3.11 HYDROLOGY AND WATER QUALITY

3.11.1 INTRODUCTION

This section describes existing surface and groundwater hydrology in the project area, including issues related to floodplain, storm water, and water quality, and summarizes the regulations that govern hydrologic modification, protect water quality, and control floodplain development and storm water management. It also analyzes the potential effects to hydrology and water quality that could result from the implementation of the Proposed Action and the alternatives.

The Applicant has put forth a compensatory wetland mitigation plan that includes wetland restoration activities at three off-site mitigation properties. The temporary, short-term effects on hydrology and water quality associated with the grading activities at the mitigation sites are discussed in the analysis below. Since no housing/commercial or other development would occur on any of the three mitigation properties, no long-term impacts on hydrology and water quality would occur as a result of wetland mitigation construction, and the impacts are not discussed below.

Sources of information used in this analysis include:

- Amoruso Ranch Specific Plan (ARSP) EIR by the City of Roseville (City of Roseville 2016a).
- City of Roseville General Plan 2035 (City of Roseville 2016b); and
- Amoruso Ranch Specific Plan Area Drainage Master Plan, Kimley-Horn, February 2016 (Kimley-Horn 2016)

3.11.2 AFFECTED ENVIRONMENT

3.11.2.1 Regional Surface Water Hydrology

The project site is located within the Pleasant Grove Creek watershed, which encompasses an area of approximately 400,000 acres in the Sacramento River Basin. The majority of the project site flows south into University Creek, a 3,477-acre watershed that is tributary to Pleasant Grove Creek. Pleasant Grove Creek drains into the Natomas Cross Canal watershed.

The Sacramento River Basin covers approximately 27,210 square miles (or 17,414,400 acres), extending from the Cascade and Trinity Ranges in the north to the Sacramento–San Joaquin Delta in the south, and from the Coast Ranges in the west to the Sierra Nevada in the east. It includes all watersheds draining to the Sacramento River north of the Cosumnes River watershed, as well as the closed (interior drainage) Goose Lake Basin and the Cache and Putah Creek subwatersheds (Central Valley RWQCB 2016a). Besides the Sacramento River, principal streams within the watershed include the Pit, Feather, Yuba, Bear, and American Rivers, which are tributary from the east; and Cottonwood, Stony, Cache, and Putah Creeks, which are tributary from the west. Important reservoirs and lakes include Shasta, Oroville, Folsom, Clear Lake, and Lake Berryessa (Central Valley RWQCB 2016a).

The City receives its water supply from Folsom Lake, which in turn receives water diverted from the North Fork and South Fork of the American River. A discussion of the project's water supply effects can be found in **Section 3.16, Utilities and Service Systems.**

3.11.2.2 Regional Groundwater Hydrology

Overview

The project site is located in the North American subbasin of the Sacramento Valley groundwater basin. The North American subbasin has an area of almost 550 square miles (or 352,000 acres) and is bounded on the north by the Bear River, on the south by the American River, on the west by the Sacramento and Feather Rivers, and on the east by an artificial north-south line extending from the Bear River south to Folsom Lake, passing about 2 miles east of the City of Lincoln and approximately corresponding to the edge of the Sacramento Valley alluvial basin. The western portion of the subbasin comprises the flood basin of the Bear, Feather, Sacramento, and American Rivers and tributary drainages (Department of Water Resources [DWR] 2003).

Groundwater in the North American subbasin is produced from two aquifer systems. The upper aquifer system consists of the Quaternary Victor, Fair Oaks, and Laguna Formations and is typically unconfined. The lower aquifer is primarily within the Mehrten Formation of Miocene age and is semi-confined (DWR 2003). Average well yields are on the order of 800 gallons per minute (gpm) (DWR 2003). Total storage capacity in the North American subbasin is estimated at approximately 4.9 million acre-feet (MAF) and recent data suggest that withdrawals of up to 95,000–97,000 acre-feet per year (AFY) are within the basin's safe yield. The majority of groundwater production occurs in the northern portion of the subbasin (DWR 2003).

Groundwater Use

The upper aquifer has historically been pumped for agricultural use, while urban water providers have relied on the lower, semi-confined aquifer. The Integrated Water Resources Plan (IWRP) indicates a potential safe yield of approximately 95,000 acre-feet per year (AFY) for the basin. It was also estimated that the average annual agricultural and urban demands on groundwater in western Placer County have been around 97,000 AFY. There are no existing legal constraints that limit groundwater pumping (City of Roseville 2016a). The City and other participants in the West Placer County Groundwater Management Plan (WPCGMP) (see **Subsection 1.11** of the Introduction**, Regulatory Framework/Laws, Regulations, Plans and Policies Applicable to the EIS**) have publically stated their intent to manage their groundwater use consistent with the plan's objectives.

The City relies primarily on surface water for potable supply (see related discussion in **Section 3.16 Utilities and Service Systems**), but groundwater provides additional short-term emergency or backup supply during dry years. The most recent use of groundwater in the City was under drought conditions in 2014 and before that, in 1991. Several private domestic supply wells and a number of agricultural irrigation wells are also located in unincorporated areas in the project vicinity. The City currently operates six groundwater supply wells. The City has plans to construct up to 10 more wells to improve overall system reliability during drought and emergency conditions (West Yost 2016).

3.11.2.3 Regional Water Quality

Each Regional Water Quality Control Board (RWQCB) is required to develop and periodically update a water quality control plan (basin plan) that designates beneficial uses for the major water bodies under its jurisdiction. Water quality standards must be adopted to protect the designated beneficial uses, and for water bodies that are impaired (affected by the presence of pollutants or contaminants), total maximum daily load (TMDL) programs are developed to limit pollutant input and ensure a return to standards. To identify water bodies in which TMDLs may be needed, each RWQCB maintains a list of impaired water bodies, as required by Section 303(d) of the Clean Water Act (40 CFR 130.7). The Section 303(d) lists are periodically reviewed and updated so they reflect prevailing water quality conditions.

Table 3.11-1 shows the currently designated beneficial uses and listed impairments for water bodies in the project region. Pleasant Grove Creek is listed on the Clean Water Act (CWA) Section 303(d) list of impaired waterbodies for the following constituents: oxygen, dissolved; pyrethroids; and sediment toxicity (Central Valley RWQCB 2016b). Total Maximum Daily Loads (TMDLs) are still being established for these pollutants, and are expected in 2021 (Central Valley RWQCB 2016b).

3.11.2.4 Regional Flood Hazards

Flooding is the result of water flow that cannot be contained within the banks of natural or artificial drainage courses. Flooding can be caused by an excessive storm event, snow melt, blockage of watercourses by human or wildlife activity (e.g., beavers), dam failure, or a combination of these or other events. A flood event can cause injury or loss of property such as the flooding of structures, including homes and businesses; uplift vehicles and other objects; damage roadways, bridges, infrastructure, and public services; and cause soil instability, erosion, and land sliding.

Runoff from the project site ultimately passes through Pleasant Grove Creek and the Natomas Cross Canal before it enters the Sacramento River. Development and the resulting increase in impervious surfaces within these watersheds could worsen existing flooding issues in Sutter County. To prevent such exacerbated regional flooding, predicted for development within the City of Roseville, the City collects a drainage fee from developers that will be utilized to develop a storm water retention facility within the Al Johnson Wildlife Area (AJWA), located immediately adjacent to and west of the project site (Kimley-Horn 2016).

3.11.2.5 Project Site – Surface Water Hydrology

The northern corners of the project site are within the PL11B, PL11C, and PL11D sub-watersheds which drain to the north (see **Figure 3.11-1, Existing Conditions Drainage Patterns**). Most of the project site is located within the PL10Q and PL10N sub-watersheds. PL 10Q sub-watershed covers approximately 255 acres in the northern half of the project site and includes an approximately 50 acre area on the eastern end of this sub-watershed that is under rice fields and is irrigated. The sub-watershed drains generally from east to northwest and then in a southwesterly direction. PL10N sub-watershed covers about 168 acres in the central and southern portions of the project site. This area drains to the south and southwest.

