4.6 GEOLOGY, SOILS, AND MINERAL RESOURCES

4.6.1 INTRODUCTION

The Geology, Soils, and Mineral Resources section of this EIR describes the geologic and soil characteristics of the proposed project site and evaluates the extent to which implementation of the project could be affected by the following geologic and seismic hazards: rupture of a known earthquake fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction; soil erosion; soil stability; and expansive soils. The information provided in this section is drawn from the *Davis General Plan*,[1] the associated EIR,[2] and the *Preliminary Geotechnical Engineering Report* prepared for the project site by Wallace Kuhl and Associates, Inc.[3]

4.6.2 EXISTING ENVIRONMENTAL SETTING

The following setting information focuses on the seismic, geotechnical, and soil conditions of the proposed project site. In addition, existing mineral resources in the area are described.

Seismicity Definitions

A fault is defined as a fracture or zone of closely associated fractures along which rocks on one side have been displaced with respect to those on the other side. A fault zone is a zone of related faults that commonly are braided and subparallel, but may be branching or divergent. Movement within a fault causes an earthquake. When movement occurs along a fault, the energy generated is released as waves which cause ground shaking. Ground shaking intensity varies with the magnitude of the earthquake, the distance from the epicenter, and the type of rock or sediment the seismic waves move through.

Strong ground shaking is described as a motion of sufficient strength to affect people and their environment or any ground movement recorded on a strong motion instrument or seismograph. The common way to describe ground motion during an earthquake is with the motion parameters of acceleration and velocity in addition to the duration of the shaking.

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1 City of Davis. *Davis General Plan.* Adopted May 2001. Amended through January 2007.
2 City of Davis. *Program EIR for the City of Davis General Plan Update and Project EIR for Establishment of a New Junior High School*. January 2000.
3 Wallace Kuhl and Associates, Inc. *Preliminary Geotechnical Engineering Report.* January 20, 2015.

Regional Seismicity

According to the Davis General Plan, earthquake faults do not run through the General Plan planning area.[4] The City of Davis' planning area is located 11 miles west of Sacramento and approximately 79 miles northeast of San Francisco and consists of approximately 160 square miles. The fault located nearest to the project site is approximately 20 miles to the east.[5] The San Andreas fault system is located approximately 71 miles to the west and the Eastern Sierra fault system is located approximately 93 miles to the east. Numerous quakes along the San Andreas and Eastern Sierra fault systems have been felt in Davis. Major quakes occurred in 1833, 1868, 1892, 1902, 1906, and most recently in 1989; however, Davis did not suffer significant damage during these events.

The project site is not located within an Alquist-Priolo Earthquake Fault Zone.[6] The Office of Planning and Research has placed the Davis area in Seismic Activity Intensity Zone II, which indicates that the maximum intensity of an earthquake would be VII or VIII on the Modified Mercalli Intensity Scale. An earthquake of such magnitude would result in "slight damage in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures." The Uniform Building Code (UBC) places all of California in the zone of greatest earthquake severity because recent studies indicate high potential for severe ground shaking.

A low-intensity zone is defined by the United States Geological Survey (USGS) as an area that is likely to experience an earthquake measuring a maximum of 5.0 to 5.9 in magnitude on the Richter scale, and a maximum intensity of VII or VIII on the Modified Mercalli scale. The Richter scale measures the amplitude of seismic waves recorded by a seismograph. The Modified Mercalli scale measures the intensity of an earthquake by the way the shaking is felt and responded to by humans, and by the amount of damage the earthquake causes to buildings and structures. The Modified Mercalli scale is shown in Table 4.6-1.

Regional Geology

Davis is located in the eastern portion of the Putah Creek Plain, one of the major features of the southwestern Sacramento River valley. According to the Davis General Plan, the land slopes at generally less than one percent, and elevations range from 60 feet above sea level in the west parts of the City to 25 feet in the east parts of the City.[7] The foothills of the Coast Range are approximately fourteen miles to the west, and the Sacramento River is approximately eleven miles to the east.

Beneath the Sacramento Valley floor is a layer of metamorphic and igneous rock at depths greater than 17,000 feet. Atop this layer is a layer of marine and sedimentary rocks up to 15,000

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4 City of Davis. *Davis General Plan [pg. 318].* Adopted May 2001. Amended through January 2007.
5 U.S. Geological Survey. *Interactive Fault Map.* 2015.
6 California Department of Conservation. *Seismic Hazard Zone Maps.* 2007. Available at: http://www.quake.ca.gov/gmaps/WH/regulatorymaps.htm.
7 City of Davis. *Davis General Plan [pg. 318].* Adopted May 2001. Amended through January 2007.

feet thick. Neither of the layers bear water. The surface layers consist of up to 3,000 feet of water-bearing alluvial sediments, most of which are semi-consolidated, while only the uppermost layer, up to 200 feet deep, consists of unconsolidated alluvial deposits.

Due to a high proportion of silt and clay, the soils in the planning area are only moderately or slowly permeable, which hinders drainage and ground water recharge. Erosion hazards are “none to slight.” Shrink-swell potential, which is the potential for soil to expand and contract due to moisture and temperature, is predominantly “moderate to high.”

