Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

June 20, 2019
Project No. 108828001

Mr. Bryce Storm
Santee School District
9880 Riverwalk Drive
Santee, California 92071

Subject: Geotechnical Pavement Evaluation
Cajon Park School Hardcourt Pavement
10300 North Magnolia Avenue
Santee, California

Dear Mr. Storm:

In accordance with your authorization (P.O. No. 8008), we have performed a geotechnical pavement evaluation of the existing hardcourt pavement at the Cajon Park School campus located at 10300 North Magnolia Avenue in Santee, California (Figure 1). Our evaluation was focused on the asphalt concrete (AC) paved hardcourt play area located in the southwest portion of the school campus. The purposes of our services were to evaluate the subsurface conditions beneath the existing hardcourt pavement and provide our conclusions regarding the potential cause(s) of the observed pavement cracks as well as provide recommendations for the replacement or renovation of the hardcourt surfacing.

SCOPE OF SERVICES

Ninyo & Moore's scope of services for this project included the following tasks:

- Reviewing background information including previous geotechnical reports for the school campus prepared by our office, available geologic and topographic maps, and historic aerial photographs.
- Performing a site reconnaissance to document the hardcourt pavement conditions and to locate our exploratory borings for clearance by Underground Service Alert (USA) and school personnel. Selected photographs are included in Attachment A.
- Performing a subsurface exploration consisting of manually excavating, logging, and sampling of four exploratory borings. The existing AC was cored prior to excavating the borings. Bulk samples of the encountered subgrade materials were collected and transported to our in-house laboratory for testing.

- Measuring the existing pavement sections encountered in our borings.
- Evaluating for the presence of Petromat® or similar paving fabric materials within the existing AC pavement sections at the locations of our borings.
- Performing geotechnical laboratory testing on representative soil samples to evaluate in-situ moisture content, percent fines, expansion index, and R-value.
- Compiling and analyzing the data obtained from our background review, subsurface exploration, and laboratory testing.
- Preparing this report providing our findings regarding the subsurface conditions and our laboratory test results as well as our conclusions regarding the potential cause(s) of the AC cracking and our recommendations for the replacement or renovation of the hardcourt play area pavement.

SITE DESCRIPTION AND OBSERVATIONS

Our evaluation was focused on the AC paved hardcourt play area located in the southwest portion of the school campus. The play area (Photographs 1 through 3) is relatively flat with elevations ranging between approximately 415 and 420 feet above mean sea level (MSL). The play area includes basketball courts, tetherball, and foursquare areas. Concrete ball walls, swings, and jungle gyms over dirt surfacing are located to the north of the AC-paved play area. Dirt surfacing also extends along the western and southern sides of the hardcourt (Photographs 1 and 5). The eastern edge of the hardcourt is bounded by concrete flatwork.

Based on our discussions with you and the observations during our May 1, 2019 site visit, the existing AC hardcourt has experienced cracking and separation at several locations. Many of those cracks had been previously sealed or repaired and the cracks continue to propagate through the patching.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

Our field exploration was conducted on June 4, 2019 and consisted of manually excavating, logging, and sampling of four exploratory borings (B-1 through B-4) within the existing AC paved hardcourt play area. Prior to drilling, the locations were cleared of underground utilities by participating members of USA and the existing AC was cored using an 8-inch diameter core barrel. The exploratory borings were excavated to depths of up to approximately 4 feet. Bulk soil samples were obtained from the borings. The samples were then transported to our in-house geotechnical laboratory for testing. The approximate locations of the exploratory borings are shown on Figure 2. Table 1 summarizes the encountered hardcourt pavement sections and subgrade materials encountered during our field exploration.

