Case Study: Recharge Net Metering

Incentivizing Groundwater Recharge

Case Study #8

Working Draft

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Center for Law, Energy, and the Environment
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This case study is part of a series focusing on incentives for Managed Aquifer Recharge, and the institutional context in which MAR projects are conducted. The series is being produced as part of a larger project examining this topic. A symposium on September 10, 2019 will highlight these and other projects. More information is available at law.berkeley.edu/recharge2019.

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Recharge Net Metering (ReNeM)

Incentivizing Groundwater Recharge - Case Study #8

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Overview

Location: Pajaro Valley, California
Motivation for MAR: Reducing groundwater overdraft
Groundwater Challenges: Overdraft and seawater intrusion
MAR Challenges: Water source
Project Goals: Infiltrate 1,000 AFY
Key Actor(s): Pajaro Valley Water Management Agency (PV Water); landowners and tenants; Resource Conservation District of Santa Cruz County (RCD); UC Santa Cruz (UCSC)
Water Source: Stormwater runoff
Start Date: 2016
Current Status: Pilot
Average Annual Yield: TBD, goal is infiltration benefit of 1,000 AFY from the aggregate of regional projects
Cost: Varies by project, ~$200-300 /AF

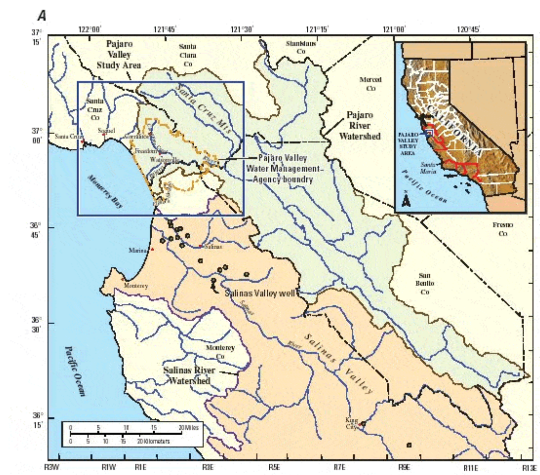

Figure 1. The Pajaro Valley is located on California's central coast, adjacent to Monterey Bay. Photo courtesy of PV Water.

1. Motivation and Goals

Recharge Net Metering (ReNeM) is a novel incentive program for groundwater recharge. Akin to the mechanisms used in solar net metering, ReNeM encourages development of infiltration projects on private or public land by offering a rebate on groundwater pumping fees based on the net increase in infiltration. A ReNeM program is currently being piloted in California's Pajaro Valley. The goal of the pilot is to infiltrate 1,000 AFY to regional aquifers by creating and operating infiltration projects at multiple sites to help reduce groundwater overdraft and associated undesirable consequences (seawater intrusion, disconnection with surface water, and degradation to water quality).

2. Geographic and Historical Context

Pajaro Valley is one of the most productive agricultural areas in California and is known for its large output of high-value berry crops. Precipitation is highly seasonal, with the vast majority of rainfall (snow is rare) occurring during November to May, and averages 21.9 inches per year. Surface water resources are scarce, and the valley lacks access to the federal Central Valley Project, which serves as a vital water source for areas further inland.

Due to the lack of rainfall and surface water, the valley has been heavily dependent on groundwater, which accounts for about 94% of current water use. Decades of groundwater overdraft have contributed to groundwater depletion, lowering of water levels, seawater intrusion, and a decline in groundwater quality. The basin presently faces an estimated annual overdraft of 12,100 AFY, representing about 20% of total annual pumping. Climate change predictions suggest rainfall patterns in California will become more erratic, with rain events shifting to shorter duration and higher intensity.[1] Climate change is also expected to cause sea-level rise, which would further pressure the aquifer and exacerbate seawater intrusion in the valley.[2]

3. Regulatory Setting

California groundwater rights and rules, specifically state legislation that created the Pajaro Valley Water Management Agency (PV Water), govern groundwater use in Pajaro Valley. Additionally, groundwater use is subject to regulations set by PV Water in order to meet its management obligations and remain economically viable.

