Borrego Water District Board of Directors
Special Meeting
March 20, 2018 @ 9:00 a.m.
806 Palm Canyon Drive
Borrego Springs, CA 92004

I. OPENING PROCEDURES

- **A.** Call to Order
- **B.** Pledge of Allegiance
- **C.** Roll Call
- **D.** Approval of Agenda
- **E.** Approval of Minutes
- **F.** Comments from the Public & Requests for Future Agenda Items (may be limited to 3 min)
- **G.** Correspondence Received
  1. AAWARE Letter – J Seley (3-8)
  2. Revised Community Sponsor Group Letter – Rebecca Falk (9)
- **H.** Comments from Directors

II. ITEMS FOR BOARD CONSIDERATION AND POSSIBLE ACTION

- A. Consideration of District Baseline Pumping Allocation (BPA) and Inclusion of Human Right to Water Component. (10-11)
- B. Proposal for Additional Groundwater Extraction Wells for the Borrego Water District (12-17)
- C. Public Hearing Schedule for Developers Policy and Emergency Declaration (18)

AGENDA: March 20, 2018

All Documents for public review on file with the District's secretary located at 806 Palm Canyon Drive, Borrego Springs CA 92004

Any public record provided to a majority of the Board of Directors less than 72 hours prior to the meeting, regarding any item on the open session portion of this agenda, is available for public inspection during normal business hours at the Office of the Board Secretary, located at 806 Palm Canyon Drive, Borrego Springs CA 92004.

The Borrego Springs Water District complies with the Americans with Disabilities Act. Persons with special needs should call Geoff Poole – Board Secretary at (760) 767 – 5806 at least 48 hours in advance of the start of this meeting, in order to enable the District to make reasonable arrangements to ensure accessibility.

If you challenge any action of the Board of Directors in court, you may be limited to raising only those issues you or someone else raised at the public hearing, or in written correspondence delivered to the Board of Directors (c/o the Board Secretary) at, or prior to, the public hearing.

III. INORMATIONAL ITEMS (19)

A. Discussion of GSP imposed Reductions Period: Is 2040 too long?
B. Sector Reductions
C. Discussion of Anthropogenic Climate Disruption (Climate Change) Impacts on USGS's Sustainable Yield of 5,700 AF for the Borrego Springs Subbasin of the Borrego Valley Groundwater Basin
D. Discussion of Agricultural Return Flows Impacts on USGS's Sustainable Yield of 5,700 AF for the Borrego Springs Subbasin of the Borrego Valley Groundwater Basin. (20-44)
E. Discussion of Fallowing and Land Restoration Standards Research
F. Discussion of Water Transfers:35MM Earmark Public Bond Initiative Rules

IV. CLOSED SESSION:

A. Conference with legal counsel-anticipated litigation: Initiation of litigation pursuant to subdivision (d) (4) of Government Code Section 54956.9: one (2) cases

B. Conference with Real Property Negotiators

Property: (APN: 140-010-03, 06 and 09)
Agency Negotiator: (Geoff Poole)
Negotiating Parties (Dennis Jensen of Oasis Ranch)
Under Negotiation: (Price and Terms of Payment)

V. CLOSING PROCEDURE

A. Suggested Items for Next/Future Agenda
B. The next Meeting of the Board of Directors is scheduled for March 28, 2018 at the Borrego Water District

All Documents for public review on file with the District's secretary located at 806 Palm Canyon Drive, Borrego Springs CA 92004
Any public record provided to a majority of the Board of Directors less than 72 hours prior to the meeting, regarding any item on the open session portion of this agenda, is available for public inspection during normal business hours at the Office of the Board Secretary, located at 806 Palm Canyon Drive, Borrego Springs CA 92004.
The Borrego Springs Water District complies with the Americans with Disabilities Act. Persons with special needs should call Geoff Poole – Board Secretary at (760) 767 – 5806 at least 48 hours in advance of the start of this meeting, in order to enable the District to make reasonable arrangements to ensure accessibility.
If you challenge any action of the Board of Directors in court, you may be limited to raising only those issues you or someone else raised at the public hearing, or in written correspondence delivered to the Board of Directors (c/o the Board Secretary) at, or prior to, the public hearing.

Comments by Agricultural Alliance for Water and Resource Education (AAWARE)
March 5, 2018 Advisory Committee Meeting
Regarding Public Input on Socio Economic and Other Issues Related to Development of the Groundwater Sustainability Plan for Borrego Springs

The Agricultural Alliance for Water and Resource Education ("AAWARE") is comprised of most of the agricultural well owners in Borrego Valley. AAWARE seeks to protect and preserve the Borrego Basin groundwater resources. To that end, AAWARE is a member of the Borrego Water Coalition, and two of AAWARE's members serve as agricultural representatives on the Advisory Committee to the Borrego Valley California Groundwater Basin ("Borrego Basin") Groundwater Sustainability Agency ("GSA").

When the Sustainable Groundwater Management Act ("SGMA") was enacted, the Legislature adopted the following State policy:

> It is the policy of the state that groundwater resources be managed sustainably for long-term reliability and multiple economic, social, and environmental benefits for current and future beneficial uses. Sustainable groundwater management is best achieved locally through the development, implementation, and updating of plans and programs based on the best available science.

(Water Code section 113.) AAWARE is pleased to submit the following comments for consideration as part of this effort.

1. Listening Session

- Present Day: Issues and Concerns Related to Water Quality, Availability and Usage
    - Information about present day agricultural water use was previously provided to the Advisory Committee.
    - The Borrego Water District's ("BWD") November 2015 Water Operations Report indicates that Improvement District 4 has a system loss of 16.9%. Much lower losses were reported for Improvement Districts 1 and 3. Combining the data for Improvement Districts 1 and 3, we see that a 2.4% loss is attainable. The system loss in Improvement District 4 should be reduced to achieve efficiency closer to that of Improvement Districts 1 and 3. As discussed below, funding is earmarked for BWD programs including end-use efficiency in the 2018 water bond measure.

- GSP Implementation Concerns: Impacts on Rate Payers; and Economic Impacts

    - The USGS groundwater basin model is overestimating groundwater level declines. Page 15 of the October 26, 2017 Advisory Committee Agenda packet says, regarding Dudek's calibration of the USGS Model, "the model is overestimating groundwater level decline in some areas of the aquifer", and that the model may be "overestimating pumping, underestimating recharge, underestimating water stored in the aquifer, or some combination of these three factors." The Department of Water Resources' ("DWR") draft Sustainable Management Criteria Best Management Practices ("BMP") explains that "A GSA will need to understand the basin's physical condition, the overlying management and legal structures, and the basin's water supplies and demands prior to developing sustainable management criteria." (DWR [Draft] Sustainable Management Criteria BMP, p. 3.) The model should be corrected before the sustainability criteria are approved (including the 70% water reduction) in order to avoid undue socioeconomic burdens on the Borrego Valley community.

    - A study commissioned by San Diego County ("County") in 2015 concluded that agriculture has a 1.62 multiplier effect. Whatever the actual crop price is multiplied by 1.62 gives the true value of agriculture to the local economy. The multiplier accounts for business-to-business transactions and payment for services as well as employee and owner spending. For instance, in 2016 the value of all crops in the county was $1.746 billion. Multiply that by 1.62 and it gives a total value to the County's economy of $2.83 billion. A proper economic impact analysis should account for such direct losses due to reduction in agricultural production.

    - The reduction or loss of agriculture would also have indirect economic impacts on the community. A proper economic impact analysis should evaluate impacts such as the effect on local ratepayers due to the reduction in agricultural contribution to electricity and gas transmission to the area, impacts to local schools due to reduction in agricultural employment base, etc.

2. Identifying Solutions that Work

- The Groundwater Model should be corrected and validated with DWR support as necessary to appropriately define "undesirable results" and sustainable management criteria

  The first step of stakeholder engagement is to properly inform the stakeholder. (DWR Stakeholder Communication and Engagement Guidance Document, p. 4.) As discussed in Dudek Consultants' slides 19-22 at the October 27, 2017 Advisory Committee

Meeting and as further discussed by the AAWARE January 24, 2018 Agricultural Water Use Survey and Report, there is not yet a working groundwater model and the analyses to date have not included best available data for agricultural irrigation water production and return flows.

The foundational step for a GSP is to obtain correct basin information. "A GSA will need to understand the basin's physical condition, the overlying management and legal structures, and the basin's water supplies and demands prior to developing sustainable management criteria." (DWR [Draft] Sustainable Management Criteria BMP, p. 3.) "A thorough understanding of the historical and current state of the basin is necessary before sustainable management criteria can be set. Much of the understanding is gained in the development of a hydrogeologic conceptual model, water budget, and description of groundwater conditions." (*Id.*) It is only after that correct foundation is laid that sustainable management criteria can be evaluated with appropriate public involvement.

Without a working model and supportable water budget, the true extent of overdraft and contribution by the various constituents cannot be reliably determined or meaningfully resolved through the GSP stakeholder input process: "When setting sustainable management criteria, GSAs must consider the beneficial uses and users of groundwater in their basin. Consideration of the potential effects on beneficial uses and users underpin the minimum thresholds." (DWR [Draft] Sustainable Management Criteria BMP, p. 3.) Without a working model and reliable water budget, minimum thresholds and other GSP sustainable management criteria cannot be reliably determined.

