

5.2 HYDROLOGY AND FLOOD

5.2.1 PURPOSE

The County of Los Angeles Department of Regional Planning Environmental Checklist Form, which has been prepared pursuant to the California Environmental Quality Act (CEQA), requires that hydrology and flooding issues be evaluated as part of the environmental documentation process. The impacts of the proposed development on the Project site are analyzed at a Project-level of detail; direct and indirect impacts are addressed for each threshold criterion for both the on-site and off-site Project features. Growth-inducing impacts and cumulative impacts related to hydrology and flooding are described in Sections 6.0 and 7.0, respectively. Water quality issues are analyzed in Section 5.4, Water Quality; water supply is analyzed in Section 5.18, Water Resources (Supply and Services); and recycled water use is analyzed in Section 5.19, Wastewater.

Summary

In 2014, the County of Los Angeles (County) prepared a Low Impact Development Standards Manual (LID Standards Manual) to implement the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit for storm water and non-storm water discharges issued to the County by the California Regional Water Quality Control Board, Los Angeles Region (CAS004001, Order No. R4- 2012-0175) (MS4 Permit). The LID Standards Manual also implements the County's Low Impact Development (LID) requirements (County Code, Section 12.84). The objectives and goals of the LID Standards Manual, the County MS4 permit, and the County LID standards per Chapter 12.84 of the County Code are to (1) lessen the adverse impacts of storm water runoff from development and urban runoff on natural drainage systems, receiving waters, and other water bodies; (2) minimize pollutant loadings from impervious surfaces by requiring development projects to incorporate properly designed, technically appropriate Best Management Practices (BMPs) and other LID strategies; and (3) minimize erosion and other hydrologic impacts on natural drainage systems by requiring development projects to incorporate properly designed, technically appropriate hydromodification control development principles and technologies (County Code, Section 12.84).

The proposed Project has been designed to meet or exceed County MS4 Permit, LID Standards Manual and LID requirements, and hydromodification and hydrology (flood control) requirements for new development. The Project will implement site-design, source-control, LID, hydromodification, flow-control and runoff water quality BMPs and treatment requirements. Most Project runoff will be subject to control and treatment in a regional system that consists of 28 detention and retention basins located throughout the Project site (see Exhibit 5.2-4). Other developed areas will provide runoff control and treatment by utilizing distributed, smaller or parcel-specific LID measures (see Exhibit 5.4-2 in Section 5.4, Water Quality). As discussed in Section 5.4, Water Quality, these regional and distributed measures will also meet County LID standards for new development and will provide sufficient treatment capacity to reduce potential surface and ground water quality impacts to less than significant levels.

The hydromodification BMPs for the Project would be consistent with County requirements for new development set forth in Section 8 – Hydromodification Impacts of the County LID Standards Manual, as incorporated in Mitigation Measure (MM) 2-1. Performance standards for post-development peak flow rates and volumes during major (50-year) storm events are also consistent with County requirements and are incorporated in MM 2-2. Both mitigation measures require that Project compliance with flood-control performance standards be confirmed in a Drainage System Engineering and Planning Report submitted to the County during the review and approval of each Project tract map. All Project development will be consistent with the County LID requirements. Project runoff will not exceed the planned storm drain capacity and will not require construction of additional drainage facilities not considered in this EIR and that could have significant environmental effects.

During construction, the Project will comply with and implement the requirements of the General Construction Permit issued by the State Water Resources Control Board (CAR000002, Order 2009-0009-DWQ as amended by Order 2010-0014-DWQ and Order 2012-0006-DWQ)(Construction General Permit). The Construction General Permit requires that potential risks to water quality be evaluated for construction activity, and the implementation of a Storm Water Pollution Prevention Plan (SWPPP), including specific BMPs that will avoid potentially significant construction period storm water impacts based on the Project risk assessment.

Portions of the Project along the northern and eastern site boundaries are located within a 100-year floodplain area mapped by the Federal Emergency Management Agency (FEMA)(see Exhibit 5.2-5). As discussed in Section 4.0, Project Description, and as required by MM 2-3, these areas will be subject to a Specific Plan Floodplain Safety Overlay (see Exhibit 4-6, Centennial Project – Safety Overlay Districts) that precludes habitable residential, commercial, school and institutional structures in the floodplain. All applications for Project tract maps that would locate any structures not precluded by the Floodplain Safety Overlay in the floodplain must include a Drainage System Engineering and Planning Report that provides a detailed description of the floodplain boundaries and a description of applicable flood protection measures. This report must demonstrate that, after construction, structure designs and floodplain flows will comply with all applicable FEMA and County of Los Angeles floodplain flood flow and development standards. If required, a conditional letter of map revision (CLOMR) from FEMA will be obtained prior to any construction within a mapped 100-year floodplain. There will be no housing development in on-site floodplains, and no significant impacts will occur from placing structures within a floodplain.

Potential mudflow impacts will be reduced to less than significant levels by capturing debris flows in on-site basins and engineered and natural stream channels and by minimizing disturbance in on-site locations with slopes in excess of 25 percent that could generate mudflows. Storm water basins will be managed to avoid potential mosquito-borne health vectors by implementing California Department of Public Health (CDPH) recommendations and fully discharging captured storm water within 96 hours. An integrated pest management program must be developed and confirmed during the County review and approval process for Project tract maps (see MM 4-2). The Project site is not subject to tsunamis, seiches or dam and levee failure inundation.

Section Format

As described in Section 5.0, Environmental Setting, Impacts, and Mitigation, and in accordance with State CEQA Guidelines Article 9 (Contents of Environmental Impact Reports), each topical environmental analysis includes a description of the existing setting; identification of thresholds of significance; analysis of potential Project effects and identification of significant impacts; identification of mitigation measures, if required, to reduce significant impacts; and level of significance after mitigation, if any. This information is presented in the following format (please refer to Section 2.0, Introduction, and Section 5.0 for descriptions of each of these topics):

- Introduction
 - Purpose
 - Summary
 - Section Format
 - References
- Relevant Plans, Policies, and Regulations
- Environmental Setting
- Project Design Features
- Threshold Criteria
- Environmental Impacts—A separate analysis is provided for each of the following categories of potential impacts:
 - On-Site Impacts
 - Off-Site Impacts
- Mitigation Measures
- Level of Significance After Mitigation
- References

References

All references cited for preparation of this analysis are listed in Section 5.2.9. The primary technical references for this section are listed below.

1. Psomas. 2017 (April). *Centennial Master Plan Hydrology*. Santa Clarita: Psomas (Appendix 5.2-A).
2. Geosyntec Consultants. 2016 (March). *Draft Centennial Project Hydromodification Technical Report*. Oakland, CA: Geosyntec (Appendix 5.2-B).

5.2.2 RELEVANT PLANS, POLICIES, AND REGULATIONS

Federal

Sections 401 and 404 of the Clean Water Act

Section 401 of the Clean Water Act (CWA, *United States Code* [USC], Title 33, Sections 1251 et seq.) requires that any person applying for a federal permit or license that may result in a discharge of pollutants into “waters of the U.S.” obtain a State water quality certification which concludes that the activity complies with all applicable water quality standards, limitations, and restrictions. Subject to certain limitations, no license or permit may be issued by a federal agency until a Section 401-required certification has been granted. Further, no license or permit may be issued if certification has been denied. The CWA Section 404 permits and authorizations, described in the next paragraph, are subject to Section 401 certification by the local Regional Water Quality Control Boards (RWQCB).

Section 404 of the CWA is a program that regulates the discharge of dredged and fill material into “waters of the U.S.”, including wetlands. Activities in “waters of the U.S.” that are regulated under this program include fills for development (including physical alterations to drainages to accommodate storm drainage, stabilization, and flood-control improvements); water resource projects (such as dams and levees); infrastructure development (such as highways and airports); and conversion of wetlands to uplands for farming and forestry. The U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE) have issued Section 404(b)(1) Guidelines (*Code of Federal Regulations* [CFR], Title 40, Section 230) that regulate dredge and fill activities, including water quality aspects of such activities. Subpart C of Sections 230.20–230.25 contains water quality regulations applicable to dredge and fill activities. Among other topics, these guidelines address discharges that alter substrate elevation or contours; suspended particulates and water clarity; nutrients and chemical content; current patterns and water circulation; water fluctuations (including those that alter erosion or sediment rates); and salinity gradients. As discussed in Section 5.7, Biological Resources, approximately 1.8 acres of drainages have been delineated as federally jurisdictional waters by the USACE (see Table 5.7-9, Jurisdictional Wetlands and Waters Summary).

National Pollutant Discharge Elimination System

The NPDES permit program is authorized by the federal CWA and regulates point sources that discharge pollutants into “waters of the U.S.”. Point sources are discrete conveyances such as pipes or man-made ditches. Examples of pollutants include, but are not limited to, rock, sand, dirt as well as agricultural, industrial, and municipal waste discharged into “waters of the U.S.”. Point sources that discharge into municipal sewer systems (e.g., residential wastewater conveyance pipes) do not require individual permits, but the sewer systems do require an NPDES permit.

In California, responsibility for implementing the NPDES program has been delegated to the State Water Resources Control Board (SWRCB) and the nine RWQCBs acting under the auspices of the state board. The State and regional boards typically issue NPDES permits that

also include waste discharge requirements (WDRs) under State law. The Los Angeles County MS4 permit and the state General Construction Permit have been issued as NPDES permits and as WDRs and are discussed in more detail below.

The MS4 permit program has been implemented in two phases. Phase I, which was initiated in 1990, includes permits for medium (serving between 100,000 and 250,000 people) and large (serving 250,000 people) municipalities. Phase II was implemented as a General Permit for the Discharge of Storm Water from Small MS4s (WQ Order No. 2013-0001-DWQ) and covers smaller municipalities and non-traditional Small MS4s such as military bases, public campuses, prisons, and hospital complexes. The Phase II Small MS4 General Permit regulates discharges from small MS4s with a population density of at least 1,000 people per square mile and a population of at least 10,000.

Executive Order 11198

In 1977, the President of the United States issued Executive Order 11198 to regulate impacts associated with development within a designated 100-year floodplain. This Executive Order is implemented through FEMA's Floodplain Mapping Program and through federal agency review of projects that may require federal permits or approvals. Under this Executive Order, the USACE is the regulating agency authorized to provide leadership and to take action to:

- Avoid development in the base floodplain unless it is the only practical alternative;
- Reduce the hazard and risk associated with floods;
- Minimize the impact of floods to human safety, health, and welfare; and
- Restore and preserve the natural and beneficial values of the base floodplain.

Flood hazard areas identified on the Flood Insurance Rate Map (FIRM) are identified as Special Flood Hazard Area (SFHAs). SFHAs are areas that will be inundated by a flood event and have a one percent chance of being equaled or exceeded in any given year. The one-percent annual chance flood is also referred to as the "base flood" or "100-year flood". SFHAs are labeled as "Zone A". Moderate flood hazard areas (labeled "Zone B" or "Zone X") are also shown on the FIRM and are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are labeled "Zone C" or "Zone X".

State

California Porter-Cologne Act

The Porter-Cologne Water Quality Control Act of 1970 (Porter-Cologne Act)(*California Water Code*, Sections 13000 et. seq.) is California's primary statute governing water quality and water pollution issues, including sediment transport and protection of surface waters and groundwater. The Porter-Cologne Act provides the SWRCB and nine Regional Water Quality Control Boards (RWQCBs) the authority to protect water quality and is the primary vehicle for implementing California's responsibilities under the federal CWA. Each RWQCB must formulate and adopt a water quality control plan (commonly referred to as a "basin

plan”) for the region within its jurisdiction. The basin plan must conform to the policies set forth in the Porter-Cologne Act and the State water policy established by the SWRCB. The basin plan establishes beneficial uses for surface and groundwaters in the region and includes narrative and numeric water quality standards to protect those beneficial uses. Each RWQCB is also authorized to include water discharge prohibitions applicable to particular conditions, areas, or types of waste within its jurisdiction. The Act requires that, unless otherwise authorized by a general or other permit, reports of waste discharges to regulated waters of the state must be provided to each RWQCB. The RWQCB may issue discharge permits under State law in response to a report of waste discharge. These permits are commonly referred to as “waste discharge requirements” (WDRs) and are issued by the RWQCBs for activities within each regional board’s jurisdiction.

Construction General Permit

The NPDES program allows for the issuance of general permits that cover specific actions by multiple parties, such as construction activities. Dischargers covered under a general permit must comply with the permit terms and conditions. In 2009, the SWRCB issued the statewide Construction General Permit to regulate discharges or pollutants in storm water associated with construction activities (NPDES No. CAR000002, Water Quality Order 2009-0009-DWQ as amended by 2010-0014-DWQ and 2012-006-DWQ). Dischargers are required to obtain coverage under the Construction General Permit if a project disturbs one or more acres of soil or disturbs less than one acre, but is part of a larger common plan of development that in total disturbs one or more acres.

The Construction General Permit requires that projects implement an SWPPP that includes specific BMPs and establishes numeric effluent limitations to meet water quality and technology-based standards. Major components of the adopted Construction General Permit include the those discussed below.

Risk-Based Permitting Approach. The Construction General Permit includes a three-tiered system for discharges (identified as Risk Levels 1, 2, and 3) that is based on the relative risk a project poses to causing water quality impacts. Risk levels are established by calculating two factors: (1) the project’s sediment risk and (2) receiving water risk during periods of soil exposure (i.e., grading and site stabilization) (SWRCB 2012a). Sediment risk is determined by the relative amount of sediment that can be discharged from the construction site given the duration of construction, project location, and other project site details. Receiving water risk is based on whether a project drains to a sediment-sensitive waterbody. A high-risk waterbody has one of the following conditions:

- It is listed as impaired for sediment on the most recent List of Impaired Waterbodies maintained in compliance with CWA Section 303(d);
- It has a USEPA-approved Total Maximum Daily Load implementation plan for sediment; or
- It has been designated in an applicable basin plan for COLD, SPAWN, and MIGRATORY beneficial uses.

Depending on the level of risk identified for a project, the Construction General Permit requirements progressively increase. Certain short-duration projects of less than 5 acres and constructed during one dry season may qualify for a rainfall erosivity waiver under the permit.

Numeric Action Levels and Numeric Effluent Limitations. To be covered by the Construction General Permit, dischargers must meet specific Numeric Action Levels (NALs) for hydrogen potential (pH) and turbidity. Exceedance of an NAL does not constitute a permit violation, but does trigger mandatory implementation of additional BMPs and/or corrective actions. In addition, the Construction General Permit requires that Risk Level 3 dischargers with direct discharges to surface waters monitor the receiving water body if an effluent sampling result exceeds receiving water monitoring triggers (i.e., effluent pH outside the range of 6.0 and 9.0 pH units or turbidity exceeding 500 Nephelometric Turbidity Units [NTU]). Where active treatment systems are used, discharges must meet Numeric Effluent Levels (NELs) for turbidity. Exceedances of the Active Treatment System turbidity NEL are considered to be violations of the Construction General Permit.

Post-Construction Standards. The Construction General Permit requires that the pre-project water balance (i.e., the volume of rainfall that ends up as runoff) be replicated under post-construction conditions for the smallest storms up to the 85th percentile storm event (or the smallest storm event that generates runoff, whichever is larger). In addition, for projects that disturb more than two acres, the post-project time of runoff concentration must be equal to or greater than pre-project time of concentration. Finally, BMPs to reduce pollutants in storm water discharges that are reasonably foreseeable after all construction phases have been completed must be implemented under the permit.

Best Management Practices. The Construction General Permit specifies mandatory, minimum BMPs to prevent storm water pollution and post-construction impacts. The required level of BMPs increases with a project's risk level. The minimum BMPs for all projects include site run-on control, perimeter controls, and good housekeeping practices, among numerous other requirements. BMPs must be implemented to meet the Best Available Technology Economically Achievable (BAT)/Best Conventional Pollutant Control Technology (BCT) standard.

Rain Event Action Plan. During the rainy season, the permit requires that adequate sediment control materials be available to control sediment discharges in the event of a predicted storm. Risk Level 2 and 3 sites must also develop and implement a Rain Event Action Plan (REAP) designed to protect all exposed portions of the site within 48 hours prior to any likely precipitation event. A written REAP specific for each rain event is required whenever there is a 50 percent or greater chance of receiving precipitation in the project area.

Monitoring and Reporting Requirements. In addition to visual monitoring at all sites, the Construction General Permit requires the following:

- Sampling, analysis, and monitoring requirements for non-visible pollutants at all sites;

- Effluent and receiving water monitoring for pH and turbidity for all Risk Level 3 sites;
- Receiving water bioassessment sampling before and after project completion for larger Risk Level 3 sites; and
- Electronic submission of an Annual Report no later than September 1 of each year via the SMARTS website. Each Annual Report must include sampling data, a summary of all exceedances and violations, corrective actions, names of all responsible parties, and training documentations.

California Green Building Standards Code

In January 2013, the State of California enacted the third revision of the California Green Building Standards Code (CALGreen Code) as part 11 of the California Building Standards Code (Title 24). CALGreen measures are designed to improve public health, safety, and general welfare by utilizing design and construction methods that reduce the negative environmental impact of development and encourage sustainable construction practices.

CALGreen provides mandatory direction to developers of all new construction and renovations of residential and non-residential structures with regard to all aspects of design and construction, including but not limited to site drainage design, storm water management, and water use efficiency. Required measures are accompanied by a set of voluntary standards that are designed to encourage developers and cities to aim for a higher standard of development.