Table 4.6-1
Modified Mercalli Scale of Earthquake Intensity

Scale	Effects
I.	Earthquake shaking not felt.
II.	Shaking felt by those at rest.
III.	Felt by most people indoors; some can estimate the duration of shaking.
IV.	Felt by most people indoors. Having objects swing, windows and doors rattle, wooden walls and frames creak.
V.	Felt by everyone indoors; many estimate duration of shaking. Standing autos rock. Crockery clashes, dishes rattle, and glasses clink. Doors close, open, or swing.
VI.	Felt by everyone indoors and most people outdoors. Many now estimate not only the duration of the shaking, but also its direction and have no doubt as to its cause. Sleepers awaken. Liquids disturbed, some spilled. Small unstable objects displaced. Weak plaster and weak materials crack.
VII.	Many are frightened and run outdoors. People walk unsteadily. Pictures thrown off walls, books off shelves. Dishes or glasses broken. Weak chimneys break at roofline. Plaster, loose bricks, unbraced parapets fall. Concrete irrigation ditches damaged.
VIII.	Difficult to stand. Shaking noticed by auto drivers, waves on ponds. Small slides and cave-ins along sand or gravel banks. Stucco and some masonry walls fall. Chimneys, factory stacks, towers, elevated tanks twist or fall.
IX.	General fright. People thrown to the ground. Steering of autos affected. Branches broken from trees. General damage to foundations and frame structures. Reservoirs seriously damaged. Underground pipes broken.
X.	General panic. Conspicuous cracks in ground. Most masonry and frame structures destroyed along their foundations. Some well-built wooden structures and bridges are destroyed. Serious damage to dams, dikes, and embankments. Railroads bent slightly.
XI.	General panic. Large landslides. Water thrown out of banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flatland. General destruction of buildings. Underground pipelines completely out of service. Railroads bent greatly.
XII.	General panic. Damage nearly total, the ultimate catastrophe. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.

Source: California Division of Mines and Geology, 1973.

Project Site Conditions

The overall proposed project site is comprised of the 212-acre MRIC site, and the 16.58-acre Mace Triangle site, which is being included in the proposed annexation area to avoid the creation of a County island. According to Wallace Kuhl and Associates, the ground surface elevations across the site generally decrease in the east direction with surface elevations ranging between about 25 and 30 feet mean sea level (msl).

MRIC

Based on the Geotechnical Report and the National Resources Conservation Service (NRCS) web soil survey, (see Figure 4.6-1) the following soils are located on the MRIC site:

- Capay silty clay (map symbol Ca);
- Sycamore silt loam, drained (Sp);
- Sycamore complex, drained (Sv);
- Tyndall very fine sandy loam, drained (Tc);
- Willows clay (Wb); and
- Willows clay, alkali, drained (Wd).

Mace Triangle

Based on the Geotechnical Report and the NRCS web soil survey, the Mace Triangle site is entirely made up of Sycamore complex, drained (Sv).

Soil limitations can include slow or very slow permeability, limited ability to support a load, high shrink-swell potential, moderate depth to hardpan, low depth to rock, and frequent flooding. Each soil type identified above has characteristics that affect soil behavior, and each is described in further detail below.

