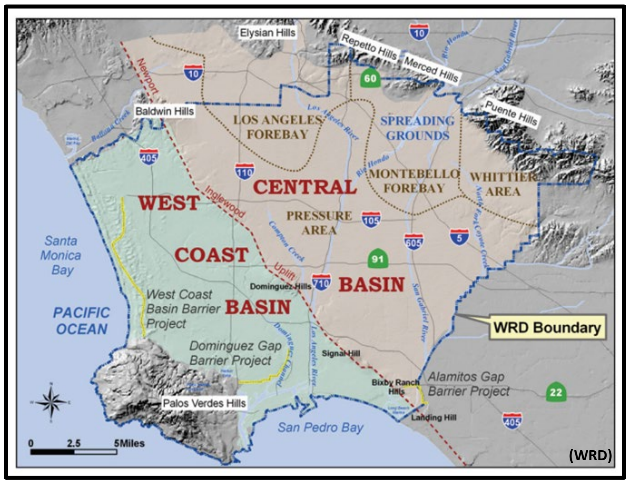
White Paper Evaluating the Potential of Managed Aquifer Recharge using Los Angeles River Wet Weather Flows (April 25, 2022)



GSI Environmental (GSI) has been requested by the Water Replenishment District (WRD) to prepare this white paper evaluating the technical feasibility of recharging excess wet weather flows from the Los Angeles River (LA River) into the underlying groundwater basin with an emphasis on conducting recharge in close proximity to the Los Angeles Forebay.[1] These types of centralized recharge schemes are collectively referred to as Managed Aquifer Recharge (MAR) and are commonly used throughout the world owing to its early adoption here in southern California. The figure to the right shows WRD's service area, which includes the lower section of the Los Angeles River, the southern portion of the Los Angeles Forebay, and the two adjudicated groundwater basins (Central Basin and West Coast Basin). For the purposes of this high-level evaluation, the analysis has been divided into two distinct phases:

Phases	Items Considered
Hydrogeologic Feasibility	1. Nature and quality of source water; 2. Suitability of an aquifer to receive, store, and retrieve recharged water; and 3. Identification of appropriate potential technologies to recharge water.
Engineering / Financial Feasibility	1. Permit operations; 2. Conveyance of water to recharge facilities; 3. Pretreatment of source water; and 4. Source water recharge facilities.

This analysis does not consider local solutions that promote infiltration via local stormwater capture in public or open spaces, stormwater best management practices (BMPs) and low-impact development (LID), or Complete Streets (i.e., streets that serve transportation users but also promote the retention, filtration, and/or infiltration of stormwater [CH2M, 2015]).

Wet weather flows in the LA River watershed represent a potential new source of recharge water for the WRD. This analysis presents an evaluation of the opportunities and potential challenges related to implementing various forms of MAR within WRD's service area and particularly within the Los Angeles Forebay. Our evaluation resulted in the following key findings:

1. LA River wet weather flows are inconsistent, high volume, and short duration. Flow estimates indicate that roughly 107,000 acre feet (AF) of stormwater is discharged to the Pacific Ocean during an average wet weather season with average runoff volumes of 9,900 AF per storm. On average, 11 large storm events occur within the LA River watershed on an annual basis that could

[1] Wet weather flows are flows during and immediately following storm events.

provide sufficient flows for MAR. However, the future supply of wet weather flow may change based on the options currently being considered in the LA River Master Plan.

2. Potential recharge is best suited in the Los Angeles Forebay of the Central Basin using gravity methods similar to recharge basins in the Montebello Forebay Spreading Grounds (MFSG). The Los Angeles Forebay provides direct hydrogeologic communication to the deeper water supply aquifers and the thick vadose zone provides treatment for most of the pollutants typically found in stormwater, including bacteria and metals. Like the MFSG, the water would need to be stored prior to or during recharge. Direct recharge of wet weather stormwater flows into drinking water aquifers is uncommon and would likely require compliance with Title 22 water reuse requirements and waste discharge requirements (WDRs).

3. Because of the intensely developed land use in the Los Angeles Forebay, the potential capital costs to capture, treat, and recharge a significant volume of wet weather flows would include engineering, property acquisition, conveyance, and other infrastructure. By comparison, ongoing operations and maintenance costs would likely be relatively inexpensive.

