Appendix F

Paleontological Resources Assessment Technical Memorandum

MEMORANDUM

To:	Kara Peterson, San Diego State University
From:	Sarah Siren, MSc, Paleontologist, Dudek
Subject:	SDSU Imperial Valley Off-Campus Center – Calexico, Affordable Student Housing Project–Paleontological Resources Assessment Memorandum
Date:	December 12, 2024
cc:	Mollie Brogdon, Sarah Lozano, Michael Williams, PhD, Dudek
Attachments:	A – Figures B – Geotechnical Report C – Confidential SDNHM Paleontological Records Search Results

Dudek has conducted an evaluation pursuant to the requirements of the California Environmental Quality Act (CEQA) and the current guidelines of the Society of Vertebrate Paleontology (SVP; 2010) to determine the presence of and potential impacts related to paleontological resources associated with construction and operation of the proposed San Diego State University (SDSU) Calexico Affordable Student Housing Project (Project or proposed Project), to be located at the SDSU Imperial Valley Off-Campus Center, located in Calexico, California. This technical memorandum provides the results of the paleontological resources investigation and was prepared by Shawna L. Johnson, MSc, with editorial comments by Sarah Siren, MSc, and Michael Williams, PhD. Ms. Siren and Dr. Williams are qualified paleontological principal investigators.

To determine the paleontological sensitivity of the Project site, Dudek performed a paleontological resources inventory in compliance with the CEQA and SVP guidelines. The inventory consisted of a paleontological records search through the San Diego Natural History Museum (SDNHM) and a review of geological mapping and geological and paleontological literature. The results of the paleontological records search were negative for paleontological resources within the Project site; that is, the records search did not reveal the location of any paleontological resources within the Project site and a one-mile radius buffer.

1 Project Overview and Background

In September 2003, the California State University (CSU) certified an environmental impact report for the SDSU Imperial Valley Master Plan Project (State Clearinghouse No. 2002051010) and approved a Campus Master Plan for the expansion and improvement of the SDSU Imperial Valley Off-Campus Center, which includes locations in Calexico and Brawley, both located in Imperial County (SDSU 2003). The Off-Campus Center is an extension of SDSU's main campus in San Diego and furthers the University's regional educational mission to provide additional educational opportunities to the outlying communities of Imperial County. The previously certified and approved Campus Master Plan and EIR provided the authorization necessary for enrollment of 850 full-time equivalent (FTE)[1] students at the Off-Campus Center, corresponding associated faculty and staff, and a framework for development of the facilities necessary to serve this projected enrollment and campus population.

1 A full-time equivalent (FTE) student is one full-time student taking 15 course credits, or 3 part-time students each taking 5 course credits.

The Off-Campus Center - Calexico is approximately 8.3 acres in size and is located in the City of Calexico (City). Most of the Calexico location is built out, consisting of several educational and support facilities. The environmental impacts associated with development of the Off-Campus Center – Calexico were evaluated at a program level of review in the 2003 EIR. In the CSU's continuing effort to build out the Imperial Valley Off-Campus Center and provide additional educational opportunities, SDSU presently proposes construction and operation of a four-building complex that would provide affordable student housing at the Calexico location for 80 students and a resident manager. Additional details regarding the proposed housing is provided below.

2 Project Location and Existing Conditions

The Off-Campus Center – Calexico is located at 720 Heber Avenue in downtown Calexico, approximately 0.5 miles north of the United States–Mexico border (see Figure 1, Regional Map). Regional access to the Off-Campus Center is provided via SR-111 and SR-98 to the north. The Calexico location is bordered by four streets: Heber Avenue to the west, Sherman Street to the north, Blair Avenue to the east, and 7th Street to the south. Residential uses bound the Calexico complex to the north, east, south, and west. Other surrounding uses include Calexico High School, located northeast, and Calexico City Hall, located immediately south. The Off-Campus Center - Calexico currently consists of 17 buildings and an associated surface parking lot (see Figure 2, Vicinity Map, and Figure 3A, Existing Campus Master Plan).

As a state entity, the CSU/SDSU is not subject to local government plans, regulations, and guidelines, such as those contained in the City's General Plan. The above notwithstanding, for information purposes, the Off-Campus Center - Calexico is zoned as Open Space and is designated as Public Facilities in the City's General Plan (City of Calexico 2015a).

The proposed Project site is approximately 0.58 acres in size (25,320 square feet) and is located at the southeast corner of the campus, at the northwest corner of East 7th Street and Blair Avenue (see Figure 2). The entirety of the Project site has previously been graded and is relatively flat in nature, with an average elevation of 3.5 feet above mean sea level. The Project site encompasses the locations identified in the Campus Master Plan as future Building 21 (see Figure 3A and Figure 3B, Proposed Campus Master Plan). The Project site consists of vacant and undeveloped land with two trees located along the northern boundary of the site. A chain-link fence separates the Project site from the recently removed temporary Campus Buildings 201, which were located immediately west of the Project site.

3 Project Description

3.1 Affordable Student Housing Complex

The proposed Project would involve the construction of a single-story, four-building complex approximately 12,840 square feet in size that would provide for affordable student housing. The complex would include three student housing buildings, including one smaller live-in unit building, and a community building. Two of the three proposed residential buildings would each be approximately 5,500 square feet in size and would include five four-bedroom, two-bathroom apartment units, totaling 40 student beds per building (two student beds per bedroom, 80 student beds in total). The third proposed residential building would be a live-in manager unit that would consist of a single two-bedroom, one-bathroom apartment. The proposed live-in unit would also include approximately 100 square feet of office space that is intended to provide a space for tenant meetings, social services, or counseling. All apartment units would also be equipped with a living area and kitchen. The proposed community building program would be approximately 840 square feet and include laundry, mail, restroom, electrical, and maintenance facilities. The mail room would be located outside, under the shaded amenity patio of the community building (see Table 1).

Table 1. Affordable Student Housing Complex Area Calculations

	Quantity	Area (Square Feet)	Beds
Residential Buildings (3)			
4-Bedroom, 8-Bed Unit	5	5,150	40
4-Bedroom, 8-Bed Unit	5	5,150	40
Live-In Unit	1	1,000	2
Office (Included in Live-In Unit)	N/A	N/A	N/A
Subtotal	*11*	*11,300*	*82*
Community Building (1)			
Laundry Room	1	300	N/A
Service Rooms	4	450	N/A
Restroom	2	100	N/A
Mail/Package (Outside)	1	270	N/A
Subtotal	*N/A*	*1,150*	*N/A*
Other			
Trash/Recycling Enclosure	1	850	N/A
Open Space	N/A	2,300	N/A
Landscaping/hardscaping	N/A	12,500	N/A
Subtotal	*N/A*	*13,650*	*N/A*
Combined Total	**N/A**	**26,100**	**82**

Note: N/A = not applicable.
All square foot amounts presented in the table are approximate amounts only and may not add to the site plan area totals described in this document due to rounding.

Other on-site proposed amenities include a courtyard, bike racks, and a community waste enclosure. The courtyard would be approximately 1,600 square feet and would be centrally located in the proposed complex (see Figure 4, Site Plan). Approximately 15 bike racks would be provided throughout the Project site. A community waste enclosure at the northeast corner of the Project site would allow residents a convenient place to dispose of waste and recyclables.

3.1.1 Operation

The Off-Campus Center - Calexico, including the Project site, is owned and operated by the CSU/SDSU. The CSU Board of Trustees, on behalf of SDSU, is the lead agency responsible for certifying the adequacy and completeness of this document and approval of the proposed Project. SDSU and the IVCCD have received joint funding under the State of California Higher Education Student Housing Grant Program to construct the proposed Project.

To support basic housing needs for students in the Imperial Valley, SDSU and IVCCD have executed a 30-year master lease agreement that details operation of the Project. This agreement dictates that 40 of the 82 proposed student beds would be reserved for IVCCD students who attend the Imperial Valley College in Imperial. Likewise, 40 of the proposed 82 beds, would be reserved for SDSU Off-Campus Center - Calexico students. A 2-bedroom unit would also provide living space for on-site management. SDSU would be responsible for operating, managing, and maintaining the proposed Project once operational.

Student beds made available under the proposed Project would be leased/rented to eligible low-income students. Eligible low-income students are defined as having 30% of 50% of the Annual Median Income for Imperial County. In the event, after a good faith outreach effort, there is not sufficient demand from students meeting the eligibility requirements within 90 days of the start of the fall semester, unassigned beds may be leased at market rates to SDSU and IVCCD students not meeting the low-income eligibility requirements. In addition to meeting the low-income criteria, eligible students would be required to be enrolled students and take a minimum average of 12 degree-applicable units per semester term, or the quarterly equivalent (with exceptions permitted), to facilitate timely degree completion.

3.1.2 Other Project Elements

Building and Site Design

The proposed buildings have been designed to reflect the character and massing of the existing Off-Campus Center - Calexico, as well as the surrounding neighborhood. Building design is centered around a courtyard-style housing complex and would consist of smooth stucco walls with downspouts and rafters, punctuated by composite terra cotta–colored roof tile accents and windows. Maximum building heights would range from 14 feet to 18 feet.

Landscaping, Other Site Improvements, and Lighting

The Project would include approximately 16,000 square feet of on-site landscaping and hardscape improvements (i.e., pedestrian walkways). All proposed landscaping would consist of drought-tolerant, indigenous plants. The landscape scheme would include shrubs, hedges, and a variety of trees. A total of 39 trees would be added to the Project site including five fan palms, eight mesquite trees, six evergreen elms, and 20 yucca trees.

All exterior on-site lighting would be hooded or shielded, directed downward, and would be compliant with applicable standards for lighting control and light pollution reduction (i.e., Title 24, American National Standards Institute/Illuminating Engineering Society).

The proposed complex would be secured via an iron security fence that would measure 6 feet in height and run approximately 64 linear feet, connecting to the proposed buildings. Access to the complex would only be available to residents and their guests via two pedestrian gates located at the northwestern corner and southern portion of the proposed complex. The gates would be equipped with security card access for residents.

Utilities and Public Services

New points of connection for domestic water, fire supply water, sewer, storm drainage and electrical connections from existing utility lines would be required to serve the proposed Project. Potable water service, as well as sewer collection services at the Project site, would be provided by the City. The Project would connect to an existing sanitary sewer maintenance access line located in Blair Avenue via new 6-inch mains. Connections for water (including domestic, fire, and irrigation) would be from an existing water main located in Blair Avenue. Distribution water pipes would be extended underground to serve each proposed building. A new water meter would be located in the proposed maintenance room in the community building. Adequate water treatment capacity and supply and sewer treatment capacity exists within the City's water and sewer system to accommodate the Project; therefore, no capacity upgrades to infrastructure would be necessary.

Stormwater drainage includes two stormwater catch basins. One basin would be located on the eastern boundary of the Project site, and the second would be situated immediately east of the existing chain-link fence at the western boundary of the Project site. The proposed catch basins would function as both water quality and flood control features, by filtering out surface water contaminants and slowing stormwater runoff prior to stormwater discharge into the City's stormwater system via one new storm drain located in the southeast corner of the Project site.

Electrical services within the Project area are provided by Imperial Irrigation District, which provides electric power to over 158,000 customers in the Imperial Valley in addition to areas of Riverside and San Diego counties (IID 2024). New utility connections and infrastructure would be required to support electrical services on site. The Project would connect to on-site electrical power infrastructure via an existing 12kV, three phase, three wire, 60 Hertz overhead line routed along East 7th Street. No natural gas usage is proposed for the Project.

The Project would require a new point of connection for on-site telecommunications and would connect to the existing AT&T communications via the on-campus minimum point of entry.

Access, Circulation, and Parking

Regional access to the Project site is provided via SR-111 and SR-98 to the north. Local access is provided via Blair Avenue and East 7th Street. Parking to the Project site is available in the existing campus parking lot, immediately north of the Project site, which has sufficient capacity to serve the proposed Project. On-site circulation improvements would consist of additional paved pathway/pedestrian walkway features throughout the proposed complex and along the northern boundary of the Project site (see Figure 4). Emergency access would be provided directly adjacent to the Project site on East 7th Street and Blair Avenue.

3.1.3 Design Standards and Energy Efficiency

In May 2014, the CSU Board of Trustees broadened the application of sustainable practices to all areas of the university by adopting the first systemwide sustainability policy, which applies sustainable principles across all areas of university operations, including facility operations and utility management. In May 2024, the CSU Sustainability Policy was updated to expand on existing sustainability goals (CSU 2024). The CSU Sustainability Policy seeks to integrate sustainability into all facets of the CSU, including academics, facility operations, the built environment, and student life (CSU 2018). Relatedly, the state has also strengthened energy-efficiency requirements in the California Green Building Standards Code (Title 24 of the California Code of Regulations).

As a result, all CSU new construction, remodeling, renovation, and repair projects, including the proposed Project, would be designed with consideration of optimum energy utilization, low life cycle operating costs, and compliance with all applicable state energy codes and regulations. Progress submittals during design are monitored for individual envelope, indoor lighting, and mechanical system performances. In compliance with these goals, the proposed Project would be equipped with solar ready design features that would facilitate and optimize the future installation of a solar photovoltaic (PV) system.

3.1.4 Off-Site Improvements

Off-site improvements would include the resurfacing of a portion of Blair Avenue adjacent to the eastern boundary of the Project site that would be disturbed as a result of trenching to make necessary connections to the existing water main and sanitary sewer maintenance access. Any area disturbed as a result of this connection within Blair Avenue would be resurfaced to existing conditions. All off-site improvements would occur within the Blair Avenue right-of-way.

3.1.5 Construction

Construction would be performed by qualified contractors. Plans and specifications would incorporate stipulations regarding standard CSU/SDSU requirements and acceptable construction practices, such as those set forth in the SDSU Stormwater Management Plan, CSU Seismic Policy, The CSU Office of the Chancellor Guidelines, and the CSU Sustainability Policy, regarding grading and demolition, safety measures, vehicle operation and maintenance, excavation stability, erosion control, drainage alteration, groundwater disposal, public safety, and dust control.

Construction Timeline

Construction of the proposed Project would take approximately 17 months to complete and is estimated to begin as early as January 2025 and be completed by May 2026, with occupancy planned for fall 2026. Construction activities would generally occur Monday through Friday between the hours of 8:00 a.m. and 5:00 p.m., with the potential for weekend construction on Saturday between 9:00 a.m. and 5:00 p.m. No construction would occur on Sundays or holidays or at night.

Construction Activities

A construction mobilization or staging area would be located immediately northeast of the proposed Project site and would occupy approximately 8,000 square feet. The area would be located east of existing Campus Building 6, west of Blair Avenue, and south of the existing parking lot (see Figure 2 and Figure 3A). To accommodate use of this area, four trees would be removed.

Construction would include site preparation, grading and excavation, utility installation/trenching, building foundation pouring, building construction, and landscaping. Excavation depths are anticipated to be 3 feet below grade. The majority of waste (i.e., excavated gravel/soil) generated during Project construction would be balanced/used within the site. Approximately 2,600 cubic yards of soil would be removed from the site and exported to Republic Services Allied Imperial Landfill, approximately 12 miles north. The entire Project site, including construction mobilization area (approximately 34,000 square feet in total) would be disturbed as a result of Project construction. Two trees would be removed from the Project site to accommodate the proposed Project.

Table 2 displays the construction equipment anticipated to be used during construction.

Table 2. Anticipated Construction Equipment

Aerial Lifts	Pressure Washers
Air Compressors	Pumps
Cement and Mortar Mixers	Rollers

Table 2. Anticipated Construction Equipment

Concrete/Industrial Saws	Rough Terrain Forklifts
Dumpers/Tenders	Rubber-Tired Dozers
Excavators	Rubber-Tired Loaders
Forklifts	Scrapers
Generator Sets	Signal Boards
Graders	Skid Steer Loaders
Off-Highway Tractors	Surfacing Equipment
Off-Highway Trucks	Sweepers/Scrubbers
Other Construction Equipment	Tractors/Loaders/Backhoes
Other General Industrial Equipment	Trenchers
Other Material Handling Equipment	Welders
Plate Compactors	

Source: Dorsey and Nielson Construction Inc, pers. comm., 2024

Construction Waste

The Project would generate construction debris during on-site clearing activities. In accordance with Section 5.408 of the California Green Building Standards Code, the Project would implement a construction waste management plan for recycling and/or salvaging for reuse of at least 65% of nonhazardous construction/demolition debris. Additionally, the Project would be required to meet Leadership in Energy and Environmental Design v4 requirements for waste reduction during construction. Solid waste generated during construction would be hauled off site to the Republic Services Allied Imperial Landfill at 104 East Robinson Road in Imperial, California.

4 Analysis Methodology

The analysis presented here considers the potential impacts of the proposed Project on paleontological resources relative to existing conditions. Establishment of the Project site's existing paleontological conditions have been informed by reviewing published geological maps and published and unpublished reports to identify geological units located on the Project site and determine their paleontological sensitivity.

A paleontological records search request was sent to SDNHM on June 10, 2024. The records search area included the Project site and a 1-mile radius buffer. The purpose of the records search was to determine whether there are any known fossil localities in or near the Project site to aide in determining whether a paleontological mitigation program is warranted to avoid or minimize potential adverse effects of construction on paleontological resources.

5 Paleontological Resources

Paleontological resources are the remains or traces of plants and animals that are preserved in Earth's crust and, per SVP guidelines, are older than written history or older than approximately 5,000 years, which approximates the middle Holocene Epoch. (Cohen et al. 2023). They are limited, nonrenewable resources of scientific and educational value and are afforded protection under state laws and regulations. This analysis complies with guidelines and significance criteria specified by CEQA and SVP. Table 3, Paleontological Resource Sensitivity Criteria, provides definitions for high, undetermined, low, and no paleontological resource potential, or sensitivity, as set forth in and by the SVP Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources.

Table 3. Paleontological Resource Sensitivity Criteria

Resource Sensitivity/ Potential	Definition
High Potential	Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered are considered to have a high potential for containing additional significant paleontological resources. Rock units classified as having high potential for producing paleontological resources include, but are not limited to, sedimentary formations and some volcaniclastic formations (e.g., ashes or tephras), and some low-grade metamorphic rocks which contain significant paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils (e.g., middle Holocene and older, fine-grained fluvial sandstones, argillaceous and carbonate-rich paleosols, cross-bedded point bar sandstones, fine-grained marine sandstones, etc.). Paleontological potential consists of both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, plant, or trace fossils and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data. Rock units which contain potentially datable organic remains older than late Holocene, including deposits associated with animal nests or middens, and rock units which may contain new vertebrate deposits, traces, or trackways are also classified as having high potential.
Undetermined Potential	Rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment are considered to have undetermined potential. Further study is necessary to determine if these rock units have high or low potential to contain significant paleontological resources. A field survey by a qualified professional paleontologist (see “definitions” section in this document) to specifically determine the paleontological resource potential of these rock units is required before a paleontological resource impact mitigation program can be developed. In cases where no subsurface data are available, paleontological potential can sometimes be determined by strategically located excavations into subsurface stratigraphy.
Low Potential	Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus only preserve fossils in rare circumstances and the presence of fossils is the exception not the rule, e. g. basalt flows or Recent colluvium. Rock units with low potential typically will not require impact mitigation measures to protect fossils.

Table 3. Paleontological Resource Sensitivity Criteria

Resource Sensitivity/ Potential	Definition
No Potential	Some rock units have no potential to contain significant paleontological resources, for instance high- grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Rock units with no potential require no protection nor impact mitigation measures relative to paleontological resources.

Source: SVP 2010.

5.1 Regulatory Framework

California Environmental Quality Act

This paleontological resources evaluation was completed to satisfy the requirements of CEQA. The CEQA Guidelines require that all private and public activities not specifically exempted be evaluated against the potential for environmental impacts, including effects to paleontological resources. Paleontological resources, which are limited, nonrenewable resources of scientific, cultural, and educational value, are recognized as part of the environment under these state guidelines. This study satisfies project requirements in accordance with CEQA (14 CCR 15000 et seq.).

Paleontological resources are explicitly afforded protection by CEQA, specifically in CEQA Guidelines Appendix G Section VII(f), which addresses the potential for adverse impacts to “unique paleontological resource[s] or site[s] or unique geological feature[s]” (14 CCR 15000 et seq.). This provision covers fossils of significant importance, which include the remains of species or genera new to science, for example, or fossils exhibiting features not previously recognized for a given animal group, as well as localities that yield fossils significant in their abundance, diversity, preservation, and so forth.

California Public Resources Code Section 5097.5

In addition to CEQA’s requirements, Public Resources Code Section 5097.5 regulates removal of paleontological resources from state lands, defines unauthorized removal of fossil resources as a misdemeanor, and requires mitigation of disturbed sites.

5.2 Environmental Setting

Geological Literature, Map, and Geotechnical Report Review

The Project site is located within the Colorado Desert Geomorphic Province, which lies between the Mojave Desert and Peninsular Ranges Geomorphic Provinces. The Colorado Desert Geomorphic Province is the on-land extension of the Gulf of California and is a low-lying, arid basin that contains sediments from ancient Lake Cahuilla. This geomorphic province is also characterized by numerous geothermal areas as a result of the tectonic activity in the region (CGS 2002).

According to surficial geological mapping by Jennings et al. (2010) at a 1:750,000 scale and Morton (1977) at a 1:125,000 scale and the geological time scale of Cohen et al. (2023), the Project site is underlain by late Pleistocene to Holocene (129,000 years ago to recent) lake beds (map unit Ql)/alluvium, lake, playa, and terrace deposits (map Unit Q). These deposits are typically unconsolidated to semi-consolidated, tan and gray fossiliferous clay, silt, sand, and gravel from ancient Lake Cahuilla and playa lakes. The August 2022 geotechnical report prepared for the Project by Group Delta (Attachment B, Geotechnical Report) states that these sediments are up to 100 feet thick. Undocumented fill up to 4 feet thick was found in three boreholes, with the rest of the sediments primarily being clays, sand, and silty sands to a target depth of approximately 51 feet (Attachment B).

Paleontological Literature Review

The SDNHM locality SDNMH 4651, near Holtville, produced a fossil horse specimen, and another fossil horse was recorded from the Glamis sand dunes (Jefferson 2012). The Los Angeles County Museum locality LACM 1719, from the Mountain Signal Gravel pit, yielded a fossil horse specimen (Jefferson 2012). The University of California Museum of Paleontology recorded a locality (UCMP V53003) near Niland, that produced a fossil camel (Jefferson 2012). The Imperial Valley County Museum has several localities (IVCM 188, 192, 194, 228–229, 278, and 238) that have produced a mammoth and an elephantid (mammoths and their relatives), deer, several bison and bovid, horse, and camel from along the Coachella Canal and near Glamis (Jefferson 2012). A project in the City of La Quinta produced the following fossils from the Lake Cahuilla beds: pollen, numerous diatoms (microscopic plants), land dwelling plants, invertebrates (sponges, clams, snails, microscopic crustaceans), fish, lizards, snakes, birds, mammals (rabbits, pikas, squirrels, ground squirrels, mice, kangaroo rats, wood rats) (Whistler et al. 1995).

Paleontological Records Search

SDNHM paleontological records search results were received on June 21, 2024 (Confidential Attachment C, SDNHM Paleontological Records Search Results). SDNHM did not report any fossil localities from within the Project site; however, they did report the nearest SDNHM locality was located 7 miles west of the Project site and produced shells of freshwater gastropods and mussels (Confidential Attachment C).

6 Impact Analysis and Conclusions

6.1 Thresholds of Significance

The thresholds of significance used to evaluate the impacts of the proposed Project related to paleontological resources are based on Appendix G of the CEQA Guidelines (14 CCR 15000 et seq.). A significant impact under CEQA would occur if the proposed Project would:

a. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

6.2 Impact Analysis

a) Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

No paleontological resources were identified within the Project site as a result of the institutional records search or desktop geological and paleontological review. In addition, the Project site is not anticipated to be underlain by unique geologic features. The Project site is underlain by late Pleistocene to Holocene lake deposits, which have high paleontological sensitivity. If intact paleontological resources are located on site, ground-disturbing activities associated with construction of the proposed Project, such as grading during site preparation and trenching for utilities, have the potential to destroy a unique paleontological resource or site. As such, the Project site is considered to be potentially sensitive for paleontological resources, and without mitigation, the potential damage to paleontological resources during construction associated with the Project is considered a potentially significant impact. Given the proximity of past fossil discoveries in the surrounding area within similar Pleistocene deposits, the Project site is highly sensitive for supporting paleontological resources below the depth of fill and weathered lake deposits. However, upon implementation of **Mitigation Measure (MM) GEO-1** (see below), impacts would be reduced to below a level of significance. Impacts of the proposed Project are considered **less than significant with mitigation incorporated** during construction.

MM-GEO-1: Prior to commencement of any grading activity on site, CSU/SDSU, or its designee, shall retain a qualified paleontologist consistent with the Society of Vertebrate Paleontology (SVP) (2010) guidelines, to prepare a Paleontological Resource Impact Mitigation Program (PRIMP) for the Project. The PRIMP shall be consistent with the SVP (2010) guidelines and outline the following requirements: worker attendance and environmental awareness training at preconstruction meeting/s; monitoring within the proposed Project site as necessary based on construction plans and/or geotechnical reports; procedures for discoveries treatment; and methods (including sediment sampling for microvertebrate fossils), for reporting and collections management.

The paleontologist shall attend the preconstruction meeting and shall be on site during the preliminary phase of construction during rough grading and other significant ground-disturbing activities (including augering) to monitor the discovery, if any, of previously undisturbed, fine-grained lake deposits. In the event that paleontological resources (e.g., fossils) are unearthed during grading, the monitor will temporarily halt and/or divert grading activity to allow recovery of any discovered paleontological resources. Once documentation and collection of the find is completed, the monitor will allow grading to recommence in the area of the find. Any costs associated with laboratory processing of sediments and fossils, and curation fees are the responsibility of CSU/SDSU.