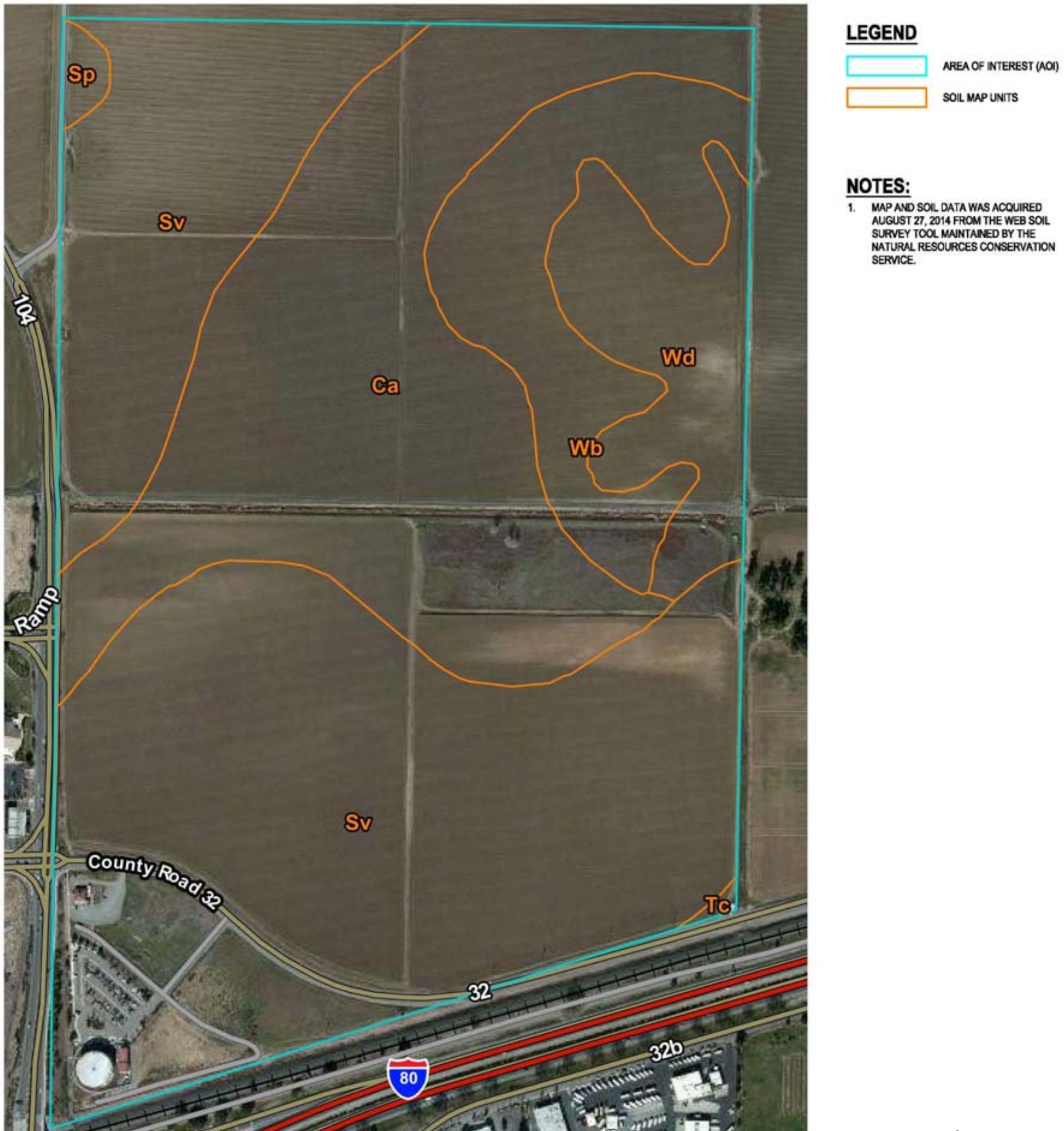
Soil Descriptions

Capay silty clay (Ca) is located on basin rims. In a typical profile, the soil is grayish-brown, dark grayish-brown, and pale-brown silty clay that extends to a depth of more than 60 inches. Permeability of this Capay silty clay is slow. Surface runoff is very slow, and the erosion hazard is none.

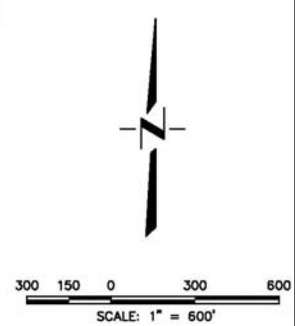
Sycamore silt loam, drained (Sp), is located on alluvial fans. In a typical profile, the surface layer is grayish-brown silty clay loam about 14 inches thick. The subsoil is mottled, dominantly light yellowish-brown silty clay loam about 30 inches thick. The substratum is mottled pale-olive loam that extends to a depth of more than 60 inches. Permeability of this Sycamore silt loam is moderate. Surface runoff is moderately slow, and the erosion hazard is none to slight.

Sycamore complex, drained (Sv), is located on alluvial fans. The soils consists of about 60 percent Sycamore silty clay loam and about 25 percent Sycamore silt loam. The soils are underlain by a silty clay soil at a depth that ranges from 40 to 60 inches. Permeability of the clay substratum is low. Surface runoff is moderately slow, and the erosion hazard is none to slight.

Figure 4.6-1
Project Site Soils



YOLO COUNTY, CALIFORNIA (CA113)				
MAP UNIT SYMBOL	MAP UNIT NAME	HSG	ACRES IN AOI	% OF AOI
Ca	CAPAY SILTY CLAY	C	65.2	28.3%
Sp	SYCAMORE SILT LOAM, DRAINED	B	1.3	0.6%
Sv	SYCAMORE COMPLEX, DRAINED	C	122.5	53.1%
Tc	TYNDALL VERY FINE SANDY LOAM, DRAINED	A	0.3	0.1%
Wb	WILLOWS CLAY	D	23.9	10.4%
Wd	WILLOWS CLAY, ALKALI, DRAINED	D	17.3	7.5%
TOTALS FOR AREA OF INTEREST			230.5	100.0%



[1] HSG = Hydrologic Soil Group

Source: USDA, National Resources Conservation Service, Web Soil Survey, Accessed January 30, 2015.

Tyndall very fine sandy loam, drained (Tc), is located on alluvial fans. The soils consist of small areas of Lang sandy loam, Laugenour very fine sandy loam, Reiff very fine sandy loam, Sycamore silt loam. Permeability of this Tyndall very fine sandy loam is moderately rapid. Surface runoff is very slow, and the erosion hazard is none to slight.

Willows clay (Wb) is located on basins where slopes are less than one percent. The soil consists of Capay silty clay, Marvin silty clay loam, Pescadero silty clay, Riz loam, and Sacramento clay. Permeability of this Willows clay is slow. Surface runoff is very slow, and the erosion hazard is none to slight.

Willows clay, alkali, drained (Wd), is located on basins where slopes are less than one percent. The soil has a profile similar to Willows clay, except that the content of sodium is so high that only crops tolerable to alkali can be grown. Permeability of this Willows clay is slow. Surface runoff is very slow, and the erosion hazard is none to slight.

Erosion

Erosion is the process by which materials of the earth's crust are loosened, dissolved, or worn away and simultaneously moved from one place to another. This often occurs during construction activities when topsoils are loosened and subsequently transported off-site by wind or water forces. As noted previously, all of the on-site soils have an erosion hazard of none to slight.

Expansive Soils

Expansive soils are those that increase in volume when they absorb water and shrink when they dry out, commonly referred to as "shrink-swell" potential. Soil surveys generally rate shrink-swell potential in soils on a low, medium, and high basis. If the shrink-swell potential is rated moderate to high, shrinking and swelling can cause damage to buildings, roads, and other structures. Based on the laboratory tests performed for the Geotechnical Report and Wallace Kuhl and Associates' experience on nearby projects, the on-site near-surface clays are capable of exerting significant expansion pressures on structural foundations, interior slabs, exterior flatwork, and pavements. It should be noted that the degree of expansion potential possessed by the surface and near-surface soils at the site will likely vary across the site.

