Geotechnical Evaluation Report

Proposed Carroll Park Concession Building
1717 Marco Drive
La Crosse, Wisconsin

Prepared for

Makepeace Engineering, LLC

Brandon K. Wright, PE
Senior Engineer
License Number: 40141
January 18, 2022

WISCONSIN
BRANDON K. WRIGHT
PE 40141
LACROSSE, WI
PROFESSIONAL ENGINEER

Project B2110717

Braun Intertec Corporation

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
2309 Palace Street
La Crosse, WI 54603

Phone: 608.781.7277
Fax: 608.781.7279
Web: braunintertec.com

January 18, 2022

Project B2110717

Mr. James Makepeace
Makepeace Engineering, LLC
200 Mason Street, Suite 15
Onalaska, WI 54650

Re: Geotechnical Evaluation
Proposed Carroll Park Concession Building
1717 Marco Drive
La Crosse, Wisconsin

Dear Mr. Makepeace:

We are pleased to present this Geotechnical Evaluation Report for the proposed Carroll Park Concession Building to be constructed in Carroll Park on Marco Drive in La Crosse, Wisconsin.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Brandon Wright at 608.781.7277 or by email (bwright@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Brandon K. Wright, PE
Senior Engineer

Ray A. Huber
Vice President

AA/EOE

Table of Contents

Description **Page**

BRAUN INTERTEC

Table of Contents (continued)

BRAUN INTERTEC

A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed design and construction of a proposed concession building, located at 1717 Marco Road in La Crosse, Wisconsin. The project will include the construction of single-story concession building. The plans are preliminary at this time; however, we understand that the building will be unheated and will be constructed with exterior structural masonry or wood-framing and will have a floating slab. The figure below shows an illustration of the proposed site layout.