7 References

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Attachment A

Figures

SOURCE: ESRI

FIGURE 1
Regional Map

DUDEK

0 4 8 Miles

SOURCE: AERIAL-ESRI MAPPING SERVICE 2023; DEVELOPMENT-SDSU 2024

DUDEK

0 100 200 Feet

FIGURE 2
Vicinity Map

Technical Memorandum for the SDSU Imperial Valley Off-Campus Center - Calexico Affordable Student Housing Project

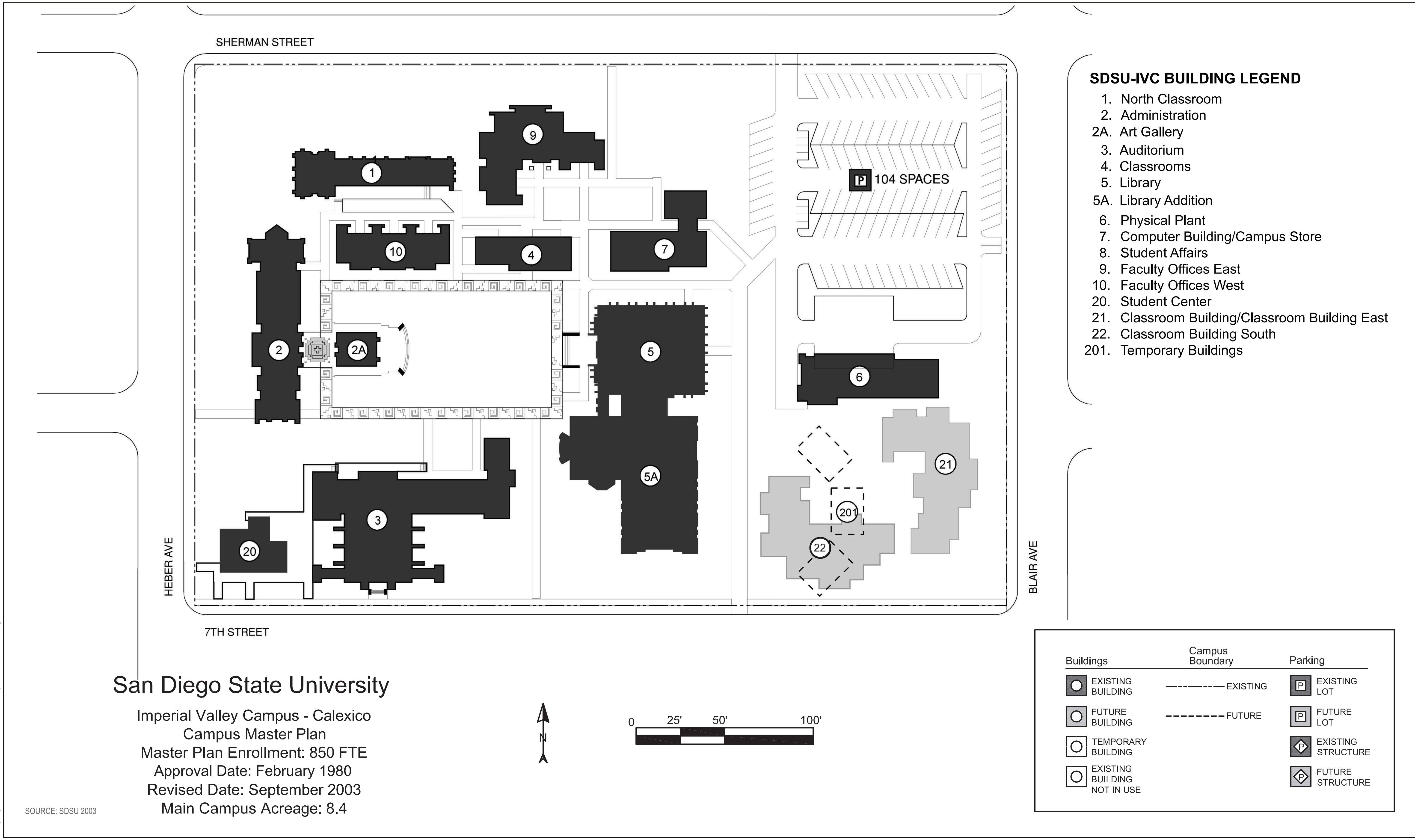


FIGURE 3A

Existing Campus Master Plan

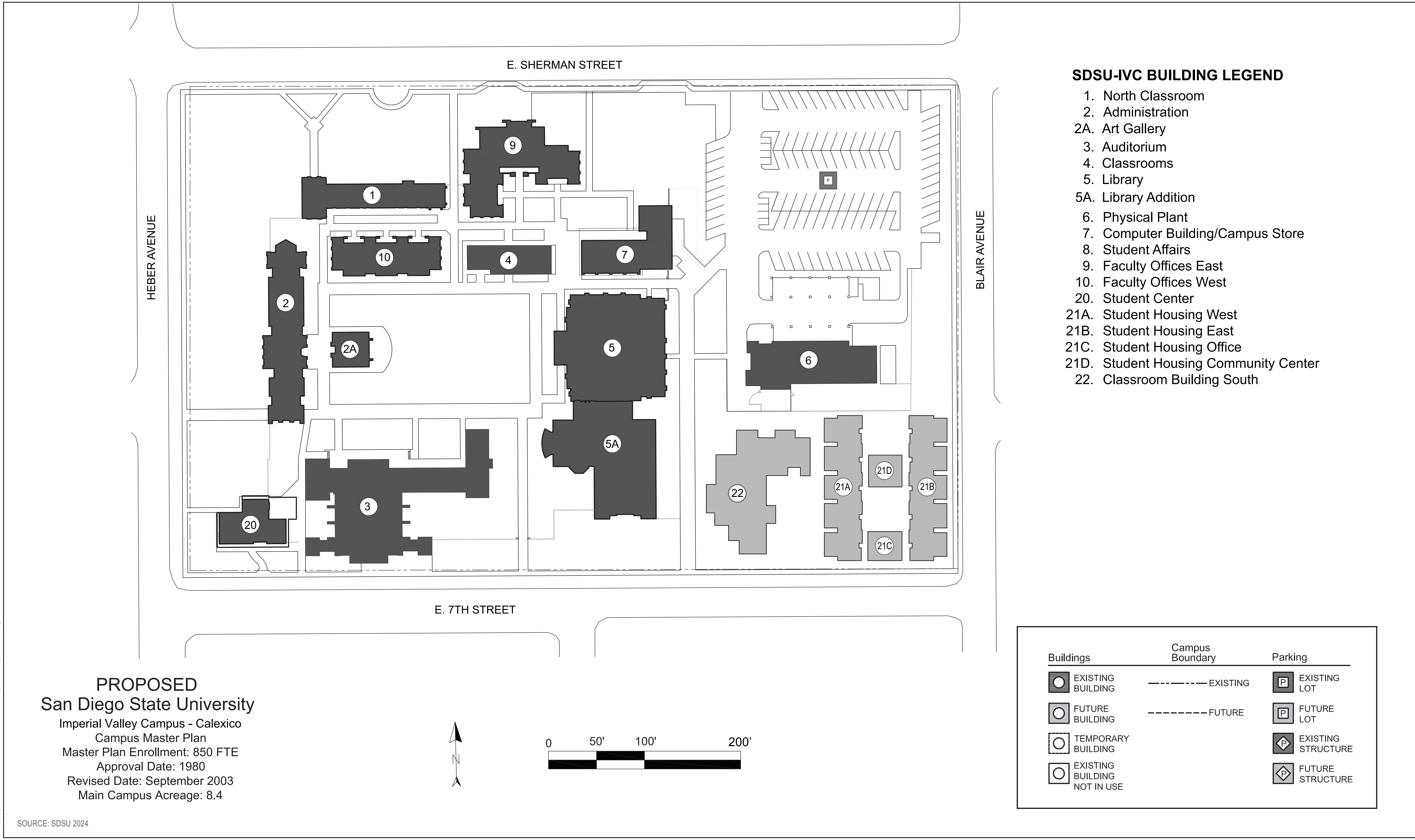
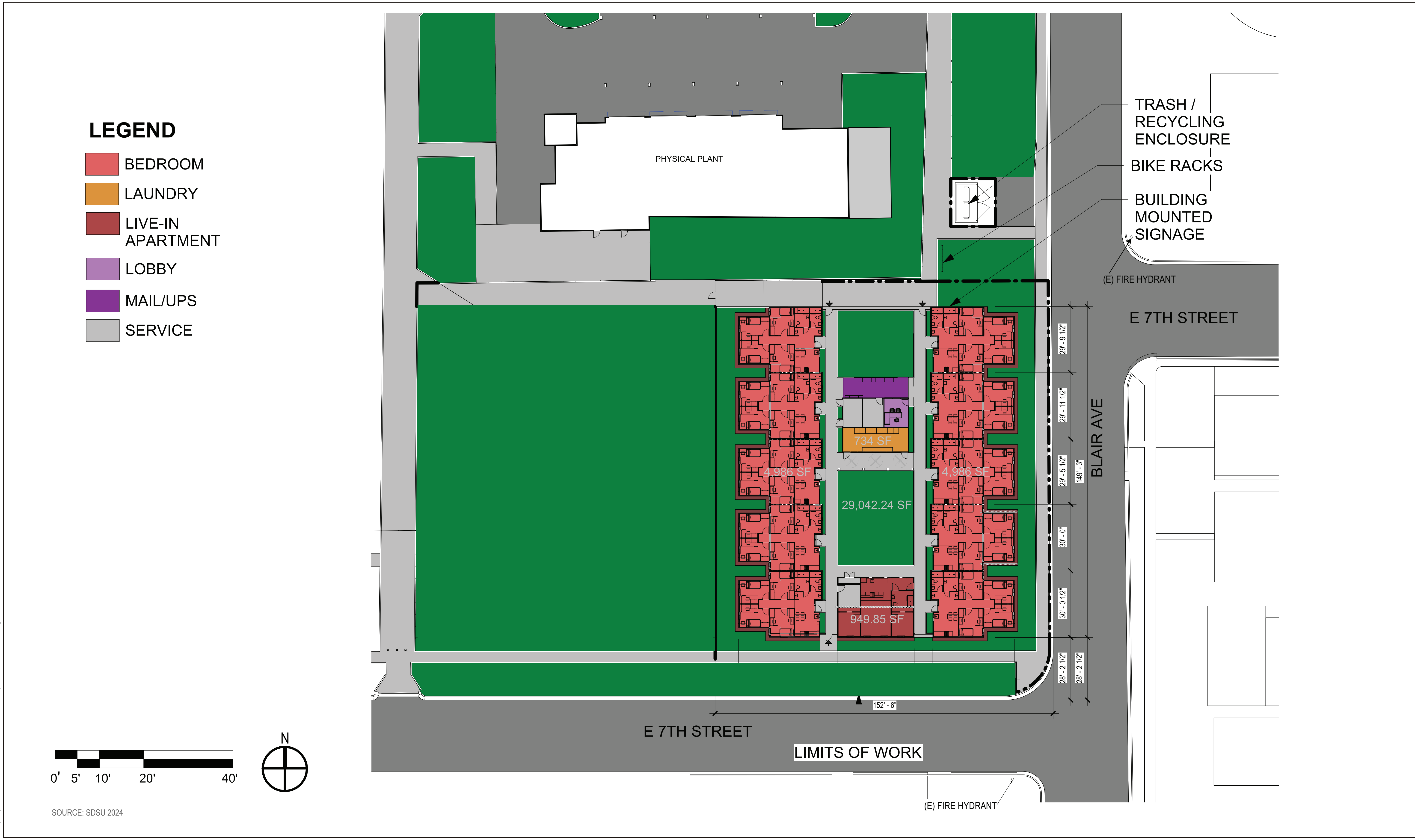


FIGURE 3B

Proposed Campus Master Plan

Technical Memorandum for the SDSU Imperial Valley Off-Campus Center – Calexico Affordable Student Housing Project

DUDEK



SOURCE: SDSU 2024

FIGURE 4

Site Plan

DUDEK

Attachment B
Geotechnical Report

REPORT OF GEOTECHNICAL INVESTIGATION
STUDENT RESIDENCE HALL
SAN DIEGO STATE UNIVERSITY
IMPERIAL VALLEY CAMPUS
CALEXICO, CALIFORNIA

Prepared for

SAN DIEGO STATE UNIVERSITY
Facilities Planning, Design & Construction
5500 Campanile Drive
San Diego, California 92182-1624

Prepared by

GROUP DELTA CONSULTANTS, INC.
9245 Activity Road, Suite 103
San Diego, California 92126

Project No. SD732
August 3, 2022

San Diego State University
Facilities Planning, Design & Construction
5500 Campanile Drive
San Diego, California 92182-1624

Project No. SD732
August 3, 2022

Attention: Ms. Amanda Scheidlinger, Director of Construction

SUBJECT: REPORT OF GEOTECHNICAL INVESTIGATION
Student Residence Hall
San Diego State University – Imperial Valley Campus
Calexico, California

Ms. Scheidlinger:

Group Delta Consultants, Inc. are pleased to submit this report of geotechnical investigation for the proposed Student Residence Hall building at the San Diego State University Imperial Valley Campus in Calexico, California. This report summarizes our conclusions regarding the geologic and geotechnical site constraints, and provides geotechnical recommendations for remedial grading, foundation, slab, utilities, and pavement section design.

We appreciate this opportunity to be of professional service. Please feel free to contact the office with any questions or comments, or if you need anything else.

GROUP DELTA CONSULTANTS

Samuel R. Narveson, P.G. 10060
Project Geologist

Christopher K. Vonk, P.E. 86619
Senior Engineer

James C. Sanders, C.E.G. 2258
Principal Engineering Geologist

Distribution: (1) Addressee, Ms. Amanda Scheidlinger (ascheidlinger@sdsu.edu)

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FIGURES

APPENDICES

1.0 INTRODUCTION

Group Delta Consultants, Inc. (Group Delta) are pleased to submit the following report of geotechnical investigation that provides geotechnical recommendations for the proposed Student Residence Hall building at the San Diego State University (SDSU) Imperial Valley Campus (IVC) in Calexico, California. The general location of the site is shown on Figure 1, Site Location, and the campus location is shown in more detail on Figure 2, Site Vicinity. The approximate locations of the subsurface explorations that were completed at the site are shown on Figure 3, Exploration Locations, along with the proposed Phase I and Phase II building addition approximate footprint limits (HED, 2022).

1.1 Scope of Services

Our geotechnical services were provided in general accordance with the provisions of the referenced proposal (Group Delta, 2022). The purpose of this work was to characterize the geologic and geotechnical constraints to site development, and to provide recommendations for grading and design of the new foundations, slabs, utilities, and pavements. The recommendations provided herein are based on subsurface investigation, the findings from laboratory tests, our engineering analyses, and our previous experience with similar geologic conditions in the site vicinity. In summary, we provided the following services for this project.

- A visual reconnaissance of the surface characteristics of the site and surrounding areas, and a review of the relevant reports.
- A subsurface exploration of the site including five Cone Penetration Test (CPT) soundings along with three geotechnical borings. The exploratory geotechnical boring and CPT sounding locations are shown on Figure 3, Exploration Locations. The boring records and CPT sounding data are provided in Appendix A.
- Laboratory tests were conducted on soil samples collected from the explorations. Laboratory tests conducted included sieve and hydrometer analyses, percent passing the number 200 sieve, Atterberg limits, Expansion Index (EI), soil corrosivity, in-situ moisture content, undrained shear strength, consolidation, and one-dimensional swell tests. The laboratory test results are summarized in Appendix B.
- Engineering analysis of the field and laboratory data to develop geotechnical recommendations for site preparation, remedial earthwork, foundation and pavement design, soil reactivity, site drainage and moisture protection.
- Preparation of this report summarizing our findings, conclusions and geotechnical recommendations for the proposed Student Residence Hall building.

1.2 Site Description

SDSU IVC is located at 720 Heber Avenue in Calexico, California. The campus in situated near the international border with Mexico within the Imperial Valley. The site is located about 30 miles south of the Salton Sea, as shown on Figure 1, Site Location. The proposed project site is located in the southeast corner of the campus, near the intersection of East 7th Street and Blair Avenue. The site currently contains an empty grass lot, three modular buildings, chain-link fencing, and landscaping consisting of several trees. The site location is relatively flat-lying and located approximately 4 to 6 feet above mean sea level (Google Inc., 2022).

1.3 Proposed Development

Outside of conceptual drawings (HED, 2022), details of the proposed building additions are not yet available. Based on the conceptual drawings, we understand that the project will consist of two development phases, each adding a two-story structure at the approximate locations shown on Figure 3, Exploration Locations. The buildings will likely consist of a relatively light-weight wood-framed or steel structure supported on conventional shallow reinforced concrete foundations or a post-tensioned slab. Other new site improvements may include new sidewalks and pavement areas, as well as various new landscape areas and subsurface utilities. It is assumed that site grades will remain approximately consistent with the current elevations, and that fill placements above existing grades are not needed for the site development.

2.0 FIELD AND LABORATORY INVESTIGATION

Our field investigation included advancing five CPT soundings on May 31st, 2022, and three geotechnical borings on June 1st, 2022. The maximum depth explored was approximately 100 feet below grade. Soil samples were collected at selected intervals within each geotechnical boring for laboratory testing and geotechnical analysis. The exploration locations are shown on Figure 3, Exploration Locations. The boring records and CPT sounding data are provided in Appendix A. Shear wave velocity measurements were collected at CPT-1 at 5-foot depth intervals, and the measurements are also presented in Appendix A.

The laboratory testing program included sieve and hydrometer analyses, percent passing the number 200 sieve, and Atterberg limits to aid in material classification according to the Unified Soil Classification System (USCS). Additional tests were performed to evaluate the in-situ moisture content and dry density, soil expansion characteristics (i.e., EI), compressibility parameters, undrained shear strength, and corrosivity potential. The in-situ moisture content and dry density, sieve and hydrometer analyses, percent passing the number 200 sieve, Atterberg limits, expansion index and unconfined compressive strength results and presented on the boring records in Appendix A. The laboratory test results are also shown in Appendix B.

3.0 GEOLOGY AND SUBSURFACE CONDITIONS

The site is located within the Salton Trough of the Colorado Desert geomorphic province, a topographic and structural depression bound to the north by the Coachella Valley and to the south by the Sea of Cortez. The Salton Trough is a region of transition from the extensional tectonics of the East Pacific Rise to the transform tectonic environment of the San Andreas system. Late Cenozoic extension of the Sea of Cortez formed this deep topographic and structural depression.

The Salton Trough is an actively growing rift valley in which sedimentation has almost kept pace with tectonism (Elders, 1979). Periodically throughout its history, the Colorado River delta has diverted and filled the trough producing cycles of sedimentation from marine, to deltaic, to fluvial and lacustrine. Today, the Salton trough is dominated by the Salton Sea and the Mesozoic-age crystalline basement rocks are covered by about 15,000 feet of Cenozoic sedimentary accumulation (Van De Kamp, 1973).

The site is located in an area that has been covered by lakes during the Quaternary time. The most recent of the lakes that formed in the Salton Trough was known as Lake Cahuilla, which was formed by flooding of the Colorado River and existed until approximately 300 years ago (Elders, 1979). The old shoreline of Lake Cahuilla can be traced along the Santa Rosa Mountains north of the site, and averages about 40 feet above mean sea level. The site is underlain at depth by hundreds of feet of lacustrine deposits, overlain by shallow fill.

The approximate locations of the explorations conducted at the site are shown on Figure 3, Exploration Locations. The general geology in the site vicinity is shown on Figure 4, Regional Geology. Logs interpreting the subsurface conditions we encountered in the explorations are provided in Appendix A. The geologic materials at the site are described below.

3.1 Lacustrine Deposits

The entire site is underlain by deep lacustrine deposits associated with the ancestral Lake Cahuilla. The lacustrine sediments are estimated to be well over 100 feet thick (Kovach et al., 1962). The lake sediments are typically fine grained, and generally consist of interbedded clays (USCS classifications CL and CH), with thin lenses of silt (ML) and occasional beds of silty sand (SM). The granular soils within the lake deposits are typically medium dense in consistency. The clays range from medium to high plasticity, and range in consistency from medium stiff to hard.

Laboratory tests indicate that the surficial clays have a moderate expansion potential and would be considered corrosive to severely corrosive based on the results of our limited corrosion screening tests. The estimated undrained shear strength (Su) of the predominately clayey lacustrine deposits typically ranges from about 1 to greater than 4 kips per square foot (ksf), based on interpretations of pocket penetration (PP) tests, CPT data, and an undrained shear strength test, as shown in Appendices A and B. This indicates the clayey soils are medium stiff to hard in consistency. Shear wave velocity measurements performed at CPT-1 indicated an average shear wave velocity of about 690 feet per second (ft/s), or 210 meters per second (m/s). In our opinion, a 2019 California Building Code (CBC) Site Class D (Stiff Soil) would be most applicable to the general site conditions.

Several roughly 2-foot-thick beds, but some up to 4-feet thick locally, of silty sand (SM) and non-plastic silt (ML) were encountered in the explorations within the Lacustrine deposits at depths ranging between approximately 13 to 20, 28 to 30, and 48 to 50 feet below existing grade. The hammer energy corrected blow counts (N_{60}) within these layers ranged from approximately 11 to 29 and CPT tip resistance ranged from 75 to 175 tons per square foot (tsf), which is indicative of a loose to medium dense material. Our analyses indicate that these zones of material are potentially liquefiable under a high seismic demand, as described in the *Earthquake-Induced Ground Failure* section of this report.

3.2 Fill

Undocumented fill was encountered in all our explorations. The fill is “undocumented” because there are no known records of observation and in-place density testing of the fill placement and compaction by a Geotechnical Engineer. The fill was measured to be approximately three to four feet thick in our explorations. The surficial fill generally consists of lean clay (CL) with varying amounts of sand and organics. The fill soils have a medium potential for expansion (EI between 51 and 90) and are considered to be corrosive to severely corrosive.

3.3 Groundwater

Groundwater was measured at a depth of approximately 28 feet below ground surface (roughly elevation of -24 feet MSL) in boring B-1 after drilling. Note that groundwater levels fluctuate over time due to changes in groundwater extraction, irrigation, or rainfall. It should also be noted that changes in rainfall, irrigation practices, or site drainage may produce seepage or locally perched groundwater conditions at any depth within the fill or lacustrine deposits underlying the site.

4.0 GEOLOGIC HAZARDS

The site is located within the Salton Trough of the Colorado Desert geomorphic province, which is a seismically active area in southern California, as shown on Figure 5A, Regional Fault Locations. The Salton Trough is the zone of transition between the ocean floor spreading regime in the Sea of Cortez and the right-lateral, strike-slip regime of the San Andreas system. Geologic hazards at the site are related to the potential for strong ground shaking due to an earthquake on one of several nearby active faults, as well as the potential for associated soil liquefaction and dynamic settlement. Each of the potential geologic hazards is described in more detail below.

4.1 Strong Ground Motion

The site is in a seismically active area. There are several active faults in the site vicinity that have produced moderate to large earthquakes within the past 100 years. The Imperial Fault Zone ruptured with a magnitude 6.9 earthquake in 1940, and again with a magnitude 6.4 earthquake in 1979 (USGS, 1982). The trace of the ground rupture from the 1940 earthquake was located about 5 miles east of the site (see Figure 4 and Figure 5B for the approximate 1940 ground rupture location). Additionally, there are several other known active faults close to the site, including the Superstition Hills and Superstition Mountain fault zones to the northwest, and the Laguna Salada and Cerro Prieto fault zones to the south (see Figures 4 and 5A). The Superstition Hills fault experienced a magnitude 6.7 earthquake in 1987 (Magistrale, 1989). In 2010, a magnitude 7.2 earthquake occurred on the Laguna Salada fault zone south of the international border (Gonzalez-Ortega, 2014). These earthquakes caused damage to structures throughout Imperial Valley, including soil liquefaction, settlement, and surficial slumps along the Imperial Irrigation District canal and drains (USGS, 1982, Gonzalez-Ortega 2014, Holzer, 1989).

The new building will likely be subjected to numerous small to moderate magnitude earthquakes, as well as occasional larger magnitude earthquakes from nearby active faults over its expected life span. The resulting strong ground motions associated with this hazard may be managed by structural design per the governing edition of the CBC and California State University (CSU) Seismic Requirements (CSU, 2020). Seismic design parameters are provided in the *Recommendations* section of this report.

4.2 Ground Rupture

Ground rupture results from movement on an active fault reaching the ground surface. The site is not located within an Alquist-Priolo Active Fault Zone and no known active faults are present in the immediate site vicinity, as shown on Figure 5B, Local Faults. Potential for ground rupture should therefore be considered low.

4.3 Earthquake-Induced Ground Failure

Potentially liquefiable soils underlie the site. Figure 4, Regional Geology, illustrate that the site is mapped in an area underlain by Quaternary Lake Deposits (i.e., Lacustrine Deposits) that are known to be potentially susceptible to liquefaction and its secondary effects (e.g., earthquake-induced ground failure).

4.3.1 Background

Liquefaction is the sudden loss of soil shear strength within saturated, loose to medium dense, sands and non-plastic silts. Liquefaction is caused by the build-up of pore water pressure during strong ground shaking from an earthquake. Secondary effects of liquefaction are sand boils, settlement and instabilities within sloping ground that occur as lateral spreading, seismic deformation and flow sliding. Lateral spreading is the horizontal deformation of gently sloping ground (slope less than 6 percent), and seismic deformation is the horizontal movement of more steeply sloping ground, both of which can occur during strong ground shaking. Flow sliding is an overall instability of more steeply sloping ground that can occur following or near the end of strong ground shaking, depending on its duration. Associated with liquefaction is seismic compaction, which is the densification of loose to medium dense granular soils that are above groundwater. Of these, liquefaction-induced settlement and seismic compaction are considered more likely to occur given the site surface and subsurface conditions, as discussed below.

4.3.2 Vertical Settlement Analyses

4.3.2.1 Volumetric Settlements

The computer program CLiq (Geologismiki, 2019) was used to perform liquefaction triggering calculations using several CPT-based methods, including those recommended by the NCEER Workshops (Youd et al., 2001) and Boulanger and Idriss (2014). CLiq also calculates the estimated free-field volumetric settlement (below groundwater) and seismic compaction (above groundwater). The analyses adopted the following input parameters:

Peak Ground Acceleration (PGA_M):..0.59g
Earthquake Magnitude (Mw):... 7.1
Groundwater Level: ....20 feet Below Ground Surface

The PGA_M was evaluated using the maximum of the: 1) most recent version of the CSU Seismic Requirements (CSU, 2020), and; 2) maximum considered earthquake geometric mean (MCE_G) peak ground acceleration adjusted for Site Class effects obtained from the OSHPD Seismic Design Maps Tool (SEAOC/OSHPD, 2019) in accordance with the 2019 California Building Code (CBSC, 2019). The controlling magnitude used in the liquefaction evaluation was selected by reviewing deaggregation results obtained from the USGS Unified Hazard Tool (USGS, 2022). A design groundwater level of 20 feet below ground surface was adopted based on our interpretation of the soil saturation in in-situ soil samples and CPT data.

The analyses were performed using data collected from the CPTs performed at the site (CPT-1 through CPT-5). The correlated CPT parameters were compared to the results of our field and laboratory testing collected from Boring B-1. The CPT Soil Behavior Type (SBT) correlated from the CPT data was adjusted to best fit the observations, classifications and material properties of the soils within the borings.

In accordance with Special Publication 117A (CGS, 2008) and general geotechnical engineering practices, a factor of safety against liquefaction of 1.3 was adopted in the analyses, and the liquefaction analyses were limited to a depth of 50 feet.

The liquefaction settlement analyses include depth weighting proposed by Cetin et al. (2009), which consists of a simple linear weighting factor that weights the volumetric strain with depth. This reduces the impact of volumetric strains at large depths. The weighting starts at one at the ground surface and reduces to zero at the weighting limit depth, selected to be the depth of analysis for this project (i.e., 50 feet).

4.3.3 Vertical Settlement Summary

Based on the results of the triggering analyses there are several potentially liquefiable zones within the subsurface profile. In general, the potentially liquefiable soils consist of occasional thin beds that are generally less than 2-foot-thick each, but some up to 4-feet thick locally. The estimated liquefaction-induced volumetric settlement is approximately 1-inch or less at each exploration location. The estimated liquefaction-induced differential settlement is approximately 0.5-inch or less over a horizontal distance of 30 feet.

4.3.4 Instability of Sloping Ground

Since the site is essentially level and the buildings are not located immediately adjacent to sloping ground, the potential for significant liquefaction-induced lateral displacement should be low.

4.4 Landslides

Evidence of ancient landslides or slope instabilities was not observed during our literature review or site reconnaissance and the site is essentially level. Provided that our geotechnical recommendations are properly implemented during construction, it is our opinion that slope instability does not adversely impact the proposed development.

