Title

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Executive Summary

Background and Study Area

Implementing integrated water management systems (IWM) that incorporate all components of the urban water cycle, including imported water, local groundwater, captured stormwater, greywater, and treated wastewater is crucial to creating a sustainable water supply for the city of Los Angeles (City). The City has researched, written, and initiated implementation of recommendations from many reports critical to creating an IWM plan for the City as well as to defining the current capacity of the system. While work on this issue has been ongoing for many years, the extreme drought currently impacting water supplies throughout California has created a new urgency to increase the City's ability to provide a secure water supply through local sources. In April 2015, Governor Brown directed the first-ever statewide mandatory cut of 25% in urban water use due to the continuing drought conditions.

In addition to statewide efforts, many policies and plans have been created on a local level within the City that address urban water management, integrated resources planning, stormwater capture, and groundwater management. The Los Angeles Mayor's Office recently set strong goals to increase the sustainability of the City's water supply over the next several years. The goals included completing a comprehensive sustainability plan containing objectives for water supply and demand in the City, which was released in April 2015 (Sustainable City pLAn). In an emergency drought directive released in October 2014, the Mayor identified additional accelerated water goals including reducing per capita potable water use by 20% by 2017 (from 2014 baseline of 130 gallons per capita per day (GPCD) to 104 GPCD), reducing the City's reliance on MWD water by 50% by 2025, and converting 85% of public golf course acreage to recycled water by 2017.

Through building upon regional research and reports that have been generated on potential components of the local water supply portfolio (e.g., groundwater, recycled water, and stormwater), as well as gathering and analyzing current data on flows of water and wastewater throughout the City systems and environment, this project further identifies and refines opportunities to implement integrated water management throughout the City. As water quality regulation in the Los Angeles area currently drives much of the current water management practices, we examined greater water self-reliance through this lens. Therefore, the City has been divided by watershed to assess Total Maximum Daily Load (TMDL) compliance alongside integrated water management opportunities and challenges that exist and must be addressed in order to meet water quality compliance requirements and maximize local water supply. This first report focuses on the Ballona Creek Watershed and the Hyperion Service Area; following reports will focus on the Dominguez Channel and Los Angeles River watersheds.

Study Approach

Stormwater modeling was carried out using the EPA's System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) model version 1.2 in ArcGIS 9.3. Model simulations focused on impairing metal pollutants copper, lead, and zinc because they are conservative pollutants for which sufficient water quality data was available. The model was calibrated and validated for the Ballona Creek watershed using observed flow data and historical precipitation data from various sources in the watershed (the LA County Department of Public Works' Stormwater Quality Monitoring program and the Southern California Coastal Water Research Project (SCCWRP)) as well as BMP performance data from the International BMP Database.

Multiple approaches to achieving compliance with metal WQS were examined in model scenarios that explored stormwater treatment through different BMP types over varied drainage areas. Infiltration basins and dry ponds were chosen to represent large-scale regional stormwater capture BMPs. Vegetative swales, porous pavement, and bioretention ponds were used to represent smaller, parcel-scale distributed BMPs and LID practices. In the initial scenarios, the number of BMPs was optimized for lowest cost and greatest pollutant load reduction at the outlet. These optimization scenarios tested treatment of runoff routed from 33%, 67% and 90% of the watershed's area through all BMP types. Capturing and treating runoff from 90% of the watershed area achieved the best pollutant removal and metals WQS compliance. These results informed the next set of scenarios in which the number of treatment BMPs were determined to capture the runoff volume during the 85th percentile, 24-hour storm (approximated with the ¾" rainfall event) over the watershed. Different BMP types were highlighted in multiple scenarios to determine the relative impact of utilizing regional treat and release BMPs, regional infiltration BMPs, or distributed LID BMPs.

From the continuous model outputs of hourly flow and metal pollutant load, TMDL compliance was calculated for metals. TMDL compliance is measured separately for wet and dry weather days, separated by the 64 cfs maximum daily flow threshold. Wet weather TMDLs are calculated with an acute exposure concentration limit for each metal multiplied by the total daily storm volume. Dry weather TMDLs are based on the chronic exposure concentration for each metal multiplied by the median daily flow for Ballona Creek (17 cfs) and are constant for all days considered dry weather.

<u>SUSTAIN Stormwater Modeling Results</u>

Results of simulated BMP implementation scenarios reveal that as long as a significant drainage area is routed to BMPs, dry weather exceedances can be nearly eliminated for copper, zinc, and lead, assuming pollutant contributions to dry weather runoff do not increase in future conditions. Wet weather exceedances were significantly reduced to around 11 or less per year for copper and zinc, with zero lead exceedances, even for multi-day storms with conservative pollutant loadings applied in the model. Benefits of peak flow reduction and potential groundwater recharge were also assessed for each BMP implementation scenario, and results varied based on the characteristics of the BMPs in each.