Figure 1. Site Layout

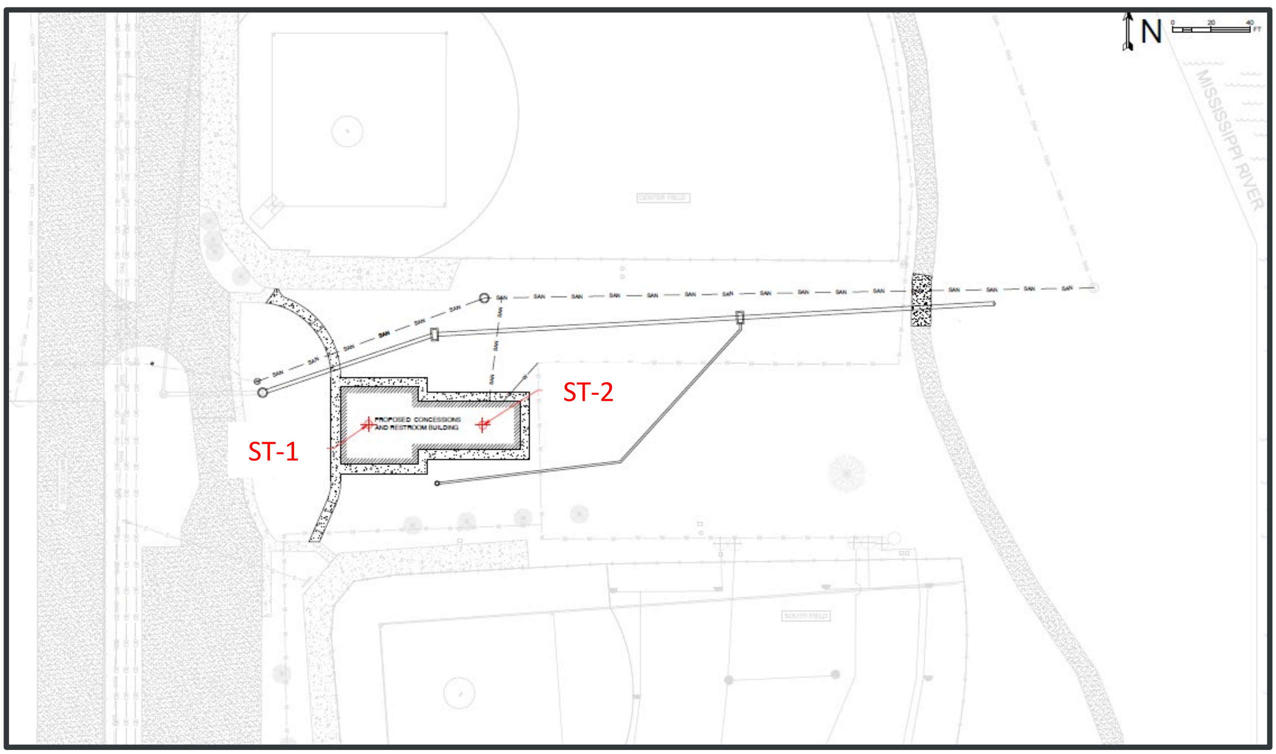


Figure provided by Makepeace Engineering, dated December 14, 2021.

A.2. Site Conditions and History

This site is located on Isle le Plume, which was historically utilized as the City of La Crosse landfill and refuse area. Accurate records depicting the limits of the landfill were not kept by the City of La Crosse, therefore the exact extent of the landfill and refuse area are unknown.

Currently, the site is part of Carroll Park and has three baseball fields, underground utilities, and associated parking. Current grades range from about 642 to 650.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.3. Scope of Services

We performed our scope of services for the project in accordance with our Proposal Makepeace Engineering, dated July 23, 2019, and authorized on November 9, 2021. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Staking and clearing the exploration location of underground utilities. Makepeace Engineering selected and staked the exploration locations. Surface elevations were estimated using topographic data from the La Crosse County GIS website. Elevations are estimated to the nearest foot. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.
- Performing two standard penetration test (SPT) borings, denoted as ST-1 and ST-2, to nominal depths of 30 feet below grade across the site.
- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.

- Preparing this report containing a boring location sketch, logs of soil borings, a summary of the soils encountered, results of laboratory tests, and recommendations for structure subgrade preparation and the design of foundations, floor slabs, and utilities.

Our scope of services did not include environmental services or testing and our geotechnical personnel performing this evaluation are not trained to provide environmental services or testing. We can provide environmental services or testing at your request.

B. Results

B.1. Geologic Overview

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

B.2. Boring Results

Table 1 provides a summary of the soil boring results; in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheets in the Appendix include definitions of abbreviations used in Table 1.

Table 1. Subsurface Profile Summary*

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Topsoil fill	SM	NA	▪ Composed of silty sand. ▪ Dark brown to brown. ▪ Thicknesses at boring locations varied from ½-foot to 2 feet.
Fill**	SP-SM	2 to 16 BPF	▪ Composed of poorly graded sand with silt. ▪ Moisture condition was moist to wet. ▪ Extended to depths of 11 ½ feet in both borings. ▪ Contained debris including refuse, glass, and plastic.

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Alluvial	SP	7 to 14 BPF	▪ Beneath the fill, the borings encountered alluvial sand soils. ▪ Composed of fine-grained poorly graded sand that was wet. ▪ Penetration resistance testing indicates the alluvial sand was loose to medium dense.

*Abbreviations defined in the attached Descriptive Terminology sheets.

**For simplicity in this report, we define existing fill to mean existing, uncontrolled, or undocumented fill.

B.3. Groundwater

Table 2 summarizes the depths where we observed groundwater; the attached Log of Boring sheets in the Appendix also include this information and additional details.

Table 2. Groundwater Summary

Location	Estimated Surface Elevation	Measured or Estimated Depth to Groundwater (ft)	Corresponding Groundwater Elevation (ft)
ST-1	643	11 ½	631 ½
ST-2	645	12 ½	632 ½

As indicated, groundwater was within 1 foot of elevation 632 feet. Given the proximity of the Mississippi River to the site, and the free draining characteristics associated with sand soils, we believe this represents the groundwater elevation for this site. Seasonal and annual fluctuations of groundwater should also be anticipated as the flow and stage of the river change. We recommend assuming the seasonal high groundwater will be near the 100-year flood elevation, which is elevation 642 ½ feet.