- Additional study should be undertaken with DWR support to assist in correcting and refining the groundwater model

    1) It is recommended that DWR funding be sought by the GSA to install lysimeters (which record the amount of water percolating through the soil) to more accurately measure irrigation return flows. Funding is available under the DWR's Sustainable Groundwater Management Program whose initial focus is for the very purpose of providing technical assistance to GSAs in the development of their GSPs for critically overdrafted basins.

    2) The GSA should obtain DWR technical support to develop a graphic model of the Borrego Basin based on available well logs, and if necessary, additional soil data. DWR technical support is available particularly to GSAs in critically overdrafted basins.

    3) The GSA should obtain DWR technical support to identify inaccuracies in the model as necessary to verify the model. Until a verified model is developed, GSP program elements such as the basin's sustainable yield and production allocations should be considered only interim measures.

4) The portion of agricultural irrigation resulting in return flows to the basin (potentially 41% based on best available information) should be calculated and agricultural recharge to the basin should be credited against agricultural production restrictions.

5) The current irrigated agricultural acreage in Borrego Valley should be verified to determine whether there is any additional irrigated agricultural acreage not included in AAWARE's January 24, 2018 Agricultural Water Use Survey and Report.

- Sustainable management factors including undesirable results, minimum thresholds and sustainable yield should be defined after correcting the model and receiving community input

The Agenda Package for the March 5 meeting incorrectly says that there is a "state mandated goal that requires an approximately 70% groundwater use reduction by 2040." (March 5, 2018 Agenda Packet, p. 2.) That statement puts the cart before the horse. Rather, under SGMA, "GSAs will need to set minimum thresholds at representative monitoring sites for each applicable sustainability indicator after considering the interests of beneficial uses and users of groundwater, land uses, and property interests in the basin." (DWR [Draft] Sustainable Management Criteria BMP, p. 8, emphasis added.)

The GSP development process must proceed with interested party input, not merely obtain interested party comment after the fact: "The GSP must discuss how groundwater conditions at a selected minimum threshold could affect beneficial uses and users. This information should be supported by a description of the beneficial uses [of] groundwater and identification of beneficial uses, which should be developed through communication, outreach, and/or engagement with parties representing those beneficial uses and users, along with any additional information the GSA used when developing the minimum threshold." (DWR [Draft] Sustainable Management Criteria BMP, p. 9; see also Water Code, § 10727.8 [active involvement of all elements of the population during development of GSP].)

As discussed above, the 70% cutback measure is based on a groundwater model that does not accurately estimate the basin's sustainable yield and is not required by the state. Among other things, the 2015 USGS model and report do not appear to account for the amount of groundwater in storage that might allow for production from the basin without causing any locally determined undesirable result. The minimum thresholds for chronic overdraft are not defined in terms of groundwater use or consumption, but instead are defined in terms of groundwater levels. (DWR [Draft] Sustainable Management Criteria BMP, pp. 10-11.) Minimum thresholds may be selected by a GSA at groundwater levels below currently existing levels. (*Id*, pp. 28-29.)

Undesirable results are defined in terms of minimum threshold exceedances, which are determined locally by each GSA as part of the flexible GSA stakeholder process: "The

GSP Regulations require undesirable results to be quantified by minimum threshold exceedances. GSAs have significant flexibility in defining the combinations of minimum threshold exceedances that constitute an undesirable result. GSA should evaluate multiple spatial scales when setting the criteria for undesirable results." (DWR [Draft] Sustainable Management Criteria BMP, p. 23.) Fortunately, there is flexibility in the Borrego Valley Basin, unlike other critically overdrafted basins experiencing a "basinwide loss of domestic well pumping capacity." (*Id.*, p. 6.)

Rather than requiring a 70% cutback in production, the Core Team should work with the stakeholders to determine appropriate groundwater levels, with cutbacks implemented if the groundwater levels fall below the defined minimum thresholds.

- Significant infrastructure leakage should be repaired

  The source of BWD Improvement District 4's system leakage should be verified and repaired. The 2018 bond measure includes $35 million in funding for BWD programs such as water end-use efficiency.

- A program should be developed to fund agricultural land acquisition and/or fallowing and to provide for landowner pumping rights transfers.

  The details of funding for agricultural land acquisition and fallowing, and for transfer of production rights should be agendized for discussion at the upcoming Advisory Committee meeting. The Borrego Water Coalition recommended a program to fund agricultural land acquisition and/or fallowing and to provide for landowner pumping rights transfers. The Coalition members made it clear that without such a program, support for the Policy Recommendations from all members of the Coalition should be considered non-binding.

  The 2018 bond measure proceeds are intended to expand water supplies primarily through the purchase and preservation of agricultural lands and water rights, and investment in agricultural water conservation programs, among other authorized uses of any bond proceeds.

- A program should be developed to fund agricultural water use efficiency for remaining agricultural operations

  The 2018 bond measure funding for end-use efficiency also could be used to improve agricultural water use efficiency for agricultural operations desiring to remain in operation. This could reduce the loss of agricultural production and the resulting direct and indirect socioeconomic benefits contributed by the agricultural sector.

- A proper socioeconomic impact study should be completed

  It is unclear from the Agenda Packet what constituencies the socioeconomic impact/demographic analysis will focus on. The scope of work should be provided at the upcoming Advisory Committee meeting. It appears that the study may be focused on the Severely Disadvantaged Community ("SDAC"). However, impacts to SDAC are only a part of the equation. SGMA is clear that the interests (economic and other) of all beneficial uses and users of water must be considered, including agricultural users. (Water Code, § 10723.2.)

  Other factors should be studied through the Advisory Committee process, including: composition of the local economy, connection of each economic sector to water use, employment composition of each economic sector, population demographics, sales level composition, labor profile, government and private sector data, etc.

February 5, 2018

TO: Borrego Springs GSP Core Team Members, Borrego Water District Board Members, Geoff Poole

At the January 4, 2018 Borrego Sponsor Group meeting, an important issue arose during the discussion of Borrego Country Club Estates (DS24) as part of a larger decision to submit a letter from the Sponsor Group to San Diego County as part of the Supplemental EIR for Property Specific Requests for a General Plan Amendment.

A Sponsor Group member brought to our attention that if Borrego Springs is to provide its residents and visitors with 24/7 walk-in medical care (somewhere between an urgent and the emergency room) and a pharmacy open 24/7, that we need to have a full time population of 8000.

The Sponsor Group continues to express its concern about the overdrafted aquifer and implications for land use decisions as a result of limitations water use may place on the town. At the same time, we want Borrego Springs to prosper and it is well known that the lack of more comprehensive medical facilities is a problem for many residents.

We would like to see a study of whether a goal of 8000 residents is possible given water use restraints under SGMA and what paths would make that possible. What is the sustainable population of Borrego under conceivable scenarios? At what costs? This is very important information for the Advisory Committee and the GSA to consider as soon as possible as decisions get made going forward. Having an idea of what our community may look like and at what cost to ratepayers as a consequence of possible GSP decisions is important to every Borregan.

Sincerely,

Rebecca Falk

Rebecca Falk

Rebecca Falk, Chair, Borrego Community Sponsor Group and Member of the Advisory Committee for the Groundwater Sustainability Plan

Letter approved by Borrego Springs Community Sponsor Group at the February 1, 2018 meeting.

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – MARCH 20, 2018

AGENDA BILL 2.A

March 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, General Manager

SUBJECT: Consideration of Including Human Right to Water Component to District Baseline Pumping Allocation (BPA)

RECOMMENDED ACTION:

Discuss Adoption of Including Human Right to Water Component to District Baseline Pumping Allocation (BPA)

ITEM EXPLANATION:

The California Legislature has adopted laws pertaining to Human Right to Water. The BWD Core Team is proposing including Human Right to Water in the BWD Baseline Pumping Allocation and would like to discuss the concept with the full Board.

The main impact of including HTR water in BWD BPA is that quantity of water would not be subject to future reductions. Dudek has estimated the HTR water for BWD and using the Tier One rate structure as the logic behind the calculation, 380 acre feet of water has been identified as HTR. Following is a timeline on the actions related to HTR:

• United Nations (UN): In November 2002, the UN Committee on Economic, Social and Cultural Rights adopted its general comment No. 15 on the right to water stating that: "The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses;"

• In April 2011, the UN Human Rights Council adopted, through Resolution 16/2, access to safe drinking water and sanitation as a human right: a right to life and to human dignity;

• The water supply and sanitation facility for each person must be continuous and sufficient for personal and domestic uses. These uses ordinarily include drinking, personal sanitation, washing of clothes, food preparation and personal and household hygiene. According to the World Health Organization (WHO), between 50 and 100 liters of water per person per day are needed to ensure that most basic needs are met and few health concerns arise;

• Why? According to the World Health Organization, improvements related to drinking-water, sanitation, hygiene, and water resource management could result in the reduction of almost 10% of the total burden of disease worldwide.

