4.7 HYDROLOGY AND WATER QUALITY

4.7.1 INTRODUCTION

This section of the Revised Draft EIR describes the existing hydrology and water quality conditions on the UC Santa Cruz campus and analyzes the potential for the proposed Student Housing West (SHW) project to affect water quality, result in substantial siltation or erosion or flooding due to the alteration of drainage patterns, and deplete groundwater supplies or interfere with groundwater recharge. The section also presents the potential hydrology and water quality impacts from the anticipated construction and operation of the separate, but related, Porter and Rachel Carson Colleges dining facilities expansion project, which would serve residents of the SHW project and existing colleges (see **Section 4.7.5** below).

The information in this section is based on information in the draft Post-Construction Stormwater Plans prepared for each site, and previous environmental documentation and technical studies prepared for the UC Santa Cruz campus, including the 2005 LRDP EIR.

The section is revised from the section in the Draft EIR, in that it presents the updated draft storm water control plans that have been prepared for both project sites. In addition, comments received on the Draft EIR related to hydrology and water quality impacts were reviewed and the key issues raised in the comments are summarized below:

- What are the effects of moving water that currently percolates into and at the south end of the East Meadow to Jordan Gulch? Would the flow at Kalkar and Westlake springs, and in the stream that emanates from Kalkar Quarry pond be reduced? Would the flow at Bay Street spring increase, possibly even enough to result in a flooding problem?

- What are the effects on Kalkar Quarry Pond from adding more runoff to the detention basin/sinkhole on the Hagar site?

- What are the potential water quality impacts of directing Hagar site storm water to Kalkar Quarry pond? Commenters expressed concern about an increase in the discharge of sediment, lead and arsenic in the runoff directed to the detention basin/sinkhole and the effect on the pond.

- The Draft EIR does not provide sufficiently detailed storm water flow calculations.

- The Draft EIR relies on the LRDP EIR's conclusions with respect to cumulative impacts associated with off-site runoff and water quality. Because the LRDP EIR never analyzed the impacts associated with development of the Hagar site, it is erroneous for the Draft EIR to rely on the LRDP EIR for these purposes.

These comments are addressed in the revised analysis presented in this section. A commenter stated that previous EIRs prepared for Colleges Nine and Ten projects on the campus included a mitigation measure that required that no new runoff be directed to Jordan Gulch. Note that the mitigation measure was imposed with respect to the middle reach of Jordan Gulch on the central campus due to erosion problems and does not apply to the lower reach of Jordan Gulch.

4.7.2 ENVIRONMENTAL SETTING

4.7.2.1 Campus Hydrology

UC Santa Cruz campus is located on a series of upward sloping marine terraces from an elevation of 300 feet at its southern boundary to about 1,200 feet along its northwest boundary. The northern one-third of campus is composed of weathered schist and granitic rocks with some overlay of Santa Margarita sandstone. Surface flows in these areas are dispersed and the geology of the area encourages percolation of precipitation before eventually gathering in well-defined drainages. The southern two-thirds of the campus consist of marble and schist bedrock overlain by deposits of residual soils and colluvium, where karst topography has developed as a result of the dissolution of marble. While this portion of the campus is cut by several steep-walled north-south flowing streams, an integrated drainage system is not present due to sporadic stream capture by sinkholes and swallow holes (i.e., the location in karst limestone at which a surface stream goes underground). Most storm water on campus eventually reaches the karst aquifer, where it flows through a complex system of fractures. Some of the runoff reappears at the surface in springs at lower elevations to the east, south, and west of the campus (UCSC 2006).

On account of steep gradients and the presence of fractured rocks and soils highly susceptible to erosion, the potential for erosion by storm water runoff is generally high on the central and north campus. Furthermore, the potential for erosion on the central and lower campus has been exacerbated by the addition of impervious surfaces as the central campus has developed over the years (UCSC 2006).

There is no campus-wide storm drain system. Within the developed portions of the campus, storm drains have been installed to capture local runoff and convey it to natural areas. Flow rates are reduced through detention basins and underground detention vaults. After detention, the runoff is discharged into the nearest drainage channel or dissipated for infiltration in open grasslands or other undeveloped land. However, runoff from some older development is discharged to drainage channels without detention.

Surface Water Hydrology Precipitation and Evapotranspiration

Rainfall averages approximately 38 inches per year for the entire campus (Gilchrist & Associates 1990). Rainfall levels vary considerably on campus with elevation; the lower campus receives an average of approximately 30 inches of rainfall annually, while the upper campus receives approximately 40 to 45 inches or more (Johnson and Weber & Associates 1989). Average evapotranspiration is estimated to be

19.7 inches per year (Johnson and Weber & Associates 1989). Based on the Bay Area Hydrology Model (BAHM runoff model), which is a tool for analyzing the hydromodification effects of land development projects and sizing solutions to mitigate the impacts from the increased runoff from these projects, precipitation at the Heller and Hagar sites is estimated to be 34 inches per year and evapotranspiration is estimated to be 14.8 inches per year (BKF 2018a, 2018b).

Campus Drainages and Watersheds

The UC Santa Cruz campus is located within the Big Basin Hydrologic Unit. Multiple watersheds drain the campus, but the main drainages are Cave Gulch, Moore Creek, and Jordan Gulch, which drain approximately 1,100 acres of the approximately 2,020-acre campus. Cave Gulch drains most of the northwestern portions of the campus and joins Wilder Creek immediately west of the campus. Moore Creek drains the central part of the campus, flowing in a southwesterly direction before draining into Antonelli Pond, approximately 1.6 miles south of the campus. Jordan Gulch drains the central and eastern portions of the campus before flowing down along Bay Street as a spring-fed channel (Bay Creek). Due to the karst geomorphology of the campus, many tributaries discharge into in-stream swallow holes, which intercept most of the surface water flow and divide the campus drainages into more than 50 sub-watersheds. Therefore, surface runoff is relatively low when compared to other locations with similar rainfall. Other watersheds on the campus are the Wilder Creek, Arroyo Seco, High Street, Kalkar Quarry, and the San Lorenzo River watershed (UCSC 2006). A detailed description of the major watersheds on campus, including a comprehensive evaluation of watershed properties and storm water runoff analysis for each of these watersheds, is presented in the 2005 LRDP EIR.

Erosion

As discussed above, on account of the steep gradients and the presence of fractured rocks and soils highly susceptible to erosion, the potential for erosion by storm water runoff is generally high on the central and lower campus. Furthermore, erosion on campus has increased with the addition of impervious surfaces as the campus has developed over the years. Sedimentation from channel incision and other sources can affect the capacity of campus sinkholes to accommodate storm water flows, resulting in increased discharge to downstream channels from sinkhole overflows. Other contributing factors include repeated disturbance of channel beds and banks by bicycles and foot traffic on undesignated trails along the drainages, roadway runoff, activities that disturb banks and increase runoff, burrowing animals, and naturally occurring erosive soils. Since 2005, the Campus has been implementing a phased infrastructure improvement program to address erosion conditions in the drainages, by redirecting runoff, constructing detention basins and other detention structures, and in-channel improvements.

Flooding

As noted above, the UC Santa Cruz campus relies on a series of natural drainage courses and sinkholes for storm drainage. Storm water drains via pipes into the natural drainages. Most of the storm water enters the subsurface through a series of sinkholes. Detention basins and settling tanks serve local building clusters. While this system meets current overall capacity requirements, there are localized areas of concern. Areas that have experienced flooding from surface ponding include the area near the McLaughlin Drive sinkholes and on Moore Creek at Highview Drive south of the campus (UCSC 2006). The UC Santa Cruz campus is not located within a 100-year flood zone (FEMA 2012).

Groundwater

UC Santa Cruz is not within a designated groundwater basin (DWR 2016). It is bordered to the east and immediately to the south by the West Santa Cruz Terrace basin. Lands to the west and immediately north are also not within a designated groundwater basin but the Santa Margarita Basin lies approximately 2.5 miles north of the campus. The campus itself is roughly divided into two hydrogeologic systems, upper/north campus and central/lower campus. These two hydrogeologic systems are closely associated with campus geology (i.e., rock types, faults, and fracture zones) (UCSC 2006).

Upper/North Campus

The upper/north campus hydrogeologic system lies north of McLaughlin Drive and includes shallow-water bearing zones of moderate permeability consisting of Santa Margarita sandstone, weathered schist and granitic rocks, which overlie relatively impermeable unweathered schist and granitic rocks. Groundwater occurs in portions of thin (5- to 30-foot) eroded remnants of Santa Margarita sandstone as well as within the upper portions of weathered and fractured schist and granitic basement complex rocks (UCSC 2006).

This portion of the campus has a relatively uniform shallow groundwater system; depths to groundwater throughout the main portion of the north campus range from about 2 to 16 feet below ground surface. Due to the shallow groundwater table and the moderate permeability of the near-surface materials, the north campus area has a high density of springs and seeps. These features generally occur where topography becomes steeper and the shallow groundwater table intersects the land surface (UCSC 2006).

Topographically, the hydrologic system of the upper/north campus is dominated by broad and gently sloping surfaces, giving way to overland flows that seep into the soil and provide groundwater recharge. Surface runoff to the south and west eventually enters the karst (marble) aquifer system of the central and lower campus via Cave Gulch, Moore Creek, and Jordan Gulch. Due to the shallow nature and moderate permeability of the upper/north groundwater system, the aquifer system is not adequate to meet campus water supply needs for the long-term (UCSC 2006).

Central/Lower Campus

The lower two-thirds of the campus are largely underlain by marble and schist. The marble allows for the presence of karst topography, which is characterized by: (1) a relative absence of surface streams and drainage channels with most precipitation discharging to the subsurface through fractures, and (2) the presence of sinkholes, closed depressions, and swallows. More than 50 sinkholes are located throughout the marble-underlain area on the campus and these features are estimated to capture up to 40 percent of campus runoff (UCSC 2006).

Within the marble is an extensive underground drainage network of subterranean caverns and channels formed by the dissolution of limestone and marble by groundwater. The locations of these channels are predominantly governed by bedrock fractures that provide a zone where water can penetrate, weather and dissolve the rock, eventually widening the fracture. Crystalline non-fractured marble will not be readily weathered or dissolved, because unlike sandstone, for example, it does not have space between grains (inter-granular porosity) that would allow water penetration in any appreciable amounts. The two main underground channels on the campus lie in Jordan Gulch and Moore Creek, where they coincide with two north-south trending fault/fracture systems, and large volumes of water flows within these channels. In addition, there are several east-west fractures in the central and southern portions of the campus (UCSC 2006).

The marble aquifer system on this portion of the campus has the greatest potential for groundwater supply on the campus as a substantial portion of (about 40 percent) of the surface runoff enters the system. However, as the Campus receives water from the City for domestic and irrigation purposes, groundwater on campus is not extracted at this time (UCSC 2006).

Four dye tracing studies have been completed on the UC Santa Cruz campus that provide information on groundwater in the karst area of the campus. The first study was conducted in 1994 to evaluate groundwater flow paths and to determine whether pumping from Water Supply Well 1 (WSW #1), located in the Jordan Gulch watershed in the lower campus, would affect flow rates in individual springs in the area on and off campus. Dye was injected into monitoring well MW-1a (situated approximately 50 feet northeast of WSW#1) and a sinkhole located near the East Remote parking lot (Weber and Associates 1994). Results of this study confirmed that dye traveled fairly rapidly between the dye injection location and nearby monitoring wells and springs. The dye was detected at four of the monitoring locations within 2 days and at eight of the monitoring locations within 2 weeks. The monitoring data also demonstrated that WSW #1 is hydraulically connected (i.e., partial or complete groundwater flow path between locations) to MW-1a, MW-1b, Bay Street Spring, West Lake Spring, and Messiah Lutheran Spring (Aley and Weber & Associates 1994).

Three subsequent dye tracing studies were conducted on the central campus to evaluate the potential for foundation pressure grouting programs to impact groundwater quality or flow rates at springs around the campus. Dye injected at the proposed grouting locations on the central campus was not detected at any of the off-campus monitoring points within each of the 18-week study periods, indicating that there are no rapid flow paths capable of moving water, grout or other fluid from the dye injection sites to off-campus springs. Because no rapid flow paths were identified, the studies concluded that pressure grouting programs in the areas tested would not have any significant impact on water recharge in the karst aquifer, or on water discharge rates or quality at springs, through leaching or grout transport (UCSC 2006).

Hydrologic Monitoring

Spring and Stream Flow Monitoring

Thirteen recognized springs, seeps or spring fed streams have been mapped to outcrop on- and off-campus. Monthly to semi-annual monitoring of flows from these surface water locations has been conducted by the Campus since 1984; currently, nine are being monitored for flow semi-annually. In addition, groundwater levels are measured in three wells that are completed in the karst aquifer in lower Jordan Gulch. Generally spring and stream flow measurements are collected at the end of the winter wet season and at the end of the summer/fall dry season. Because wet season measurements are influenced by the amount and timing of rainfall, there is more variation in wet season measurements. The dry season measurements represent base flow conditions and are therefore more suitable for year-to-year comparisons. The monitoring has indicated that development activities on campus have not created a measurable increase or decrease in flow rates at any of the springs and streams monitored, and have not affected groundwater elevations in on–campus monitoring wells (Weber, Hayes and Associates 2017b). A statistical summary of the monitoring data gathered by the Campus since 1984, including average, maximum, minimum spring flows and standard deviation for spring discharge data, and water surface elevations for the monitoring wells is presented in the 2005 LRDP EIR. **Table 4.7-1, Spring Base Flows,** presents results of base flow monitoring at four of the springs down gradient of the campus, including the Kalkar Quarry spring.