Table 3.11-1
Designated Beneficial Uses and Listed Water Quality Impairments in Project Area

Water Body	Beneficial Uses	Listed Impairments
Curry Creek	None designated[1]	Placer and Sutter Counties: pyrethroids (urban runoff/storm sewers)
Pleasant Grove Canal	None designated[1]	None identified
Natomas Cross Canal	None designated[1]	Sutter County: mercury (resource extraction)
Sacramento River *Below Chico*	Irrigation, stock watering, water contact recreation, canoeing and rafting, warm freshwater habitat, cold freshwater habitat, coldwater migration, warmwater spawning, wildlife habitat	Knights Landing to Delta reach: mercury (resource extraction), unknown toxicity (source unknown), chlordane (agriculture), DDT (agriculture), dieldrin (agriculture), Polychlorinated biphenyls (PCBs) (source unknown)
Sacramento River *Colusa Basin Drain to I Street Bridge (Sacramento)*	Municipal and domestic supply, irrigation, water contact recreation, canoeing and rafting, other noncontact recreation, warm freshwater habitat, cold freshwater habitat, warmwater spawning, coldwater spawning, wildlife habitat, navigation	
Sacramento – San Joaquin Delta	Municipal and domestic supply, irrigation, stock watering, industry (process supply, service supply), water contact recreation, other noncontact recreation, warm and cold freshwater habitat, warmwater migration, coldwater migration, warmwater spawning, wildlife habitat, navigation	*Northern portion:* chlordane (agriculture), chlorpyrifos (agriculture, urban runoff/storm sewers), DDT (agriculture), diazinon (agriculture, urban runoff/storm sewers), dieldrin (agriculture), exotic species (source unknown), Group A pesticides (agriculture), mercury (resource extraction), PCBs (source unknown), unknown toxicity (source unknown) *Central portion:* chlorpyrifos (agriculture, urban runoff/storm sewers), DDT (agriculture), diazinon (agriculture, urban runoff/storm sewers), invasive species (source unknown), Group A pesticides (agriculture), mercury (resource extraction), unknown toxicity (source unknown) *Export area:* chlorpyrifos (agriculture, urban runoff/storm sewers), DDT (agriculture), diazinon (agriculture, urban runoff/storm sewers), electrical conductivity (agriculture), invasive species (source unknown), Group A pesticides (agriculture), mercury (resource extraction), unknown toxicity (source unknown)
Sacramento Valley groundwater	Municipal and domestic supply, agricultural supply (irrigation and stock watering), industry (process supply, service supply), unless specifically designated otherwise by the RWQCB	None identified

Source: Central Valley RWQCB 2010; 2016b

1 *The Central Valley RWQCB will evaluate the beneficial uses of these water bodies on a case-by-case basis. Water bodies that do not have beneficial uses designated are assigned the designation of municipal and domestic supply in accordance with the provisions of State Water Board Resolution No. 88-63. Exceptions listed in Resolution No. 88-63 may apply to these water bodies.*

In addition, there are four sub-watersheds in the southeastern portion of the site that drain to the south and east. The project site also gets runoff from an approximately 4.5-acre residential area to the north of Sunset Boulevard West. Most of the project site flows enter directly into University Creek, an intermittent tributary of Pleasant Grove Creek that flows along the site's southern boundary.

The historic low flow drainage path away from the site has been altered with berms and ditches to avoid agricultural fields. Specifically, the historic low flow drainage path from sub-watershed PL10Q1 has been redirected to the north of a bermed rice field. A ditch is located just west of Discharge Point G, which has a slightly eastwardly slope for a distance of approximately 700-feet west of the property line. The highest point on the invert of the ditch is about 81.3 feet. Runoff is retained onsite until it reaches an elevation of 81.3 feet. The capacity of the ditch at this location is less than 10 cubic feet per second (cfs), which is less than the 2-year event flow rate for the tributary area. Low flows from PL10Q1 flow through the ditch, but runoff from larger storm events in excess of 10 cfs spills over the berm to the south and continues south and west towards University Creek and Pleasant Grove Creek as overland flow. The overland flow creates a ponded area that extends from the neighboring Gleason property onto the project site. This ponded area, which is outside of the 100-year floodplain, can reach a water surface elevation on the project site of about 82.5 feet and is controlled by the elevation of the berm and the ditch. The maximum extent of the ponding at elevation 82.5 feet covers an area of about 2.7 acres within the project site (**Figure 3.11-2, Western Boundary Existing Conditions Runoff Patterns**) (City of Roseville 2016a).