Liquefaction

Liquefaction is the process by which water-saturated sediment temporarily loses strength and acts as a fluid and can be caused by earthquake shaking.[8] The results of the seismic cone penetrometer test (SCPT) soundings performed at the site revealed the underlying soils generally consist of silty clays with interbedded silt layers extending to the maximum explored depth of 100 feet below existing site grades. Based upon the relatively thick layers of cohesive soils, and

[8] U.S. Geological Survey. *Earthquake Glossary: Liquefaction.* 2014. Available at: http://earthquake.usgs.gov/learn/glossary/?term=liquefaction. Accessed March 2015.

the lack of historic occurrence of liquefaction, Wallace Kuhl and Associates concluded that the potential for liquefaction of the soils beneath most of the site is relatively low. Furthermore, the results of a soil liquefaction test performed by Wallace Kuhl and Associates confirmed that the potential for liquefaction of the soils beneath the site is very low.

Groundwater, the presence of which can contribute to liquefaction potential, was not encountered by the Wallace Kuhl and Associates soil borings performed on January 5 and 6, 2015 to the maximum explored boring depth of 26 feet below existing site grades. However, groundwater was encountered in SCPT explorations performed on November 26, 2014, at a depth of about 34 feet below existing site grades.

In addition, Wallace Kuhl and Associates reviewed available groundwater information at the California Department of Water Resources (DWR) website. The DWR periodically monitors groundwater levels in wells across the State. The DWR website shows a well located adjacent to the east of the central portion of the site. The well is identified as Well No. 08N03E07B001M with a ground surface elevation of +27.5 feet msl, similar to the project site. Groundwater data for the well was recorded from November 7, 1948 to at least November 1967. Data shows the highest recorded groundwater elevation was about +16 feet msl at the well (about 11.5 feet below the ground surface at the well) on April 1, 1952. The lowest recorded groundwater elevation was about -45 feet msl at the well (about 72.5 feet below the ground surface at the well) on July 20, 1964.

Furthermore, Wallace Kuhl and Associates reviewed the Yolo County Flood Control Water Conservation District Annual Engineer's Report for 2003 and 2004, prepared by Wood Rodgers, Inc. Based on review of the reports, the groundwater elevation beneath the site was about +15 feet msl from spring 2003 to spring 2004.

Based on the available groundwater data, groundwater depths at the site have likely ranged from approximately nine to 75 feet below site grades since 1948. The groundwater conditions are consistent with the groundwater level encountered in the SCPT explorations and explorations for previous studies performed in the general vicinity of the site. Groundwater levels at the site should be expected to fluctuate throughout the year based on variations in seasonal precipitation, local pumping, and other factors.

4.6.3 REGULATORY CONTEXT

The following section includes a brief summary of the regulatory context under which soils and geologic hazards are managed at the State and local levels.

State Regulations

The following are the State environmental laws and policies relevant to geology and soils.

Alquist-Priolo Earthquake Fault Zoning Act (AP Zone Act)

The 1972 AP Zone Act regulates development near active faults so as to mitigate the hazard of surface fault rupture. The AP Zone Act requires that the State Geologist (Chief of the California Department of Mines and Geology [CDMG]) delineate "special study zones" along known active faults in California. Cities and counties affected by these zones must regulate certain development projects within these zones. The AP Zone Act prohibits the development of structures for human occupancy across the traces of active faults. According to the AP Zone Act, active faults have experienced surface displacement during the last 11,000 years. A fault may be presumed to be inactive based on satisfactory geologic evidence; however, the evidence necessary to prove inactivity sometimes is difficult to obtain and locally may not exist.

California Building Standards Code

Current law states that every local agency enforcing building regulations, such as cities and counties, must adopt the provisions of the California Building Code (CBC) within 180 days of its publication. The publication date of the CBC is established by the California Building Standards Commission, and the code is also known as Title 24, Part 2 of the California Code of Regulations. The most recent building standard adopted by the legislature and used throughout the state is the 2013 version of the CBC (which became effective January 1, 2014 – except for the energy provisions that become effective July 1, 2014). These codes provide minimum standards to protect property and public safety by regulating the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions. The CBC contains provisions for earthquake safety based on factors including occupancy type, the types of soil and rock onsite, and the strength of ground shaking with specified probability of occurring at a site.

In brief, based on the engineering properties and soil-type of soils at a proposed site, the site is assigned a Site Class ranging from A to F. The Site Class is then combined with Spectral Response (ground acceleration induced by earthquake) information for the location to arrive at a Seismic Design Category ranging from A to D, of which D represents the most severe conditions. The classification of a specific site and related calculations must be determined by a qualified person and are site-specific.

Seismic Hazards Mapping Act

The California Seismic Hazards Mapping Act of 1990 (California Public Resources Code Section1690-2699.6) addresses non-surface rupture earthquake hazards, including liquefaction, induced landslides, and subsidence. A mapping program is also established by this Act, which identifies areas within California that have the potential to be affected by such non-surface rupture hazards. The Seismic Hazards Mapping Act specifies that the lead agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

Local Regulations

The following are the local environmental laws and policies relevant to geology and soils.

<u>Davis General Plan</u>

The Davis General Plan goals and policies relating to geology and soils that are applicable to the proposed project are presented at the end of the section in Table 4.6-2.

<u>City of Davis Municipal Code</u>

The City of Davis regulates site grading design in Chapter 40, Zoning, of the Municipal Code. The following guidelines are outlined in the ordinance:

40.42.110 Grading design plan

(a) For the efficient use of water, grading of a project site shall be designed to minimize soil erosion, runoff, and water waste. A grading plan shall be submitted as part of the landscape documentation package. A comprehensive grading plan prepared by a civil engineer for other local agency permits satisfies this requirement.

1) The project applicant shall submit a landscape grading plan that indicates finished configurations and elevations of the landscape area including:
   - A. Height of graded slopes;
   - B. Drainage patterns;
   - C. Pad elevations;
   - D. Finish grade; and
   - E. Stormwater retention improvements, if applicable.