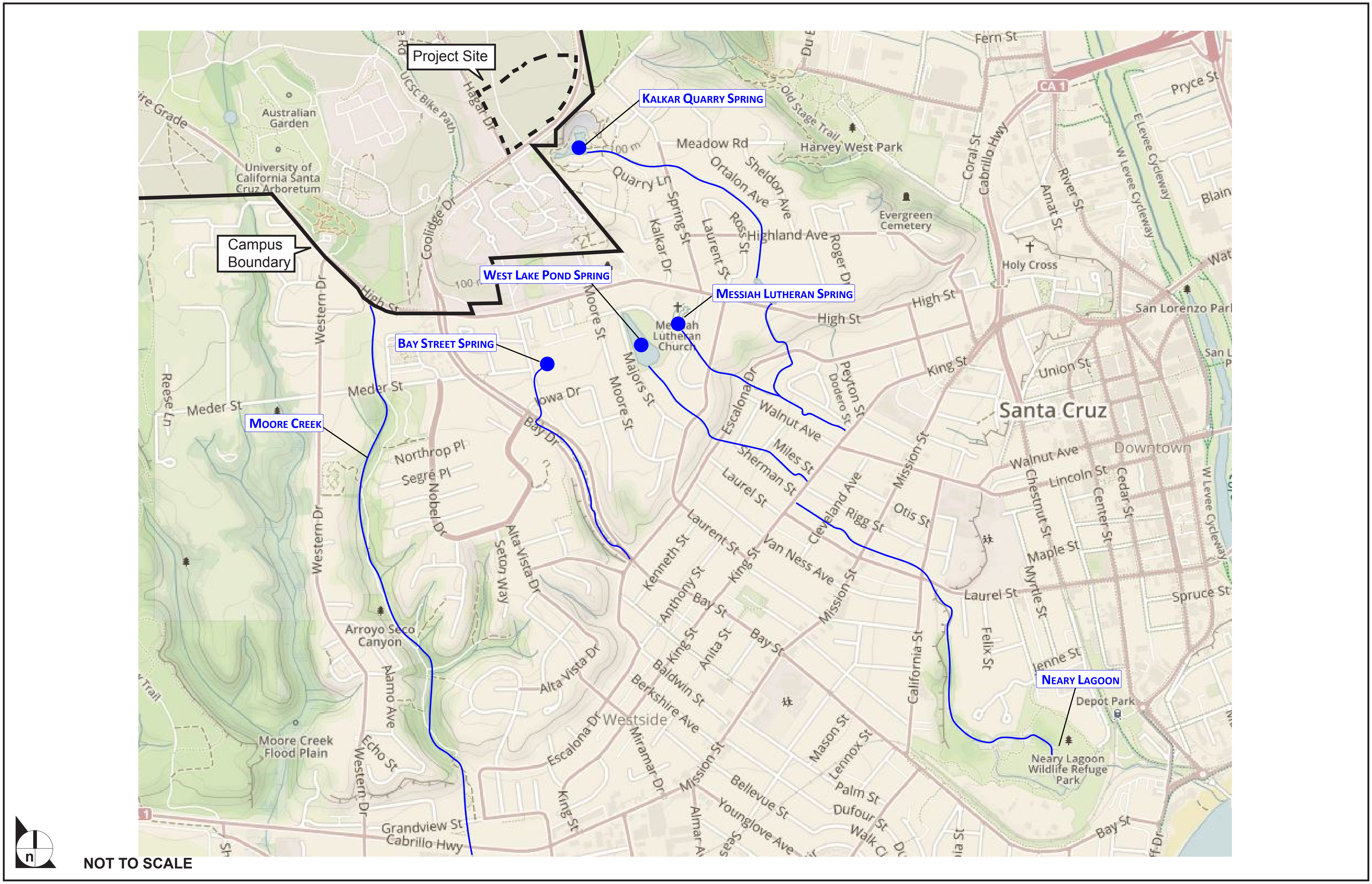
Table 4.7-1
Spring Base Flows (June through September) (gpm)

Date	Kalkar Quarry	Bay Street	West Lake	Messiah Lutheran
09/11/84		95	4	
09/25/84		110	4	
06/18/85		144	40	
07/24/85	50	145	20	
08/12/87	60	120	25	
06/15/88	85	130	13	
09/26/88	50	120	1	
06/05/89	148	121.2	22.5	22.5
06/23/89	81			45.6
07/10/89	85	115.7	5.8	
07/11/89				44.7
08/11/89	85	114.5		
08/18/89	81	118.8	4.7	48
06/02/90	15.5	121	40.9	52.7
06/08/90	23.6	124	21.1	39.5
07/05/90		130.7	0	36
07/20/90	5	129	0	33
08/12/90	0	124	0	38
09/05/90	0	109.1	0	3.6
09/28/90	0	103.8	0	29.2
06/05/91	45.2	121.2	30.7	44
06/20/91	33	112.5	14.65	39.75
07/05/91	38.6	118.1	8.96	39.1
07/23/91	21.87	112.3	8.96	38.86
08/12/91	32.69	112.1	0	34.77
08/23/91	5.44	107.4	0	36.97
09/05/91	2.3	105.5	0	33.79
09/19/91	3.1	110.3	0	31.53
06/03/92	190.1	86.86	59.58	55.63
07/09/92	172.5	81.42	48.4	46.85
07/25/92	121.1	78.27	40.35	7.765
08/12/92	108.1	74.88	27.09	44.75
08/28/92	83.2	81.59	33.82	47.45
09/15/92	93.33	74.23	21.96	42.84
09/28/92	81.76	72	32.56	40.53
08/20/99	259.18	77	40.35	44
09/25/00	135.58	73.59	21.96	41.62

Date	Kalkar Quarry	Bay Street	West Lake	Messiah Lutheran
06/04/02	197.9	122.12	11.96	45.5
09/30/03	78.45	76.7	4.23	38.28
09/22/04	77.5	96.3	1	38.24
09/28/05	164.76	104.83	24.77	55.87
09/18/06	160.63	108.01	114.13	71.76
09/18/07	127.35	60.35	1.07	31.92
09/19/08	178.79	81	4.23	22.8
09/19/09	105.36	66	1.49	17
09/17/10	49.22	88.57	16.71	21
09/16/11	151.68	70	40.35	30
09/21/12	106.1	43	1.49	15
09/20/13	19.37	67	0	23
09/19/14	10	21	0	15
09/25/15	10	23	0	12
09/23/16	72.8	36	4.23	55.5
09/22/17	155.43	36	27.68	81
Average	80.4	95.6	16.9	37.2
Standard Deviation	63.9	30.2	21.2	15.4

Source: Weber, Hayes and Associates 2017b

Figure 4.7-1, **Off-Site Springs**, presents the locations of the four down gradient springs, and the water bodies/drainages that the springs discharge into. As the graphic shows, Kalkar Quarry spring is the closest to the campus located just south east of Glenn Coolidge Drive near the Hagar site. The spring discharges into the Kalkar Quarry pond which drains to the southeast via an unnamed creek. Messiah Lutheran spring and West Lake spring are located south of High Street, and are approximately 1,300 and 1,380 feet respectively from the campus's southeastern boundary. The unnamed drainages that emanate from the two springs also drain to the southeast. Kalkar Quarry pond flows combine with the flows from the Messiah Lutheran spring and the combined flow is inferred to flow southwest in a storm drain under King Street and combine with the flow from the West Lake spring. The combined flow is conveyed in a storm drain under King Street which discharges into a surface creek south of King Street near Laurel Street. This creek flows into Neary Lagoon. The Bay Street spring is located near Meder Street, approximately 660 feet from the campus' southern boundary. The flows from this spring are contained in storm drains and culverts, which discharge into Bay Creek just south of Nobel Street. Bay Creek runs in the median of Bay Street up to Escalona Drive, beyond which point it is culverted. However, based on the topography, it is inferred that the creek flows also discharge into Neary Lagoon.



SOURCE: Weber, Hayes & Associates, 2018

FIGURE **4.7-1**

IMPACT SCIENCES

Off-site Springs

680.019•07/18

Surface Water and Groundwater Quality

Historically, the Campus monitored water quality at nine spring, groundwater and/or surface locations on the campus. Samples were collected to test the water quality of groundwater, spring water, and surface water. Samples collected at these locations were tested for general mineral, physical, and inorganic content and semi- to non-volatile range hydrocarbons (diesel-kerosene-motor oil range) and compared against performance criteria (e.g., water quality standards, guidelines, and benchmarks). This historic monitoring program was conducted between 1989 through 2008 pursuant to the LRDP Mitigation Measure 4.1-9. During this monitoring period, lead and arsenic were detected occasionally, and were consistently detected at concentrations below established stormwater parameter benchmark values. In 2009, the Campus began monitoring storm water discharge from specific land use areas around campus as part of the University's Storm Water Management Program. Currently, samples are collected from seven surface locations and two wells during the first significant precipitation event of the wet season and are tested for general indicator storm water parameters, including pH, total suspended solids, specific conductance, and oil & grease. In addition, three of the surface water locations are tested for general mineral, physical, and inorganic content. An analysis of historic and recent sampling does not show an increase in urban runoff pollutants over time and there does not appear to be any significant identifiable water quality impacts from campus activities (Weber, Hayes and Associates 2017a).

4.7.2.3 Project Site Hydrology

Heller Site

The approximately 13-acre Heller site is currently developed with the Family Student Housing complex and the campus childcare center. Most of the storm water generated within the developed site is collected by storm drains that discharge into a storm drain that leaves the site via a culvert to discharge into the Rachel Carson College detention basin located to the east of Heller Drive.

The Heller site is located substantially within Moore Creek watershed, although a small northwesterly portion of the site is within the Cave Gulch watershed. The Moore Creek watershed covers approximately 920 acres above Antonelli Pond, which is located in the city of Santa Cruz. Approximately 320 acres of the drainage area is located on the campus. The Moore Creek drainage system consists of the main stem and several tributaries. The head of the main stem (also referred to as the East Fork) is located near University House. The creek flows south to the East Dam and then into the Arboretum Pond. The Rachel Carson College detention basin discharges to the West Entrance Fork, which originates just south of the west entrance to the campus, and flows in a southerly direction down to the West Dam. A sinkhole is present in this channel just upstream of the dam (UCSC 2006). Significant erosion conditions exist in the West Entrance Fork. Most flow in the West Entrance Fork is detained behind the West Dam, which rarely overflows. Overflow from the West Dam flows to the Arboretum Pond. Below the Arboretum Dam, Moore Creek flows off campus and under Empire Grade. About 500 feet south of Empire Grade, where Moore Creek flows under Highview Drive, localized flooding has occurred as a result of an undersized culvert. Since the adoption of the LRDP in 2005, the Campus has made a number of in-channel and source area improvements to the East Fork and West Entrance Fork of Moore Creek, including the clean-out of the Rachel Carson College detention basin to enable it to function as originally designed.

The Cave Gulch watershed covers approximately 336 acres and drains most of the northwestern part of the campus. The Cave Gulch stream channel is aligned north-south and is a tributary basin to the Wilder Creek watershed, flowing into Wilder Creek immediately west of the campus. The two main tributaries to Cave Gulch are the Porter Tributary and the Pump Station Tributary. The Porter Tributary flows west of the Family Housing complex and two sinkholes near the complex capture runoff in the area. There are some existing erosion conditions within the watershed, associated mainly with the Pump Station Tributary and the Porter Tributary (UCSC 2006).

Hagar Site

The approximately 13-acre Hagar site is currently an undeveloped hillside that generally slopes in a south southeasterly direction towards Glenn Coolidge Drive. Runoff from the site flows into a closed depression in the southwestern corner of the site. The Campus constructed a detention basin at this location in 1991 to detain runoff from Glenn Coolidge Drive that is conveyed by a concrete ditch that parallels the road, and from Hagar Drive. The detention basin was designed to discharge to a new piped storm drain system which discharges into Kalkar Quarry Pond (see below), south of the project site. A sinkhole formed in the detention basin in 2001. The Campus made repairs to the sinkhole in 2001 and again in 2006. However, runoff to the detention basin currently flows to the sinkhole without being detained rather than to the piped storm drain system via the detention basin outlet structure.

The Hagar site is located within the Kalkar Quarry watershed, which is a subarea of the Jordan Gulch/Neary Lagoon watershed. The Kalkar Quarry watershed covers a total of about 60 acres, 90 percent of which are located on the southeastern portion of the campus and the remainder off campus. The campus portion of the Kalkar Quarry watershed is largely undeveloped, with an estimated 1.73 acres of impervious surfaces (portions of Hagar Drive and Glenn Coolidge Drive) present in the watershed under current conditions. Runoff from a portion of Glenn Coolidge Drive, which is conveyed by the drainage ditch, and all of the runoff from Hagar Drive currently flows into the sinkhole and the underlying karst system.