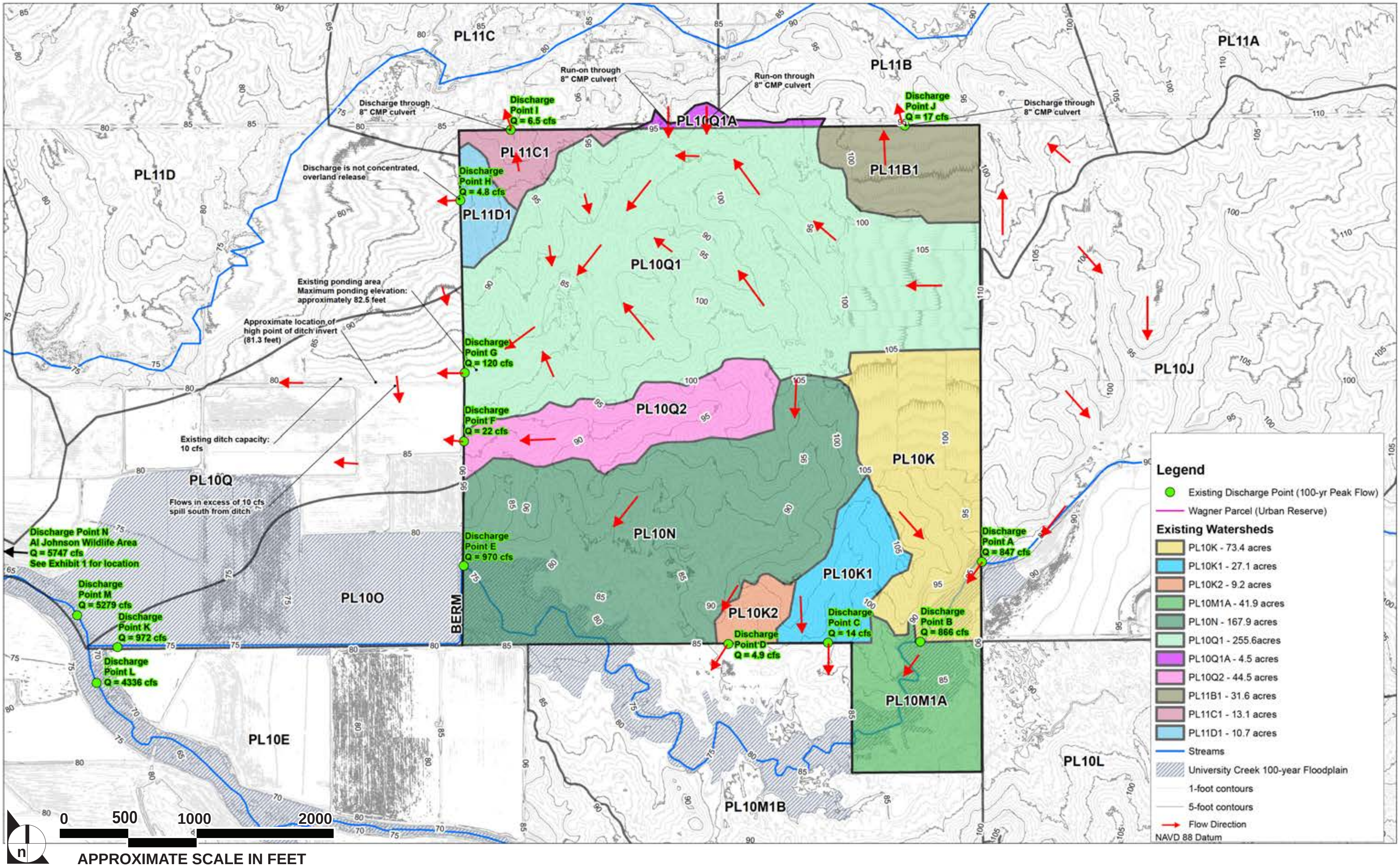
3.11.2.6 Project Site - Flood Hazards

University Creek flows to Pleasant Grove Creek, which drains into the Pleasant Grove Canal and then to the Natomas Cross Canal. Natomas Cross Canal then drains to the Sacramento River. At present, water ponds along the western boundary of the project site during large storm events, then overtops the ditch onto adjacent properties. In addition, water in Pleasant Grove Creek downstream from the project site overflows its banks, flooding homes and ranches. According to the Federal Emergency Management Agency (FEMA), the southern portion of the project site along the University Creek corridor is located within a floodway.

The project site is within an area that could be affected by flooding in the event that the western dikes along Folsom Lake fail (Dikes Nos. 4, 5, and 6). The most likely disaster-related causes of dam failure in Placer County and the Roseville vicinity are earthquakes, excessive rainfall, and landslides (City of Roseville 2016c). The National Inventory of Dams database considers these high-hazard structures (County of Placer 2005), meaning that loss of human life is considered likely in the event of a failure.

3.11.2.7 Project Site – Groundwater Levels and Groundwater Recharge

DWR has monitored groundwater levels in the project region for the last several decades and has three monitoring wells in the project vicinity, which range in depth between 303 and 450 feet. One is located adjacent to Pleasant Grove Creek, immediately west of Fiddyment Road; the second is on Kaseberg Creek southeast of the intersection of Fiddyment Road and Phillip Road; and, the third is on City property north of the project area (West Yost 2016). According to exploratory boreholes at well sites north of the project site, the aquifer zone (Mehrten Formation) for drinking water was found at depths ranging from approximately 300 to 525 feet below ground surface (bgs) with thicknesses ranging from approximately 100 to 200 feet



SOURCE: Kimley Horn, 2015; AES, 2015

FIGURE **3.11-1**

Existing Conditions Drainage Patterns

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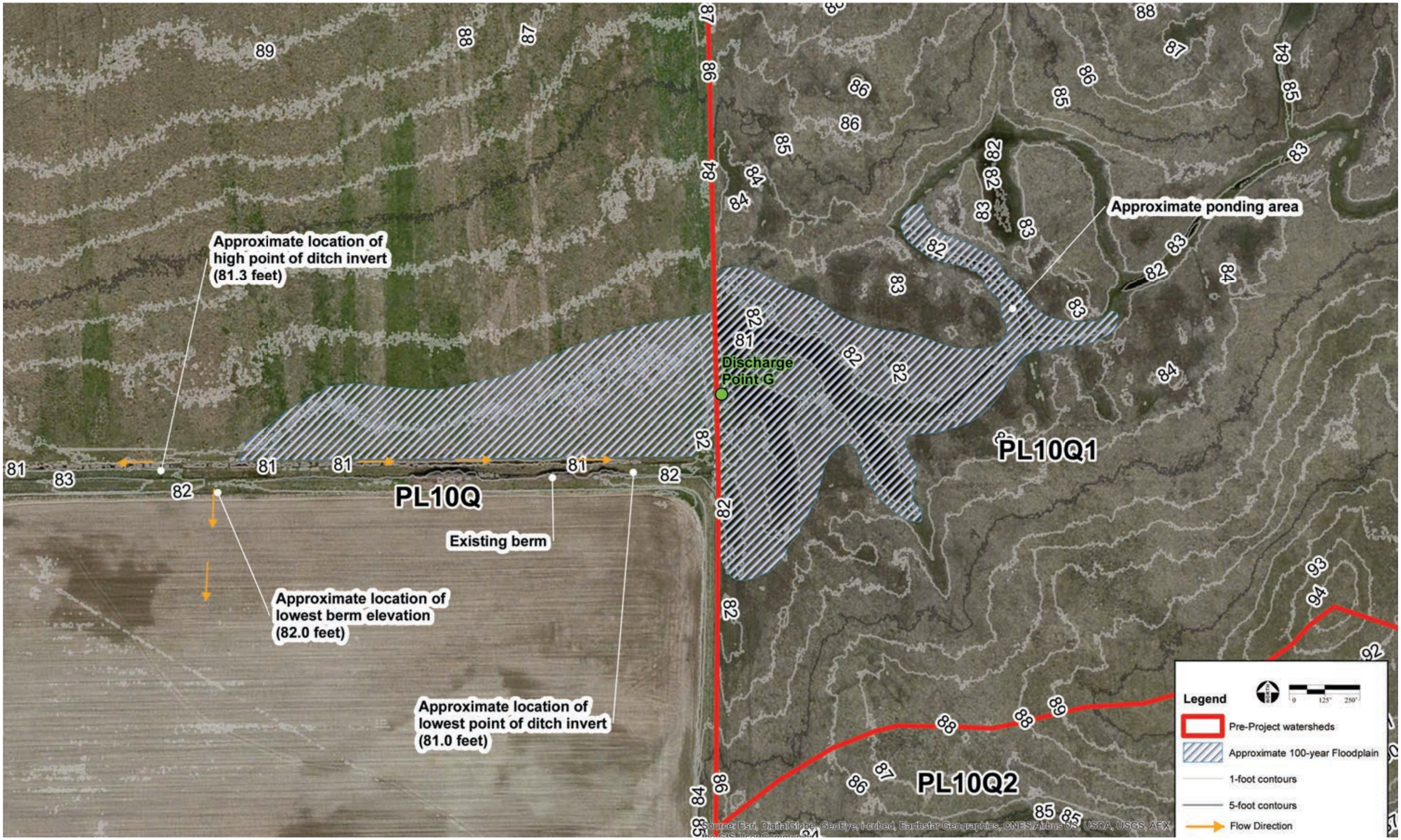

SOURCE: Kimley Horn, 2015; AES, 2015

FIGURE **3.11-2**

IMPACT SCIENCES

Western Boundary Existing Conditions Runoff Patterns

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(Montgomery Watson Harza [MWH] 2007). Monitoring data suggest that groundwater levels in the vicinity have been generally stable since about 1980, with local increases reported in the first well (MWH 2007). Groundwater elevations tend to be significantly higher on the eastern edge of the sub-basin near the Sierra Nevada foothills and lower on the western edge of the groundwater sub-basin (MWH 2007).

The project site is not within a significant recharge area for the Sacramento Valley groundwater basin. Hardpan and claypan soils in the project area may further limit recharge in this portion of the basin.

3.11.3 SIGNIFICANCE THRESHOLDS AND ANALYSIS METHODOLOGY

3.11.3.1 Significance Thresholds

Council on Environmental Quality (CEQ) guidance requires an evaluation of a proposed action's effect on the human environment. The Corps has determined that the Proposed Action, or an alternative, would result in significant effects related to hydrology and water quality if it would:

- an increase in the rate or amount of surface runoff in a manner which would result in flooding on or off-site;
- place housing or structures within a 100-year floodplain or place structures that would impede or redirect flood flows;
- 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;
- during and post construction, create substantial additional sources of polluted runoff that could affect water quality;
- cause an exceedance of applicable effluent discharge standards;
- interfere substantially with groundwater recharge or substantially deplete groundwater supplies such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level; or
- substantially increase runoff such that the geomorphology of creeks is altered.