Table 1 – Summary of Hardcourt Pavement Sections and Subgrade Materials			
Boring Location	**Boring Depth (feet)**	**Encountered AC Thickness**	**Encountered Subgrade Materials**
B-1	4	6 inches (2½-inch top layer over 3½-inch bottom layer with Petromat® in between)	Clayey SAND (Fill) to Total Depth Explored
B-2	2	5 inches (2-inch top layer over 3-inch bottom layer with Petromat® in between)	~4 inches of Clayey SAND (Fill) Over Granitic Rock
B-3	2	5 inches (1-inch top layer over 4-inch bottom layer with Petromat® in between)	~ 4 inches of Clayey SAND (Fill) Over Granitic Rock
B-4	3.5	7 inches (3-inch top layer over 4-inch bottom layer with Petromat® in between)	Silty and Clayey SAND (Fill) to Total Depth Explored

The fill materials generally consisted of various shades of brown and gray, moist, loose to medium dense, silty and clayey sand with 37 to 43 percent passing the No. 200 sieve (based on the results of our laboratory testing on samples collected from borings B-1 and B-4). Scattered gravel and cobbles were encountered within the fill materials. The underlying granitic rock generally consisted of yellowish brown to gray, moist, weathered granitic rock.

LABORATORY TESTING

Laboratory testing of the fill materials encountered beneath the existing AC hardcourt included evaluation of the in-situ moisture content in general accordance with ASTM International (ASTM) D 2216, percent fines (i.e., 200 wash) in general accordance with ASTM D 1140, expansion index in general accordance with ASTM D 4829, and R-value in general accordance with California Test (CT) 301. The laboratory tests were performed at our in-house geotechnical laboratory. The results of our testing are summarized in Table 2 and in the preceding section.

Table 2 – Summary of Laboratory Tests					
Boring Location	**Sample Depth (feet)**	**Encountered Subgrade Material**	**In-Situ Moisture Content (%)**	**Expansion Index**	**R-Value**
B-1	0.5 - 3.0	Clayey SAND (Fill)	13.0	8 (Very Low)	--
B-2	0.5 - 2.0	Granitic Rock	10.0	--	--
B-4	0.5 - 1.5	Silty SAND (Fill)	11.2	--	--
B-4	1.5 - 3.5	Clayey SAND (Fill)	14.7	--	Less than 5

FINDINGS AND CONCLUSIONS

As noted previously, the purposes of our evaluation were to evaluate the subsurface conditions beneath the existing hardcourt pavement and the potential cause(s) of the observed pavement cracks as well as provide recommendations for the replacement or renovation of the hardcourt surfacing. Our evaluation has included a review of geotechnical-related background materials, a site reconnaissance, a subsurface exploration program consisting of four exploratory borings, and geotechnical laboratory testing.

Based on our evaluation, the observed cracks within the existing AC paved hardcourt are due to poor and variable subgrade conditions, heat stress, poor surface drainage, and insufficient edge confinement. This conclusion is supported by the following:

- The western side of the existing AC paved hardcourt (i.e., near borings B-1 and B-4) is underlain and supported on fill materials while the eastern side (i.e., near borings B-2 and B-3) is underlain and supported by a thin fill layer over granitic rock.
- The fill materials underlying the play area are clayey in nature.
- Moisture conditions of the fill materials range between approximately 11 and 15 percent.
- Headers (i.e., edge confinement) were not observed along the southern, western, and northwestern sides of the play area where the AC is bounded by dirt surfacing (Photograph 5).
- Cracks previously patched have or are reopening (Photographs 1, 3, 4, and 5).

RECOMMENDATIONS

Due to the variable moisture conditions and types of the subgrade materials along with the presence of Petromat® and crack sealants, we recommend that the AC hardcourt pavement be reconstructed. The proposed reconstruction should be performed in accordance with the recommendations provided herein and the requirements of the applicable governing agencies. Ninyo & Moore should be contacted for questions regarding the recommendations or guidelines presented herein.

Pre-Construction Conference

We recommend that a pre-construction meeting be held prior to commencement of grading. The owner or his representative, the Project Inspector, the agency representatives, the architect, the civil engineer, Ninyo & Moore, and the contractor should attend to discuss the plans, the project, and the proposed construction schedule.

Excavation Characteristics

The results of our field exploration program indicate that the project site is underlain by fill with weathered granitic rock underlying the fill in the eastern portion. Excavation of the subsurface materials should be feasible with heavy-duty excavation equipment in good working condition. However, due to the potential variability in the thickness of the fill layer and the presence of gravel and cobbles in the fill, the contractor should anticipate difficult conditions when performing excavations.

Site and Subgrade Preparation

For areas to receive new pavement, site preparation activities should begin by clearing and removing existing AC, deleterious materials, including organics (such as roots), and oversize materials. As noted previously, our exploratory borings encountered a layer of Petromat® within the encountered AC surfacing. Underground utilities within the proposed limits of the replacement should be located prior to the commencement of earthwork operations.