Kalkar Quarry is an old marble quarry located southeast of the Hagar site across Glenn Coolidge Drive. A pond has developed in the quarry floor, fed by an underlying spring emanating from the karst aquifer. In addition, the pond receives runoff from a series of culverts that drain the Hagar Meadows and Hagar Court employee housing complexes south of Glenn Coolidge Drive in the southeastern portion of the campus; there is an estimated 2.88 acres of impervious surfaces within the two employee complexes. It is not known, and cannot be determined with reasonably available means, whether the detention basin/sinkhole on the Hagar site is hydraulically connected to the Kalkar Quarry Pond and, if so, to what degree and volume. However, due to the proximity of the detention basin/sinkhole to the Kalkar Quarry Pond, it is considered possible that some of the runoff that discharges into the sinkhole flows into the Kalkar Quarry Pond via the spring.

4.7.3 REGULATORY CONSIDERATIONS

4.7.3.1 Federal Laws and Regulations

Clean Water Act

In 1972, the Federal Water Pollution Control Act—also known as and hereafter referred to as the Clean Water Act (CWA)—was amended to require National Pollutant Discharge Elimination System (NPDES) permits for discharge of pollutants into the "waters of the United States" that include oceans, bays, rivers, streams, lakes, ponds, and wetlands from any point source. In 1987, the CWA was amended to require that the US EPA establish regulations for permitting under the NPDES permit program of municipal and industrial storm water discharges. The U.S. EPA published final regulations regarding storm water discharges on November 16, 1990. The regulations require that municipal separate storm sewer system (MS4) discharges to surface waters be regulated by an NPDES permit.

In addition, the CWA requires the states to adopt water quality standards for water bodies and have those standards approved by the U.S. EPA. Water quality standards consist of designated beneficial uses—e.g., wildlife habitat, agricultural supply, fishing, etc.—for a particular water body, along with water quality criteria necessary to support those uses. Water quality criteria are prescribed concentrations or levels of constituents—such as lead, suspended sediment, and fecal coliform bacteria—or narrative statements that represent the quality of water that supports a particular use. Because California has not established a complete list of acceptable water quality criteria, the U.S. EPA established numeric water quality criteria for certain toxic constituents in the form of the California Toxics Rule (40 CFR 131.38).

Water bodies not meeting water quality standards are deemed "impaired" and, under CWA Section 303(d), are placed on a list of impaired waters for which a Total Maximum Daily Load (TMDL) must be developed for the impairing pollutant(s). A TMDL is an estimate of the total load of pollutants from point, nonpoint, and natural sources that a water body may receive without exceeding applicable water quality standards (with a "factor of safety" included). Once established, the TMDL is allocated among current and future pollutant sources discharging to the water body.

CWA Permits for Discharge to Surface Waters

CWA Sections 401 and 402 contain requirements for discharges to surface waters through the NPDES program, administered by the U.S. EPA. In California, State Water Resources Control Board (SWRCB) is authorized by the U.S. EPA to oversee the NPDES program through the RWQCBs (see related discussion under **Porter-Cologne Water Quality Control Act**, below). The NPDES program provides for both general permits (those that cover a number of similar or related activities) and individual permits. The permit contains requirements of allowable concentrations of contaminates contained in the discharge.

Construction General Permit

The SWRCB administers the NPDES *General Permit for Discharges of Storm Water Runoff Associated with Construction Activity* (Construction General Permit). In order to cover a construction project disturbing 1 acre or more of land under the General Construction Permit, the entity responsible for the project must submit a Notice of Intent to the State Board prior to the beginning of construction. Effective July 1, 2010, all dischargers are required to obtain coverage under the Construction General Permit Order 2009-0009-DWQ adopted on September 2, 2009, as amended by 2010-0014-DWQ and 2012-006-DWQ.

The Construction General Permit requires that projects develop and implement a Storm Water Pollution Prevention Plan (SWPPP), identifying potential sources of pollution and specifying runoff controls during construction for the purpose of minimizing the discharge of pollutants in storm water from the construction area. The documents required to register the project under the Construction General Permit include a site map which shows storm water collection and discharge points, general topography both before and after construction, drainage patterns across the project site and "best management practices" (BMPs) to be followed during construction to minimize pollutant discharge. The permit registration documents also include a risk assessment, which determines the BMPs and the level of monitoring required during construction. The risk level is based on the potential for sediment transport and whether the project is in the watershed of a sediment-impaired water body. The SWPPP must list Best Management Practices (BMPs) the discharger will use to protect storm water runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment. For projects within the Central Coast Regional Water Quality Control Board jurisdiction, a Storm Water

Control Plan documenting the project compliance with the Post-Construction Requirements is also required for entities regulated under the Municipal Separate Storm Sewer System Permit for registration under the Construction General Permit.

Municipal Separate Storm Sewer System Permit

In 1987, in recognition that diffuse, or non-point, sources were significantly impairing surface water quality, Congress amended the CWA to address non-point source storm water runoff pollution in a phased program requiring NPDES permits for operators of MS4s, construction projects, and industrial facilities. Phase I, promulgated in 1990, required permits for facilities of these types generally serving populations over 100,000, construction permits for projects five acres or greater, and industrial permits for certain industries. The Phase II program expanded on the Phase I program by requiring operators of small MS4s in urbanized areas and operators of small construction sites, through the use of NPDES permits, to implement programs and practices to control polluted storm water runoff. Phase II is intended to reduce these adverse impacts to water quality and aquatic habitat by instituting the use of controls on the unregulated sources of storm water discharges. Under Phase II of the NPDES program, SWRCB has issued three general permits: (1) Municipal permits – required for operators of small MS4s, including universities, (2) Construction permits – required for projects involving one acre or more of construction activity, and (3) Industrial permits. The municipal permit requires development and implementation of a guidance document identifying all permit requirements. The Campus has developed a guidance document, or Storm Water Management Program (SWMP). The goal of the SWMP is to reduce the discharge of pollutants to the Maximum Extent Practicable, as defined by the U.S. EPA. "Minimum Control Measures" (MCMs) is the term used by the U.S. EPA for the six MS4 program elements aimed at achieving improved water quality through NPDES Phase II requirements.

Safe Drinking Water Act and Underground Injection Control Regulations

The Safe Drinking Water Act (SDWA) establishes requirements and provisions for the Underground Injection Control (UIC) program. The UIC program is regulated by the U.S. EPA.

The federal regulations for the UIC program are found in Title 40 of the Code of Federal Regulations. 40 CFR Part 144 provides minimum requirements for the UIC program promulgated under the SDWA. The criteria and standards for various classes of injection wells are set forth in 40 CFR Part 146. State UIC program requirements are set forth in 40 CFR Part 145; and include the procedures for U.S. EPA to approve, revise, and withdraw UIC Programs that have been delegated to the states (US EPA 2018).

The UIC program consists of six classes of injection wells (Class I to Class VI). Each well class is based on the type and depth of the injection activity, and the potential for that injection activity to result in endangerment of an underground source of drinking water. Class V wells are used to inject non-hazardous fluids underground. Most Class V wells are used to dispose of wastes into or above underground sources of drinking water. As this disposal can pose a threat to ground water quality if not managed properly, the construction, operation, permitting and closure of Class V wells is regulated by the U.S. EPA (US EPA 2018). The administration of the UIC program related to Class V wells is not delegated to the state of California, although the U.S. EPA provides the well application information to the pertinent Regional Water Quality Control Board and the State Water Resources Control Board and the Regional Water Quality Control Boards in California can prescribe requirements for discharges into California waters, including groundwater.

The U.S. EPA has no design requirements for Class V wells; that responsibility is left to local authorities. However, the following design practices are encouraged (OEHHA 2014):

- Should not be constructed deeper than the seasonal high water table.
- Follow local guidelines for setback distances from the dry well bottom to the water table.
- Go through a thorough site evaluation to prevent the spread of contaminants.
- Utilize pre-treatment to remove sediment and the pollutants that they frequently carry.
- Use backfill to improve dry well column stability.

The U.S. EPA has also set forth the following minimum requirements for Class V wells (OEHHA 2014):

- Register injection wells at www.epa.gov/region09/water/groundwater/injection-wells-register.html
- Operate injection wells in a way that will not endanger underground sources of drinking water (USDW).
- Abandoned Class V wells should be properly destroyed, with notification to the U.S. EPA, to prevent movement of contaminated fluids into USDW.

4.7.3.2 State Laws and Regulations

State law pertaining to surface and groundwater quality is set forth in the Porter-Cologne Act. State statutes and regulations pertaining to the use of recycled water in California can be found in the California Water Code (CWC), California Code of Regulations (CCR), and California Health and Safety Code. Relevant laws and regulations are briefly summarized below.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act), which is the state's clean water act, provides the statutory authority for State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (RWQCB) to regulate water quality and was amended in 1972 to extend the federal CWA authority to these agencies (see **Clean Water Act**, above). The Porter-Cologne Act established the SWRCB and divided the state into nine regions, each overseen by a RWQCB. The SWRCB is the primary state agency responsible for protecting the quality of the state's surface and groundwater supplies, but much of the daily implementation of water quality regulations is carried out by the nine RWQCBs.

Under the Porter-Cologne Act, the RWQCB's are given the responsibility and authority to prepare water quality plans for areas within the region (Basin Plans), identify water quality objectives, and issue NPDES permits and Waste Discharge Requirements (WDRs). Water quality objectives are defined as limits or levels of water quality constituents and characteristics established for reasonable protection of beneficial uses or prevention of nuisance. NPDES permits, issued by RWQCBs pursuant to the CWA, also serve as WDRs issued pursuant to the Porter-Cologne Act. WDRs are also issued for discharges that are exempt from the CWA NPDES permitting program, discharges that may affect waters of the state that are not waters of the United States (i.e., groundwater), and/or wastes that may be discharged in a diffused manner. WDRs are established and implemented to achieve the water quality objectives (WQOs) for receiving waters as established in the Basin Plans, as described below. Sometimes they are combined WDRs/NPDES permits.

California Water Code

The use of water in the State is governed by the California Water Code or Title 23 of the California Code of Regulations. Title 23 requires that water resources must be put to beneficial use to the fullest extent of which they are capable, and that the waste, unreasonable use, or unreasonable method of use of water is illegal. The conservation of water is encouraged as a reasonable and beneficial use in the interest of the people and for the public welfare.

State Water Resources Control Board Recycled Water Policy

The State Water Resources Control Board (State Water Board) has encouraged the safe use of recycled water in California to supplement surface and groundwater supplies since passage of the Porter-Cologne Act in 1969. Since that time, the state has been active in developing legislation, issuing resolutions and policies, setting goals for recycled water use, and funding recycled water projects. The Policy for Water Quality Control for Recycled Water (Recycled Water Policy) is an important element of the overall effort to encourage the safe use of recycled water in a manner that is protective of public health and the environment (SWRCB 2017).

The Recycled Water Policy includes goals for recycled water use, criteria for streamlined permitting of projects that use recycled water for landscape irrigation, criteria for permitting projects that use recycled water for groundwater recharge, requirements for monitoring recycled water for constituents of emerging concern (CECs), and a requirement to convene a Science Advisory Panel every five years to guide future actions relating to CECs. The Recycled Water Policy also includes guidelines and a process to encourage stakeholders to collaborate with the RWQCB staff to prepare salt and nutrient management plans for groundwater basins and sub-basins throughout California. Salt and nutrient management planning was incorporated into the policy to address potential cumulative impacts to groundwater quality that may be associated with use of recycled water, considering all sources of salts and nutrients in groundwater basins throughout the state (SWRCB 2017).

Recycled water use is regulated under the California Code of Regulations, Title 22 (Title 22), which sets forth the treatment criteria and allowed uses for treated municipal wastewater. The regulations in Title 22 focus on protection of public health and include specific requirements for control of pathogens, limitations on recycled water use based on the level of treatment of the water, and monitoring and reporting requirements. The Recycled Water Policy supplements the requirements in Title 22 by providing guidance for use of recycled water that considers protection of surface water and groundwater (SWRCB 2017).

Water Reclamation Requirements for Recycled Water Use

On June 7, 2016, the proposed Water Reclamation Requirements for Recycled Water Use was adopted by the State Water Board, effective August 6, 2016. The proposed Water Reclamation Requirements for Recycled Water Use (General Order) replaces 2014-0090-DWQ General Waste Discharge Requirements for Recycled Water Use. The General Order establishes standard conditions for recycled water use and conditionally delegates authority to an Administrator to manage a Water Recycling Program and issue Water Recycling Permits to recycled water users. Treated municipal wastewater can only be permitted for non-potable uses, such as landscape irrigation, crop irrigation, dust control, industrial/commercial cooling, decorative fountains, etc. Potable reuse activities are not authorized under this General Order (SWRCB 2016).