Out of the five generalized BMP types represented in the model, treat and release BMP types achieve the best wet weather compliance because they return treated, cleaner water to the channel to dilute remaining pollutants. They have lower relative construction cost due to economies of scale. However, these BMP types cannot reduce peak flows as effectively as infiltration-based BMPs, and do not remove as much pollutant load or provide as much recharge potential, only 40% of the total runoff (as little as 20,000 acre-feet per year (AFY) with an annual average of 15 inches of precipitation).

Infiltration based BMPs demonstrate the greatest potential groundwater recharge through infiltration, up to 77% of the total runoff (up to 60,000 AFY with 15 inches of annual precipitation), and achieve considerable peak flow reduction in large storms (up to 47% peak reduction for storms with less than 2" of rain). Though infiltration-based BMPs significantly reduce TMDL exceedances compared to no BMPs, they are not as good for reducing exceedances as treat and release BMPs because infiltration BMPs remove water from the channel, lowering the TMDL target at the point of compliance. However, infiltration BMPs remove more pollutant load than treat and release BMPs, so they improve the quality of the receiving waters as well as offer other potential IWM benefits such as groundwater recharge.

Distributed BMPs have high infiltration capabilities resulting in the second greatest infiltration capacity (up to 56% of total runoff, or 43,000 AFY with average annual precipitation of 15 inches). Infiltration along with vegetation in distributed BMPs increases evapotranspiration and flow attenuation, significantly reducing flood peaks as well. However, wet weather exceedances are greater when implementing distributed BMP systems than regional BMPs due to their shallow depth and smaller treatment capacity per BMP. Distributed systems also cost more because they lack the economy of scale of regional BMP projects, and many more BMPs are needed to achieve similar benefits. In general, all scenarios are more compliant at smaller storm sizes because there is more capacity to treat and/or infiltrate stormwater volumes. No scenario completely eliminates wet weather exceedances, especially for extreme storm events.

The land area needed for regional BMPs may not be available where it would be most effective – i.e. further downstream in the watershed where runoff from larger drainage areas can be captured and treated. Distributed BMPs achieve similar benefits but often require permission and cooperation from private land-owners to construct and maintain these technologies. Infiltration BMPs provide the most benefit, though because they narrow the window for TMDL compliance, they may be less appealing to implement. Creative alternatives to regional BMPs or distributed BMPs on private property are needed in an already highly urbanized watershed. One alternative is in-channel BMPs that would treat and infiltrate stormwater during all flow regimes, similar to distributed infiltration BMPs. These would be implemented in tributary confluences prior to flowing into the main channel. A variation of this is to place distributed BMPs next to the channel to capture diverted stormwater flow and return it back to the channel after treatment.

The range of stormwater volume estimated for potential groundwater recharge in the various BMP implementation scenarios is 20,000 to 60,000 AFY based on average annual precipitation of 15 inches. At the high end of this range are BMPs that infiltrate a large majority of stormwater runoff, which also achieve the greatest benefits in pollutant reduction and peak flow reduction. These types of BMPs also will reduce other pollutants such as bacteria and toxics. However, further research needs to be done on appropriate placement of these BMPs to ensure that runoff is not infiltrated in areas that will cause the mobilization of existing subsurface contaminant plumes. Also, it is important to consider that the volume of recharged stormwater water available to augment potable supply is less than the theoretical maximum infiltrated by BMPs. In order to get the complete picture of actual groundwater recharge due to BMP infiltration, the system should be analyzed using a more complex groundwater model, which is outside the scope of this study.

Groundwater Supply

Groundwater basins in Los Angeles provide significant opportunities to store advanced treated recycled water as well as captured stormwater that can be used later in times of need. However, contamination by legacy pollutants and complex political, legal, and regulatory environments present challenges that need to be addressed to take full advantage of this local water supply opportunity. This report examines these issues in detail, for the first time, pointing to delicate policy needs and tradeoffs. There are four groundwater basins that partially underlie the Ballona watershed: West Coast Basin, Central Basin, Santa Monica Basin, and Hollywood Basin. The City has water rights in both West Coast Basin and Central Basin, which are adjudicated basins. Santa Monica Basin and Hollywood Basin are both unadjudicated basins, with the city of Santa Monica and the city of Beverly Hills being the primary pumpers, respectively, in these basins.