Under CALGreen, all residential and non-residential sites are required to be planned and developed to keep surface water from entering buildings and to incorporate efficient outdoor water use measures. Construction plans are required to show appropriate grading and surface water management methods such as swales, water collection and disposal systems, French drains, water retention gardens, and other water measures that keep surface water away from buildings and aid in groundwater recharge. Plans should also include outdoor water use plans that utilize weather or soil moisture controlled irrigation systems. Non-residential structures are also required to develop an irrigation water budget for landscapes greater than 2,500 square feet that conforms to a local water efficient landscape ordinance or to the state Model Water Efficient Landscape Ordinance (MWELo), per Title 31, Green Building Standards Code, where no local ordinance is applicable. The MWELo was recently updated by the California Governor's Drought Executive Order (B-19-25) on July 15, 2015. The MWELo requirements for the project are discussed in Section 5.18, Water Supply.

County of Los Angeles

Storm Water Permitting (Municipal Separate Storm Sewer System Permit)

In 2012, the California Regional Water Quality Control Board, Los Angeles Region issued an MS4 permit covering Los Angeles County and several municipalities within the County in accordance with the federal NPDES permit program and WDRs under state law (CAS004001, Order No. R4-2012-0175) (MS4 Permit). In 2013, the County amended Chapter 12.84 of the Los Angeles County Code to require that new development utilize LID BMPs in conformance

with the MS4 Permit. In 2014, the County prepared the LID Standards Manual to provide guidance for new development in meeting the storm water runoff standards in Chapter 12.84 of the County Code and in the MS4 Permit.

County Low Impact Development Standards

As amended in 2013, Chapter 12.84 requires that new development:

- Mimic undeveloped storm water runoff rates and volumes in any storm event up to and including the “Capital Flood” event (a 50-year storm);
- Prevent pollutants of concern from leaving the development site in storm water as the result of storms, up to and including a water quality design storm event; and
- Minimize hydromodification impacts to natural drainage systems.

To achieve these objectives, Chapter 12.84 requires compliance with the following standards:

1. The project shall retain 100 percent of the Storm Water Quality Design Volume (SWQDv) on site, through infiltration, evapotranspiration, rainfall harvest and use, or a combination thereof, unless the Director of Public Works determines that it would be technically infeasible to do so.
2. If the Director determines that it would be technically infeasible to retain 100 percent of the SWQDv on site, the project shall comply with one of the following alternative compliance measures:
 - a. The project shall provide for on-site biofiltration of 1.5 times the portion of the SWQDv that is not retained on site.
 - b. The project shall include infiltration or bioretention BMPs to intercept the portion of the SWQDv that is not retained on site at an off-site location, as approved by the Director of Public Works. The project shall also provide for treatment of the portion of the SWQDv discharged from the project site, as approved by the Director of Public Works.
 - c. The project shall provide for the replenishment of groundwater supplies that have a designated beneficial use in the Basin Plan.
 - i. Groundwater replenishment projects shall include infiltration or bioretention BMPs to intercept the portion of the SWQDv that is not retained on site at an off-site location, as approved by the Director of Public Works.
 - ii. Groundwater replenishment projects shall also provide for treatment of the portion of the SWQDv discharged from the project site, as approved by the Director of Public Works.
 - d. The project shall include infiltration, bioretention, or rainfall harvest and use BMPs to retrofit an existing development with similar land uses as the project to intercept the portion of the SWQDv that is not retained on site.

- e. The County, independently or in conjunction with one or more cities, may apply to the RWQCB for approval of a regional or sub-regional storm water mitigation program to substitute in part or wholly for the provisions of this chapter for the area covered by the regional or sub-regional storm water mitigation program. If the RWQCB approves the program, provisions of the program shall apply in lieu of any conflicting provisions of this chapter.

Development projects that consist of five or more residential units, or nonresidential development projects, must further comply with the 2014 LID Standards Manual. As required, the excess storm water runoff volume (ΔV , defined by the Los Angeles County Department of Public Works [LACDPW] as the post-developed runoff volume minus the pre-developed runoff volume for the 85th percentile storm event) from each lot upon which such development is occurring shall be infiltrated at the lot level or in the alternative, the excess storm water runoff volume from the entire development site (including streets and public rights-of-way) shall be infiltrated in sub-regional infiltration facilities built for this specific purpose. The tributary area of a sub-regional infiltration facility shall be limited to five acres, but may be exceeded with approval of the Director of LACDPW. When infiltration of all excess storm water runoff volume is not technically feasible, on-site storage, reuse, or other water conservation uses of the excess runoff volume is required and shall be implemented as authorized by the Director of LACDPW in accordance with the requirements and provisions of the LID Standards Manual.

County Low Impact Development Standards Manual

The 2014 LID Standards Manual was prepared by LACDPW and updates and provides a compilation of the following documents:

- Development Planning for Storm Water Management: A Manual for the Standard Urban Storm Water Mitigation Plan (SUSMP Manual, September 2002).
- Technical Manual for Stormwater Best Management Practices in the County of Los Angeles (2004 Design Manual, February 2004).
- Stormwater Best Management Practice Design and Maintenance Manual (2010 Design Manual, August 2010).
- Low Impact Development Standards Manual (2009 LID Manual, January 2009).

The LID Standards Manual also supersedes the water quality portions of the following ordinances and policies:

- Water Quality section of the Los Angeles County Hydrology Manual
- Interim Drainage Policy for Quartz Hill
- Acton Interim Drainage Policy and Guidelines
- Antelope Valley Interim Drainage Policy
- Financing the Cost to Maintain Standard Urban Stormwater Mitigation Plan Devices/Systems

- Permanent Standard Urban Storm Mitigation Plan Devices for No Fee Miscellaneous Transfer Drains, Small Drainage Systems, and Storm Drain Connection Permits
- Interim Peak Flow Runoff Criteria for New Development
- Policy for New Percolation Basin Testing, Design, and Maintenance
- Clarification on the Policy for Financing the Cost to Maintain Standard Urban Stormwater Mitigation Plan (SUSMP) Devices/Systems Constructed by New Development or Other Agencies (LADPW 2014).

The LID Standards Manual requires that “Designated Projects”, which include large scale residential and nonresidential development projects, prioritize the selection of BMPs to retain 100 percent of the SWQDv on site through infiltration, evapotranspiration, storm water runoff harvest and use, or a combination thereof, unless it is demonstrated that it is technically infeasible to do so. BMPs should be implemented in the following order of preference: (1) infiltration and/or bioretention and (2) storm water runoff harvest and use.

Designated Projects that are unable to fully retain the SWQDv on site through retention-based storm water quality control measures must implement alternative compliance measures (e.g., on-site biofiltration, off-site groundwater replenishment, off-site infiltration and/or bioretention, and off-site retrofit). Prior to off-site mitigation, the portion of the SWQDv that cannot be reliably retained on site must be treated to meet effluent quality standards.

The LID Standards Manual indicates site conditions where infiltration may not be possible, including the following:

- Locations where the corrected in-situ infiltration rate is less than 0.3 inch per hour and it is not technically feasible to amend the in-situ soils to attain an infiltration rate necessary to achieve reliable performance of retention-based storm water quality control measures for the SWQDv on site.
- Locations where seasonal high groundwater is within 10 feet of the surface.
- Locations within 100 feet of a groundwater well used for drinking water.
- Brownfield development sites or other locations where pollutant mobilization is a documented concern.
- Locations with potential geotechnical hazards.
- Smart growth and infill or redevelopment locations where the density and/or nature of the project would create significant difficulty for compliance with the on-site retention requirement.
- Locations where infiltration could cause adverse impacts to biological resources.
- Locations where infiltration would cause health and safety concerns.

The LID Standards Manual also indicates where runoff harvest and use may not be possible:

- Projects that would not provide sufficient irrigation or (where permitted) domestic grey water demand for use of stored runoff due to limited landscaping or extensive use of low-water-use plant palettes in landscaped areas.
- Projects that are required to use recycled water for landscape irrigation.
- Development projects in which the storage and reuse of storm water runoff would conflict with local, State, or federal ordinances or building codes.
- Locations where storage facilities would cause potential geotechnical hazards, as outlined in a report prepared by a licensed geotechnical engineer.
- Locations where storage facilities would cause health and safety concerns.

Chapter 12.84 and the LID Standards Manual establishes requirements for hydromodification, hydrology (flood), and water quality control and require projects to fully mitigate for off-site drainage impacts caused by hydromodification and changes in water quality, flow velocity, flow volume, and the depth/width of flow, as determined by the Director of Public Works, in accordance with the requirements and provisions specified in the LID Standards Manual. If the Director of Public Works determines that it is infeasible for a project to comply with applicable mitigation standards, then the project must obtain written consent to the unmitigated impacts from the owner of every impacted downstream property. In addition, the project must comply with one of the following alternative requirements:

1. The project shall infiltrate on site at least the runoff from a 2-year, 24-hour rainfall event;
2. The runoff flow rate, volume, velocity, and duration for the project's post-development condition shall not exceed the pre-development condition for the 2-year, 24-hour rainfall events; or
3. The erosion potential (Ep), as defined in the LID Standards Manual, in the receiving water channel shall approximate one, as demonstrated by a hydromodification analysis study approved by the Director of Public Works.

Los Angeles County Flood Control Act

The Los Angeles County Flood Control Act of 1915 (Act) authorized the formation of the Los Angeles County Flood Control District (District or LACFCD) for the purpose of controlling and conserving the district's flood, storm, and other waste waters for beneficial and useful purposes. The Act enables the District to identify projects that would improve conservation and replenishment of water resources. The Act also empowers the District to protect the harbors, waterways, public highways, and property within its jurisdiction from damage from such waters. Providing for recreational use of district facilities and enhancing scenic beauty are also parts of its duties. The District, which is administered by the Los Angeles County Department of Public Works (LACDPW), is also authorized to establish special zones and to acquire and to conserve imported and reclaimed water.

In 1986, the LACDPW issued a memorandum entitled “Level of Flood Protection and Drainage Protection Standards” for all development projects in Los Angeles County (Psomas 2017). This memorandum has served as the County policy concerning flood protection and requires that flood-control facilities in the county be designed to convey the “Capital Flood” (the storm event used by LACDPW for flood-control facility design purposes, which is defined as a 50-year frequency design storm occurring in a previously saturated watershed). The standard method for runoff computations for sizing of flood-control structures accepted by the County is the Los Angeles County Modified Rational Hydrology Method. Design criteria for major drainage facilities require that facilities provide enough capacity for storm water runoff generated by a 50-year return frequency standard hypothetical storm from a burned watershed with consideration of sediment-loaded flows (e.g., burned and bulked flows). County-approved programs for the application of this method are described in the current LACDPW Hydrology Manual (LACDPW 2006).

Antelope Valley Comprehensive Plan of Flood Control and Water Conservation

The Antelope Valley Comprehensive Plan of Flood Control and Water Conservation (AV Drainage Plan) was adopted by the Los Angeles County Board of Supervisors on June 23, 1987. The AV Drainage Plan objective is to “provide mitigation for the regional flood control needs”. The AV Drainage Plan was proposed “because development in this [Antelope Valley] area has not always adequately addressed the area-wide flood hazards” (LACDPW 1987).

The AV Drainage Plan area covers approximately 1,200 square miles of land in northern Los Angeles County that are tributary to the inland basin dry lake areas in and around the Edwards Air Force Base, including the Oso Canyon and East Drainage areas of the Project site. The AV Drainage Plan requires new development projects to detain the change in peak flow from the predevelopment condition and to percolate the change in volume. Percolation basins are specified as the preferred design concept and are required to be sized on a 25-year rainfall frequency storm event. As discussed below, the Project has been designed to meet the most current County flow and flood-control standards for a 50-year storm event, which is more stringent and provides a greater level of protection than the 25-year rainfall frequency storm event in the AV Drainage Plan.

Los Angeles County Green Building Standards Code

In 2008, the County adopted the Green Building Program, which included the Drought-Tolerant Landscaping, Green Building, and Low Impact Development Ordinances (the Ordinances), and created an Implementation Task Force and Technical Manual. In November 2013, in response to the mandates set forth in the 2010 CALGreen Code, the Board of Supervisors adopted the Los Angeles County Green Building Standards Code (Title 31 of the Los Angeles County Code). The CALGreen Code and the Ordinances adopted in 2008 comprise the County’s primary green building and low impact development standards.

Los Angeles County Building Code

The Los Angeles County Building Code (Title 26, Section 110 of the Los Angeles County Code) specifically restricts the construction of buildings and/or structures within designated flood-hazard areas. As stated in Section 110.1.2 of the County Code,

A person shall not perform work for which a building or grading permit is required within the boundaries of an established floodway if such work increases the flood hazard to adjacent properties by either increasing the capital flood water surface elevation, deflecting flows or increasing bank erosion. Such work may be performed within an established floodway, and a building or grading permit therefore may be issued, where provisions are made to the satisfaction of the Building Official to avoid such an increase in the flood hazard.

Los Angeles County General Plan and Antelope Valley Area Plan

The *Los Angeles County General Plan* and the *Antelope Valley Area Plan (AVAP)*, part of the County General Plan, were updated in 2015 and include goals and policies that address hydrology and flood issues in the unincorporated County. The AVAP goals and policies applicable to the analysis of hydrology and flooding with Project implementation are listed below. Section 5.8, Land Use, Entitlements, and Planning, presents a more in-depth analysis of the Project's consistency with relevant plans, policies and regulations.

Goal LU 1: A land use pattern that minimizes threats from hazards.

Policy LU 3.3: Except within economic opportunity areas, limit the amount of potential development in Flood Zones designated by the Federal Emergency Management Agency, through appropriate land use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.

Goal COS 3: A clean water supply untainted by natural and man-made pollutants and contaminants.

Policy COS 1.3: Limit the amount of potential development in groundwater recharge areas through appropriate land use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.

Goal COS 2: Effective conservation measures provide an adequate supply of clean water to meet the present and future needs of humans and natural ecosystems.

Policy COS 2.3: Require onsite stormwater infiltration in all new developments through the use of appropriate measures, such as permeable surface coverage, permeable paving of parking and pedestrian areas, catch basins, and other low impact development strategies.

Goal COS 17: Buildings are sustainable, conserving energy, water, and other resources, and limiting greenhouse gas emissions.

Policy COS 17.8: Require onsite stormwater infiltration in all new developments through use of appropriate measures, such as permeable surface coverage, permeable paving of parking and pedestrian areas, catch basins, and other low impact development strategies.

Goal PS 3: Protection of the public through flood hazard planning and mitigation.

Policy PS 3.1: Limit the amount of potential development in Flood Zones designated by the Federal Emergency Management Agency through appropriate land use designations with very low residential densities, as indicated in the Land Use Policy Map (Map 2.1) of this Area Plan.

Policy PS 3.2: Require onsite stormwater filtration in all new developments through use of appropriate measures, such as permeable surface coverage, permeable paving of parking and pedestrian areas, catch basins, and other low impact development strategies.

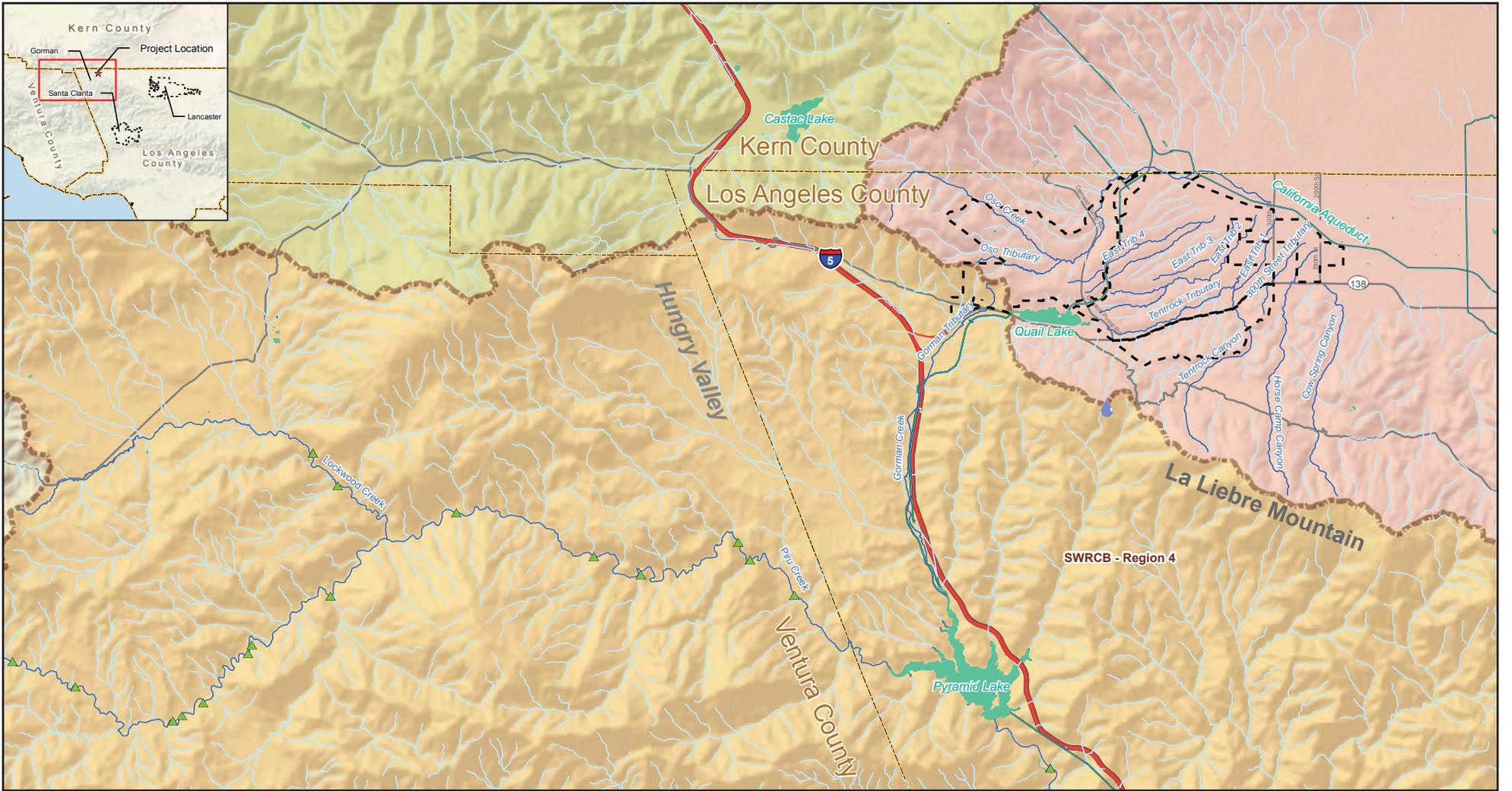
Policy PS 3.3: Review the potential local and regional drainage impacts of all development proposals to minimize the need for new drainage structures.