4.5 Tsunamis, Seiches, and Flooding

The distance between the subject site and the Sea of Cortez precludes damage due to seismically induced waves (tsunamis) or seiches within the Pacific Ocean or Sea of Cortez. The Salton Sea is located over 30 miles north of the site at more than 230 feet below mean sea level, which is more than 200 feet below the existing site elevations. The New River is located about three quarters of a mile west of the site, and the Alamo River is located about 7 miles east of the site. However, the normal water surface elevations in these rivers are roughly 20 to 40 feet below site grades. Further, the site is mapped in Federal Emergency Management Agency (FEMA) zone designated “Area of Minimal Flood Hazard” (FEMA, 2008). Consequently, the potential for earthquake induced or other flooding at the site is considered to be low. However, the flooding hazard at the site should be evaluated by the project civil engineer.

5.0 GEOTECHNICAL CONDITIONS

Fill and lacustrine deposits underly the site, as discussed in the *Geology and Subsurface Conditions* section of this report. Geotechnical conditions associated with these units are discussed below.

5.1 Expansive Soils

Laboratory tests indicate the surficial soils at the site should have a “Medium” Potential Expansion. The results of three Expansion Index (EI) tests conducted on bulk soils samples obtained from the ground surface to a depth of about 5 feet below existing grades ranged from 60 to 82, averaging 71 with a median of 70 (i.e., Medium Potential Expansion). Appendix B provides the test results.

5.1 Compressible Soils

Compressible soils underlie the site. Most of these soils are clay that should experience some time dependent consolidation settlement (i.e., long-term settlement). There are also beds of non-plastic silty sand and silt that should settle elastically with the initial fill and structure loading (i.e., short-term settlement). In general, the clay has a medium to high plasticity and we interpret it to be relatively stiff and slightly overconsolidated from consolidation testing, pocket penetrometer tests, undrained shear strength testing, CPT interpretations, and Plasticity Index data. The in-situ moisture contents are generally near the Plastic Limit and the Liquidity Indices are less than 0.7, which indicate relatively stiff and low compressibility soils.

Provided minimal fill placement is needed at the site to achieve the proposed finish grades and foundation loading is limited to the bearing pressures provided in the *Recommendations* section of this report, most of the long-term settlement should occur in a relatively short time following initial loading. However, there are zones of thick clay that could experience some time dependent consolidation settlement if significant loading from fill or foundation loads are proposed for the project. The estimated settlement magnitude and duration associated with the proposed fill placements and foundation loads should be evaluated during the design development phase of the project to evaluate the potential impact to the project.

5.2 Reuse of Onsite Soils

Soils from proposed onsite excavations at the site are anticipated to consist of lean and fat clay (CL and CH) and are generally not considered suitable for re-use as compacted fill without specific recommendations [see the *Post-Tensioned Slabs (Case B – Existing Clay)* section of this report]. Imported fill is anticipated to be needed to replace expansive materials underlying the proposed structures, flatwork, and pavements. Recommendations for imported fill are provided in the *Recommendations* section of this report.

6.0 CONCLUSIONS

The proposed Student Residence Hall building appears to be feasible from a geotechnical perspective, provided that appropriate measures are implemented during construction. Several geotechnical conditions exist on site that should be addressed.

- Laboratory tests indicate that the surficial soils at the site have a moderate potential for expansion (EI between 51 and 90). The use of thickened foundations and slabs underlain by imported non-expansive soil (EI<20) could reduce the potential for future distress to the building associated with soil expansion. Alternatively, a post-tensioned slab-on-grade could be used to support the new building. Alternative post-tension slab design parameters are provided for slabs bearing on either imported select soil or compacted on-site clay.

- The fill is not suitable for reuse as engineered fill without specific recommendations. Laboratory tests indicate the fill soils primarily consist of lean and fat clay (CL and CH) with a medium expansion potential. To reduce the potential for heave related distress, we recommend placing and compacting non-expansive soil (EI<20) beneath structures, pavements, flatwork and other heave-sensitive improvements.

- Groundwater was encountered at the site at a depth of about 28 feet below existing surface grades. The site is also located in an area of high seismic activity, and the potential does exist for relatively minor earthquake-induced liquefaction and settlement of the granular lacustrine deposits beneath the site. We estimate that the proposed building could experience post-liquefaction differential settlement on the order of 0.5-inch over a horizontal distance of 30 feet. In addition to helping reduce the potential for distress associated with expansive soils, the use of thickened and heavily reinforced conventional building foundations or post-tensioned could also help to reduce the potential for distress to the building associated with post-liquefaction settlement.

- The site is underlain by zones of thick clay that could experience some time dependent consolidation settlement if significant loading from fill or foundation loads are proposed for the project. The estimated settlement magnitude and duration associated with the proposed fill placements and foundation loads should be evaluated during the design development phase of the project to evaluate the potential impact to the project

- Laboratory tests indicate that the clayey surficial soils at the site present a *severe* risk of sulfate attack and are also *corrosive* to *very corrosive* to buried metals. The recommended placement of two to five feet of imported sand beneath the sidewalks and building slabs-on-grade could help to reduce the potential for sulfate attack and corrosion. However, sulfate resistant Type V cement is recommended for use at the site. Various corrosion control measures may also be needed for buried metal structures. A corrosion consultant may be contacted.

- Our previous experience indicates that the on-site clayey soils are not suitable for effective storm water infiltration measures. An infiltration rate of less than 0.05 inches per hour is estimated based on previous infiltration tests we have conducted on similar clay soils. The clays typically have a permeability of 10^{-7} to 10^{-9} centimeters per second (essentially impermeable). This suggests that the on-site soils are not suitable for full or partial infiltration measures.

- The potential for active faults or landslides to adversely impact the building is considered remote. However, the site is situated within a zone of high seismic activity. The strong ground shaking hazard may be mitigated by structural design in accordance with the applicable provisions of the governing CBC and minimum CSU Seismic Requirements.

7.0 RECOMMENDATIONS

The remainder of this report presents recommendations for earthwork construction and the design of the proposed improvements. These recommendations are based on empirical and analytical methods typical of the standards of practice in southern California. If these recommendations do not cover a specific feature of the project, please contact our office for revisions or amendments.

7.1 Plan Review

We recommend that grading and foundation plans be reviewed by Group Delta prior to finalization. We anticipate that substantial changes in the development may occur from the preliminary design concepts used for this investigation. Such changes may require additional geotechnical evaluation, which may result in substantial modifications to the remedial grading and foundation recommendations provided in this report.

7.2 Excavation and Grading Observation

Foundation and grading excavations should be observed by the project geotechnical consultant. During grading, the geotechnical engineer's representative should provide observation and testing services continuously. Such observations are considered essential to identify field conditions that differ from those anticipated by this investigation, to adjust designs to the actual field conditions, and to evaluate that the remedial grading is accomplished in general accordance with the recommendations in this report. The recommendations provided in this report are contingent upon Group Delta providing these services. Our personnel should perform sufficient testing of fill and backfill during grading and improvement operations to support our professional opinion as to compliance with the compaction recommendations.

7.3 Earthwork

Grading and earthwork should be conducted in general accordance with the requirements of the current CBC and the earthwork recommendations provided within this report. The following recommendations are provided regarding specific aspects of the proposed earthwork. These recommendations should be considered subject to revision based on the conditions observed by the geotechnical consultant during the grading operations.

7.3.1 Site Preparation

General site preparation should begin with the removal of deleterious materials, including any existing structures, vegetation, turf, contaminated soil, trash, and demolition debris. Existing subsurface utilities or groundwater wells that underly the proposed improvements should be properly abandoned and relocated outside of the proposed building footprint. Excavations associated with abandonment operations should be backfilled and compacted as described in *Fill Compaction* Section of this report. Wells, if present, should be abandoned per local and State guidelines. Alternatively, abandoned utilities may be grouted with a two-sack sand-cement slurry under the observation of the project geotechnical consultant.

7.3.2 Improvement Areas

At least two feet of compacted fill with an Expansion Index of 20 or less is recommended beneath new concrete sidewalks and exterior flatwork areas. To accomplish this objective, the upper 24-inches of soil below slab subgrade (i.e., bottom of the slab) should be excavated and removed from the site. The over-excavation should include the soil within 2-feet of the sidewalk perimeter (measured horizontally). The resulting excavation surface should be scarified, brought to 3-percentage points or more above optimum moisture content and compacted to at least 90 percent of the maximum dry density per ASTM D1557. The excavation bottom should then be backfilled to the planned slab subgrade elevations using a non-expansive (EI<20) granular material and be compacted in accordance with the recommendations in the *Fill Compaction* section below. Subgrade compaction should be conducted immediately prior to placing concrete or base.

7.3.3 Building Areas

The clayey lacustrine deposits beneath the proposed building addition consist of expansive lean clay (CL) and fat clay (CH). We recommend that the upper 5 feet of clayey soil beneath the proposed building finish pad elevations be excavated and removed from the site. The remedial excavations should extend at least 5 feet horizontally beyond the perimeter of the proposed building, wherever possible. However, the excavations should not pass below a 1:1 plane extending down and out from the bottom outside edge of any existing foundations, in order to avoid undermining these footings and causing distress to existing structures. The resulting excavation surface should be scarified, brought to 3-percentage points or more above optimum moisture content and compacted to at least 90 percent of the maximum dry density at per ASTM D1557. The excavation bottom should then be backfilled to the planned slab subgrade elevations using a non-expansive (EI<20) granular material and be compacted in accordance with the recommendations in the Fill Compaction section below.

7.3.4 Fill Compaction

All fill and backfill should be placed and compacted at or slightly above optimum moisture content per ASTM D1557 using equipment capable of producing a uniformly compacted product. The loose lift thickness should be 8 inches, unless performance observed and testing during earthwork indicates a thinner loose lift is needed, or a thicker loose lift is possible, up to a loose lift thickness of 12 inches.

The minimum recommended relative compaction is 90 percent of the maximum dry density per ASTM D1557. Sufficient observation and testing should be performed by the project geotechnical consultant during grading so that an opinion can be rendered as to the compaction achieved. Rocks or concrete fragments greater than 6 inches in maximum dimension should not be used in compacted fill.

A two-sack sand and cement slurry may be used as an alternative to compacted fill soil. It has been our experience that slurry is often useful in confined areas which may be difficult to access with typical compaction equipment. A minimum 28-day compressive strength of 100 psi is recommended for the two-sack sand and cement slurry. Samples of the slurry should be fabricated and tested for compressive strength during construction.

7.3.5 Import Soil

Imported fill sources should be observed and tested by the project geotechnical consultant prior to hauling onto the site to evaluate the suitability for use. In general, imported fill materials should consist of granular soil with more than 70 percent passing the ¾-inch sieve and less than 35 percent passing the No. 200 sieve based on ASTM C136, and an Expansion Index less than 20 based on ASTM D4829. Samples of the import should be tested by the geotechnical consultant in order to evaluate the suitability of these soils for their proposed use.

Additional testing per the guidelines provided by the Department of Toxic Substances Control (DTSC, 2001) is required by the Owner prior to accepting soil for import. Test results should meet most stringent State and Federal residential screening levels including the most up-to-date DTSC Modified Screening Levels (DTSC-SLs) and United States Environmental Protection Agency Regional Screening Level (RSL).

7.3.6 Subgrade Stabilization

All excavation bottoms should be firm and unyielding prior to placing fill. In areas of saturated or "pumping" subgrade, a geogrid such as Tensar BX-1200 or Terragrid RX1200 may be placed directly on the excavation bottom, and then covered with at least 12 inches of minus ¾-inch aggregate base. Once the excavation is firm enough to attain the recommended compaction within the base, the remainder of the excavation may be backfilled using either compacted soil or aggregate base. If wet soil conditions are encountered where further excavations are needed, an additional 12-inches of free draining open graded material (such as minus ¾-inch crushed rock) should be placed between the stabilizing geogrid and the compacted well graded aggregate base. The open graded material should be completely enveloped in filter fabric (such as Mirafi 140N).

7.3.7 Temporary Excavations

Temporary excavations may be needed to construct the planned improvements. Excavations should conform to Cal-OSHA guidelines (2018). In general, we recommended that temporary excavations be inclined no steeper than 1:1 for heights up to 5 feet. Vertical excavations should be shored. Any excavations that encounter groundwater seepage should be evaluated on a case-by-case basis.

The design, construction, maintenance, and monitoring of all temporary slopes is the responsibility of the contractor. The contractor should have a competent person evaluate the geologic conditions encountered during excavation to determine permissible temporary slope inclinations and other measures as required by Cal-OSHA. The below assessment of OSHA Soil Types for temporary slopes is based on preliminary engineering classifications of material encountered in widely spaced explorations.

Based on the findings of our subsurface investigation, the following OSHA Soil Types may be assumed for planning purposes.

PRELIMINARY CAL/OSHA SOIL TYPES

Geologic Unit	Cal/OSHA Soil Type
Fill	Type B[1]
Lacustrine Deposits	Type B[1]

1. This assumes that no groundwater seepage or caving is encountered in the excavations.

7.4 Surface Drainage

Foundation and slab performance depends greatly on how well surface runoff drains from the site. The ground surface should be graded so that water flows rapidly away from structures and top of slopes without ponding. The surface gradient needed to achieve this may depend on the prevailing landscaping. Planters should be designed and built so that water will not seep into the foundation, slab, pavement or other heave/settlement structure areas. If roof drains are used, the drainage should be channeled by pipe to the storm drain system, or discharge at least 10 feet from buildings. Irrigation should be limited to the minimum needed to sustain landscaping, and consideration should be given to utilizing drought tolerant landscape to further minimize water used for irrigation. Excessive irrigation, surface water, water line leaks, or rainfall may cause perched groundwater to develop within the underlying soil.

7.5 Storm Water Management

We anticipate that various bioretention basins, swales or pervious paver block pavements may be proposed to promote on-site infiltration for storm water Best Management Practice (BMP). In order to help evaluate the feasibility of on-site infiltration, the infiltration rate of the on-site soil may be estimated using borehole percolation or double ring infiltrometer tests conducted within the planned BMP areas. However, our experience indicates that infiltration testing in clay soils should result in a “No Infiltration” condition per the applicable BMP Design Manual. An infiltration rate of less than 0.05 inches per hour is estimated based on previous infiltration tests we have conducted in similar clay soils. The clays typically have a permeability of 10^{-7} to 10^{-9} cm/s (essentially impermeable).

7.6 Foundation Recommendations

The foundations for the new buildings should be designed by the project structural engineer using the following geotechnical parameters. These are only minimum criteria, and should not be considered a structural design, or to preclude more restrictive criteria of governing agencies or the structural engineer. The following recommendations should be considered preliminary, and subject to revision based on decisions made during design development and the conditions observed by the geotechnical consultant during grading.

7.6.1 Conventional Foundations

The following recommendations assume that remedial grading will be conducted for the building pad area as recommended in the *Earthwork* Section, and that the building pad grade will be underlain by at least 5-feet of granular non-expansive compacted fill (EI<20). Conventional shallow foundations would be considered appropriate for this condition, as shown in Figure 6.

Allowable Bearing:	*2,000 psf (allow ⅓ increase for short-term wind or seismic loads)*
Minimum Footing Width:	*12 inches*
Minimum Footing Depth:	*24 inches below lowest adjacent soil grade*
Minimum Reinforcement:	*Two No. 5 bars at both top and bottom in continuous footings*

7.6.2 Post-Tensioned Slabs

Two different post-tensioned slab foundation design conditions are summarized below. Case A provides recommendations assuming the building will be underlain by at least 5-feet of non-expansive compacted fill, and Case B assumes that a post-tension slab foundation may be designed to bear directly on recompacted expansive on-site clay. The following recommendations are provided using the Post-Tensioning Institute (PTI) Document *PTI DC10.5-19* (2019).

7.6.2.1 Case A – Select Fill

For Case A, we have assumed that remedial grading will be conducted per our recommendations, and that the proposed building will be underlain by at least 5-feet of imported granular non-expansive compacted fill in accordance with the *Earthwork* Section of this report, overlying the existing expansive clay. The following post-tension slab foundation design parameters are considered applicable to buildings that will be underlain by such conditions. Note that these recommendations should be considered preliminary, and subject to revision based on the as-graded conditions observed by the geotechnical consultant during fine grading of the site.

Post-Tension Slab Design Parameters (Case A):

Moisture Variation Distance, e_m:	*Center Lift:*	*5.5 feet*
	Edge Lift:	*2.5 feet*
Differential Soil Movement, y_m:	*Center Lift:*	*0.5 inches*
	Edge Lift:	*1.0 inches*
Allowable Bearing:	*2,000 psf at slab subgrade*	

7.6.2.2 Post-Tensioned Slabs (Case B – Existing Clay)

As an alternative to remedial grading to replace the highly expansive clays with imported sand as described in Case A above, a post-tension slab foundation may be designed to bear directly on the highly expansive on-site clay. For Case B, the undocumented fill soils underlying the proposed structure should be excavated and replaced as a uniformly compacted fill beneath the building (as a minimum). The undocumented fill depth is anticipated to extend approximately three to four feet below existing grades at the site. The clayey fill soil should be compacted to at least 90 percent relative compaction at 3-percentage points or more above optimum moisture content per ASTM D1557. The following post-tension slab foundation design parameters are considered appropriate for a building underlain by recompacted clayey fill soils.

Post-Tension Slab Design Parameters (Case B):

Moisture Variation Distance, e_m:	*Center Lift:*	*7.0 feet*
	Edge Lift:	*3.5 feet*
Differential Soil Movement, y_m:	*Center Lift:*	*1.5 inches*
	Edge Lift:	*2.5 inches*
Allowable Bearing:	*2,000 psf at slab subgrade*	

7.6.3 Settlement

Total and differential settlements of the proposed structure due to the allowable bearing loads provided above are not expected to exceed 1.5 and 0.75 inches in 30 feet, respectively. In addition to static settlement, the site may experience post-liquefaction total and differential settlements on the order of approximately 1-inch and 0.5 inches in 30 feet, respectively, as discussed in *Earthquake Induced Ground Failure* Section.

7.6.4 Lateral Resistance

Lateral loads against the structure may be resisted by friction between the bottoms of footings and slabs and the underlying soil, as well as passive pressure from the portion of vertical foundation members embedded into compacted fill. A coefficient of friction of 0.25 and a passive pressure of 250 psf per foot of depth may be used for level ground conditions.

7.7 Seismic Design

Structures should be designed in general accordance with the governing seismic provisions of the 2019 CBC, as well as the minimum seismic design requirements of the California State University (CSU, 2020). Field testing consisting of shear wave measurements in CPT-1 resulted in average shear wave velocity in the upper 30 meters ($V_{S,30}$) of approximately 210 m/s. Based on these measurements, the Site Classification using Chapter 20 of ASCE 7-16 would be Site Class D. The following preliminary seismic design parameters are recommended by the California State University Seismic Requirements (CSU, 2020) for the site.

CSU – SDSU IMPERIAL CAMPUS SEISMIC DESIGN PARAMETERS

Hazard Level	Parameter	Site Class D
BSE-1N	PGA_D	0.40
	S_{D0}	0.40
	S_{DS}	1.00
	S_{D1}	0.68
BSE-2N	PGA_M	0.59
	S_{M0}	0.60
	S_{MS}	1.50
	S_{M1}	1.02

7.8 On-Grade Slabs

The following recommendations assume that remedial grading will be conducted for the building pad area as recommended in the *Earthwork* Section, and that the building pad grade will be underlain by at least 5-feet of non-expansive compacted fill (EI<20). Conventional concrete building slabs should be at least 6 inches thick and should be reinforced with at least No. 3 bars on 12-inch centers, each way. Slab thickness, control joints, and reinforcement should be designed by the project structural engineer and should conform to the requirements of the current CBC.

7.8.1 Moisture Protection for Slabs

Moisture protection should comply with requirements of the current CBC, American Concrete Institute (ACI 302.1R-15) and the desired functionality of the interior ground level spaces. The project Architect typically specifies an appropriate level of moisture protection considering allowable moisture transmission rates for the flooring or other functionality considerations.

Moisture protection may be a “Vapor Retarder” or “Vapor Barrier” that use membranes with a thickness of 10 and 15 mil or more, respectively. The membrane may be placed between the concrete slab and the AB or finished subgrade immediately below the slab, provided it is protected from puncture and repaired per the manufacturer’s recommendations if damaged. Note that the CBC specifies that a capillary break such as 4 inches of clean sand be used beneath building slabs (as defined and installed per the California Green Building Standards), along with a Vapor Retarder.

7.9 Exterior Slabs

Exterior slabs and sidewalks subjected to pedestrian traffic and light vehicle loading (e.g., golf carts) should be at least 4 inches thick and underlain by 2-feet of granular non-expansive soil in accordance with the *Improvement Areas* section of this report. Control joints should be placed on a maximum spacing of 10-foot centers, each way, for slabs, and on 5-foot centers for sidewalks. The potential for differential movements across the control joints may be reduced by using steel reinforcement. Typical reinforcement would consist of 6x6 W2.9/W2.9 welded wire fabric placed securely at mid-height of the slab.

7.10 Preliminary Pavement Design

For all pavement areas, the upper 12 inches of clayey subgrade soil (below the pavement aggregate base section) should be removed. This removal should extend 2 feet or more beyond the outside edge of the pavement perimeter measured horizontally. The resulting excavation surface should be scarified immediately prior to constructing the pavements, brought to optimum moisture, and compacted to at least 90 percent of the maximum dry density at 3-percentage points or more above optimum moisture content per ASTM D1557. The excavation bottom should then be backfilled to the planned pavement subgrade (i.e., bottom of the aggregate base section) using a non-expansive (EI<20) granular material (i.e., subbase). Aggregate base and subbase should be compacted to 95 percent relative compaction at or slightly above optimum moisture content per ASTM D1557. Aggregate base should conform to the Standard Specifications for Public Works Construction (*SSPWC),* Sections 200-2.2, -2.4, or -2.5 (PWSI, 2018). Asphalt concrete should conform to Section 203-6 of the *SSPWC* and should be compacted to 91 and 97 percent of the Rice density per ASTM D2041 (PWSI, 2018).

7.10.1 Asphalt Concrete

Based on our previous experience, we anticipate that the clayey on-site soils have an R-Value of 5 or less. Preliminary asphalt concrete pavement design was conducted using the Caltrans Design Method (2018). We anticipate that a Traffic Index ranging from 5.0 to 6.0 may apply to new pavement areas. The project civil engineer should review the assumed Traffic Indices to determine if and where they may be applicable. Based on the minimum R-Value of 5 and the assumed range of Traffic Indices, the following pavement sections would apply.

SUMMARY OF PRELIMINARY ASPHALT CONCRETE PAVEMENT SECTIONS

PAVEMENT TYPE	TRAFFIC INDEX	ASPHALT SECTION	BASE SECTION	SUBBASE SECTION[1]
Passenger Car Parking	5.0	3 Inches	10 Inches	12 Inches
Light Truck Traffic Areas	6.0	4 Inches	12 Inches	12 Inches

1) NOTE*: One foot of non-expansive subbase should be placed beneath the pavement section to reduce the potential for cracking due to soil heave/shrink behavior.*

7.10.2 Portland Cement Concrete

Concrete pavement design was conducted in general accordance with the simplified design procedure of the Portland Cement Association (1984). This methodology is based on a 20-year design life. For design, it was assumed that aggregate interlock would be used for load transfer across control joints. The concrete was assumed to have a minimum flexural strength of 600 psi. The flexural strength of the pavement concrete should be confirmed during construction using ASTM C78. For concrete pavement design, the subgrade materials were assumed to provide "low" support, based on our experience with similar materials. Using these assumptions and the same traffic indices presented previously, we recommend that the PCC pavement sections at the site consist of at least 6 inches of concrete placed over 6 inches of compacted aggregate base over 12 inches of compacted non-expansive subbase (i.e., EI < 20).

Crack control joints should be constructed for PCC pavements on a maximum spacing of 10 feet, each way. Concentrated truck traffic areas, such as trash truck aprons and loading docks, should be reinforced with number 4 bars on 18-inch centers, each way.

7.11 Pipelines

The planned addition may include various pipelines such as water, storm drain and sewer systems. Geotechnical aspects of pipeline design include lateral earth pressures for thrust blocks, modulus of soil reaction, and pipe bedding. Each of these parameters is discussed below.

7.11.1 Thrust Blocks

Lateral resistance for thrust blocks may be evaluated using a passive pressure value of 250 lbs/ft^2 per foot of embedment, assuming a triangular distribution and level ground conditions. This value may be used for thrust blocks embedded into compacted fill soils as well as the underlying lacustrine deposits, provided that these soils are located above the groundwater table.

7.11.2 Modulus of Soil Reaction

The modulus of soil reaction (E') is used to characterize the stiffness of soil backfill placed along the sides of buried flexible pipelines. For the purpose of evaluating deflection due to the load associated with trench backfill over the pipe, a value of 1,000 lbs/in^2 is recommended for the general conditions, assuming granular bedding material is placed around the pipe and the soils are located above the groundwater table.

7.11.3 Pipe Bedding

Typical pipe bedding as specified in the *Standard Specifications for Public Works Construction* may be used. As a minimum, we recommend that pipes be supported on at least 4 inches of granular bedding material such as minus ¾-inch crushed rock, disintegrated granite or granular materials with a Sand Equivalent of 20 or more. Where open graded material (e.g., ¾-inch minus crushed rock) is used as bedding and shading around and above the pipe, we recommend that open graded material should be completely enveloped in filter fabric (such as Mirafi 140N).

Where pipeline or trench excavations exceed a 15 percent gradient, we do not recommend that open graded rock be used for bedding or backfill because of the potential for piping and internal erosion. For sloping utilities, we recommend that coarse sand with a Sand Equivalent of 20 or more or sand-cement slurry be used for the bedding and pipe zone. The slurry should consist of a 2-sack mix having a slump no greater than 5 inches.

7.12 Reactive Soils

In order to assess the sulfate exposure of concrete in contact with the site soils, samples were tested for pH, resistivity, water-soluble sulfate and chloride content, as shown in Figure B-5. The sulfate test results indicate that the on-site soils present a *severe* potential for sulfate attack based on commonly accepted criteria (Bentivegna, et al., 2020). A *negligible* sulfate content is recommended for any imported soils and should be confirmed through laboratory testing prior to import.

The saturated resistivity and chloride content of the near surface soils are indicative of a *corrosive* to *very corrosive* soil with respect to buried metals based on commonly accepted criteria (Caltrans, 2021). Typical corrosion control measures should be incorporated into the project design, such as providing minimum clearances between reinforcing steel and soil, and sacrificial anodes for any buried metal structures. A corrosion consultant may be contacted for specific recommendations.

8.0 LIMITATIONS

This report was prepared using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in similar localities. No warranty, express or implied, is made as to the conclusions and professional opinions included in this report.