3.11.3.2 Analysis Methodology

The analysis presented below is based primarily on the Drainage Master Plan prepared by Kimley-Horn for the project site, which is included in **Appendix 3.11**. Specific methodology related to how peak flows of storm water were calculated are discussed in more detail below.

Storm Water Peak Flows

Precipitation data for the regional and site models were developed using methodology outlined in the Placer County SWMM, which requires multiple storm centering scenario analysis. Site-specific hydrologic modeling was performed for the 2-year, 10-year, and 100-year 24-hour storm events using the HEC-HMS model (Version 4.0). Using the HEC-HMS model and following the Placer County SWMM methodology allows for the efficient processing of multiple storm scenarios involving multiple recurrence intervals, storm centerings, and storm approach angles.

Storm Water Runoff Water Quality

The analysis of potential water quality effects was based on a qualitative comparison of predevelopment and post-development land uses. The Proposed Action would also incorporate a wide range of low-impact development (LID) options, including the following.

- Disconnected roof drains
- Interceptor tree planting
- Soil amendments in landscaped areas and storm water planters
- Alternative driveways and porous pavement
- Vegetated swales
- Separated sidewalks

3.11.4 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

Impact HYDRO-1 Effect related to On- or Off-Site Flood Hazards

No Action Alt. The project site is currently undeveloped. Development under the No Action alternative would modify existing topography and drainage on the project site by constructing a moderate-scale, mixed-use development on the project site. Assuming the use of conventional hardscape, buildout under the No Action alternative would add approximately 282 acres of impervious surface to the site, with approximately 305 acres preserved as open space.

Although it is outside of the existing 100-year floodplain, the area on- and off-site along the western project boundary currently experiences flooding. The existing westerly agricultural ditch and berm cannot contain flows in excess of 10 cfs, which is less than the 2-year event flow rate for the area. Therefore, ponding is common on the Gleason property, Toad Hill Ranches to the northwest of the project site, and on the project site following storm events. However, development under the No Action alternative would be located outside of the areas that are prone to flooding on the project site; thus, development under the No Action alternative would not place development at risk for localized flooding. In addition, the proposed on-site drainage system would be designed with sufficient capacity to accommodate the storm water runoff generated on the site under the No Action alternative. Additionally, considerations would be made for the safe conveyance and overland flow of a 100-year storm event assuming a total blockage of the storm drain system (e.g., elevated building pads). Thus, **no direct** or **indirect** effects on localized flooding under the No Action alternative were identified.

Flood flows exiting the project site were not separately calculated for the No Action alternative. As shown in **Table 3.11-2** below, under the Proposed Action, peak flows exiting the site under post-project conditions slightly exceed the pre-project peak flows for the 2-year and 10-year events. Although the increases would be small, given the severity of the flooding problems downstream, the increases may result in off-site flooding or siltation. This represents a **significant indirect** effect. However, as shown in **Table 3.11-3** below, peak flows exiting the site under post-project conditions would equal pre-project peak flows for a 100-year, 24 hour event, and thus would not result in off-site flooding or siltation.

The No Action alternative would result in less peak flows than the Proposed Action due to its smaller development size and reduced amount of impervious surfaces. However, similar to the Proposed Action, off-site flooding or siltation would not occur during a 100-year, 24 hour event, but off-site flooding or siltation could occur during 2-year and 10-year events under the No Action alternative. This is a result of the deliberate routing of water away from the Gleason property and Toad Hill Ranches, which is intended to remediate flooding outside the 100-year floodplain, such as that which occurs in a 2- or 10-year storm event. Under pre-project conditions, this water would eventually drain to University Creek downstream from the proposed location. Thus, the No Action alternative would not change the overall amount of water in the system, although it would alter where it enters the creek. These small increases in peak flow from the 2- and 10-year events reflect the addition of flows that would normally negatively impact off-site properties to the north.

The slight increases in peak flow in the 2- and 10-year storm events may result in impacts to off-site flooding or siltation, and this represents a **significant indirect** effect.

Mitigation Measure HYDRO-1a would be implemented to address this effect, which requires the Applicant develop a plan to monitor for erosion and to implement measures to prevent and/or remediate erosion, should it occur. This measure is the same as Mitigation Measure 4.13-5 in the ARSP EIR, and is highly likely to be imposed by the City of Roseville under the No Action alternative to address this effect.

Development under the No Action alternative would also increase the volume of storm water runoff entering University Creek and Pleasant Grove Creek compared to existing conditions. This volume increase, when combined with the larger watersheds contributing to the Natomas Cross Canal watershed, has the potential to peak with the flood waters of the Sacramento River to cause flooding downstream of the project site in Sutter County. This **indirect** effect is considered **significant**.

The City is currently developing flood protection improvements to address flooding in the Natomas Cross Canal–Pleasant Grove Canal sump area through its Pleasant Grove Retention Basin project, which would construct a 2,530 acre-foot flood storage basin in the AJWA to manage increased runoff from existing and planned (entitled) development in those portions of the City that drain to the Natomas Cross Canal. This includes projects within the University Creek and Pleasant Grove Creek watersheds.

Table 3.11-2
2-Year & 10-Year Peak Flow Comparison (CFS)

Discharge Point	Description	2-Year Peak Flow			10-Year Peak Flow		
		Pre-Project	Post-Project	Net Change in Flow	Pre-Project	Post-Project	Net Change in Flow
A	Flow in University Creek upstream of ARSP	110	110	0.0	391	391	0.0
B	Flow in University Creek downstream of PL10K	112	111	-1.0	399	393	-6.0
C	Flow out of PL10K1	1.2	0.0	N/A	5.8	0.0	N/A
D	Flow out of PL10K2	0.4	0.0	N/A	2.8	0.0	N/A
E	Flow in University Creek existing ARSP	127	133	+7.0	446	452	+6.0
F	Flow out of PL10Q2	2.2	0.0	N/A	7.8	0.0	N/A
G	Flow out of PL10Q1	12	0.0	N/A	43	0.0	N/A
H	Flow out of PL11D1	0.5	0.0	N/A	1.7	0.0	N/A
I	Flow out of PL11C1	0.7	0.0	N/A	2.3	0.0	N/A
J	Flow out of PL11B1	1.6	0.0	N/A	6.7	0.0	N/A
K	Flow in University Creek upstream of confluence with Pleasant Grove Creek	127	134	+7.0	447	453	+7.0
L	Flow in Pleasant Grove Creek upstream of confluence with University Creek	1,017	1,017	0.0	2,020	2,020	0.0
M	Flow in Pleasant Grove Creek downstream of confluence with University Creek	1,115	1,123	+8.0	2,440	2,442	+2.0
N	Flow in Pleasant Grove Creek at Al Johnson Wildlife Area	1,192	1,194	+2.0	2,663	2,647	-16.0
O	Flow from ARSP on-site channels	N/A	58	+50	N/A	151	+119

Source: Kimley-Horn. 2016
* *Values in the Post-Project condition that are 0.0 cfs represent basins where water is being directed away from the pre-project discharge points.*

Mitigation Measure HYDRO-1b would be implemented to address the downstream flooding effect. It requires the Applicant to pay the City's Pleasant Grove Watershed Mitigation Fee, which would provide a fair-share contribution toward the cost of the Pleasant Grove Retention Basin project. This measure is the same as Mitigation Measure 4.13-3 in the ARSP EIR and it is highly likely that the City of Roseville would impose this mitigation measure under the No Action alternative. Although the start date for construction of the flood storage facility has not been decided, the City of Roseville has a process in place to monitor the need for the flood storage project which will determine when the detention facility will be built. **No direct** effects related to on- and off-site flood hazards under the No Action alternative were identified.

The No Action alternative would not require any wetlands restoration activities at the mitigation sites. There would be no impacts to downstream flooding. **No direct** or **indirect** effects related to on- and off-site flood hazards were identified.