2) To prevent excessive erosion and runoff, it is highly recommended that project applicants:
   - A. Grade so that all irrigation and normal rainfall remains within property lines and does not drain on to non-permeable hardscapes;
   - B. Avoid disruption of natural drainage patterns and undisturbed soil; and
   - C. Avoid soil compaction in landscape areas; and
   - D. Decompact and break up compacted soil in landscape areas.

3) The grading design plan shall contain the following statement: "I have complied with the criteria of the ordinance and applied them accordingly for the efficient use of water in the grading design plan" and shall bear the signature of a licensed professional as authorized by law. (Ord. 2369 § 2, 2010)

4.6.4 IMPACTS AND MITIGATION MEASURES

This section describes the standards of significance and methodology utilized to analyze and determine the proposed project's potential impacts related to geology and soils. A discussion of the project's impacts, as well as mitigation measures where necessary, is also presented.

Standards of Significance

The following thresholds of significance related to geology, soils, and seismicity are derived from the criteria listed in Appendix G of the State CEQA Guidelines. Impacts resulting from the project would be considered significant if the project would:

- Expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving:
  1. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. Refer to Division of Mines and Geology Special Publication 42;
  2. Seismic ground shaking; or
  3. Seismic-related ground failure, including liquefaction.
- Result in substantial soil erosion or loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide(s), lateral spreading, subsidence, liquefaction or collapse;
- Be located on expansive soil, as defined in Table 118-1-B of the Uniform Building Code (1994), creating substantial risks to life or property;
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water;
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state;
- Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan; or,
- Conflict, or create an inconsistency, with any applicable plan, policy, or regulation adopted for the purpose of avoiding or mitigating environmental effects related to geology, soils, and mineral resources.

<u>Issues Not Discussed Further</u>

According to the Davis General Plan, the most important mineral resources in the region are sand and gravel, which are mined on Cache Creek and other channels in Yolo County.[9] A survey of aggregate resources by the State Division of Mines and Geology did not show significant aggregate resources in the planning area. The only mineral resource known to exist in the planning area is natural gas, but resource areas have not been identified.[10] As a result, mineral resources were found not to be a significant issue for the City and further environmental analysis was not required in the Davis General Plan EIR.

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[9] City of Davis. *Davis General Plan [pg. 290].* Adopted May 2001. Amended through January 2007.
[10] *Ibid.*

Known mineral resources are not located on the project site or in the immediate vicinity and land designated or zoned for mineral resources is not within the City limits. As mineral resources are not located in the vicinity of the proposed project or the City, implementation of the proposed project would not result in the loss of availability of a known mineral resource or of a locally-important mineral resource recovery site. Therefore, the proposed project would have no impact related to mineral resources. Issues related to known or locally-important mineral resources are not further discussed.

In addition, the proposed project would connect to the existing City wastewater collection infrastructure and be served by the City's wastewater treatment facility. Therefore, the proposed project would not utilize a septic tank system and no impact would occur. Issues related to septic tanks or alternative wastewater disposal systems are not further discussed.

Method of Analysis

The analysis for the proposed project is based on the Preliminary Geotechnical Engineering Report prepared by Wallace Kuhl and Associates and the *Davis General Plan*. Wallace Kuhl and Associates' geotechnical analysis for the project site is comprised of a number of analytical tasks, including site reconnaissance, review of previous reports completed in the project vicinity, review of USGS topographic maps, geological maps, historical aerial photographs, SCPT soundings (two tests at a depth of approximately 100 feet below the existing ground surface) subsurface exploration (drilling and sampling of 17 borings to depths of 15 to 26.5 feet below the existing ground surface), laboratory testing of selected soil samples to determine various soil engineering properties, and engineering analyses. The proposed project's components are compared to the existing conditions of the project site, and the Standards of Significance identified above to determine the severity of potential impacts.

Project-Specific Impacts and Mitigation Measures

The following discussion of impacts is based on the implementation of the proposed project in comparison with the standards of significance identified above. The discussions and mitigation measures presented below apply to both the MRIC and the Mace Triangle unless otherwise stated.

4.6-1 Risks to people and structures associated with seismic activity, including ground shaking and ground failure. Based on the analysis below, the impact is *less than significant*.

The project site is not located within an Alquist-Priolo Earthquake Fault Zone, and surface evidence of faulting was not observed by Wallace Kuhl and Associates during site reconnaissance. Groundshaking is not considered a major geologic hazard in Davis, according to the City's General Plan EIR.[11]

[11] City of Davis. *Program EIR for the City of Davis General Plan Update and Project EIR for Establishment of a New Junior High School [pg. 5I-10]*. January 2000.

According to the information obtained from the shear wave velocity measurements taken on the MRIC site, the soils at the project site can be designated as seismic site Class D in determining seismic design forces for this project in accordance with Table Section 1613A.3 of the 2013 CBC. While a site-specific geotechnical report has not been prepared for the Mace Triangle site, Wallace Kuhl and Associates' findings for the neighboring MRIC site are expected to be similar with respect to seismic activity, given the close proximity of the two sites.

Although damage to structure and risks to people from ground rupture and ground failure is highly unlikely at the project site, all project structures would be required to adhere to the provisions of the 2013 CBC, based upon seismic site Class D. The CBC contains provisions to safeguard against major structural failures or loss of life caused by earthquakes or other geologic hazards.

As a result of the above considerations, seismic activity in the area of the proposed project would not expose people or structures to substantial ground rupture, groundshaking; and therefore, the impact is considered ***less than significant.***

Mitigation Measure(s)
None required.