The findings of this report are valid as of the present date. However, changes in the condition of a property can occur with the passage of time, whether due to natural processes or the work of humans on this or adjacent properties. In addition, changes in applicable or appropriate standards of practice may occur from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

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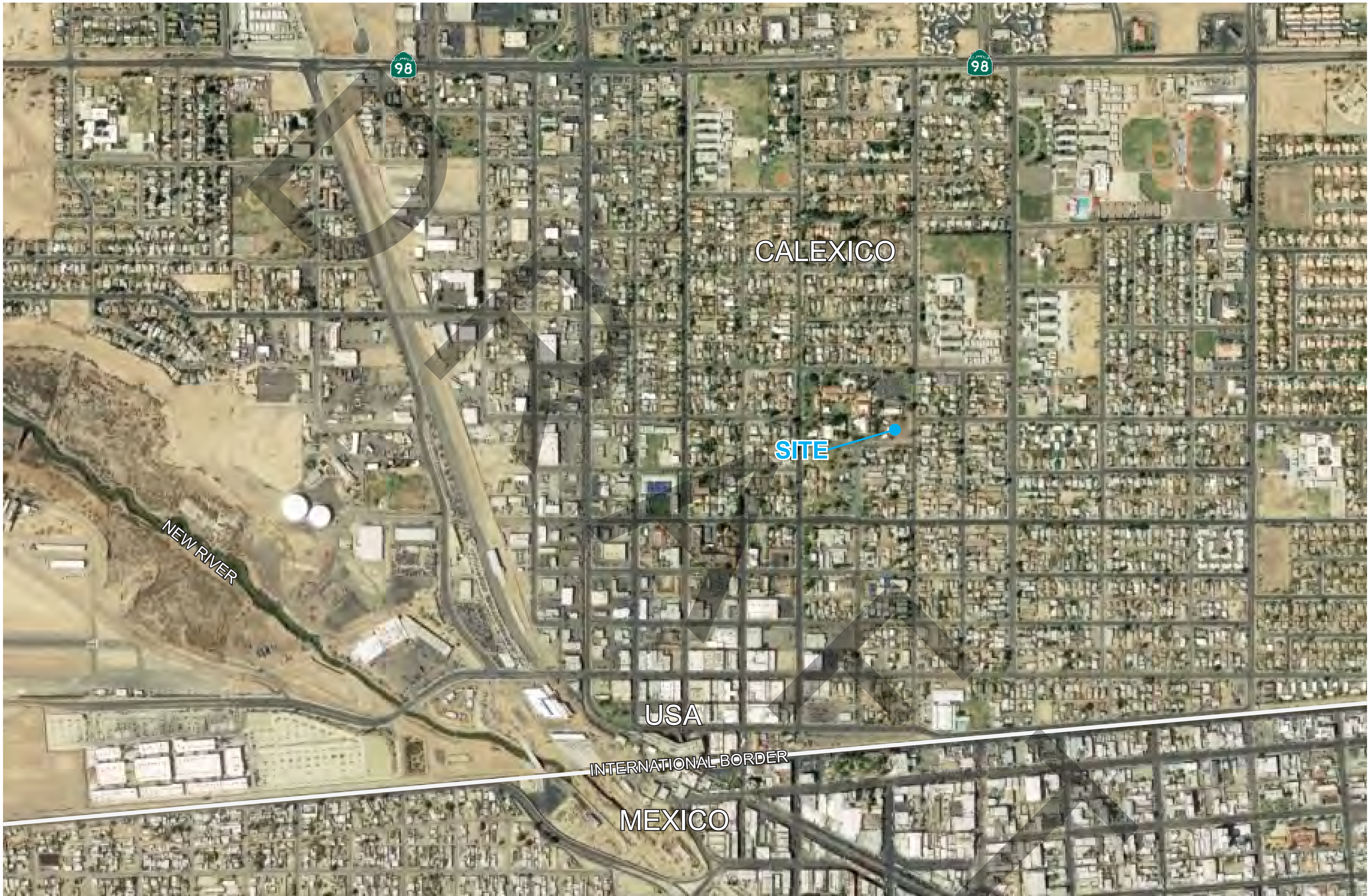

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NO SCALE

PROJECT NAME	FIGURE NAME	GROUP DELTA	
SDSU IMPERIAL VALLEY CAMPUS NEW RESIDENCE HALL CALEXICO, CALIFORNIA	**SITE LOCATION**	PROJECT NUMBER SD732	FIGURE NUMBER **1**

REFERENCE: GOOGLE EARTH PRO 7.3.4.8248. IMAGERY DATE APRIL 4, 2018.

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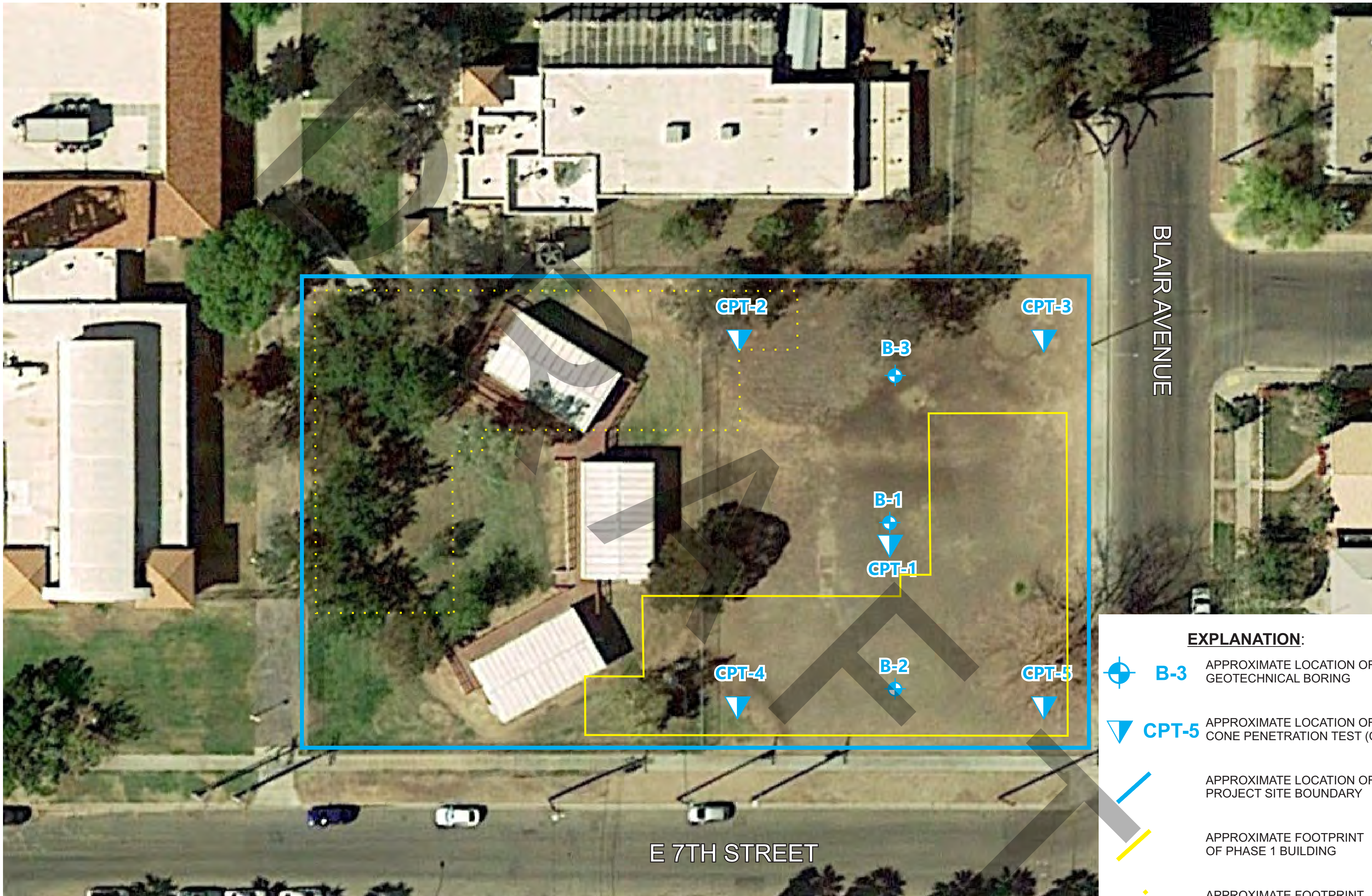
NO SCALE

PROJECT NAME	FIGURE NAME	GROUP DELTA	
SDSU IMPERIAL VALLEY CAMPUS NEW RESIDENCE HALL CALEXICO, CALIFORNIA	**SITE VICINITY**	PROJECT NUMBER SD732	FIGURE NUMBER **2**

REFERENCE: GOOGLE EARTH PRO 7.3.4.8248. IMAGERY DATE APRIL 4, 2018



EXPLANATION:

B-3	APPROXIMATE LOCATION OF GEOTECHNICAL BORING
CPT-5	APPROXIMATE LOCATION OF CONE PENETRATION TEST (CPT)
	APPROXIMATE LOCATION OF PROJECT SITE BOUNDARY
	APPROXIMATE FOOTPRINT OF PHASE 1 BUILDING
	APPROXIMATE FOOTPRINT OF PHASE 2 BUILDING

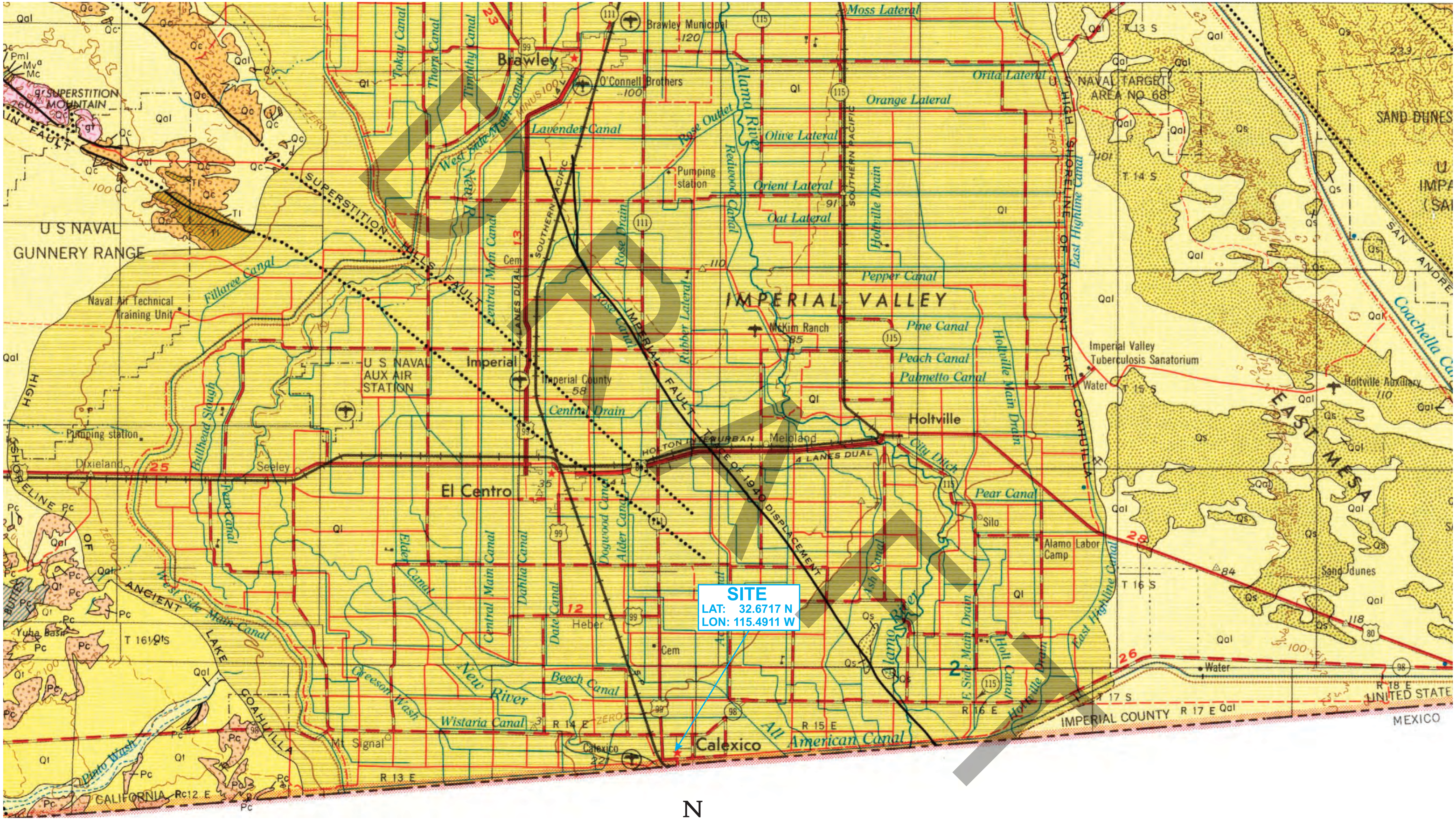
APPROXIMATE SCALE IN FEET

0 25 50

N

PROJECT NAME	FIGURE NAME	GROUP DELTA	
SDSU IMPERIAL VALLEY CAMPUS NEW RESIDENCE HALL CALEXICO, CALIFORNIA	**EXPLORATION LOCATIONS**	PROJECT NUMBER: SD732	FIGURE NUMBER: **3**

REFERENCE: GOOGLE EARTH PRO 7.3.4.8248. IMAGERY DATE AUGUST 1, 2021.



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NO SCALE

EXPLANATION:

Ql	Quaternary lake deposits
Qal	Alluvium
Qs	Dune sand
Qt	Quaternary nonmarine terrace deposits
Qc	Pleistocene nonmarine

PROJECT NAME	FIGURE NAME		
SDSU IMPERIAL VALLEY CAMPUS NEW RESIDENCE HALL CALEXICO, CALIFORNIA	REGIONAL GEOLOGY	GROUP DELTA	
		PROJECT NUMBER	FIGURE NUMBER
		SD732	4

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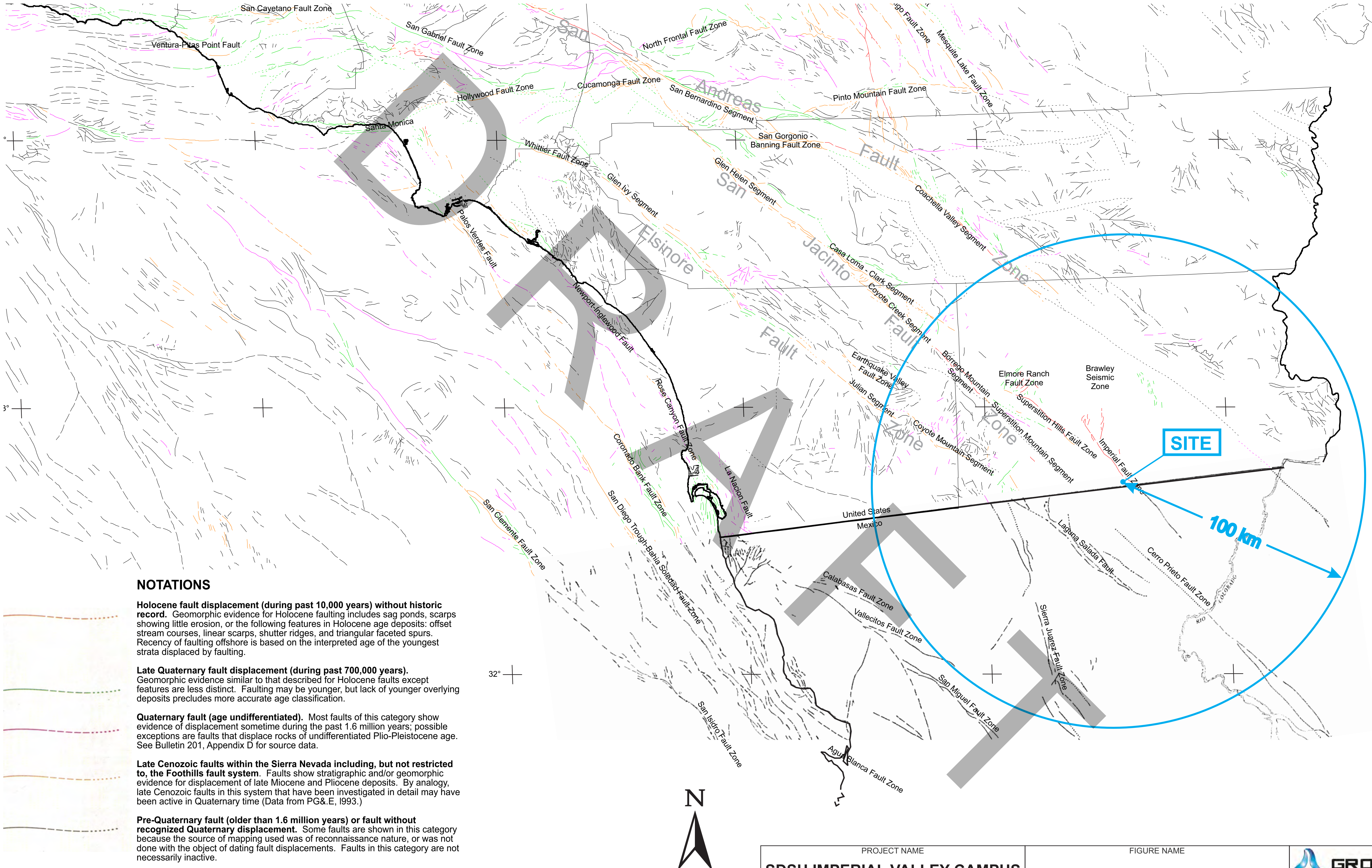

NOTATIONS

Holocene fault displacement (during past 10,000 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults that displace rocks of undifferentiated Plio-Pleistocene age. See Bulletin 201, Appendix D for source data.

Late Cenozoic faults within the Sierra Nevada including, but not restricted to, the Foothills fault system. Faults show stratigraphic and/or geomorphic evidence for displacement of late Miocene and Pliocene deposits. By analogy, late Cenozoic faults in this system that have been investigated in detail may have been active in Quaternary time (Data from PG&E, l993.)

Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissance nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

PROJECT NAME	FIGURE NAME	GROUP DELTA	
SDSU IMPERIAL VALLEY CAMPUS NEW RESIDENCE HALL CALEXICO, CALIFORNIA	**REGIONAL FAULT LOCATIONS**	PROJECT NUMBER: SD732	FIGURE NUMBER: 5A

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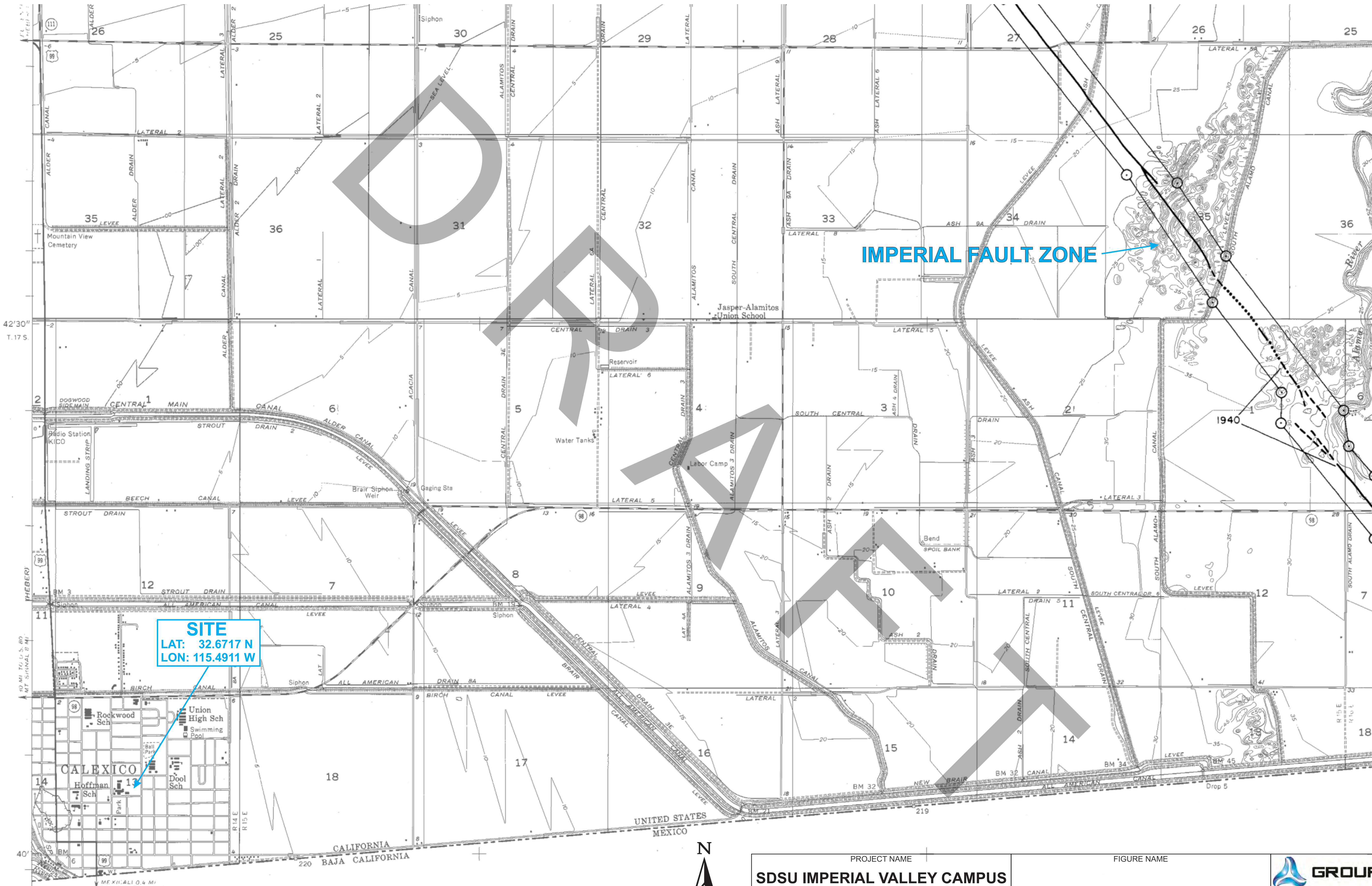

PROJECT NAME	FIGURE NAME	GROUP DELTA	
SDSU IMPERIAL VALLEY CAMPUS NEW RESIDENCE HALL CALEXICO, CALIFORNIA	LOCAL FAULT LOCATIONS	PROJECT NUMBER: SD732	FIGURE NUMBER: 5B

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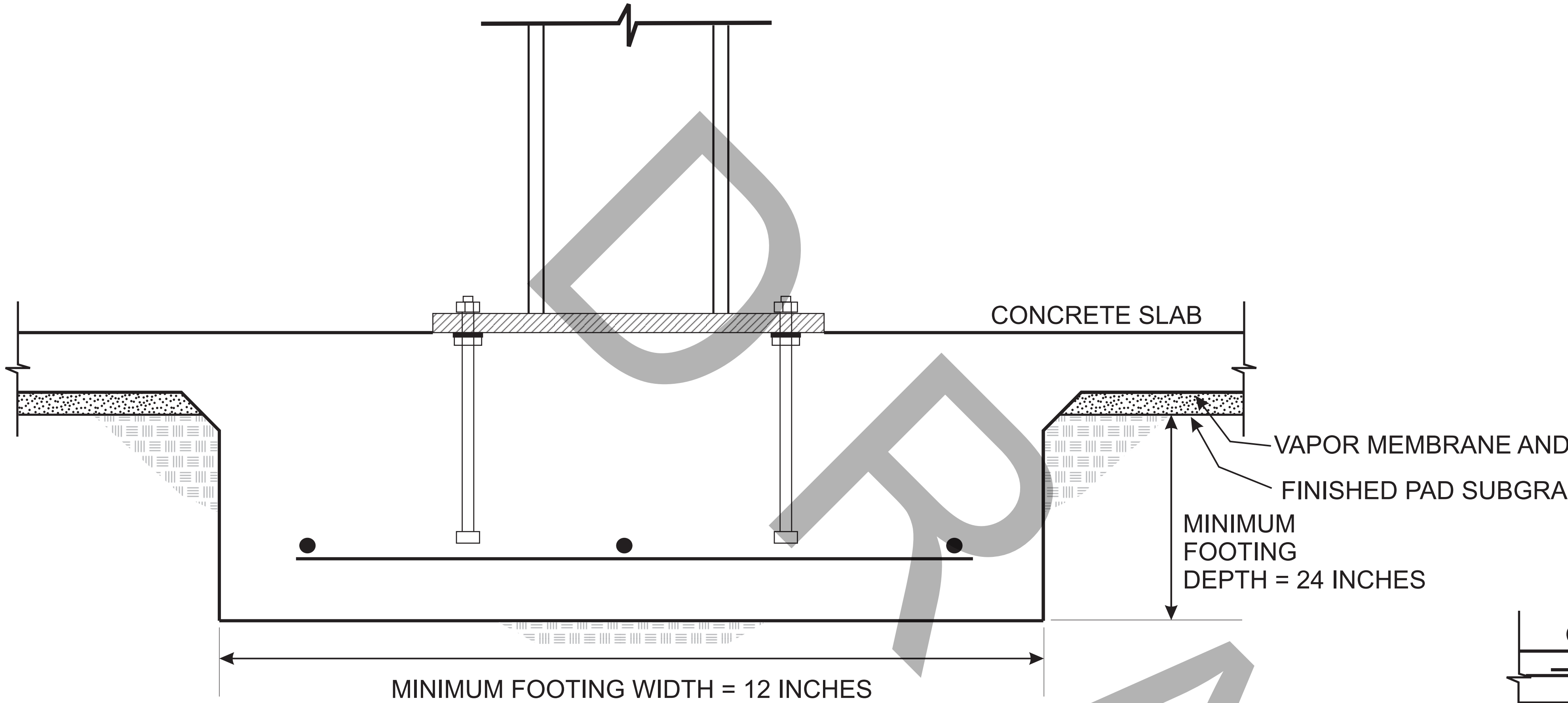
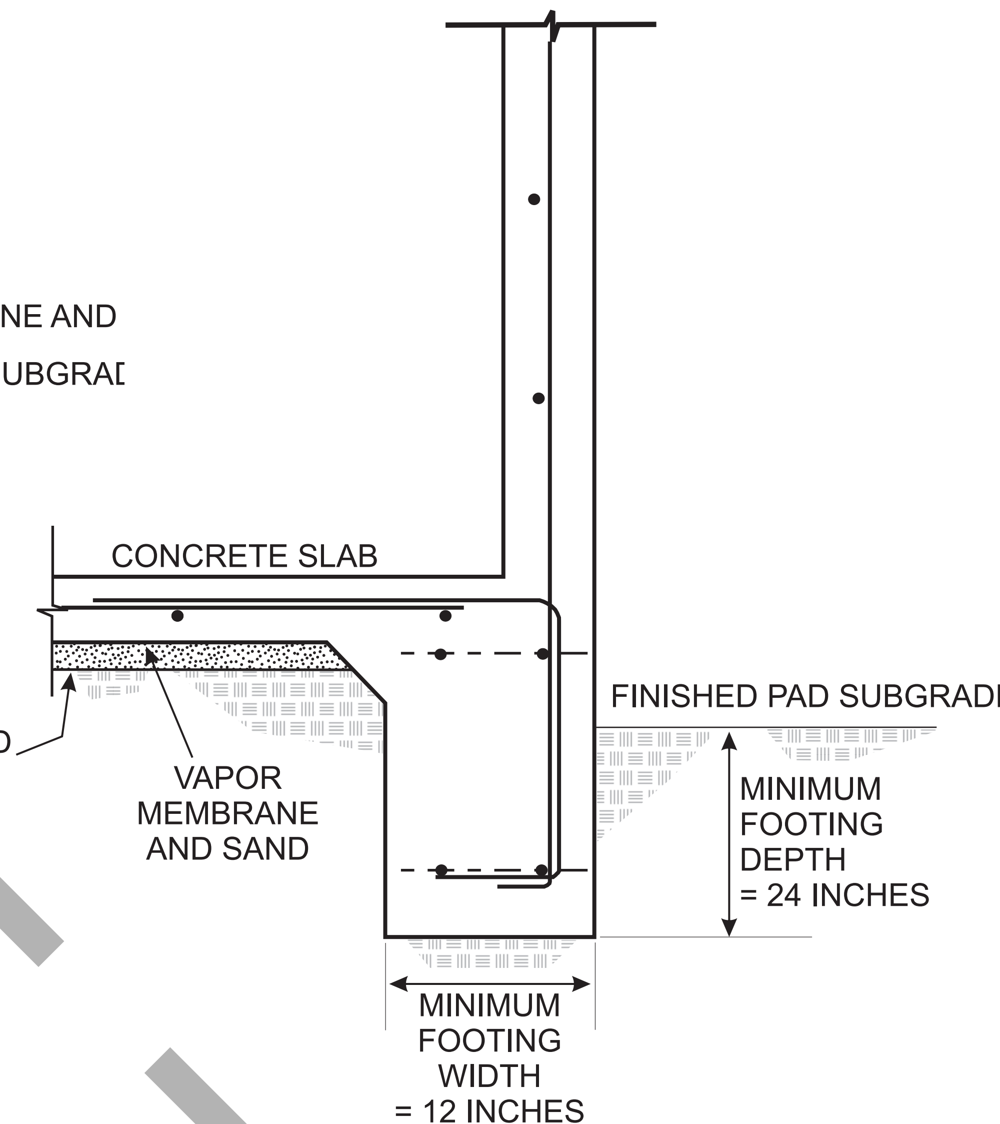
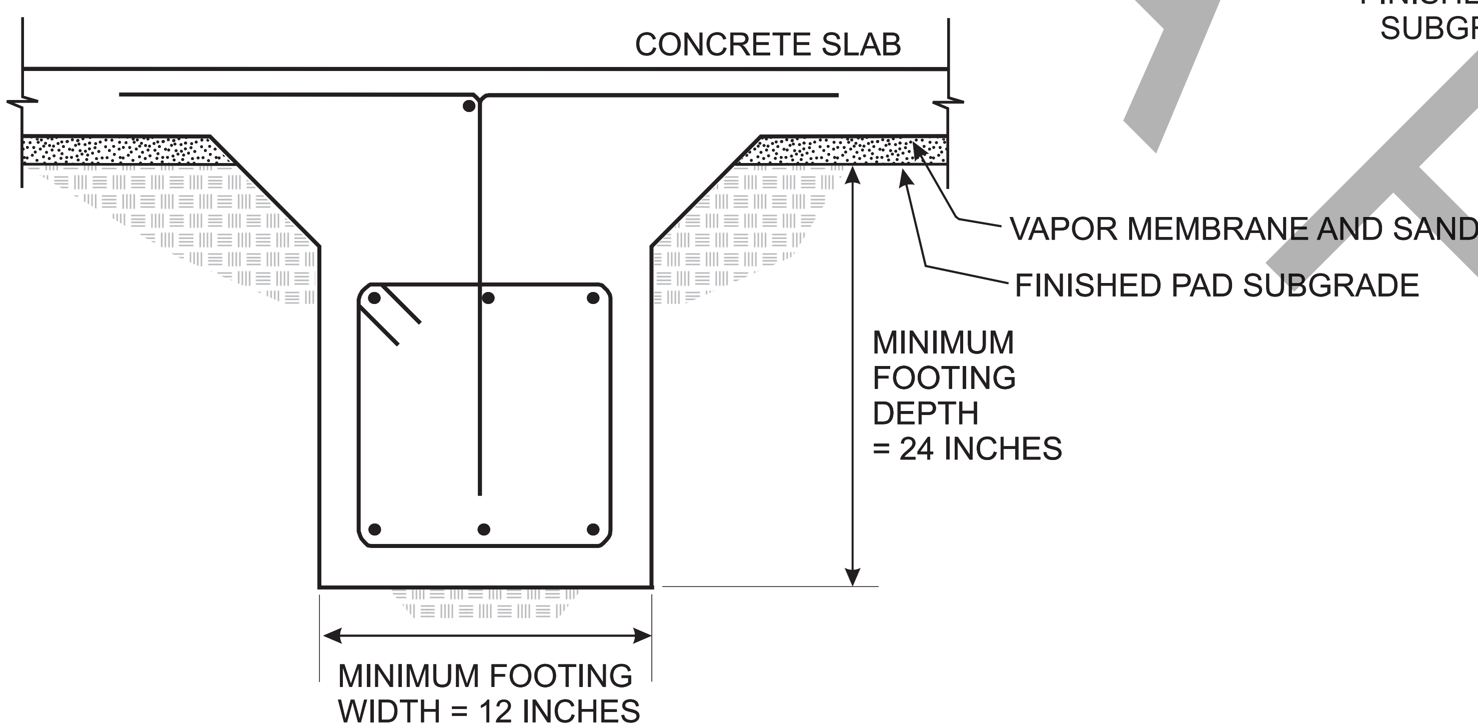