The results of our laboratory testing indicated that the subgrade soils have variable moisture conditions in their current condition. Therefore, following the site preparation and the removals to achieve finished subgrade elevation, the upper 12 inches of exposed subgrade should be scarified, and moisture conditioned to near optimum moisture content. The moisture conditioned subgrade should then be compacted to a relative compaction of 95 percent of the modified Proctor density in accordance with ASTM International (ASTM) D 1557.

Pavement Reconstruction

As previously noted, laboratory testing performed on a sample of the fill materials collected from boring B-4 indicated an R-value of less than 5. Actual flexible pavement recommendations should be based on R-value tests performed on bulk samples of the soils that are exposed at the finished subgrade elevations across the site at the completion of the grading operations. We recommend that Ninyo & Moore re-evaluate the pavement design, based on the R-value of the subgrade material exposed at the time of construction. The recommended preliminary pavement section is as follows:

Table 3 – Recommended Preliminary Flexible Pavement Section

Location	Design R-Value	Asphalt Concrete (inches)	Aggregate Base (inches)
Southwestern Hardcourt Play Area	5	3	6

Aggregate base materials should conform to Caltrans Class 2 aggregate base materials as defined in Section 26 of the Caltrans Standard Specifications (2018b). Aggregate base materials should be moisture conditioned to near optimum moisture content and should be placed over prepared subgrade materials. We recommend that the aggregate base materials be compacted to a relative compaction of 95 percent of the modified Proctor density in accordance with ASTM D 1557.

The AC materials should consist of a 3/8-inch gradation in accordance with Class D materials as presented in Section 206-6.5.4 of the Greenbook (2018) with a Performance Grade (PG) 70-10 polymer modified (PM) binder. The AC materials should be placed over the aggregate base materials and be compacted to 95 percent relative compaction as compared to the material's Hveem density.

Headers (i.e., edge confinement) were not observed along the play area perimeter where the hardcourt surfacing abuts dirt surfacing. As part of the reconstruction, we recommend that continuous headers be utilized along the portions of the play area perimeter which are adjacent to the dirt surfacing. Also, the AC surface should be placed in such a manner to provide positive drainage so that surface water is not permitted to pond on the surface and is diverted off of and away from the AC materials.

The above recommendations are based on the understanding that the play area will be subject to pedestrian use with the occasional maintenance vehicle. In the event that areas of the hardcourt pavement are to be used as fire lanes, we recommend that the flexible pavement section consist of 4 inches of AC over 16 inches of aggregate base over the prepared subgrade soils.

LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

Respectfully submitted,
NINYO & MOORE

Gabriel Smith, PE, GE
Project Engineer

Jeffrey T. Kent, PE, GE
Principal Engineer

GS/JTK/gg

Attachments: References
Figure 1 – Site Location
Figure 2 – Boring Locations
Attachment A – Select Photographs

Distribution: (1) Addressee (via e-mail)

REFERENCES

Building News, 2018, “Greenbook,” Standard Specifications for Public Works Construction: BNI Publications.

California Department of Transportation (Caltrans), 2018a, Highway Design Manual.

California Department of Transportation (Caltrans), 2018b, Standard Specifications.