B.4. Laboratory Test Results

Table 3 presents the results of our laboratory tests.

Table 3. Laboratory Classification Test Results

Location	Sample Depth (ft)	Classification	Moisture Content (w, %)	Percent Passing a #200 Sieve
ST-1	2 ½	FILL: Poorly Graded Sand with Silt	40	11
ST-1	7 ½	FILL: Poorly Graded Sand with Silt	11	9
ST-2	2 ½	FILL: Poorly Graded Sand with Silt	7	11
ST-2	5	FILL: Poorly Graded Sand with Silt	9	---
ST-2	10	FILL: Poorly Graded Sand with Silt	20	---

C. Recommendations

C.1. Design and Construction Discussion

C.1.a. Introduction

The site is composed of fill that extended to a depth of 11 ½ feet and alluvial sand beneath the fill. The fill contains various amounts of debris including glass, plastic, and refuse. The fill was noted to have variable compaction and due to its composition of general refuse, is considered compressible. The fill is not suitable for support of the proposed concession building.

C.1.b. Building Subgrade Preparation

As mentioned above, the site is composed of fill that is associated with the former landfill. The fill contains debris including glass, plastic, and refuse. The proposed structures will require the fill to be removed to limit post construction settlement, or to have intermediate foundation systems installed to provide support. We have summarized these approaches below:

- **Soil Corrections:** This approach will require excavations to depths of 11 ½ feet to remove the fill and refuse. Dewatering may be required. Also, imported structural fill will be needed to replace the excavation spoils. Consideration may need to be given to properly disposing the excavated material.

- **Partial Soil Correction:** This approach would include removing and replacing the upper 5 feet of fill and refuse with compacted granular structural fill. The fill should be composed of non-frost-susceptible fill composed of sand or gravel that has less than 7 percent particles by weight passing a number 200 sieve. This approach, being less conservative than the soil correction mentioned above, and helical piers mentioned below, could potentially result in the proposed building experiencing some unusual total and differential settlement. This approach should include thickened edge slab, and a minimum 6-inch interior concrete slab to help tolerate settlement and potential mud-jacking of the slab/structure if needed. This approach should also include installation of sub-drains at the bottom of the soil correction. The drains should be placed to collect subsurface water and should be daylighted where collected water can be directed.

- **Helical Piers:** This approach will require the building's footings and slab be supported on helical piers that extend through the fill and into the underlying alluvial sand soils. The fill, however, could contain debris or obstacles that may prohibit some of the piers from being installed. Furthermore, this approach, often, helical piers tend to "run" in loose waterbearing sands resulting in lengthen piers to achieve the anticipated torque resistance at the design depths. This can lead to piles extending significantly beyond the estimated design installation depth. With this approach, the interior helical piers should be designed as a structural slab or mat foundation.

C.1.c. Utility Support

Consolidation and settlement associated with the fill and refuse is difficult to estimate, therefore, we recommend the water main and sanitary sewer lines be supported in the alluvial sand soils, or sand or gravel backfill that extends through the fill and refuse to the alluvial sand soils.

C.1.d. Dewatering

Project planning should include temporary sumps and pumps for excavations above elevation 635 feet. However, any excavation that extends below elevation 635 feet should anticipate the need for dewatering. In the sand soils present at this site, well points or deep wells will likely be required for dewatering. A licensed dewatering contractor should review our report and provide recommendations for dewatering.

C.1.e. Reuse of On-Site Soils

In general, the on-site fill material was found to be debris laden. The debris consisted of variable amounts of glass, plastic, and refuse. Re-use of the on-site fill as structural fill is not recommended due to the amount of debris within the on-site fill. Therefore, these materials should be discarded, or placed in areas where settlement or subsidence is not a concern.

Structural fill, however, should be composed of sand or gravel soils having less than 7 percent particles by weight passing a number 200 sieve. This material will likely have to be imported.