SQUARE FOOTING



EXTERIOR CONTINUOUS FOOTING



INTERIOR CONTINUOUS FOOTING

PROJECT NAME	FIGURE NAME	GROUP DELTA	
SDSU IMPERIAL VALLEY CAMPUS NEW RESIDENCE HALL CALEXICO, CALIFORNIA	SHALLOW FOUNDATION DETAILS	PROJECT NUMBER SD732	FIGURE NUMBER 6

APPENDIX A
EXPLORATION RECORDS

APPENDIX A

EXPLORATION RECORDS

Field exploration included a visual reconnaissance of the site, the drilling of three (3) hollow stem auger geotechnical borings, and the advancement of five (5) cone penetration tests (CPTs) between May 31st and June 1st, 2022. The maximum depth of exploration was approximately 100 feet below ground surface (bgs). The approximate exploration locations are shown on Figure 3. Logs of the explorations are provided in Figures A-1 through A-3, immediately after the Boring Record Legends.

HOLLOW STEM BORINGS

The hollow stem borings were advanced on June 1st, 2022, by Tri-County Drilling using a Diedrich D-120 truck mounted drill rig. Disturbed samples were collected from the borings using a 2-inch outside diameter unlined Standard Penetration Test (SPT) sampler and less disturbed samples were collected using a 3-inch outside diameter ring lined modified California sampler. Bulk samples of surficial soils were also collected from auger cuttings. The samples were sealed in plastic bags, labeled, and returned to the laboratory for testing.

The drive samples were collected from the exploratory borings using an automatic hammer with average Energy Transfer Ratio (ETR) of approximately 86 percent. For each sample, the 6-inch incremental blow-counts were recorded on the logs. The field blow counts (N) were normalized to approximate the standard 60 percent ETR, as shown on the logs (N_{60}). The modified California ring samples were also corrected for the 3-inch sampler diameter using Burmister's correction factor. The exploratory borings were logged using the Caltrans Soil and Rock Logging, Classification and Presentation Manual (2010) as a guideline.

CONE PENETRATION TESTS

The CPT soundings were advanced by Kehoe Testing and Engineering on May 31st, 2022, in general accordance with ASTM D5778. The CPT soundings were carried out using an integrated electronic cone system manufactured by Vertek. The CPTs were advanced using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (q_c);
- Sleeve Friction (f_s);
- Dynamic Pore Pressure (u);
- Inclination; and
- Penetration Speed.

APPENDIX A

EXPLORATION RECORDS

At location CPT-1, shear wave velocity measurements were obtained at five foot intervals to a depth of approximately 100 feet. The shear wave was generated using an air-actuated hammer placed under the CPT rig at a specified offset distance from the rods. The cone was equipped with a triaxial geophone, which recorded the shear wave signal generated by the air hammer. The above parameters were recorded and viewed in real time using a laptop computer. A summary of the collected shear wave measurements is presented in Figure A-9.

The lines designating the interface between differing soil materials on the logs may be abrupt or gradational, and soil conditions at locations between the explorations may be substantially different from those at the specific locations we explored. It should be noted that the passage of time may also result in changes in the soil conditions reported in the logs.

The exploration locations were determined by taping or pacing distances from landmarks shown on Figure 3. The locations shown should not be considered more accurate than is implied by the method of measurement used and the scale of the figure. Approximate existing elevations at the boring locations were estimated using Google Earth Pro 2021.

SOIL IDENTIFICATION AND DESCRIPTION SEQUENCE

Sequence	Identification Components	Refer to Section: Field	Refer to Section: Lab	Required	Optional
1	Group Name	2.5.2	3.2.2	●	
2	Group Symbol	2.5.2	3.2.2	●	
	Description Components				
3	Consistency of Cohesive Soil	2.5.3	3.2.3	●	
4	Apparent Density of Cohesionless Soil	2.5.4		●	
5	Color	2.5.5		●	
6	Moisture	2.5.6		●	
7	Percent or Proportion of Soil	2.5.7	3.2.4	●	⬬
	Particle Size	2.5.8	2.5.8	●	⬬
	Particle Angularity	2.5.9			○
	Particle Shape	2.5.10			○
8	Plasticity (for fine-grained soil)	2.5.11	3.2.5		○
9	Dry Strength (for fine-grained soil)	2.5.12			○
10	Dilatency (for fine-grained soil)	2.5.13			○
11	Toughness (for fine-grained soil)	2.5.14			○
12	Structure	2.5.15			○
13	Cementation	2.5.16		●	
14	Percent of Cobbles and Boulders	2.5.17		●	
	Description of Cobbles and Boulders	2.5.18		●	
15	Consistency Field Test Result	2.5.3		●	
16	Additional Comments	2.5.19			○

Describe the soil using descriptive terms in the order shown

Minimum Required Sequence:

USCS Group Name (Group Symbol); Consistency or Density; Color; Moisture; Percent or Proportion of Soil; Particle Size; Plasticity (optional).

⬬ = optional for non-Caltrans projects

Where applicable:

Cementation; % cobbles & boulders; Description of cobbles & boulders; Consistency field test result

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

HOLE IDENTIFICATION

Holes are identified using the following convention:

H – YY – NNN

Where:

H: Hole Type Code

YY: 2-digit year

NNN: 3-digit number (001-999)

Hole Type Code and Description

Hole Type Code	Description
A	Auger boring (hollow or solid stem, bucket)
R	Rotary drilled boring (conventional)
RC	Rotary core (self-cased wire-line, continuously-sampled)
RW	Rotary core (self-cased wire-line, not continuously sampled)
P	Rotary percussion boring (Air)
HD	Hand driven (1-inch soil tube)
HA	Hand auger
D	Driven (dynamic cone penetrometer)
CPT	Cone Penetration Test
O	Other (note on LOTB)

Description Sequence Examples:

SANDY lean CLAY (CL); very stiff; yellowish brown; moist; mostly fines; some SAND, from fine to medium; few gravels; medium plasticity; PP=2.75.

Well-graded SAND with SILT and GRAVEL and COBBLES (SW-SM); dense; brown; moist; mostly SAND, from fine to coarse; some fine GRAVEL; few fines; weak cementation; 10% GRANITE COBBLES; 3 to 6 inches; hard; subrounded.

Clayey SAND (SC); medium dense, light brown; wet; mostly fine sand,; little fines; low plasticity.

GROUP DELTA

PROJECT NO. SD732

SDSU IVC NEW RESIDENCE HALL
CALEXICO, CALIFORNIA

BORING RECORD LEGEND #1

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 5333)
CP	Compaction Curve (CTM 216)
CR	Corrosion, Sulfates, Chlorides (CTM 643; CTM 417; CTM 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeability (CTM 220)
PA	Particle Size Analysis (ASTM D 422)
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89, AASHTO T 90)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
R	R-Value (CTM 301)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T 100)
SL	Shrinkage Limit (ASTM D 427)
SW	Swell Potential (ASTM D 4546)
UC	Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 2938)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 2937)
WA	Percent passing the No. 200 Sieve (ASTM D 1140)

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler (2.4" ID, 3" OD)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (after drilling, date)

Definitions for Change in Material

Term	Definition	Symbol
Material Change	Change in material is observed in the sample or core and the location of change can be accurately located.	
Estimated Material Change	Change in material cannot be accurately located either because the change is gradational or because of limitations of the drilling and sampling methods.	
Soil / Rock Boundary	Material changes from soil characteristics to rock characteristics.	

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

GROUP DELTA

PROJECT NO. SD732

SDSU IVC NEW RESIDENCE HALL
CALEXICO, CALIFORNIA

BORING RECORD LEGEND #2

CONSISTENCY OF COHESIVE SOILS				
Description	Shear Strength (tsf)	Pocket Penetrometer, PP Measurement (tsf)	Torvane, TV, Measurement (tsf)	Vane Shear, VS, Measurement (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 - 0.25	0.25 - 0.5	0.12 - 0.25	0.12 - 0.25
Medium Stiff	0.25 - 0.5	0.5 - 1	0.25 - 0.5	0.25 - 0.5
Stiff	0.5 - 1	1 - 2	0.5 - 1	0.5 - 1
Very Stiff	1 - 2	2 - 4	1 - 2	1 - 2
Hard	Greater than 2	Greater than 4	Greater than 2	Greater than 2

APPARENT DENSITY OF COHESIONLESS SOILS	
Description	SPT N_{60} (blows / 12 inches)
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Greater than 50

MOISTURE	
Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS	
Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 - 10%
Little	15 - 25%
Some	30 - 45%
Mostly	50 - 100%

PARTICLE SIZE		
Description		Size (in)
Boulder		Greater than 12
Cobble		3 - 12
Gravel	Coarse	3/4 - 3
	Fine	1/5 - 3/4
Sand	Coarse	1/16 - 1/5
	Medium	1/64 - 1/16
	Fine	1/300 - 1/64
Silt and Clay		Less than 1/300

CEMENTATION	
Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Plasticity

Description	Criteria
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), with the exception of consistency of cohesive soils vs. N_{60}.

CONSISTENCY OF COHESIVE SOILS	
Description	SPT N_{60} (blows/12 inches)
Very Soft	0 - 2
Soft	2 - 4
Medium Stiff	4 - 8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	Greater than 30

Ref: Peck, Hansen, and Thornburn, 1974, "Foundation Engineering," Second Edition.

Note: Only to be used (with caution) when pocket penetrometer or other data on undrained shear strength are unavailable. Not allowed by Caltrans Soil and Rock Logging and Classification Manual, 2010.

GROUP DELTA

PROJECT NO. SD732

SDSU IVC NEW RESIDENCE HALL
CALEXICO, CALIFORNIA

BORING RECORD LEGEND #3

BORING RECORD

PROJECT NAME	PROJECT NUMBER	BORING
SDSU IVC Student Residence Hall	SD732	**B-1**

SITE LOCATION	START	FINISH	SHEET NO.
720 Heber Avenue, Calexico, CA	6/1/2022	6/1/2022	1 of 3

DRILLING COMPANY	DRILLING METHOD	LOGGED BY	CHECKED BY
Tri-County Drilling Inc.	Hollow Stem Auger	C. Vonk	S. Narveson

DRILLING EQUIPMENT	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GROUNDWATER (ft)
Diedrich D-120	8	51.5	4	▼ 28.0 / *-24.0*

SAMPLING METHOD	NOTES
Hammer: 140 lbs., Drop: 30 in. (Automatic)	ETR ~ 86%, N_{60} ~ $1.43 * N_{SPT}$ ~ $0.96 * N_{MC}$

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
												Grass and Organics
			B1				21.7		EI PA PI			**FILL:** Lean CLAY (CL); brown; moist; mostly fines; few to little SAND; medium plasticity. 13% Sand, 87% Fines LL=46, PL=20, PI=26; EI = 70
	0											**LACUSTRINE DEPOSITS (Ql):** Fat CLAY (CH); brown; moist; mostly fines; trace SAND; high plasticity. 4% Sand, 96% Fines LL=65, PL=23, PI=42 Hard; minor caliche cementation; trace organics. PP>4.5 tsf
5			S2	3 8 13	21	30			PA PI			
	-5											
10			R3-1 R3-2	8 19 24	43	41	16.1	108	PA PI			No sand. 100% Fines LL=70, PL=25, PI=45 PP>4.5 tsf
	-10											SILTY SAND (SM); medium dense; light grayish brown; moist; mostly fine SAND; some fines; non-plastic. 63% Sand, 37% Fines
15			S4-1 S4-2	3 2 7	9	13	6.0		PA			SILT with SAND (ML); medium dense; brown; moist; mostly fines; little fine SAND; low plasticity.
	-15											Fat CLAY (CH); very stiff; brown; moist; mostly fines; trace fine SAND; high plasticity. PP=2.25 tsf
20			R5	4 7 12	19	18	32.9	89	C			
	-20											

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San Diego, California 92126

FIGURE A-1 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	BORING
SDSU IVC Student Residence Hall	SD732	**B-1**

SITE LOCATION	START	FINISH	SHEET NO.
720 Heber Avenue, Calexico, CA	6/1/2022	6/1/2022	2 of 3

DRILLING COMPANY	DRILLING METHOD	LOGGED BY	CHECKED BY
Tri-County Drilling Inc.	Hollow Stem Auger	C. Vonk	S. Narveson

DRILLING EQUIPMENT	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GROUNDWATER (ft)
Diedrich D-120	8	51.5	4	▼ 28.0 / *-24.0*

SAMPLING METHOD	NOTES
Hammer: 140 lbs., Drop: 30 in. (Automatic)	ETR ~ 86%, N_{60} ~ 1.43*N_{SPT} ~ 0.96*N_{MC}

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S6-1 S6-2	2 3 5	8	11	28.7		PI WA			**LACUSTRINE DEPOSITS (Ql): continued** Fat CLAY (CH) *(see previous page for full description):* Stiff to very stiff. PP=1.0 tsf
											▼	SILT (ML); loose to medium dense; brown; moist to wet; mostly fines; few fine SAND; non-plastic. 94% Fines. LL=NP, PL=NP, PI=NP
	-25											
30			R7-1 R7-2	3 5 8	13	12	31.6	92	C PI			Lean CLAY (CL); stiff; brown; moist; mostly fines; few fine SAND; medium plasticity. LL=40, PL=21, PI=19 PP=1.5 tsf
	-30											
35			R8-1 R8-2	6 16 23	39	37	27.9	97	C PI WA			Fat CLAY (CH); hard; brown; moist; mostly fines; high plasticity. 100% Fines LL=69, PL=22, PI=47 PP>4.5 tsf
	-35											
40			S9	6 11 15	26	37	25.4					PP>4.5 tsf
	-40											
45			R10-1 R10-2	5 7 8	15	14	32.0	91				Very stiff. PP=2.5 tsf
	-45											

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-1 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	BORING
SDSU IVC Student Residence Hall	SD732	**B-1**

SITE LOCATION	START	FINISH	SHEET NO.
720 Heber Avenue, Calexico, CA	6/1/2022	6/1/2022	3 of 3

DRILLING COMPANY	DRILLING METHOD	LOGGED BY	CHECKED BY
Tri-County Drilling Inc.	Hollow Stem Auger	C. Vonk	S. Narveson

DRILLING EQUIPMENT	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GROUNDWATER (ft)
Diedrich D-120	8	51.5	4	▼ 28.0 / *-24.0*

SAMPLING METHOD	NOTES
Hammer: 140 lbs., Drop: 30 in. (Automatic)	ETR ~ 86%, N_{60} ~ 1.43*N_{SPT} ~ 0.96*N_{MC}

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S11	8 4 10	14	20	28.3		WA			**LACUSTRINE DEPOSITS (Ql): continued** SILT (ML); medium dense; brown; wet; mostly fines; few fine SAND; non-plastic; trace mica. 88% Fines
	-50											Total Depth = 51.5 feet (target depth reached). Groundwater measured at 28.0 feet after drilling. Boring backfilled on 6/1/2022 shortly after drilling. This Boring Record is part of a geotechnical report which must be considered in its entirety.
55												
	-55											
60												
	-60											
65												
	-65											
70												
	-70											

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE

A-1 c

BORING RECORD

PROJECT NAME	PROJECT NUMBER	BORING
SDSU IVC Student Residence Hall	SD732	**B-2**

SITE LOCATION	START	FINISH	SHEET NO.
720 Heber Avenue, Calexico, CA	6/1/2022	6/1/2022	1 of 1

DRILLING COMPANY	DRILLING METHOD	LOGGED BY	CHECKED BY
Tri-County Drilling Inc.	Hollow Stem Auger	C. Vonk	S. Narveson

DRILLING EQUIPMENT	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GROUNDWATER (ft)
Diedrich D-120	8	21.5	5	▼ NE / *na*

SAMPLING METHOD	NOTES
Hammer: 140 lbs., Drop: 30 in. (Automatic)	ETR ~ 86%, N_{60} ~ 1.43*N_{SPT} ~ 0.96*N_{MC}

DEPTH (feet)	ELEVATION (feet)	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
0	5								Grass and Organics
									FILL: Lean CLAY (CL); brown; moist; mostly fines; few fine SAND; medium plasticity; scattered organics (rootlets). EI = 60
		B1				18.3		EI CR	**LACUSTRINE DEPOSITS (Ql):** Fat CLAY (CH); hard; brown; moist; mostly fines; few fine SAND; high plasticity; trace organics. PP>4.5 tsf
5	0	R2-1 R2-2	11 13 22	35	34	20.4	93		
10	-5	R3	8 19 33	52	50	24.4	101	SW	Brown to dark brown. PP>4.5 tsf
									Lean CLAY (CL); medium stiff; brown; moist; mostly fines; some fine SAND; medium plasticity. LL=31, PL=21, PI=10
15	-10	S4-1 S4-2	2 2 10	12	17	24.3		PI	
									Silty SAND (SM); medium dense; light grayish brown; moist; mostly fine SAND; little fines; non-plastic.
									Fat CLAY (CH); stiff to very stiff; dark brown; moist; mostly fines; trace fine SAND; high plasticity 1% Sand, 99% Fines PP=2.0 tsf; UC = 2.5 ksf
20	-15	R5-1 R5-2	4 7 13	20	19	29.2	93	PA UC	

Total Depth = 21.5 feet (target depth reached).
Groundwater not encountered during drilling.
Boring backfilled on 6/1/2022 shortly after drilling.
This Boring Record is part of a geotechnical report which must be considered in its entirety.
Boring caved to 16.5 feet upon extracting augers.

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9245 Activity Road, Suite 103
San Diego, California 92126

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

BORING RECORD

PROJECT NAME	PROJECT NUMBER	BORING
SDSU IVC Student Residence Hall	SD732	B-3

SITE LOCATION	START	FINISH	SHEET NO.
720 Heber Avenue, Calexico, CA	6/1/2022	6/1/2022	1 of 1

DRILLING COMPANY	DRILLING METHOD	LOGGED BY	CHECKED BY
Tri-County Drilling Inc.	Hollow Stem Auger	C. Vonk	S. Narveson

DRILLING EQUIPMENT	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GROUNDWATER (ft)
Diedrich D-120	8	21.5	5	▼ NE / *na*

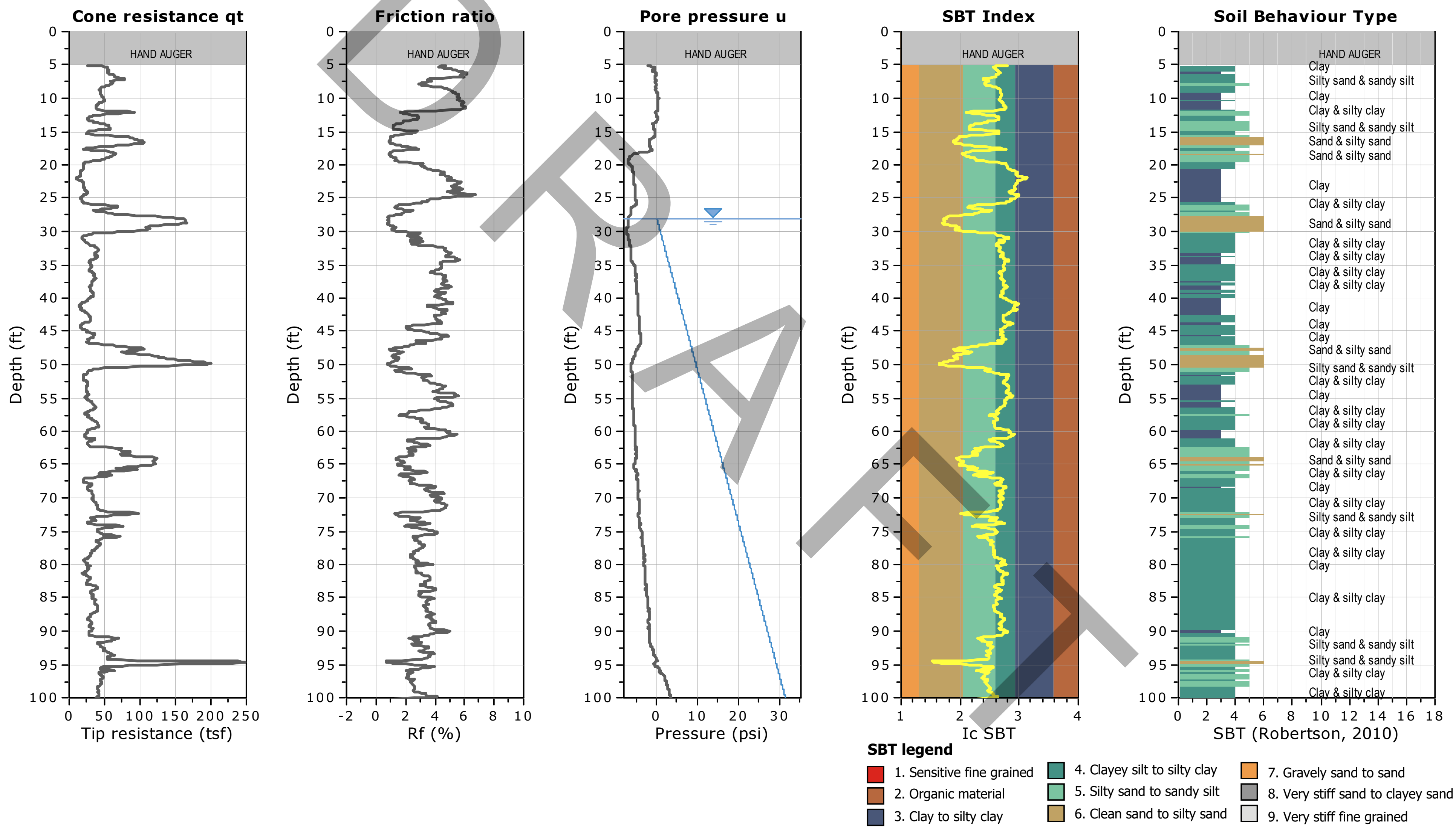
SAMPLING METHOD	NOTES
Hammer: 140 lbs., Drop: 30 in. (Automatic)	ETR ~ 86%, N_{60} ~ 1.43*N_{SPT} ~ 0.96*N_{MC}

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
												Grass and Organcis
			B1				21.5		CR EI PA			**FILL:** Lean CLAY (CL); brown; moist; mostly fines; few fine SAND; low to medium plasticity. 7% Sand, 93% Fines EI = 82
5	0		R2-1 R2-2	7 17 25	42	40	20.9	96	C SW			**LACUSTRINE DEPOSITS (Ql):** Fat CLAY (CH); brown; moist; mostly fines; few fine SAND; high plasticity. Hard. PP>4.5 tsf
10	-5		S3	6 14 20	34	49	19.8					PP>4.5 tsf
												SANDY SILT (ML); medium dense; brown; moist to wet; mostly fines; some fine SAND; low plasticity to non-plastic.
15	-10		R4-1 R4-2	3 11 19	30	29	11.7	99				Silty SAND (SM); medium dense; light grayish brown; moist; mostly fine SAND; little fines; non-plastic.
20	-15		S5	4 6 9	15	21			PI			Fat CLAY (CH); very stiff; brown; moist; mostly fines; trace fine SAND; high plasticity. LL=68, PL=23, PI=45 PP=2.5 tsf
												Total Depth = 21.5 feet (target depth reached). Groundwater not encountered during drilling. Boring backfilled on 6/1/2022 shortly after drilling. This Boring Record is part of a geotechnical report which must be considered in its entirety.

Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, CA
http://www.groupdelta.com

CPT: CPT-1
Total depth: 100.47 ft, Date: 5/31/2022
Surface Elevation: 4.00 ft

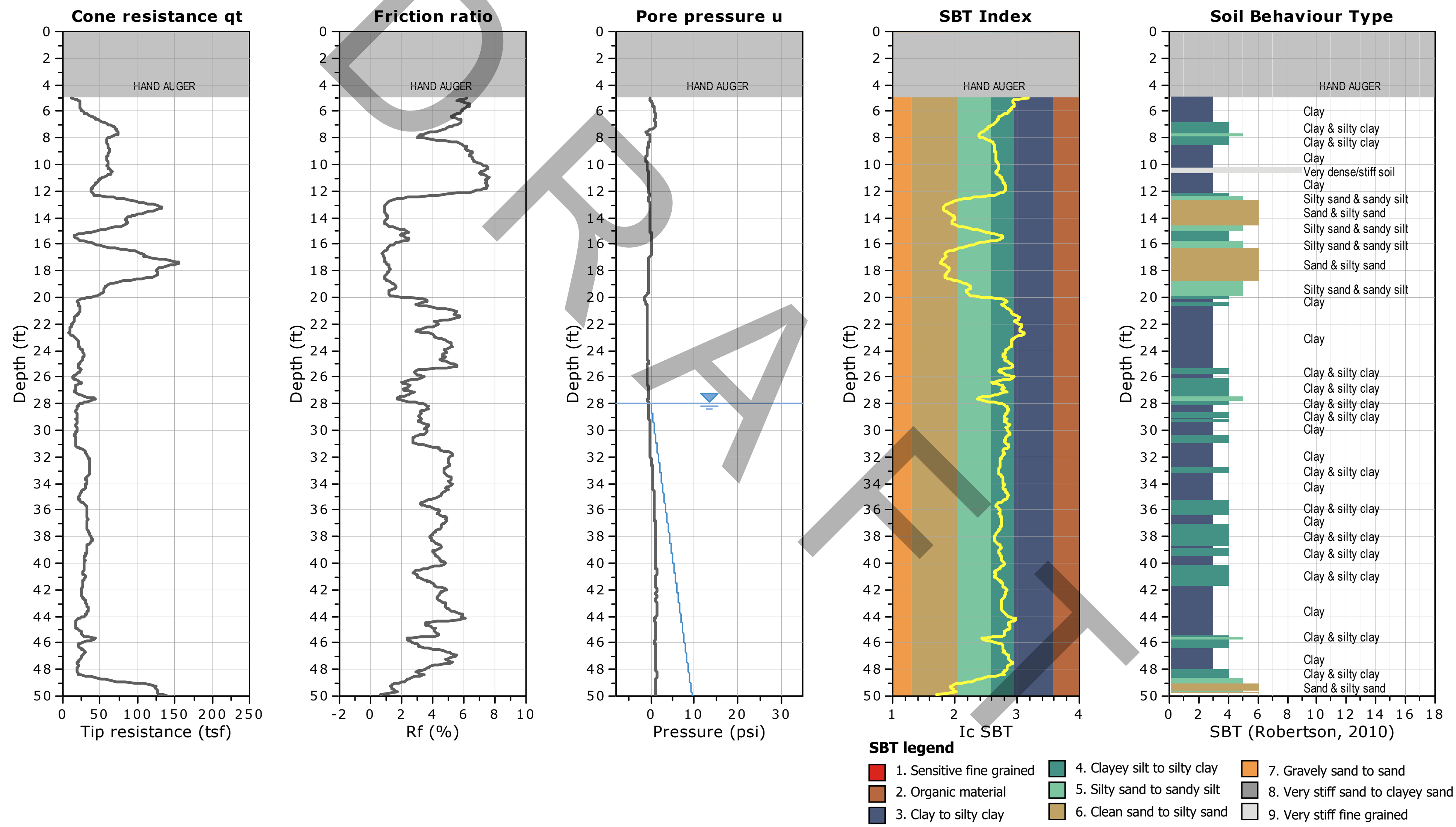
Project: **SD732 SDSU IVC New Residence Hall**
Location: **720 Heber Ave, Calexico, CA**



Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, CA
http://www.groupdelta.com

CPT: CPT-2
Total depth: 50.14 ft, Date: 5/31/2022
Surface Elevation: 6.00 ft

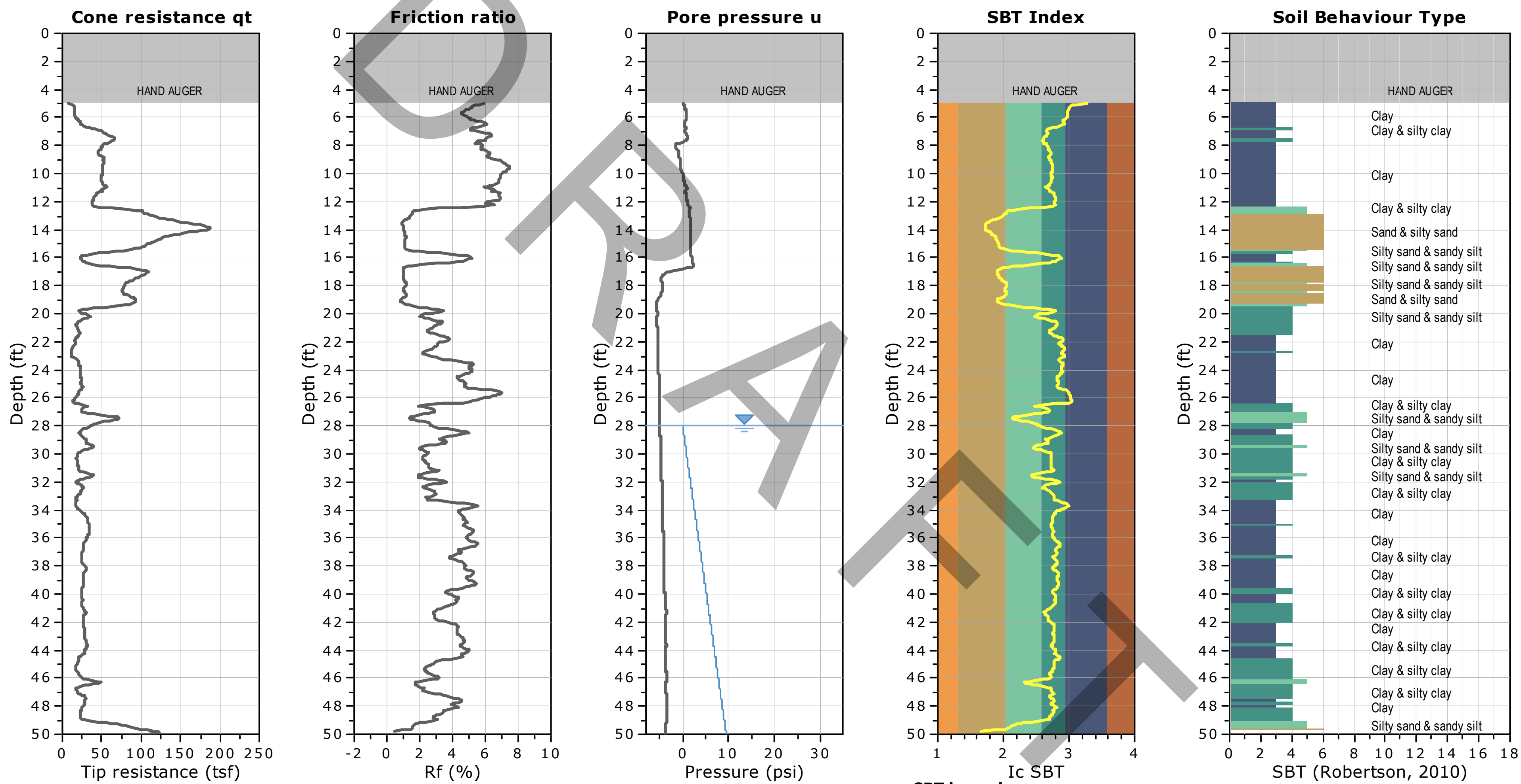
Project: SD732 SDSU IVC New Residence Hall
Location: 720 Heber Ave, Calexico, CA



Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, CA
http://www.groupdelta.com

CPT: CPT-3
Total depth: 50.13 ft, Date: 5/31/2022
Surface Elevation: 6.00 ft

Project: SD732 SDSU IVC New Residence Hall
Location: 720 Heber Ave, Calexico, CA



SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

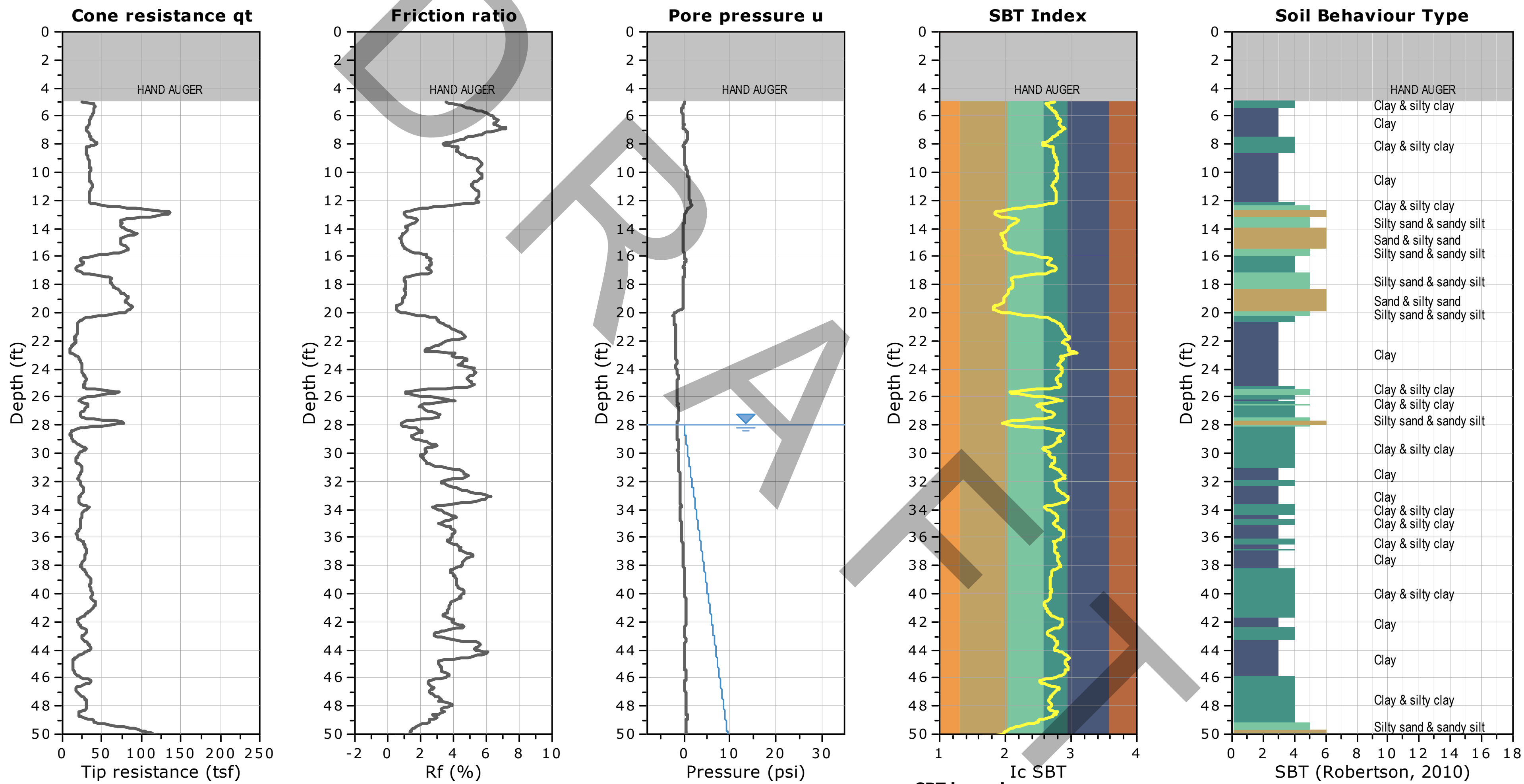
CPeT-IT v.3.5.2.2 - CPTU data presentation & interpretation software - Report created on: 6/10/2022, 10:42:26 AM
Project file: \\192.168.10.4\Files$\Projects\SD\SD700\SD732 SDSU Calexico Campus New Residence Hall\7. Calcs\CPeT-IT\SD732-CPeT-IT.cpt

FIGURE A-6

Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, CA
http://www.groupdelta.com

CPT: CPT-4
Total depth: 50.47 ft, Date: 5/31/2022
Surface Elevation: 5.00 ft

Project: **SD732 SDSU IVC New Residence Hall**
Location: **720 Heber Ave, Calexico, CA**



SBT legend

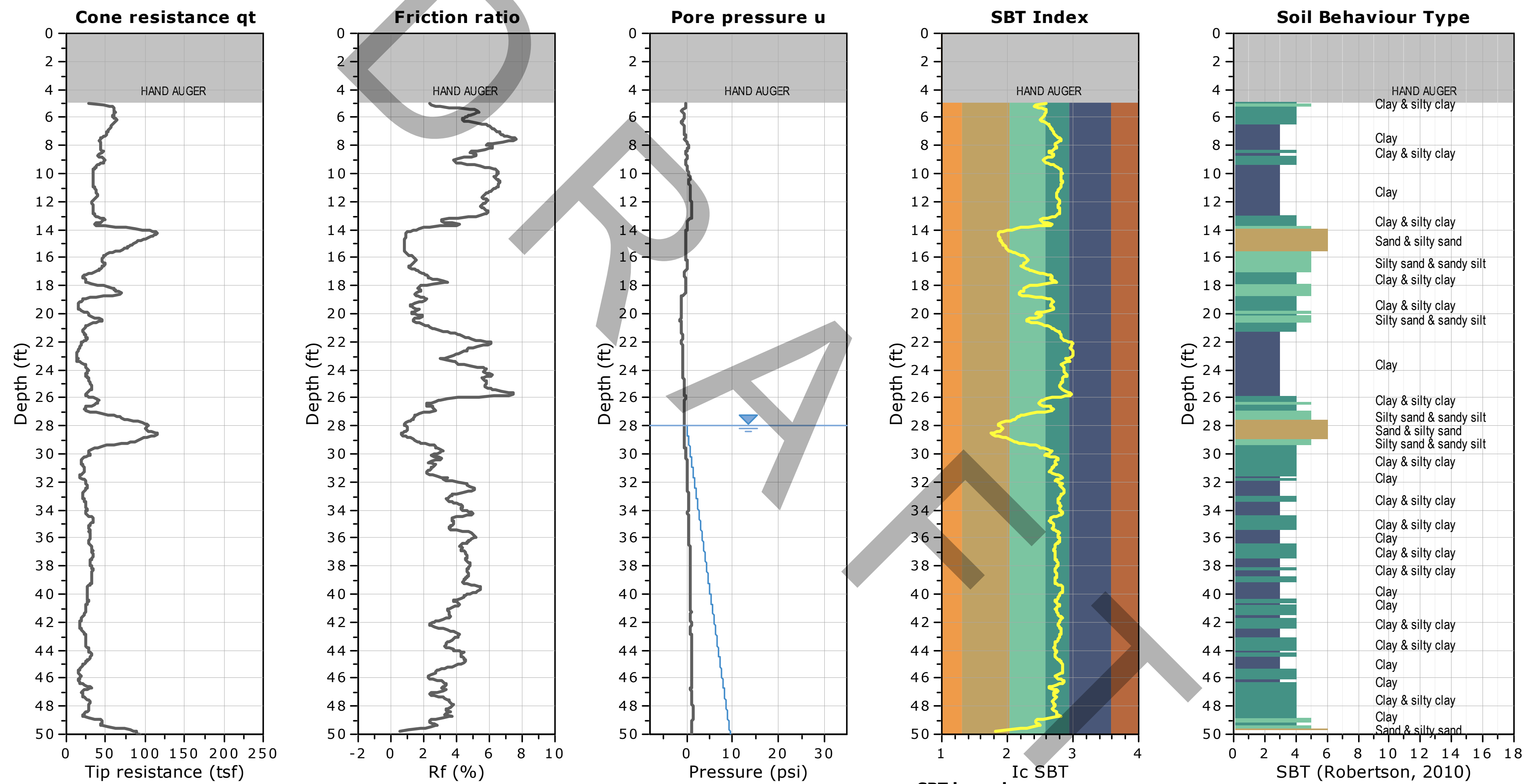
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

FIGURE A-7

Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, CA
http://www.groupdelta.com

CPT: CPT-5
Total depth: 50.09 ft, Date: 5/31/2022
Surface Elevation: 5.00 ft

Project: **SD732 SDSU IVC New Residence Hall**
Location: **720 Heber Ave, Calexico, CA**



SBT legend

1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

FIGURE A-8

Group Delta Consultants, Inc.
Project No. SD732

SDSU IVC Student Residence Hall
720 Heber Ave
Calexico, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-1	5.02	4.02	4.49	9.40	478	
	10.04	9.04	9.26	21.62	428	390
	15.06	14.06	14.20	31.16	456	518
	20.08	19.08	19.18	38.32	501	696
	25.03	24.03	24.11	46.68	517	590
	30.02	29.02	29.09	52.78	551	816
	35.04	34.04	34.10	58.76	580	838
	40.06	39.06	39.11	67.42	580	579
	45.08	44.08	44.13	75.14	587	650
	50.03	49.03	49.07	81.44	603	785
	55.18	54.18	54.22	89.08	609	674
	60.10	59.10	59.13	95.92	616	719
	65.06	64.06	64.09	102.36	626	770
	70.01	69.01	69.04	109.00	633	745
	75.10	74.10	74.13	115.20	643	821
	80.05	79.05	79.08	122.38	646	689
	85.07	84.07	84.09	128.04	657	887
	90.03	89.03	89.05	134.48	662	770
	95.01	94.01	94.03	140.04	671	895
	100.03	99.03	99.05	145.16	682	980

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

FIGURE A-9

APPENDIX B
LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

Laboratory testing was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions and in the same locality. No warranty, express or implied, is made as to the correctness or serviceability of the test results, or the conclusions derived from these tests. Where a specific laboratory test method has been referenced, such as ASTM or Caltrans, the reference only applies to the specified laboratory test method, which has been used only as a guidance document for the general performance of the test and not as a "Test Standard". A brief description of the tests follows.

Classification: Soils were visually classified according to the Unified Soil Classification System as established by the American Society of Civil Engineers per ASTM D2487. The soil classifications are shown on the Boring Records in Appendix A.

Particle Size Analysis: Particle size analyses were performed in general accordance with ASTM D6913, D7928 and D1140, and were used to supplement visual classifications. The test results are summarized on the Boring Records in Appendix A and are presented in detail in Figures B-1.1 through B-1.6 and B-2.

Atterberg Limits: ASTM D4318 was used to determine the liquid and plastic limits, and plasticity index of selected soil samples. The test results are presented with the associated gradation analyses in Figures B-1.1 through B-1.3 and are also summarized in Figure B-3.

Expansion Index: The expansion potential of selected soil samples was estimated in general accordance with ASTM D4829. The test results are summarized in Figure B-4, along with a summary of previous expansion index tests we conducted at the site. Figure B-4 also presents common criteria for evaluating the expansion potential based on the expansion index.

pH and Resistivity: To assess the potential for reactivity with buried metals, selected soil samples were tested for pH and minimum resistivity using Caltrans test method 643. The corrosivity test results are summarized in Figure B-5, along with previous corrosion tests we conducted on site.

Sulfate Content: To assess the potential for reactivity with concrete, selected soil samples were tested for water soluble sulfate. The sulfate was extracted from the soil under vacuum using a 10:1 (water to dry soil) dilution ratio. The extracted solution was tested for water soluble sulfate in general accordance with ASTM D516. The test results are also presented in Figure B-5, along with common criteria for evaluating soluble sulfate content.

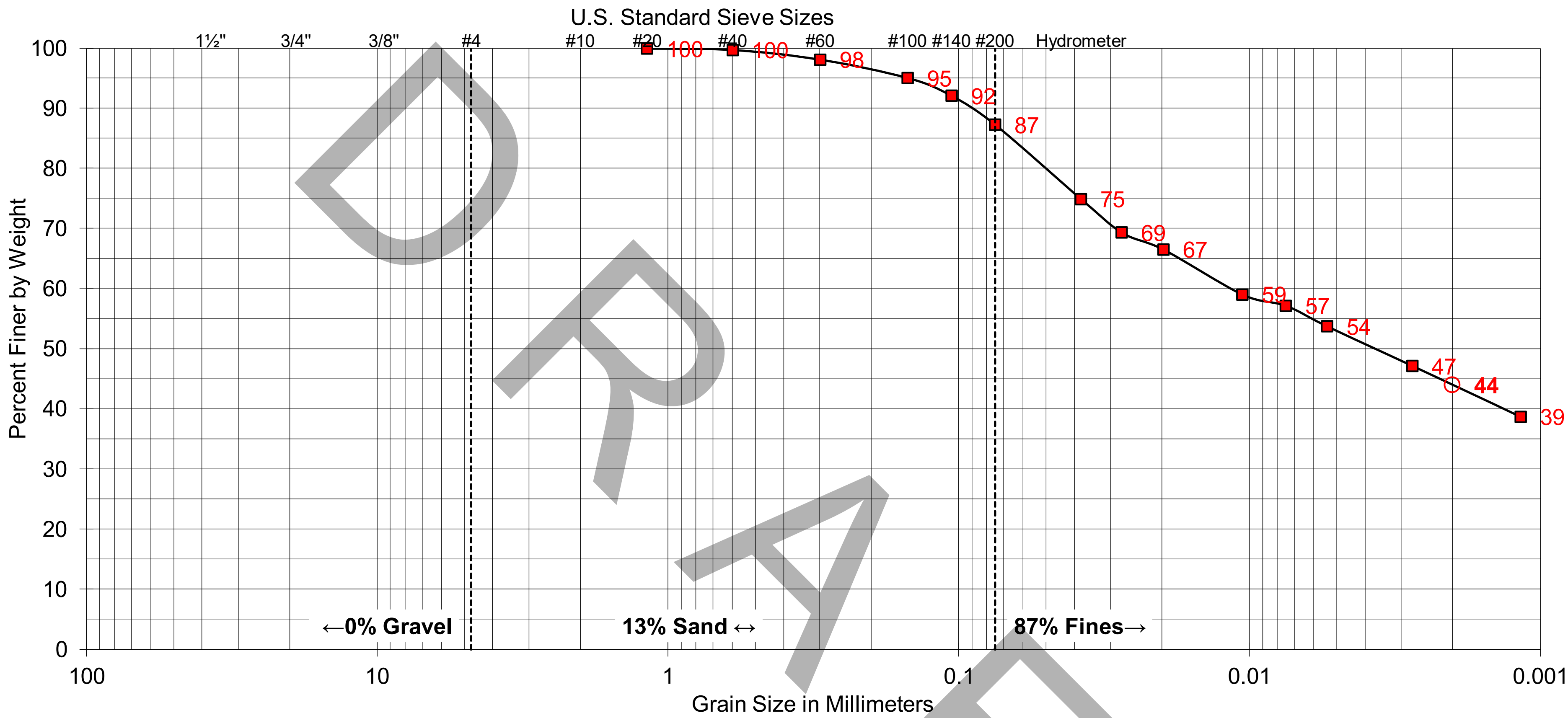
Chloride Content: Soil samples were also tested for water soluble chloride. The chloride was extracted from the soil under vacuum using a 10:1 (water to dry soil) dilution ratio. The extracted solution was then tested for water soluble chloride using a calibrated ion specific electronic probe in general accordance with ASTM D512. The test results are also shown in Figure B-5.

APPENDIX B

LABORATORY TESTING (Continued)

Unconfined Compressive Strength: The undrained shear strength of a selected soil sample was assessed using unconfined compression testing performed in general accordance with ASTM D2166. The test results are presented in Figure B-6. The Pocket Penetration tests conducted on clayey samples during the field investigation are shown in the Boring Records in Appendix A.

Consolidation: The one-dimensional consolidation properties of selected soil samples were evaluated in general accordance with ASTM D2435. With the exception of the sample R-2-2 collected from Boring B-3 from depths of 6 to 6.5 feet as shown on Figure B-7.5, the samples were inundated with water under a nominal seating load, allowed to swell, and then subjected to controlled stress increments while restrained laterally and drained axially. Sample R-2-2 collected from Boring B-3 from depths of 6 to 6.5 feet as shown on Figure B-7.5 was not inundated with water during testing to evaluate the samples strain behavior to the controlled stress increments in an unsaturated state. The test results are presented in Figure B-7.1 through B-7.6.