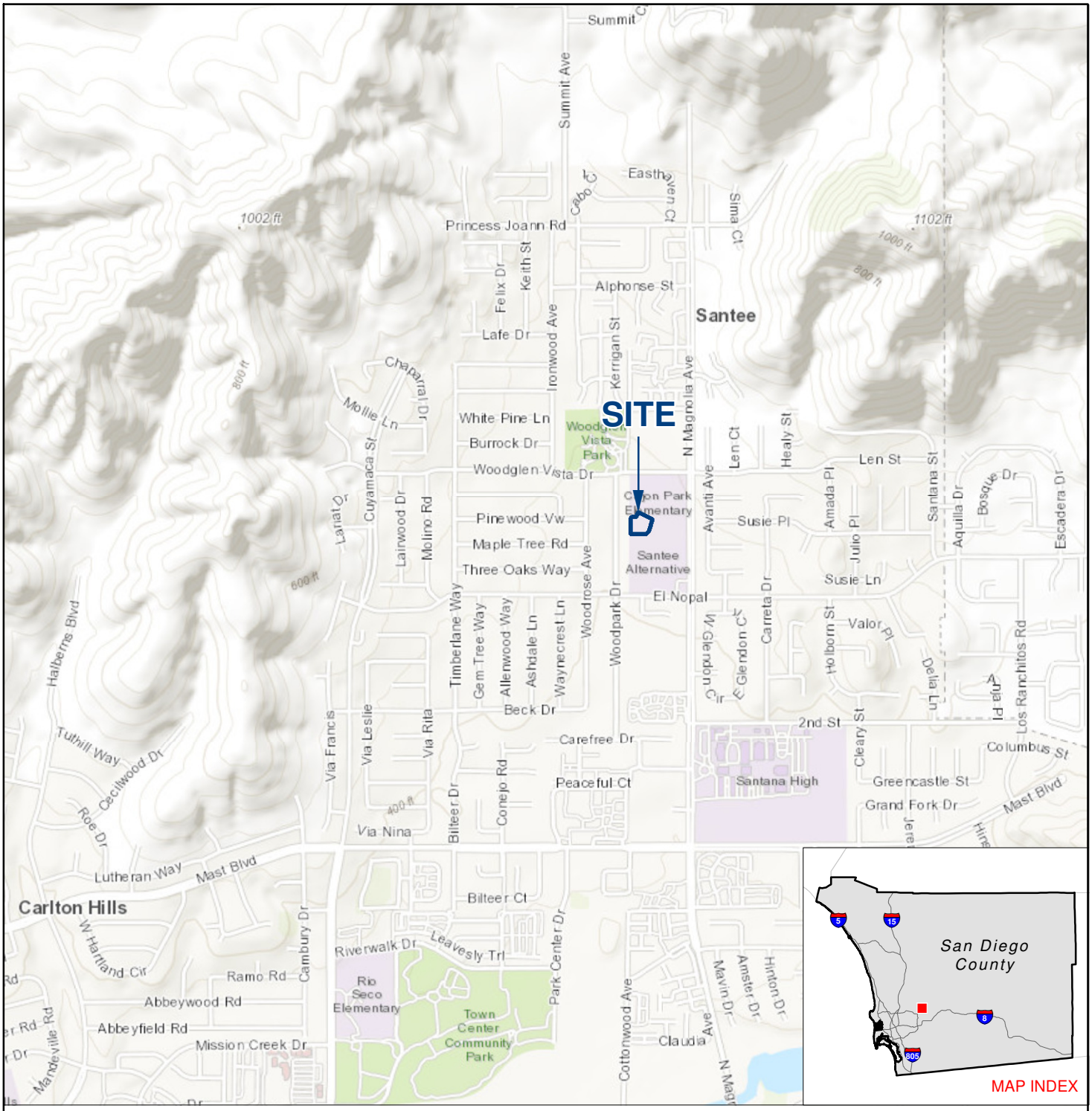
Google, Inc., 2019, www.googleearth.com.

Historic Aerials, 2019, www.historicaerials.com/viewer.

Ninyo & Moore, 2007, Geotechnical Evaluation, Cajon Park School, Santee, California, Project No. 106109001: dated July 3.

Ninyo & Moore, 2019, Proposal Geotechnical Pavement Evaluation, Hardcourt Pavement, Cajon Park School, 10300 North Magnolia Avenue, Santee, California: dated May 7.

Public Works Standards, Inc., 2018, “Greenbook,” Standard Specifications for Public Works Construction.