California Code of Regulations, Title 22

California Code of Regulations, Title 22, Division 4, Chapter 3, Sections 60301 through 60355 (commonly referred to as "Title 22") specifies treatment requirements for reuse of water. **Table 4.7-2** sets forth the water quality criteria for the four types of recycled water as defined by Title 22. **Table 4.7-3** sets forth the allowable non-potable uses for each recycled water type.

Table 4.7-2
Water Quality Standards for Various Water Recycling Sites

Water Type[a,b]	Parameter	Quality Criteria[d,e]
Disinfected Tertiary [c,f] (recycled water that has been oxidized, filtered and disinfected)	Total Coliform	• Median concentration must not exceed 2.2 MPN/ 100 mL using the last 7 days analyses were completed • Must not exceed 23 MPN/ 100 mL in more than one sample in any 30 day period • Must not exceed 240 MPN/ 100 mL at any time
	Turbidity for Filtration Using Natural Undisturbed Soils or a Filter Bed	• Must not exceed average turbidity of 2 NTU within a 24-hour period • Must not exceed 5 NTU more than 5 percent of the time within a 24-hour period • Must not exceed 10 NTU at any time
	Turbidity for Filtration Using Microfiltration, Ultrafiltration, Nanofiltration or Reverse Osmosis	• Must not exceed 0.2 NTU more than 5 percent of the time within a 24-hour period • Must not exceed 0.5 NTU at any time
Disinfected Secondary- 2.2 (recycled water that has been oxidized and disinfected)	Total Coliform	• Median concentration must not exceed 2.2 MPN/ 100 mL using the last 7 days analyses were completed • Must not exceed 23 MPN/ 100 mL in more than one sample in any 30 day period
Disinfected Secondary- 23 (recycled water that has been oxidized and disinfected)	Total Coliform	• Median concentration must not exceed 23 MPN/ 100 mL using the last 7 days analyses were completed • Must not exceed 240 MPN/ 100 mL in more than one sample in any 30 day period
Un-disinfected Secondary (recycled water that has been oxidized but not disinfected)	---	---

Source: Brown and Caldwell, 2011
Notes:
a. Water type based on requirements for recycled water as defined by the State of California Department of Public and Title 22 of the California Administrative Code.
b. "Oxidized" refers to a wastewater in which the organic matter has been stabilized, is nonputrescible and contains dissolved oxygen.
c. The filtered wastewater must be disinfected using:
1. A process that provided a CT (product of total chlorine residual and modal contact time measured at the same point) or not less than 450 mg-min/L at all times with a modal contact time of at least 90 minutes based on peak dry weather flow; or
2. A process that, when combined with filtration, has been demonstrated to inactivate and/or remove 99.999 percent of plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for demonstration

d. MPN/100 mL is a bacterial count in most probable number per 100 milliliters.
e. NTU is Nephelometric turbidity units.
f. Disinfected Tertiary effluent is sometimes referred to as "Title 22 Unrestricted" or "Title 22 Unrestricted Access."

Table 4.7-3
Allowable Non- Potable Uses based on Title 22 Treatment Level

Type of Recycled Water Use	Recycled Water Treatment Level			
	Disinfected Tertiary	Disinfected Secondary- 2.2	Disinfected Secondary- 2.3	Undisinfected Secondary
Agricultural Irrigation Uses				
Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop	X			
Food crops where the edible portion is produced above ground and not contacted by the recycled water	X	X		
Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans	X	X	X	X
Orchards where the recycled water does not come into contact with the edible portion of the crop	X	X	X	X
Vineyards where the recycled water does not come into contact with the edible portion of the crop	X	X	X	X
Non-food bearing trees (Christmas trees are included provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting or allowing access to the general public	X	X	X	X
Fodder and fiber crops and pasture animals not producing milk for human consumption	X	X	X	X
Seed crops not eaten by humans	X	X	X	X
Ornamental nursery stock and sod farms where access by the general public is not restricted	X	X	X	
Pasture for animals producing milk for human consumption	X	X	X	
Any nonedible vegetation where access is controlled so that the irrigated area cannot be used as if it were part of a park, playground or school yard	X	X	X	
Ornamental nursery stock and sod farms provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting, retail sale, or allowing access to the general public	X	X	X	X

Type of Recycled Water Use	Recycled Water Treatment Level			
	Disinfected Tertiary	Disinfected Secondary- 2.2	Disinfected Secondary- 2.3	Undisinfected Secondary
Urban Irrigation Uses				
Parks and Playgrounds	X			
Schoolyards	X			
Residential Landscaping	X			
Unrestricted Access Golf Courses	X			
Cemeteries	X	X	X	
Freeway Landscaping	X	X	X	
Restricted Access Golf Courses	X	X	X	
Impoundment Uses				
Source of water supply for non-restricted recreational impoundments	X[a]			
Source of water supply for restricted recreational impoundments	X	X		
Publicly accessible impoundments at fish hatcheries	X	X		
Landscape impoundments that do not utilize decorative fountains	X	X	X	
Cooling Water Uses				
Industrial or commercial cooling or air conditioning that involves the use of a cooling tower, evaporative condenser, spraying or any mechanism that creates a mist	X[b]			
Industrial or commercial cooling or air conditioning that does not involve the use of a cooling tower, evaporative condenser, spraying or any mechanism that creates a mist	X	X	X	
Other Uses				
Flushing Toilets and Urinals	X			
Priming Drain Traps	X			
Industrial Process Water that May Come into Contact with Workers	X			
Structural Fire Fighting	X			
Decorative Fountains	X			
Commercial Laundries	X			
Consolidation of Backfill Around Potable Water Pipelines	X			
Artificial Snow-making for Commercial Outdoor Use	X			
Commercial car washes including hand washes if recycled water is not heated, where the general public is excluded from the washing process	X			

Type of Recycled Water Use	Recycled Water Treatment Level			
	Disinfected Tertiary	Disinfected Secondary- 2.2	Disinfected Secondary- 2.3	Undisinfected Secondary
Industrial Boiler Feed	X	X	X	
Nonstructural Fire Fighting	X	X	X	
Backfill Consolidation Around Non-potable Piping	X	X	X	
Soil Compaction	X	X	X	
Mixing Concrete	X	X	X	
Dust Control on Roads and Streets	X	X	X	
Cleaning Roads, Sidewalks, and Outdoor Work Areas	X	X	X	
Industrial Process Water that Will Not Come into Contact with Workers	X	X	X	
Flushing Water for Sanitary Sewers	X	X	X	X

Source: Brown and Caldwell, 2011

Notes:

a. Requires conventional treatment where conventional treatment utilizes a sedimentation unit between coagulation and filtration and produces an effluent that meets the definition of disinfected tertiary recycle. If conventional treatment is not used, the recycled water must be monitored for pathogens in accordance with section 60305(b) of Title 22.

b. If a cooling tower is used or if a mist is created that could into contact with employees or the public, the cooling system shall have a drift eliminator whenever the cooling system is in operation and a chlorine or other biocide shall be used to treat the cooling tower recirculation water to minimize the growth of Legionella and other microorganisms.

For recycled water to be used for toilet flushing and landscape irrigation, it must meet State of California Title 22 Level 4 treatment standards, specifically the disinfected tertiary recycled water standard (the most stringent level of treatment required in California). Title 22 Level 4 standards require specific treatment parameters including total coliform and turbidity as well as scheduled testing and reporting requirements to ensure ongoing water quality performance and regulatory compliance. Title 22 of California's Water Recycling Criteria refers to California state guidelines for how treated and recycled water is discharged and used. Title 22 also includes standards from state's Department of Health Services to water and bacteriological treatment standards for water recycling and reuse.

4.7.3.3 Regional and Local Plans

Central Coast Basin Plan

The UC Santa Cruz campus is within the jurisdiction of the Central Coast RWQCB (Region 3). The CCRWQCB has the authority to implement water quality protection standards through the issuance of permits for discharges to waters located within its jurisdiction. Beneficial uses of inland surface waters and water quality objectives for the region are specified in *The Water Quality Control Plan for the Central Coast Basin* (Basin Plan) prepared by the Central Coast RWQCB in compliance with the federal CQA and the state Porter-Cologne Water Quality Control Act. **Table 4.7-4, Beneficial Uses of Surface Water Bodies on or near UC Santa Cruz**, lists the beneficial uses of creeks and other water bodies on or near the campus. The objective of the Basin Plan is to show how the quality of the surface and ground waters in the Central Coast Region should be managed to provide the highest water quality reasonably possible. The RWQCB Board implements the Basin Plan by issuing and enforcing WDRs to individuals, communities, or businesses whose waste discharges can affect water quality. These requirements can be either State WDRs for discharges to land, or federally delegated permits for discharges to surface water.

Table 4.7-4
Beneficial Uses of Surface Water Bodies on or near UC Santa Cruz

Water Body	Beneficial Uses in the Basin Plan
Wilder Creek	MUN, AGR, GWR, REC1, REC2, WILD, COLD, WARM, MIGR, SPWN, BIOL, FRESH, COMM
Cave Gulch	MUN, GWR, REC1, REC2, WILD, COLD, WARM, COMM
Moore Creek	MUN, AGR, GWR, REC1, REC2, WILD, COLD, WARM, SPWN, BIOL, FRESH, COMM
San Lorenzo River	MUN, AGR, IND, GWR, REC1, REC2, WILD, COLD, MIGR, SPWN, BIOL, RARE, FRESH, COMM
Antonelli Pond	GWR, REC1, REC2, WILD, WARM, MIGR, SPWN, RARE, COMM

Source: Central Coast RWQCB 2017
***Beneficial Use Definitions**: Municipal and Domestic Supply (MUN); Agricultural Supply (AGR); Industrial Service Supply (IND); Ground Water Recharge (GWR); Freshwater Replenishment (FRSH); Water Contact Recreation (REC-1); Non-Contact Water Recreation (REC-2); Commercial and Sport Fishing (COMM); Warm Fresh Water Habitat (WARM); Cold Fresh Water Habitat (COLD); Wildlife Habitat (WILD), Preservation of Biological Habitats of Special Significance (BIOL); Rare, Threatened, or Endangered Species (RARE); Migration of Aquatic Organisms (MIGR); Spawning, Reproduction, and/or Early Development (SPWN).*

Central Coast Low Impact Development Initiative

The Central Coast RWQCB established the Low Impact Development Initiative (LIDI) to support healthy watersheds throughout the Central Coast region through the implementation of LID design principles, hydromodifcation controls, and sustainable development.

UC Santa Cruz Storm Water Management Program

The UC Santa Cruz Storm Water Management Program (SWMP) was developed in 2004 to comply with the State Water Resources Control Board Phase II NPDES requirements and was last updated in 2009. The intent of the SWMP is to facilitate comprehensive management of storm water quality and to subsequently enhance UC Santa Cruz's environmental stewardship. The SWMP covers all UC Santa Cruz sites, identifies constituents of concern (COC), sources or activities that would have the potential to discharge a COC into runoff, and best management practices to be implemented to address the COC.

UC Santa Cruz Post-Construction Storm Water Management Requirements

In 2014, the Campus prepared the UC Santa Cruz Post-Construction Stormwater Management Requirements (PCRs), a document for use on the campus to ensure that the Campus is reducing pollutant discharges to the maximum extent possible and preventing storm water discharges from causing or contributing to a violation of receiving water quality standards. The PCRs are incorporated into the Stormwater Management Program. The document was last updated in March 2017. The document divides the campus into four watershed management zones based on geologic conditions, slope, and other factors; defines regulated projects as include new development and redevelopment projects that would create or replace more than 2,500 square feet of impervious surface over a project site, and sets forth a series of performance requirements related to site design and runoff reduction; water quality treatment; stormwater control plan requirements; runoff retention; LID development standards; and peak flow management. The PCRs emphasize protecting and, where degraded, restoring key watershed processes to create and sustain linkages between hydrology, channel geomorphology, and biological health necessary for healthy watersheds. Maintenance and restoration of watershed processes impacted by storm water management is necessary to protect water quality and beneficial uses. All regulated projects on the campus are required to comply with the requirements set forth in this document. The specific performance requirements for runoff reduction, water quality treatment, and peak flow management, depend on the size of the project and which watershed management zone the project site is located in.

The Heller site is located within Watershed Management Zone 9, while the Hagar site is located within Watershed Management Zone 3. Generally, projects in all watershed management zones that add or replace more than 5,000 square feet of impervious surface, must provide storm water treatment systems that treat the volume of runoff generated by the 85th percentile 24-hour storm, with specific performance requirements for low impact development systems, biofiltration treatment systems, and non-retention-based systems such as engineered treatment systems. For both sites, all runoff from the 85th percentile 24-hour rainfall event must be retained on site; compliance must be achieved via storage, rainwater harvesting, infiltration, and/or evapotranspiration. In addition, post-development peak flows may not exceed pre-project flows for the 2- through 10-year 24-hour storms.