5.2.3 ENVIRONMENTAL SETTING

On-Site Watercourses and Drainage Areas

Approximately 97.3 percent of the Project site, including locations that will be preserved in open space and remain undeveloped, is located within the Antelope Valley Watershed (95.5 percent of the site) and the much smaller Quail Lake Watershed to the south (1.8 percent of the site), both of which are within the jurisdiction of the Lahontan RWQCB. Approximately 2.7 percent of the site drains to Gorman Creek, which is located about 4.5 miles downstream from the southwestern edge of the Project site. Gorman Creek is within the Santa Clara River Watershed and the Santa Clara-Calleguas Hydrologic Unit, Piru Hydrologic Area as defined in the *Water Quality Control Plan for the Los Angeles Region* (Los Angeles Basin Plan). The Santa Clara River watershed is under the jurisdiction of the Los Angeles RWQCB. Exhibit 5.2-1, Regional Water Quality Control Board Boundaries, shows the jurisdictional boundaries of the Los Angeles and Lahontan RWQCBs relative to the Project site.

As discussed in Section 5.18, Water Supply, in December 2015, the California Superior Court entered an adjudication Judgment and Physical Solution for the consolidated Antelope Valley Groundwater Cases litigation. A copy of the Judgment and Physical Solution is attached as Appendix 5.18-E of this Draft EIR. The adjudication regulates groundwater use in the Antelope Valley basin and surrounding watershed to avoid overdraft conditions and to ensure that future groundwater production is consistent with a total sustainable yield of approximately 110,000 acre-feet per year. Most of the Project site is located within the adjudication area boundary, including the Antelope Valley groundwater basin and its contributing watershed (see Exhibit 5.18-3 in Section 5.18, Water Resources, for a map of the Antelope Valley Adjudication Area as defined in the litigation). The groundwater basin and watershed includes low lying alluvial portions of the Antelope Valley in Los Angeles County and Kern County, which receive flows from drainages that originate in the surrounding mountains and foothills. Most of the surrounding drainages flow only during storm events and are dry during other periods. In general, the valley floor lacks defined natural channels outside the foothills and is subject to unpredictable sheet-flow patterns.



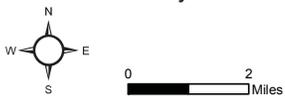
- ▲ Surface Water Monitoring Locations
- Channels of Interest
- Other Channels
- Aqueduct
- Lakes and Reservoirs
- 💧 Sandberg Rain Gauge
- Highways
- Existing Roads
- Centennial Project Boundary
- County Boundary
- RWQCB Boundaries**
- Central Valley
- Lahontan
- Los Angeles

Source: Geosyntec Consultants 2015

Regional Water Quality Control Board Boundaries

Exhibit 5.2-1

Centennial Project



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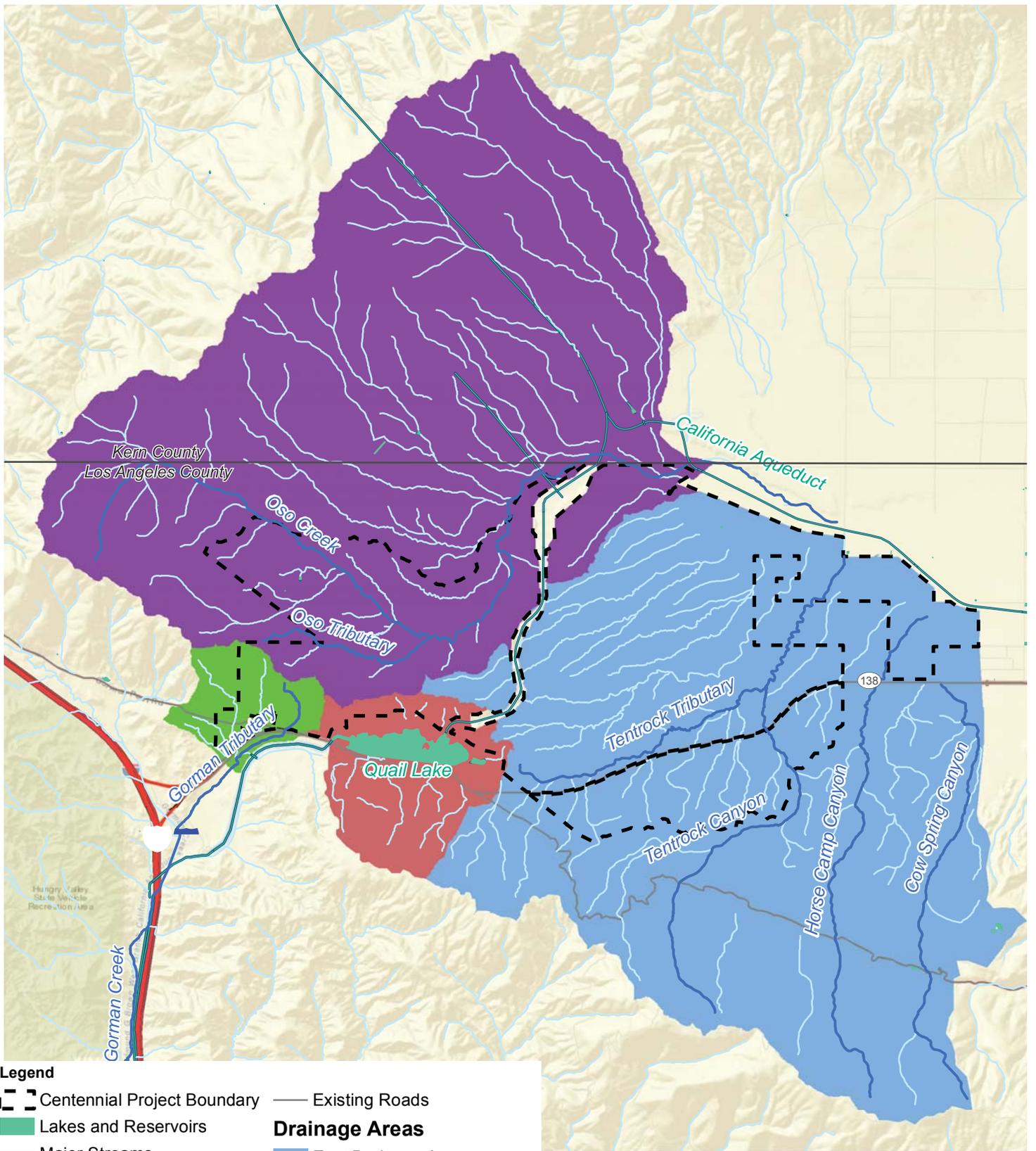
For more information concerning the Antelope Valley Watershed, please see Section 5.18.3, Environmental Setting (specifically, the subsection entitled “Antelope Valley Groundwater Basin”). For more information regarding site geology, topography, and drainage characteristics, please see Section 5.7, Biological Resources (specifically, Section 5.7.3, Environmental Setting “Characteristics of the Site”).

The drainage area of the Project site is within both Los Angeles County and Kern County. As shown on Exhibit 5.2-2, Drainage Areas on the Project Site, four drainage systems extend into portions of the Project site. The two largest systems are the East Drainage Area and the Oso Creek Drainage Area. Portions of the Gorman Creek Drainage Area and the Quail Lake Drainage Area also extend into the west and southwest portions of the site. Larger canyons that have flows in the Project area include Oso Canyon and Tentrock Canyon. As shown on Exhibit 5.2-3, Existing Watershed and Drainage Nodes, Little Sycamore Creek and Los Alamos Creek are tributary to Oso Creek and traverse through a small portion of the site from the north.

There are 15 larger tributary systems within the Project site, including 12 within the East Drainage Area, as listed in Table 5.2-1 below.

**TABLE 5.2-1
EXISTING DRAINAGE AREAS AND ASSOCIATED TRIBUTARY SYSTEMS
WITHIN THE PROJECT SITE**

Drainage Area	Tributary System	Tributary Area (sq mi)
East Drainage Area	Cow Spring Canyon	5.6
	Horse Camp Canyon	1.9
	300 th Street Tributary	1.1
	Tentrock Canyon	13.0
	East Tributary 1	0.5
	East Tributary 2	2
	East Tributary 3	1.1
	East Tributary 4	2.1
	East Tributary 6	1.2
	East Tributary 7	0.3
	East Tributary 8	0.3
	East Tributary 9	0.4
Oso Canyon Drainage Area	Oso Creek	31.3
Quail Lake Drainage Area	Quail Lake	3.2
Gorman Drainage Area	Gorman Tributary	1.5
sq mi: square miles		
Source: Geosyntec 2016		



Legend

- Centennial Project Boundary
- Lakes and Reservoirs
- Major Streams
- Minor Streams
- Aqueduct
- Highways
- Existing Roads
- Drainage Areas**
- East Drainage Area
- Gorman Creek Drainage Area
- Oso Creek Drainage Area
- Quail Lake Drainage Area

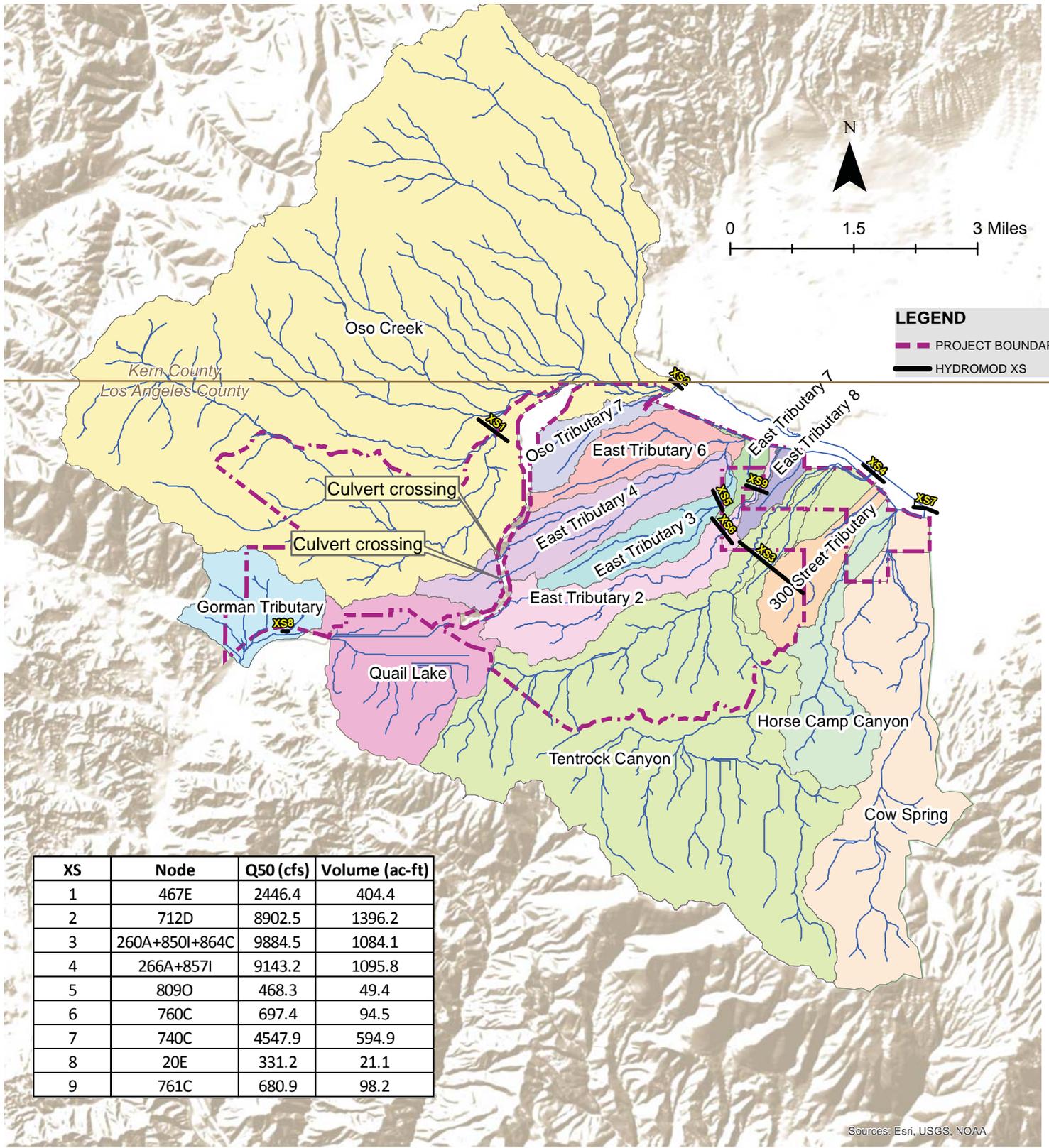
Source: Geosyntec Consultants 2016

Drainage Areas on the Project Site

Exhibit 5.2-2

Centennial Project





XS	Node	Q50 (cfs)	Volume (ac-ft)
1	467E	2446.4	404.4
2	712D	8902.5	1396.2
3	260A+850I+864C	9884.5	1084.1
4	266A+857I	9143.2	1095.8
5	809O	468.3	49.4
6	760C	697.4	94.5
7	740C	4547.9	594.9
8	20E	331.2	21.1
9	761C	680.9	98.2

Sources: Esri, USGS, NOAA

Source: Geosyntec Consultants 2017

Existing Watershed and Drainage Nodes

Exhibit 5.2-3

Centennial Project



Exhibit 5.2-4, Proposed Infiltration Basin Locations, shows the locations of the proposed development areas and the 28 regional detention and retention basins that comprise the primary hydromodification and hydrology BMPs that will be implemented for the Project. As discussed in Section 5.2.5 below and in Section 5.7 Biological Resources (specifically, Threshold 7-3) and as shown in Exhibit 5.2-5, Receiving Channels of Concern and 100-Year Floodplain, the Project will avoid most of the watercourses and watershed areas in the Gorman Creek, Quail Lake, and Oso Creek Drainage Areas. Approximately 18 percent of the proposed development would occur west of the West Branch of the Aqueduct, and drainage impacts in this area would primarily affect Oso Creek tributaries flowing north from the south side (i.e., the northerly face) of Oso Canyon. Drainage impacts in the Gorman Creek Drainage Area would largely be avoided. No drainage impacts will occur in the Quail Lake Drainage Area.

Approximately 88 percent of the proposed development would occur east of the West Branch of the Aqueduct. As discussed in Section 5.2.5 below and in Section 5.7 Biological Resources (Threshold 7-3) and as shown on Exhibit 5.2-2, most of the Project impacts to existing drainages would occur in the East Drainage Area. Smaller drainages in this location would generally be integrated with the Project's storm drain system. Flow patterns associated with several existing larger tributary systems, including East Tributary systems and the Cow Spring Canyon, Horse Camp Canyon, the 300th Street Tributary systems, will largely be maintained by avoiding or constructing flow controls in existing channels or by recreating existing channels after site grading. Flow, LID, and hydromodification management facilities (e.g., detention and retention basins) will be constructed adjacent to channels, primarily in downstream reach locations. Approximately 17 basins would be at the elevation of the development pads, 3 would be adjacent to a channel, and 8 would be within a channel.