3.1 *Groundwater Rights in California*

The right to use groundwater in California is largely defined by common law.[1] The most common types of groundwater rights in California are overlying, appropriative, and prescriptive.

- Overlying rights are tied to land ownership – a landowner may pump the reasonable amount of water needed for beneficial use on the overlying land. These rights are also correlative, meaning that other overlying landowners' ability to pump must be taken into account when determining what is a reasonable use of water.
- Appropriative rights are groundwater rights that do not rely on overlying land ownership to pump. Appropriative rights have a priority date vis-à-vis other appropriative rights based on the date the appropriative user began pumping, but are subordinate to any overlying rights.
- Prescriptive rights are rare but may come into play when someone with an appropriative groundwater right continues to pump in times of shortage. "Acquisition of a prescriptive right in groundwater rearranges water rights priorities among water users, elevating the right of the one acquiring it above that of an appropriator to a right equivalent in priority to that of a landowner."[3]

3.2 *The Sustainable Groundwater Management Act (SGMA)*

In 2014, California passed the Sustainable Groundwater Management Act (SGMA). Under SGMA, the state categorized groundwater basins as low, medium, or high priority.[4] Newly formed local groundwater sustainability agencies (GSAs) in basins designated as high or medium priority are required to develop groundwater sustainability plans (GSPs). These GSPs must be designed to achieve groundwater sustainability by avoiding six "undesirable results":

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply;
- Significant and unreasonable reduction of groundwater storage;

- Significant and unreasonable seawater intrusion;
- Significant and unreasonable degraded water quality;
- Significant and unreasonable land subsidence; and
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of surface water.

High and medium priority basins that fail to adopt an adequate GSP or successfully implement their GSP may face intervention by the State Water Resources Control Board. The Pajaro Valley Water Management Agency (PV Water) is the GSA for the Pajaro Valley, and the Pajaro Valley groundwater basin is designated as a critically overdrafted, high priority groundwater basin.

3.3 *Pajaro Valley Water Management Agency Regulations*

In 1984, the California Legislature created PV Water as a special act district to oversee water resources in the valley and to address long-term groundwater overdraft. PV Water follows a Basin Management Plan (BMP), which dictates water management and projects for the basin, with the goal of aiding PV Water in preventing further overdraft. [5, 6] The BMP and additional informational and planning documents were submitted to serve as an alternative to the required GSP under SGMA; this alternative was accepted by DWR in July 2019.[7] PV Water operates several water projects within the basin pursuant to the BMP, including conservation programs, a managed aquifer recharge (MAR) and recovery project, a water recycling facility (that treats wastewater from the nearby city of Watsonville), and a coastal pipeline network that is used to deliver a blend of recovered MAR water, recycled water, and additional groundwater from farther inland in the basin to more coastal areas.

Since 1994, PV Water has charged all groundwater pumpers within the district a pumping fee.[8] The fees are currently $246-338/AF, depending on the location of where the water is pumped.[9] Agricultural groundwater users who decide to forgo pumping or supplement their groundwater pumping with delivered water pay $392/AF for supplemental irrigation water. Delivered waters users are often near the coast in zones affected by seawater intrusion and choose to have this water delivered instead of only utilizing native groundwater.[10] Delivered water allows farmers to continue to grow crops in areas where the groundwater is contaminated or threatened by seawater intrusion.

To calculate pumping fees, PV Water requires all wells that pump more than 10 AFY to be metered.[11] Pumping fees are calculated based on amount of water pumped as reported by the meters, multiplied by the applicable pumping fee rate. The pumping fees make up 60-70% of the agency's revenues.[12] The fees are used to fund PV Water's operations, including agency administration, basin management, and facility operations.[13] While these pumping fees are high compared to other pumping fees in California and the United States, the farmers paying those fees often raise high-value crops. For example, the total pumping fees paid in 2017 amounted to just over $9 million, while the area produced around $900 million in agricultural products.[14]

4. Managed Aquifer Recharge through Recharge Net Metering

The ReNeM program was launched at the start of the 2016-2017 water year. The program is a five-year pilot with the possibility of extension. ReNeM does not require a particular type of water source or recharge design. However, in the Pajaro Valley, distributed stormwater collection (DSC-MAR) is used to collect water for the project sites. Under DSC-MAR, infiltration sites are dispersed across the basin, constructed at sites that demonstrate favorable conditions for recharge activities. Two project sites are currently in operation, with an additional site under construction in 2019. Additional sites are currently being evaluated for potential development.