4. The water quality of wet weather flows is generally characterized by high suspended solids and low concentrations of dissolved constituents. However, given their current low notification levels (NLs) and response levels (RLs), the likely presence of per- and polyfluoroalkyl substances (PFAS) could make pre-treatment for this emerging class of compounds technically challenging. Detailed wet weather flow water quality data represents a significant data gap to be addressed as part of a feasibility study to use LA River water for recharge.

5. The presence of known (and unknown) environmentally impacted sites within a heavily industrial portion of the study area may present some challenges and may require future consideration as it relates to California's anti-degradation policy under Resolution 68-16.

6. Technical studies, subsurface investigations, extensive engineering analysis, and pilot testing would be required to further assess the feasibility of recharging LA River wet weather flows. These studies would include chemical characterization of the wet weather flows, modeling, permitting, engineering, and outreach to other LA River stakeholders.

LA RIVER WET WEATHER FLOWS AS A POTENTIAL SOURCE OF RECHARGE WATER

The LA River drains a watershed of approximately 824 square miles before it discharges to the Pacific Ocean. Its watershed is diverse and ranges from forest and open space near the headwaters in the Santa Monica and San Gabriel Mountains to highly urbanized residential, commercial, and industrial development in the WRD service area. The LA River is measured in river miles starting at its mouth in Long Beach (mile 0) and ending in Canoga Park near the confluence of Arroyo Calabasas and Bell Creek (mile 51). WRD's service area extends north along the LA River south of downtown Los Angeles at about river mile 20.5.

The LA River is hydraulically connected to the San Gabriel River Watershed by the Rio Hondo River, which flows through the Whittier Narrows Reservoir before it merges with the LA River in the City of South Gate. During large flood events, flows from the San Gabriel River may impact the LA River via the Rio Hondo River (mile 12). [2]

In response to the significant flood risk posed by the LA River, by the 1950's the U.S. Army Corp of Engineers (Army Corps) had lined the river with concrete over most of its reach to convey water quickly to the Pacific Ocean. There are also two unlined soft bottom segments: 1) the section of the river found in the Glendale Narrows upstream of WRD's service area,[3] and 2) near the river's southern terminus in Long Beach.

Flows in the LA River are typically divided into "dry weather" and "wet weather" flows. Dry weather flows occur most of the year and consists primarily of discharges from three water reclamation plants (WRPs). A study conducted in 2000 reported that discharge from the WRPs represented 72% of the dry weather flow in the LA River (Ackerman, et al., 2003). Over the last 30 years, the average dry weather (base) flows have ranged from around 100 cubic feet per second (cfs) between 1992 and 2000 to 150 cfs between 2001 and 2010 as measured at Arroyo Seco (F57C-R). This increase was due to increased discharges from the WRPs (CH2M, 2016). However, under wet weather flow conditions, WRP discharge accounts for less than 1% of the flow (CREST, 2009).

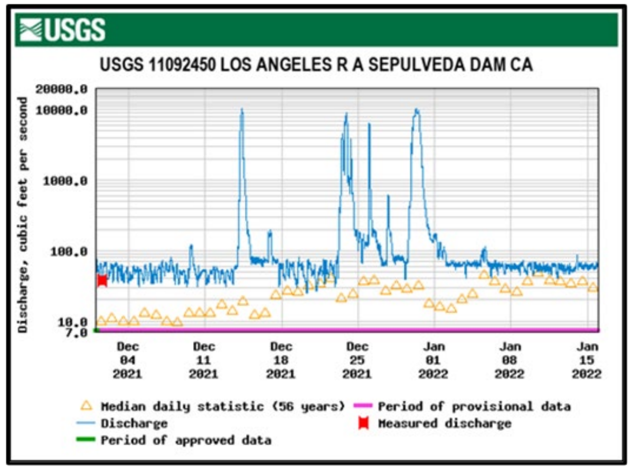
In 2020, dry weather flows immediately south of downtown Los Angeles at river mile 20 measured approximately 70 cfs of which 55 cfs originated from the three WRPs (78%), 10 cfs from incidental urban runoff (14%), and 5 cfs from groundwater upwelling (7%). During this same year, 50,000 AF of dry weather flows were discharged into the ocean at Long Beach (Geosyntec, et. al, 2021). Roughly 10 to 15% of the

[2] https://www.waterboards.ca.gov/rwqcb4/water_issues/programs/regional_program/Water_Quality_and_Watersheds/los_angeles_river_watershed/la_summary.shtml

[3] The high-water table in the Glendale Narrows made lining this section of the LA River impractical.

flow contribution was due to discharges into the LA River south of Bell Gardens at river mile 13 (Geosyntec, 2021).