Table 3.11-3
100-Year Peak Flow Comparison (CFS)

Discharge Point	Description	Pre-Project	Post-Project No Storage/ (With Storage)[1]	Net Change in Flow
A	Flow in University Creek upstream of ARSP	847	847 (847)	0.0 (0.0)
B	Flow in University Creek downstream of PL10K	866	851 (860)	-15.0 (-6.0)
C	Flow out of PL10K1	14	0.0	N/A
D	Flow out of PL10K2	4.9	0.0	N/A
E	Flow in University Creek existing ARSP	970	970 (990)	0.0 (+20.0)
F	Flow out of PL10Q2	22	0.0	N/A
G	Flow out of PL10Q1	120	0.0	N/A
H	Flow out of PL11D1	4.8	0.0	N/A
I	Flow out of PL11C1	6.5	0.0	N/A
J	Flow out of PL11B1	17	0.0	N/A
K	Flow in University Creek upstream of confluence with Pleasant Grove Creek	972	972 (992)	0.0 (+20.0)
L	Flow in Pleasant Grove Creek upstream of confluence with University Creek	4,336	4,336 (4,336)	0.0 (0.0)
M	Flow in Pleasant Grove Creek downstream of confluence with University Creek	5,279	5,276 [5,294]	-3.0 (+15.0)
N	Flow in Pleasant Grove Creek at Al Johnson Wildlife Area	5,747	5,704 (5,715)	-43.0 (-32.0)
O	Flow from ARSP on-site channels	N/A	394 (359)	+310.0 (+750.0)

Source: Kimley-Horn. 2016

* *- Values in the Post-Project condition that are 0.0 cfs represent basins where water is being directed away from the pre-project discharge points.*

1. *Flows in (parenthesis) are the Post-Project flows with Low Impact Development (LID) measures incorporated.*

Proposed Action

As noted above, the project site is currently undeveloped. Development under the Proposed Action would modify existing topography and drainage on the project site by constructing a large-scale, mixed-use development on the project site. Assuming the use of conventional hardscape; buildout under the Proposed Action would add approximately 458 acres of impervious surface to the site (compared to 282 acres under

No Action alternative), with approximately 108 acres preserved as open space (compared to 305 acres under No Action alternative).

As discussed above, there are existing flooding issues within the project site and surrounding properties along the western property boundary. In response, the proposed drainage system would redirect current flows negatively affecting the Gleason property and Toad Hill Ranches to the southern portion of the project site via the proposed open channel conveyance facility along the western boundary of the site.

The proposed on-site drainage system has been designed with sufficient capacity to accommodate the Proposed Action as well as to address ongoing drainage issues in the vicinity (Kimley-Horn 2016a). The proposed drainage patterns and proposed outflows are shown in **Figure 3.11-3, Proposed Conditions Drainage Patterns**. Furthermore, additional considerations would be made for the safe conveyance and overland flow release of the 100-year storm event assuming a total blockage of the storm drain system. For these reasons, the Proposed Action would not increase the risk for localized flooding on-site. Based on the significance criteria listed above and for the same reasons as the No Action alternative, no **direct** or **indirect** effects on localized flooding under the Proposed Action were identified.

Peak flow runoff rates were determined for the Proposed Action to identify drainage features that would be necessary to mitigate post-project development flows. Pre-project and post-development peak hydraulic grades for University Creek and Pleasant Grove Creek in the 2-year, 10-year, and 100-year storm scenarios are presented in **Tables 3.11-2** and **3.11-3** above**.**

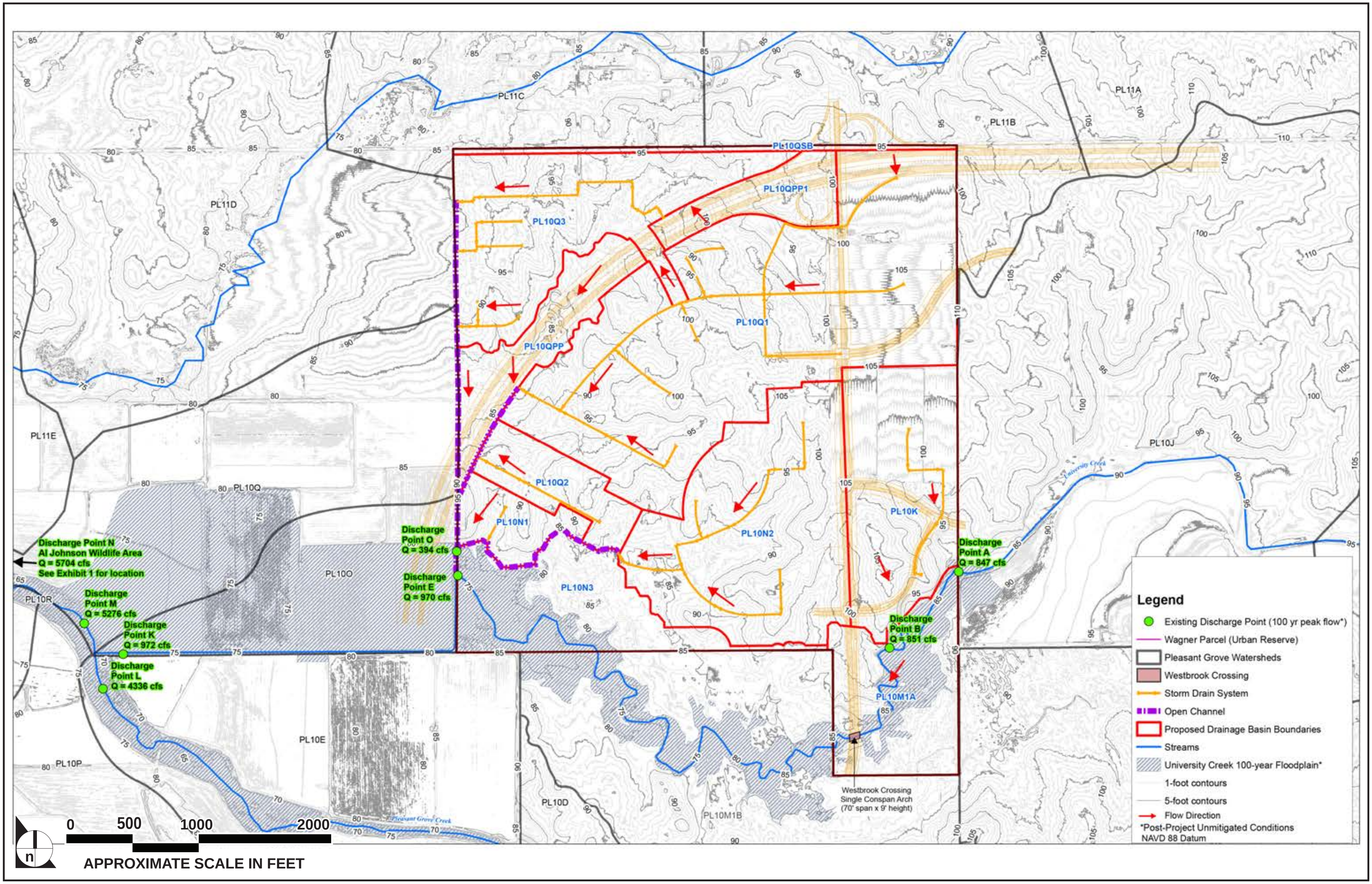
As shown in **Table 3.11-2**, peak flows exiting the site under post-project conditions slightly exceed pre-project peak flows for the 2-year and 10-year events, which given the severity of the flooding problem downstream, may result in impacts to off-site flooding or siltation, and this represents a **significant indirect** effect. However, the Proposed Action would include numerous Low Impact Development (LID) measures such as vegetated swales, porous pavement, and interceptor trees. Although these measures are primarily utilized to improve storm water quality, in small storms such as the 2- and 10-year events, they would also function to slow the rate of runoff leaving the site. As a result, the modeling presented in the tables represents conservative scenarios. In addition, the deliberate routing of water away from the Gleason property and Toad Hill Ranches is intended to remediate flooding outside the 100-year floodplain, such as that which occurs in a 2- or 10-year storm event. Under pre-project conditions, this water would eventually drain to University Creek downstream from the proposed location. Therefore, the Proposed Action would not change the overall amount of water in the system, although it would alter where it enters the creek. These small increases in peak flow from the 2- and 10-year events reflect the addition of flows that would normally negatively impact off-site properties to the north.