4.6-2 Result in substantial soil erosion or loss of topsoil. Based on the analysis below and with implementation of mitigation, the impact is *less than significant.*

According to the Soil Survey of Yolo County, California, the erosivity of the soils on the project site are "none" to "slight." The surface runoff potential ranges from "very slow" to "moderately slow." However, the potential for human-caused erosion associated with construction activities is always a valid concern that should be addressed.

The proposed project includes utility excavation and recompaction of a portion of the project site soils. In addition, during earthwork operations, existing soils must be completely removed to expose firm undisturbed soil. Such earthwork activities could result in the exposure of loose soil to wind and/or water. Eroded soils could then be inadvertently transported into off-site drainage facilities.

MRIC

As illustrated in Figure 4.5-2, the Mace Drainage Channel (MDC) runs through the center of the MRIC site. The MDC is a storm water drainage ditch that transports urban runoff from the Mace Ranch Drainage Basin in the City of Davis east through the center of the MRIC site, to the Railroad Channel, which drains to the Yolo Bypass, approximately 2.5 miles east of the MRIC site.[12] Therefore, should construction of the project result in

[12] Sycamore Environmental Consultants, Inc. *Jurisdictional Delineation Report for the Mace Ranch Innovation Center Project [pg. 15]*. February 3, 2015.

sediment entering the MDC during times when water is flowing in the Channel, project construction could result in adverse sedimentation impacts downstream. It should be noted that the hydrology of the portion of the MDC in the MRIC site is artificial and ephemeral, meaning the Channel has flowing water only during and for a short duration after precipitation events in a typical year.[13] Based on drainage maps, aerial photographs, and field observations, the portion of the MDC in the MRIC site is anticipated to flow only during and immediately after precipitation events and in association with artificial input due to urban irrigation or other urban runoff within the City of Davis. As such, water does not flow in the MDC year-round and runoff water is not always in the Channel.

Approximately 64.6 acres (or 30.5 percent) of the MRIC site would be preserved as open space, including the 150-foot agricultural buffer along the north and east perimeters of the MRIC site. Therefore, 69.5 percent of the MRIC site would be directly disturbed during construction of the project.

Mace Triangle

The Mace Triangle site does not contain any open channels and the Park-and-Ride lot would not be disturbed as part of the project. Future disturbance of topsoil within the Mace Triangle site is anticipated to be limited to any future development at the Ikedas market parcel and the easternmost vacant parcel.

Conclusion

While the erosion potential of on-site soils is not considered substantial, construction could nevertheless result in the transportation of loosened topsoils off-site, and subsequent sedimentation of downstream waterways. With implementation of the following mitigation measure, the impact would be ***less than significant***.

Mitigation Measure(s)

MRIC and Mace Triangle

4.6-2 *Prior to initiation of any grading activities for each phase of development of the MRIC or Mace Triangle, the project proponent shall submit a Notice of Intent (NOI) and Storm Water Pollution Prevention Plan (SWPPP) to the RWQCB in accordance with the NPDES General Construction Permit requirements. The SWPPP shall be designed to control pollutant discharges utilizing Best Management Practices (BMPs) and technology to reduce erosion and sediments. BMPs may consist of a wide variety of measures taken to reduce pollutants in stormwater runoff from the project site. Measures shall include temporary erosion control*

[13] *Ibid* [pg. 16].

measures (such as silt fences, staked straw bales/wattles, silt/sediment basins and traps, check dams, geofabric, sandbag dikes, and temporary revegetation or other groundcover) that will be employed to control erosion from disturbed areas. Final selection of BMPs will be subject to approval by the City of Davis and the RWQCB. The SWPPP will be kept on site during construction activity and will be made available upon request to representatives of the RWQCB.

4.6-3 Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in lateral spreading, subsidence, liquefaction, or collapse. Based on the analysis below and with implementation of mitigation, the impact is *less than significant*.

MRIC

The following discussion pertains to the MRIC site, for which Wallace Kuhl and Associates performed a geotechnical report.

Liquefaction

As noted previously, based upon the relatively thick layers of cohesive soils, and the lack of historic occurrence of liquefaction, Wallace Kuhl and Associates concluded that the potential for liquefaction of the soils beneath most of the project site is relatively low. Furthermore, the results of a soil liquefaction test performed by Wallace Kuhl and Associates confirmed that the potential for liquefaction of the soils beneath the site is very low. As such, impacts related to liquefaction would be less than significant.

Post-Liquefaction Settlement

Given the results of the post-liquefaction settlement analysis performed for the Geotechnical Report, the worst-case estimate of total post-liquefaction settlement at the project site is calculated to be about 0.6 inches of total and differential settlement across 50 feet, or the least dimension of the structure, whichever is less. The estimates of post-liquefaction seismic settlements represent free-field ground settlement, not settlement of the proposed structures.

Liquefaction potential at the site was also evaluated based on the Liquefaction Potential Index (LPI). The LPI is a measure of the liquefaction potential based on an analysis of the entire vertical soil profile not just discrete layers. Factors taken into consideration for the LPI calculations include: thickness of the liquefied layer; proximity of the liquefied layer to the surface; and the factor of safety. The LPI ranges from 0 to 100 with the value zero representing no liquefaction potential. Surface manifestations of liquefaction occur at LPI greater than or equal to five.

Based on the soil conditions encountered at the site and the liquefaction analysis performed for the Geotechnical Report, including LPI evaluations, Wallace Kuhl and

Associates concluded that the potential for liquefaction of the soils beneath the site is very low. In addition, based on the calculated settlements, structures designed to withstand complete collapse from "worst-case scenario" total and differential seismic settlements of 0.6 inches across 50 feet, or the shortest dimension of the structure, whichever is less, would be capable of achieving life safety requirements as established by the 2013 CBC. As such, impacts related to post-liquefaction settlement would be less than significant.