Given typical southern California weather patterns, wet weather flows have been characterized as inconsistent with a high volume of discharge over a short duration (i.e., flashy); they are sporadic and rise/fall rapidly in response to storm events in the watershed. The LA River discharge hydrograph on the right shows the flashy nature of the flows at the Sepulveda Dam (mile 43), with flow rates rapidly rising and falling over a six-week period from less than 100 cfs to over 10,000 cfs within a 24-hour period (14 December 2021).[4]



LA River stormwater quantities typically average 107,000 acre-feet per year (AFY), with an average of 11 storm events during a stormwater year (i.e., generally November through April), and average runoff of 9,900 AF per storm event (WRD, 1997). By comparison, on average 128,000 AFY has been recharged at the MFSG and generally consists of approximately 57,000 AFY of local runoff captured by the Los Angeles County Department of Public Works (LACDPW), 21,000 AFY of imported water (no longer purchased as it has been replaced with advanced treated water produced by the Albert Robles Center), and 50,000 AFY of recycled water purchased from the Los Angeles County Sanitation District (LACSD) (WRD, 2016).

Therefore, LA River wet weather flows represent a significant volume of potential water for MAR, provided that the often high-intensity, sporadic flows can be efficiently and effectively captured, recharged, and recovered. This analysis focuses on the technical challenges associated with recharging wet weather flows, which include: the flashy and sporadic nature of the wet weather flows, stormwater quality and potential treatment, and where and how the water can be recharged in a cost-effective manner to directly augment drinking water aquifer storage.

POTENTIAL RECHARGE METHODS AND LOCATIONS ARE LIMITED

A wide variety of MAR methods have been successfully used to replenish groundwater across southern California. The recharge method or scheme used is selected based on a rigorous feasibility analysis supplemented with field investigations followed by engineering analysis, design and construction. The MAR scheme selected is tailored to site-specific conditions and is a dependent on several factors or constraints including source water characteristics (i.e., flow rate, consistency of flow, and water quality), subsurface hydrogeologic conditions, interested stakeholders including parties managing or remediating nearby groundwater contamination plumes, land use in the planned recharge area, permitting, and engineering feasibility. These constraints are briefly discussed below.

[4] USGS, 2022, Waterdata.usgs.gov, National Water Information System

Constraints in MAR Site Selection, Design, and Implementation	
Feasibility Factor	**Discussion**
Source Water Availability	LA river wet weather flows are typically sporadic, short term, and high volume. The MAR scheme would need to quickly capture and store large volumes of LA River stormwater for recharge.
Source Water Quality	Treatment of the source water may be required; the complexity of treatment will be based on the pollutant and the MAR scheme used. Turbidity and suspended sediment may be removed by simple settling basins or soil aquifer treatment (SAT) while other contaminants may require more aggressive treatment methods. Although wet weather flow water quality may be better than dry weather flows, the presence of emerging contaminants such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) (collectively PFAS) could require significant capital and ongoing operation/maintenance costs for treatment, given the possibility of very low drinking water regulations being considered (i.e. California has already adopted nanogram per liter (ng/L) NLs and RLs). The lack of LA River water quality data for these types of constituents is a significant data gap that would require multiple years of sampling both during wet weather and dry weather conditions.
Geology	Fine-grained soil layers that restrict percolation into the target aquifers will impact recharge methods. The geology of the Los Angeles Forebay is better suited for MAR due to the presumed presence of a relatively thick coarse-grained vadose zone and unconfined aquifers. Fine-grained layers (i.e., silts and clays) may be present in discontinuous lenses within the vadose zone that may result in localized lateral flows and could possibly restrict downward percolation in some areas of the Los Angeles Forebay. Site-specific investigations would be required at any potential MAR location. The lateral delineation of these soil types may be problematic due to existing access constraints posed by the heavily developed land and utility conflicts along the surface streets located adjacent to the LA River.
Depth to Groundwater	Greater depth to groundwater can provide greater subsurface water storage, improved recharge rates, and reduced potential for undesirable increases in the water table elevation. Depth to groundwater in the Los Angeles Forebay is approximately 100 to 200 feet below ground surface, creating a thick soil section for storage and will help mitigate mounding effects.
Groundwater Contamination	Any recharge scheme should consider minimizing potential impacts to existing groundwater contamination per California's antidegradation policy under Resolution 68-16. Groundwater contamination plumes (known and unknown) are present in the Los Angeles Forebay.
Land use	Land use in the vicinity of the LA River is heavily urbanized with industrial development in the Forebay and residential / commercial land use in the Pressure Area (WRD, 2016). Available real estate for use in a MAR scheme will likely be limited, expensive to procure, and may have land use restrictions that could preclude surface infiltration or the installation of wells for water supply due to past environmental releases (i.e., Land Use Covenant).
Permitting	Depending on the recharge scheme, permitting may require water quality compliance with Title 22 and WDRs. A permit to access the LA River will also be required from the Army Corps and depending on the particular river reach, the LACDPW.
Engineering Feasibility/Costs	The MAR scheme needs to be constructable and have a satisfactory return on investment based on measurable metrics.
Other Stakeholders	LA River MAR schemes would require working closely with a number of private, governmental and non-governmental interests including the Army Corps, the LA County Flood Control District (now LACDPW), and the LA Department of Water and Power (LADWP).

