world, accounting for between two and ten percent of electricity use in a country. In the U.S., water systems account for about three percent of electricity consumed annually (about 75 billion kWh). About 39% of freshwater use in the U.S. is used for thermal electric energy production. See AWWA Water Loss Control Committee, "Applying Worldwide BMPs in Water Loss Control," *AWWA Journa*l 95:8 (August 2003), 75 and U.S. Department of the Interior, U.S. Geological Survey, http://ga.water.usgs.gov/edu /wupt.html (accessed 5/1/08).

California's water infrastructure uses electricity to collect, move, and treat water; dispose of wastewater; and power the large pumps that move water throughout the state. California consumers also use electricity to heat, cool, and pressurize the water they use in their homes and businesses. Total water related electrical consumption for the state amounts to ~52,000 Gigawatthours (GWh). Electricity to pump water by the water purveyors in the state amounts to 20,278 GWh, which is approximately 8% of the statewide total annual electrical use. 32,000 GWh represent electricity used on the customer side of the meter, that is, electricity that customers use to move, heat, pressurize, filter, and cool water. See Lon W. House, "Water Supply Related Electricity Demand in California," *Demand Response Research Center* (December 2006), 1.

[47] Committee on Valuing Groundwater, *Valuing Ground Water: Economic Concepts and Approaches*, National Research Council Press, 1997.

to irrigate cotton fields that resulted in a hydrologic Chernobyl.[48] The failure to place an economic and environmental value on freshwater has created a situation of groundwater overdraft and freshwater shortage not only in the state and the nation, but globally that is "no longer a philosophical threat, no longer a future threat, *no longer a threat at all*. It's our reality."[49]

The *purpose of economic analysis* in this context is to understand the consequential risk of decisions in the absence of accurate market pricing for water resources.[50]

FALLACIES:

Anchoring, Adjustment and Contamination: Specific knowledge may *anchor* one's perception of risk by *contaminating* one's analysis of new data that is *adjusted* to fit one's cognitive map. The most common result is the logical *fallacy of generalization from fictional evidence*.

One example is the common refrain that "if 70% of the overdraft is due to overlyer's withdrawals for agricultural purposes, then what value is there in encouraging conservation by end-users of appropriator withdrawals who account for less than 10% of the basin's overdraft?" The reality is that efficiency measures taken by end-users produce economic value primarily by the avoidance of expensive water treatment, supply augmentation, and distribution infrastructure expenditures. This economic value has absolutely nothing to do with the 70% of overdraft produced by overlyer withdrawals. For example, typically, water efficiency can deliver another unit of water for a fraction of the cost of a supply augmentation project's total cost.

Availability Fallacy: the risk of overdraft is discounted because the dewatering of the aquifer or reaching point beyond economically extractable water has never occurred in the experience of the observer. The tendency is to take no action against the larger potential risk of actually running out of water and to imagine the risk of this occurring at much less than it actually is in reality.

Confirmation Bias: Often with information that is difficult or that rubs against one's heuristic sensibilities, we look for evidence to refute a reasonable analysis. This, biased reasoning looks for data that *fits* one's preconceived notion of the solution set. Unfortunately, this approach to framing problems almost always gets economic risk very wrong. Oftentimes the more sophisticated the person's experience or training, the more confirmation bias is in play. Experts regularly do a poorer job of assessing risk in some cases than a naive observer.

Conjunction Fallacy: Studying the problem reduces the risk of occurrence of running out of water. That is, by adding detail, we sometimes get the risk vastly wrong because we are

[48] Solomon, 377.

[49] Bill McKibben, *Eaarth: Making a Life on a Tough New Planet* (New York: Times Books, Henry Holt and Company, 2010), xiii.

[50] Systemic risk is often discounted. See http://www.scribd.com/doc/22163392/.

overconfident. For example, many people who have heard the USGS Town Hall presentation believe that dewatering of the upper aquifer will occur in 50-years because that is what the model predicts. But, the model is not reality. In reality, there is risk that the aquifer can become dewatered less than 50-years.

Preferential Use Fallacy: My use is preferred to your use sets overlyers against appropriators. "It cannot be said, for example, that the residential use of water is always more desirable (or more valuable) than irrigation, or visa versa. Protagonists in public debates about water may sponsor the idea that water is universally more desirable in one sector than another, but economic evidence does not support such thinking."[51] The logical outcome of this fallacy is that a *CocaCola* bottling plant whose economic return of more than $300,000/af should be preferred over all other uses. This argument was actually used in a few towns in India who saw their aquifers dry-up and the town destroyed by this economic fallacy (of course, the bottling plant actually withdrew the water at no fee to the town).