4.7.4 IMPACTS AND MITIGATION MEASURES

4.7.4.1 Significance Criteria

The impacts with respect to hydrology and water quality from the implementation of the proposed project would be considered significant if they would exceed the following significance criteria, in accordance with Appendix G of the State CEQA Guidelines and the 2005 LRDP EIR:

- Violate any water quality standards or waste discharge requirements;
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level;
- 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 site or off site;
- 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 site or off site;
- Create or contribute runoff water that would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff;
- Otherwise substantially degrade water quality;
- 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;
- Place within a 100-year flood hazard area structures which 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; or
- Inundation by seiche, tsunami, or mudflow.

4.7.4.2 CEQA Checklist Items Adequately Analyzed at the 2005 LRDP Level or Not Applicable to the Project

- Violate any water quality standards or waste discharge requirements

Wastewater on the campus is discharged into the City of Santa Cruz sewer system and treated at the City's wastewater treatment plant. The analysis in Section 4.8 of the 2005 LRDP EIR found that campus development under the 2005 LRDP would not result in wastewater that would violate wastewater discharge requirements as the City's existing wastewater treatment plant has sufficient capacity to handle the expected increase in flow due to campus growth under the 2005 LRDP in combination with other city growth through 2020 (UCSC 2006). The proposed SHW project would not increase enrollment at UC Santa Cruz or the regional population levels. Furthermore, the SHW project will include an on-site membrane bioreactor wastewater treatment facility (MBR plant) at each of the two project sites and wastewater from the proposed development will not discharge to the City's collection and treatment system. Therefore, the proposed SHW project would not increase the amount of wastewater generated on the campus that was previously evaluated, and impacts with respect to waste discharge requirements would not be greater than those discussed in the 2005 LRDP EIR. This impact is adequately addressed in the 2005 LRDP EIR and the project's impact is considered less than significant.

- 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 place within a 100-year flood hazard area structures which would impede or redirect flood flows.

The analysis in the Initial Study prepared for the 2005 LRDP EIR found that campus development under the 2005 LRDP would not place housing or any other structures within a 100-year flood hazard area (UCSC 2006). As both the Heller and Hagar sites are located within campus boundaries and the latest flood map prepared by FEMA confirms that the campus is not located within a 100-year flood zone, the proposed SHW project would also not place housing or any other structures within a 100-year flood hazard area. This impact was adequately addressed in the 2005 LRDP EIR and no project impacts would occur.

- 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.

The analysis in the Initial Study prepared for the 2005 LRDP EIR found that campus development under the 2005 LRDP would not 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 as the campus is not within an area that could be inundated due to the failure of a nearby dam (UCSC 2006). As both the Heller and Hagar sites are located within campus boundaries, the proposed SHW project would also not expose people or structures to risks involving flooding due to the failure of a levee or dam. This impact was adequately addressed in the 2005 LRDP EIR and no project impact would occur.

- Inundation by seiche, tsunami, or mudflow.

The analysis in the Initial Study prepared for the 2005 LRDP EIR found that campus development under the 2005 LRDP would not be subject to inundation by seiche, tsunami, or mudflow (UCSC 2006). As both the Heller and Hagar sites are located within campus boundaries, the proposed SHW project would also not be subject to inundation by seiche, tsunami, or mudflow. This impact was adequately addressed in the 2005 LRDP EIR and no project impact would occur.

All of the other CEQA checklist items are analyzed at a project-level below. Furthermore, the cumulative impacts analyzed in the 2005 LRDP EIR are re-analyzed to address the proposed development of the Hagar site and the higher density of development proposed for the Heller site.

4.7.4.3 Methodology

This section analyzes the potential hydrologic and water quality impacts associated with the proposed project based on post-construction storm water control plans prepared for each of the two project sites. The BAHM was used to prepare the storm water control plans. As noted earlier, the BAHM is a tool for analyzing the hydromodification effects of land development projects and sizing solutions to mitigate the impacts from the increased runoff from the projects. Using the model, the existing runoff from both project sites and the increase in runoff with the proposed development was calculated. The increase in storm water runoff was used to size the controls required to meet the PCRs.

Because all of the post-development runoff from the Hagar site would leave the site via discharge into the underlying karst rather than to a surface water body, the potential for the proposed Hagar site development to affect the karst aquifer was evaluated in terms of potential changes in spring flows.

4.7.4.4 2005 LRDP EIR Mitigation Measures Included in the Proposed Project

Table 4.7-5, 2005 LRDP EIR Mitigation Measures, presents the mitigation measures in the 2005 LRDP EIR that are applicable to the proposed project. Since these previously adopted mitigation measures are already being carried out as part of implementation of the 2005 LRDP, they are included in and are a part of the proposed project and will not be readopted. Implementation of these mitigation measures is assumed as part of the project impact analysis.

Table 4.7-5
2005 LRDP EIR Mitigation Measures

Mitigation Measure	Description
HYD-2B	No grading shall be conducted on hillsides (sites with slopes greater than 10 percent) during the wet season (October 1 through May 31) unless controls that prevent sediment from leaving the site are implemented. Erosion control measures, such as erosion control blankets, seeding or other stabilizing mechanisms shall be applied to graded hillside prior to predicted storm events.
HYD-3C	Each new capital project proposed under the 2005 LRDP that creates new impervious surface shall include design measures to ensure that post-development peak flows from 2-, 5- and 10-year storms do not exceed the 2-, 5-, and 10-year pre-development peak flows and that post-development peak flows from a 25-year storm do not exceed the pre-development peak flow from a 10-year storm. Each new capital project shall also include design measures to avoid

Mitigation Measure	Description
	or minimize the increase in the volume of runoff discharged from the site to the maximum extent feasible.
HYD-3D	The Campus shall incorporate measures into project designs under the 2005 LRDP that maximize infiltration of runoff. Infiltration shall be achieved preferably near the area where new runoff is generated.
HYD-5B	For projects involving construction on karst, if: (a) groundwater is encountered beneath the building site during the geotechnical investigation, and (b) the proposed foundation type would require pressure grouting, the Campus will follow the procedures outlined below: • Perform a dye tracing study to determine if there is a potential for pressure grouting to affect water quality in springs and seeps around the UC Santa Cruz campus. If a potential impact is indicated, alternative building foundation plans will be considered. • As an alternative, the Campus may conduct a preliminary hydrogeological study to evaluate whether the groundwater zone encountered during the geotechnical investigation is hydraulically connected to the karst aquifer. If the hydrogeological study indicates that the groundwater zone is hydraulically independent of the karst aquifer, such that there is no potential for grout injected during construction to affect karst water quality, a dye tracing study need not be performed. If results of the hydrogeological study indicate hydraulic connectivity between the groundwater encountered beneath the site and the karst aquifer, the Campus shall conduct a dye tracing study as described above.

Source: UC Santa Cruz 2006

4.7.4.5 Project Impacts and Mitigation Measures

SHW Impact HYD-1: Construction activities associated with the proposed SHW project would not substantially degrade surface or groundwater quality. (*Less than Significant*)

Heller Site

Construction on the Heller site would involve construction activities such as grading and excavation, which could cause increases in erosion during storm events and result in the discharge of sediment into surface waters. Other pollutants such as fuels, paints, and cleansers could be accidentally released at the site and could also enter surface waters. These pollutants could adversely affect water quality and other beneficial uses of the campus creeks and drainages as well as downstream receiving waters, including the Monterey Bay.

The disturbance footprint of the Heller site would exceed the 1-acre threshold that triggers the NPDES requirement to prepare and implement a SWPPP. In compliance with the NPDES requirements, appropriate erosion- and sediment-control measures would be incorporated into the SWPPP for the site and implemented during site grading and construction. These measures would include, but are not limited to, control of surface flows over exposed soils and use of sediment traps. Therefore, the impact to surface water quality from erosion and sedimentation during project construction would be less than significant.

In addition, according to the 2005 LRDP EIR, the use of pressure grouting to stabilize building sites in some locations on the campus could negatively affect groundwater quality if groundwater is present. The Heller site is underlain mostly by schist. However, the geotechnical investigation has identified areas of likely doline fill on top of marble bedrock in a portion of the site. Although at this time it is anticipated that the soft soil areas would be stabilized by excavating the soft materials and replacing with lime-treated engineered fill or geo-grid reinforced native soil, construction in these areas may involve pressure grouting to densify and stabilize soft soils. However, no groundwater water was encountered in the small-diameter borings advanced within the dolines on the site. As a result, pressure grouting, if required, would not result in a groundwater quality impact at the Heller site.

Hagar Site

Construction on the Hagar site would also involve construction activities such as grading and excavation, which could cause increases in erosion during storm events and result in the discharge of sediment into surface waters, and via sinkholes into groundwater. Other pollutants such as fuels, paints, and cleansers could also be accidentally released at site and could also enter surface waters and groundwater. However, with preparation and implementation of a SWPPP, the potential for construction activities to cause erosion and other water quality impacts is low. In addition, as the slopes on the Hagar site are greater than 10 percent, no grading would occur on the site during the wet season (October 1 through May 31) unless controls that prevent sediment from leaving the site are implemented as required by LRDP Mitigation HYD-2B. Therefore, the impact related to erosion and sedimentation during project construction would be less than significant.

According to the geotechnical report prepared for the project, the Hagar site is underlain by marble, and some relatively soft soils have been encountered near the contact between the marble bedrock and overlying soil in the soil borings. The June 2018 geotechnical report for the proposed project recommends that the karst hazard be mitigated by a combination of the following: (1) structures founded upon mat foundation systems designed and constructed to span a 10-foot diameter void appearing anywhere beneath the structure and distributing foundations loads; (2) foundation elements bearing upon a uniform zone of engineered fill comprised of chemically treated native material or geogrid-reinforced native material, and pressure grouting of potentially collapsing soils beneath building foundations in areas mapped as dolines. The proposed project would be consistent with the recommendations of the final geotechnical report prepared for the project.

The 2005 LRDP EIR analyzed the potential that pressure grouting to densify and stabilize soft soils by injecting very stiff cement grout into the soil could affect ground water quality at springs around the campus. The LRDP EIR determined that a potential impact to ground water quality could occur only if grout were to be placed where groundwater is present. This is because the grout that is used for this purpose is extremely stiff and does not flow without high pumping pressures. Furthermore, because pressure grouting is an expensive process, extreme care is taken not to pump excessive amounts of grout into bedrock voids and crevices. Pressure readings are taken during the grouting procedure to confirm that grout is not entering into the marble but into the soil. If the pocket of soft soil being grouted is large, sometimes grouting is stopped for a day or two to allow the grout to harden, thus further ensuring that grout is not lost to voids. As no groundwater has been encountered in the soil borings on the Hagar site and these precautions will be taken during pressure grouting, there would be no impact on groundwater quality due to the inadvertent discharge of grout into groundwater.

Mitigation Measures: No mitigation is required.

SHW Impact HYD-2: Heller site development and operations would not substantially degrade surface or groundwater quality, interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level, or result in downstream erosion and flooding. (*Less than Significant*)

The Heller site is currently developed with the Family Student Housing (FSH) complex. This complex includes 199 housing units, a childcare facility, parking, utilities, roads and pedestrian infrastructure. Approximately 5.95 acres, or 44 percent, of the approximately 13-acre site is developed with impervious surfaces. Currently, runoff from approximately 10 percent of the Heller site drains to Cave Gulch and the rest to Moore Creek via the Rachel Carson College detention basin located across Heller Drive to the east. The total annual volume of run-off generated on the site at the present time is about 26.2 acre-feet, of which approximately 23.6 acre-feet of runoff is discharged into the Rachel Carson College detention basin, and about 2.6 acre-feet of runoff is discharged into Cave Gulch (BKF 2018a).

The proposed project includes the demolition of the existing FSH complex and the construction of five buildings to house undergraduate students, one apartment building for graduate students, parking, and other support spaces. Compared to about 6 acres of impervious surfaces at the present time, there would be about 9.07 acres of impervious surfaces on the site after project construction. Consequently, post-construction, the total volume of runoff that would be generated on the project site would be about 28.1 acre-feet (BKF 2018a). Storm water runoff would be collected in storm drains that would be directed to six bio-filtration basins distributed throughout the site where the runoff would be treated to remove urban pollutants. Treated runoff from the northern half of the site would be conveyed to the northwest for discharge via a level spreader on a hillslope in the Cave Gulch, watershed while the treated runoff from the southern half of the site would drain via a culvert under Heller Drive to discharge into the Rachel Carson College detention basin. The potential effects of the proposed storm water control system are evaluated below.

Impact on Surface Water Quality

As noted above, site storm water would be directed to six bio-filtration basins distributed throughout the site for treatment before discharge. As shown in **Appendix 4.7, Post Construction Storm Water Control Plan – Heller Site**, the bio-filtration basins have been sized and designed to treat the runoff to standards that are defined the UC Santa Cruz PCRs (volume of runoff generated by the 85th percentile 24-hour storm event). All bio-filtration basins would treat the runoff to remove urban pollutants, and three of the six basins would not be lined and would also provide a small amount of on-site infiltration of runoff. Furthermore, similar to other existing colleges and facilities on the campus, operations at the Heller site housing development would be required to comply with the MS4 permit. Therefore, the impact of site runoff on surface water quality would be less than significant.