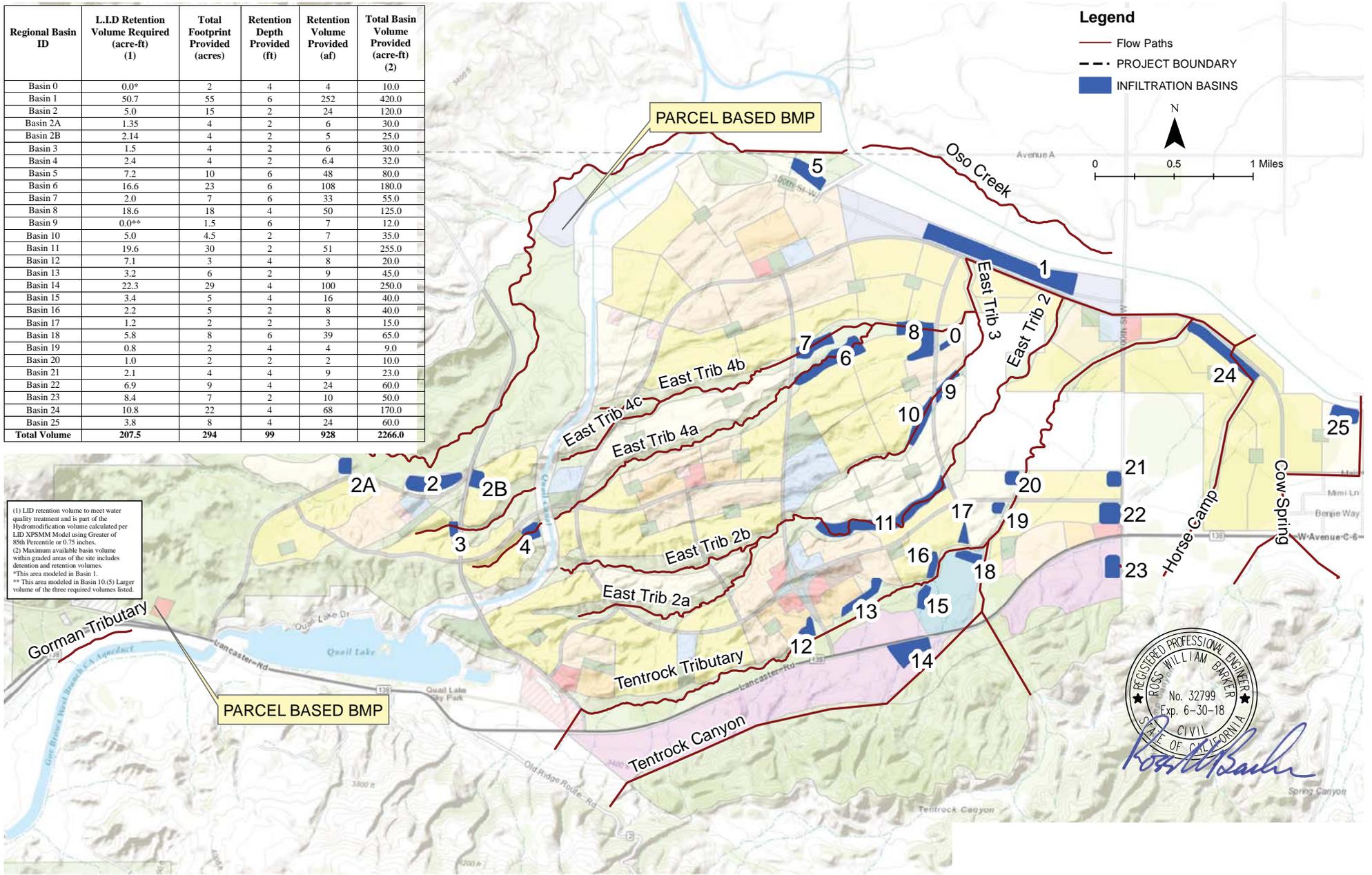
The following sections provide additional information about existing conditions in the four drainage areas that extend into the Project site, as shown on Exhibit 5.2-2.

East Drainage Area

The East Drainage Area includes approximately 18,900 acres, of which 41 percent is within the Project site. Flows in the drainage that are conveyed through the East Tributary systems originate just west of the West Branch of the Aqueduct where flows are conveyed under the Aqueduct via existing culverts. All watersheds contributing runoff to the East Tributaries are located on the Project site and within areas of proposed development. Flows from the north-facing slopes of La Liebre Mountain are conveyed to the north and east under State Route (SR) 138 through Cow Spring Canyon, Horse Camp Canyon, the 300th Street Tributary, Tentrock Canyon, and lower-lying tributaries. Ground elevations within the East Drainage Area range from 2,960 feet above sea level (msl) to 5,800 feet above msl. Flows from the East Drainage Area reach the East Branch of the Aqueduct to the east of the Project boundary and are conveyed by crossings at 292nd Street and 286th Street. In low-flow conditions, East Drainage Area flows are infiltrated in the valley floor prior to reaching the Aqueduct crossings.

Regional Basin ID	L.LD Retention Volume Required (acre-ft) (1)	Total Footprint Provided (acres)	Retention Depth Provided (ft)	Retention Volume Provided (af)	Total Basin Volume Provided (acre-ft) (2)
Basin 0	0.0*	2	4	4	10.0
Basin 1	50.7	55	6	252	420.0
Basin 2	5.0	15	2	24	120.0
Basin 2A	1.35	4	2	6	30.0
Basin 2B	2.14	4	2	5	25.0
Basin 3	1.5	4	2	6	30.0
Basin 4	2.4	4	2	6.4	32.0
Basin 5	7.2	10	6	48	80.0
Basin 6	16.6	23	6	108	180.0
Basin 7	2.0	7	6	33	55.0
Basin 8	18.6	18	4	50	125.0
Basin 9	0.0**	1.5	6	7	12.0
Basin 10	5.0	4.5	2	7	35.0
Basin 11	19.6	30	2	51	255.0
Basin 12	7.1	3	4	8	20.0
Basin 13	3.2	6	2	9	45.0
Basin 14	22.3	29	4	100	250.0
Basin 15	3.4	5	4	16	40.0
Basin 16	2.2	5	2	8	40.0
Basin 17	1.2	2	2	3	15.0
Basin 18	5.8	8	6	39	65.0
Basin 19	0.8	2	4	4	9.0
Basin 20	1.0	2	2	2	10.0
Basin 21	2.1	4	4	9	23.0
Basin 22	6.9	9	4	24	60.0
Basin 23	8.4	7	2	10	50.0
Basin 24	10.8	22	4	68	170.0
Basin 25	3.8	8	4	24	60.0
Total Volume	207.5	294	99	928	2266.0

(1) LID retention volume to meet water quality treatment and is part of the Hydromodification volume calculated per LID XFSMM Model using Greater of 85th Percentile or 0.75 inches.
(2) Maximum available basin volume within graded areas of the site includes detention and retention volumes.
*This area modeled in Basin 1.
** This area modeled in Basin 10.(5) Larger volume of the three required volumes listed.



Source: Psomas 2017

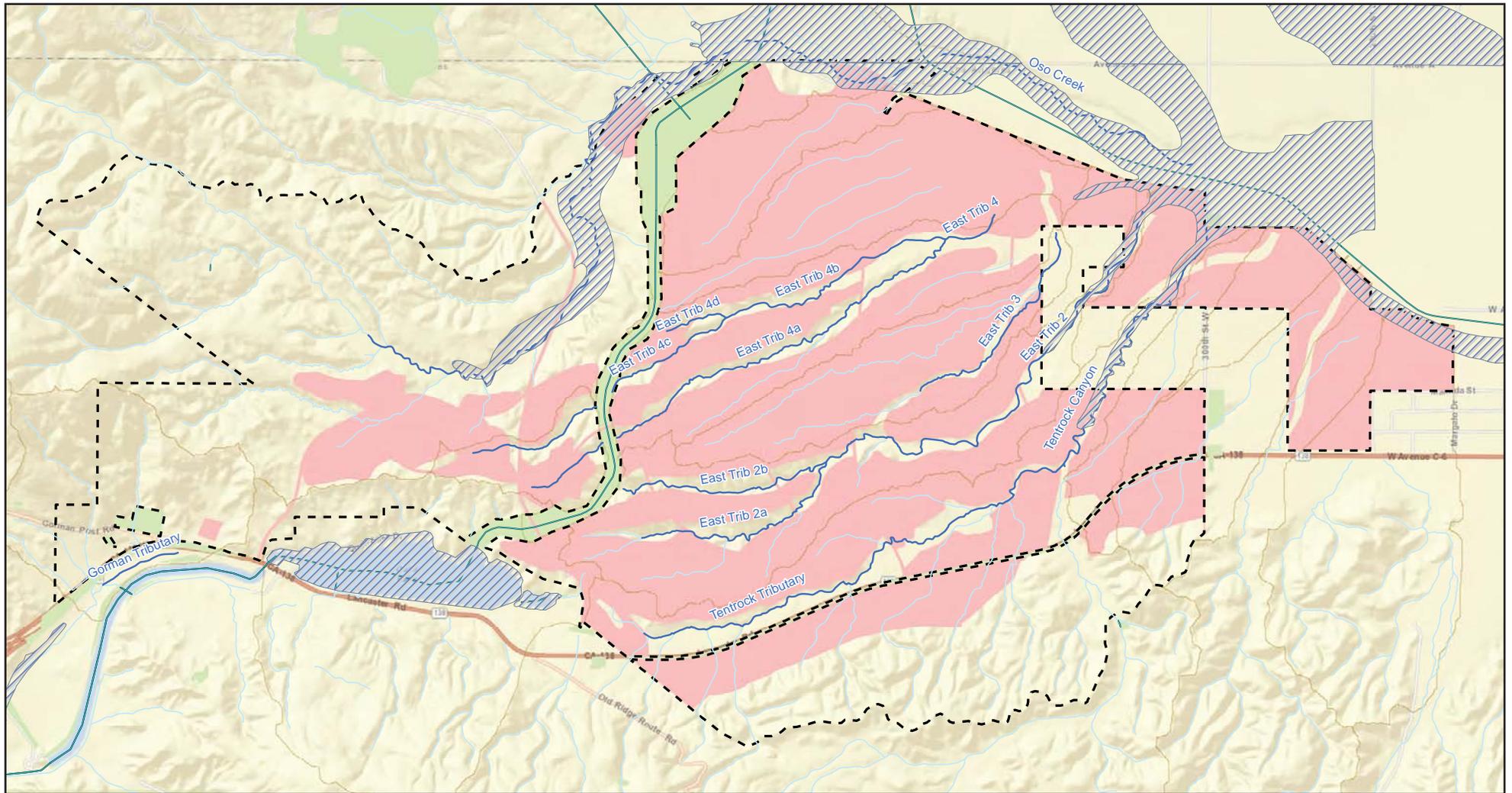
Proposed Infiltration Basin Locations

Exhibit 5.2-4

Centennial Project

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Legend

- Existing Development
- Proposed Development
- 100-Year Flood Plain
- Centennial Project Boundary
- Receiving Channels of Concern
- Other Channels
- Aqueduct
- Watershed Boundary

Source: Geosyntec 2015

Receiving Channels of Concern and 100-Year Floodplain

Exhibit 5.2-5

Centennial Project



Oso Canyon Drainage Area

The Oso Canyon Drainage Area drains approximately 20,040 acres, of which approximately 16 percent is located on the Project site. Ground elevations in the drainage range from 3,000 feet above msl to 4,500 feet above msl. The primary watercourse in the Oso Canyon Drainage Area is Oso Canyon Creek (Oso Creek), which originates in the Tehachapi Mountains to the northwest of the site. Oso Creek drains northwest to east through the northern part of the site and merges with Los Alamos Creek at the eastern site boundary. The flows are conveyed across the West Branch of the California Aqueduct; reenter the extreme eastern portion of the site; and then merge with flows from Little Sycamore Canyon off site after crossing the East Branch of the Aqueduct. Flows in the main stem of Oso Creek are typically ephemeral in the Project area and generally infiltrate when they reach the valley floor under low-flow conditions.

Quail Lake Drainage Area

The Quail Lake Drainage Area encompasses approximately 2,026 acres, of which approximately 17 percent is on the Project site. Ground elevations in the drainage range from 3,320 feet above msl at Quail Lake to approximately 3,600 feet above msl. Quail Lake is 1 of 29 storage facilities used to convey water in the State Water Project (SWP) and is managed by the California Department of Water Resources (DWR). The SWP conveyance system, which includes Quail Lake, is used to provide imported water for urban and agricultural uses throughout California, including Southern California. The lake was historically a sag pond along the San Andreas Fault and was expanded to store approximately 7,500 acre-feet of imported water from the West Branch of the Aqueduct. The SWP system conveys water from Quail Lake south to Pyramid Lake and further downstream to Castaic Lake, which is the southern terminus of West Branch of the California Aqueduct. Pyramid Lake stores SWP water for delivery to Southern California; provides regulated storage for the Castaic power plant; and provides flood protection along Piru Creek. Downstream of Pyramid Lake, Piru Creek flows south approximately 19 river miles to Piru Lake (which is formed by the Santa Felicia Dam) and then flows for approximately 6 miles below the Santa Felicia Dam southward to join Reach 4 of the Santa Clara River. The point of confluence with the Santa Clara River is located approximately 40 miles south of the Project site.

Gorman Drainage Area

The Gorman Drainage Area encompasses approximately 963 acres, of which approximately 55 percent is within the Project site boundaries. The primary direction of surface water flow is westerly along SR-138. Ground elevations range from 3,100 feet above msl at the outlet to Gorman Creek to 3,600 feet above msl in the drainage. As shown in Exhibit 5.2-2, the Gorman Tributary flows into Gorman Creek about 1.5 miles downstream from the Project boundary. Gorman Creek flows to Cañada de los Alamos in the Lower Hungry Valley before discharging to Pyramid Lake about six miles downstream from the Project boundary.

Existing Drainage Geomorphic Conditions

The dominant factors influencing existing drainage channels on the Project site are hydrology, channel geometry, bed and bank material, and sediment supply.

The Project site is predominately undeveloped with localized changes related to ongoing livestock grazing and agriculture. Most of the Project site is currently used for cattle grazing, which has occurred for over 150 years. Portions of the eastern half of the site are used for agriculture. A few residential dwellings are located near the center of the northern property line, including single-family units and several trailers used in support of grazing and property caretaking activities. An inactive hunters' camp, located in the western portion of the site, consists of six trailers, a shooting range, and two outhouses. The site contains two aboveground water storage tanks and a water well (Geosyntec 2016).

Several unpaved roads exist on the Project site. Paved roadways also traverse portions of the site and provide access to the National Cement Plant located to the north, facilities associated with the Aqueduct, and agricultural operations. SR-138 traverses through the southern portion of the Project site and 300th Street West runs north from SR- 138. Several siphons and culverts have been installed in conjunction with the Aqueduct to convey flows from existing drainages over or under the Aqueduct. Minor agricultural drainage ditches have also been constructed in certain locations (Geosyntec 2016).

The existing site channel network is generally a dynamic (i.e., changing) system originating locally in the foothills of the Tehachapi Mountains to the west and north of the site and the La Liebre Mountains to the south. Uplift along the San Andreas Fault has tipped the valley floor down toward the north causing drainage channels to trend along south-facing hill slopes. Sediment production is highest in the upgradient portions of the Oso Canyon and East Drainage Areas. In the downstream and eastern portions of the Oso Canyon and East Drainage Areas, the alluvial valley floor is broader; the longitudinal slope is flatter; sediment supply is high relative to sediment transport capacity; and the bed and banks consist of unconsolidated sands and fine gravel that promotes infiltration. East of the West Branch of the Aqueduct, and outside the Project's northeastern boundary, the channels become less defined and Oso Creek and the Eastern Drainage Area channels disappear into flat agricultural areas associated with the western portion of Antelope Valley (Geosyntec 2016).

Certain channels on the site consist of a primary (bankfull) channel situated in a wider, alluvial valley corridor and a compound channel morphology that consists of a low flow channel within a primary channel and a larger overbank channel which is then contained within an alluvial valley corridor. Bed material on the site consists predominantly of sand, with some intermixed gravel and localized cobbles and boulders. Sparse grass was observed in certain drainages but not in amounts that would provide added strength to the channels. Most of the existing channel reaches are live-bed alluvial channels in which the bed material is composed of sediments produced and transported from upstream locations and are sensitive to perturbations in bed sediment supply. Bank material consists predominantly of silty sand to sandy loam. Bank material in the broad valley floor is generally loosely consolidated alluvial silts, sands, and gravels. Bank vegetation consists of grasses and shrubs, with some trees in the upper reaches of Oso Creek. Root density of the more prevalent grasses and shrubs is low to moderate and does not appear to add significant strength to the bank material. Silty sand to sandy loam materials comprise the bed and bank in many of the more eroded channels. This uniformity in channel material is a function of historic channel incision into the relatively homogenous native alluvium (Geosyntec 2016).

Existing sediment supply has been affected by prior land uses. Cattle grazing reduced vegetation cover in canyon bottoms, which has increased surface rill and gully erosion. Cattle access to active channels and bank vegetation grazing has disturbed stream channel banks and bed and increased in-channel sediment supplies (Geosyntec 2016).

The Sediment Yield Map for the Western United States published by the National Resources Conservation Service (NRCS; formerly Soil Conservation Service) indicates three ranges of sediment yield apply to the Project site's drainage areas. A sediment yield rate of 0.5 to 1.0 acre-foot per square mile per year (af/mi²/yr) applies to mountainous terrain south of the site within the La Liebre Mountain Range, with 40 percent of that rate generated from out-of-stream sources (i.e., sheet and rill erosion) and 60 percent from in-stream sources (i.e., channel and gully erosion). A sediment yield rate of 0.2 to 0.5 af/mi²/yr applies to the undulating hills on the Project site and the Tehachapi Mountain Range north and west of the site, with 60 percent of that rate generated from out-of-stream sources and 40 percent from in-stream sources. A sediment yield rate of 0.1 to 0.2 af/mi²/yr applies to the flat alluvium associated with the Antelope Valley floor within and east of the Project site, with 60 percent of that rate generated from out-of-stream sources and 40 percent from in-stream sources (Geosyntec 2016).

Floodplains

As shown in Exhibit 5.2-5, Receiving Channels of Concern and 100-Year Floodplain, the Federal Emergency Management Agency (FEMA) has identified the 100-year floodplain for the Oso Creek drainage. Northern portions of the Project site are also identified as within a 100-year floodplain and as flood-prone areas on the *Flood Hazard Zones Policy Map* of the *Los Angeles County General Plan (Figure 12.2)* (DRP 2015). As discussed in Thresholds 2-6 and 2-7 below, no habitable residential, school, administration, or commercial structures will be constructed in these locations.

Existing Runoff Conditions

The hydrology calculations for the Project were prepared using the Los Angeles County Department of Public Works' methodology as outlined in their Hydrology Manual (January 2006). Where soils and rainfall data were not available (area south of County line) in the Manual and for areas in Kern County, data was obtained from the National Oceanic and Atmospheric Administration (NOAA) Rainfall Atlas. Soil classifications were obtained from NRCS data and then compared to Los Angeles County soil types for areas within Los Angeles County (where there were overlapping soil groups). The dominant Los Angeles County soil classification number was then assigned to the NCRS classification.