4.1. Recharge

To supply water for infiltration, current ReNeM sites collect water from hillslope runoff during storm events. Water is drained from drainage areas typically greater than 100 acres and routed via ditches or other structures towards targeted infiltration systems. These targeted infiltration systems are placed strategically throughout the basin where recharge can replenish underlying aquifers. This water would have otherwise run off to the ocean and is available due to the combination of increasing frequency of high-intensity rain events and the increase of impermeable surfaces in the basin as urban areas expand.[15] Critically, the use of this water is unlikely to have negative impacts on the Pajaro River ecosystems, because the projects only collect water when surface waters in the basin are experiencing high flows during major rain events.[16] The water collected represents a small percentage of runoff generated from the basin's hillslopes.[17]

The infiltration sites are selected and designed to infiltrate ≥100 AFY during a water year having median annual precipitation. The drainage and infiltration sites in the Pajaro Valley are mostly agricultural, although the availability of agricultural land is not essential for the program. Third party certifiers from UC Santa Cruz (UCSC) and the Resource Conservation District of Santa Cruz County (RCD) provide a neutral assessment of the site suitability and design of infiltration systems.

Infiltration vs Recharge

Infiltration *is the amount of water that enters the soil from surface water sources.*

Recharge *is the amount of water actually reaching a defined aquifer. Recharge can be difficult to measure with precision. ReNeM tracks infiltration instead, which is consistent with the program's goal of incentivizing behavior which benefits for the basin as a whole.*

4.2. Accounting

Landowners and/or tenants who participate in the ReNeM program receive a rebate on pumping fees based on the amount of water successfully infiltrated by the project on their property. Third-party certifiers monitor the rate and quantity of infiltration using conventional and experimental techniques (e.g., mass balance, using heat as a tracer)[18], and verify the amount of water successfully infiltrated in a given year. [19] The numbers are submitted to project stakeholders and PV Water, who calculates the rebate. The rebate uses the following equation:

$$Rebate = W_{50} \times (Inf_{tot} - Inf_{inc})$$

Where Inf_{inc} is the incidental infiltration that would have occurred without the project, Inf_{tot} is total measured infiltration, and W_{50} is the pumping fee assessed to the landowner based on location, with a 50% discount factor. The discount factor is included in the rebate formula to account for uncertainties, storage of soil water, and to ensure financial viability of the program for PV Water.[20] PV Water calculates and administers payment of the rebate based on third=party certifier calculations, which are published in an annual report.

4.3. Recovery

Water that recharges into the aquifer and is made available for subsequent recovery as opposed to discharging to surface water systems or the ocean can contribute to mitigating historical overdraft (raising water levels, reducing seawater intrusion, diluting salts and nutrients). Consistent with the mission of PV Water, the recharged water is considered to contribute broadly as a non-extractive beneficial use, incrementally improving the overall health of the basin by reducing overdraft and its impacts.[21] Any recharged water is available for extraction, subject to the pumping fees administered by PV Water.

5. Project Management

5.1. Institutional Arrangements

Collaboration between PV Water, valley landowner, and the third party certifiers is a critical part of ReNeM.

PV Water controls the overall management, oversight, and administration of the ReNeM program. PV Water is governed by the PV Water Board of Directors, the selection of which reflects the agricultural character of the area: four directors are elected by voters living with the agency boundaries. The remaining three directors are appointed by Monterey County, Santa Cruz County, and the City of Watsonville, but these appointed directors are required to derive at least 51% of their net income from agriculture.[22] The Board of Directors possesses sole authority to terminate the program at any time during the pilot stage.[23] PV Water calculates the final rebate and issues the rebates to landowners or tenants.