Impact related to Hydromodification, Erosion, and Flooding

As described above, the proposed drainage plan includes three bio-filtration basins that would not be lined and would allow for some water to infiltrate. In addition, as stated above, runoff from about half the project site would be directed to the northwest and discharged into the Cave Gulch watershed via a level spreader which would infiltrate the runoff into the ground surface. As a result, even though the total runoff generated on the Heller site would increase from 26.2 acre feet under the current conditions to about 28.1 acre-feet with the project, the volume that would leave the site to drain into Moore Creek would be about 23.1 acre-feet. This volume is less than the estimated 23.6 acre-feet of runoff that currently discharges into the Rachel Carson College detention basin) (BKF 2018a). Furthermore, in compliance with LRDP Mitigation HYD-3C and the Campus's PCRs, the Heller site drainage system has been designed to ensure that post-development peak flows do not exceed pre-development peak flows from 2 to 10-year storms; for calculations see the Post-Construction Storm Water Control Plan – Heller Site, included in **Appendix 4.7** (BKF 2018a). Therefore, the project would not result in downstream hydromodification effects or exacerbate severe in-channel conditions (i.e., erosion) along the West Entrance Fork of Moore

Creek. The project would also avoid adding flows to the West Entrance Fork of Moore Creek so that instances of overflow from the West Dam are minimized and the project would not contribute additional flow to lower portions of Moore Creek, including the segment at the Highview Drive crossing.

In addition, storm water runoff leaving the site to the northwest would be infiltrated into the ground in soils underlain by schist via a level spreader in the Cave Gulch watershed and would not drain into caves on- or off-campus. Therefore, development and operation of the proposed Heller site development would not alter drainage patterns or increase runoff such that substantial erosion, siltation, or flooding would occur off-site. This impact is considered less than significant.

Impact on Groundwater Recharge

As noted above, the proposed project would result in an increase in impervious surface area on the Heller site compared to existing conditions. However, a substantial reduction in groundwater recharge would not occur because bio-filtration basins and a level spreader are included in the project to infiltrate all of the additional storm water generated on the site, such that slightly less runoff would leave the site via surface flows than under current conditions (BKF 2018a). Additional infiltration of site runoff would occur in the Rachel Carson College detention basin. Therefore, the direct impact of Heller site development on groundwater recharge would be less than significant.

In addition to the direct impact on groundwater recharge discussed above, the 2005 LRDP EIR identified another potential manner in which recharge of the karst aquifer could potentially be reduced. According to the 2005 LRDP EIR, it is possible that increased runoff from new campus impervious surfaces within the Moore Creek watershed could result in the filling of sinkholes with sediment, and thus runoff would no longer enter the karst system and would instead leave the campus as stream discharge. Some reduction in karst aquifer recharge could occur under these circumstances (UCSC 2006). However, as described above, erosion and sedimentation of sinkholes would be avoided as the Heller site storm water drainage system has been designed to include infiltration to reduce flows, as well as detention and metering of flows such that they do not cause downstream erosion and sedimentation. Therefore, the addition of impervious surfaces on the Heller site would not interfere substantially with groundwater recharge indirectly within the Moore Creek watershed, and this impact is considered less than significant.

Impact on Groundwater Quality

As discussed in **Chapter 3.0, Project Description**, the proposed development at the Heller site includes a MBR plant located in the southwestern portion of the site, where the wastewater generated in the proposed housing would be treated to current Title 22 standards and recycled water that would be produced would be used on site for toilet flushing and irrigation. The volume of recycled water generated each month would vary consistent with water use and wastewater generation in the student housing complex. The use of recycled water would also vary from month to month, depending on the number of students present in the housing as well as whether the water is needed for irrigation. Based on the volume that would be generated and used within the Heller site complex, as well as the volume planned to be used in Porter College and potentially Kresge College, it is projected that in July and August, between 80 and 83 percent of the recycled water would be used, and the balance would be disposed in one or two dry wells. During the rest of the year, as the irrigation use of the recycled water would decrease or cease, between 43 and 60 percent of the recycled water would be used and the rest disposed in the dry wells. An estimated 13.2 million gallons of recycled water would need to be disposed each year. In the event that the recycled water cannot be used in Porter and Kresge Colleges, about 16.31 million gallons of excess recycled water would be generated per year that would require disposal (see **Appendix 4.7, SHW Recycled Water Model**). Excess recycled water would be disposed of in dry wells until such time that other campus uses are identified or constructed that could receive and utilize this excess recycled water.

The dry wells would be located in the southeastern portion of the project site, in an area underlain by schist. Infiltration tests were conducted in July 2018 in the portion of the project site where the wells are planned. The tests indicated that the area was appropriate for siting the dry wells. However because groundwater was encountered in the borings at depths between 46 and 48 feet, the wells must be designed to include a separation between the bottom of the dry well and the groundwater elevation. Furthermore, because karst occurs near the area under consideration for the dry wells, the dry wells must be sited to be at least 60 feet away from the contact between karst and schist, and at least 30 feet from any infrastructure. The wells also need to be at least 30 feet apart. Based on these requirements, and to accommodate the planned volume and discharge rates for the proposed recycled water disposal, a battery of seven wells is planned. Each well would be six feet in diameter and up to 30 feet deep, although the wells could be up to 35 feet deep if needed and still provide the needed separation from groundwater.

The recycled water produced at the MBR plant would meet Title 22 Level 4 treatment standards, specifically the disinfected tertiary recycled water standard, which is the most stringent level of treatment required in California. Title 22 Level 4 standards set forth specific treatment parameters, including total coliform and turbidity as well as scheduled testing and reporting requirements to ensure ongoing water quality performance and regulatory compliance. Title 22 allows Level 4 recycled water to be used for all types of irrigation and to be infiltrated into the ground using UIC wells /dry wells. As noted above in **Section 4.7.3, Regulatory Considerations**, UIC wells are governed by the U.S. EPA UIC program and administrated and enforced by the State of California. Water discharged to UICs generally requires compliance with the Safe Drinking Water Act standards to ensure that potential sources of drinking water are protected as though the sources are currently used for drinking water. The proposed UIC wells will be classified as Class V wells. Class V UIC wells are authorized by rule and specific treatment requirements are defined on a case-by-case basis based on the water quality of the injected water and geological and hydrogeological characteristics of the soil. As the water would be treated to a level that allows unrestricted irrigation use, the injection of this recycled water into the dry wells for disposal would not adversely affect the quality of groundwater and this impact would be less than significant.

Mitigation Measures: No mitigation is required.

SHW Impact HYD-3: Hagar site development and operations would not substantially degrade surface or groundwater quality; interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level or cause substantial changes in spring flows; but could result in erosion and sedimentation in Jordan Gulch. (*Potentially Significant; Less than Significant with Mitigation*)

The Hagar site is located in the lower portion of a larger area known as the East Meadow. The East Meadow, including the Hagar site, is undeveloped land covered with grasses and underlain by karst. An approximately 45.4-acre portion of the East Meadow, which includes the Hagar site and about 31.5 acres upslope of the site, contributes flow to the sinkhole/detention basin. About 43.8 acres of this drainage area are pervious and about 1.6 acres are impervious (Coolidge Drive) at the present time. Storm water that is not lost due to evapotranspiration or infiltration into the ground within this area runs off to the south and east to discharge into a detention basin that was constructed in the southeastern corner of the Hagar site in 1991. In addition to runoff from the meadow area, the detention basin also receives runoff from a portion of Coolidge Drive, conveyed by a concrete drainage ditch that runs alongside the site's eastern boundary, parallel to Glenn Coolidge Drive. In 2001, a sinkhole formed in the detention basin. Excess storm water that does not leave the detention basin via the sinkhole drains into an underground storm drain that conveys the runoff east to discharge into Kalkar Quarry Pond located to the east of Glenn Coolidge Drive. Due to the proximity of the detention basin/sinkhole to the Kalkar Quarry Pond, it is possible that some of the runoff that discharges into the sinkhole flows into the Kalkar Quarry Pond via the Kalkar Quarry spring, although the existence and degree of such a hydraulic connection has not been established. Note that there is no dye trace information directly relating the area within the footprint of the proposed development or the detention basin/sinkhole to Kalkar Quarry Pond.

The proposed project includes clearing and grading of the Hagar site and the construction of 35 two-story buildings, childcare facility, parking, and other support spaces. While the total area of the Hagar site is about 17.3 acres, the development area within the site would be about 12.7 acres. Within the 12.7-acre development area, there would be about 6.32 acres of impervious surfaces on the site after project construction. Consequently, post-construction, the total volume of runoff that would be generated on the project site would increase and would require control, treatment and disposal.

The Hagar site is underlain by karst, and runoff cannot be infiltrated into the site soils. Therefore increased storm water runoff due to new impervious surfaces cannot be managed by locally infiltrating the additional runoff adjacent to where it is generated. Furthermore, unless controlled, a substantial increase in the amount of runoff, or the flow rate, to the on-site detention basin/sinkhole has the potential to result in the expansion of the sinkhole. Sinkhole expansion could, in turn, result in an increase in sediment deposition in the karst fracture system to which the sinkhole is connected, which could impact the springs fed by the karst aquifer. In addition, due to the presumed hydraulic connection between the detention basin/sinkhole and the Kalkar Quarry spring and pond, the project must not cause a substantial increase or reduction in storm water flows to the detention basin/sinkhole such that flows to the Kalkar Quarry spring are substantially increased or reduced. Lastly, due to its location at the lower end of the East Meadow, the Hagar site receives run-on from approximately 31.5 acres of land up-gradient of the site. The project site storm water system must manage the storm water flowing onto the site from this area, such that the run-on does not enter the Hagar site storm drain system and that runoff still continues to flow into the sinkhole so that the volume of storm water flowing into the underlying karst formation does not decrease.

The proposed storm water management system for the Hagar site has been developed in a manner that addresses these site limitations. As on-site infiltration is not feasible, the storm water drainage system for the Hagar site has been designed to direct all new runoff into storm drains located in the proposed roadways. The collection system would convey the runoff from the upper two thirds of the development area (DMA 2 and 3) into two bio-filtration basins along Glenn Coolidge Drive, where the runoff would be detained and treated, and then metered into the sinkhole. Runoff from the lower one-third of the development area (DMA 4) would be discharged into a third bio-filtration basin from where it would be metered into a storm drain that would convey it to Jordan Gulch. To address the run-on from the meadow upslope of the site, the site storm water control plan includes a series of cobble lined channels and storm drains that would intercept and convey the run-on around the developed Hagar site to discharge to the detention basin/sinkhole, as it does in the current conditions (BKF 2018b). The detention basin/sinkhole would also continue to receive runoff from the existing ditch that parallels Glenn Coolidge

Drive and Hagar Drive. The impacts of the proposed storm water control system on surface and groundwater quality and volume are analyzed below.

Impact on Surface and Groundwater Quality

The proposed project would create approximately 6.32 acres of new impervious surfaces and 6.38 acres of pervious surfaces on the Hagar site. With the development of urban uses, site runoff after project completion would have the potential to contain pollutants, including sediment, which could adversely affect water quality. However, in general, the potential for erosion and sedimentation after development would be low as the site would be under buildings, pavement, and landscaping. Furthermore, the project is required to comply with water quality (treatment) and volume reduction requirements as defined by the UC Santa Cruz PCRs. These require that water quality treatment be provided on the project site and that the post-development peak flows discharged from the site not exceed pre-project peak flows for the 2- through 10-year 24-hour storm events. In compliance with these requirements, the collection system would convey site runoff to three lined bio-filtration basins along Glenn Coolidge Drive that would treat the runoff to campus standards (see **Appendix 4.7, Post Construction Storm Water Control Plan – Hagar Site**). As noted above, in order to limit the impact to the sinkhole, a portion of the treated and metered runoff from the developed Hagar site would be piped under Hagar Drive and into a storm drain that would discharge the runoff through a dissipation structure into lower Jordan Gulch. The remaining run-off and run-on would be directed to the existing sinkhole at approximately the same total volume as under the existing conditions. As the runoff would be detained and treated to the standards specified in the PCRs before discharge into the existing sinkhole and Jordan Gulch, the discharge is not expected to adversely affect water quality. However, to verify this, **SHW Mitigation Measure HYD-3A** will be implemented to monitor the quality of the treated discharge water.