Mitigation Measure HYDRO-1a would be implemented to address this effect and is the same as Mitigation Measure 4.13-5 in the ARSP EIR, which has been imposed and would be enforced by the City of Roseville under the Proposed Action to address this effect. **No direct** effects on erosion and siltation under the Proposed Action were identified. Peak flows for the 100-year storm event are presented in **Table 3.11-3** below, and includes a "Post-Project (No Storage)" model, which represents the proposed drainage system, and a "Post-Project (With Storage)" model, which represents a hypothetical scenario where storm water detention basins are included as part of the proposed drainage system. The Post-Project (With Storage) model was included because the volume of runoff leaving the project site under the Proposed Action would increase by 75.31 acre-feet under the post-development conditions. Three one-acre detention basins were added to the Post-Project (No Storage) model to create the Post-Project (With Storage) model. Although onsite storage reduces flow volume, onsite storage causes higher peak flows than those under the Post-Project (No Storage) condition. This is due to peak flow timing and therefore onsite storage is not recommended.

Peak flows in Pleasant Grove Creek downstream of the confluence do not increase under Post-Project (No Storage) 100-year, 24-hour conditions. However, detaining runoff in the three hypothetical detention basins in the Post-Project (With Storage) scenario causes higher peak flows (shown in **Table 3.11-3**) and results in a delay in the Post-Project runoff. This causes peak flow coming from the project site to align in timing with the peak flows in University Creek and Pleasant Grove Creek.

The results of the hydrologic modeling indicate that the runoff from the project site occurs approximately 5.5 hours before the peak in the natural hydrograph of both Pleasant Grove Creek and University Creek. Providing onsite storage to retain runoff would result in the delay of the runoff so that it results in an increase in peak flows in both University Creek (where it exits the project site) and Pleasant Grove Creek (downstream of the confluence with University Creek and downstream of AJWA). This may result in increased flooding and erosion issues within Pleasant Grove Creek. Based on the significance criteria listed above and for the same reasons identified under the No Action alternative, **no indirect** effects due to an increase in 100-year flows under the Proposed Action were identified.

In addition, runoff from the project site under the Proposed Action would also contribute to flooding in the sump area upstream of the Natomas Cross Canal–Pleasant Grove Canal confluence. Based on the significance criteria and same reasons detailed under the No Action alternative listed above, **indirect** effects as a result of off-site flooding or siltation would be **significant**. However, **Mitigation Measure HYDRO-1b** would address this effect and is the same as Mitigation Measure 4.13-3 in the ARSP EIR, which



SOURCE: Kimley Horn, 2015; AES, 2015

FIGURE **3.11-3**

IMPACT SCIENCES

Proposed Conditions Drainage Patterns

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has been imposed and will be enforced by the City of Roseville under the Proposed Action. **No direct** effects as a result of on- and off-site flooding under the Proposed Action were identified. The wetlands restoration activities at the mitigation sites would not add any impervious surfaces and result in increased runoff that could affect peak flows. **No direct** or **indirect** effects related downstream flooding were identified.

Alts. 1, 2, 3 Like the Proposed Action, Alternatives 1, 2, and 3 would construct a large-scale, mixed-use development on the project site. Buildout under theses alternative would add approximately 421 to 469 acres of impervious surface to the site (compared to 282 acres under No Action alternative), with approximately 92 to 142 acres preserved as open space (compared to 305 acres under No Action alternative). As with the Proposed Action, the onsite drainage system under all three alternatives would be designed with sufficient capacity to accommodate storm water runoff from impervious surfaces, and include sufficient capacity to address existing drainage issues in the vicinity as well. Unlike the No Action alternative, Proposed Action and Alternatives 2 and 3, due to topographic constraints, Alternative 1 would require the construction of an additional drainage channel that would convey storm water runoff from the south-central portions of the project site through the southern preserve to University Creek. Additional considerations in the design of the development (e.g., elevated building pads) would be made for the safe conveyance and overland flow release of a 100-year storm event assuming a total blockage of the storm drain system. For these reasons, Alternatives 1, 2, or 3 would not increase the risk for localized flooding on-site. Based on the significance criteria listed above, and for the same reasons identified under the No Action alternative, **no direct** or **indirect** effects related to localized flooding under Alternatives 1, 2, or 3 were identified.

The three on-site alternatives would contribute to flooding and siltation downstream from the project site and contribute to flooding in the sump area upstream of the Natomas Cross Canal–Pleasant Grove Canal confluence. Based on the significance criteria listed above and for the same reasons presented above for the No Action alternative, this **indirect** effect is considered **significant**. **Mitigation Measures HYDRO-1a** and **HYDRO-1b** would address this effect. As noted above, these measures are the same as Mitigation Measures 4.13-3 and 4.13-5 in the ARSP EIR. The Corps assumes that the City of Roseville would impose the same mitigation measures on the alternatives to address these effects. **No direct** effects as a result of on- and off-site flooding were identified.

The wetlands restoration activities at the mitigation sites would not add any impervious surfaces and result in increased runoff that could affect peak flows. **No direct** or **indirect** effects related to downstream flooding were identified.

Mitigation Measure HYDRO-1a: Erosion Monitoring Plan
(Applicability – No Action, Proposed Action, and Alternatives 1, 2, and 3)

At the onset of any grading activities within the project site that increase the existing drainage area tributary to the University Creek channel within Al Johnson Wildlife Area, a geomorphologic assessment of University Creek through the Al Johnson Wildlife Area property shall be conducted.

The geomorphologic assessment shall include erosion protection measures, such as stream bank stabilization and velocity reduction measures, and the location for their implementation. The construction of the erosion protection measures shall be triggered by criteria established within the geomorphologic assessment.

Mitigation Measure HYDRO-1b: Fair Share Payment to Regional Storm Water Retention
(Applicability – No Action, Proposed Action, and Alternatives 1, 2, and 3)

The Applicant shall annex into the fee district and pay the Pleasant Grove Watershed Mitigation fee to the City prior to the approval of each building permit, which would cover the cost of retention for that development's portion of the Pleasant Grove Retention Basin Project at the Al Johnson Wildlife Area.

Impact HYDRO-2 Effects from Construction within a Floodplain

No Action Alt. Construction within a floodplain area can be of concern because it has the potential to impede flood conveyance and/or redirect flood flows, and can exacerbate existing flood hazards or create new hazards in areas not presently subject to flooding.

As discussed in the **Affected Environment** above, the project site is within the City's Regulatory Floodplain and also lies within a FEMA designated 100-year floodplain. This consists of the University Creek corridor that enters the site from the southeast, leaves the site along the southern boundary, then re-enters and leaves the project site in the southwestern corner. Under the No Action alternative, the entire 100-year floodplain would be located within an area designated as open space and no major structures would be placed within the 100-year floodplain, except for an extension of Westbrook Boulevard north from the Creekview Specific Plan area onto the project site. This roadway would include the placement of a 9 foot high by 70 foot wide arch culvert crossing over University Creek, and would be constructed within the 100-year floodplain under the No Action alternative. Compared to Pre-Project conditions, construction of the culvert crossing would result in a slight constriction of the floodplain, which would increase the water surface elevation upstream to the east; but would not increase downstream to the west of Westbrook Boulevard. Since the increase in surface water elevation would be contained entirely within the project site and located within the proposed open space preserve area (City of Roseville 2106a), there would be no significant increase in the risk of flooding. Thus, **no direct** or **indirect** effects from construction within the floodplain under the No Action alternative were identified.