In 2013, County LID standards were amended to require that new development mimic undeveloped storm water runoff rates and volumes for a 50-year storm event. The County method for analyzing a project site's pre-and post-development storm water runoff rates and volumes includes the preparation of an existing conditions hydrologic and hydraulic model using a hydrology module developed by the County for use within the XPSWMM analysis program (LACDPW 2006). The proposed development will result in an increased amount of impervious surfaces in the Project area and increase the volume of storm water flowing from

currently undeveloped locations. The XPSWMM program is utilized to estimate post-development conditions with proposed flow-control measures; to compare the results with preconstruction conditions; and to verify compliance with the County's storm water runoff rate and volume performance standards.

To implement the XPSWMM analysis for existing site conditions, on-site watersheds were mapped in accordance with County criteria and 9 "cross sections" were identified at downstream (outbound flow) locations along the Project boundary. The analysis methodology is described in more detail in Threshold 2-2 below and in Appendix 5.2-A (Psomas 2017). The locations of the cross sections under existing conditions are shown on Exhibit 5.2-3, Existing Watersheds and Cross Sections. Rainfall rates associated with a 50-year storm were estimated for areas within Los Angeles County, based on the design rainfall isohyets in the Los Angeles County Hydrology Manual where the data is available and, where data was not available and for areas in Kern County, the NOAA Atlas 14 data was used (see Appendix 5.2-A). Runoff into existing watercourses generated by the precipitation was calculated using the existing levels of impervious and pervious surfaces on the site (Psomas 2017). Table 5.2-2, Existing Runoff Discharge Rates and Volumes, 50-Year Storm Event, Cross Sections Along Project Boundaries, summarizes the peak flow rate (also called the "Q" rate) and volume of storm water runoff at each of the 16 nodes during a 50-year storm event under existing conditions and utilizing the County analysis methodology. These nodes are depicted on Exhibit 5.2-3, Existing Watershed and Drainage Nodes.

**TABLE 5.2-2
EXISTING CONDITIONS PEAK DISCHARGE RATES AND VOLUMES,
50-YEAR STORM EVENT, EXISTING CROSS SECTIONS ALONG PROJECT BOUNDARIES**

Existing Cross Section I.D.	Peak Discharge Rate (Q)(cfs)	Runoff Volume (acre feet)
1	2446.4	404.4
2	8902.5	1396.2
3	9884.5	1084.1
4	9143.2	1095.8
5	468.3	49.4
6	697.4	94.5
7	4547.9	594.9
8	331.2	21.1
9	680.9	98.2
cfs: cubic feet per second		
Source: Psomas 2017 (Appendix 5.2-A)		

5.2.4 PROJECT DESIGN FEATURES

PDF 2-1 The Project will implement a comprehensive system of site design, source control, low impact development, and hydromodification Best Management Practices that meets or exceeds the hydrology (storm water runoff) standards

for new development in the County LID standards (Los Angeles County Code, Section 12.84) and the County LID Standards Manual which were adopted and prepared by the County of Los Angeles Department of Public Works to comply with the revised Los Angeles County Municipal Separate Storm Sewer System (MS4) Permit (Order No. R4-2012-0175).

PDF 2-2 The Project will incorporate a Floodplain Safety Overlay that applies to on-site locations that have been designated as Federal Emergency Management Agency (FEMA) Zone A floodplain zones. No habitable residential, commercial, school and institutional building construction will occur in Project site locations subject to the Floodplain Safety Overlay.

5.2.5 THRESHOLD CRITERIA

The following significance threshold criteria are derived from the County of Los Angeles Environmental Checklist. The Project would result in a significant impact if it would:

Threshold 2-1 Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site.

Threshold 2-2 Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site.

Threshold 2-3 Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff.

Threshold 2-4 Conflict with the Los Angeles County Low Impact Development Ordinance (L.A. County Code, Title 12, Ch. 12.84).

Threshold 2-5 Create drainage system capacity problems, or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.

Threshold 2-6 Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, or within a floodway or floodplain.

Threshold 2-7 Place structures, which would impede or redirect flood flows, within a 100-year flood hazard area, floodway, or floodplain.

- Threshold 2-8** Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.
- Threshold 2-9** Place structures in areas subject to inundation by seiche, tsunami, or mudflow.
- Threshold 2-10** Add water features or create conditions in which standing water can accumulate that could increase habitat for mosquitoes and other vectors that transmit diseases such as the West Nile virus and result in increased pesticide use.

5.2.6 ENVIRONMENTAL IMPACTS

The analysis of potential Project impacts associated with Thresholds 2-1 to 2-10 is primarily based on the *Centennial Master Plan Hydrology* study prepared by Psomas (Appendix 5.2-A) and the *Centennial Project Hydromodification Technical Report* prepared by Geosyntec (Appendix 5.2-B).

- Threshold 2-1** **Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?**

The Hydromodification Technical Report prepared by Geosyntec evaluates impacts to natural streams using the Ep methodology that is an alternate methodology identified in the County LID Manual. This evaluation is summarized below to demonstrate how the Centennial Master Plan Hydrology analysis results in no increases in downstream flow conditions and therefore does not result in hydromodification impacts. Per the requirements of MM 2-1, the Project will be designed to meet the requirements of Section 8 – Hydromodification Impacts of the County LID Standards Manual, which will be confirmed through the preparation of a Drainage System Engineering and Planning Report to be submitted with each Project tract map application.

Changes in runoff patterns caused by introducing development-related impervious surfaces and drainage infrastructure can modify natural watershed and stream hydrologic (water flow) and geomorphic (landform) processes. These potential channel changes are commonly referred to as hydromodification impacts and can cause channel erosion, migration, or sedimentation unless managed and controlled. The Project hydromodification impact analysis includes geomorphic field assessments conducted by Geosyntec from August 31 and September 1, 2015. The analysis also utilizes relevant data and reports, including but not limited to, aerial photography; NRCS soils and sediment yield rate data; the Los Angeles and Lahontan RWQCB Basin Plans that include the Project site; scientific and/or academic publications related to hydromodification; laboratory analysis of grain size distribution from soil samples collected on site; and an assessment of the potential hydromodification impacts of the Project under post-development conditions and with planned BMPs (Geosyntec 2016).

One method for predicting the likelihood of channel changes due to watershed and channel hydrologic and geomorphic variables and for sizing and situating hydromodification BMPs and other controls utilizes the concept of erosion potential (Ep). Ep is defined as the ratio of post-project long-term effective work or sediment transport capacity within a channel boundary compared with pre-project conditions (i.e., post-project conditions/pre-project conditions). This ratio is affected by changes in hydrology, channel geometry, and bed and bank material due to land use alterations. Recent studies that have analyzed and further developed the Ep methodology include the Southern California Coastal Water Research Project's Technical Report 753, which documents an empirical relationship between Ep and stream instability in the Southern California region (i.e., a 2007 report by Palhegyi and Rathfelder) that identifies a widely accepted method of quantitatively accounting for sediment supply changes without replacing bed sediment sources and the derivation of upper-end Ep values in Southern California.

The County MS4 permit, LID standards per Chapter 12.84 of the County Code, and the LID Standards Manual require that projects discharging to natural drainage systems implement hydrologic control measures to prevent accelerated downstream erosion and to protect stream habitat. New development must minimize hydromodification impacts to natural drainage systems, and the LID standards per Chapter 12.84 of the County Code requires full on-site mitigation for off-site drainage impacts caused by hydromodification (Geosyntec 2016).

In order to avoid significant environmental impacts related to erosion/siltation, the Project will be designed to meet the requirements of Section 8 – Hydromodification Impacts of the County LID Standards Manual.

Receiving channels of concern for hydromodification impacts were identified with a desktop assessment and supported by a geomorphic field assessment. Per the Los Angeles County MS4 Permit, receiving waters that are not susceptible to hydromodification impacts include lakes, sumps, tidally influenced water bodies, large rivers, and modified engineered conveyances (LARWQCB 2012). Receiving waters that are considered susceptible to hydromodification impacts are the remaining natural stream channels. In addition to being susceptible channels, the Project's receiving channels of concern for hydromodification are limited to State and federal jurisdictional drainage features and drainages downstream of Project development (e.g., via outfalls). Existing tributary systems that would not be subject to Project development area runoff discharges under post-development conditions were determined to not be receiving channels of concern for hydromodification, many of which will be graded with drainage features incorporated into the proposed storm drainage system.

Such tributary systems include East Tributary 6, for which the existing channels will be removed entirely by the Project; East Tributaries 7, 8, and 9, which do not have defined channels in either the existing or proposed condition; East Tributary 1, 300th Street Tributary, and several side channels throughout the Project site, which will have reduced drainage area due to diversion of runoff to downgradient outfalls; and Horse Camp Creek and Cattle Camp Creek, for which the susceptible channels are all upgradient of the Project outfalls. All other existing susceptible tributary systems and tributary reaches that could

potentially receive Project development area runoff discharges under developed conditions were identified as receiving channels of concern for hydromodification impacts, which are listed in Table 5.2-3 and generally include state jurisdictional drainage features in the East, Oso Creek, and Gorman Drainage Areas. No receiving channels will receive Project development area runoff discharges under developed conditions in the Quail Lake Drainage Area.

**TABLE 5.2-3
RECEIVING CHANNELS OF CONCERN FOR HYDROMODIFICATION**

Drainage Area	Watershed	Reach	Percent Impervious
East Drainage Area	Tentrock Canyon	Tentrock Canyon	1.1
		Tentrock Tributary	
	East Tributary 2	East Tributary 2	1.0
		East Tributary 2a	
		East Tributary 2b	
	East Tributary 3	East Tributary 3	1.0
	East Tributary 4	East Tributary 4	1.0
		East Tributary 4a	
		East Tributary 4b	
		East Tributary 4c	
Oso Canyon Drainage Area	Oso Creek	Oso Creek	0.4
Gorman Drainage Area	Gorman Tributary	Gorman Tributary	3.6
Source: GeoSyntec 2016 (Appendix 5.2-B)			

Discharge locations from the East Drainage Area associated with drainage crossings of the East Branch of the Aqueduct at approximately 292nd Street and 286th Street were not considered jurisdictional features and were not identified as receiving channels of concern. Surface water runoff is only expected to occur at these discharge locations during high magnitude, low frequency storm events. Potential hydrology and flood impacts at these locations are considered in Threshold 2-2.

Construction Impacts

The primary hydromodification concern during construction is potential erosion and sedimentation caused by soils carried in runoff flows that could physically alter receiving channels. As discussed in Section 5.2.2 above, the Project must comply with the state General Construction Permit, which requires that construction period BMPs be implemented in accordance with an impact risk assessment. A SWPPP must be prepared and implemented that includes BMPs that meet or exceed the permit requirements applicable to the level of construction risk. Hydromodification construction period BMPs may include erosion controls that prevent erosion and sediment controls that trap sediment carried in runoff in basins or other facilities. The permit requires that BMPs incorporate the best available

technology economically achievable and best conventional pollutant control technology. BMP implementation must be based on the phase of construction and current weather conditions to control erosion and sediment. A Construction Site Monitoring Program that identifies monitoring and sampling requirements during construction is a required component of the SWPPP.

Project construction is anticipated to be classified as Risk Level 2 as defined in the General Construction Permit. Hydromodification erosion, sediment and other applicable BMPs will be implemented in response to the risk assessment (Geosyntec 2016). Additional information concerning the implementation of the Construction General Permit during Project construction is provided in Section 5.4, Water Quality, of this EIR. Through implementation of all requirements of the Construction General Permit, construction period hydromodification impacts related to erosion and other discharges of sediment in runoff would be less than significant and no additional mitigation is required.

Operational Impacts

Potential operational hydromodification impacts could occur if the post-Project long-term effective work or sediment transport capacity in a channel is greater than existing levels (i.e., Ep greater than 1.0 or other applicable level as described in the County LID standards per Chapter 12.84 of the County Code. Additional runoff from developed impervious surfaces could mobilize sediment and physically alter receiving channels. As discussed above, all existing tributary systems on the Project site that could receive runoff from developed areas were classified as receiving channels of concern for hydromodification impacts (see Table 5.2-3). Impacts to these channels could be significant if post-development runoff conditions are not controlled to meet the requirements in Section 8 – Hydromodification Impacts of the County LID Standards Manual, as required by MM 2-1.

The Project will meet the requirements in Section 8 – Hydromodification Impacts of the County LID Standards Manual in MM 2-1 by implementing nonstructural and structural site design measures that reduce erosion and sedimentation risks; on-site distributed and parcel-based LID measures that capture and avoid runoff and sediment mobilized by runoff; and by constructing a regional runoff retention and detention system that includes 28 basins distributed throughout the site (see Exhibit 5.2-4). The following sections describe these measures in more detail.

Non-Structural Site Design Measures

Minimize Impervious Areas/Preservation of Open Spaces

Project design to minimize impervious areas and reduce increases in runoff volumes and rates associated with development. Undeveloped areas with uncompacted soils also provide opportunities for infiltration of runoff in impervious areas and help to preserve pre-development infiltration, evapotranspiration, percolation, subsurface flow, groundwater recharge, and surface runoff conditions. The Project includes preserved open spaces of approximately 5,787 acres (approximately 47 percent) of the 12,323-acre Project site proposed for active and passive recreational use in the form of parks (i.e., 163 acres of Park Overlay) or natural resource protection (i.e., 5,624 acres of Open Space).

Prioritize Soils for Development and Infiltration

Development on the Project site is generally located on existing poorly infiltrating soils, and avoids soils with higher infiltration rates for flow and volume management and groundwater recharge. Distributed and parcel-based LID and regional BMPs will be implemented to provide infiltration capacity for developed areas that affect locations with higher infiltration rates.

Establish Riparian Buffer Zones

Riparian buffer zones are included in the Project design to prevent changes to channel geometry (i.e., narrowing of the floodplain width) or bed and bank materials that can contribute to increased erosion independent of upstream flow changes; sustainably support existing flora and fauna; to maintain existing native wood and leaf debris input into the drainage system; to filter storm water runoff before it enters a receiving channel; and to maintain the hydrologic connectivity between channels and floodplains. Existing riparian corridor widths will be conserved while avoiding in-stream constrictions (i.e., culverts, bridges, and at-grade crossings) to the extent possible.

Prohibit Disturbance within Riparian Corridors

In addition to riparian buffers, riparian corridors on the Project site will be protected by prohibiting cattle grazing and other significant erosion-inducing activities, such as off-highway vehicle use. These activities adversely affect channel vegetation and erosion; decrease the resistance of channel bed and banks; and increase the risk of further erosion when water is flowing.

Avoid Significant Bed Material Supply Sources in Site Design

The Project will reduce changes in bed sediment supply associated with hydromodification impacts by avoiding development in locations and channels that are significant contributors of bed material load. Where feasible, development is located outside natural channels and on existing soils that have a lower potential to contribute bed material to a receiving channel.

Pass Through Sediments from Natural Open Space

Drainage pathways for open spaces upstream of development have been designed to pass coarse bed sediments from natural areas and channels to alluvial receiving channels of concern. Maintaining natural bed sediment supplies to channels reduces the potential for excess erosion in alluvial channels.

Structural Site Design Measures

Distributed Volume and Flow Management

The Project includes volume and flow management structural measures that achieve the following hydromodification control objectives:

- Detain runoff in basins or similar facilities for release in a controlled way that mimics pre-development in-stream sediment transport capacity.

- Manage excess runoff volumes through infiltration; evapotranspiration; storage and use; discharge at a rate below the critical low-flow rate; or by downstream discharge to a conveyance system and locations that are not susceptible to hydromodification.

Distributed facilities are smaller-scale facilities typically treating runoff from one or a few parcels, including LID BMPs and hydromodification-control detention facilities such as underground vaults and pipes. Exhibit 5.4-2, Low Impact Development (LID) Drainage Areas Within Project, shows the locations of the primary distributed LID management measures that will be implemented for portions of the Project site. As discussed in Threshold 2-2 below and Section 5.4, Water Quality, these measures provide flood and water quality controls in addition to hydromodification control. Distributed and parcel-based measures will meet the LID performance standard incorporated into MM 4-1 (see Section 5.4, Water Quality).

Regional Detention and Retention Basins

Regional detention and retention basins are storm water management facilities designed to detain or infiltrate runoff from multiple parcels or project areas. The basins are typically shallow with flat, vegetated bottoms. Regional basins are constructed by either excavating a depression or building a berm to create aboveground storage. Runoff is stored in the basin and in the pore spaces of the underlying surface soils. Storm water treatment measures such as swales, filter strips, and sedimentation forebays that intercept runoff prior to reaching the basins minimize fine sediment loads and reduce basin maintenance requirements. Basin outlet structures are designed to mimic pre-development in-stream sediment transport capacity. As discussed in Threshold 2-2 below, and in Section 5.4, Water Quality, the regional detention and retention basin system has been sized and designed to also meet applicable flood control and water quality requirements.

The regional infiltration detention system for the Project includes 28 basins that will provide both hydromodification and flow control and water quality treatment for the majority of the proposed development area. The locations of the basins are shown on Exhibit 5.2-4. Normalized sizing charts were applied to the proposed development areas that are tributary to each basin to identify the flow retention and duration volumes required to match the pre-development flow conditions based on site soils and geology, infiltration rates, and stream channel resiliency (i.e., critical shear stress values). The hydromodification control volumes required to meet the performance standard and the total volume provided for hydromodification, as well as flood and water quality control at each basin location, are listed in Table 5.2-4.