On-Site Fill

Review of an aerial photograph taken in 1957 shows the MRIC site as agricultural land, with a meandering, linear depression in the southwestern-southern portion of the site. According to the Geotechnical Report, the former linear depression was backfilled with soil excavated during the construction of the detention basin; however, Wallace Kuhl and Associates is not aware of documentation regarding the backfill observation/compaction operations. If documentation of the backfill observation/compaction operations for the former linear depression is not available, the area of the former linear depression should be properly identified and investigated to evaluate the conditions of the backfill material.

Based on review of historical aerial photographs, the approximate location of the former linear depression is shown in Figure 4.6-2. The subsurface exploration completed for the Geotechnical Report included three borings in the near vicinity of the former linear depression; however, evidence of the presence of fill soils was not observed. Excavations and depressions resulting from the removal of the fill items must be backfilled with engineered fill.

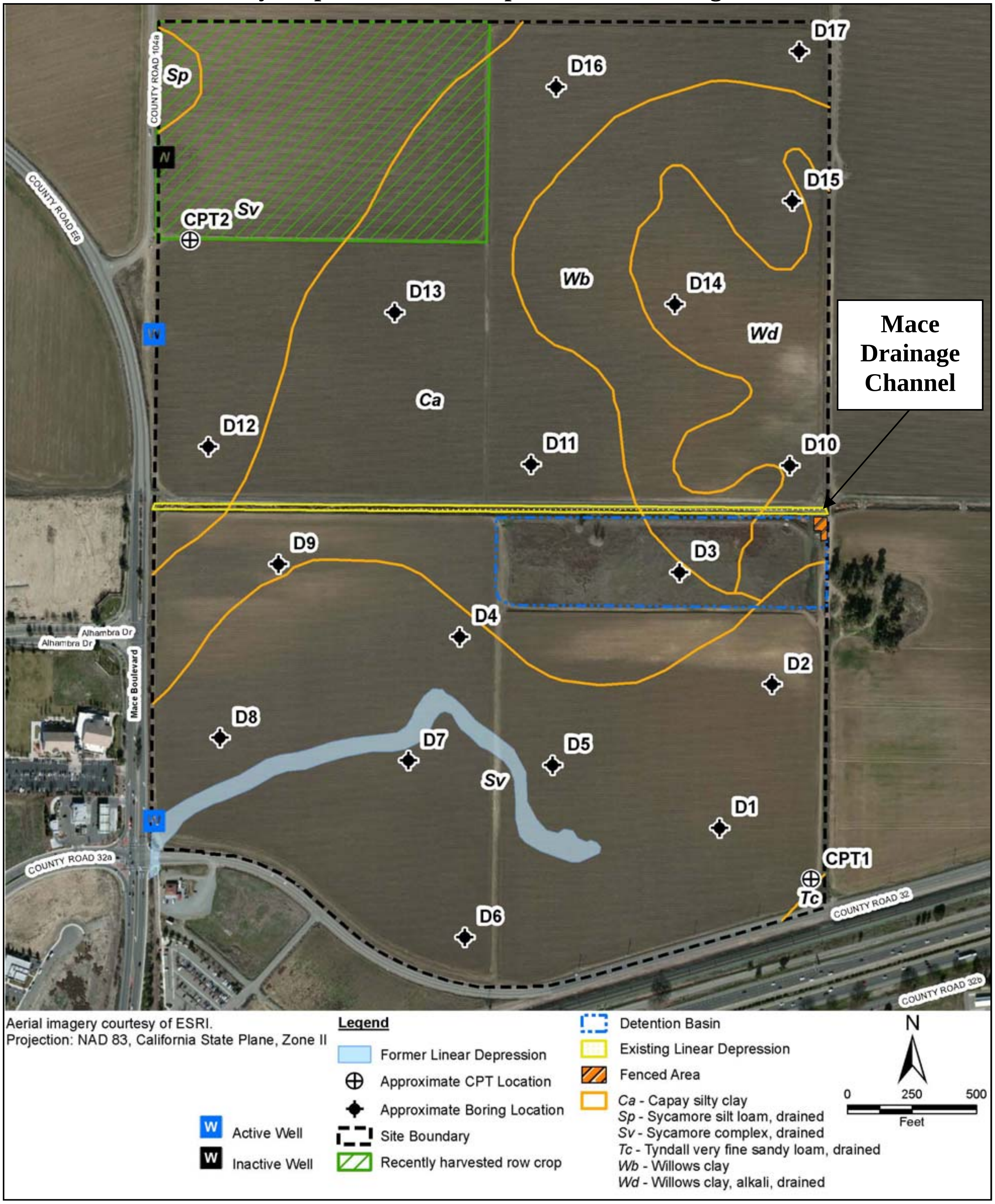
Unsuitable Topsoils

Due the presence of disturbed/soft surface and near-surface soils within the upper one to two feet of major portions of the site, a combination of over-excavation, processing, moisture conditioning and uniform recompaction of the surface and near-surface soils will likely be required to achieve stable support conditions for the proposed improvements associated with the innovation center.

Mace Triangle

A site-specific geotechnical report has not been prepared for the Mace Triangle site. This EIR evaluates the potential development of two of the three parcels in the event that additional discretionary entitlements are first obtained from the City of Davis. While geotechnical issues are not anticipated for the Mace Triangle, based upon the findings of the evaluation for the neighboring MRIC site, the possibility exists that fill material or other unsuitable soft soils could be located on portions of the Mace Triangle site. This EIR includes a mitigation measure for submittal of a geotechnical report in conjunction with any future development application submittal for the Mace Triangle parcels.