The MAR evaluation for LA River wet weather schemes was divided into two general categories; in-channel and off-channel. Each are discussed below.

In-Channel Recharge

In-channel MAR schemes require modifying the mainstem LA River channel to induce recharge into the subsurface; either by installing recharge structures (i.e., dry wells or trenches) or by removing the concrete lining of the channel to create a soft bottom. This recharge scheme is only practical in the Los Angeles Forebay area where percolation can reach the underlying water supply aquifers and generally includes just under three miles of river channel located within WRD's service area.

In 2012, WRD proposed a demonstration project to the Army Corps within a lined portion of the LA River channel to install a series of gravel-filled infiltration trenches or large diameter dry wells allowing for subsurface recharge during storm events (WRD, 2012). The infiltration structures would be placed in the Los Angeles Forebay portion of the LA River to allow the water to reach the unconfined aquifer. A novel and innovative in-channel engineering solution would be needed to minimize sediments from entering and rapidly clogging the recharge structure. Infiltration of dry weather flows would be avoided by placing the infiltration trenches or dry wells on the sloped apron adjacent to but above the dry weather channel or even higher up on the channel side slope. A monitoring program would need to be implemented to assess the percolation rate and quality of the infiltration water and underlying groundwater. The 2012 proposal was highly conceptual and provided little detail on the design, operation, or implementation of the in-channel passive infiltration system. The demonstration project was not pursued as there were concerns raised at a subsequent meeting including (but not limited to) potential damage to the concrete-lined channel, ability to safely gain access for routine testing/maintenance, a lengthy and complex permitting process, and the overall viability of full-scale implementation especially outside the Los Angeles Forebay. From an engineering perspective, maintaining a sediment and particulate-free recharge water would be technically very challenging and require extensive pilot testing under a variety of flow conditions.

In-channel modifications can also involve removing the concrete lining on the bottom of the river channel and reducing the speed of the flows to allow time for percolation into the subsurface. Slowing the speed of the flows can be achieved in a number of ways including temporary low head dams, dikes, side channels, and detention structures ("river speed bumps"). This recharge scheme was evaluated in a 2015 peer-reviewed study prepared by CH2M, Bureau of Reclamation, Los Angeles County Flood Control District, and LACDPW (CH2M, 2015). The study found that modifications to the LA River channel could yield roughly 8,000 AFY to 10,000 AFY in additional recharged stormwater at an estimated "build-out" cost of between $42,700/AF and $53,100/AF, respectively (CH2M, 2015).

Inflatable rubber dams have also been used in some applications to reduce stream velocities and promote groundwater recharge or to divert water to off-channel areas similar to the existing facilities on the San Gabriel River within the Montebello Forebay (see photo to the right). The inconsistency of the flows will likely present a significant challenge in developing a cost-effective design as a large storage structure or basin will be required. Furthermore, the logistics of operating a rubber dam in a critical flood control structure are complex. If the dam were to malfunction and not lower during a severe storm, the river reach could lose channel capacity and create a flooding hazard. Issues related to public safety (recreation, accidents, emergency response) as well as trash accumulation and maintenance would need to be addressed.