**TABLE 5.2-4
SUMMARY OF REGIONAL RETENTION AND DETENTION
FOR HYDROMODIFICATION CONTROL**

Regional Basin Number	Receiving Channel	Discharges to a Receiving Channel of Concern for Hydromodification (Y/N)	Tributary Area	Tributary Percent Impervious	Required LID Retention Volume	Total Retention Volume Provided	Total Basin Volume Provided
			(acres)	(%)	(acre-feet)	(acre-feet)	(acre-feet)
Basin 0	East Tributary 4	Y	21.5	54.9	0.00*	4	10
Basin 1	Aqueduct crossing at ~292 nd St	N	1,528.5	52.0	50.7	252	420
Basin 2	Oso Creek	Y	326.9	45.0	5.0	24	120
Basin 2a	Oso Creek	Y	64.1	30.0	1.35	6	30
Basin 2b	Oso Creek	Y	76.5	43.8	2.14	5	25
Basin 3	East Tributary 4c	Y	52.2	42.0	1.5	6	30
Basin 4	East Tributary 4a	Y	97.9	47.7	2.4	6.4	32
Basin 5	Oso Creek	Y	321.4	36.3	7.2	48	80
Basin 6	East Tributary 4a	Y	533.4	52.6	16.6	108	180
Basin 7	East Tributary 4b	Y	230.5	33.4	2.0	33	55
Basin 8	East Tributary 4	Y	398.6	47.1	18.6	50	125
Basin 9	East Tributary 3	Y	48.0	30.0	0.00**	7	12
Basin 10	East Tributary 3	Y	164.4	28.8	5.0	7	35
Basin 11	East Tributary 2	Y	754.6	52.3	19.6	51	255
Basin 12	Tentrock Tributary	Y	30.7	86.0	7.1	8	20
Basin 13	Tentrock Tributary	Y	114.0	59.1	3.2	9	45
Basin 14	Tentrock Tributary	Y	420.9	90.8	22.3	100	250
Basin 15	Tentrock Tributary	Y	59.8	91.0	3.4	16	40

**TABLE 5.2-4
SUMMARY OF REGIONAL RETENTION AND DETENTION
FOR HYDROMODIFICATION CONTROL**

Regional Basin Number	Receiving Channel	Discharges to a Receiving Channel of Concern for Hydromodification (Y/N)	Tributary Area	Tributary Percent Impervious	Required LID Retention Volume	Total Retention Volume Provided	Total Basin Volume Provided
			(acres)	(%)	(acre-feet)	(acre-feet)	(acre-feet)
Basin 16	Tentrock Tributary	Y	99.5	57.5	2.2	8	40
Basin 17	Tentrock Tributary	Y	43.8	42.0	1.2	3	15
Basin 18	Tentrock Tributary	Y	101.6	91.0	5.8	39	65
Basin 19	Tentrock Canyon	Y	36.9	30.0	0.8	4	9
Basin 20	Tentrock Canyon	Y	43.4	30.0	1.0	2	10
Basin 21	Aqueduct crossing at ~292 nd St	N	70.8	42.0	2.1	9	23
Basin 22	Aqueduct crossing at ~292 nd St	N	182.8	59.3	6.9	24	60
Basin 23	Aqueduct crossing at ~292 nd St	N	148.5	91.0	8.4	10	50
Basin 24	Aqueduct crossing at ~292 nd St	N	550.8	48.7	10.8	68	170
Basin 25	Aqueduct crossing at ~286 th St	N	148.3	35.3	3.8	24	60

N/A: not applicable
 *This area modeled in Basin 1
 **This area modeled in Basin 10
 Source: Geosyntec 2016, Psomas 2017.

As shown in Table 5.2-4, no receiving channels of concern would potentially be affected by development area discharges from Basin 1 and Basins 21 through 25, and no hydromodification control volumes are required at these locations. The total volumes for Basin 1 and Basins 21 through 25 (see the last column of Table 5.2-4) represent capacity provided for flood and water quality control. Basin 0 and Basins 2 through 20 would discharge to receiving channels of concern. Table 5.2-4 shows that the detention and retention volumes required to meet the hydromodification control standard has been provided at these locations.

In-Channel Controls and Channel Restoration

To provide additional hydromodification control, the Project includes in-channel measures that protect or restore receiving channel hydraulic properties and bed and bank material resistance to control runoff and sediment. In general, in-channel measures are most effective in locations where a receiving channel of concern has previously been impacted by erosive flows and excessive sediment, erosion or deposition or where it is a hardened channel. As discussed in Section 5.7, Biological Resources, the receiving channels of concern for hydromodification impacts are regulated by the California Department of Fish and Wildlife (CDFW) or the Los Angeles or Lahontan RWQCBs. A small portion of the on-site channels in the western portions of the Project site is subject to federal jurisdiction. Any in-channel measures within State or federal jurisdictional waters will not be constructed until all required permits and approvals have been obtained from the appropriate State and federal agencies.

In-channel measures used to reduce hydromodification risks are discussed in more detail in Appendix 5.2-B (Geosyntec 2016). The Project's proposed in-channel hydromodification measures include grade-control structures, bed and bank reinforcement, and flow diversions.

Grade-control structures maintain the existing channel slope while allowing for minor amounts of local scour. These control measures consist of a narrow trench across the width of the channel that is backfilled with concrete or similar material and a constructed "plunge pool" consisting of boulders and vegetation. Grade-control structures are proposed within portions of the East Tributary system, including East Tributary Reaches 2, 2a, 2b, 4a, 4b, 4c, and 4d (Geosyntec 2016).

Bed and bank reinforcement measures control erosion by stabilizing bed and bank surfaces and by re-establishing native plant communities. Receiving channels of concern within the lower alluvial portions of the site have often abandoned older channels and created new flow paths as a result of the high level of sediment production that occurs within the Tehachapi and La Liebre Mountain Watersheds. Sediment from the upper reaches of the watersheds accumulates in alluvial locations and diverts channel flows. Buried bank stabilization will be provided as necessary along the edges of proposed channels adjacent to development that are susceptible to movement from sediment deposition, including most or all of the receiving channels of hydromodification concern (Geosyntec 2016).

Flow-diversion measures redirect runoff to channels that are susceptible to hydromodification impacts to other watercourses or receiving facilities that are not susceptible to hydromodification effects. Storm water diversions to non-susceptible receiving facilities will be implemented for the 300th Street tributary and its smaller side channels as well as East Tributary 1 to decrease tributary areas and to reduce flow volumes.

Design for Stream Constrictions

In-channel hydraulic constrictions (e.g., culverts and bridge crossings) may be unavoidable in certain situations and could potentially create backwater effects upstream and higher shear stresses near piers and abutments. These localized effects will be managed with

proper in-stream energy dissipation; design of in-stream structures for anticipated toe down scour without undermining infrastructure; and stream crossings with spans that are long enough to limit reductions in cross-sectional flow area. Stream constriction measures will be implemented where new road crossings intersect with channels, including along the Tentrock Tributary, within Tentrock Canyon, along Oso Creek, and along East Tributary Reaches 2a, 2b, 2, 3, 4a, 4b, 4c, and 4d.

Dissipate Flow Energy at Outfalls

Energy dissipation at the Project drainage system outfalls will be required to minimize localized scour in the receiving channels and to reduce the potential for in-channel sharp changes in channel slope resulting from the formation of scour holes caused by concentrated flows of concern. Energy dissipation measures used to reduce hydromodification risks are discussed in more detail in of Appendix 5.2-B (Geosyntec 2016).

Replace Significant Bed Material Sources

As shown on Exhibit 5.2-4, the proposed on-site regional detention and retention basins would generally be located adjacent to post-development channels. If in-channel basins are required due to topographic or hydrological constraints, bed material sources at in-channel basin outfalls will require replacement as a result of sediment accumulation at these locations. If required, replacement bed material sources would be selected to approximate the same grain size distribution as the receiving channel and would not contain a significant amount of fine sediment. Natural bed sediment deposited in on-site locations would be utilized to the extent feasible to replace bed material. Further information concerning the criteria and methods for replacing bed material is provided in Appendix 5.2-B (Geosyntec 2016).

As discussed in Section 5.18, Water Resources, the Project's potable and recycled water infrastructure, including potable and recycled water treatment, delivery, metering and monitoring, will be managed by a water district or public utility district (PUD) that will serve the Project (the "Project Water Purveyor"). The Project Water Purveyor could also operate and maintain non-construction hydromodification BMPs on the site, and would be responsible for BMP inspections, monitoring, maintenance, and enforcement. Until the Project Water Purveyor or a similar BMP management agency is established, the Project Applicant/Developer will be responsible for all hydromodification BMPs, including design, permitting, construction, operations, and maintenance.

Implementation of the Project's structural and non-structural measures summarized above, including distributed and parcel-specific LID measures and the regional runoff retention and detention basin system, will meet the requirements in Section 8 – Hydromodification Impacts of the County LID Standards Manual, as required in MM 2-1. LID measures will also meet or exceed County LID performance standards as required by MM 4-1 (see Section 5.4, Water Quality). Pursuant to MM 2-1, the effectiveness of Project hydromodification controls will be confirmed during the County tract map approval process. A Drainage System Engineering and Planning Report must be submitted with each tract map application to demonstrate that the proposed BMPs will meet the requirements in Section 8 – Hydromodification Impacts of the County LID Standards Manual for all applicable receiving

channels of concern (see MM 2-1). With mitigation, potential operational hydromodification impacts will be less than significant.

Off-Site Impacts

Proposed off-site Project facilities are described in Section 4.0, Project Description, and include intersections with SR-138, utility connections, water wells, and Aqueduct crossings. None of these smaller locations would generate runoff volumes and silt or sediment flows in amounts that could cause significant hydromodification impacts under post-development conditions. Runoff from new impervious surfaces related to intersection improvements along SR-138, utility connections, and Aqueduct crossings would be controlled and distributed to parcel-specific LID facilities or to the proposed regional detention and retention basin system (see Exhibit 5.4-2).

Off-site well installation would result in a nominal increase in impervious surface area of up to approximately 312 square feet per well. Storm water runoff from the proposed off-site well locations currently drains as sheet flow, and the installation off-site well impervious surfaces would not create additional runoff volumes that could generate significant hydromodification impacts. All off-site well locations will implement parcel-specific hydromodification and other flow or water quality controls as required by the County LID Ordinance. Potential impacts would be less than significant.

Impact Summary: The Project will implement a comprehensive system of site-design, source-control, LID, and hydromodification BMPs that will meet or exceed the hydromodification control requirements of the County MS4 Permit, the LID standards per Chapter 12.84 of the County Code, and the LID Standards Manual. MM 2-1 requires compliance with County requirements for hydromodification control. All distributed and parcel-specific LID control facilities will comply with the LID performance standard in MM 4-1 (see Section 5.4, Water Quality), consistent with County requirements. Project compliance with the requirements in Section 8 – Hydromodification Impacts of the County LID Standards Manual will be confirmed by the County during the tract map application and review and approval process. Runoff from most off-site locations will be controlled in the proposed regional or distributed, parcel-specific LID facilities. Off-site water wells will comply with all applicable LID requirements. During construction, the Project will comply with the Construction General Permit and will implement hydromodification BMPs based on the level of risk determined for the site in accordance with an SWPPP. With the implementation of MM 2-1, MM 4-1, and compliance with all laws and regulations, including the LID standards per Chapter 12.84 of the County Code and the Construction General Permit, potential impacts from existing drainage pattern alterations that could result in substantial erosion or siltation on or off the site will be less than significant.

Threshold 2-2 Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?

As discussed in Section 5.2.3 above, Project development will alter portions of the existing drainage pattern, primarily in the East Drainage Area, and will introduce new impervious surfaces into the site. These changes could result in on- or off-site flooding unless managed with flow controls and a storm drain system.

Potential Project on- and off-site hydrology and flooding impacts were analyzed by comparing post-development peak runoff rates and volumes, including the implementation of flow-control measures such as detention and retention basins, with predevelopment levels. The County LID Standards Manual includes the following hydrology analysis methodological requirements and performance standards (Psomas 2017):

- A 50-year design storm event must be used to design storm water conveyance facilities.
- There must be no increase in peak discharges off site (50-year design storm event).
- There must be no increases in runoff volume off site (50-year design storm event).
- Design flows must be adjusted for burned and bulked scenarios.
- Individual watershed areas within the site must average 40 acres and shall not exceed approximately 60 acres.
- The hydrologic analysis must use the Modified Rational Method (also referred to as MODRAT), as defined by the County and an approved computer program.
- BMPs must be utilized to meet flow, storm water quality, and LID requirements.

The analysis of potential Project hydrology impacts was performed by using the County's Modified Rational Hydrology Method and the XPSWMM computer program with a Los Angeles County module as described in the LACDPW Hydrology Manual (LACDPW 2006). The LACDPW was also consulted on the selection of the software used for the Project analysis. The County's most current requirement that peak discharges and volumes match pre-development conditions for a 50-year storm event represents the most stringent hydrology standard utilized by the County and significantly exceeds previous standards based on a 25-year storm event or other, less intensive design flow criteria. The 50-year post-development peak and volume discharge control requirement has been incorporated into MM 2-2.

Data required for developing the hydrologic parameters used in the analysis for each watershed were collected from multiple sources, including the County, the National Oceanic and Atmospheric Administration (NOAA), the National Resource Conservation Service (NRCS), and the U.S. Geological Service (USGS). Table 5.2-5, Summary of Hydrologic Data

Sources, summarizes the data sources and methodologies used for the Project hydrologic analysis.

**TABLE 5.2-5
SUMMARY OF HYDROLOGY DATA SOURCES**

Parameter	Source or Method
Watershed Characteristics (areas, slope, length)	USGS National Elevation Data Set Digital Elevation Model
Rainfall Depths	Los Angeles County (for LA County where available) and NOAA Atlas 14 (for LA County area where data was not available and for Kern County)
Rainfall Distribution	MODRAT
Runoff	MODRAT
Soils Data	Los Angeles County Shapefiles (GIS)
USGS: U.S. Geological Survey; NOAA: National Ocean and Atmospheric Administration; MODRAT: Modified Rational Method; GIS: Geographic Information Systems	
Source: Psomas 2017 (Appendix 5.2-A)	

Existing and post-development hydrologic conditions were analyzed by using ARC GIS software and the XPSWMM program to process the watershed data and to perform all calculations. Existing site conditions were analyzed by initially using the ARC GIS system to develop the following information:

- Determine all reaches with a contributing area of approximately 40 acres or more.
- Delineate watersheds.
- Determine the longest flow path, length, and slope for each watershed.
- Determine the centroid and rainfall depth of each watershed.
- Assign rainfall depth and soil type data to each watershed.

The ARC GIS data was imported into the XPSWMM program (with the Los Angeles County module) to perform the following functions and hydrologic calculations for the site:

- Assign Los Angeles County nomenclature to each watershed.
- Calculate the time of concentration for each watershed.
- Calculate the peak discharge from and generate a hydrograph for each watershed.
- Route runoff from each watershed downstream.

As shown in Exhibit 5.2-3 and summarized in Table 5.2-2, existing condition peak flows and volumes for a 50-year storm event were analyzed at 16 existing locations or “nodes” at upstream and downstream points along the Project boundary. Post-development hydrologic conditions were evaluated by modifying the existing conditions model, including the following methods:

- Proposed land uses were imported into the XPSWMM program and existing watershed boundaries were removed from areas of proposed development.
- Post-development watersheds were delineated manually based on the proposed Project land uses and on-site detention retention and LID facilities, including 28 regional basins.
- A conservative single rainfall value was assumed for each post-development watershed.
- Post-development flow lengths were estimated and proposed graded slopes were assigned to each watershed.
- The proposed Project storm drain system and post-development drainage channel alignment properties were determined.
- The time of concentration in each watershed was calculated.

Post-development storm water runoff volumes will be affected by the amount of impervious area introduced into each watershed. The Project hydrology analysis integrated pre- and post-development impervious surface data into the delineation of each watershed based on proposed land uses and the proposed grading plan. Post-development watersheds were further subdivided as necessary to meet the County 40- to 60-acre analysis size requirement (LADPW 2006). The hydrology analysis method is described in more detail in the *Centennial Master Plan Hydrology* study attached as Appendix 5.2-A of this EIR (Psomas 2017). Appendix 3 of the study provides representative maps of the pre-development watersheds, subareas, channel reaches, and flow analysis points used in the analysis. Appendix 4 of the study provides representative maps of the post-development (proposed conditions) watersheds, subareas, channel reaches, and flow analysis points.

Construction Impacts

The primary hydrology concern during Project construction is that construction activities could substantially increase the rate or amount of surface runoff in a manner that would result in flooding on or off the site. As discussed in Section 5.2.2 above, the Project must comply with the state General Construction Permit, which requires the implementation of construction period BMPs in accordance with an impact risk assessment for the Project. An SWPPP must be prepared and implemented that includes BMPs that meet or exceed the permit requirements applicable to the level of construction risk. Hydrology construction period BMPs may include on-site flow retention controls that prevent runoff and/or catchments or basins that collect and control runoff. The permit requires that BMPs incorporate the best available technology economically achievable and best conventional pollutant control technology. BMP implementation must be based on the phase of construction and current weather conditions to control erosion and sediment. A Construction Site Monitoring Program that identifies monitoring and sampling requirements during construction is a required component of the SWPPP.

Project construction is anticipated to be classified as Risk Level 2, as defined in the General Construction Permit. Other applicable BMPs will be implemented in response to the risk assessment (Geosyntec 2016). Additional information concerning the implementation of the

Construction General Permit during Project construction is provided in Section 5.4, Water Quality, of this EIR. Through implementation of all requirements of the Construction General Permit, construction period hydrology and flood impacts would be less than significant and no additional mitigation is required.