LEGEND

SITE BOUNDARY

N

FEET

0 1,500 3,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: ESRI WORLD TOPO, 2019

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FIGURE 1

SITE LOCATION

CAJON PARK SCHOOL HARDCOURT PAVEMENT
10300 NORTH MAGNOLIA AVENUE, SANTEE, CALIFORNIA

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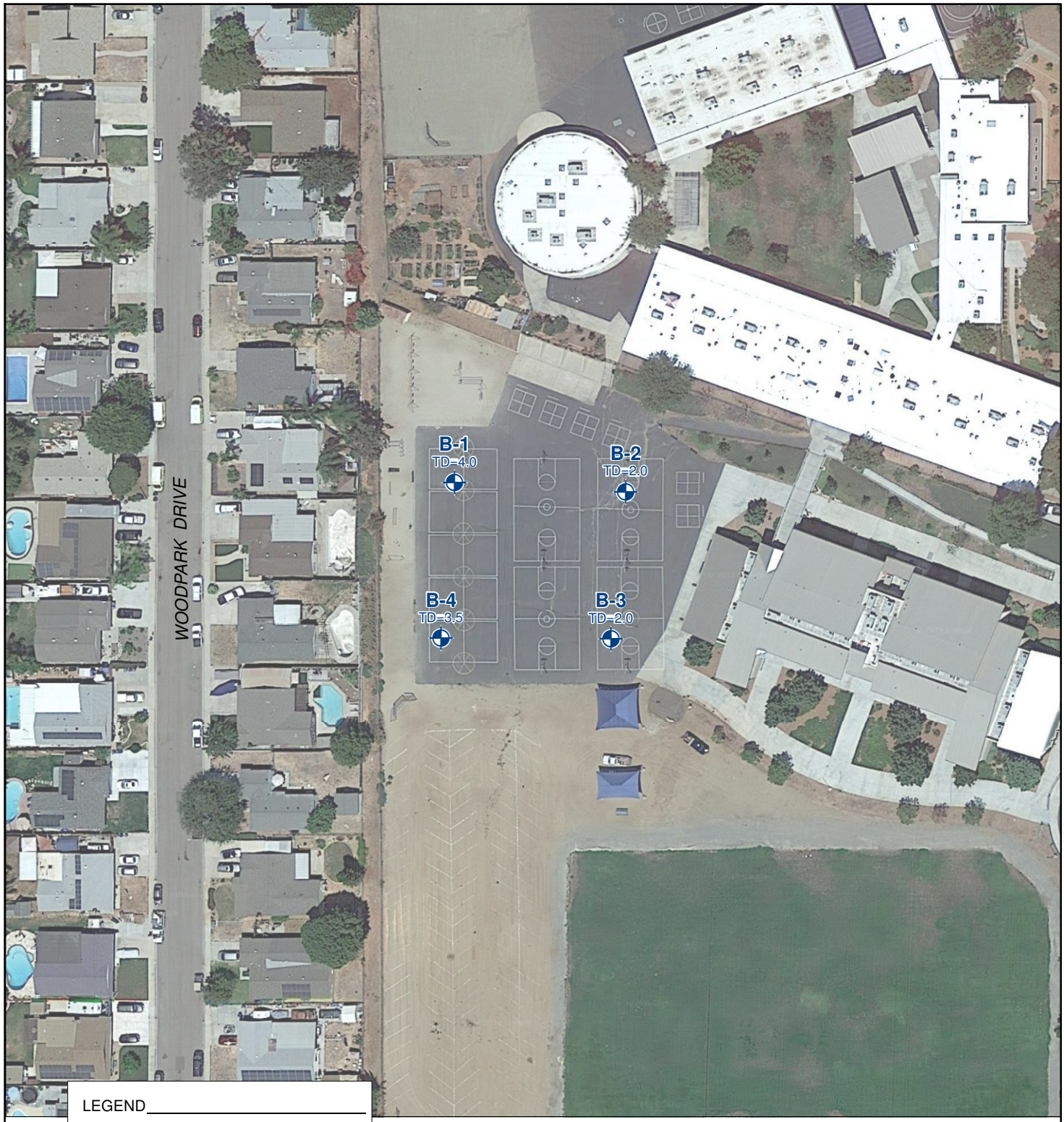