Another potential opportunity would be the conversion of the concrete lined channel to a permeable soft bottom section within the Los Angeles Forebay. However, removal of the concrete panels that line the LA River bottom may pose hydraulic design challenges as river bottom scour is currently mitigated by the panelized river concrete bottom and side slopes. This potential issue was discussed in the draft LA River Master Plan (2021). It is highly impractical to remove the concrete panels as the existing channel would require a wider river channel to accommodate the flows displacing existing transportation, businesses and residences (Geosyntec, 2021). The draft Master Plan goes on to state that "Once the (wet weather) flows reach the mainstem of the LA River, the opportunities for infiltration are mostly lost unless the water can be safely diverted from the channel for potential recharge or reuse." Alternatively, deepening the river may also be an option if the bottom concrete panels are removed. Both widening and/or deepening the existing concrete lined channel would require significant time and resources to plan, design, permit, and construct off-channel recharge schemes are discussed below.

Off-Channel Recharge

New off-channel recharge schemes generally consist of using either spreading basins, dry or injection wells, or some combination of the two. Both methods were evaluated in the 2015 study (CH2M, 2015).

Spreading basins are a well-known and effective recharge scheme where the subsurface geology is suitable (i.e., coarse-grained), the underlying aquifer is unconfined, and land is available to build large basins. This method relies on the vadose zone to filter and treat the stormwater as it percolates downward into the underlying unconfined aquifer via SAT. In CH2M's 2015 study, this scheme was projected to capture and recharge between 26,100 AFY and 59,900 AFY of stormwater at a cost of $900/AF to $2,100/AF provided that suitable real estate (estimated at 682 acres) was available in close proximity to the LA River channel.[5] This was the lowest cost/acre-foot option in the 2015 study. It is likely the total cost for this scheme has increased significantly since 2015 based on the dramatic increased cost of real estate in southern Los Angeles County (likely at minimum of 20% to 30%).

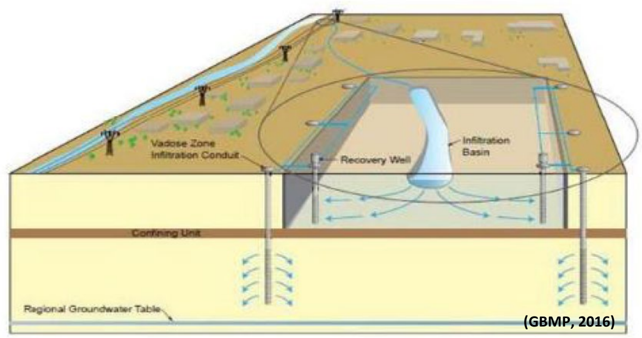
Groundwater injection into the deeper drinking water aquifers could also be used to augment aquifer storage in areas where available land is limited, or the aquifer is confined. This would require that stormwater be diverted, temporarily stored, and treated before injection, an important constraint. Title 22 and WDR permitting would be required to accommodate direct injection which includes the installation of a groundwater monitoring well network.

Another potential indirect recharge scheme included diverting stormwater flows to small shallow recharge ponds for SAT (CH2M, 2015). The recharged water would form a local perched aquifer where it would later be extracted and recharged into the underlying drinking water aquifer below the perched zone. Approximately 3,800 AFY to 6,900 AFY of recharge was projected using this scheme at an estimated range of present value costs of $1,400/AF to $2,400/AF in 2015. This scheme required 34 acres of real

[5] Cost estimates in the 2015 study were annualized over a 50-year period.

estate, a much smaller footprint than the spreading grounds option, but would also recharge 80-90% less water.

A slightly modified version of this option was carried forward in the Groundwater Basin Master Plan (GBMP) and was referred to as the Aquifer Recharge Recovery Facility or ARRF (CH2M and RMC, 2016). For this option, a larger shallow spreading basin would be located along an easement of the 710 Freeway. Also, rather than using injection wells, the groundwater recovered from the perched aquifer would infiltrate into the lower vadose zone below the perched aquifer using dry wells. The facility would take advantage of the unconfined aquifer conditions located within the Los Angeles Forebay.[6] Recharge to the vadose zone in the pressure area would not be readily available for extraction as it would be placed on top of the regional aquitard that confines the lower drinking water aquifers.