• In California: With passage of AB 685 in September 2012, California became the first state in the nation to legally recognize the human right to water;

• AB 685 creates an ongoing obligation for state agencies to explicitly consider the human right to water in every relevant agency decision and activity;

• The California Water Code requires all relevant state agencies, specifically Department of Water Resources, the State Water Recourses Control Board, and California Department of Public Health, to "consider" how state actions impact the human right to water;

• California Water Code 106.3 (a) "It is hereby declared to be the established policy of the state that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."

• Section 106.3 (a) does not apply to any irrigation uses for water: municipal, recreational or agricultural;

• In Borrego: Tier 1 municipal water rates were developed specifically to meet AB 685 and CWC 106.3 (a) intent;

• Subsequent to SGMA, the District may wish to re-visit its present rate structure in its next Proposition 218 process, which is presently scheduled to begin in the Fall of 2019

FISCAL IMPACT:

TBD

ATTACHMENTS:
None

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – MARCH 20, 2018

AGENDA BILL 2.B

March 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, General Manager

SUBJECT: Proposal for Additional Groundwater Extraction Wells for the Borrego Water District

RECOMMENDED ACTION:

Approve Proposal

ITEM EXPLANATION:

As previously reported, BWD and The County of SD made the initial list of projects to be funded by the newest round or Prop One Funding for GSP Implementation. The $1 million grant includes funding for investigation of a new productions well for BWD. Dudek has provided the following Scope of Work.

On the topic of funding, here is the latest information from Tim Ross at DWR:

> *The Grants program is going through the comments and formulating the final awards. The last I have heard is that they expect to finalize the list by the end of this month. I also understand that they are moving forward on preparing draft contract documents for the critically overdrafted basins so that they can get moving as quickly as possible.*

Hope this helps, Tim

FISCAL IMPACT:

Project is funded by DWR Grant - $35,420

Board meetings/presentations in Borrego and related activities is not reimbursable under the original Grant submittal, so it has been removed from the Project Budget and will be covered, if needed, via a separate agreement.

ATTACHMENTS:

1. Dudek Proposal

October 12, 2017 (Revised March 14, 2018)

Geoff Poole, General Manager
Borrego Water District
806 Palm Canyon Drive
Borrego Springs, California 92004

Subject: **Proposal for Additional Groundwater Extraction Wells for the Borrego Water District**

Dear Mr. Poole:

We appreciate the opportunity to present the following proposal for evaluating additional groundwater extraction wells for the Borrego Water District (BWD). The following sections outline our proposed approach, scope of services, and fee estimate for the project.

1 Approach and Scope of Services

1.1 Project Understanding

Dudek understands the goal of the project is to determine the most feasible and cost-effective options for providing suitable drinking water for BWD customers with future consideration given the identified groundwater overdraft condition and the aging existing BWD water supply infrastructure. The Borrego Valley Subbasin (Basin), which is the sole source of water supply for the BWD, has been identified as a critically overdrafted basin (DWR 2015). Declining groundwater levels has resulted in loss of production from existing BWD extraction wells. In portions of the Borrego Springs Subbasin, the upper aquifer as defined by the U.S. Geological Survey (USGS) has become unsaturated limiting the potential to simply drill deeper at existing well locations. Likewise, limited remaining useful life of aging water wells will require replacement within the next few years. Additionally, arsenic concentrations exceeding State of California drinking water maximum contaminant levels (MCLs) have been identified in several wells in the South Management Area of the Borrego Springs Subbasin. Ultimately, loss of production and well failure will result in decreased water supply to reliably serve BWD customers. As the capital investment to design and construct several new water wells and associated pipelines represents a substantial cost to BWD directly impact the affordability of water at a detriment to customers in an area which has already been identified by the Department of Water Resources (DWR) as a severely disadvantaged community.

In order to provide a reliable and cost effective water resource supply to customers, the BWD must evaluate locating replacement groundwater extraction wells. Dudek proposes the BWD consider a proposed well site ranking system in order to assist in decision making as it pertains to the addition of groundwater extraction wells. The well site ranking system will consider but not limited to the below criteria;

- Aquifer properties

- Well interference
- Groundwater Quality
- Existing BWD water supply infrastructure (pressure zones, wellhead distribution system pressures)
- Longevity of existing wells (age and declining groundwater levels)
- District Owned Property, Property Acquisition and Easement acquisition
- Other Environmental Constraints (flood zones, biological resources, etc.)

The Dudek team will apply the above ranking system to prioritize well locations for BWD. Each category will be assigned a ranking that ranges from 1 ("least favorable") to 4 ("most favorable"). The ranking for each category will be totaled for each perspective well location, and the highest total represented by the most favorable locations will be recommended for consideration of installing test or production wells. A detailed description of each criterion is outlined below.

Aquifer Properties

A hydrogeologic assessment will be developed to determine the most productive site for additional extraction wells based on the productivity of the Basins aquifers. Dudek will review available well completion reports, available literature, and aquifer test data to determine the aquifer properties of the three primary aquifers. Aquifer properties to be considered include transmissivity, conductivity, lithology, and depth and saturated thickness of aquifer. Dudek will use a groundwater numeric model completed by the USGS in cooperation with the BWD to determine saturated thickness of each aquifer unit within the Basin.

Well Interference

Well interference will be reviewed in order to determine nearby pumping influences of existing wells. Because the time and duration of nearby pumping wells can affect the long term use of additional BWD wells, production wells, including agriculture and recreation wells, and their assumed production amount, will be used to identify areas where the least amount of well interference will be encountered.

Water Quality

Given the potential for arsenic to exceed the California drinking water standard in BWD wells that are primarily screened in the lower aquifer (USGS 2015), it is a concern that as groundwater levels in the Basin continue to decline, arsenic levels may increase above the drinking water standard of 10 micrograms per liter (µg/L).

As part of Dudek's ongoing work with the Sustainable Groundwater Management Act (SGMA) and the preparation of the Groundwater Sustainability Plan (GSP), groundwater sampling of at least 30 wells, in addition to sampling the District's wells will be conducted in the Basin during the month of November 2017. Dudek will use groundwater quality results from 2017 and historical data to identify areas of desirable groundwater quality to determine additional well locations.

Existing BWD Water Supply Infrastructure

Dudek will assess the feasibility of connecting additional wells to the existing water supply infrastructure. If wells are considered outside of the current water system infrastructure, Dudek will consider cost and feasibility of additional water system infrastructure to connect to the existing BWD system. Dudek's team of water system infrastructure engineers will evaluate feasibility and cost of potential well hooks ups using a WaterCAD hydraulic model previously developed for the BWD.

Longevity of Existing Wells

Existing BWD wells will be reviewed with information provided by the BWD including well drillers report, historical PumpCheck motor test data, groundwater levels, groundwater quality and rehabilitation and maintenance logs to estimate the remaining useful life of groundwater extraction wells currently in use by the BWD. In order to decrease cost to the BWD, existing wells and infrastructure will be evaluated to provide recommendations for additional rehabilitation and maintenance.

Easement Acquisition

Acquiring land for the drilling of additional groundwater extraction wells will play a pivotal role in the feasibility and cost of the project needs. Sites will be evaluated based on cost and cooperation with current property owners to grant a groundwater extraction well easement on private property. Additionally, Dudek will assess the suitability of drilling new water wells on BWD owned land to minimize cost.

Other Environmental Constraints

Well sites will be evaluated for potential impacts to environmental constraints such as well construction in flood plains, jurisdictional waterways, potential impacts to groundwater dependent ecosystems, and other biological resources.

1.2 Project Approach and Scope of Work

Dudek proposes to approach the development of the project through the research and preparation of several concurrent work elements that address the various aspects of the project. Following the completion of each of the work elements, the report will be prepared based on the consolidated information. The following describes the general nature and scope of each work element:

Task 1 – Additional Groundwater Extraction Well Ranking System

The ultimate goal of the project is to determine the most feasible approach to supply customers of the BWD safe and cost efficient water. Dudek will investigate potential new water sources to replace production from BWD wells that are reaching their useful life. The investigation will include a ranking system to determine the best approach for drilling new groundwater wells for the BWD.

Task 2 – Water Model Update & Calibration

To better assess the feasibility of additional groundwater extraction wells, it is necessary to identify system supply and demands by improvement zones. Dudek will use the existing WaterCAD Model to estimate average and maximum day demand for each improvement or major pressure zone and aid in the development of the alternatives.

There are currently two existing WaterCAD models for the District. One model covers Improvement Districts (IDs) 1 and 3 and another covers IDs 4 and 5. Dudek anticipates the District would like to combine the two models into one, functional model. Once combined, Dudek will update the demands, well flow rates, controls and any improvements made to the distribution system infrastructure. It is assumed water meter data for the demands update of the model will be made available in GIS format for accurate geographical locating of demand loads.

Once the model is updated, Dudek will calibrate the model with SCADA and fire hydrant pressure data (provided by the District), resulting in a hydraulic model that accurately represents field conditions.

Deliverable: *Updated and calibrated WaterCAD hydraulic modeling files.*

Task 3 –Technical Memorandum

The results of the ranking system will be consolidated into a technical memorandum for District review. Draft and final versions of the technical memorandum will be submitted to the District.

Deliverables: *Draft and final technical memorandums in electronic format.*

Task 4 –Meetings and Project Management

Dudek will perform typical project coordination and project management tasks, including budget and scheduling, for the project. One Kickoff Meeting and one (1) status meeting was assumed for the fee estimate.