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	B-1
SAMPLE DEPTH:	0.5' - 5'

UNIFIED SOIL CLASSIFICATION: CL

DESCRIPTION: LEAN CLAY

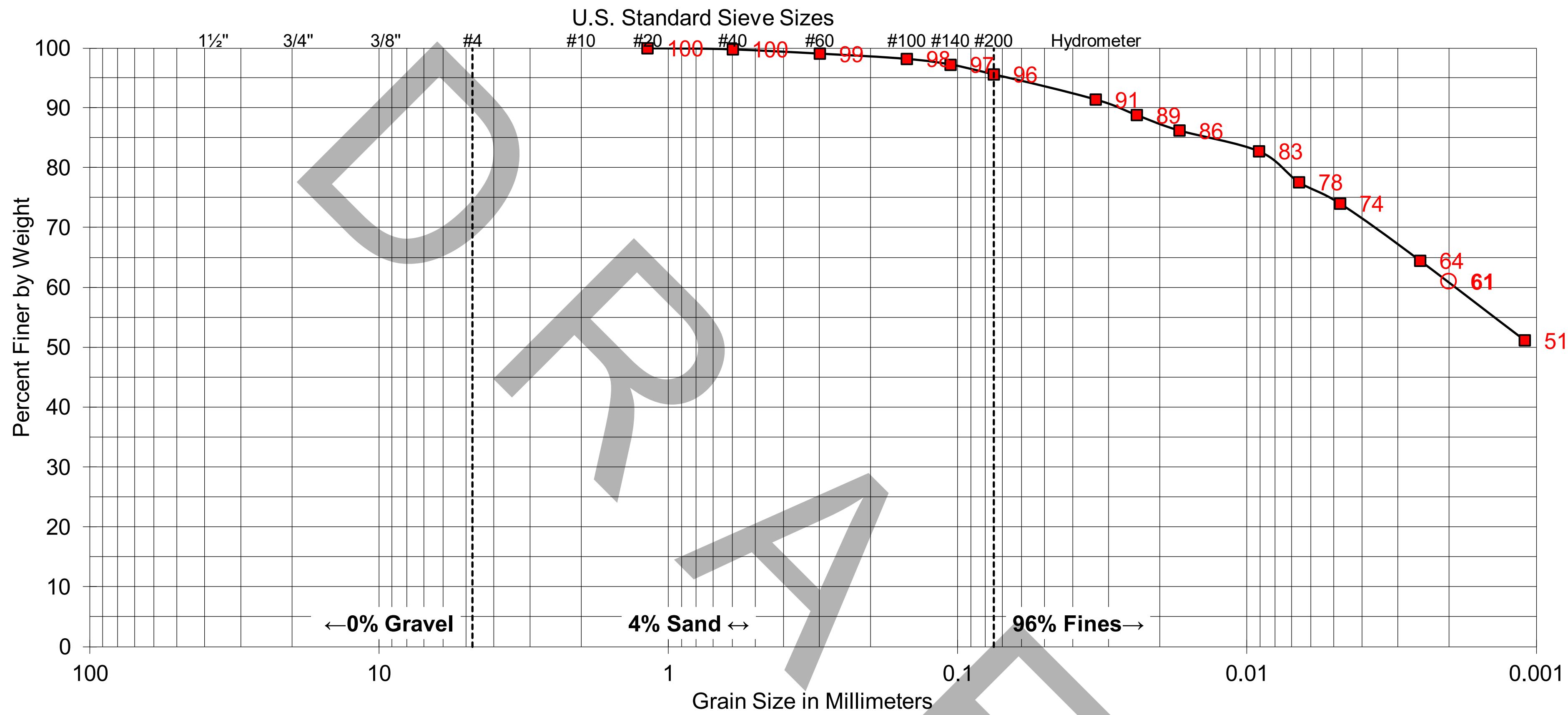
ATTERBERG LIMITS	
LIQUID LIMIT:	46
PLASTIC LIMIT:	20
PLASTICITY INDEX:	26

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD732

FIGURE B-1.1



GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION ID:	B-1
SAMPLE DEPTH:	5' - 6.5'

UNIFIED SOIL CLASSIFICATION: CH

DESCRIPTION: FAT CLAY

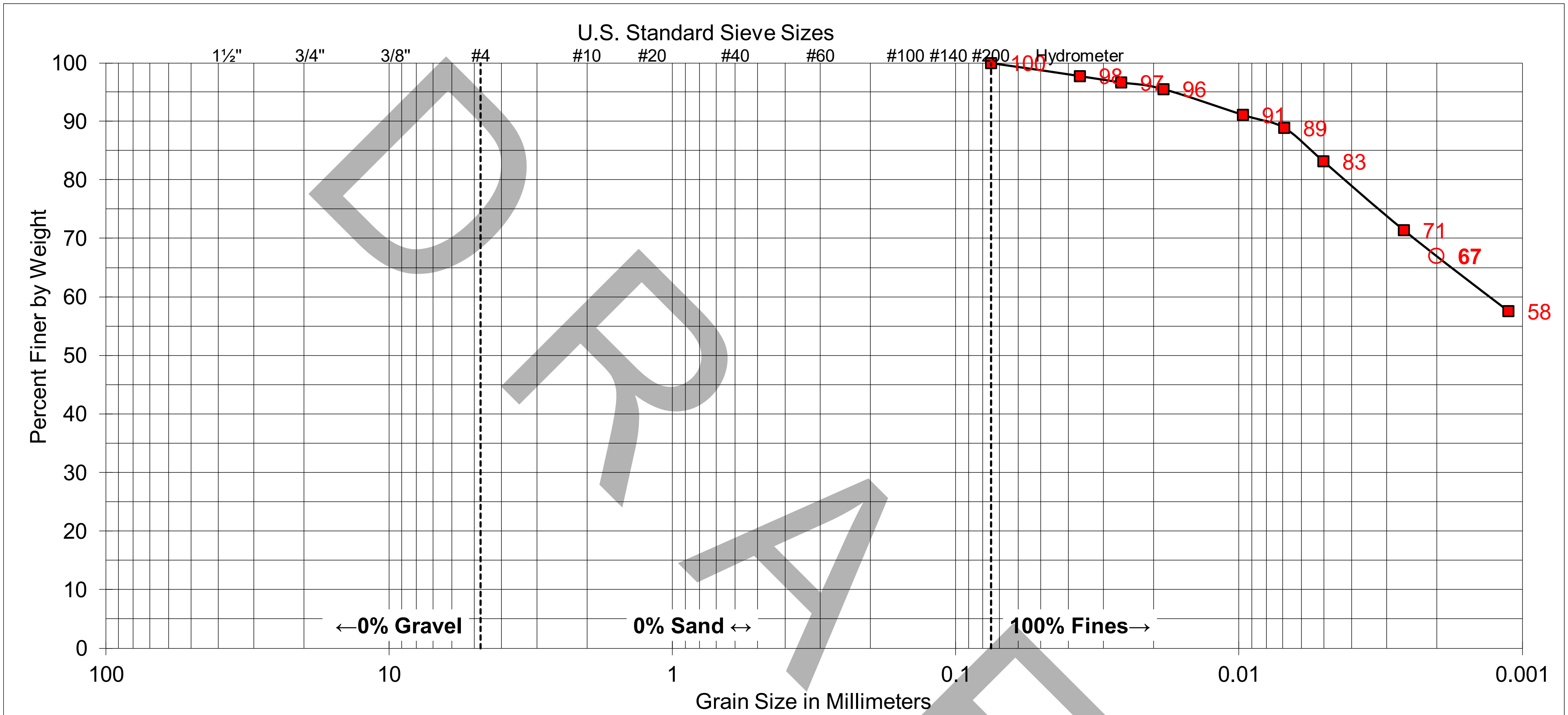
ATTERBERG LIMITS	
LIQUID LIMIT:	65
PLASTIC LIMIT:	23
PLASTICITY INDEX:	42

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD732

FIGURE B-1.2



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	B-1
SAMPLE DEPTH:	10.5' - 11'

UNIFIED SOIL CLASSIFICATION: CH

DESCRIPTION: FAT CLAY

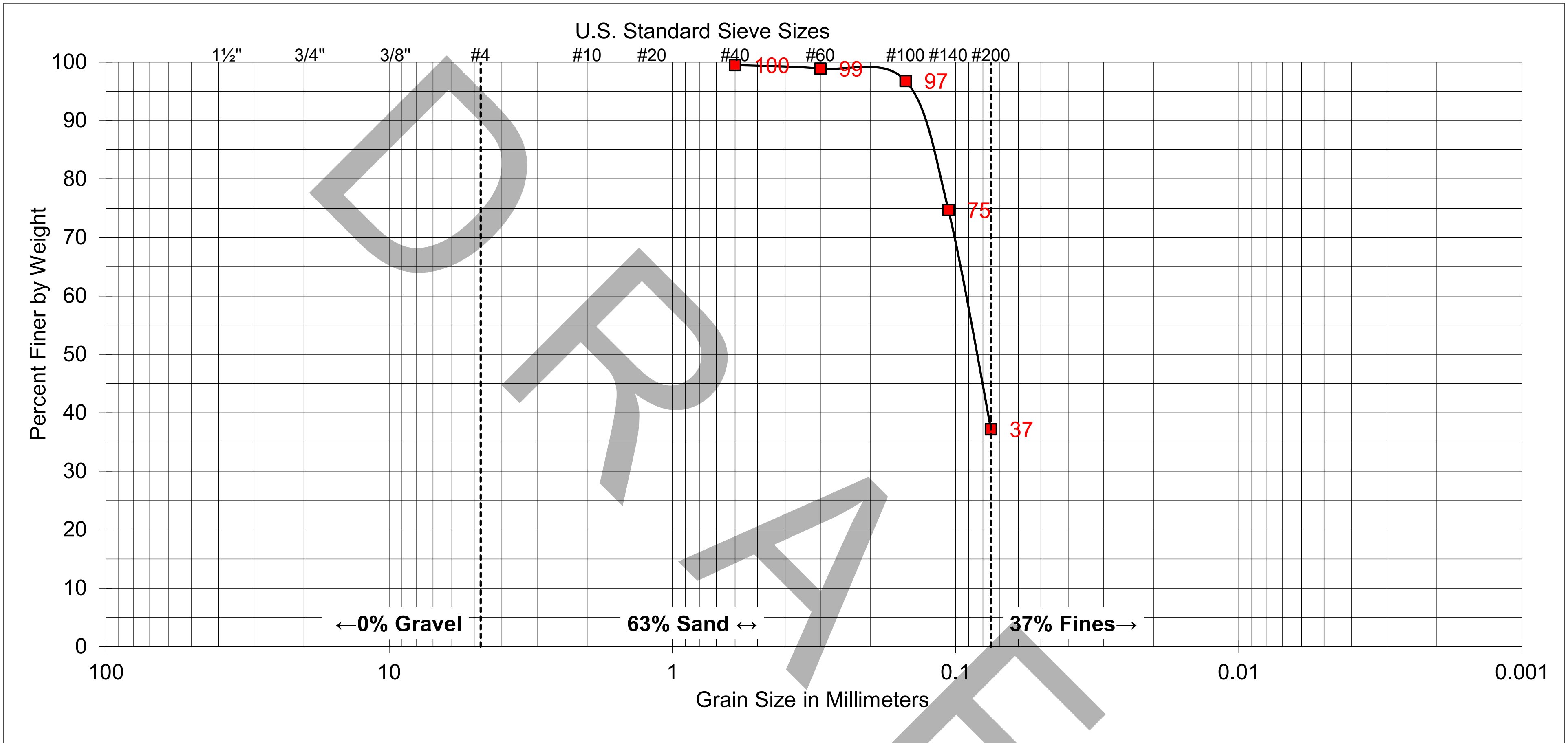
ATTERBERG LIMITS	
LIQUID LIMIT:	70
PLASTIC LIMIT:	25
PLASTICITY INDEX:	45

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD732

FIGURE B-1.3



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND
GRAVEL		SAND			CLAY

SAMPLE	
EXPLORATION ID:	B-1
SAMPLE DEPTH:	15' - 15.5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

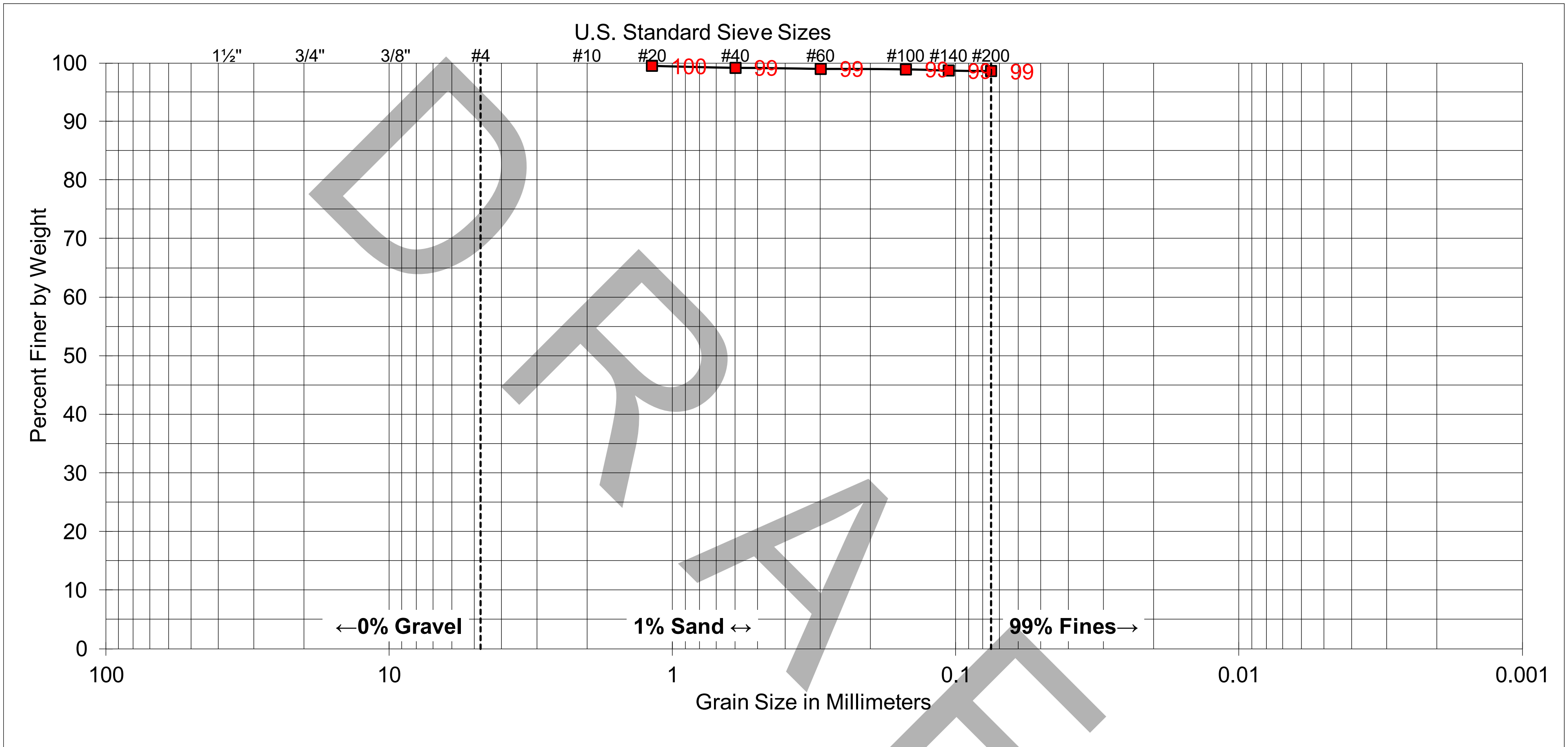
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD732

FIGURE B-1.4



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	B-2
SAMPLE DEPTH:	20.5' - 21'

UNIFIED SOIL CLASSIFICATION: CH

DESCRIPTION: FAT CLAY

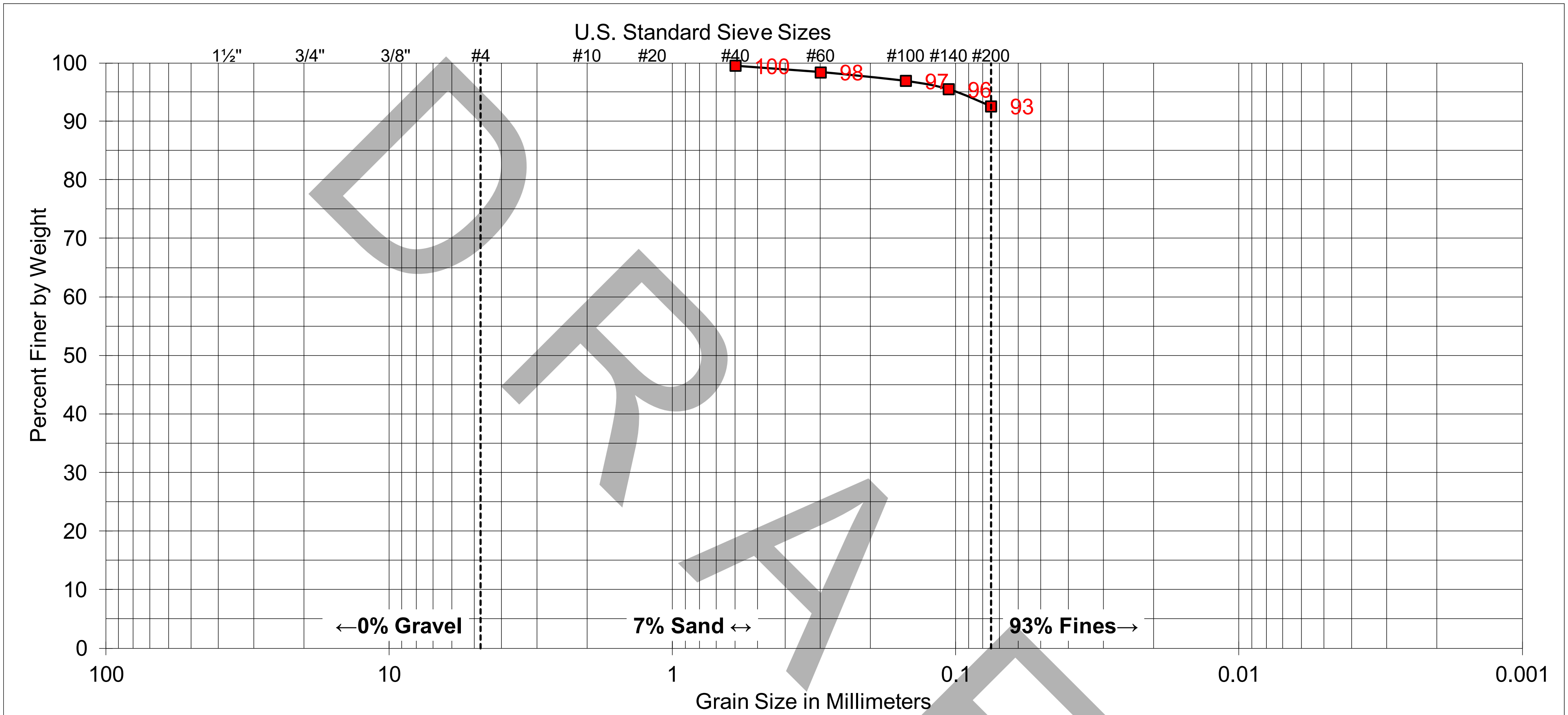
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD732

FIGURE B-1.5



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	B-3
SAMPLE DEPTH:	0.5' - 5'

UNIFIED SOIL CLASSIFICATION: CL

DESCRIPTION: LEAN CLAY

ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

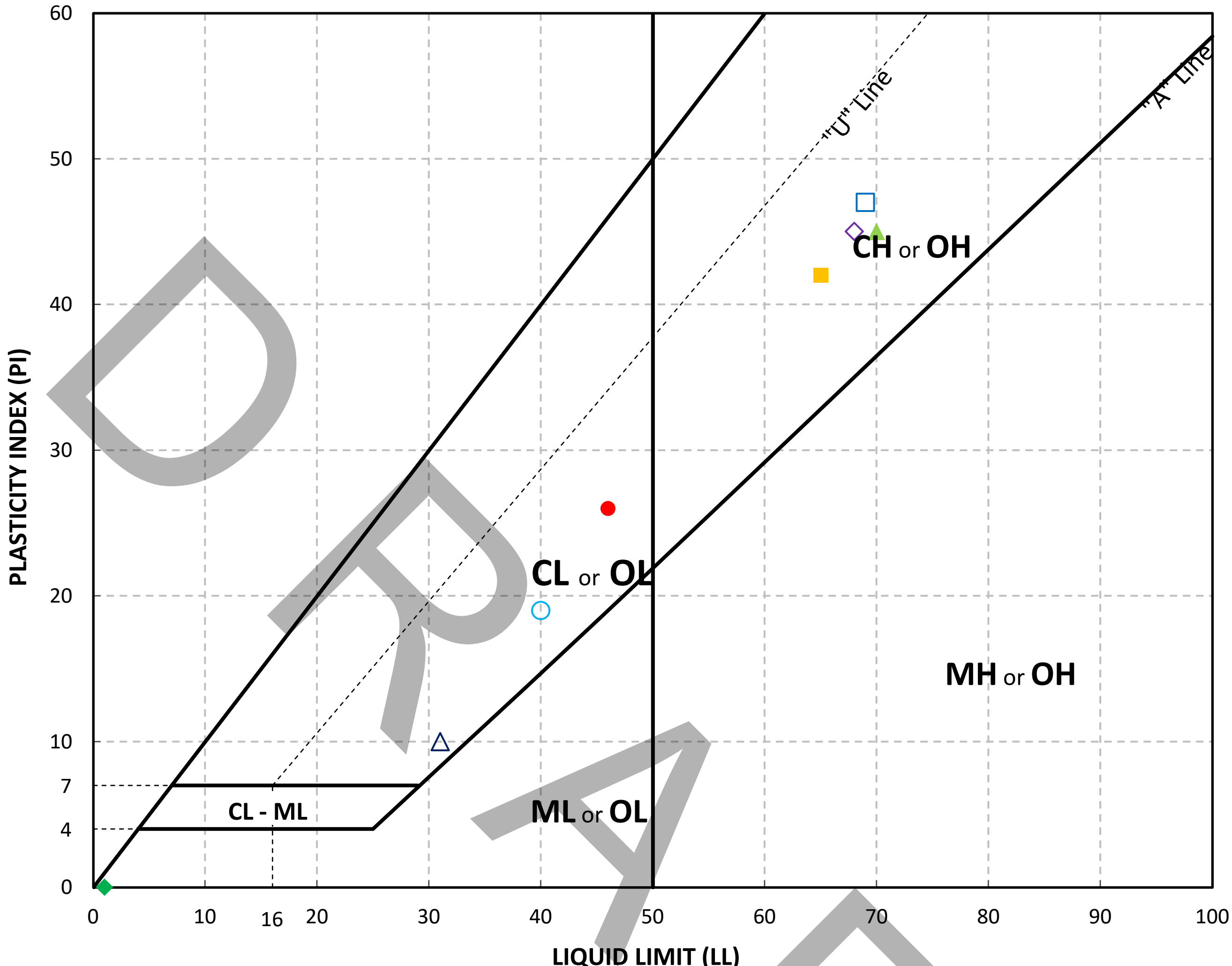
Project No. SD732

FIGURE B-1.6

PERCENT PASSING THE NO. 200 SIEVE TEST RESULTS
(ASTM D1140)

SAMPLE	DESCRIPTION	PERCENT PASSING THE NO. 200 SIEVE
B-1 @ 26' – 26.5'	SILT (ML)	94
B-1 @ 35.5' – 36'	Fat CLAY (CL)	100
B-1 @ 50' – 51.5'	SILT (ML)	88

ATTERBERG LIMITS
(ASTM D4318)



SYMBOL	BORING NO.	SAMPLE NO.	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION (USCS)
●	B-1	B-1 @ 0.5' - 5'	46	20	26	Lean CLAY (CL)
■	B-1	B-1 @ 5' - 6.5'	65	23	42	Fat CLAY (CH)
▲	B-1	B-1 @ 10.5' - 11'	70	25	45	Fat CLAY (CH)
◆	B-1	B-1 @ 26' - 26.5'	NP	NP	NP	SILT (ML)
○	B-1	B-1 @ 30.5' - 31'	40	21	19	Lean CLAY (CL)
□	B-1	B-1 @ 35.5' - 36'	69	22	47	Fat CLAY (CH)
△	B-2	B-2 @ 15' - 16'	31	21	10	Lean CLAY (CL)
◇	B-3	B-3 @ 20' - 21.5'	68	23	45	Fat CLAY (CH)

Notes: (1) Unified Soil Classification System (USCS) per ASTM D2487
(2) NP = Non-Plastic per ASTM D4318

GROUP DELTA

LABORATORY TEST RESULTS

Project No. SD732

FIGURE B-3

EXPANSION TEST RESULTS
(ASTM D4829)

SAMPLE	DESCRIPTION	EXPANSION INDEX
B-1 @ 0.5’ – 5’	Lean CLAY (CL)	70
B-2 @ 0.5’ – 5’	Lean CLAY (CL)	60
B-3 @ 0.5’ – 5’	Lean CLAY (CL)	82

EXPANSION INDEX	POTENTIAL EXPANSION
0 to 20	Very low
21 to 50	Low
51 to 90	Medium
91 to 130	High
Above 130	Very High

CORROSIVITY TEST RESULTS
(ASTM D512, ASTM D516, CTM 643)

SAMPLE	pH	RESISTIVITY [OHM-CM]	SULFATE CONTENT [%]	CHLORIDE CONTENT [%]
B-2 @ 0.5' – 5'	7.67	482	1.08	0.05
B-3 @ 0.5' – 5'	7.88	268	1.08	0.06

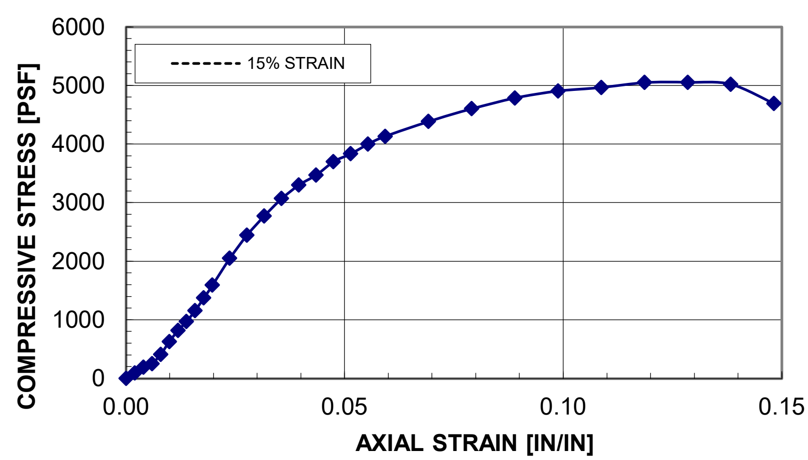
SULFATE CONTENT [%]	SULFATE EXPOSURE	CEMENT TYPE
0.00 to 0.10	Negligible	-
0.10 to 0.20	Moderate	II, IP(MS), IS(MS)
0.20 to 2.00	Severe	V
Above 2.00	Very Severe	V plus pozzolan

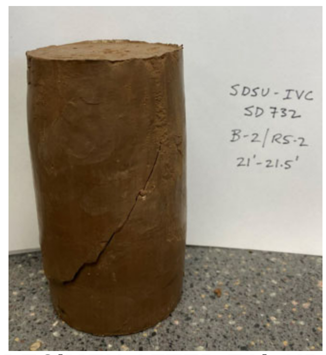
SOIL RESISTIVITY [OHM-CM]	GENERAL DEGREE OF CORROSIVITY TO FERROUS METALS
0 to 1,000	Very Corrosive
1,000 to 2,000	Corrosive
2,000 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
Above 10,000	Slightly Corrosive

CHLORIDE (Cl) CONTENT [%]	GENERAL DEGREE OF CORROSIVITY TO METALS
0.00 to 0.03	Negligible
0.03 to 0.15	Corrosive
Above 0.15	Severely Corrosive

PROJECT:	**SDSU IVC Student Residence Hall**	TEST METHOD:	**ASTM D2166**
SAMPLE I.D.:	**B-2 @ 21' - 21.5'**	TESTED BY:	**J. Krehbiel**
DESCRIPTION:	**Fat CLAY (CH)**	DATE:	**6/17/22**

TYPE OF SAMPLE	CAL	
WET WT. OF SAMPLE	725.26	[g]
INITIAL DIAM.	2.4	[in]
INITIAL HEIGHT	5.060	[in]
INITIAL AREA	4.524	[in^2]
INITIAL VOLUME	22.89	[in^3]
WET DENSITY	120.7	[pcf]
DRY WT. OF SAMPLE	561.16	[g]
WEIGHT OF WATER	164.1	[g]
INITIAL TOTAL MOISTURE	29.2	[%]
DRY DENSITY	93.4	[pcf]
L-D RATIO	2.1:1	
STRAIN RATE	1.21	[%/min]
STRAIN AT FAILURE	12.85	[%]
STRAIN AT FAILURE	0.650	[in]
15% STRAIN	0.759	[in]
FAILURE CRITERIA:	Yield	
COMP. STRENGTH:	5054	[psf]
SHEAR STRENGTH:	2527	[psf]
SPEC. GRAVITY (Assumed)	2.85	
SATURATION:	92	[%]
FAILURE MODE:	Plastic	