There is space in groundwater basins underlying Ballona Creek Watershed to capture and store additional stormwater or advanced treated recycled water. In FY 2012-2013, approximately 20,000 acre-feet and 40,000 acre-feet, respectively, of total groundwater rights went unextracted in West Coast Basin and Central Basin. The City specifically did not use approximately 1,800 acre-feet of water rights in West Coast Basin (1,503 acre-feet adjudicated rights and 300 acre-feet carryover rights) and approximately 17,000 acre-feet in Central Basin (of approximately 23,000 acre-feet allowed City pumping allocation including 15,000 acre-feet of adjudicated rights and 8,000 acre-feet of carryover rights). Further, recent amendments to these adjudications identified 330,000 acre-feet of additional space in Central Basin and 120,000 acre-feet of additional space in West Coast Basin that is available to be used for storage and basin management purposes.

An additional opportunity to increase demand for groundwater recharge in West Coast Basin lies in creating a regional desalting project that incorporates many rights holders in the basin to address the legacy saltwater plume from seawater intrusion that currently occupies approximately 600,000 acre-feet of potential storage space. Creating a regional desalting project would provide dual benefits: remediating contaminated groundwater to increase the storage capacity for freshwater, and creating higher demand in West Coast Basin for groundwater recharge using either recycled water [from Hyperion Treatment Plant (HTP) or the West Basin Municipal Water District Ed C Little Water Recycling Facility (WRF)] or captured stormwater.

Challenges to utilizing this available space include working within the adjudications, a lack of infrastructure, legacy contamination, and potential seawater intrusion. However, the adjudications in West Coast and Central Basins cap the volume of additional water that rightsholders can store in the basins above their adjudicated rights and they also limit the volume of water that can be extracted annually above the adjudicated rights to a maximum of either 120% or 140% (West Coast Basin and Central Basin, respectively) although requests for excess storage and extraction can be presented to the Storage Board for approval. Additional infiltration of any water into these basins would need to be planned and monitored to address or at a minimum not spread legacy contamination or exacerbate seawater intrusion issues. In West Coast Basin, the City would need to install groundwater pumping wells in order to access any of the groundwater as they currently have no active wells there.

Recycled Water

Addressing these restrictions on the use of the groundwater basins will be critical in order to increase the reuse of wastewater generated in the Ballona Creek Watershed by the Hyperion Treatment Plant (HTP), located in Playa Del Rey. Currently, HTP does not have advanced water treatment facilities on-site. Secondary effluent from HTP is sent to the Ed C Little WRF for additional treatment and reuse to produce waters ranging in quality from disinfected tertiary effluent to advanced treated recycled water for a variety of uses, including a seawater intrusion barrier. Flows going through HTP in FY 2013-2014 averaged 279 MGD; 32 MGD of secondary treated effluent went to the Ed C Little WRF in 2013. As HTP and Ed C Little WRF are downstream from many customers, increasing the capacity for advanced water treatment through a process such as microfiltration - reverse osmosis (MFRO) at these facilities to generate flows of high-quality recycled water to recharge the groundwater basins provides a promising opportunity to increase the use of treated wastewater from HTP.

Brine disposal is among the most pressing difficulties in need of resolution in order to expand the advanced treatment of recycled water since the concentration of the constituents leaving through the HTP NPDES permitted discharge outfall increases as the volume of brine generated by a process such as MFRO increases. Effluent concentrations must remain in compliance with the NPDES effluent limits as well as with the limits to protect marine aquatic life in the California Ocean Plan. We used the FY 2013-2014 flow level of 279 MGD at HTP and assumed MFRO treatment to calculate the effect of increasing brine discharges on effluent quality at the HTP outfall. Under these conditions, maximum recycled water production at HTP is 198 MGD. We examined effects on the concentrations of effluent for several parameters (Ammonia as N, TSS, Turbidity, Cu, Zn, Pb, and Ni) to determine the effects of increasing concentrations going through the outfall from increasing volumes of brine discharge on water quality compliance. Concentrations of the majority of constituents remained in compliance at full capacity with the exception of Ammonia as N, which exceeded the California Ocean Plan standard at approximately 56 MGD of produced MFRO water, and TSS, which exceeded NPDES permit requirements at approximately 100 MGD of produced MFRO water. Based on this analysis, it is clear that additional treatment to address TSS and an additional nitrogen removal step (for example, nitrification-denitrification or a Membrane Bioreactor) is needed to ensure maximum HTP water recycling potential. The impacts of increasing volumes of brine from upstream plants in the HTP Service Area on HTP effluent quality would also need to be examined before implementation of these processes at upstream plants.