Deliverables: *Agendas and meeting minutes for Kickoff and status meetings*

2 Project Fee

Our attached fee proposal broken down by task and for each proposed staff member. Our fee proposal submittal includes the fee proposal and our current 2017 Standard Rate Schedule. We understand that the work will be performed on a time-and-materials basis, not to exceed, and that no additional compensation will be provided without advance written approval from the City.

We have assembled a highly experienced team eager to prepare your water quality feasibility assessment and we look forward to continuing to support the District. Please feel free to contact me at 760.479.4154 or by email at tdriscoll@dudek.com, if you have any questions or require any additional information.

Sincerely,

DUDEK

Trey Driscoll, PG, CHG
Principal Hydrogeologist/Project Manager

FEE ESTIMATE

		Labor Hours and Rates								
	Project Team Role:	Project Manager	Engineer	Project Engineer	Hydrogeo VI	Hydrogeo I	TOTAL DUDEK HOURS	DUDEK LABOR COSTS	OTHER DIRECT COSTS	TOTAL FEE
	Team Member:	T. Driscoll	E. Caliva	H. Dodd	P. Rentz	H. McManus				
	Billable Rate :	$240	$190	$135	$160	$110				
Task 1	**Additional Groundwater Extraction Well Ranking System**									
1.1	Well Location Analysis using ranking criteria	4				30	34	$ 4,260		$ 4,260
1.2	Groundwater Model Analysis	2				8	10	$ 1,360		$ 1,360
1.3	Water Quality Evaluation	6			8	8	22	$ 3,600		$ 3,600
1.4	Peak Hour and Max Day Demand	2		8		2	12	$ 1,780		$ 1,780
1.5	Determine Remaining Useful Life of BWD Wells	2				8	10	$ 1,360		$ 1,360
1.6	Identify Well Issues	2				8	10	$ 1,360		$ 1,360
	Subtotal Task 1	**18**		**8**	**8**	**64**	**98**	**$ 13,720**	**$ -**	**$ 13,720**
Task 2	**Water Model Update and Calibration**									
2.1	Combine Water Models		4	8			12	$ 1,840		$ 1,840
2.2	Update Water Model		4	16			20	$ 2,920		$ 2,920
2.3	Calibrate Model		4	8			12	$ 1,840		$ 1,840
2.4	Feasibility Assessment to Include Additional Wells		2	8			10	$ 1,460		$ 1,460
	Subtotal Task 2		**14**	**40**			**54**	**$ 8,060**	**$ -**	**$ 8,060**
Task 3	**Technical Memorandum**									
3.1	Draft Technical Memorandum	8	8	24	4	24	68	$ 9,960		$ 9,960
3.2	Final Technical Memorandum	4	4	8		8	24	$ 3,680		$ 3,680
	Subtotal Task 3	**12**	**12**	**32**	**4**	**32**	**92**	**$ 13,640**	**$ -**	**$ 13,640**
~~**Task 4**~~	~~**Meetings and Project Management**~~									
~~4.1~~	~~Meetings (1)~~	~~6~~	~~6~~	-	-	-	~~12~~	~~$ 2,580~~	~~$ 101~~	~~$ 2,681~~
~~4.2~~	~~Project Management~~	~~8~~	-	-	-	-	~~8~~	~~$ 1,920~~	-	~~$ 1,920~~
	~~**Subtotal Task 4**~~	~~**14**~~	~~**6**~~	-	-	-	~~**20**~~	~~**$ 4,500**~~	~~**$ 101**~~	~~**$ 4,601**~~
	Total Non-Optional Hours and Fee	~~**44**~~**30**	~~**32**~~**26**	**80**	**12**	**96**	~~**264**~~**244**	**$** ~~**39,920**~~**35,420**	~~**$ 101**~~	**$** ~~**40,021**~~**35,420**
	Percent of Hours:	*~~17~~12%*	*~~12~~11%*	*~~30~~33%*	*5%*	*~~36~~39%*	*100%*			

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – MARCH 20, 2018

AGENDA BILL 2.C

March 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, General Manager

SUBJECT: Public Hearing Schedule for Developers Policy and Emergency Declaration

RECOMMENDED ACTION:

Receive Report on Schedule for Public Hearings and direct staff accordingly

ITEM EXPLANATION:

The need exists to hold Public Hearings on the Developers Policy and Emergency Shortage Ordinance. BWD is required to publish the Notice in the newspaper one time at least 7 days before the public hearing. The next Edition of The Sun is March 22nd and there is not enough time to hold the Public Hearing on March 28th.

Staff would like to discuss the preference of the Board on holding a Special Meeting for the Public Hearings or waiting until the Regular Meeting in April 25th.

FISCAL IMPACT:
TBD

ATTACHMENTS:
None

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – MARCH 20, 2018

AGENDA BILL 3

March 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, General Manager

SUBJECT: Informational Items

RECOMMENDED ACTION:

Discuss the various informational items and direct staff accordingly

ITEM EXPLANATION:

Board discussion is requested on the following items:

A. Discussion of GSP imposed Reductions Period: Is 2040 too long?
B. Sector Reductions
C. Discussion of Anthropogenic Climate Disruption (Climate Change) Impacts on USGS's Sustainable Yield of 5,700 AF for the Borrego Springs Subbasin of the Borrego Valley Groundwater Basin
D. Discussion of Agricultural Return Flows Impacts on USGS's Sustainable Yield of 5,700 AF for the Borrego Springs Subbasin of the Borrego Valley Groundwater Basin.
E. Discussion of Fallowing and Land Restoration Standards Research
F. Discussion of Water Transfers:35MM Earmark Public Bond Initiative Rules

FISCAL IMPACT:

TBD

ATTACHMENTS:

1. Agricultural Water Use Survey and Report – 2017 Borrego Valley, CA - AAWARE

AGRICULTURAL WATER USE SURVEY AND REPORT—2017

BORREGO VALLEY, CA

January 25, 2018

by

Agricultural Alliance for Water and Resource Education ("AAWARE")
William R. Mills, P.E., R.G., DEE
Jackson Tidus—A Law Corporation

Chapter 1.0 Executive Summary

The Agricultural Alliance for Water and Resource Education ("AAWARE") is comprised of most of the agricultural well owners in Borrego Valley. AAWARE seeks to protect and preserve the Borrego Basin groundwater resources, and is a member of the Borrego Water Coalition. Two of AAWARE's members serve as agricultural representatives on the Advisory Committee to the Borrego Valley California Groundwater Basin ("Borrego Basin") Groundwater Sustainability Agency ("GSA").

This report summarizes groundwater production data obtained from a confidential survey presented to AAWARE members and other and agricultural well owners in the Borrego Basin to determine agricultural groundwater production information, crop types and acreages. The information obtained from the survey was reviewed and synthesized by William R. Mills, a professional engineer/registered geologist. This report responds to a request from the GSA Core Team for agricultural groundwater production information, and is intended for use in preparing a water budget in connection with a Groundwater Sustainability Plan ("GSP") for the Borrego Basin under the Sustainable Groundwater Management Act ("SGMA," Water Code, sections 10720-10737.8)..

Existing studies note the lack of measured agricultural groundwater production and crop acreage information for the Borrego Valley. The absence of measured agricultural groundwater production and of crop acreage information hinders the development of a GSP groundwater budget for the Borrego Valley. Without measured agricultural groundwater production and crop acreage information, it is difficult to accurately determine crop water consumption (also known as evapotranspiration) and irrigation water return flows to the groundwater basin. If return flows are not counted in the water budget, then agricultural consumptive use may be significantly overstated.

Agricultural groundwater production amounts included in Table 1 of this report are based on data from metered agricultural wells representing 89% of total agricultural acreage calculated by Borrego Water District ("BWD") in 2015. Agricultural evapotranspiration included in Table 2 of this report has been estimated based upon climate data and established consumption rates for each type of crop and upon reported crop acreages. Table 3 of this Report shows the potential irrigation return flows from agriculture applied water, determined by subtracting the evapotranspiration amount in Table 2 from the groundwater production amount in Table 1.

To summarize the results of Tables 1-3, the highest total Borrego Valley agricultural groundwater production determined from the agricultural acreage responding to the survey is about 16,300 acre-feet per year ("AFY"), the total agricultural consumptive use is calculated to be about 9,600 AFY, and the potential agricultural irrigation return flow to the Borrego Basin is estimated to be between 3,600 AFY (based on an earlier study calculating 22% agricultural irrigation return flows in Borrego Basin) and 6,700 AFY (based on the difference between groundwater production and crop evapotranspiration). Further study should be undertaken to refine the agricultural return flow number by means of measurements with lysimeters as discussed below.