C.2. Concession Building Support

C.2.a. Soil Corrections

We recommend removing unsuitable materials from below the proposed concession building. We define unsuitable materials as existing fill, frozen materials, organic soils, and soft or loose soils. Table 4 shows the anticipated excavation depths and bottom elevations for each of the borings.

Table 4. Building Excavation Depths

Location	Approximate Surface Elevation (ft)	Anticipated Excavation Depth (ft)	Anticipated Bottom Elevation (ft)
ST-1	643	11 ½	631 ½
ST-2	645	11 ½	633 ½

Excavation depths will vary between the borings. Portions of the excavations may also extend deeper than indicated by the borings. A geotechnical representative should observe the excavations to make the necessary field judgments regarding the suitability of the exposed soils.

The contractor should use equipment and techniques to minimize soil disturbance. If soils become disturbed or are wet, we recommend excavation and replacement.

C.2.b. Partial Soil Correction

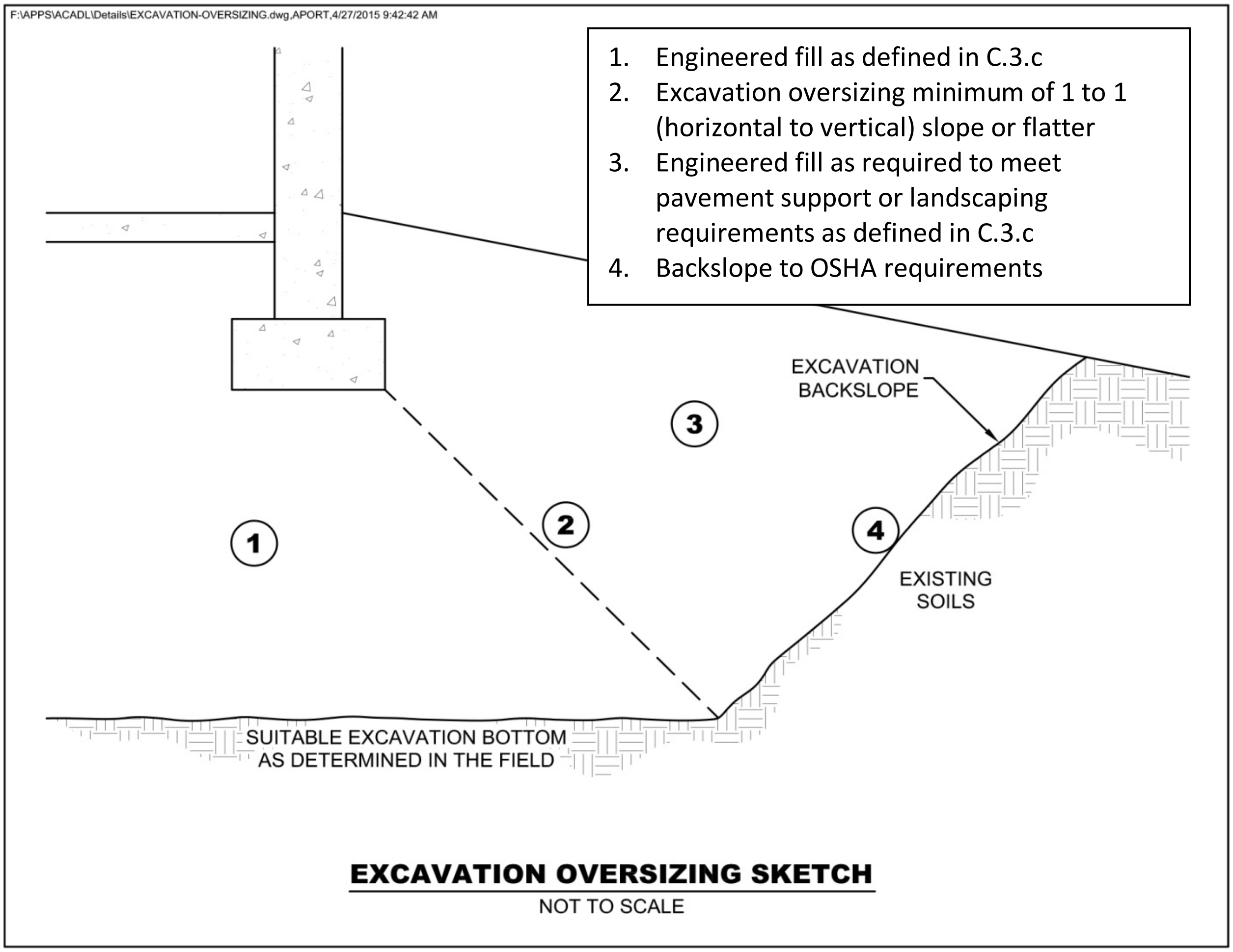
This approach would include removing and replacing the upper 5 feet of fill and refuse with compacted granular structural fill. The fill should be composed of non-frost-susceptible fill composed of sand or gravel that has less than 7 percent particles by weight passing a number 200 sieve. This approach, being less conservative than the soil correction mentioned above, and helical piers mentioned below, could potentially result in the proposed building experiencing some unusual total and differential settlement. This approach should include thickened edge slab, and a minimum 6-inch interior concrete slab to help tolerate settlement and potential mud-jacking of the slab/structure if needed.