Figure 4.6-2
Soil Survey Map With Linear Depression and Boring Locations



Conclusion

The geotechnical report prepared by Wallace Kuhl and Associates for the MRIC site determined that existing fill material and other unsuitable topsoils would need to be replaced prior to development of buildings at the MRIC site. In addition, geotechnical concerns, such as fill material, may be present at the Mace Triangle site, which would need to be addressed through appropriate design. Therefore, with implementation of the following mitigation measures, impacts associated with unstable soils on the project site would be ***less than significant***.

Mitigation Measure(s)

MRIC

4.6-3(a) *Prior to final design approval and issuance of building permits for each phase of the MRIC, the project applicant shall submit to the City of Davis Building Inspection Division, for review and approval, a design-level geotechnical engineering report produced by a California Registered Civil Engineer or Geotechnical Engineer. The report shall include the recommendations in the report entitled Preliminary Geotechnical Engineering Report, Mace Ranch Innovation Center, dated January 20, 2015 unless it is determined in the design-level report that one or more recommendations need to be revised. The design-level report shall address, at a minimum, the following:*

- *Compaction specifications and subgrade preparation for on-site soils;*
- *Structural foundations, including retaining wall design (if applicable);*
- *Grading practices; and*
- *Expansive/unstable soils, including fill.*

Design-level recommendations shall be included in the foundation and improvement plans and approved by the Davis Public Works Department prior to issuance of any building permits.

Mace Triangle

4.6-3(b) *Prior to final design approval and issuance of building permits for future on-site development, the future project applicant for the Mace Triangle site shall submit a site-specific, design-level geotechnical report produced by a California Registered Geotechnical Engineer to the City of Davis Building Inspection Division for review and approval. The geotechnical report shall include, but would not be limited to, an analysis of the on-site geologic and seismic conditions, including soil sampling and testing. Recommendations shall be included regarding project design measures to* *avoid risks to people and structures, including compliance with the latest CBC regulations, structural foundations, and grading practices.*

4.6-4 Be located on expansive soil, as defined in Table 118-1-B of the Uniform Building Code (1994), creating substantial risks to life or property. Based on the analysis below and with implementation of mitigation, the impact is *less than significant*.

Construction of the proposed project would require solid building surfaces. Expansive soils shrink and swell as a result of moisture changes, causing heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations.

MRIC

Laboratory testing of clay soils performed by Wallace Kuhl and Associates revealed the near-surface soils of the project site are of high to very high plasticity when tested in accordance with the American Society of Testing and Materials (ASTM) D4318. In addition, laboratory test results of near-surface soils collected from the upper four feet revealed the near-surface clay soils possess a “medium” to “very high” expansion potential when tested in accordance with ASTM D4829 test method. Therefore, based on the laboratory tests performed for the Geotechnical Report and Wallace Kuhl and Associates’ experience on nearby projects, the on-site near-surface clays are capable of exerting significant expansion pressures on structural foundations, interior slabs, exterior flatwork, and pavements. However, measures can be taken to reduce the effects of expansive soils on the project site, as provided in the *Preliminary Geotechnical Engineering Report.* It should be noted that the degree of expansion potential possessed by the surface and near-surface soils at the site will likely vary across the site.

Mace Triangle

While a site-specific geotechnical report has not been prepared for the Mace Triangle site, Wallace Kuhl and Associates’ findings for the neighboring MRIC site are expected to be similar with respect to expansive soils, given the close proximity of the two sites.

Conclusion

Expansive soils are present on-site and the use of on-site soils as engineered fill could be subject to certain limitations if not properly treated. A ***less-than-significant*** impact would result by implementing the recommendations contained in the *Preliminary Geotechnical Engineering Report*, as shown below.

Mitigation Measure(s)

MRIC

4.6-4(a) Implement Mitigation Measure 4.6-3(a).

Mace Triangle

4.6-4(b) Implement Mitigation Measure 4.6-3(b).

4.6-5 Conflict, or create an inconsistency, with any applicable plan, policy, or regulation adopted for the purpose of avoiding or mitigating environmental effects related to geology, soils, and mineral resources. Based on the analysis below, the impact is *less than significant*.

In order to further demonstrate the project's consistency with any applicable plan, policy, or regulation adopted for the purpose of avoiding or mitigating environmental effects related to geology and soils, Table 4.6-2 includes a list of the relevant policies and a corresponding discussion of how the project is consistent with each policy. As demonstrated in the table, the proposed project is generally consistent with the applicable plan, policy, or regulation adopted for the purpose of avoiding or mitigating environmental effects related to geology, soils, and mineral resources. Therefore, the project would have a ***less-than-significant*** impact regarding policy consistency.

Mitigation Measure(s)
None required.

Table 4.6-2
Geology and Soils Policy Discussion

Policy		**Project Consistency**
Chapter 19, Hazards, of the Davis General Plan		
HAZ 2.1	Take necessary precautions to minimize risks associated with soils, geology, and seismicity.	The Geotechnical Report prepared for the proposed project includes analysis and recommendations related to any potential hazards associated with soils, geology, and seismicity. In addition, pursuant to Mitigation Measures 4.6-3(a) and 4.6-3(b), both the MRIC project applicant and the future project applicant(s) for the Mace Triangle would be required to submit site-specific, design-level geotechnical reports produced by a California Registered Geotechnical Engineer to the City of Davis Department of Community Development and Sustainability for review and approval, and comply with all recommendations included within said report. As such, the proposed project would take the necessary precautions to minimize risks associated with soils, geology, and seismicity.