Similar to the Heller site development, the Hagar site development also includes a MBR plant to treat wastewater on site and generate recycled water for unrestricted irrigation use and toilet flushing. As described in **Chapter 3.0, Project Description**, based on the volume of recycled water that would be generated and used within the Hagar site development, it is projected that April through September, all of the recycled water would be used on site, and there would be no excess recycled water that would require disposal. During the rest of the year, as the irrigation use of the recycled water would decrease or cease, there would be excess recycled water (ranging from a low of 21,400 gallons (October) to a high of 278,700 gallons (January) that would require disposal. The excess recycled water would be conveyed off site in a pipeline and discharged via an outfall with an energy dissipater into Jordan Gulch south of Hagar Drive. An estimated 1 million gallons of recycled water would be disposed each year. During the times that recycled water is discharged into Jordan Gulch, the disposal rate would be about 30 gallons per minute. As with the MBR plant at the Heller site, the Hagar site MBR plant would produce recycled water that meets Title 22 requirement for unrestricted irrigation and toilet flushing use. As a result, recycled water used on the Hagar site for irrigation and the excess recycled water disposed of in Jordan Gulch would not adversely affect surface or groundwater quality. However, a potential impact to water quality could occur if the discharge of the storm water and recycled water resulted in the formation of sinkholes in Jordan Gulch that could then cause the discharge of sediment into the underlying karst and affect water quality in downstream springs.[1] Such sinkholes could also undermine nearby infrastructure present in Jordan Gulch, which includes a sanitary sewer main and campus roadway. As noted in **Section 4.5, Geology and Soils**, the sidewall of Jordan Gulch appear to be solid marble that defines the boundaries of the linear doline that forms this gulch. Furthermore, the proposed discharge location is not near a sinkhole. Therefore, the potential that a reactivated sinkhole within Jordan Gulch would affect the adjacent bike path, road or infrastructure is very low. However, should a sinkhole expand beneath critical infrastructure such as Ranch View Road, Coolidge Drive, or utility infrastructure, the impact would be significant in terms of its effect on the infrastructure and for causing erosion and sedimentation in the karst aquifer. **SHW Mitigation HYD-3B and -3C** are set forth below to ensure that the Jordan Gulch discharge points for both storm water and recycled water do not result in the formation of sinkholes that could affect water quality or cause damage to nearby campus infrastructure. With mitigation, the impact would be less than significant.

Impact on Kalkar Quarry Spring and Pond

As described above, in order to limit the impact to the sinkhole, a portion of the treated and metered runoff from the developed Hagar site would be piped under Hagar Drive and into a storm drain that would discharge the runoff through a dissipation structure into Jordan Gulch. The remaining run-off and run-on would be directed to the existing sinkhole at approximately the same total volume as in the existing conditions.

To evaluate the potential effect on Kalkar Quarry Pond from the reduction in infiltration and recharge, pre- and post-development runoff data for the Kalkar Quarry watershed presented in the Post-Construction Storm Water Control Plan – Hagar Site (BKF 2018b) was utilized. The pre-development runoff estimates are summarized in **Table 4.7-6, Hagar Site Pre-Development Infiltration Recharge and Runoff to Detention Basin/Sinkhole,** below. Post-development estimates are presented in **Table 4.7-7, Hagar Site Post Development Infiltration Recharge and Runoff to Detention Basin/Sinkhole,** which

[1] Previous EIRs prepared for Colleges 9 and 10 projects on the campus included a mitigation measure that required that no new runoff be directed to Jordan Gulch. However, that mitigation measure was imposed with respect to the middle reach of Jordan Gulch on the central campus due to erosion problems and does not apply to the lower reach of Jordan Gulch where there is no evidence of erosion.

follows. The Post-Construction Storm Water Control Plan – Hagar Site and detailed calculations are presented in **Drainage Basin Area Rainfall Runoff & Recharge Spreadsheet** in **Appendix 4.7**.

Table 4.7-6
Hagar Site Pre-Development Infiltration Recharge and Runoff to Detention Basin/Sinkhole

Pre-Development (45.4-Acre Drainage Area)				
Variable	**Pervious Area**		**Impervious Area**	
	Amount (inches/year)	**Volume (acre-feet)**	**Amount (inches/year)**	**Volume (acre-feet)**
Existing area (acres)	43.7		1.7	
Rainfall	34.0	124.04	34.0	4.68
Evapotranspiration	14.8	53.78	3.9	0.54
Infiltration Recharge	10.1	36.95	0	0
Soil Moisture Storage	0.7	2.64	0	0
Total Runoff	8.4	30.67	30.1	4.14
Combined Recharge & Runoff	18.5	67.62	30.1	4.14
Total Combined Infiltration Recharge & Runoff to Detention Basin / Sinkhole = 71.8 acre-ft/yr				
Source: BKF 2018b				

Table 4.7-7
Hagar Site Post-Development Infiltration Recharge and Runoff to Detention Basin/Sinkhole

Variable	**Pervious Area**		**Impervious Area**	
	Amount (inches/year)	**Volume (acre-feet)**	**Amount (inches/year)**	**Volume (acre-feet)**
Existing area (acres)	35.5		4.5	
Rainfall	34.0	100.72	34.0	17.31
Evapotranspiration	14.8	43.71	15.4	2.01
Infiltration Recharge	10.1	30.01	13.6	0
Soil Moisture Storage	0.7	2.16	0	0
Total Runoff	8.4	24.84	4.1	15.30
Combined Recharge & Runoff	18.5	54.85	17.7	15.30
Total Combined Infiltration Recharge & Runoff to Detention Basin / Sinkhole = 70.2 acre-ft/yr **Change from existing Recharge & Runoff = 1.6 acre-ft/yr**				
Source: BKF 2018b				

As **Table 4.7-6** above shows, currently about 71.8 acre-feet/year of runoff and recharge are directed to the sinkhole. With the project, as **Table 4.7-7** shows, the recharge and runoff to the sinkhole would be about 70.2 acre-feet/year. The reduction in the amount of post-development recharge is calculated to be about 1.6 acre-feet/year or approximately 521,362 gallons per year. This volume of water would no longer infiltrate or make its way to the detention basin/sinkhole and presumably would not be delivered to Kalkar Quarry Pond via the karst spring system. As noted above, there is no dye trace information directly relating the area within the footprint of the proposed development or the detention basin/sinkhole to Kalkar Quarry Pond. Therefore, that all of the recharge water from the study watershed ends up at Kalkar Quarry Pond is a conservative assumption. Nonetheless, to assess the significance of this reduction in recharge or runoff to the sinkhole, the reduction in runoff and infiltration was compared to the average annual spring flow and the average base or dry season flow at Kalkar Quarry spring. Based on monitoring data for the Kalkar Quarry spring, the average annual flow (January through December) was calculated to be 90.9 million gallons per year (MGPY) and the average annual dry season or base flow (June through September only) was calculated to be 42.3 MGPY. The estimated reduction in recharge of about 521,362 gallons would represent a reduction of about 0.6 percent in the average annual flow and a reduction of 1.2 percent in the average annual base flow at Kalkar Quarry spring.

As noted in **Section 4.7.2.1, Campus Hydrology**, the karst aquifer is highly complex. There is no evidence that *all* of the storm water that infiltrates on the Hagar site under current conditions or *all* of the runoff that discharges into the detention basin/sinkhole flows into the Kalkar Quarry Pond. Therefore, the estimated reduction in the Kalkar Quarry spring discharge due to the development at the Hagar site is a conservative estimate. Second, as shown in **Table 4.7-1**, this spring displays a high level of variability in base flows from year to year, and a reduction of about 0.6 percent in the annual flows and about 1.2 percent in base flows would be relatively insignificant and well within the annual variability in flows. Last, Kalkar Quarry Pond receives runoff not only via spring discharge but also from storm drains, and therefore the percent reduction in pond volume would be less than the percent reduction in annual and base flows. As the amount of post-development recharge would be nearly equal to existing recharge (within 2 percent), the impact is considered less than significant.

Impact on Jordan Gulch and Downstream Springs

As discussed above, the proposed project would collect, treat and direct new runoff from DMA 4 to Jordan Gulch. DMA 4 has an area of about 3.8 acres. Based on modeling results shown in **Appendix 4.7**, about 2.8 acre-feet/year of runoff from pervious areas and 4.7 acre-feet/year of runoff from impervious areas for a total of about 7.5 acre-feet/year or 2.4 MGPY of runoff from DMA 4 would be directed to Jordan Gulch. In addition to the new runoff, excess recycled water generated at the Hagar site MBR plant would also be disposed via a separate outfall in Jordan Gulch. From both discharge points, the water would flow into the underlying karst in Jordan Gulch. The two concerns with respect to the discharge of storm water and recycled water in Jordan Gulch relate to the potential for the discharges to result in increased spring flow that could cause downstream erosion and/or flooding, and the potential for the discharges to cause localized erosion and formation/expansion of sinkholes. These potential effects are analyzed below.

Given the complexity of the underlying karst system, it is difficult to predict how much of the site runoff and recycled water that is directed to Jordan Gulch would discharge to off-site springs fed by the karst aquifer. However, a previous dye trace study confirmed that the karst fracture system in lower Jordan Gulch in the immediate vicinity of the proposed discharge location is directly connected to three off-site springs or spring-fed ponds (i.e., Bay Street spring, West Lake Pond and Messiah Lutheran spring) and is not directly connected to Kalkar Quarry spring. A dye trace study conducted near the East Remote parking lot confirmed that points on the central campus are connected to an even greater number of springs. Therefore, conceptually, diversion of a portion of the Hagar site runoff and recycled water discharge to Jordan Gulch could potentially increase the spring flow at the three springs mentioned above as well as at other off-site spring locations.

To analyze the potential for the diverted runoff and recycled water to affect spring flows, as a first step, the watershed that drains into Jordan Gulch and the underlying karst system was defined based on topography, geology, the systems of faults that are known to underlie central and lower campus, and existing roadways that direct runoff, and are expected to control and direct groundwater within the karst aquifer. Note that the watershed was conservatively defined and limited to lower Jordan Gulch; in reality, based on the results of the dye trace study near the East Remote parking lot, off-site springs receive runoff from additional areas north of this watershed. The approximately 227-acre watershed is shown in **Figure 4.7-2**. All of the storm water within this watershed infiltrates into a complex fracture system in the underlying marble and eventually exits via downgradient springs; storm water does not flow into or exit from the watershed via one or more surface stream. This watershed is largely under undeveloped meadows and Jordan Gulch, and impervious surfaces (roads and paths) account for about 6 percent of the watershed. Using these watershed characteristics, the peak flows generated under 2-, 5-, 10-, 25- and 100-year 24-hour storm events were calculated for the watershed. The estimated flows are reported in **Table 4.7-8** below.

Storm water from DMA 4 on the Hagar site, an approximately 3.8-acre area, would be directed to Jordan Gulch. Peak flows for DMA 4 were calculated for the 2-, 5-, 10-, 25- and 100-year 24-hour storm events and are presented in **Table 4.7-8**. Finally, recycled water that would be discharged to Jordan Gulch was added to the peak storm water flows. A comparison of the project inputs to the peak flows for the watershed as a whole shows that the project inputs would increase the peak flows by about 1.2 percent under the smaller storm events and by 1.5 percent under the larger storm events.

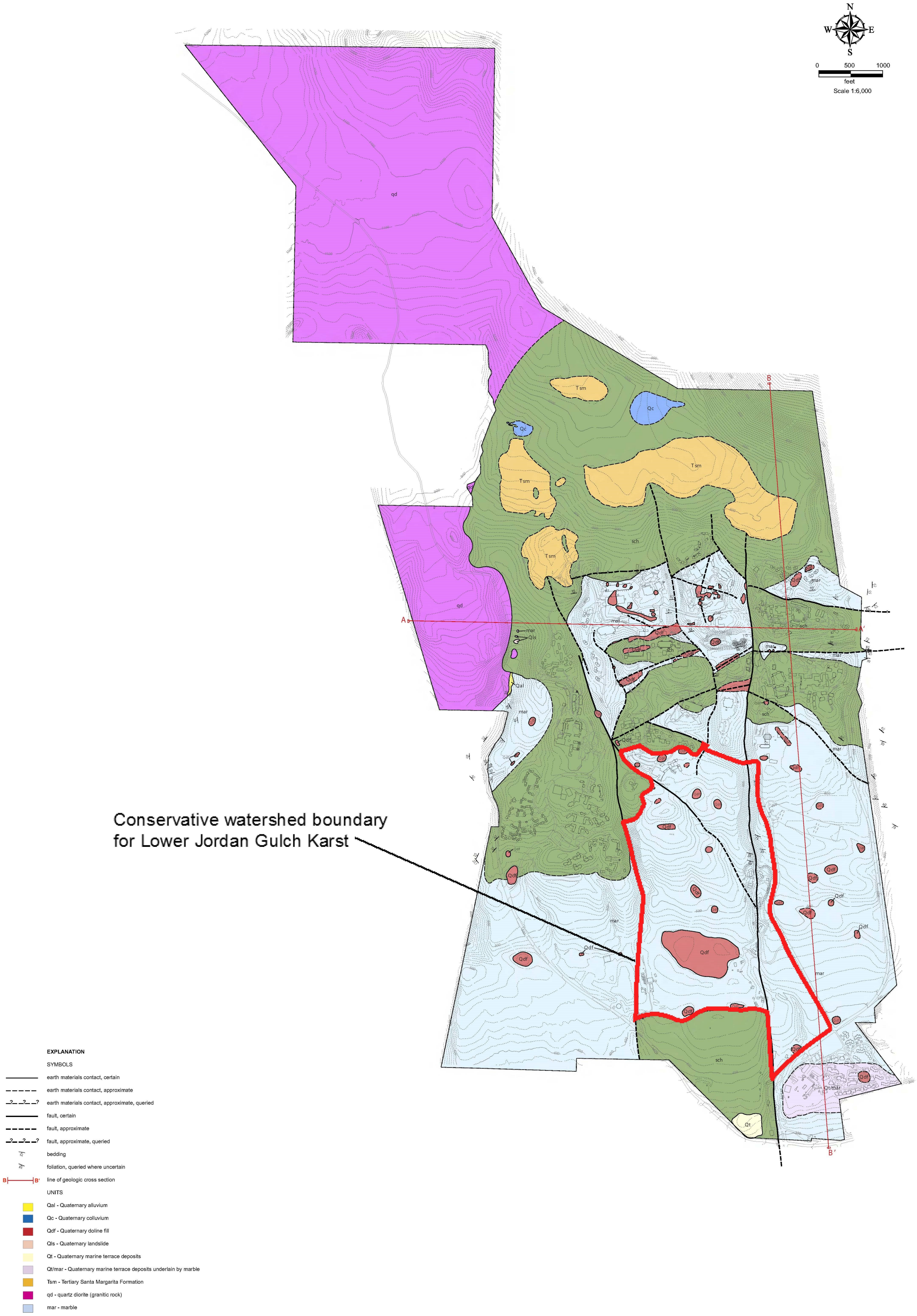
Table 4.7-8
Changes in Jordan Gulch Watershed Peak Flows with Project

Area	2-year	5-year	10-year	25-year	100-year
Jordan Gulch Watershed	119.97	207.87	259.44	350.41	478.70
DMA 4 Runoff	1.31	2.50	3.16	5.02	6.95
Recycled Water	0.07	0.07	0.07	0.07	0.07
Total Project Input	**1.38**	**2.57**	**3.23**	**5.09**	**7.02**
Percent Increase in watershed flows	1.15	1.24	1.24	1.45	1.47

An increase of 1.2 to 1.5 percent in peak spring flows would be well within the variability in spring flows, especially under storm conditions, and the impact would be less than significant.