This approach should also include installation of sub-drains at the bottom of the soil correction. The drains should be placed to collect subsurface water and should be daylighted where collected water can be directed.

C.2.c. Soil Correction Oversizing

When removing unsuitable materials below structures, we recommend the excavation extend outward and downward at a slope of 1H:1V (horizontal: vertical) or flatter. See Figure 2 for an illustration of excavation oversizing.

Figure 2. Generalized Illustration of Oversizing



C.2.d. Helical Piers

As an alternative approach to soil corrections, the concession building's footings and slabs could be supported on helical piers. With this approach, helical piles should be installed and extended at least 5 to 10 feet below existing fill and should bear in the underlying alluvial sand soils. To facilitate installation in debris-laden soils, the contractor may need to "open up" or "sea shelled". The design submittal should identify if the contractor can alter the helices in this manner. We recommend including a contingency in the project budget to account for installation difficulty and possibly additional piles.

In fine-grained, waterbearing sands, the helical piles may "run", or not achieve the anticipated torque resistance at the design depths. This can lead to piles extending significantly beyond the estimated installation depth. Therefore, we recommend including a contingency in the project budget to account for piles longer than the plan.

With this approach, the interior helical piers should be designed as a structural slab or mat foundation.

C.3. Earthwork Recommendations

C.3.a. Excavated Slopes

Based on the borings, we anticipate on-site soils in excavations will consist of fill and alluvial sand soils. These soils are typically considered Type C Soil under OSHA (Occupational Safety and Health Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type C soils should have a gradient no steeper than 1.5H:1V. Slopes constructed in this manner may still exhibit surface sloughing. OSHA requires an engineer to evaluate slopes or excavations over 20 feet in depth.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

C.3.b. Excavation Dewatering

Any excavation that extends below elevation 635 should anticipate the need for dewatering. In the sand soils present at this site, well points or deep wells will likely be required for dewatering. A licensed dewatering contractor should review our report and provide recommendations for dewatering.

C.3.c. Engineered Fill Materials and Compaction

We recommend spreading engineered fill in loose lifts of approximately 12 inches thick. We recommend compacting engineered fill in accordance with the criteria presented below in Table 5.

Table 5. Engineered Fill Materials*

Locations To Be Used	Engineered Fill Classification	Possible Soil Type Descriptions	Gradation	Compaction Requirements (ASTM D698)
▪ Below foundations ▪ Below interior slabs	Structural fill	GW, GP, SW, SP, SP-SM	100% passing 2-inch sieve <7% passing #200 sieve <2% organic content Free of debris and refuse	98
Below landscaped surfaces, where subsidence is not a concern	Non-structural fill	On-site soils	100% passing 6-inch sieve	90

* More select soils comprised of coarse sands with < 5% passing #200 sieve may be needed to accommodate work occurring in periods of wet or freezing weather.