Landowners and/or tenants provide the land for the recharge sites. Once stormwater collection and infiltration systems are installed, these stakeholders are responsible for maintenance and upkeep. This is the primary basis for PV Water supplying a rebate: to offset loss of land use and operation/maintenance costs associated with hosting a project.

The third-party certifiers, UCSC and the RCD, play an important role by securing grant funding for the project sites, designing the infiltration sites, and verifying the amount of water infiltrated at each site. These institutional arrangements will likely shift somewhat should the ReNeM program continue beyond the pilot, following assessment of costs and benefits, effort required for project siting and design, short- and longer-term maintenance, and system performance.

5.2. Costs and Financing

The ReNeM program is in a pilot phase, and developing the concept continues to depend on funding from state and federal agencies, foundations, and academic sources[24] obtained by the Resource Conservation District of Santa Cruz County and UC Santa Cruz in their capacity as third-party certifiers.[25] These grants and contracts cover most of the pilot program's activities, including site evaluation and permitting, project design and installation, validation to certify the performance of the infiltration sites, and assessments of impacts on water quality.[26]

If the design of the ReNeM model can be developed and proven viable in the Pajaro Valley, the program could be extended in the valley and be tested elsewhere subject to a variety of modifications. Research is underway to evaluate the feasibility of ReNeM-like programs in other basins. The full realization of the ReNeM concept could be more, or entirely, financially self-sufficient, at least in places like the Pajaro Valley where marginal water costs are relatively high. Rather than depending on external grants for primary capital costs, a ReNeM program could be structured such that water supply agencies and/or landowners take on the costs of design, construction, operation, and maintenance of their respective infiltration sites, in anticipation of the returns from extraction fees or other operating fees. Similarly, the costs of a third party certifier to validate the amount of water recharged may be incorporated into standard basic measurement and operation activities. The agency's costs, including managing the program, calculating the rebate fee (or a simple payment system), issuing checks, and other administrative costs, could also be internalized in the fee and rebate structure.[27]

5.3. Project Revenues and Benefits

Benefits of the program include the addition of water to the basin, improvements to water quality, and engagement of stakeholders who receive payments based on project performance.

The pilot project goal is to add 1,000 AFY to the Pajaro Valley aquifer system once fully implemented. Recharged water benefits water users across the Pajaro Valley and residents by improving the health of the aquifer. Although the ReNeM program is not officially a part of PV Water's BMP, the addition of water to the basin through the ReNeM program offers PV Water a margin for error in achieving its recharge goals. It also serves as a hedge against ongoing and future climate change, and diversifies PV Water's project portfolio.

For landowners who participate in the ReNeM program, the ability to receive a rebate on their groundwater pumping fees poses a significant monetary benefit. Groundwater pumping fees in the Pajaro Valley are an outlier in California, significantly higher than most other regions of California and the United States where they exist at all. For farmers who participate in this program, the rebate allows them to reduce their production costs.

Unlike conservation programs, which reduce water use and therefore payments to a water agency that are linked to supply (much like solar net metering results in a loss of revenue to power utilities), ReNeM may be revenue neutral or positive for an agency. ReNeM can be revenue positive if amortized project development and operating costs (e.g., site assessment, servicing bonds, and payment for performance) are less than the revenue generated by the supplemental water supply. Part of the motivation for conducting a pilot ReNeM program is to get a better estimate of actual costs for a program of this kind; these are likely to vary considerably by basin and region.

6. Analysis and Summary

ReNeM is an innovative recharge incentive system, benefitting from new tools and methods being developed in response to growing pressures on the world's groundwater systems. By offering the potential for a rebate on pumping fees, ReNeM provides an incentive for individual landowners to participate in the improvement of water resource conditions in a basin. However, as ReNeM is currently being tested, and effort and costs are being quantified, it poses several unanswered questions that must be addressed before widespread adoption is possible.