Overconfidence Fallacy: This is a form of *calibration error* that occurs oftentimes where planning assumes *Technological Optimism*, the misbelief that some future technology can fix any water problem. Not only has this belief not been borne out historically, technological fixes are typically expensive and ultimately uncertain. The overconfidence engendered by this misbelief then leads to assuming that the uncertainties in a risk situation allows one to construct a relatively benign future. This *calibration error* provides for ignoring futures in which water supply runs out. The doubters are right that uncertainties are rife. They are wrong when they present that as a reason for inaction.[52]

Scope Neglect: A person's stated willingness to pay (SWTP) is not re-calibrated when the scope is magnitudes different between two risk scenarios. Essentially, the analyst is unable to imagine the relative magnitudes of consequences from the associated risk of the solution set, as the consequences lie too far outside his/her life experience. For example, few people, unless they have experienced this for themselves first hand, have a clear picture of what the consequences would be for the Borrego Valley to dewater its basin and the magnitude of economic risk as the final dewatering grows closer in time.

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[51] See Ronald C. Griffin, *Water Resource Economics: The Analysis of Scarcity, Policies, and Projects* (Cambridge, MA. & London, The MIT Press, 2006), 12.

[52] See *The American West at Risk*, 5, 8, 365, 367

Appendix C: Groundwater Management Plan Update Table of Contents

Appendix D: Borrego Valley Community Scope of Work for Updating the 2002 Groundwater Management Plan

Project Understanding and Approach

Fundamental to developing an effective Groundwater Management Plan (GWMP) is a clear understanding of the problems and challenges facing the groundwater users in the region. Based on the Borrego Valley Community's experience and the information provided to us by stakeholders, the major water resources challenges/issues include the following:

- Borrego Valley (BV) Groundwater Basin (BVGB) groundwater overdraft;
- Entire BV relies exclusively on groundwater;
- Lack of accessibility to alternative surface water or imported water sources;
- Changing agricultural production and recreational land use; and
- Low probability of inelastic land subsidence caused by deep well pumping.

<u>Goals</u>

The District believes that the primary purpose of preparing an update to the 2002 GWMP at this time is to constellate a practical vision that is articulated in the following three statements:

1. Develop a negotiated, agreed-upon plan to address the overdraft that is feasible, quantifiable, and measurable, that describes in writing what, by when, for how much, who is accountable, what metrics will be used to measure success, and includes the process to make mid-course corrections from the initial plan;
2. Create as part of the plan a deliberative body with the authority to enforce the negotiated plan consistent with current state law;
3. Create as part of the plan a mechanism to pay for implementing the plan. The plan must have adequate funding to produce desired, agreed-upon results

Further the District believes the goals of the GWMP to include:

1. Update the existing 2002 GWMP to reflect the overriding vision stated above and to be eligible for state grants, loans and special drought assistance;
2. Update hydrogeologic data from the existing plan to reflect current conditions;
3. Provide a valuable reference document with useful technical and policy information;
4. Improve understanding of groundwater conditions;
5. Identify and document recommendations for addressing water supply, water quality and land subsidence problems;
6. Identify potential multi-agency projects and programs;
7. Assert control over local groundwater to prevent future adjudication and/or state control;

4. Document progress in achieving previous goals; and

5. Address policy and management changes since previous the GWMP was prepared.

The Borrego Valley Basin GWMP itself will not represent approval for recommended actions and policies, but rather establish goals, objectives, strategies and ideas for improving groundwater management.

<u>Groundwater Management Plan Content</u>

The Borrego Water District (District) and its advisors are thoroughly familiar with legislative requirements for GWMPs, including recent requirements passed in 2011. The GWMP will include DWR recommended, voluntary and required components for GWMPs listed in the California Water Code. **Table X** (at the end of this section) includes a list of these topics and which are addressed in the existing GWMP for the Borrego Water District. Many of these topics are missing in current GWMP, and topics that are addressed will typically require updating or expansion. A proposed outline for the GWMP is also included at the end of this section.

<u>Geographical Area</u>

The GWMP will cover the portion of Borrego Valley Basin located within DWR defined Groundwater Basins. This will include the entire XXXX Basin and portions of the XXXX Basin and XXXX Basin. As a result, the GWMP will not include foothill and mountain portions of San Diego County because they are not within a DWR defined groundwater basin.

<u>Scope of Work</u>

Following is a detailed scope of work, based on the information provided in the Request for Proposals.

Category 1- Water Resources

This task will involve collecting information from existing sources.

<u>1.1 - Identify Groundwater Supplies</u>

This overview will be based on sections in the existing Borrego Water District GWMP. Discussions on groundwater supplies, well production, and demand projections will be updated.

<u>1.2 - Identify Other Supplies</u>

Other potential water supplies will be identified and discussed including effective bio-retention recharge areas, recycled water, agricultural drainage water, and conjunctive use opportunities identified by Reclamation's Southeast Basin Study.