The project documents should not allow the contractor to use frozen material as engineered fill or to place engineered fill on frozen material. Frost should not penetrate under foundations during construction.

We recommend performing density tests in engineered fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

C.4. Building Design

C.4.a. Spread Footings on Soil Corrected Subgrades

Table 6 below contains our recommended parameters for foundation design.

Table 6. Recommended Spread Footing Design Parameters

Item		Description
Subgrade Improvement and Building Support	Full Soil Correction to remove 11 ½ feet of refuse and fill	Partial Soil Corrections to remove upper 5 feet of refuse and fill
Maximum net allowable bearing pressure (psf)	4,000	

Item		Description
Interior column pad footings Perimeter strip footings		2,000
Minimum factor of safety for bearing capacity failure	3	3
Minimum width (inches)	24	Thickened Edge Slab with 6-inch interior slab
Minimum embedment below final exterior grade for unheated structures or for footings not protected from freezing temperatures during construction (inches)	60	60
Total estimated settlement (inches)	1	1 ½ - 2
Differential settlement	½	1

* Actual differential settlement amounts will depend on final loads and foundation layout. When tying into the existing buildings, the total settlement of this new building will be differential to the existing building. We can evaluate differential settlement based on final foundation plans and loadings.

C.4.b. Subgrade Modulus for Concrete Floor Slabs

The anticipated floor subgrade is expected to be composed of compacted structural fill. We recommend using a modulus of subgrade reaction, k, of 175 pounds per square inch per inch of deflection (pci) to design the slabs. If the slab design requires placing 6 inches of compacted crushed aggregate base immediately below the slab, the slab design may increase the k-value by 50 pci. We recommend that the aggregate base materials be free of bituminous. In addition to improving the modulus of subgrade reaction, an aggregate base facilitates construction activities and is less weather sensitive.

C.5. Utilities

C.5.a. Subgrade Stabilization

Consolidation and settlement associated with the fill and refuse is difficult to estimate, therefore, we recommend the water main and sanitary sewer lines be supported in the alluvial sand soils, or sand or gravel backfill that extends through the fill and refuse to the alluvial sand soils. Project design and construction should not place utilities within the 1H:1V oversizing of foundations.

C.5.b. Dewatering

Any excavation that extends below elevation 635 should anticipate the need for dewatering. In the sand soils present at this site, well points or deep wells will likely be required for dewatering. A licensed dewatering contractor should review our report and provide recommendations for dewatering.

C.6. Equipment Support

The recommendations included in the report may not be applicable to equipment used for the construction and maintenance of this project. We recommend evaluating subgrade conditions in areas of shoring, scaffolding, cranes, pumps, lifts and other construction equipment prior to mobilization to determine if the exposed materials are suitable for equipment support, or require some form of subgrade improvement. We also recommend project planning consider the effect that loads applied by such equipment may have on structures they bear on or surcharge – including pavements, buried utilities, below-grade walls, etc. We can assist you in this evaluation.

D. Procedures

D.1. Penetration Test Borings

We drilled the penetration test borings with a truck-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D6151 taking penetration test samples at 2 1/2- or 5-foot intervals in general accordance with ASTM D1586. The boring logs show the actual sample intervals and corresponding depths.

D.2. Exploration Logs

D.2.a. Log of Boring Sheets

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials and present the results of penetration resistance and other in-situ tests performed. The logs also present the results of laboratory tests performed on penetration test samples, and groundwater measurements. The Appendix also includes a Fence Diagram intended to provide a summarized cross-sectional view of the soil profile across the site.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

D.2.b. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

D.3. Material Classification and Testing

D.3.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

D.3.b. Laboratory Testing

The exploration logs in the Appendix note most of the results of the laboratory tests performed on geologic material samples. The remaining laboratory test results follow the exploration logs. We performed the tests in general accordance with ASTM procedures.