Operational Impacts

Potential operational flood and hydrology impacts could occur if the peak rate or amount of surface runoff under post-project condition increases above pre-development levels and results in flooding on or off the site. The Project will increase the amount of impervious surfaces, and runoff would increase from new, impervious locations on the site, which could result in significant flooding impacts. As discussed above, the County MS4 permit, the LID standards per Chapter 12.84 of the County Code, and the LID Standards Manual require flow-control measures designed to ensure that upstream or downstream flooding will not occur during a 50-year storm event. MM-2-2 requires that the Project comply with this hydrology performance standard.

To achieve these objectives, the Project will implement a 28-basin regional flow-control system with sufficient capacity to reduce peak runoff flow rate and volumes from a 50-year storm event to levels consistent with or below pre-development conditions. As discussed in Threshold 2-1 above and in Section 5.4, Water Quality, other on-site measures (e.g., break structures and parcel-based BMPs) also provide hydrology and flood controls. The Project hydrology analysis conservatively assumes that the required level of development flow control is achieved by utilizing the proposed regional basin system and does not consider the additional peak and total runoff volume attenuation that would be provided by other proposed measures (Psomas 2017).

The 28 regional detention and retention basins are storm water management facilities that are designed to detain or infiltrate runoff. The basins impound water at depths of approximately six to eight feet to promote higher infiltration rates and to minimize evaporation losses; they are designed to allow for regular maintenance and monitoring of infiltration rates to ensure optimum operating efficiency. Basin outlet structures are designed to mimic pre-development runoff peak flow rates and volumes for a variety of storm events with recurrence intervals from 2 years to the 50-year design storm. The regional runoff retention and detention system for the Project includes 28 basins that will provide runoff, hydromodification and water quality controls for the majority of the proposed development area. The locations of the 28 basins are shown on Exhibit 5.2-4. The volume of flood control required and the total volume capacity provided for each basin are listed in Table 5.2-6. As shown in Table 5.2-6, all basins have been sized to meet and exceed the required storage volume for a 50-year storm event and therefore will meet and exceed volume requirements from storm events with a more frequent recurrence interval.

Consistent with LACDPW policy, storm event flow rates are based on “clear” flow that does not include a bulking factor that will result from debris flows generated from natural hillside areas in either a natural condition or a burned condition that would exist after a fire burns the natural vegetation. This bulking factor has the effect of increasing the peak flow rates. To manage this effect, debris-carrying channels and debris basins will be designed as part of the construction permit plans to intercept and manage the debris flows so that the storm water

discharge from the debris basins will meet the design “clear” flow rates to the regional detention and retention basins.

**TABLE 5.2-6
SUMMARY OF REGIONAL RETENTION AND DETENTION BASINS
FOR FLOOD CONTROL**

Regional Basin Number	Flood Control Retention Volume Provided (acre-feet)	Total Basin Volume Provided (acre-feet)
Basin 0	4	10
Basin 1	252	420
Basin 2	24	120
Basin 2A	6	30
Basin 2B	5	25
Basin 3	6	30
Basin 4	6.4	32
Basin 5	48	80
Basin 6	108	180
Basin 7	33	55
Basin 8	50	125
Basin 9	7	12
Basin 10	7	35
Basin 11	51	255
Basin 12	8	20
Basin 13	9	45
Basin 14	100	250
Basin 15	16	40
Basin 16	8	40
Basin 17	3	15
Basin 18	39	65
Basin 19	4	9
Basin 20	2	10
Basin 21	9	23
Basin 22	24	60
Basin 23	10	50
Basin 24	68	170
Basin 25	24	60
Total Volume	928	2,266
Source: Psomas 2017		

As discussed in Section 5.2.3, peak runoff rates and volumes for a 50-year storm event under existing conditions were estimated at 9 existing locations or “cross sections” at downstream locations along the Project boundary utilizing the County’s methodology. The locations of the cross sections under existing conditions are shown on Exhibit 5.2-3. Table 5.2-2, Existing Runoff Discharge Rates and Volumes summarizes the peak flow rate (also called the “Q” rate)

and volume of storm water runoff at each of the 9 nodes during a 50-year storm event under existing conditions.

The existing condition nodes were relabeled to conduct the post-development analysis and are located at the same points along the Project boundary. The locations and identification labels for the post-development nodes are shown in Exhibit 5.2-6, Location and Designation of Storm Water Runoff Discharge Cross Sections with Project.

Table 5.2-7, Summary of Pre- and Post-Development Peak Discharge Rates or the 50-Year Storm Event, and Table 5.2-8, Summary of Pre- and Post-Development Runoff Volumes for the 50-Year Storm Event, summarize the rate (Q) of peak discharge and runoff volume at the same discharge nodes under existing and post-development conditions for a 50-year storm event. The tables show that post-development peak flow rates and volumes during the 50-year design storm event will either be unchanged from existing conditions or will be lower than under existing conditions. Consequently, post-development conditions in all locations will meet or exceed the County flood and hydrology control standards.

**TABLE 5.2-7
SUMMARY OF PRE- AND POST-DEVELOPMENT PEAK
DISCHARGE RATES FOR THE 50-YEAR STORM EVENT**

Existing XS	Proposed XS	Existing Condition Q (cfs)	Developed Condition Q with Controls (cfs)	Difference from Existing Conditions (cfs)
Gorman Watershed				
8	8	331.2	331.2	0
Oso Creek Watershed				
1	1	2446.4	2346.3	-100.1
2	2	8902.5	8844.1	-58.4
Tentrock/East Trib Watersheds				
3	3	9884.5	9433.1	-451.4
4	4	9143.2	2484.6	-6658.6
East Tributary Watersheds				
5	5	468.3	42.7	-425.6
6	6	697.4	197.5	-499.9
9	9	680.9	315.8	-365.1
Cow Springs/Horse Camp Canyon/300th Street Trib Watersheds				
7	7	4547.9	2104.9	-2443.0
Q: peak flow rate; cfs: cubic feet per second Note: numbers may not balance due to rounding error. Source: Psomas 2017 (Appendix 5.2-A)				

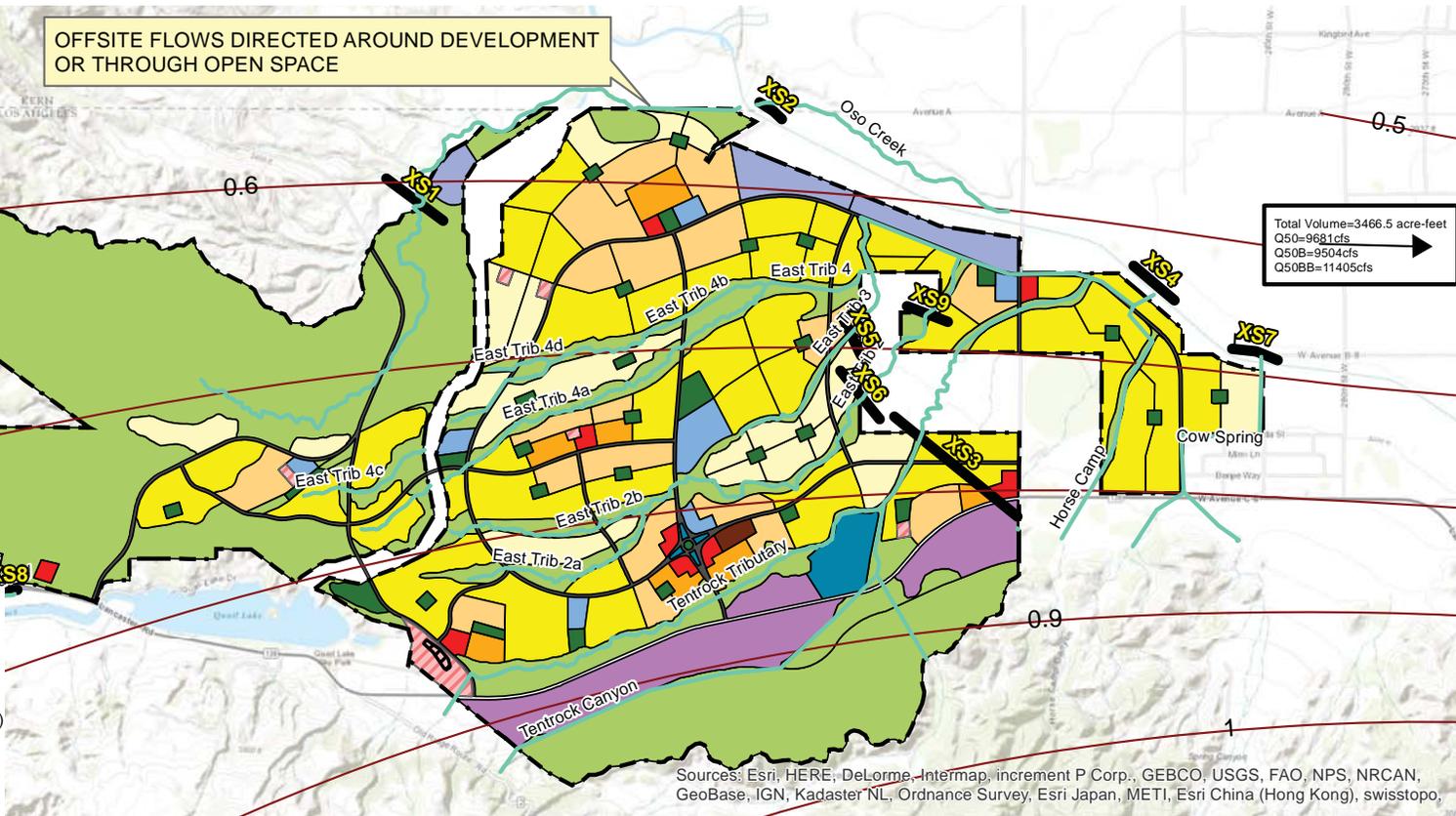


William Barker

OFFSITE FLOWS DIRECTED AROUND DEVELOPMENT
OR THROUGH OPEN SPACE

Legend

- PROJECT BOUNDARY
- HYDROMOD XS
- Flow Paths
- 85th_Percentile_Isohyet
- HABITAT (1% IMP)
- VLDR (30% IMP)
- LDR (42% IMP)
- MDR (55% IMP)
- HDR (86% IMP)
- VHDR (86% IMP)
- C (96% IMP)
- BP (91% IMP)
- I/C (81% IMP)
- OS (1% IMP)
- UTILITY (91% IMP)
- R/E Overlay (82% IMP)
- SCHOOL Overlay (82% IMP)
- PARK Overlay (10% IMP)
- ROW (91% IMP)
- NAP (1% IMP)



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo,

Source: Psomas 2017

Location and Designation of Storm Water Runoff Discharge Cross Sections with Project

Exhibit 5.2-6

Centennial Project



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**TABLE 5.2-8
SUMMARY OF PRE- AND POST-DEVELOPMENT
RUNOFF VOLUMES FOR THE 50-YEAR STORM EVENT**

Existing Cross Section	Proposed Cross Section	Existing Volume (acre-feet)	Proposed Volume (acre-feet)	Difference from Existing Conditions (acre-feet)
Gorman Watershed				
8	8	21.1	21.1	0
Oso Creek Watershed				
1	1	404.4	358.3	-46.1
2	2	1396.2	1335.7	-60.5
Tentrock/East Trib Watersheds				
3	3	1084.1	1032.0	-52.1
4	4	1095.8	953.8	-142
East Tributary Watershed				
5	5	49.4	28.3	-21.1
6	6	94.5	86.3	-8.2
9	9	98.2	94.6	-3.6
Cow Springs/Horse Camp Canyon/300 th Street Trib Watersheds				
7	7	594.9	400.3	-194.6
cf: cubic feet; af: acre-feet				
Source: Psomas 2017 (Appendix 5.2-A)				

As discussed in Section 5.18, Water Resources, the Project's potable and recycled water infrastructure, including potable and recycled water treatment, delivery, metering and monitoring, will be managed by a water district or PUD that will serve the Project (the "Project Water Purveyor"). The Project Water Purveyor could also operate and maintain the flood and hydrology BMPs within the site, and would be responsible for BMP inspections, monitoring, maintenance, and enforcement. The Project Water Purveyor will be funded through a rate-payer system and fees. Until the Project Water Purveyor or a similar BMP management agency is established, the Project Applicant/Developer will be responsible for all hydrology BMPs, including design, permitting, construction, operations, and maintenance.

The implementation of the proposed flood-control measures summarized above, including the regional runoff retention and detention basin system, will meet or exceed the hydrology performance standard required by the County based on a 50-year storm event and incorporated in MM 2-2. These results are conservative because the development conditions analysis does not include flow attenuation effects that would be achieved by parcel-specific or distributed BMPs that will also be implemented on the site. Pursuant to MM 2-2, the effectiveness of Project hydrology controls will be confirmed during the County tract map approval process. A Drainage System Engineering and Planning Report must be submitted with each tract map application to demonstrate that the proposed BMPs will achieve the

hydrology performance standard for a 50-year design storm event (see MM 2-2). With mitigation, potential operational hydrology and flood impacts will be less than significant.

Off-Site Impacts

Proposed off-site Project facilities are described in Section 4.0, Project Description, and include intersections with SR-138, utility connections, water wells, and Aqueduct crossings. None of these smaller locations would generate peak flow rate or volumes that could cause significant flooding impacts under post-development conditions. Runoff from new impervious surfaces related to intersection improvements along SR-138, utility connections, and Aqueduct crossings would be controlled in the proposed regional detention and retention basin system or in distributed or parcel-specific LID facilities as necessary to meet LID requirements (see Exhibit 5.4-2).

Off-site well installation would result in a nominal increase in impervious surface area of up to approximately 312 square feet per well. Storm water runoff from the proposed off-site well locations currently drains as sheet flow, and the installation of off-site well impervious surfaces would not create additional peak flow and total runoff volumes that could generate significant flood impacts. All off-site well locations will implement parcel-specific flow or other hydromodification and water quality controls as required by the County LID requirements. Potential impacts would be less than significant.

Impact Summary: The Project will implement a comprehensive system of site design, source control, LID, and hydromodification BMPs that will meet or exceed the hydrology and flood control requirements of the County MS4 Permit, the LID standards per Chapter 12.84 of the County Code, and the LID Standards Manual. MM 2-2 requires compliance with the County 50-year storm event hydrology and flood-control standards. The analysis of pre- and post-development runoff utilizing the County's methodology shows that the post-development 50-year storm event peak flow rates and runoff volumes will be the same or lower than under existing conditions. Project compliance with the hydrology and flood-control performance standards will be confirmed by the County during the tract map application and review and approval. Runoff from most off-site locations will be controlled in the proposed regional facilities. Other off-site facilities, such as water wells, will comply with all applicable LID requirements. During construction, the Project will comply with the Construction General Permit and will implement hydrology and flood-control BMPs based on the level of risk determined for the site in accordance with an SWPPP. With the implementation of MM 2-2 and compliance with all laws and regulations, including the LID standards per Chapter 12.84 of the County Code and the Construction General Permit, potential impacts from existing drainage pattern alterations or changes in peak flow rates and volumes that could cause flooding on or off the site will be less than significant.

Threshold 2-3 **Would the project create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?**

On-Site Impacts

Potential construction-related storm water runoff impacts are addressed above under Threshold 2-1 and Threshold 2-2 and will be less than significant due to compliance with the state's General Construction Permit. Potential on-site water quality impacts related to substantial additional sources of polluted runoff are discussed in Section 5.4, Water Quality, and will be less than significant with mitigation.

As discussed in Threshold 2-2 and Section 5.4, Water Quality, and as required by MM 2-2 and MM 4-1, the Project will construct and maintain distributed and parcel-specific LID and regional flood, flow, and water quality facilities that will meet or exceed applicable County, State, and federal hydrology and water quality control requirements. The locations of the primary distributed and parcel-specific LID facilities are shown in Exhibit 5.4-2. The locations of the 28 runoff detention and retention basins that comprise the region control system are shown in Exhibit 5.2-4. Each basin has been sized to provide sufficient capacity to meet hydrology and flood, hydromodification, and water quality protection requirements.

As shown in Tables 5.2-7 and 5.2-8, runoff peak flow rates and volumes under developed conditions for a 50-year storm will be the same or lower than under existing conditions. The control capacity of the distributed and regional facilities will be further confirmed in accordance with MM 2-1 (hydromodification controls), MM 2-2 (hydrology and flood controls), and MM 4-1 (LID and water quality controls, see Section 5.4, Water Quality) during the County tract map review and approval process for the Project. With implementation of the Project storm water management BMPs and compliance with MM 2-1, MM 2-2 and MM 4-1, potential impacts related to the creation or contribution of runoff water that exceeds the capacity of existing or planned storm water drainage systems will be less than significant.

Off-Site Impacts

Potential Project off-site hydromodification impacts are discussed in Threshold 2-1, and potential off-site hydrology and flood impacts are discussed in Threshold 2-2 and will be less than significant. None of the Project's off-site facilities will generate storm water in amounts that exceed planned drainage facility capacity. Runoff from off-site locations will be controlled in the proposed regional detention and retention basin system or in distributed or parcel-specific LID facilities as necessary to meet LID requirements (see Exhibit 5.4-2, Low Impact Development [LID] Drainage Areas with Project). Potential off-site water quality impacts related to substantial additional sources of polluted runoff are discussed in Section 5.4, Water Quality, and will be less than significant with mitigation.