6.1. Key Elements

ReNeM is unique in linking infiltration and recharge to a rebate of pumping fees. We are aware of no other groundwater recharge project in the United States that offers groundwater pumpers a rebate on their pumping fees if they successfully operate an infiltration project on their land. ReNeM is also unique because of its potential to work with a variety of water sources and recharge methods. Though pilot sites to date use infiltration basins and distributed stormwater runoff, ReNeM mainly requires measurable and verifiable infiltration of water. A ReNeM program could incorporate any recharge method, using any water source, and could tie rebates or flat payments to a variety of performance metrics.

6.2 Incentives and Benefits

ReNeM's rebate structure provides a strong incentive for landowners and tenants to help operate and maintain infiltration systems on their land. The more water that landowners successfully infiltrate, the larger the rebate on their pumping fees. The better designed and maintained a recharge site is, the more likely it will infiltrate higher amounts of water.

For PV Water, passage of SGMA is a major incentive to assume the risk of a pilot project such as ReNeM. Although ReNeM is not currently part of PV Water's GSP/BMP, ReNeM's success could contribute towards PV Water's the goal of increasing its water budget by 12,100 AFY through a combination of increased supply and conservation.[28] Achieving this goal will increase the likelihood that PV Water will achieve groundwater sustainability in the basin, avoiding both undesirable consequences and state intervention.

Thinking about ReNeM as an approach to MAR more broadly, programs of this type could provide incentives for a range of activities by landowners, tenants, municipalities, and other stakeholders that could benefit groundwater resources in a basin. ReNeM links rebates to infiltration, which is relatively easy to measure compared to recharge. This approach contrasts with MAR schemes in which access to additional water supply is granted based on recharge activities.

Both the environment and the local economy benefit from this incentive structure. Increased recharge using stormwater contributes to avoiding undesirable hydrologic consequences (e.g., reducing seawater intrusion) and reducing local flood risk from runoff during storms. The local economy benefits as increases to the water supply allow agricultural users to irrigate crops and support other farm-related activities. For PV Water, ReNeM allows the agency to expand its water supply portfolio and develop new recharge projects without purchasing or leasing land or managing construction and operation of individual sites. The pilot requires minimal capital costs and human resource demands from PV Water, giving the agency a chance to assess performance and better understand potential costs and obligations going forward.

6.3 Challenges and Future Considerations

While promising, ReNeM faces several challenges. First, the expected benefits of the ReNeM pilot to the basin are long-term and may not be immediately realized, understood, or quantified. Second, ReNeM requires a substantial investment in time, capital funding, design, and building new projects. In addition to capital and operating costs, there are opportunity costs for use of both land and time, and a new distribution of risks and responsibilities as well. Whether landowners and tenants will find the rebate sufficient to offset costs from taking some land out of production will depend on numerous factors that vary year by year and are difficult to predict. Third, while the ReNeM pilot incentivizes collection of excess runoff when it is available, there is no guarantee that any recharge will occur in a particular year. Finally, legal questions surrounding the ability to use stormwater runoff may vary based on location. Similarly, the level of water quality that recharge projects must meet may also vary by location, and some regions may require pretreatment of water before it is recharged. In the Pajaro Valley, results from the five-year pilot ReNeM program should help to resolve these and other questions.

Regardless of these challenges, ReNeM remains a novel and conceptually distinct set of programmatic incentives for infiltration and recharge, and its success and potential broader adoption will be worth watching in future years. While application of ReNeM in other settings is unlikely to be identical in design to that applied in the Pajaro Valley, the pilot program provides a platform for testing tools and methods, assessing the sustainability of agency and stakeholder interest, and understanding how it might be possible to align diverse interests in support of regional resources.

7 Acknowledgements

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8 Endnotes

[1] Pajaro Valley Water Management Agency (2019). *Basin Management Plan Update.* Retrieved from https://www.pvwater.org/bmp-update (last visited February 15, 2019).
[2] Pajaro Valley Water Management Agency (2019). *Basin Management Plan Update.* Retrieved from https://www.pvwater.org/bmp-update (last visited February 15, 2019).

[3] *City of Santa Maria v. Adam*, 203 Cal. Rptr. 3d 758, 764 (Cal. Ct. App. 2016).