Chapter 2.0 The Report Helps Fill Gaps for the GSP Water Budget

Section 2.1 Agricultural Factors of a GSP Water Budget

SGMA requires the GSP to include a groundwater basin water budget. The water budget must provide an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin. The water budget is the basis for estimating the basin's sustainable yield and is a key component in understanding whether a basin is operating within its sustainable yield and avoiding undesirable results.[1]

Water budgets are highly variable between groundwater basins. While precipitation may be the main contributor to groundwater recharge in some basins, in other basins the main source of recharge may be infiltration and seepage of applied irrigation water (called "irrigation return flows").[2] Identifying which water budget components are most appropriate to estimate through balancing of the water budget equation will depend on the local ability to independently measure or estimate the remaining water budget components.[3]

Some of the factors in the water budget are derived from groundwater applied for agricultural irrigation. For example, the water budget must quantify, either through direct measurements or estimates based on data: (1) inflows to the groundwater system by water source type, including applied water; (2) outflows from the groundwater system, including evapotranspiration.[4] Inflows to the groundwater system include deep percolation generated by irrigation water infiltrating downward through the root and unsaturated zones.[5] Outflows from the groundwater system include outflows due to evapotranspiration within the root zone.[6]

Crucial to the development of the water budget is the admonition: "Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin."[7] A water budget that accurately identifies and tracks changing inflows and outflows to a basin will be critically important to support GSP decision making.[8]

Section 2.2 Accounting for Production, Consumption and Return Flow

An accounting of agricultural irrigation water return flow into the Borrego Basin originates with groundwater production from the basin, and excludes that amount of water that is lost through evapotranspiration within the root zone, where plants extract moisture to meet their water needs, and any runoff or evaporation during irrigation.[9] Borrego Valley well logs do not evidence a widespread clay layer or other barrier to return flows. Instead, well logs and hydraulic testing of agricultural wells shows fine to coarse sand and gravel and water level recovery indicating the influence of a recharge source to the aquifer.[10]

Existing Borrego Valley reports and studies mention varied estimates of agricultural applied water irrigation return flows.[11] However, current calculations by the Core Team and Advisory Group seem to calculate the agricultural contribution to overdraft as the amount of agricultural water production (a portion of which is return flow), rather than the amount of crop evapotranspiration (which is consumed).[12] Because those calculations assume that agricultural production equates to consumptive use, they do not account for groundwater recharge from irrigation return flows in calculating the sustainable yield.[13]

It has been established by various studies that a significant amount of agricultural applied water must occur beyond evapotranspiration to flush away or leach out soil salinity; otherwise, the citrus and other crops would perish.[14] Therefore, the existence of agricultural applied water return flows is evident from the continued existence of healthy trees and crops.

Furthermore, additional amounts of applied water beyond evapotranspiration and leaching may be necessary due to various factors, including the plant spacing, frost protection and the moisture holding capacity of the soils, potentially adding to the amount of return flows.[15]

With more accurate groundwater production amounts based upon metering, the data gap[16] can be bridged and an accounting of maximum potential applied water irrigation return flows can take place. By more accurately quantifying agricultural groundwater production, and by subtracting a more refined estimate of particular crop evapotranspiration using actual crop and local climate information, the net water balance remaining after evapotranspiration (and any irrigation losses such as runoff and soil evaporation) should closely approximate the applied water irrigation return flows back into the basin.

All reference documents cited in this report are available for review at: https://docshare.jacksontidus.law; Username: AAWARE1; Password: 7uRNtH3L1G4t!

Section 2.3 Determining Production, Consumption and Return Flow

A. WUCOLS III Production Estimating Methodology

Prior studies have attempted to quantify applied/delivered and consumptively used amounts of water for agricultural production in the Borrego Valley without obtaining actual measurements of water produced or of particular crop acreage.[17] Instead, the prior studies rely on estimation methodologies. The most current DWR methodology for estimating delivered and consumptively used amounts of water for agricultural production is known as Water Use Classification of Landscape Species ("WUCOLS") III.[18]

The methodology uses a California map that allows the identification of the potential evaporation rate of turf grass, as derived from over 100 California Irrigation Management Information System ("CIMIS") stations located throughout the state.[19] CIMIS collects data from calibrated weather stations at more than 100 sites throughout California.[20] The hourly weather data is used to compute daily evapotranspiration (ETo) values for each station, using a standardized formula (known as a modified Penman equation).[21] Locating the agricultural site on this map provides the investigator with the approximate long term or reference evapotranspiration rate for turf grass.[22]

Next, a plant factor, or crop coefficient (Kc) for the specific crop is obtained from the most recent publications by the State of California.[23] Crop coefficients have been developed for many crops.[24] In practice, appropriate crop coefficients for a specific crop vary by region, soil type, irrigation frequency and type, reference crop type, and a host of other factors that are specific to management practices and the environment.[25] For example larger size trees and larger size fruit may consume more water.[26]

Finally, the product of the ETo and Kc estimates the consumptive use of irrigation water by the specific crop, which is then multiplied times the amount of irrigated acreage for that crop to obtain the total crop evapotranspiration.[27] When crop types and acreages are not known, they are estimated from aerial photographs.

However, caution must be exercised in using a "one-size fits all" crop coefficient for a particular crop: "In short, in order to calculate crop evapotranspiration using the equation above, one must have the reference crop evapotranspiration (ETo) for one's particular region, soil type, irrigation type, etc. However in most cases, only one set of crop coefficients per region is provided, which may not match the particulars of a grower's situation, and in cases of an unusual crop for the region, there may not be any coefficients available at all."[28]

When measured amounts of applied water are not available, they can be estimated by applying a deemed irrigation efficiency rate to the evapotranspiration amount (defined as the amount of water directly used to satisfy the plant's needs as compared to the amount of water applied). This deemed irrigation efficiency rate is expressed as a percentage of the applied water.[29] Dividing the consumptive use by the irrigation efficiency theoretically should yield an estimate of the delivered or applied water.[30]

However, a determination of deemed irrigation efficiency is challenging – a standard method has not been established.[31] Estimating irrigation efficiency is a subjective process where two assessments of the same system can vary widely.[32] The deemed irrigation efficiency rate attempts to take into account water not directly used by the plant, which may include losses from runoff and evaporation from wet soil during irrigation,[33] but does not account for supplemental agricultural water used for soil leaching, frost protection and additional irrigation needed to compensate for the low moisture holding capacity of more permeable soil discussed above.

B. Agricultural Production in Borrego Valley is Determined Based on Irrigation Metering

Because actual crop acreages and irrigation efficiencies may vary from those obtained from the method discussed above, as individual growers tend to manage the delivery amounts based on varying climatic conditions such as wind and temperature and on particular crop or soils needs, it is important to establish actual production amounts by individual growers. Thus, AAWARE undertook a survey of the growers to establish a more accurate groundwater production and consumption from the basin as described in Section 2.4 below. Table 1 is based on the results of that survey for metered crops.

Groundwater production can be directly measured with a high degree of accuracy, certainty and reliability using water meters, and other readily available monitoring devices.[34] SGMA approves of meters as well as "any other reasonable method" to determine groundwater production.[35] For electrically powered well pumps, another reasonable and accurate method to measure groundwater production is to multiply the electricity usage as shown by electric bills times the pumping capacity as shown by well pump test reports.[36]

C. Estimating Agricultural Production Based on the County Groundwater Ordinance Consumptive Use Factors is Not Appropriate

The Core Team apparently is considering estimating agricultural production based on a formula in the San Diego County Groundwater Ordinance that calculates the water allowance for a municipal water provider resulting from a change in agricultural use to municipal use.[37] . Under the Ordinance, the amount of water credited to the municipal water supplier is calculated by multiplying the agricultural acreage irrigated times a designated consumptive use factor for the agricultural crop previously grown.[38] Because the municipal production will be 100% consumptively used, the municipal water allowance credited is approximately equal to what is deemed to be the prior crop's consumptive use.[39]

However, the County's Groundwater Ordinance is not relevant to calculate agricultural groundwater production for SGMA purposes. The amount credited under the Ordinance does not account for non-consumptive agricultural uses in Borrego Valley (such as groundwater beneficially used to flush the root zone or protect against frost damage to agricultural crops or supplemental water required to irrigate sandy soils with low moisture holding capacity) and the resulting return flows that would no longer occur in situations where agricultural use is displaced by municipal use. The Ordinance itself says that it does not fix the amount of agricultural groundwater extraction that may take place in the absence of a development that constitutes a change in use from agricultural to urban use.[40] The stated intent of the Ordinance is not to limit or restrict agricultural activities, but instead to prevent development from encroaching on water supplies currently utilized for agriculture.[41]

D. Crop Evapotranspiration is Estimated Using WUCOLS III Methodology

Using the WUCOLS III methodology, evapotranspiration was determined based upon climate data and DWR established consumption rates for each type of crop. Crop-specific consumptive use factors were determined by local California Irrigation Management Information System ("CIMIS") data, by reported crop acreages, and by crop coefficients established by the Irrigation Training and Research Center ("ITRC"). Agricultural evapotranspiration amounts included in Table 2 of this report are thus based on the best currently available data, without taking into consideration the variability of the crop coefficients discussed above.

Because the nearest CIMIS station is located in Coachella Valley, adjustments should be made to account for differences in water use reported by Borrego Valley citrus growers who also farm in Coachella Valley, including supplemental water needed for irrigation due to Borrego Valley's more permeable soils and for frost protection due to Borrego Valley's more frequent occurrences of freezing temperatures overnight.