Proposed Action Compared to the No Action alternative, the Proposed Action would construct a larger mixed-use development on the project site. However, similar to the No Action alternative, no major structures would be constructed within the 100-year floodplain, except for an extension of Westbrook Boulevard north from the Creekview Specific Plan area onto the project site, including a culvert crossing of the creek. Based on the significance criteria listed above, and for the same reasons identified under the No Action alternative, there would be no significant increase in the risk of flooding due to the construction of the culvert crossing within the 100-year floodplain. Thus, **no direct** or **indirect** effects from construction within the floodplain under the Proposed Action were identified.

Alts. 1, 2, 3 Like the No Action alternative and Proposed Action, no major structures would be constructed within the 100-year floodplain under Alternatives 1, 2, or 3, except for the proposed extension of Westbrook Boulevard north from the Creekview Specific Plan area onto the project site, including a culvert crossing of the creek. Based on the significance criteria listed above, and for the same reasons identified under the Proposed Action and No Action alternative, there would be no significant increase in the risk of flooding under Alternatives 1, 2, and 3. Thus, **no direct** or **indirect** effects from construction within the floodplain under Alternatives, 1, 2, or 3 were identified.

Impact HYDRO-3 Water Quality Effects during Construction

No Action Alt. Development activities associated with the No Action alternative would entail ground disturbance, with the potential to result in accelerated erosion and delivery of increased sediment loads to surface waters in the project area. Construction and site finishing would also use a variety of substances with the potential to degrade water quality in the event they are spilled or released (such as vehicle fuels and lubricants, paints, paving media, adhesives, paints, fertilizers, etc.). This represents a **significant direct** effect.

A variety of mechanisms and policies are in place to require erosion and sediment control measures and appropriate handling of the various substances used in construction. The most important and enforceable protections are afforded through the NPDES permitting system. Because each construction phase is expected to exceed the SWRCB's 1-acre threshold, development under the No Action alternative would be required to obtain coverage under the current Construction General Permit (Order 2009-0009-DWQ and amended by 2010-0014-DWQ and 2012-0006-DWQ), which is substantially more stringent than previous requirements and requires:

- implementation of a SWPPP stipulating BMPs to prevent construction pollutants from contacting storm water and control off-site delivery of sediment and other construction related pollutants,

- elimination or reduction of non-storm water discharges to storm sewer systems and other jurisdictional waters, and
- inspection and monitoring to ensure that BMPs are functioning properly.

Furthermore, **Mitigation Measure HYDRO-3** would address effects on water quality during construction by requiring the creation and implementation of a SWPPP and BMPs to minimize erosion and the risk of polluted runoff leaving the project site during construction. This measure is the same as Mitigation Measure 4.13-1 in the ARSP EIR and is highly likely to be imposed and enforced by the City of Roseville under the No Action alternative to address this effect. **No indirect** effects on water quality during construction under the No Action alternative were identified.

Proposed Action The Proposed Action would construct a large-scale, mixed use development on the project site. The total amount of development under the Proposed Action would be greater than the No Action alternative. Therefore, construction activities associated with the Proposed Action would have a greater potential to result in short-term water quality effects. This would be a **significant direct** effect. However, **Mitigation Measure HYDRO-3** would require the preparation and implementation of a SWPPP and use of BMPs to minimize erosion and the risk of polluted runoff leaving the project site during construction. As noted above, this measure is the same as Mitigation Measure 4.13-1 in the ARSP EIR and has been imposed by the City of Roseville and will be enforced by the City under the Proposed Action to address this effect. **No indirect** effects on water quality during construction under the Proposed Action were identified.

Alts. 1, 2, 3 Similar to the Proposed Action, Alternatives 1, 2, and 3 would construct large-scale, mixed use developments on the project site. Construction activities under each alternative would have the potential to result in short-term water quality effects. This would be a **significant direct** effect. However, **Mitigation Measure HYDRO-3** would require the preparation and implementation of a SWPPP and use of BMPs to minimize erosion and the risk of polluted runoff leaving the project site during construction. As noted above, this measure is the same as Mitigation Measure 4.13-1 in the ASRP EIR and is highly likely to be imposed and enforced by the City of Roseville under Alternatives 1, 2, and 3 to address this effect. **No indirect** effects on water quality during construction under Alternatives 1, 2, or 3 were identified.

Mitigation Measure HYDRO-3: Construction Activity Storm Water Standards *(Applicability – No Action, Proposed Action, and Alternatives 1, 2, and 3)*

Prior to the issuance of a City grading permit and the commencement of construction activities, the Applicant shall demonstrate to the City compliance with the SWRCB NPDES General Permit for Discharges of Storm Water Runoff Associated with Construction Activity (General Permit), the City of Roseville's Construction Standards, and the City's Stormwater BMP Guidance Manual. The SWRCB requires that all construction sites have adequate control measures *to reduce the discharge of sediment and other pollutants to streams to ensure compliance with Section 303 of the CWA. To comply with the NPDES permit, the Applicant shall file a Notice of Intent with the SWRCB and prepare a SWPPP prior to construction, which includes a detailed, site-specific listing of the potential sources of stormwater pollution; pollution prevention measures (erosion and sediment control measures and measures to control non-stormwater discharges and hazardous spills) to include a description of the type and location of erosion and sediment control BMPs to be implemented at the project site, and a BMP monitoring and maintenance schedule to determine the amount of pollutants leaving the project site. A copy of the SWPPP must be current and remain on the project site. Control measures are required prior to and throughout the rainy season. Water quality BMPs identified in the SWPPP could include but are not limited to the following:*

- *Temporary erosion control measures (such as silt fences, staked straw bales, and temporary revegetation) shall be employed for disturbed areas. No disturbed surfaces will be left without erosion control measures in place during the winter and spring months.*
- *Sediment shall be retained onsite by a system of sediment basins, traps, or other appropriate measures.*
- *A spill prevention and countermeasure plan shall be developed which would identify proper storage, collection, and disposal measures for potential pollutants (such as fuel, fertilizers, pesticides, etc.) used onsite. The plan would also require the proper storage, handling, use, and disposal of petroleum products.*
- *Construction activities shall be scheduled to minimize land disturbance during peak runoff periods and to the immediate area required for construction. Soil conservation practices shall be completed during the fall or late winter to reduce erosion during spring runoff. Existing vegetation will be retained where possible. To the extent feasible, grading activities shall be limited to the immediate area required for construction.*
- *Surface water runoff shall be controlled by directing flowing water away from critical areas and by reducing runoff velocity. Diversion structures such as terraces, dikes, and ditches shall collect and direct runoff water around vulnerable areas to prepared drainage outlets. Surface roughening, berms, check dams, hay bales, or similar devices shall be used to reduce runoff velocity and erosion.*
- *Sediment shall be contained when conditions are too extreme for treatment by surface protection. Temporary sediment traps, filter fabric fences, inlet protectors, vegetative filters and buffers, or settling basins shall be used to detain runoff water long enough for sediment particles to settle out. Store, cover, and isolate construction materials, including topsoil and chemicals, to prevent runoff losses and contamination of groundwater.*
- *Topsoil removed during construction shall be carefully stored and treated as an important resource. Berms shall be placed around topsoil stockpiles to prevent runoff during storm events.*
- *Establish fuel and vehicle maintenance areas away from all drainage courses and design these areas to control runoff.*
- *Disturbed areas shall be revegetated after completion of construction activities.*

- *All necessary permits and approvals shall be obtained.*
- *Provide sanitary facilities for construction workers.*

Impact HYDRO-4 Water Quality Effects from Project Occupancy and Operation

No Action Alt. The No Action alternative would convert currently undeveloped lands to urban/suburban uses, including residential areas, commercial areas, roadways, parking areas, and developed recreational areas. The introduction of extensive impervious surfaces would have the potential to increase runoff from the site, and because of the introduction of developed uses, would also have the potential to decrease the quality of runoff. Water runoff from development would be typical of urban areas, where a variety of activities could contribute pollutants, such as; petroleum products, coliform bacteria, nitrogen, phosphorus, heavy metals, pesticides, herbicides, and byproducts of pavement wear, to the runoff. If runoff is uncontrolled, the long-term potential for degradation of water quality would be a **significant indirect** effect.