(GBMP, 2016)

Based on a rough conceptual modeling analysis, the GBMP estimated that about 5,000 AFY of stormwater could be recharged using the ARRF. The present value unit cost of this scheme was estimated at $820/AF in 2016. This scheme carries significant technical challenges and attendant uncertainty that would require site-specific analysis including field work, pilot testing, and development of a robust groundwater model. For example, it is likely very difficult to recover perched groundwater until the newly formed perched aquifer reaches a substantial thickness. Development of this new perched aquifer may require a significant amount of time as the recharged groundwater will expand laterally and decrease in thickness with time unless it reaches a flow boundary. Perched zone pumping rates are often very low. In addition, perched water may rise close enough to the ground surface to create a potential liquefaction hazard for the existing nearby high-power overhead utility lines, which would require an extensive geotechnical investigation along the easement of the 710 Freeway.

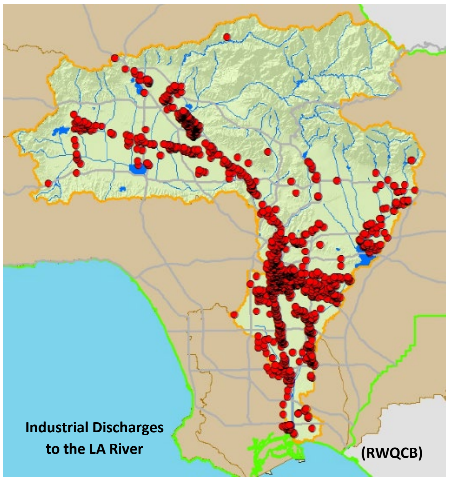
If deeper injection wells are used to recharge the water into the underlying drinking water aquifers rather than dry wells, fewer wells would likely be needed. However, the deeper injection wells would be more expensive (roughly a factor of 10) and would require significant operation and maintenance effort and costs. Importantly, direct injection of stormwater into the drinking water aquifer would require advanced treatment and compliance with Title 22 recycled water quality regulations and a WDR, representing significant costs.

WET WEATHER FLOWS WOULD REQUIRE TREATMENT PRIOR TO RECHARGE

After the initial flush of runoff, LA River surface water will typically have a relatively low concentration of pollutants but a high concentration of suspended solids. Suspended solids must be removed to promote water flow into subsurface soils. For spreading basins, this fine-grained layer of material is often removed through a desilting basin prior to entering the spreading grounds. This would require additional land and if not implemented there would be a significant amount of maintenance required to remove accumulated fine-grained sediment (i.e., regularly scraped from the basin bottom). For injection wells, the particulate

[6] The mapped location in the report appears to be overlying the pressure area south of the Forebay.

matter would need to be removed to prevent clogging the pore spaces in the aquifer. The backflushing process is only suitable for addressing a limited amount of sediment loading in an injection well. For dry wells, the fine-grained material (silt, sediment) must be removed prior to pumping to the dry well as there is no provision for backflushing a dry well to remove sediment.



Pollutant concentrations in LA River dry weather flows have been widely studied. Dry weather pollutants include ammonia, a number of metals, coliform, oil and grease, chlorpyrifos, certain pesticides, and volatile organic compounds (Ackerman et al., 2003; Mika et al., 2017). Sources of these pollutants include WRPs, permitted non-stormwater discharges, industrial stormwater discharges, and municipal stormwater discharges (MS4 discharges). WRPs discharging to the LA River include the Donald C. Tillman, Burbank and Los Angeles-Glendale facilities. Industrial stormwater discharges (1,319 in total) and municipal stormwater discharges (35 MS4s in total) are an area of significant investigation, regulatory oversight, and mitigation (LARWQCB, 2021). Data regarding the impact of industrial storm water discharges on wet weather flows in the LA River was not available for review. As part of our analysis, we contacted the LARWQCB, and they were not aware of wet weather water quality data from the mainstem of the LA River (GSI, personal communication, January 10, 2022).

Recently, PFOA and PFOS (collectively referred to as PFAS) have been found in dry weather flows in various rivers located in southern California. PFAS analytes have very low acceptable concentrations in drinking water and are difficult to remove, presenting considerable potential additional treatment costs to MAR systems. For example, the current drinking water NL and RL for PFOA are 5.1 ng/L and 10 ng/L, respectively.[7] In some watersheds such as that of the Santa Ana River, these detections have been shown to be related to WRPs (OCWD study) and have resulted in a curtailment of MAR operations. The PFOA and PFOS detections in the effluents from the three WRPs discharging to the LA river are summarized below.