Impact on Groundwater Recharge

As discussed above, the Hagar site would consist of pervious and impervious surfaces after project construction where all storm water would be captured, and rainfall would no longer infiltrate on approximately 6.32 acres of the site. However, all runoff from the site would be collected and conveyed to the detention basin/sinkhole and Jordan Gulch where it would enter the underlying karst system. Therefore, even though the rate and volume of runoff from the site would increase due to new pervious and impervious surfaces, the runoff would still enter the karst system by way of infiltration in the detention basin/sinkhole and Jordan Gulch. Furthermore, excess recycled water would also be infiltrated into the karst aquifer. For these reasons, the proposed project would not interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume, and this impact is considered less than significant.



SOURCE: Weber, Hayes & Associates, 2018

FIGURE **4.7-2**

IMPACT SCIENCES

Jordan Gulch Watershed

680.019•9/18

In summary, the Hagar site development would not result in an adverse impact related to a reduction in the amount of water received in the Kalkar Quarry Pond or an increase in off-site spring flows. Nor would the project reduce the volume of the underlying aquifer. Based on the controls included in the project, storm water runoff would be treated to the standards specified in the PCRs before discharge into the existing sinkhole and Jordan Gulch, and therefore the discharge is not expected to adversely affect water quality, although the Campus will nonetheless implement a mitigation measure to monitor water quality on the project site. The project could, however, affect groundwater quality by resulting in erosion and sinkhole formation in the area where storm water and recycled water are discharged into Jordan Gulch. Mitigation is set forth below to mitigate this potentially significant impact of the proposed project.

Mitigation Measures:

SHW Mitigation HYD-3A: Treated storm water runoff will be sampled on site, and laboratory analyzed for total suspended solids, pH, oil & grease, and nitrates and compared with applicable storm water benchmarks threshold limits in general accordance with protocols outlined in the Industrial General Permit[2]. In the event a limit is exceeded for any of the constituents, an assessment of existing best management practices will be conducted, and appropriate changes will be made to best management practices.

SHW Mitigation HYD-3B: A minimum 60-foot buffer shall be established between infiltration areas in Jordan Gulch and critical structures, existing or planned, such as buildings, roadways, and life/safety infrastructure.

SHW Mitigation HYD-3C: In the event that a sinkhole is formed or activated in Jordan Gulch by the discharge of storm water and recycled water from the Hagar site, a graded filter or another filtration system will be designed and constructed.

Significance after Mitigation: Implementation of the mitigation measure set forth above would reduce the impacts of the Hagar site development to a less than significant level.

---

2 While the Industrial General Permit is not applicable to the UC Santa Cruz campus, it establishes standard of care protocols for storm water analysis, qualifying storm events for sample collection, and provides benchmark threshold limits for evaluating water quality.

SHW Impact HYD-4: Implementation of the proposed SHW project would not substantially deplete groundwater supplies such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. (*Less than Significant*)

No groundwater extraction wells are proposed as part of the SHW project. Groundwater would not be extracted on the project site or at the existing campus well to serve the proposed SHW project's water needs. Therefore, there would be no impact of the proposed project on the local aquifer or a lowering of the groundwater table at the project sites or on the campus. There would also be no impact on any off-campus wells, including wells in the Bonny Doon area.

The project's potable water demand would be served by water that is supplied to the campus by the City of Santa Cruz and is obtained primarily from surface water sources with about 5 percent of the supply provided by groundwater wells. The water that would be needed at the two project sites was estimated and included in the estimate of total Campus water demand under the 2005 LRDP and was analyzed for its impact on available supplies from the City. That analysis, which is presented in **Section 7.1, LRDP Water Supply Assessment**, shows that the Campus's annual water demand, including the water demand associated with the proposed SHW project, would be lower than previously projected in the 2005 LRDP EIR, and would be served by existing supply sources under normal water years. Thus, during normal water years, the proposed project would not require the City to increase its withdrawal of groundwater above levels anticipated by the City in its 2015 Urban Water Management Plan (UWMP).

During periods of prolonged drought, as is current practice and as projected in the 2015 UWMP, the City's use of groundwater would increase. However, as discussed in **Section 7.1**, the City is actively evaluating the feasibility of developing a new source of water that would be used under drought conditions to augment supplies and reduce the City's reliance on existing sources, including groundwater wells in order to reduce impacts on the groundwater aquifer. The City is also evaluating the feasibility of in lieu water transfers and aquifer storage and recovery (ASR) in order to recharge the groundwater basin and bank groundwater for use during dry years. Although until such time that these new sources are developed, groundwater withdrawal from city wells could potentially increase, the proposed project would make a negligible contribution to the City's need for the additional groundwater pumping during periods of drought. Furthermore, all UC Santa Cruz facilities, including the SHW project, would be required to curtail water use in drought periods in compliance with the commitment that the Campus has made to the City in the 2008 Settlement Agreement. Therefore, the project's impact on the City's groundwater supplies would be less than significant.

Mitigation Measures: No mitigation is required.

4.7.5 PORTER AND RACHEL CARSON DINING FACILITIES EXPANSION PROJECT IMPACTS AND MITIGATION MEASURES

Environmental Setting

The proposed dining facilities expansion project would add to existing facilities on the west side of Rachel Carson College and to the southern end of Porter College. In both instances, the facilities would be located above or adjacent to existing buildings, or would replace existing buildings with larger buildings.

Impacts and Mitigation Measures

DF Impact HYD-1: The implementation of the proposed dining facilities expansion project would not have a significant impact related to water quality; siltation, erosion or flooding due to the alternation of drainage patterns; and groundwater recharge. (*Less than Significant*)

Water Quality

The proposed dining facilities expansion project would be required to implement a SWPPP (if more than 1 acre of disturbance) or, if less than 1 acre, an Erosion and Sediment Control Plan (per Campus Standards and the Storm Water Management Plan) to minimize erosion and sedimentation during construction. In addition, the design and operation of each facility would adhere to UC Santa Cruz PCRs. For these reasons, the impact of the proposed dining facilities expansion project on water quality would be less than significant.

Siltation or Erosion or Flooding

The sites of the proposed dining facilities expansion project are located within the Moore Creek watershed. The area to be developed by each facility would be small and the additional storm water generated on each site would not be substantial. These projects will be required to comply with the PCRs and therefore provide water quality, runoff reduction, and peak management. Therefore, the project's impacts associated with the addition of impervious surface would be less than significant.

Groundwater Recharge

The small increase in impervious surfaces on the dining facilities project sites would not be substantial enough to interfere with groundwater aquifer recharge. Furthermore, the increased runoff generated by the proposed dining facilities expansion project would be required to meet the runoff retention and peak flow standards in the PCRs and therefore would not result in erosion or siltation that could filling sinkholes with the Moore Creek watershed with sediment, and thus reduce aquifer recharge. This impact is less than significant.

Groundwater Supply

As the dining facilities expansion project would not increase enrollment at UC Santa Cruz or the regional population levels, demand for potable and non-potable water would not increase above levels that were previously analyzed in the 2005 LRDP EIR and now reevaluated in **Section 7.1**. Thus, the impact of the proposed dining facilities expansion project on groundwater supplies in the City's service area would be less than significant.

Mitigation Measures: No mitigation measure is required.

4.7.6 CUMULATIVE IMPACTS AND MITIGATION MEASURES

SHW Impact C-HYD-1: Implementation of the proposed project would not result in significant cumulative impacts with respect to hydrology and water quality. (*Less than Significant*)

The cumulative impact of campus development under the 2005 LRDP along with other development in the region, including in the City of Santa Cruz, with respect to urban runoff volume and water quality is analyzed in the 2005 LRDP EIR under LRDP Impact HYD-7. The analysis in the 2005 LRDP EIR found that cumulative growth in the study area, including the UC Santa Cruz campus, would increase impervious surface coverage in study area watersheds, including the Cave Gulch subwatershed, Moore Creek watershed, and Jordan Gulch watershed, and increase storm water runoff, but due to compliance with NPDES Phase II requirements by the Campus and other developers under the direction of the City and the Regional Water Quality Control Board, there would not have a substantial adverse effect on receiving water quality (UCSC 2006). Although the redevelopment of the Heller site was envisioned in the 2005 LRDP and analyzed in the 2005 LRDP EIR, the development of impervious surfaces on the Hagar site was not foreseen or analyzed in the 2005 LRDP EIR. However, as discussed above, the storm water drainage systems for the proposed SHW project as well as the related dining facilities expansion project would be designed to comply with the UC Santa Cruz PCRs and would provide water quality treatment, infiltration, and peak flow management, and thus implementation of these projects would not result in erosion within on- and off-campus watersheds. For these reasons, the proposed project would not alter the previously evaluated cumulative impact. The project's cumulative impact with respect to hydrology and water quality would be less than significant.

The cumulative impact of campus development under the 2005 LRDP along with other development in the region, including in the City of Santa Cruz, with respect to groundwater extraction during drought periods is analyzed in the 2005 LRDP EIR under LRDP Impact HYD-8. The analysis in the 2005 LRDP EIR found that cumulative growth in the study area would not contribute to a net deficit in the regional aquifer volume or a lowering of the local groundwater table. The proposed SHW project as well as the related dining facilities expansion project would not increase enrollment at UC Santa Cruz or the regional population levels, and thus not increase demand for water over what was previously analyzed in the 2005 LRDP EIR (in fact as shown in **Section 7.1**, the main campus's water demand at full development under the 2005 LRDP along with the water demand associated with other UC Santa Cruz facilities, would be substantially lower than the previous estimate in the 2005 LRDP EIR). As a result, the proposed project would not alter the previously evaluated cumulative impact. The project's cumulative impact related to groundwater extraction would be less than significant.

Mitigation Measures: No mitigation is required.

4.7.7 REFERENCES

BKF. 2018a. Post-Construction Stormwater Control Plan, UCSC Student Housing West -Heller Site. September.

BKF. 2018b. Post-Construction Stormwater Control Plan, UCSC Family Student Housing – Hagar Site. September.

California Department of Water Resources (DWR). 2016. California's Groundwater, Bulletin 118 Interim Update 2016.

Federal Emergency Management Agency. May 16, 2012. Flood Insurance Rate Map No. 06087C0331E for Santa Cruz County, California.

Office of Environmental Health Hazard Assessment (OEHHA). 2014. Dry Wells: Uses, Regulations, and Guidelines in California and Elsewhere. Available online at: https://www.waterboards.ca.gov/board_reference/2014fall/docs/dry_wells_fs.pdf, accessed March 14, 2018.

State Water Resources Control Board (SWRCB). 2017. Proposed Amendments to the Policy for Water Quality Control for Recycled Water. Available online at: https://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/2018/171221_rwp_stakeholder_issue_paper.pdf, accessed March 14, 2018.

University of California, Santa Cruz (UCSC). 2006. *2005-2020 Long Range Development Plan Final Environmental Impact Report*, SCH No. 2005012113.

U.S. Environmental Protection Agency (U.S. EPA). 2018. Protecting Underground Sources of Drinking Water from Underground Injection. Available online at: https://www.epa.gov/uic, accessed March 15, 2018.

Weber, Hayes and Associates, 2017a. 2016-17 Annual Water Quality Monitoring Results, UCSC Campus Storm Water Management Program. June.

Weber, Hayes and Associates, 2017b. UCSC Spring and Stream Flow Monitoring, March 10 and September 22, 2017, for the University of California Campus, Santa Cruz, California. December 27.