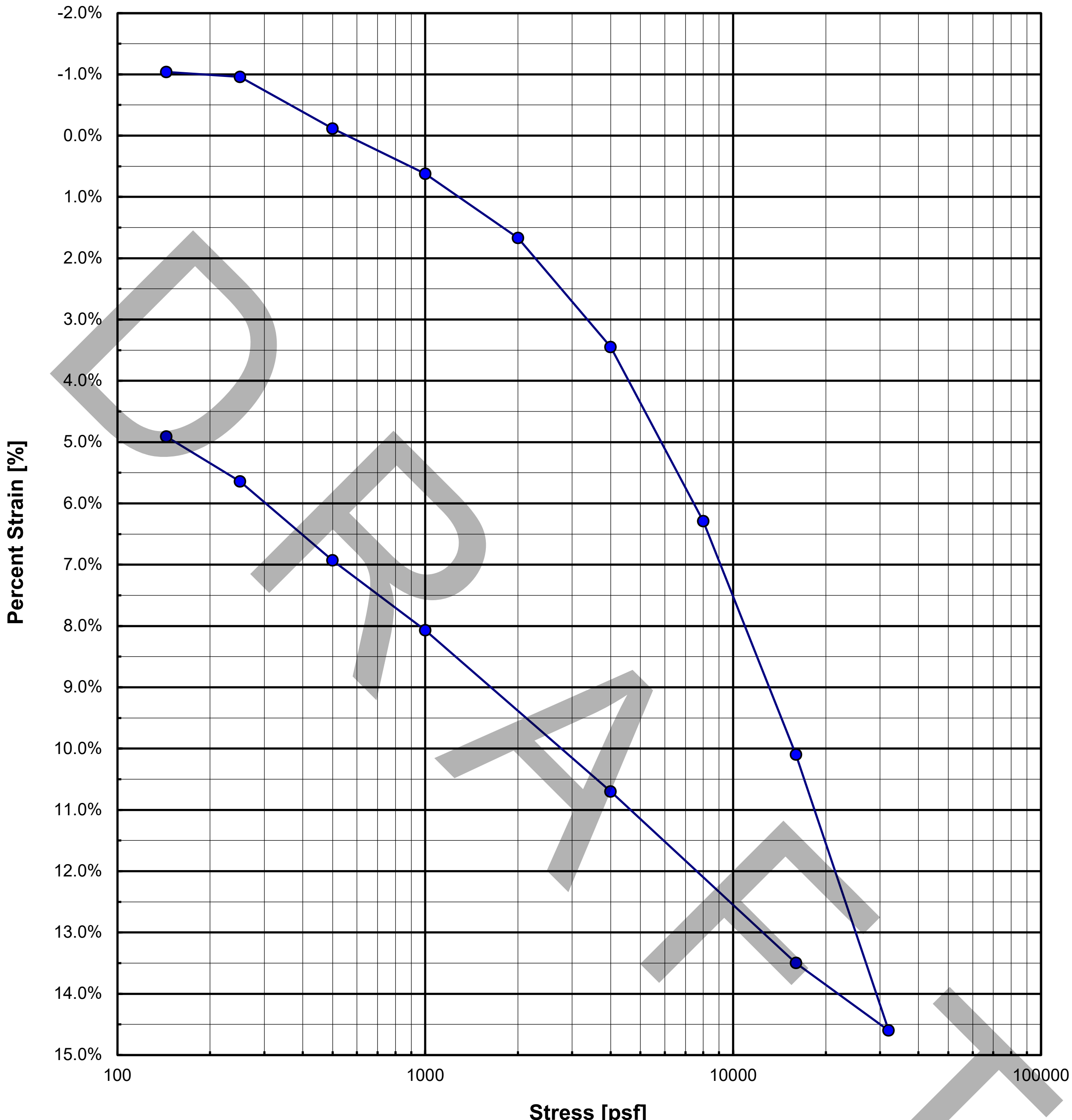
SPECIMEN AFTER FAILURE

Elapsed Time [min]	Axial Load [lb]	Strain Dial [in]	Total Deformation [in]	Axial Strain [in/in]	Corrected Area [in^2]	Stress [psf]
0.0	0.0	1.000	0.000	0.000	4.52	0.0
0.2	3.0	0.990	0.010	0.002	4.53	95.3
0.3	6.0	0.980	0.020	0.004	4.54	190.2
0.6	13.0	0.960	0.040	0.008	4.56	410.5
0.8	20.0	0.950	0.050	0.010	4.57	630.3
1.0	26.0	0.940	0.060	0.012	4.58	817.8
1.5	44.0	0.910	0.090	0.018	4.61	1375.7
1.6	51.0	0.900	0.100	0.020	4.62	1591.3
1.9	66.0	0.880	0.120	0.024	4.63	2051.0
2.3	79.0	0.860	0.140	0.028	4.65	2445.1
2.6	90.0	0.840	0.160	0.032	4.67	2774.2
2.9	100.0	0.820	0.180	0.036	4.69	3069.9
3.3	108.0	0.800	0.200	0.040	4.71	3301.9
3.6	114.0	0.780	0.220	0.043	4.73	3471.0
3.9	122.0	0.760	0.240	0.047	4.75	3699.2
4.2	127.0	0.740	0.260	0.051	4.77	3834.8
4.6	133.0	0.720	0.280	0.055	4.79	3999.3
4.9	138.0	0.700	0.300	0.059	4.81	4132.2
5.7	148.0	0.650	0.350	0.069	4.86	4385.1
6.5	157.0	0.600	0.400	0.079	4.91	4602.4

GROUP DELTA

UNCONFINED COMPRESSIVE STRENGTH

Project No. SD732
FIGURE B-6



B-1, R-5 @ 21 - 21.5'

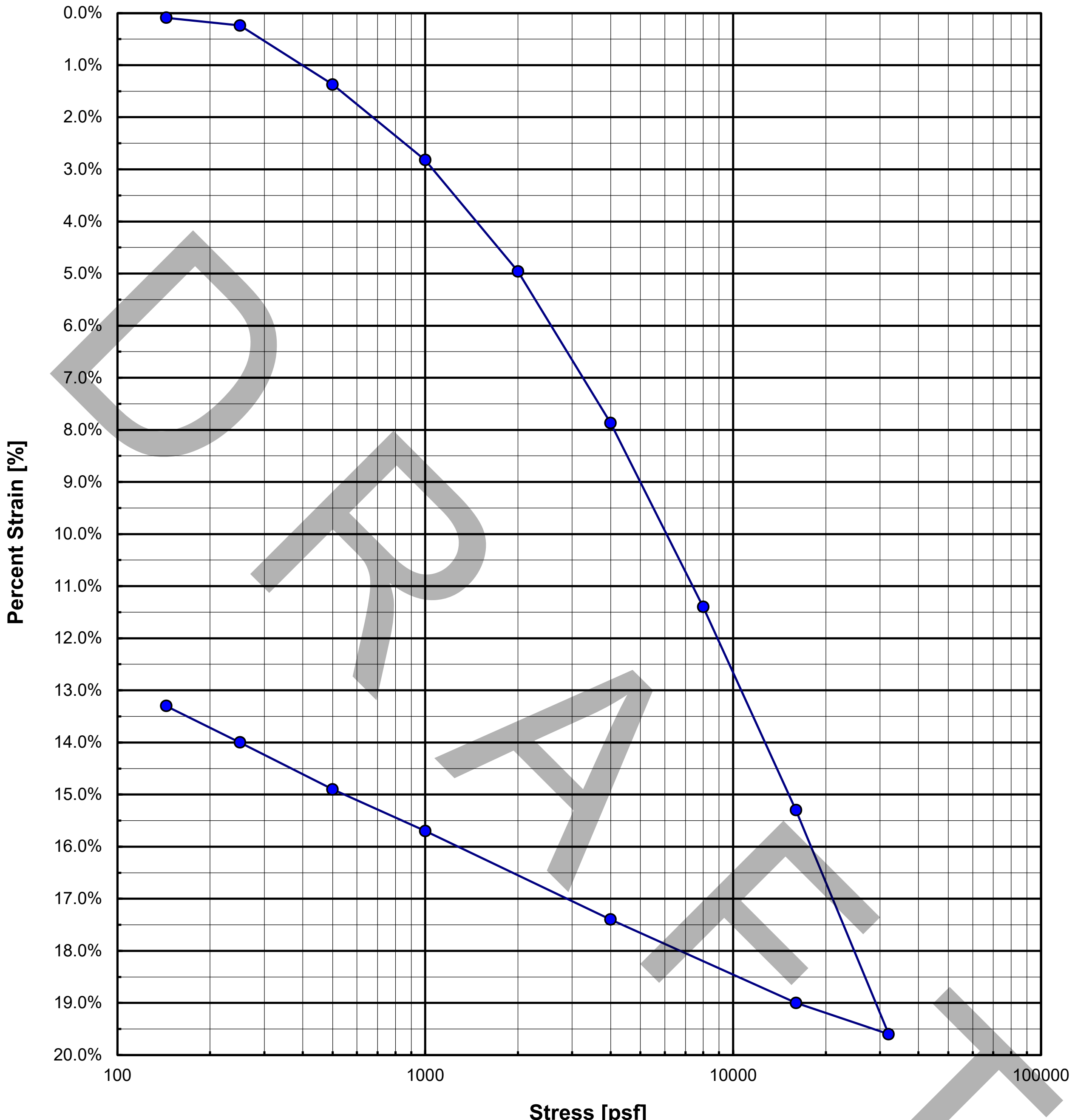
INITIAL	FINAL	
1.0000	0.9509	SAMPLE HEIGHT [IN]
89.0	93.6	DRY DENSITY [PCF]
2.79	2.79	SPECIFIC GRAVITY (ASSUMED)
0.97	0.86	VOID RATIO (e)
32.9	30.8	WATER CONTENT [%]
94.2	100.0	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

Project No. SD732

FIGURE B-7.1



B-1, R-7-2 @ 31' - 31.5'

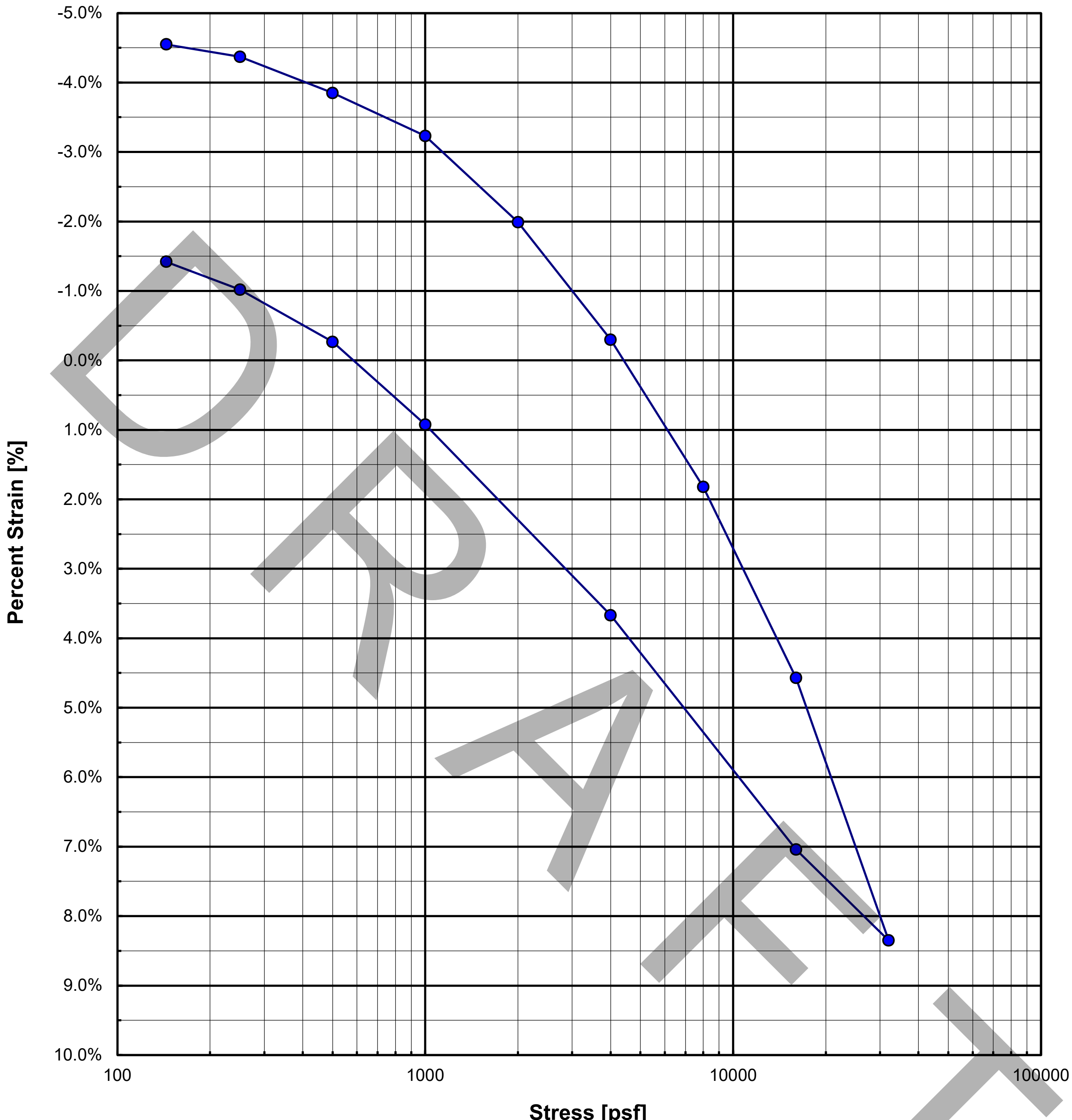
INITIAL	FINAL	
1.0000	0.8670	SAMPLE HEIGHT [IN]
91.8	105.8	DRY DENSITY [PCF]
2.77	2.77	SPECIFIC GRAVITY (ASSUMED)
0.88	0.63	VOID RATIO (e)
31.6	22.9	WATER CONTENT [%]
99.0	100.0	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

Project No. SD732

FIGURE B-7.2



B-1, R-8-2 @ 36 - 36.5'

INITIAL	FINAL	
1.0000	1.0142	SAMPLE HEIGHT [IN]
96.8	95.4	DRY DENSITY [PCF]
2.83	2.83	SPECIFIC GRAVITY (ASSUMED)
0.91	0.85	VOID RATIO (e)
27.9	30.1	WATER CONTENT [%]
86.7	100.0	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

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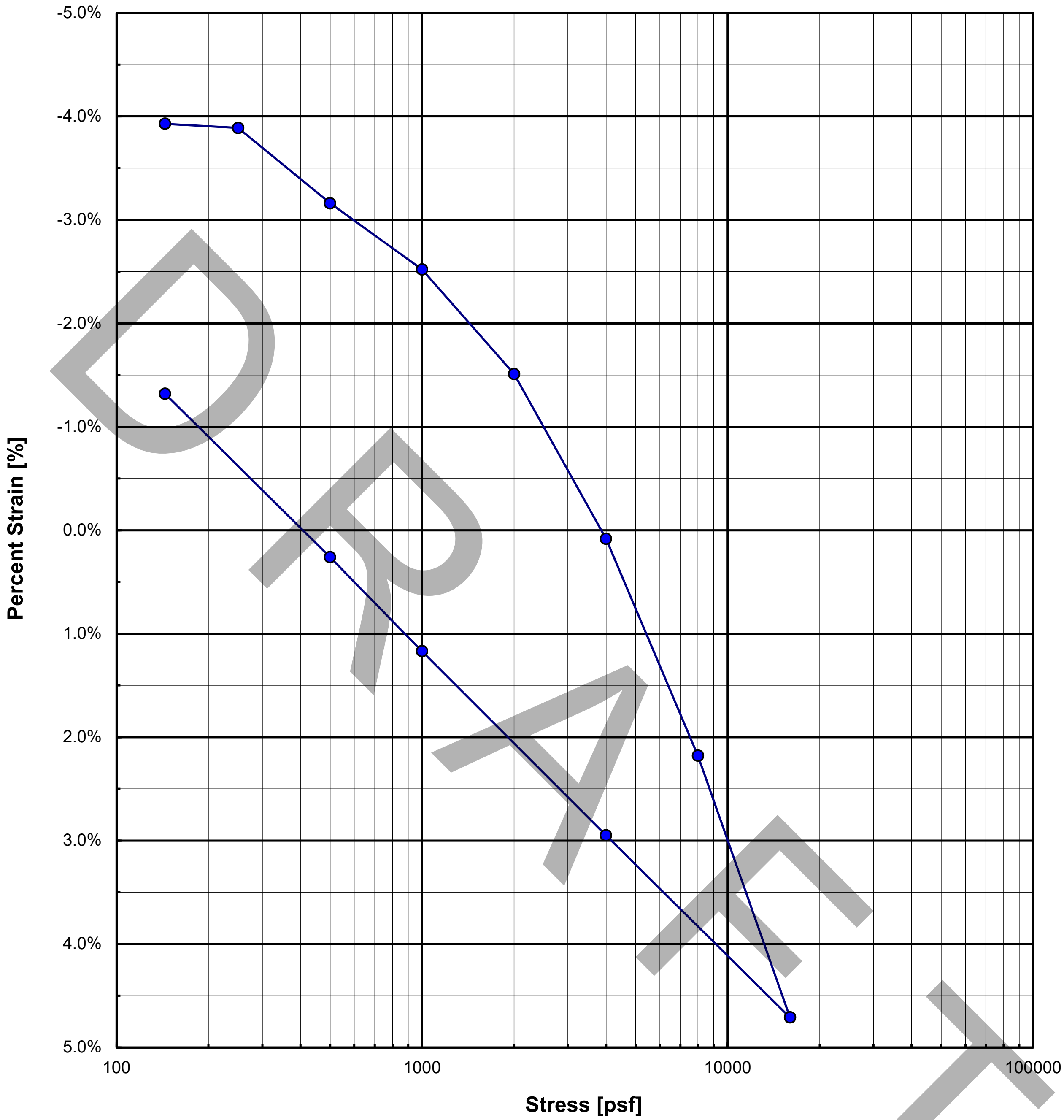
FIGURE B-7.3



B-2, R-3 @ 11 - 11.5'

INITIAL	FINAL	
1.0000	1.0132	SAMPLE HEIGHT [IN]
101.0	99.7	DRY DENSITY [PCF]
2.84	2.84	SPECIFIC GRAVITY (ASSUMED)
0.83	0.78	VOID RATIO (e)
24.4	27.5	WATER CONTENT [%]
83.7	100.0	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

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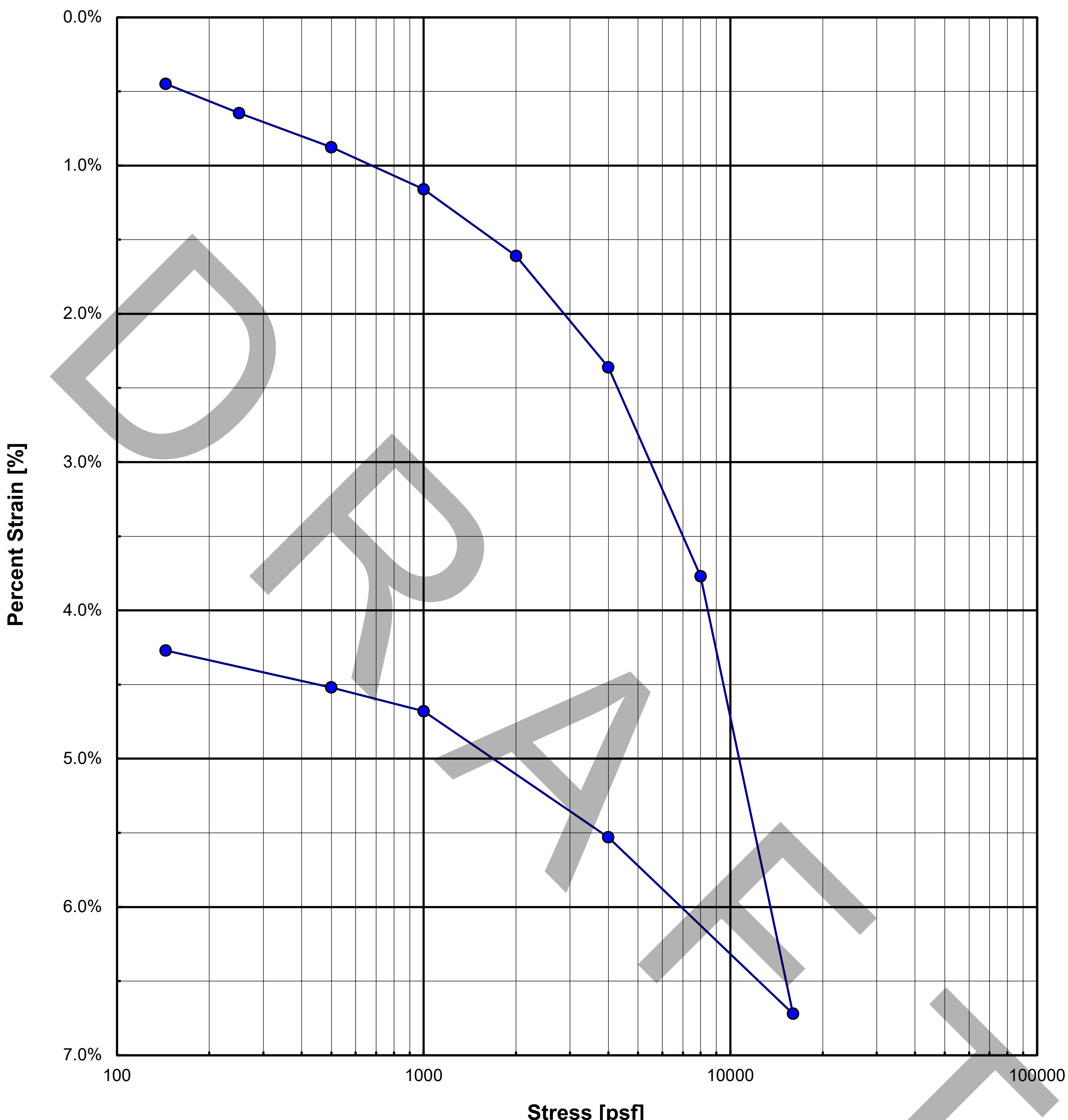
FIGURE B-7.4



B-3, R-2-2 @ 6-6.5'

INITIAL	FINAL	
1.0000	0.9573	SAMPLE HEIGHT [IN]
95.6	99.8	DRY DENSITY [PCF]
2.80	2.80	SPECIFIC GRAVITY (ASSUMED)
0.82	0.75	VOID RATIO (e)
19.8	18.9	WATER CONTENT [%]
67.5	70.6	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

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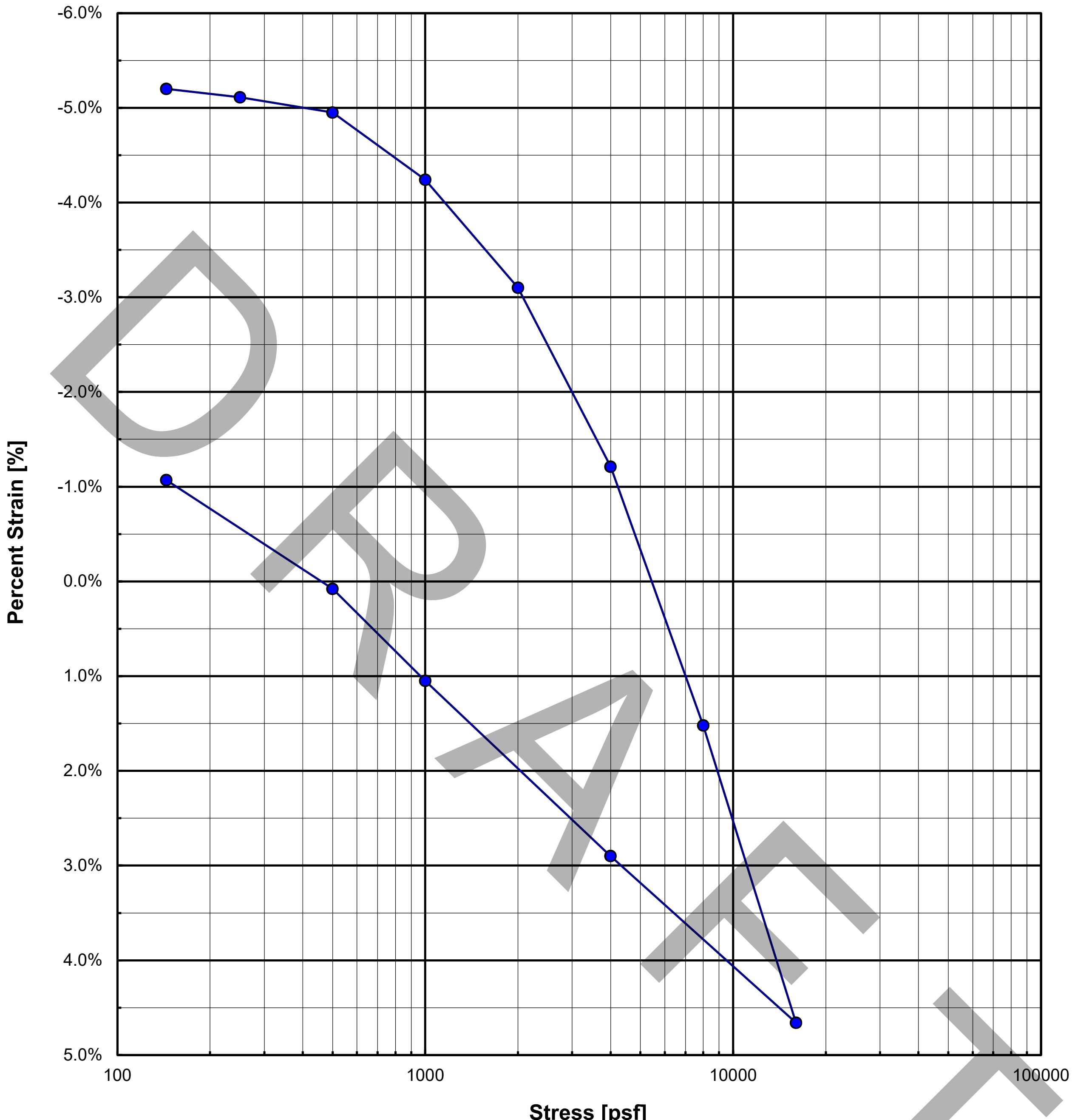
FIGURE B-7.5



B-3, R-2-2 @ 6-6.5'

INITIAL	FINAL	
1.0000	1.0107	SAMPLE HEIGHT [IN]
95.8	94.8	DRY DENSITY [PCF]
2.63	2.63	SPECIFIC GRAVITY (ASSUMED)
0.81	0.73	VOID RATIO (e)
20.9	27.9	WATER CONTENT [%]
68.5	100.0	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

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FIGURE B-7.6

Attachment C

Confidential SDNHM Paleontological Records Search Results