E. <u>The Report Estimates Potential Irrigation Return Flows and Recommends Additional Study</u>

Table 3 of this Report shows the estimated agricultural return flows from irrigated agriculture to the Borrego Basin. To estimate the potential agricultural irrigation return flows into the basin, the evapotranspiration is subtracted from the groundwater production. As noted above, irrigation return flows result from the portion of agricultural water used above and beyond the plant's consumptive use and any runoff or evaporation during irrigation. In Borrego Valley, agricultural water uses contributing to irrigation return flows include water used for salt leaching from the root zone, frost protection, and supplemental irrigation required for more permeable soils with lower holding capacity.

Section 2.4 Agricultural Water and Crop Information Obtained

Because prior estimates of agricultural water production and consumptive use were made without reporting by the agricultural community by applying general water duties to agricultural acreage shown on aerial photographs and using uncertain irrigation efficiency estimates, AAWARE undertook the task of compiling water use information and production measurements from growers. AAWARE undertook this task to assist with development of the GSP, despite there being no requirement to provide this information prior to adoption of the GSP.[42]

SGMA requires the GSA to protect well owners' personal information (name, usage data, home address, and telephone number) from public disclosure to the same extent as information about utility customers of Borrego Water District ("BWD") and other local agencies.[43] There is not yet a GSA protocol in place to protect well owners' personal information. Knowing the importance of a water budget to the GSP process, in the spirit of cooperation, AAWARE is providing the best information currently available in response to the Core Team's request in a manner consistent with SGMA's privacy protections, instead of waiting until a privacy protection protocol is approved by the GSA.

To address SGMA's privacy protection mandate, AAWARE distributed a detailed confidential questionnaire to each grower that was returned to AAWARE's attorney to maintain confidentiality of the well owners' personal information.[44] The questionnaire requested information regarding: crop types, crop acreage, crop density, irrigation methods, conservation methods, irrigation meter measurements, irrigation power records and well pump tests.

AAWARE's professional engineer and registered geologist reviewed the responses and made individual checks for anomalies. The data set was then aggregated into usage by crop type. From these data, a gross agricultural water production amount was developed, and consumptive use factors were applied to determine evapotranspiration and irrigation return flows. To address SGMA's privacy protection mandate, this report summarizes groundwater production data without including the well owners' personal information.

Growers responding to the survey reported 3,539 acres of various crops, which is approximately 89% of the 3,976 total agricultural acreage calculated by BWD in 2015. More than half of those responding had metered delivery records. Nearly 80% of the respondents were utilizing sophisticated conservation techniques such as drip irrigation and soil moisture measurements and measured percentages for root salinity flushing to determine timing and amounts of irrigation water deliveries. From the metered production numbers using these best management practices, Borrego Valley delivery application rates were determined for each crop. Where metered data was not available, the delivery rates developed from the metered production was applied to the reported crops and crop acreages.

Figure 1 on the following page is a 2018 satellite depiction of the Borrego Valley showing the agricultural production.[45]

Figure 1

https://www.google.com/map

Imagery ©2018 DigitalGlobe, Landsat / Copernicus, U.S. Geological Survey, USDA Farm Service Agency, Map data ©2018 Google 1 mi

Chapter 3.0 Production, Consumption and Return Flow Results

Section 3.1 Production Based Upon Metered Operations

Agricultural groundwater production amounts included in Table 1 of this report are based on reported metered well and crop acreage data from the agricultural survey. As shown in Table 1, the grower survey respondents returned information on four citrus crops, palm trees and potatoes. Most of the crops were metered and thus a metered Applied Water Unit Value is calculated and shown in Table 1. Metered Unit Delivery Rates were cross checked against rates found in the literature or those developed with the WUCOLS III procedure to ensure they were within reasonable range. The Applied Water Unit Value calculated for metered irrigation was then used for irrigated crops that were not metered to determine water deliveries to those crops shown in Table 1.

About 42% of the water production is measured by meters. The growers who reported production based on meters all use highly efficient irrigation techniques of drip and micro spray and irrigate during night hours. In addition to efficient methods of application, those growers using meters have also become quite sophisticated in timing of irrigation, using real-time CIMIS data (discussed below) and tensiometers installed at depths between 12 and 16 inches below ground surface to determine when watering is needed.

Also shown in Table 1 are the Applied Water Unit Values previously developed and accepted for Coachella Valley (**"CVUV"**) irrigated agriculture using the WUCOLS III procedure. The Coachella Valley CIMIS station is the one nearest to the Borrego Valley and, as such, has the most similar climate. This Report considered using CVUV delivery rates to estimate delivered water for potato crops since no Applied Water Unit Value delivery rates for that particular crop were not available from the survey. However, the potato grower confirmed that the applied rate is lower, at 2.5 AFY.

Table 1 Borrego Valley Agricultural Water Production and Calculated Unit Values ("UV" in acre-feet per acre) Compared with Coachella Valley

Crop	Method	Acres	Production	UV	CVUV[46]
Grapefruit	Meter	253	1557 AFY	6.1	6.3
Lemon	Meter	478	3420 AFY	7.1	5.8
Tangerine	Meter	53	289 AFY	5.5	6.1
Citrus	Meter	110	782 AFY	7.1	6.1
Palm	Meter	325	835 AFY	2.6	None
Metered Total		1219	6883 AFY		
Lemon	UV	254	1803 AFY	7.1	5.8
Citrus	UV	881	6255 AFY	7.1	6.1
Palm	UV	285	741 AFY	2.6	None
Potato	GUV 250		625 AFY	2.5 (GUV*)	3.4
Potato (Fallow)		650			
Unit Value Total		2320	9424 AFY		
Grand Total		3539	16307 AFY		

*GUV= Unit Value Applied by Grower

The metered information allowed for a more refined calculation of delivered unit values for each type of crop. It should be noted that individual grower delivery unit values vary according to irrigation method, crop age and other factors. With respect to lemons and citrus, it appears that the Borrego Valley growers tend to apply more water than calculated using the WUCOLS III procedure for the Coachella Valley.[47] As discussed in this Report, various factors may be at play in the Borrego Valley, including salt leaching, frost protection, supplemental irrigation water required due to more porous soil with lower holding capacity, or larger fruit sizes. As discussed in Section 2.3(A) above, the developed crop coefficients in studies are regional in nature and not crop- or location-specific, and the irrigation efficiencies used in studies are similarly generalized, as reported by the studies themselves. (See, ITRC, p. 2 and Endnotes 27, 30 and 31.)

3.2 Evapotranspiration Based on Reported Acreage

The evapotranspiration for the listed crops was determined using the above described WUCOLS III methodology.

The closest CIMIS station to the Borrego Valley is Station 136 located in Oasis, CA (Imperial/Coachella Valley). DWR provides Internet accessible real time information from the various CIMIS stations. The Chart below lists the long term average evapotranspiration by month at the Station as measured in inches of water from the soil surface of turf grass.

Chart--Long Term Average Evapotranspiration at CIMIS Station 36 (inches)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2.48	3.36	5.27	6.9	8.68	9.6	9.61	8.68	6.9	4.96	3.00	2.17	71.6

As indicated, the evapotranspiration information in the Chart is for grass. However, the grass evapotranspiration can be converted to the evapotranspiration value for other crops, using crop-specific coefficients. CIMIS presents a general coefficient for desert citrus of 0.65. The coefficient is multiplied times the evapotranspiration for grass to obtain the evapotranspiration for citrus. Using the coefficient, the annual evapotranspiration rate for citrus in the Coachella Valley region is estimated at 46.8 inches per year or 3.9 feet per year.

Table 2 below presents the estimated total annual consumptive use for acreages of the various crops grown in the Borrego Valley, as reported by the various growers. It is based on the acres irrigated for each crop set forth in Table 1, with the acreage for all of the various types of citrus grouped together, because they all have the same evapotranspiration rate and crop coefficient. Potatoes and palms are grouped separately, even though they have the same evapotranspiration rate and crop coefficient.

Table 2 Annual Evapotranspiration (ET) for Each Borrego Valley Crop Type

Crop Type	Acres Irrigated	Crop Coefficient	ET Rate	Annual ET
Citrus (all)	2,029	0.65	3.9	7,914
Palm	610	0.5	2.0	1,220
Potato	250	0.5	2.0	500
Fallow	650			
Total	3,539			9,634

As discussed above, the actual crop coefficient for the various crops may be different from that reported in the studies using the WUCOLS III methodology, because crop coefficients for a specific crop vary by area, soil type, irrigation frequency and type, reference crop type, and a host of other factors that are specific to management practices and the environment. For example, Borrego Valley citrus growers who also farm in Coachella Valley report differences in soil types and frequency of freezing temperatures requiring supplemental water in Borrego Valley. Thus, the annual evapotranspiration amount in the Borrego Valley may vary from that calculated above.

3.3 Potential Irrigation Return Flow Based on Water Balancing

As previously stated, the groundwater produced and applied to crops must be sufficient to satisfy the consumptive use or evapotranspiration need of the crop (without a reduction in yield) and to satisfy the salt leaching, frost protection and soils holding capacity requirements. Thus, that portion of the delivered water not consumed or lost as runoff or evaporation during irrigation is returned to the groundwater basin and is commonly referred to as "irrigation return flow" or "applied water return flow".