[4] Priorities were determined based on eight main factors: the overlying population and its projected growth, the number of public supply wells and total wells, the amount of irrigated acreage, the degree of reliance on groundwater, the condition of groundwater resources, and other relevant information. Cal. Water Code 10933(b).

[5] Pajaro Valley Water Management Agency (2019c). *Basin Management Plan Update.* Retrieved from https://www.pvwater.org/bmp-update (last visited February 15, 2019).

[6] The BMP also serves as the basin-wide management plan under California's Groundwater Management Act (AB 3030), and was submitted as an alternative to the required Groundwater Sustainability Plan (GSP) under the Sustainable Groundwater Management Act (SGMA). Levy, M., & Christian-Smith, J. *Groundwater Management in the Pajaro Valley*. Pacific Institute. Retrieved from https://www.pacinst.org/reports/success_stories/groundwater_management_in_pajaro_valley.pdf; California Department of Water Resources (2019). *Pajaro Valley Water Management Agency.* Retrieved from https://sgma.water.ca.gov/portal/alternative/print/22 (last visited February 15, 2019).

[7] Aside from the BMP, other documents included in the alternative GSP submission included a Salt and Nutrient Management Plan and an environmental assessment for expansion of a water plant. California Department of Water Resources (2019). *DWR Approves Nine Alternatives to Groundwater Sustainability Plans.* Retrieved from https://water.ca.gov/News/News-Releases/2019/July-19/DWR-Approves-Nine-Alternatives-to-Groundwater-Sustainability-Plans (last visited August 24, 2019); California Department of Water Resources (2019), *Cover Letter, Pajaro Valley Subbasin.* Retrieved from https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Alternatives/Files/ExistingPlans/PajaroValley/01_Pajaro_Cover-Letter.pdf (last visited August 26, 2019); California Department of Water Resources (2019), *Statement of Findings, Pajaro Valley Subbasin.* Retrieved from https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Alternatives/Files/ExistingPlans/PajaroValley/02_Pajaro_Statement_of_Findings.pdf (last visited August 26, 2019); California Department of Water Resources (2019), *Assessment Summary, Pajaro Valley Subbasin.* Retrieved from https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Alternatives/Files/ExistingPlans/PajaroValley/04_Pajaro_Assessment_Summary.pdf (last visited August 26, 2019).

[8] Pajaro Valley Water Management Agency (2019). *Your Water Bill.* Retrieved from https://www.pvwater.org/your-water-bill (last visited February 15, 2019).

[9] Kiparsky, M., Fisher, A. T., Hanemann, W. M., Bowie, J., Kantor, R., Coburn, C., & Lockwood, B. (2018). *Issue Brief: Recharge Net Metering to Enhance Groundwater Sustainability*. Retrieved from https://www.law.berkeley.edu/wp-content/uploads/2018/04/CLEE_ReNeM_IssueBrief.pdf

[10] Pajaro Valley Water Management Agency (2014). *Basin Management Plan Update*. Retrieved from https://www.pvwater.org/images/about-pvwma/assets/bmp_update_eir_final_2014/BMP_Update_Final_February_2014_(screen).pdf (last visited February 8, 2019).

[11] Hanson, R. T., Schmid, W., Faunt, C. C., Lear, J., & Lockwood, B. (2014). *Scientific Investigations Report 2014-5111: Integrated Hydrologic Model of Pajaro Valley, Santa Cruz and Monterey Counties, California*. Retrieved from https://pubs.usgs.gov/sir/2014/5111/pdf/sir2014-5111.pdf (last visited February 8, 2019).

[12] Pajaro Valley Water Management Agency (2017). *Annual Report.* Retrieved from https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/Annual_Report_2017_final.pdf (last visited February 15, 2019).

[13] Pajaro Valley Water Management Agency (2017). *Annual Report.* Retrieved from https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/Annual_Report_2017_final.pdf (last visited February 15, 2019).