<u>1.3 - Identify Existing Facilities and Operations</u>

This task will include an overview of important groundwater infrastructure with a summary for each plan area and major water user. These facilities will include production wells, groundwater banks, recharge basins, monitoring wells, pipelines, canals and reservoirs.

<u>1.4 - Provide Basin Management Objectives (BMOs)</u>

Basin Management Objectives are broad basin-wide groundwater management goals. These will be developed with direct participation of the Borrego Water Coalition and other plan participants. When feasible they be quantified. The objectives will cover the entire area within the GWMP.

1.5 – Provide Basin Management Strategies (BMSs)

Category 2 – Stakeholder Involvement

The California Department of Water Resources considers stakeholder involvement an important part of GWMP development. Some stakeholder involvement is required by law, and some new rules were established in 2011. California Assembly Bill 359 (2011) includes new public outreach requirements. These include notifying DWR when an agency plans to prepare a GWMP, so DWR can post the notice on their website, and allowing any person or entity to be placed on a list to receive all pertinent notices, meeting announcements, etc. for the GWMP. Stakeholder involvement will include public meetings, newspaper notices, website and newsletter articles, and directly contacting relevant stakeholders.

2.1 - Involving the Public

The public will be informed of the Groundwater Management Plan update and project meetings through newspaper notices, websites, and newsletter articles. They will also be welcome to attend three project meetings. A copy of the Draft GWMP will be posted on the BVWD website and the public will be given an opportunity to provide written comments. These efforts are described below.

Newspaper Notices. Newspaper notices will be published to comply with California Water Code requirements for updating GWMPs. The first notice will announce a public hearing of intention to update the GWMP. The second notice will announce the intention to adopt the updated GWMP. These notices will be published in a local newspaper one and two weeks prior to the public hearings. Sample notices will be provided to the GWMP Participants. It is assumed that the GWMP participants will coordinate publishing the notices and pay publishing costs.

Website and Newsletter Articles. Two articles will be written on the project. The first will announce plans to update the GWMP, describe the general content of the GWMP, and solicit initial input. The second article will solicit comments on the draft GWMP. These articles will be given to the participating agencies to publish in their newsletters and websites.

Project Meetings. Three public meetings will be held to discuss the Groundwater Management Plan (GWMP) update. The meetings will include the GWMP participants, and other stakeholders that choose to attend. The anticipated topics for each meeting are described below:

> Meeting 1 – Kickoff Meeting. Introduce GWMP participants and consultants. Discuss requirements in GWMPs, scope of work, and schedule. Identify important stakeholders to contact. Solicit input from the general public. Identify broad groundwater management goals and basin management objectives related to groundwater overdraft, land subsidence, groundwater recharge, monitoring, and other major topics.

Meeting 2 – Discuss Recommendations and Proposed Action Items. Discuss consultant's recommendations and proposed action items to address groundwater management issues.

Meeting 3 – Discuss Comments on Draft GWMP. If sufficient comments are received from the GWMP participants, general public, and other agencies, then a meeting will be held to review and respond to comments.

It is recognized that the GWMP participants have come to consensus on many issues and agreed by a Memorandum of Understanding to jointly prepare the GWMP. Consideration should be given to including professional meeting facilitators in the GWMP development if the GWMP participants feel they are needed. They may be needed if there are disagreements on Basin Management Objectives, recommendations for solving local problems, or the content in the GWMP. They may also be needed if third-party interests disagree with the content of the new GWMP.

2.2 - Involving Other Agencies Within and Adjacent to the Borrego Valley Basin Area

Other local agencies may want to provide input on the GWMP. A list of agencies will be developed in conjunction with the GWMP participants and they will be formally notified by letter that the GWMP is being updated.

2.3 - Utilizing GWMP Advisory Committees

The State guidelines for GWMPs require a Groundwater Advisory Committee oversee the development of the GWMP and its implementation. The Borrego Water Coalition may already be functioning to fulfill this need. If there is sufficient interest, an advisory committee of local citizens could also be formed to provide input on the GWMP. In addition, other committees that address special interests (i.e. land subsidence, agriculture, etc.) could also be formed, if there is interest. The committees would provide non-binding comments and recommendations.

2.4 - Developing Relationships with State and Federal Agencies

State and Federal Agencies will be contacted and encouraged to attend the project meetings. These will include local representatives from different departments of the California Department of Water Resources. Other State and Federal agencies will be identified during the kickoff meeting and invited to participate.

2.5 - Pursuing Partnerships Opportunities

During development of the GWMP, partnership opportunities with other agencies will be pursued. These could include partnerships to monitor groundwater with other local entities, regional water agencies or others in partnerships to identify and fund projects. Other potential partnerships will be identified during project meetings.