LEGEND

B-4
TD=3.5

BORING
TD=TOTAL DEPTH IN FEET

N

FEET
0 100 200

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: GOOGLE EARTH, 2019

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FIGURE 2

BORING LOCATIONS

CAJON PARK SCHOOL HARDCOURT PAVEMENT
10300 NORTH MAGNOLIA AVENUE, SANTEE, CALIFORNIA

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ATTACHMENT A

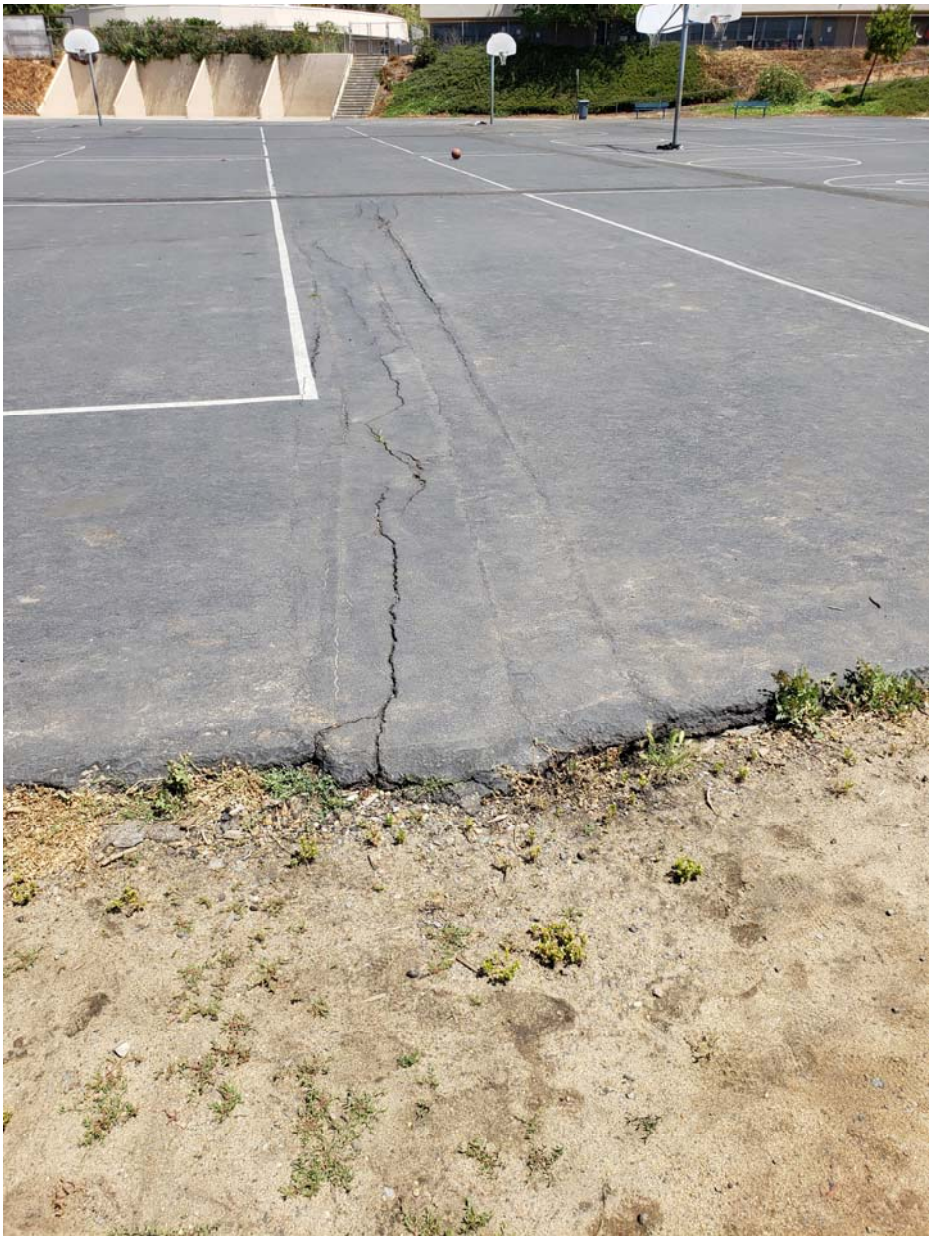
Select Photographs

Photograph 1: **View of hardcourt play area looking north. Open cracks running in the north-south orientation.**

Photograph 2: **View of hardcourt play area looking southeast. Patched cracks running in the north-south and east-west orientations.**

Photograph 3: **View of hardcourt play area looking west. Previously patched cracks reopening.**

Photograph 4: **Close-up view of open cracks and cracks previously patched and since reopened.**



Photograph 5: **View of southern edge of hardcourt play area where AC is adjacent to dirt surfacing. Pavement header (i.e., edge confinement) not present.**