Impact Summary: As discussed above, the Project includes distributed and regional runoff-control BMPs that are sufficient to control peak and volumetric flows from a 50-year storm event to meet all applicable County standards. Project development, including off-site facilities, will not generate runoff water in amounts that will exceed the capacity of planned storm water drainage systems, including regional and distributed or parcel-specific controls. Potential impacts related to the creation or contribution of runoff water that exceeds the capacity of existing or planned storm water drainage systems will be less than significant with implementation of MM 2-1, MM 2-2, and MM 4-1. Potential impacts related to the creation or contribution of runoff water that could provide substantial additional sources of polluted runoff are discussed in Section 5.4, Water Quality, and would also be less than significant with mitigation.

Threshold 2-4 **Would the project conflict with the Los Angeles County Low Impact Development Ordinance (L.A. County Code, Title 12, Ch. 12.84)?**

On-Site Impacts

As discussed above and in Section 5.4, Water Quality, the Project has been designed to meet LID requirements for hydrology and flood, hydromodification, and water quality control. MM 2-1 requires compliance with the requirements in Section 8 – Hydromodification Impacts of the County LID Standards Manual. MM 2-2 requires compliance with the County hydrology and flood control standards. MM 4-1 requires compliance with the County LID performance standards (see Section 5.4, Water Quality). Compliance with each of these LID requirements will be further confirmed in accordance with MM 2-1, MM 2-2 and MM 4-1 during the County tract map review and approval process for the Project. The Project will not conflict with the County LID standards per Chapter 12.84 of the County Code.

Off-Site Impacts

Proposed off-site Project facilities are described in Section 3.0, Project Description, and include intersections with SR-138, utility connections, water wells, and Aqueduct crossings. Runoff from new impervious surfaces related to intersection improvements along SR-138, utility connections, and Aqueduct crossings would be controlled in the proposed regional detention and retention basin system or in distributed or parcel-specific LID facilities as necessary to meet LID requirements (see Exhibit 5.4-2). Runoff from off-site water well installations will be controlled by implementing all applicable parcel-specific LID BMPs at these locations. All off-site Project facilities will be consistent with the LID requirements.

Impact Summary: The Project's comprehensive system of site-design, source-control, LID, hydrology and flood, hydromodification, and water quality BMPs will be consistent and will not conflict with the County LID requirements. Potential impacts will be less than significant with the implementation of MM 2-1, MM 2-2 and MM 4-1.

Threshold 2-5 **Would the project create drainage system capacity problems, or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?**

On-Site and Off-site Impacts

Threshold 2-3 discusses potential impacts from Project-related runoff that could exceed the capacity of planned or existing storm water drainage systems. The Project will meet or exceed County hydrology and flood performance standards, including the control of peak and total volume runoff from a 50-year storm to levels that are the same or lower than under existing conditions. Runoff from off-site intersection improvements along SR-138, utility connections, Aqueduct crossings, and water wells will be controlled within the proposed regional detention and retention system or in distributed or parcel-specific facilities consistent with the LID requirements in more isolated locations. The effectiveness of the proposed hydrology controls will be confirmed during the County tract map approval process (see MM 2-1, MM 2-2, and MM 4-1). As discussed in Threshold 2-3, the Project will not result in drainage system capacity problems, and potential impacts associated with drainage capacity will be less than significant.

As discussed in Threshold 2-1, Threshold 2-2, and in Section 5.4, Water Quality, the Project will construct distributed or parcel-specific LID and regional hydrology, hydromodification, and water quality controls and storm water drainage facilities that will be sized to meet or exceed County requirements. Potential impacts associated with the construction of these facilities are considered in the analysis of Project impacts in the topical sections of this EIR, including Section 5.7, Biological Resources; Section, 5.11, Air Resources; Section 5.18, Water Resources; and Section 5.21, Climate Change. No additional construction or expansion of storm water drainage facilities other than the proposed and planned facilities considered in the substantive sections of this EIR will be required. No significant environmental effects would be caused by the construction of any such additional storm water drainage facilities.

Impact Summary: The Project will not cause drainage capacity problems and includes the construction of storm water drainage facilities that have been sized to meet and exceed all applicable County requirements. No additional construction of new or expanded storm water drainage facilities will be required for the Project, and impacts will be less than significant.

Threshold 2-6 **Would the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, or within a floodway or floodplain?**

On-Site and Off Site Impacts

As shown in Exhibit 5.2-5, portions of the Project site in the Oso Creek drainage along the northern boundary and certain drainages along the eastern boundary of the site are within a 100-year floodplain mapped by FEMA. County flood risk maps for the site include the same

locations. The Project requires that a Floodplain Safety Overlay be implemented for the mapped floodplain portions of the site that precludes the placement of housing within a 100-year floodplain (see Exhibit 4-6, Centennial Project – Safety Overlay Districts). This requirement has been incorporated in MM 2-3. No housing will be placed in a 100-year floodplain, or other floodway or floodplain identified on other hazard delineation map. No off-site housing will be constructed with implementation of the Project.

Impact Summary: With implementation of MM 2-3 and the Floodplain Safety Overlay, potential impacts from the placement of housing within a 100-year floodplain or other floodway or floodplain identified on other hazard delineation map will be less than significant.

Threshold 2-7 **Would the project place structures, which would impede or redirect flood flows, within a 100-year flood hazard area, floodway, or floodplain?**

On-Site Impacts

As shown in Exhibit 5.2-5, portions of the Project site in the Oso Creek drainage along the northern boundary and certain drainages along the eastern boundary of the site are within a 100-year floodplain mapped by FEMA. County flood risk maps for the site include the same locations. The Project includes a Floodplain Safety Overlay that precludes the placement of habitable residential, commercial, school, and institutional buildings within a 100-year floodplain (see Exhibit 4-6, Centennial Project – Safety Overlay Districts). This requirement has been incorporated in MM 2-3. No habitable residential, commercial, school, or institutional buildings will be placed in a 100-year flood hazard area, floodway, or floodplain.

Certain proposed Project utility infrastructure, including a water treatment facility in the northwest portion of the site and utilities located along the eastern boundary of the site, could be located in a mapped 100-year floodplain. MM 2-3 requires that, prior to the recordation of any tract map that would locate any structure within a mapped 100-year floodplain, the floodplain boundaries must be more precisely determined and an engineering study must be conducted to identify applicable flood-control and floodplain development protection measures. The study must demonstrate that all applicable FEMA and County of Los Angeles floodplain flood flow and development standards will be met after the proposed construction has been completed. MM 2-3 requires that a conditional letter of map revision (CLOMR) be obtained from FEMA indicating that any proposed facility that would modify a mapped floodplain would be recognized by FEMA if built as proposed. The floodplain map would subsequently be revised based on as-built conditions in accordance with FEMA and County floodplain map revision requirements. With the implementation of MM 2-3, potential impacts from on-site structures that could impede or redirect flood flows within a 100-year flood hazard area, floodway, or floodplain would be less than significant.

Off-Site Impacts

Most of the off-site Project facilities, including intersections with SR-138, utility connections, and Aqueduct crossings, would not be located within a 100-year floodplain. Certain off-site

well locations and portions of proposed water pipelines could be located within or near a designated 100-year floodplain. As discussed above, off-site wells would result in minute changes to existing runoff conditions and would not have the potential to significantly impede or redirect flood flows. Proposed pipeline facilities would be located underground and would have no effect on existing flood flows. Potential impacts from off-site structures that could impede or redirect flood flows within a 100-year flood hazard area, floodway, or floodplain would be less than significant and no mitigation is required.

Impact Summary: The Project incorporates a Floodplain Safety Overlay to ensure that habitable residential, commercial, school, and institutional structures will not be developed in mapped 100-year floodplain areas. MM 2-3 requires an engineering analysis and a CLOMR approved by FEMA prior to other potential construction in a mapped 100-year floodplain. The engineering study and CLOMR process must demonstrate that, under post-construction as-built conditions, affected flood flows and the resulting development comply with all applicable FEMA and County requirements. With implementation of MM 2-3, potential impacts related to structures that could impede or redirect flood flows within a 100-year flood hazard area, floodway, or floodplain would be less than significant.

Threshold 2-8 **Would the project expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?**

On-Site and Off-Site Impacts

As discussed in Threshold 2-6 and Threshold 2-7, the Project incorporates a Floodplain Safety Overlay to ensure that habitable residential, commercial, school, and institutional structures will not be developed in mapped 100-year floodplain areas. MM 2-3 requires an engineering analysis and a CLOMR approved by FEMA prior to potential utility construction in a mapped FEMA 100-year floodplain. The engineering study and CLOMR process must demonstrate that, under post-construction as-built conditions, affected flood flows and the resulting development comply with all applicable FEMA and County requirements.

Most of the Aqueduct (West Branch that flows through Centennial to Quail Lake) is in a cut condition (i.e., below-ground elevation) and therefore poses no risk of inundation to the Project site due to failure. There are two areas that are built on fill materials in existing canyons where culverts convey storm flows from the west side to the east side. If there was a failure of one side of the Aqueduct channel, any water flows would discharge along the existing canyon watercourses where discharging storm flows already occur and would be directed to flood-control basins in the buildout condition. Therefore, these areas would not result in an inundation of developed areas should failure of the Aqueduct channel occur. For the East Branch of the Aqueduct, which runs east/west along the northern boundary of the Project site, there is no risk of inundation because the channel is cut into the existing ground and there is no embankment or levee that could fail. Therefore, the potential for inundation and flooding from a dam or levee failure would be less than significant.

Impact Summary: With the implementation of MM 2-3, potential impacts from exposing people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam, would be less than significant.

Threshold 2-9 **Would the project place structures in areas subject to inundation by seiche, tsunami, or mudflow?**

On-Site and Off-Site Impacts

The Project site is physically isolated by several miles from large waterbodies, such as the Pacific Ocean, that could be subject to tsunamis. Seiches are waves within smaller waterbodies, such as lakes, and are typically caused when strong winds and rapid changes in atmospheric pressure push water towards one end of a waterbody. When the winds cease or air pressure equalizes, the displaced water rebounds, a process that can cause waves and damage adjacent land and shorelines. There are no waterbodies of sufficient size to pose a significant risk of seiche on the Project site. Quail Lake is located to the south of the Project (outside the site) and is lower in elevation than adjacent proposed development areas, including an access road and a commercial area to the west of the lake. As a result, the Project is not subject to significant tsunami or seiche inundation risks.

Mudflows are rivers of liquid and flowing mud on the surface of normally dry land, often caused by a combination of brush loss and subsequent heavy rains. Mudflows can develop when water saturates the ground, such as from rapid snowmelt or heavy or long periods of rainfall, causing a thick liquid downhill flow of earth (National Flood Insurance Program 2015). As discussed in Threshold 2-1 and Threshold 2-2, the Project will implement a comprehensive system of distributed, parcel-specific, and regional BMPs, including 28 detention and retention basins and storm drainage and conveyance facilities, that will control runoff and its associated sediment flows. Flow and sediment controls will also prevent and contain mudflows on the site and in off-site flow discharge locations. Potential mudflows that could originate from off-site upland slopes would drain into on-site storm drainage infrastructure, including basins and engineered and natural stream channels, which would reduce potential impacts.

As discussed in Section 5.1, Geotechnical, topographic alterations in areas with slopes over 25 percent, which would be most prone to generate mudflows, must comply with applicable geotechnical recommendations; County subdivision and building code requirements; and grading standards adopted for the Project. With the implementation of these requirements, steeper slope alterations would not generate significant development hazards or adversely affect human health and safety, including the generation of significant mudflow risks. In addition, most of the steeper topography on the Project site is located west of the West Branch of the Aqueduct where 18 percent of the proposed Project development would occur. Potential mudflow risks will be further attenuated by siting most of the proposed development in flatter locations and avoiding steeper topography.

Impact Summary: The Project site is not subject to tsunami or seiche risks. The Project will avoid steeper topography associated with higher mudflow risks where feasible. MM 2-1, MM 2-2 and MM 4-1, require the implementation of flow and sediment-control facilities that will also capture and control mudflows should it occur on the site. With mitigation, potential impacts from mudflows will be less than significant.

Threshold 2-10 **Would the project add water features or create conditions in which standing water can accumulate that could increase habitat for mosquitoes and other vectors that transmit diseases such as the West Nile virus and result in increased pesticide use?**

On-Site Impacts

As shown in Exhibit 5.2-4, the Project would include 28 regional retention and detention basins, modifications to some existing stream channels, storm drain pipes, catch basins, distributed and parcel-specific detention facilities, and other structural BMPs that would temporarily retain wet- or dry-weather runoff. The California Department of Public Health (CDPH) has developed BMPs for mosquito control in storm water management facilities, including the full discharge of captured water in 96 hours (4 days) or less (CDPH 2012), which is the minimum time necessary for mosquito development. All soft-bottom drainage facilities—including regional and distributed basins and stream channels—would be designed to fully drain or infiltrate captured water in less than four days and avoid the creation of mosquito vectors. This drainage or infiltration management requirement is incorporated into MM 4-2 (see Section 5.4, Water Quality).

On-site wastewater and recycled water facilities will include percolation, storage, and treatment ponds in which standing water may accumulate. As discussed in Section 5.19, Wastewater, MM 19-5 requires that CDPH-recommended vector-control measures for wastewater treatment facilities be implemented for these ponds.

The vector-control BMPs developed by the CDPH include the implementation of an Integrated Pest Management (IPM) program appropriate to proposed Project land uses. The IPM program achieves long-term prevention or suppression of pest problems (i.e., insects and diseases) through a combination of techniques, including using pest-resistant plants; biological controls; cultural practices; habitat modification; and the judicious use of pesticides according to treatment thresholds, when monitoring indicates pesticides are needed because pest populations exceed established thresholds. As discussed in Section 4.0, Project Description, and Section 5.4, Water Quality, the Project includes IPM BMPs that are consistent with the integrated pest management and pesticide and fertilizer application guidelines established by the University of California Division of Agriculture and Natural Resources Statewide Integrated Pest Management Program (see PDF 4-2). These requirements are incorporated in MM 4-2, which also requires that the effectiveness of the IPM BMPs be further verified during the County tract map review and approval process. The proposed land uses associated with the Project are typical of a developed urban area, and would not involve the unusual accumulation of standing or otherwise stagnant water that

could increase habitat for mosquitos or other insect vectors. With the implementation of MM 4-2 and MM 19-5, potential impacts related to insect vectors would be less than significant.

Off-Site Impacts

None of the off-site Project features, including intersections with SR-138, utility connections, water wells, and Aqueduct crossings, would involve the capture or other collection of water that could create habitat for mosquitos or other insect vectors. There would be a less than significant impact and no mitigation is required.

Impact Summary: MM 4-2 requires that all soft-bottom drainage facilities fully drain or infiltrate captured water in less than four days, consistent with BMPs for mosquito control published by the CDPH. MM 4-2 also requires the implementation of IPM BMPs consistent with the integrated pest management and pesticide and fertilizer application guidelines established by the University of California Division of Agriculture and Natural Resources Statewide Integrated Pest Management Program. The IPM BMPs will be further confirmed prior to the issuance of building permits and during the County tract map review process. MM 19-5 requires the implementation of recommended CDPH BMPs for Project wastewater treatment facilities. Proposed Project land uses would not result in unusual standing or otherwise stagnant water accumulation that could increase habitat for mosquitos or other insect vectors. Off-site Project facilities will not result in standing or otherwise stagnant water that could support mosquitos or other vectors. With the implementation of MM 4-2 (from Section 5.4, Water Quality) and MM 19-5 (from Section 5.19, Wastewater) potential Project impacts related to insect vectors would be less than significant.

5.2.7 MITIGATION MEASURES

MM 2-1 The Project shall implement hydromodification-control Best Management Practices (BMPs) that will meet the requirements of Section 8 – Hydromodification Impacts of the County LID Standards Manual, as confirmed by the County based on a Drainage System Engineering and Planning Report to be submitted with each Project tract map application. This Drainage System Engineering and Planning Report shall describe applicable hydromodification-control BMPs and shall utilize approved Los Angeles County methods to demonstrate compliance with the County LID Standards Manual.

MM 2-2 The Project shall implement hydrology and flood-control BMPs that will achieve the following hydrology and flood performance standards:

All project water conveyance facilities must be designed to provide capital flood protection. BMPs must be implemented to ensure that, for the capital event, there is no increase in peak

discharge rates and no increase in runoff volume offsite compared with peak discharge rates and runoff volumes under existing, pre-development conditions. Compliance with the hydrology and flood performance standard shall be demonstrated by using a methodology approved Los Angeles County Department of Public Works for comparing project site pre- and post-development peak discharge rates and runoff volumes.

Compliance with the hydrology and flood performance standards shall be further confirmed by the County, based on a Drainage System Engineering and Planning Report submitted with each Project tract map application. The Drainage System Engineering and Planning Report shall describe applicable hydrology and flood-control BMPs and utilize approved Los Angeles County methodologies to demonstrate compliance with the hydrology and flood performance standards.

- MM 2-3** Each Project Tentative Map shall depict, the 100-year floodplain mapped by the Federal Emergency Management Agency (FEMA). The placement of habitable residential, commercial, school and institutional buildings shall be precluded within any mapped 100-year floodplain. All applications for Project tract maps that would locate any structures within a mapped 100-year floodplain must include an engineering report that provides a detailed description of the floodplain boundaries and demonstrates that as-built conditions comply with all applicable FEMA requirements. If required, a conditional letter of map revision (CLOMR) shall be obtained from FEMA prior to construction within a mapped 100-year floodplain.

5.2.8 LEVEL OF SIGNIFICANCE AFTER MITIGATION

The Project's impacts would be reduced to levels that are less than significant with incorporation of MM 2-1, MM 2-2, MM 2-3; MM 4-1 and MM 4-2 from Section 5.4, Water Quality; and MM 19-5 from Section 5.19, Wastewater.

5.2.9 REFERENCES

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