Consistent with NPDES requirements, the Applicant is proposing to implement LID measures to reduce impervious surfaces and ensure water quality standards are met. The Amoruso Drainage Master Plan identifies the following types of LID strategies.

- **Disconnected roof drains** allow runoff from roof systems to be treated by biological filtration while providing opportunities for infiltration.
- **Tree planting and canopy preservation** would increase uptake of runoff and decrease the volume of runoff entering the storm drain system.
- **Addition of soil amendments** in landscaped areas and storm water features can create voids that detain runoff, reducing runoff delivery to surface waters and fostering infiltration. In residential areas, this could entail amending landscape strips adjacent to roadways or other paved areas. In commercial areas, soil amendments are likely to be limited to "storm water planter" areas. Along roadways, soil amendments can be used where roadway runoff is diverted into landscaped areas.
- **Various types of permeable or porous pavements** decrease the area of impervious surface and reduce runoff generation while supporting uses similar to conventional hardscape.
- **Vegetated swales**, which will be required at all storm drain outfalls, provide opportunities for infiltration, as well as additional treatment.
- **Separated sidewalks** allow runoff to be treated before it enters the storm drain system.

The specific LID strategies and structural BMPs that could be used in the project site, either individually or in combination, will be refined at the tentative map and site development stage when more detailed plans are prepared.

In addition to general storm water quality impacts associated with urban runoff, the No Action alternative would modify existing watershed drainage basins and reroute storm water southward into University Creek. With the redirection of storm water on the project site, there is potential that increased storm water within the segment of University Creek that crosses the project site could increase scouring and cause erosion, which could lead to increased sedimentation that could adversely affect water quality downstream of the project site. This **indirect** effect would be **significant**.

Mitigation Measure HYDRO-4 would address this effect and is highly likely to be imposed and enforced by the City of Roseville. This measure is the same as Mitigation Measure 4.13-2 in the ARSP EIR and requires the City to condition development approval on the inclusion of storm water management, LID measures, and erosion control measures at University Creek. **No direct** effects on water quality from project operation and occupancy under the No Action alternative were identified.

Proposed Action Development under the Proposed Action would have the potential to generate urban runoff that could affect water quality. As with the No Action alternative, the Proposed Action would comply with NPDES requirements and implement LID strategies. However, for the same reasons presented above, **indirect** effects would still be **significant**. Mitigation would be implemented to address this effect. **Mitigation Measure HYDRO-4** would require the City to condition development approval on the inclusion of storm water management, LID measures, and erosion control measures at University Creek. As noted above, this measure is the same as Mitigation Measure 4.13-2 in the ARSP EIR and has been imposed by the City of Roseville on the Proposed Action to reduce this effect. **No direct** effects on water quality from project operation and occupancy under the Proposed Action were identified.

Alts. 1, 2, 3 Alternatives 1, 2, and 3, would also construct large-scale, mixed-use developments on the project site, but would have between eight percent less and two percent more impervious surface than the Proposed Action. Due to similar development footprints, Alternatives 1 and 2 would have roughly the same potential to affect surface water quality as the Proposed Action. Of these alternatives, Alternative 1 (Southern Avoidance) would have the greatest amount of open space and smallest development footprint. Thus, Alternative 1 (Southern Avoidance) would have the smallest effect on surface water quality. On the other hand, Alternative 3 (Distributed Avoidance) has the least amount of open space and the largest development footprint. Therefore, this alternative has a greater potential to degrade surface water quality than the other alternatives, including the Proposed Action. However, compared to existing conditions, urban land uses that would be developed on the project site under all three alternatives has the potential to degrade surface water quality. Based on the significance criteria listed above, and for the same reasons identified under the No Action alternative, this represents a significant indirect effect. Like the No Action alternative and Proposed Action, Mitigation Measure HYDRO-4 would ensure that all development under Alternatives 1, 2, and 3, minimizes its effect on surface water quality. As noted above, this measure is the same as Mitigation Measure 4.13-2 in the ARSP EIR and is highly likely to be imposed by the City of Roseville under Alternatives 1, 2, and 3 to address this effect. No direct effects on water quality from project operation and occupancy under Alternatives 1, 2, or 2 were identified.

Mitigation Measure HYDRO-4: **Storm Water Management Development Standards** ***(Applicability – No Action, Proposed Action, and Alternatives 1, 2, and 3)***

At the tentative map or site development stage, development shall be conditioned to include source control and LID strategies, treatment control measures, including but not limited to bio-retention treatment as required by the City's then current design standards and the City's then current General Phase II MS4 Permit issued by the State. The measures shall include, but are not limited to, the measures identified in the Amoruso Drainage Master Plan. In addition, necessary erosion and sediment control measures for University Creek at Discharge Point E and monitoring of University Creek downstream of the discharge point shall be incorporated into the project design plans and submitted to the City for review and approval prior to receiving building/grading permits.

Impact HYDRO-5 Effect on Groundwater Recharge

No Action Alt. As discussed in **Groundwater Hydrology**, the project site is in the North American subbasin of the Sacramento Valley groundwater basin. The No Action alternative would add about 282 acres of development footprint and increased hardscape to a currently undeveloped site, which will increase the impervious surfaces thereby reducing the potential for infiltration. However, most of the project site is underlain with hardpan or clay soils that are impermeable. As a result, infiltration on the project site is low, thereby limiting groundwater recharge. In addition, the loss of pervious surface due to development on the project site would be minimal compared to the overall size of the groundwater subbasin. Furthermore, some infiltration would occur as a result of incorporating onsite drainage controls, such as swales, channels, or other water quality features. For these reasons, **no indirect** effects on groundwater recharge under the No Action alternative were identified. Moreover, **Mitigation Measure HYDRO-4** (City of Roseville 2016a; see discussion in **Impact HYDRO-4** above) would require the Applicant to incorporate a number of LID features that would increase infiltration, including disconnected roof drains; permeable and porous pavements; and other types of storm water retention and runoff treatment features; and mandatory use of soil amendments in some settings. **No direct** effects on groundwater recharge under the No Action alternative were identified.

Proposed Action The Proposed Action would construct a larger mixed-use development on the project site compared to the No Action alternative. The Proposed Action would have a development of 458 acres (compared to 282 acres under No Action alternative), and thus would have a greater effect on groundwater recharge than the No Action alternative. However, based on the significance criteria listed above, and for the same reasons identified under the No Action alternative, **no indirect** effects on groundwater recharge under the Proposed Action were identified. **Mitigation Measure HYDRO-4** would further reduce the effect. **No direct** effects on groundwater recharge under the Proposed Action were identified.

Alts. 1, 2, 3 Alternatives 1, 2, and 3 would construct large-scale, mixed-use developments on the project site. The development footprint under these alternatives would range from 421 and 469 acres (compared to 282 acres under No Action alternative). The area of impervious surfaces under these alternatives is more comparable to the Proposed Action, than the No Action alternative, thus the effects related to groundwater recharge are similar to those identified under the Proposed Action. Based on the significance criteria listed above and for the same reasons identified under the Proposed Action, **no indirect** effects on groundwater recharge under Alternatives 1, 2, and 3 were identified. **Mitigation Measure HYDRO-4** would further reduce the effect. **No direct** effects on groundwater recharge under Alternatives 1, 2, or 3 were identified.

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