Estimates of agricultural irrigation return flows have been made by prior investigators. The 2015 U.S. Geological Survey ("USGS") model of Borrego Basin estimates the irrigation return flows as high as 30% of the delivered water. The Netto field study determined the irrigation return flows in one Borrego Valley grower's field at 22% by comparing the salinity of water contained in the root zone to that of the delivered water. (See Endnote 10.) Based on these studies, the agricultural irrigation return flows to the Borrego Basin resulting from the survey information is estimated at about 3,600-5,000 AFY

Another alternative is to estimate the return flow using a generalized irrigation efficiency rate of the delivered water. However, the estimate would be highly inaccurate, because not all irrigators need the same amount of water for leaching, not all soils have the same holding capacity, and different crops have different needs, such as frost protection, as explained above.

This Report estimates the potential irrigation return flow based on the reported delivery rate and regional evapotranspiration value for the crop. For example, if a grower reported an application rate of 5.0 AFY for citrus, the evapotranspiration value as reported by CIMIS (Oasis) was deducted to obtain the return flow amount. In this case, the amount is 5.0 minus 3.9 = 1.1 AFY. This value was multiplied by the number of acres of production reported by the grower. If a grower reported an application rate 5.7 acre-feet per acre, then the return flow amount would be 5.7 minus 3.9 or 1.8 AFY times the acreage.

Table 3 summarizes the total agricultural acreage, the total delivered water amounts determined by the survey using metered data or applied water values, the evapotranspiration amounts determined by CIMIS evapotranspiration data and regional crop coefficients, and the resulting estimated irrigation return flows.

Table 3 Potential Irrigation Return Flows

Acreage	Delivered Water	ET Amount	Potential Return Flow
3539	16,307 AFA	9,634 AFA	6,673 AFA

The difference between the delivered water and consumptive use is the potential irrigation return flow from the applied water that passes the root zone after satisfying the crops' consumptive use requirement and eventually reaches Borrego Basin,. Given the irrigation best management practices employed for water conservation, it is not likely that much of the applied water is lost from runoff and/or soil evaporation.

As explained above, the consumptive use crop coefficient is regional in nature and does not take into account the particular grower practices regarding irrigation methodology, soils and crop types. For example, a larger tree canopy, a larger trunk diameter, larger fruit size and more sandy alluvium may require supplemental applied water, some of which factors may increase the crop coefficient and amount of consumptive use beyond that shown.

Chapter 4.0 Conclusions and Recommendations

4.1 Conclusions

This report provides valuable information that helps bridge the data gaps regarding agricultural irrigation production, evapotranspiration and return flows with respect to formulation of a water budget.

As concluded by Dudek at the October 27, 2017 Advisory Committee Meeting in its Borrego Valley Model Water Budget Update powerpoint and notes, the Borrego Valley Hydrologic Model used by USGS in 2015 only estimated agricultural extraction using the WUCOLS III Farm Process, and metered agricultural pumping would "markedly" reduce uncertainty regarding extraction in model simulations. (Dudek, Slide 22.) Also, "The biggest reduction in uncertainty can be gained by using metered pumping for irrigated fields." (Dudek, Slide 20.)

As found by Dudek, "The [2015 USGS] model tends to predict lower groundwater levels than observed. In general, the model showed a slight bias towards lower modeled heads than observed heads in areas of intense pumping (i.e., the model is overestimating groundwater level declines in some areas of the aquifer). The model may overestimate groundwater level declines in the basin because it is overestimating pumping, underestimating recharge, underestimating water stored in the acquifer, or some combination of these three factors. While model calibration and validation indicated a tendency of the model to simulate lower heads than those observed in the basin, additional data is need to determine which model inputs are responsible for this model bias." (Dudek, Slide 19)

As the following conclusions explain, this report provides valuable additional data to help determine which model inputs are responsible for model bias and thus establish a more accurate water budget:

1. Confidential information related to water production and crop acreages were collected from individual growers representing 89% of the total agricultural acreage calculated by BWD in 2015. Responses are reported in a manner to comply with SGMA's privacy protection requirements.[48] A competent professional who has skillfully represented both the local water district and local growers in Borrego Valley reviewed and assimilated the information and helped fill data gaps.

2. The state places a high degree of confidence in metered and other measured well production data.[49] This is especially true when those reporting are employing the most efficient irrigation application techniques available. About 80% of the irrigated acreage is irrigated by either drip or micro spray methods. Furthermore, the metered production from which the unit values are obtained are employing best management practices for irrigation scheduling and quantification. Techniques employed include tensiometers and CIMIS real time data.

3. The predominant crops grown in the Borrego Valley are lemons, oranges, grapefruit and tangerines. Based on the survey responses, about 82% of the irrigated agricultural acreage is devoted to citrus.

4. The highest total groundwater extracted and applied each year to irrigate the agricultural acreage responding to the survey is about 16,300 acre-feet.

5. Of that amount, about 9,600 acre-feet of the agricultural water withdrawn from the Borrego Basin each year is consumptively used.

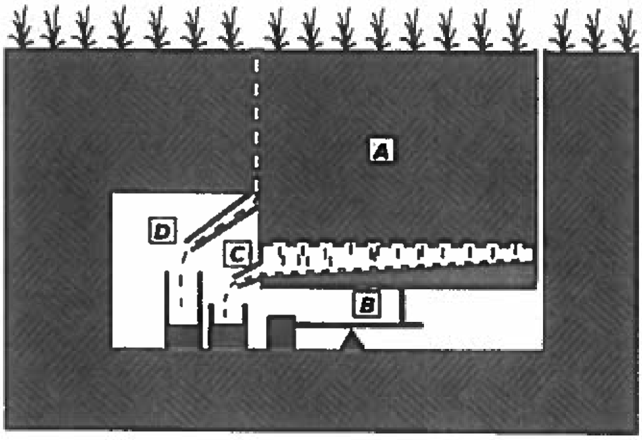
6. Potentially as much as 6,700 acre-feet of the agricultural irrigation water is returned to the Borrego Basin each year.

4.2 Recommendations

1. Additional Study Recommended With DWR Support

Given the high variability of crop coefficient values and of irrigation practices, it is possible that the consumptive use of the crops may be understated. It is difficult to substantiate the amount of water needed to account for the poor moisture holding capacity of sandy soils, or to differentiate from one field to another the tree trunk, canopy and fruit size. Therefore, it is highly recommended that in order to further refine the agricultural consumptive use and agricultural irrigation return flow estimates, lysimeters should be employed at grower locations to more precisely quantify the irrigation return flow amounts. A lysimeter is a measuring device that records the amount of water percolating through the soil. A schematic of a lysimeter station is shown in Figure 2 below. Lysimeter readings are scientifically accepted methods for measuring irrigation return flows.[50]

Figure 2



It is recommended that DWR funding be sought by the GSA to establish the lysimeters under the DWR's Sustainable Groundwater Management Technical Support Services funded by DWR's Sustainable Groundwater Management Program whose initial focus is for the very purpose of providing technical assistance to GSAs in the development of their GSPs for critically overdrafted basins.

The application must be made by the GSA by mid-February and the DWR point person for project funding has already discussed with an AAWARE representative how DWR funds would be appropriately used for testing to help fill in the data gap regarding irrigation return flows in the Borrego Valley.

2. ***The GSA should obtain DWR technical support to develop a graphic model of the Borrego Basin based on available well logs, and if necessary, additional soil data.*** DWR technical support is available particularly to GSAs in critically overdrafted basins as stated above.

3. ***The GSA should obtain DWR technical support to identify inaccuracies in the Model as necessary to verify the Model. Until a verified Model is developed, the sustainable yield and resulting production allocations should be considered only interim measures.***

4. ***The portion of agricultural irrigation resulting in return flows to the basin (potentially 41% based on currently available information) should be calculated and agricultural production resulting in recharge to the basin should not be subject to agricultural production restrictions.***

Chapter 4.0
References

1. Ayers, R.S. & Westcot, D.W., Water Quality for Agriculture, FAO Irrigation and Drainage Paper 29, Rev.1, , 1994, http://www.fao.ora/DOCREP/0051Y4263E/y4263eOe.htm.

2. Boman, B.J. & Stover, E.W., Outline for Managing Irrigation of Florida Citrus with High Salinity Water, Agricultural and Biological Engineering Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 2012, http://itc.tamu.edu/documents/extensionpubs/University%20of%20Florida/ABE332.pdf.

3. Coachella Valley Water District, Annual Statement of Groundwater Production, Average Annual Water Use Requirements, 2016

4. 1945 Department of Public Works Division of Water Resources, Bulletin No. 51—Irrigation Requirements of California Crops, http://www.water.ca.gov/waterdatalibrary/docs/historic/Bulletins/Bulletin_51/Bulletin_51__1945.pdf

5. Department of Water Resources ("DWR") Best Management Practices for the Sustainable Management of Groundwater—Water Budget BMP, http://www.water.ca.gov/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf.

6. Faunt, C.C., Stamos, C.L., Flint. L.E., Wright, M.T., Burgess, M.K., Sneed, Michelle, Brandt, Juntin, Maartin, Peter, and Coes, A.L. 2015, Hydrogeology, Hydrologic Effects of Development, and Simulation of Groundwater Flow in the Borrego Valley, San Diego County, California, U.S. Geological Survey Scientific Investigations Report 2015-5150, 135 p., http://dx.doi.org/10.3133/sir20155150USGS 2015.