Category 3 – Groundwater Conditions

3.1 - Provide Update of Current Groundwater Conditions

Data from the existing GWMP will be updated to evaluate water-level changes since the previous evaluation. These changes will be determined for both the upper and the lower aquifers in the GWMP study area to the extent there is a confined or semi-confined aquifer present.

3.2 - Groundwater Overdraft

Previous groundwater overdraft estimates will be reviewed and documented. A preliminary estimate of current overdraft will be performed based on 1) projected development and retirement of irrigated and urban lands relying on groundwater, and 2) recent rates of water-level decline and estimated specific yields. Recent USGS studies also provide estimates of current overdraft rates.

3.3 - Land Subsidence

Existing land subsidence data will be collected from the DWR, USBR, USGS and USACE. Publicly available LIDAR data that illustrates recent land subsidence will also be collected. Existing subsidence will be identified as elastic or inelastic, where feasible.

Category 4 – Groundwater Sustainability

4.1 - Mitigation of Groundwater Overdraft

A variety of methods will be investigated for mitigating groundwater overdraft including: groundwater recharge, groundwater banking, in-lieu recharge, water transfers, urban water conservation, agricultural water conservation (including land retirement), reduction-sharing formulas, and flood water and stormwater capture. The discussion will focus on the areas with the greatest overdraft and the methods most suitable for those areas. Several maps will be prepared to facilitate the evaluation including maps showing areas not receiving any surface water, and areas with groundwater recharge potential (based on various soils and geologic data).

4.2 - Mitigation of Land Subsidence

Mitigation for the potential for land subsidence, although considered low probability by the USGS, will generally follow the alternatives described below: 1) telescoping compression sections in new wells; 2) eliminate or minimize deep well permits; and 3) forecasting of possible conjunctive use projects to reduce the potential permanent loss of basin storage due to compaction. The recommendations will vary geographically within the Basin based on their feasibility and the spatial distribution of current and potential (albeit low probabilistic forecasts of) land subsidence.

4.3 - Assess Water Quality Threats to Groundwater Basin Sustainability

Water quality problems will be documented from existing data sources including the GAMA network, and other sources. The long-term threat to groundwater sustainability as it relates to quality will be discussed.

4.4 - Provide Recommendations for Potable Supply Demand Reduction

Current land use plans will be reviewed to assess their impact on groundwater sustainability. Proposed changes will be documented for consideration by land use planning agencies. Recycled water sources will be identified and their potential use for recharge, landscape irrigation, agricultural irrigation, or industrial use will be discussed.

Category 5 – Monitoring Program

5.1 - Groundwater Elevation Monitoring.

Existing groundwater monitoring programs will be reviewed including plans used by each GWMP participant and the local CASGEM. California State guidelines for monitoring will also be reviewed. The overall network will be evaluated for suitability in providing a regional monitoring network. Topics discussed will include: density of monitoring network, density in high priority areas, need for dedicated monitoring wells versus production wells, common monitoring protocols, frequency of monitoring, and data sharing.

5.2 - Groundwater Quality Monitoring Program.

Existing groundwater quality monitoring programs will be evaluated including those performed by the GWMP participants, the GAMA program, Irrigated Lands Regulatory Program (if applicable) and others. The need for additional testing will be assessed.

5.3- Land Surface Elevation/Subsidence Monitoring.

Land subsidence monitoring will be discussed including surveying networks, extensometers, and remote sensing techniques, such as LIDAR. Existing monitoring programs will be reviewed to see if they are adequate, or if the GWMP participants should develop their own program.

Category 6 – Plan Implementation

6.1 - Recommended Action Items

Recommended action items will be developed jointly by the District and GWMP participants. They will include high-priority tasks needed to address primary groundwater concerns in the region. They will be largely based on recommended actions listed in Section 4 – Groundwater Sustainability and Section 5 – Monitoring Program. This list will be developed during the second Project Meeting (see Task 2).

6.2 - Recommended Implementation Schedule

A schedule will be developed including the recommended action items over the next five years. The schedule will address practical factors such as funding availability, time to secure funding, grant application deadlines, project priorities, and availability of agency staff to implement the projects.

6.3 - Identify and Provide Recommendations for Funding Opportunities

Potential funding opportunities will be identified including local, state, and federal loans and grants. Revenue sources to fund groundwater projects will also be discussed including water fees, land assessments, water replenishment fees, capital improvement fees, and groundwater banking fees.

Draft and Final Reports

Draft and final reports will be posted on the District's web page and be available in hard copy at the District's office upon request. As required by State Assembly Bill 359, one copy of the final GWMP will be sent to the California Department of Water Resources.