D.4. Groundwater Measurements

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, as noted on the boring logs.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

We developed our evaluation, analyses, and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation, and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made several assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix

BRAUN INTERTEC

BRAUN INTERTEC
The Science You Build On.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2110717
Geotechnical Evaluation
Carroll Park Concession Building
Carroll Park
La Crosse, Wisconsin

BORING:	**ST-1**		
LOCATION: See attached sketch			
NORTHING:	125392	EASTING:	444139
START DATE:	12/22/21	END DATE:	12/22/21
SURFACING:		WEATHER:	Sunny

DRILLER:		LOGGED BY:	B. Wright
SURFACE ELEVATION:	643.0 ft	RIG: Subcontractor	METHOD:

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
641.0 / 2.0		SILTY SAND (SM), with roots, brown, moist (TOPSOIL FILL)					
639.0 / 4.0		FILL: POORLY GRADED SAND with SILT (SP-SM), fine-grained, brown, moist	X	4-4-4 (8)		11	P200=9%
631.5 / 11.5		FILL: POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, black, moist to wet	X	4-4-2 (6)			
			X	1-1-1 (2)		40	P200=11%
		Contains refuse, glass and plastic	X	1-1-4 (5)			
612.0 / 31.0	▽	POORLY GRADED SAND (SP), fine to medium-grained, gray, wet, loose to medium dense (ALLUVIUM)	X	3-6-6 (12)			
			X	4-5-6 (11)			
			X	4-4-4 (8)			
			X	4-4-5 (9)			
			X	4-5-6 (11)			
		END OF BORING Boring then grouted					Water observed at 12.5 feet while drilling.

LOG OF BORING

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2110717
Geotechnical Evaluation
Carroll Park Concession Building
Carroll Park
La Crosse, Wisconsin

BORING:	ST-2		
LOCATION: See attached sketch			
NORTHING:	125392	EASTING:	444198
START DATE:	12/22/21	END DATE:	12/22/21
SURFACING:		WEATHER:	Sunny

DRILLER:		LOGGED BY:	B. Wright		
SURFACE ELEVATION:	645.0 ft	RIG:	Subcontractor	METHOD:	

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Blows (N-Value) Recovery	q_p tsf	MC %	Tests or Remarks
644.5 / 0.5		SILTY SAND (SM), with roots, brown, moist (TOPSOIL FILL)					
		FILL: POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, black, moist	X	4-6-8 (14)		7	P200=11%
			X	6-8-8 (16)		9	
		Contains refuse and glass	X	4-5-5 (10)			
			X	4-2-2 (4)		20	
633.5 / 11.5	▽	POORLY GRADED SAND (SP), fine to medium-grained, gray, wet, loose to medium dense (ALLUVIUM)	X	3-3-4 (7)			
			X	3-3-4 (7)			
			X	4-5-6 (11)			
			X	4-5-7 (12)			
			X	4-6-8 (14)			
614.0 / 31.0		END OF BORING Boring then grouted					Water observed at 11.5 feet while drilling.

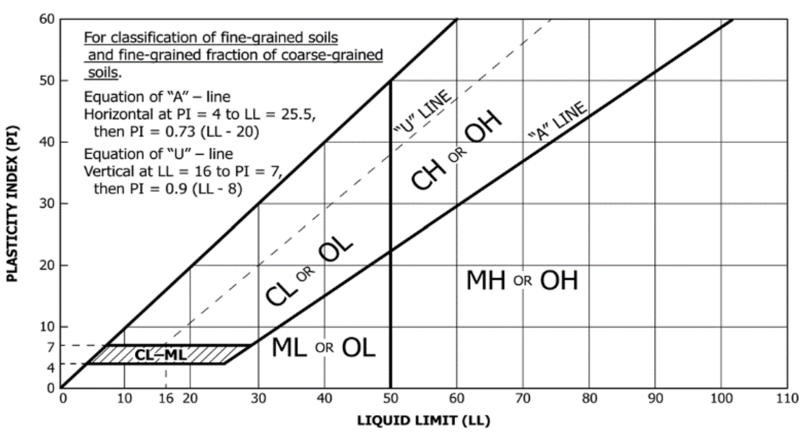
BRAUN INTERTEC
The Science You Build On.

Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-grained Soils (more than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines[C])	$C_u \geq 4$ and $1 \leq C_c \leq 3$[D]	GW	Well-graded gravel[E]
			$C_u < 4$ and/or ($C_c < 1$ or $C_c > 3$)[D]	GP	Poorly graded gravel[E]
		Gravels with Fines (More than 12% fines[C])	Fines classify as ML or MH	GM	Silty gravel[E F G]
			Fines Classify as CL or CH	GC	Clayey gravel[E F G]
	Sands (50% or more coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% fines[H])	$C_u \geq 6$ and $1 \leq C_c \leq 3$[D]	SW	Well-graded sand[I]
			$C_u < 6$ and/or ($C_c < 1$ or $C_c > 3$)[D]	SP	Poorly graded sand[I]
		Sands with Fines (More than 12% fines[H])	Fines classify as ML or MH	SM	Silty sand[F G I]
			Fines classify as CL or CH	SC	Clayey sand[F G I]
Fine-grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OL	Organic clay [K L M N] / Organic silt [K L M O]
	Silts and Clays (Liquid limit 50 or more)	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		Organic	Liquid Limit – oven dried / Liquid Limit – not dried <0.75	OH	Organic clay [K L M P] / Organic silt [K L M Q]
Highly Organic Soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:
   - GW-GM well-graded gravel with silt
   - GW-GC well-graded gravel with clay
   - GP-GM poorly graded gravel with silt
   - GP-GC poorly graded gravel with clay
D. $C_u = D_{60} / D_{10}$ $\quad C_c = (D_{30})^2 / (D_{10} \, x \, D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:
   - SW-SM well-graded sand with silt
   - SW-SC well-graded sand with clay
   - SP-SM poorly graded sand with silt
   - SP-SC poorly graded sand with clay
I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add “sandy” to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add “gravelly” to group name.
N. PI ≥ 4 and plots on or above “A” line.
O. PI < 4 or plots below “A” line.
P. PI plots on or above “A” line.
Q. PI plots below “A” line.



Laboratory Tests

DD	Dry density, pcf	**q_p**	Pocket penetrometer strength, tsf
WD	Wet density, pcf	**q_U**	Unconfined compression test, tsf
P200	% Passing #200 sieve	**LL**	Liquid limit
MC	Moisture content, %	**PL**	Plastic limit
OC	Organic content, %	**PI**	Plasticity index

Particle Size Identification

Boulders............. over 12"
Cobbles............... 3" to 12"
Gravel
   Coarse............ 3/4" to 3" (19.00 mm to 75.00 mm)
   Fine................ No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand
   Coarse............. No. 10 to No. 4 (2.00 mm to 4.75 mm)
   Medium........... No. 40 to No. 10 (0.425 mm to 2.00 mm)
   Fine................. No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt........................ No. 200 (0.075 mm) to .005 mm
Clay...................... < .005 mm

Relative Proportions[L, M]

trace............................ 0 to 5%
little............................. 6 to 14%
with.............................. ≥ 15%

Inclusion Thicknesses

lens............................... 0 to 1/8"
seam............................. 1/8" to 1"
layer.............................. over 1"

Apparent Relative Density of Cohesionless Soils

Very loose .... 0 to 4 BPF
Loose .... 5 to 10 BPF
Medium dense............. 11 to 30 BPF
Dense........................... 31 to 50 BPF
Very dense................... over 50 BPF

Consistency of Cohesive Soils	Blows Per Foot	Approximate Unconfined Compressive Strength
Very soft	0 to 1 BPF	< 0.25 tsf
Soft	2 to 4 BPF	0.25 to 0.5 tsf
Medium	5 to 8 BPF	0.5 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

Sample Symbols

Standard Penetration Test	Rock Core
Modified California (MC)	Thinwall (TW)/Shelby Tube (SH)
Auger	Texas Cone Penetrometer
Grab Sample	Dynamic Cone Penetrometer