[14] Pajaro Valley Water Management Agency (2014). *Basin Management Plan Update*. Retrieved from https://www.pvwater.org/images/about-pvwma/assets/bmp_update_eir_final_2014/BMP_Update_Final_February_2014_(screen).pdf (last visited February 8, 2019); Pajaro Valley Water Management Agency (2017). *Annual Report.* Retrieved from https://www.pvwater.org/images/about-pvwma/assets/annual_reports_assets/Annual_Report_2017_final.pdf (last visited February 15, 2019).

[15] Beganskas, S., & Fisher, A. T. (2017). Coupling distributed stormwater collection and managed aquifer recharge: Field application and implications. *Journal of Environmental Management, 200*, 366-379.

(citing Russo, T. A., A. T. Fisher, and D. W. Winslow (2013), Regional and local increases in storm intensity in the San Francisco Bay Area, USA, between 1890 and 2010, *J. Geophys. Res.-Atm.*, *18*, 1-10, doi:10.1002/jgrd.50225) (showing change from observational data).

[16] Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*.

[17] Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*.

[18] Beganskas, S., and A. T. Fisher (2017), Coupling distributed stormwater collection and managed aquifer recharge: Field application and implications, *J. Env. Management*, *200*, 366-379, doi:10.1016/j.jenvman.2017.05.058.

[19] Infiltration is used instead of actual recharge in part because it is easier to measure and track than actual recharge to the aquifer itself, and in part because it reflects the nature of the incentive in the ReNeM program. Kiparsky, M., Fisher, A. T., Hanemann, W. M., Bowie, J., Kantor, R., Coburn, C., & Lockwood, B. (2018). *Issue Brief: Recharge Net Metering to Enhance Groundwater Sustainability*. Retrieved from https://www.law.berkeley.edu/wp-content/uploads/2018/04/CLEE_ReNeM_IssueBrief.pdf (last visited February 8, 2019).

[20] Pajaro Valley Water Management Agency (2016). *Informational Item 12C: Consider Approval of Proposal to Establish Recharge Net Metering (ReNeM) as a Pilot Project for Five Years*. Retrieved from https://www.pvwater.org/images/media-room/notices/20160316_RechargeNetMeteringProgram_Info.pdf (last visited February 15, 2019); Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*.

[21] Miller, K., Green Nylen, N., Doremus, H., Owen, D., Fisher, A. (2018). *Issue Brief: When is Groundwater Recharge a Beneficial Use of Surface Water?* Retrieved from https://www.law.berkeley.edu/wp-content/uploads/2018/08/CLEE_RechargingGroundwater_BeneficialUse-2.pdf (last visited February 15, 2019).

[22] Pajaro Valley Water Management Agency (2014). *Basin Management Plan Update*. Retrieved from https://www.pvwater.org/images/about-pvwma/assets/bmp_update_eir_final_2014/BMP_Update_Final_February_2014_(screen).pdf (last visited February 8, 2019).

[23] Pajaro Valley Water Management Agency (2016). *Informational Item 12C: Consider Approval of Proposal to Establish Recharge Net Metering (ReNeM) as a Pilot Project for Five Years*. Retrieved from https://www.pvwater.org/images/media-room/notices/20160316_RechargeNetMeteringProgram_Info.pdf (last visited February 15, 2019).

[24] Pajaro Valley Water Management Agency (2016). *Informational Item 12C: Consider Approval of Proposal to Establish Recharge Net Metering (ReNeM) as a Pilot Project for Five Years*. Retrieved from https://www.pvwater.org/images/media-room/notices/20160316_RechargeNetMeteringProgram_Info.pdf (last visited February 15, 2019); Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*.

[25]Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*.

[26] Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*.

[27] Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*.

[28] Fisher, A. T., Coburn, C., Camara, K., & Lockwood, B. (2017). *Recharge Net Metering (ReNeM) in the Pajaro Valley*; *Informational Item 12C: Consider Approval of Proposal to Establish Recharge Net Metering (ReNeM) as a Pilot Project for Five Years*. Retrieved from https://www.pvwater.org/images/media-room/notices/20160316_RechargeNetMeteringProgram_Info.pdf (last visited February 15, 2019).