Site		PFOA (NL = 5.1 ng/L)			PFOS (NL = 6.5ng/L)		
		Percentage ND	Average Detection	Max	Percentage ND	Average Detection	Max
Donald C. Tillman WWRP	Influent	75%	5.8	5.8	75%	11.9	11.9
	Effluent	0.00%	22.08	34.2	100%	--	--
Burbank WRP	Influent	40.0%	1.87	2.3	--	--	--
	Effluent	0.00%	6.5	8.2	--	--	--
Los Angeles-Glendale WWRP	Influent	100%	--	--	75%	5.22	5.22
	Effluent	0.00%	5.94	6.94	100%	--	--

If the concentration of pollutants in dry weather flows at 100 cfs is combined with relatively fresh wet weather flows of 10,000 cfs, the dilution factor can be 100 or more provided no additional pollutant load is introduced via industrial discharges. However, actual concentration data from wet weather flows would be required to verify the concentrations. In addition, it would be technically challenging to manage the wet weather flows to optimize the dilution of pollutants and avoid PFAS concentrations above NLs.

[7] NLs and RLs are health based advisory levels established by the Division of Drinking Water (DDW) for chemicals that lack a maximum contaminant level (MCL).

If wet weather LA River flows are used to inject directly into the underlying drinking water aquifers using injection wells, compliance with Title 22 requirements and a WDR would be likely. This would require detailed hydrogeological and engineering analysis, modeling, water treatment, and regulatory agency interaction.

FUTURE AVAILABILITY OF WATER IN THE LOS ANGELES RIVER

The future availability of dry weather flows is not without risk as it is possible that all three WRPs will recycle 100% of their effluents and incidental urban runoff and groundwater upwelling is managed and significantly curtailed. Under certain scenarios presented in the LA River Master Plan, "the dry weather flow could be significantly reduced, resulting in a possible future dry weather flow of just a trickle at the mouth of the [LA] river" (Geosyntec, 2021). Similarly, Mayor Garcetti's Executive Directive No. 5, issued October 14, 2014, contains provisions to improve water security by constructing an Advanced Water Treatment Facility at the Tillman WRP, reducing dry weather flows in the LA River, and capturing and storing stormwater, reducing wet weather flows. Finally, there are multiple interests in the using available flows in the LA River ranging from the Taylor Yard to habitat improvement near the confluence of the LA River with Rio Hondo (Geosyntec, 2021). The State Water Resources Control Board and LARWQCB are currently studying the balance of reuse and instream needs.

SUMMARY OF FINDINGS

Based on our review and analysis of existing information, we present the following key findings:

- LA River wet weather flows are inconsistent, high volume, and short duration. Flow estimates indicate that roughly 107,000 AF of stormwater is discharged to the Pacific Ocean during an average wet weather season with average runoff volumes of 9,900 AF per storm. On average, 11 large storm events occur within the LA River watershed on an annual basis that could provide sufficient flows for MAR. However, the future supply of wet weather flow may change based on the options currently being considered in the LA River Master Plan.
- Potential recharge is best suited in the Los Angeles Forebay of the Central Basin using gravity methods similar to recharge basins in the MFSG. The Los Angeles Forebay provides direct hydrogeologic communication to the deeper water supply aquifers and the thick vadose zone provides treatment for most of the pollutants typically found in stormwater, including bacteria and metals. Like the MFSG, the water would need to be stored prior to or during recharge. Direct recharge of wet weather stormwater flows into drinking water aquifers is uncommon and would likely require compliance with Title 22 water reuse requirements and WDRs.
- Because of the intensely developed land use in the Los Angeles Forebay, the potential capital costs to capture, treat, and recharge a significant volume of wet weather flows would include engineering, property acquisition, conveyance, and other infrastructure. By comparison, ongoing operations and maintenance costs would likely be relatively inexpensive.
- The water quality of wet weather flows is generally characterized by high suspended solids and low concentrations of dissolved constituents. However, given their current low NLs and RLs, the likely presence of PFAS could make pre-treatment for this emerging class of compounds technically challenging. Detailed wet weather flow water quality data represents a significant data gap to be addressed as part of a feasibility study to use LA River water for recharge.

- The presence of known (and unknown) environmentally impacted sites within a heavily industrial portion of the study area may present some challenges and may require future consideration as it relates to California's anti-degradation policy under Resolution 68-16.
- Technical studies, subsurface investigations, extensive engineering analysis, and pilot testing would be required to further assess the feasibility of recharging LA River wet weather flows. These studies would include chemical characterization of the wet weather flows, modeling, permitting, engineering, and outreach to other LA River stakeholders.

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