Non-potable reuse (NPR) is another opportunity to utilize our treated wastewater streams to satisfy and replace demands for potable water throughout the system. The 2012 LADWP & LASAN's recycled water master planning (RWMP) documents demonstrated that expanding and maintaining the NPR system would be cost-effective relative to the projected MWD costs of Tier 1 imported water. Multiple opportunities exist to expand the current and future demands for recycled water beyond those identified in the RWMP, such as exploring partnership opportunities with other agencies to provide recycled water to customers that are outside the service area. Increasing demands at current customers would both alleviate current water quality issues caused in part by low flows through the pipes and increase demands for NPR water overall. Finally, converting customers such as golf courses, residential developments, or country clubs which currently use groundwater for irrigation would both increase the demand for NPR water and preserve groundwater for potable use.

In addition to flows of brine and recycled water for non-potable reuses, it is critical to consider all flows within and among systems to assess all foreseeable challenges and opportunities. For example, HTP currently accepts dry weather urban runoff from 23 low flow diversion facilities (LFDs) in the Santa Monica Bay, including 8 City-owned LFDs. In addition to improving water quality, increasing diversion of the dry weather runoff as well as some portion of wet weather runoff to HTP and other WRPs in the City would increase the volume of water going through these facilities that could be treated to reusable standards. These runoff flows potentially could also dilute the increasing effluent concentrations caused by increasing discharge of brine from advanced treated water processes. However, it is likely that outdoor conservation will reduce available dry weather runoff while indoor conservation will further decrease flows going through the Water Reclamation Plants (WRPs). Increased implementation of on-site greywater technologies would reduce flow volumes going to WRPs as well as increase concentrations in wastewater effluent by removing one of the cleanest wastewater streams from the system, as well as most likely locking the use of that water into the potential use at that property. Careful consideration of the impacts of each of these flows, and the impacts of changes to these flows is necessary to determine the most appropriate method to ensure the streams of water currently leaving our system through treatment plants or runoff are put to the highest possible use in maximizing our local water supply potential.

Local Water Supply Potential

Conservation is another critical component of creating a sustainable water supply for California in general, and Los Angeles in particular, as stressors such as climate change and population growth continue to increase water demand. Executive Directive 5 from the City of Los Angeles Mayor sets an aggressive goal of 20% water conservation (to 104 GPCD) by January 2017, and the City and MWD have generously funded turf removal programs to reduce outdoor landscaping demand. Many additional opportunities to support conservation can be attained through instituting changes in the Building Code. Examples include setting an outdoor water budget, requiring new buildings to be greywater ready (separate piping for greywater and blackwater), requiring that 100% of water for uses such as industrial, water closets, and urinals comes from City-recycled water when it is available and non-potable water supply when it is not, installing water sub-meters to provide water use data on individual tenants within residential and commercial buildings, and dual metering in single family dwellings for indoor and outdoor water use. Greywater is a potential distributed component of a local water supply portfolio that may provide additional potable water use replacement. However, further research must be done into the long-term effects of greywater use on landscapes and the actual impact of installing onsite greywater systems at a parcel level on water use to determine the level to which this technology should be emphasized in a program to increase the City's local water supply by decreasing customer demand. Moreover, careful monitoring and analysis should be performed for each of these options and their potential unintended consequences.

If the treatment capacity can be built and groundwater basin management can be shifted to allow the basins to be used more as a local water supply reservoir into which parties can routinely extract the water they recharge, the available supply actually exceeds the demand in the Ballona Creek Watershed. Approximately 220,000 AFY of highly treated water could be generated through treating the current volume of HTP effluent with MFRO. Additional potential recharge capacity of 20,000 to 60,000 AFY of stormwater was estimated in the various modeling scenarios as discussed in the runoff section. This makes for a total local water supply in the Ballona Creek Watershed of roughly 240,000 to 280,000 AFY as compared to a 2015 demand of 196,000 AFY (1.5 million people at 117 GPCD) or a 2017 demand of approximately 175,000 AFY (1.5 million people at 104 GPCD, reflecting the Mayor's 20% conservation goal). However, it is important to note that the volume of stormwater that can be captured does not reflect the amount of actual local groundwater supply generated, because all water infiltrated by BMPs cannot make it to the groundwater supply aquifer due to impermeable layers in the subsurface. The volume of recharged stormwater water available to augment potable supply is less than the theoretical maximum infiltrated by BMPs. Further, potential recharge volume would be significantly reduced if fewer BMPs were implemented or less annual precipitation fell in the region.

Therefore, if the City continues to implement and accelerate the current goals, programs, and projects such as the EWMPs, SCMP, the Mayor's Executive Directive, and the Recycled Water Master Planning documents, there is a wide array of potential local water supply sources. However, the City also must work very closely with regional partners such as the watermasters and the Regional Water Quality Control Board to address the challenges and the restrictions that are currently in place to moving forward with maximizing the use of recycled wastewater and captured stormwater in the Ballona Creek Watershed and other watersheds to increase the sustainability of the City's water supplies.