7. January 2013 Irrigation Training and Research Center, California Crop and Soil Evapotranspiration for Water Balances and Irrigation Scheduling/Design, IRTC Report No. R 03-001, http//www.itrc.org/reports/pdf/californiacrop.pdf.

8. Fipps, Guy, Irrigation Water Quality Standards and Salinity Management Strategies, Texas A&M Cooperative Extension 2003, Report No. B-1667, 4-03, http://www.cotton.tamu.edu/Irrigation/salinitydocument.pdf

9. Koo, R C., Water Requirements of Citrus and Response to Supplemental Irrigation, Agricultural and Education Center IFAS, University of Florida, http://irrec.ifas.ufl.edu/flcitrus/pdfs/short_course_and_workshop/second_international_citrus/Koo-Water_Requirements_of_Citrus.pdf

10. Mauk, Peggy, and Shea, Tom, Questions and Answers to Citrus Management, University of California Cooperative Extension, Revised from 1994, http://homeorchard.ucanr.edu/files/140618.pdf.

11. Netto, Steven, Water Resources of the Borrego Valley, San Diego County, California. Master's Thesis, San Diego State University, 2002

12. University of California Cooperative Extension California Department of Water Resources, 2000, A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California http://www.water.ca.gov/pubs/planning/guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_ca/wucols.pdf

Endnotes

[1] California Department of Water Resources ("DWR") Best Management Practices for the Sustainable Management of Groundwater—Water Budget BMP, http://www.water.ca.gov/groundwater/sgm/

pdfs/BMP_Water_Budget_Final_2016-12-23.pdf ("Water Budget BMP"), pp. 7, 24.

[2] Water Budget BMP, p. 3.

[3] Water Budget BMP, p. 4.

[4] 23 California Code of Regulations ("CCR"), § 354.18, subd. (b)(2)&(3).

[5] Water Budget BMP, p. 30.

[6] Water Budget BMP, p. 31.

[7] 23 CCR, § 354.18, subd. (e).

[8] Water Budget BMP, p. 8.

[9] Water Budget BMP, p. 29.

[11] 2015 Faunt, C.C., Stamos, C.L., Flint. L.E., Wright, M.T., Burgess, M.K., Sneed, Michelle, Brandt, Juntin, Maartin, Peter, and Coes, A.L. 2015, Hydrogeology, hydrologic effects of development, and simulation of groundwater flow in the Borrego Valley, San Diego County, California, U.S. Geological Survey Scientific Investigations Report 2015-5150, 135 p., http://dx.doi.org/10.3133/sir20155150 ("2015 USGS Report"), p. 2 [recharge from irrigation return flows as indicated by model results was at 10-30% for agricultural and recreational pumpages], p. 48 ["From the 1940s onward, these sources of anthropogenic recharge have significantly increased the total groundwater recharge in the valley, at times becoming many times larger in magnitude than natural recharge."]; Netto, Steven, *Water Resources of the Borrego Valley, San Diego County, California*. Master's Thesis, San Diego State University, 2002 ("Netto"), p. 109 [22%].

[12] See Dudek, November 16, 2017 Working Draft Technical Memorandum—Baseline Pumping Allocation [using production rather than consumption numbers for irrigated agriculture]; Dudek, November 15, 2017 Working Draft Technical Memorandum—Pumping Allowance [using production rather than consumption numbers for irrigated agriculture]

[13] 2015 USGS Report, p. 2 ["Over the 66-year study period, on average, the natural recharge that reached the saturated groundwater system was approximately 5,700 acre-feet per year."] ; p. 88 ["In addition to these natural sources of recharge, irrigation return flow from agricultural fields and municipal lawns and infiltration of treated and untreated wastewater also contribute to recharge."].

[14] Netto, p. 62 ["Irrigation typically involves the over-application of water to prevent salts from accumulating in the soil."]; Boman, B.J. & Stover, E.W., Outline for Managing Irrigation of Florida Citrus with High Salinity Water, Agricultural and Biological Engineering Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 2012, http://itc.tamu.edu/documents/extensionpubs/University%20of%20Florida/ABE332.pdf, p. 1 ["In addition, proper management will require flushing of salts with excess irrigation water."]; University of California Cooperative Extension—California Department of Water Resources, A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California, August 2000, http://www.water.ca.gov/pubs/planning/guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_ca/wucols.pdf ("Irrigation Guide"), p. 38 ["When soil salt concentrations are sufficiently high to cause plant injury, the application of water in excess of that needed to meet plant needs is necessary. This process is called "leaching" and the percentage of applied water used to move salts below the root zone is called the "leaching fraction. For example, if 100 gallons of water is applied, and 25 gallons percolated below the root zone to remove salts, this would be a 25% leaching fraction. The leaching fraction fraction needed for a landscape will depend on soil salt concentrations, tolerable levels, depth of the root zone, and soil physical properties. To determine an appropriate leaching fraction, it is recommended that managers consult with a qualified soil laboratory. The leaching fraction will add water to that needed for plants (ET_L), and the total water applied (TWA) will increase."]; Ayers, R.S. & Westcot, D.W., Water Quality for Agriculture, FAO Irrigation and Drainage Paper 29, Rev.1, 1994, http://www.fao.ora/DOCREP/0051Y4263E/y4263eOe.htm, § 2.4.2; Fipps, Guy, Irrigation Water Quality Standards and Salinity Management Strategies, Texas A&M Cooperative Extension 2003, Report No. B-1667, 4-03, http://cotton.tamu.edu/Irrigation/salinitydocument.pdf, p. 8.)

[15] 1945 Department of Public Works Division of Water Resources, Bulletin No. 51—Irrigation Requirements of California Crops ("Irrigation Requirements"), p. 16 ["The amount of soil moisture available for plant use depends upon a number of factors such as plant spacing, volume, porosity of soil occupied by the root system, and such characteristics as field capacity, wilting percentage (sometimes called wilting range) and readily available moisture."]; Mauk, Peggy, and Shea, Tom, Questions and Answers to Citrus Management, University of California Cooperative Extension, Revised from 1994, http://homeorchard.ucanr.edu/files/140618.pdf, p. 5 ["Limes and lemons (except for Meyer lemon) are most susceptible to frost damage. Healthy trees that are well supplied with water are better able to withstand frost than weak, dry trees. ... When frost is expected, keep the soil surface below the tree clean and wet as this will act as a heat sink."].)

[16] 23 CCR, § 351, subd. (l) ["data gap" is defined as lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of plan implementation and could limit the ability to assess whether a basin is being sustainably managed].)

[17] 2015 USGS Report, p. 97 ["There is no known reported pumpage for Borrego Valley that can be used as additional calibration data for agricultural pumpage."].

[18] Irrigation Guide, pp. 5-7, 29-31.

[19] Irrigation Guide, p. 5 and Appendix A.

[20] January 2013 Irrigation Training and Research Center, California Crop and Soil Evapotranspiration for Water Balances and Irrigation Scheduling/Design, IRTC Report No. R 03-001, www.itrc.org/reports/pdf/californiacrop.pdf. ["ITRC Report"], p. 2.

[21] ITRC Report, p. 2.

[22] CIMIS, Reference Evapotranspiration, www.cimis.water.ca.gov/App_Themes/images/etozonemap.jpg.

[23] Irrigation Guide, p. 6.

[24] ITRC Report, p. 2.

[25] ITRC Report, p. 2

[26] Koo, R C., Water Requirements of Citrus and Response to Supplemental Irrigation, Agricultural and Education Center IFAS, University of Florida, http://irrec.ifas.ufl.edu/flcitrus/pdfs/short_course_and_workshop/second_international_citrus/Koo-Water_Requirements_of_Citrus.pdf, p. 26.

[27] Irrigation Guide, p. 5-7.

[28] ITRC Report, p. 2.

[29] Irrigation Guide, pp. 29-31.

[30] Irrigation Guide, pp. 29-31.

[31] Irrigation Guide, p. 29.

[32] Irrigation Guide, p. 30.

[33] Irrigation Guide, p. 30.

[34] Water Budget BMP, p. 35.

[35] Water Code, § 10725.8, subds. (a) & (d).

[36] Water Code, § 1840, subd. (a)(1)(B)(i).

[37] County Code, §§ 67.702, 67.711.

[38] County Code, § 67.720, subds. (A) & (B)(1).

[39] County Code, § 67.720, subds. (A) and (B)(1)(d).

[40] County Code, § 67.711.

[41] County Code, § 67.702.

[42] Water Code, § 10725.8.

[43] Water Code, § 10730.8(b).

[44] Water Code, § 10730.8; Govt. Code, § 6254.16.

[45] 2018 DigitalGlobe, Landsat/Copernicus, U.S. Geological Survey, USDA Farm Service Agency, Map data, https://www.google.com/maps/@33.3052367,-116.3635645,11087m/data=!3m1!1e3?hl=en

[46] Coachella Valley Unit Values obtained from ITRC Report.

[47] 2016 Coachella Valley Water District Annual Statement of Groundwater Production Form, p. 2

[48] Water Code, §§ 10730.8; Govt. Code, § 6254.16.

[49] Water Code, §§ 1840, subd. (a)(1)(B)(i), 10725.8.

[50] Davie, Tim (2003-01-01). Fundamentals of Hydrology. Psychology Press. ISBN 9780415220286.