ADDENDUM NUMBER 1

for

Oak Creek Water and Sewer Utility, Oak Creek Wisconsin

Pre-selection Documents

for the

Prestressed Concrete Storage Tank

FROM: CH2M HILL
135 South 84th Street
Milwaukee, WI 53214

TO: Plan Holders

DATE: April 27, 2015

The following changes, additions, and deletions are hereby made a part of the project Bidding Requirements and Contract Documents as fully and completely as if the same were set forth therein. Acknowledge receipt and acceptance of this Addendum in the space provided on the BID FORM. Failure to do so may result in rejection of the Bid.

GENERAL

1. The Bid date will be extended to May 07, 2015, 2:00 pm.
2. The geotechnical memorandum has been revised and is attached for information.
3. Answers to questions raised during bidding are attached.

SPECIFICATIONS

SECTION 00 11 15 – ADVERTISEMENT

1. Page 1, third paragraph: Delete "30th day of April" and add "7th day of May.
2. Page 2, DELETE items 3) and 4): These paragraphs do not apply to the Tank Supplier since they will be a subcontractor to a General Contractor.

SECTION 00 11 57 – REQUEST FOR PROPOSAL AND STATEMENT OF QUALIFICATIONS

1. Page 2, item 2.1.2: Add "g. Signage"
2. Page 2, item 4. Change "Utility" to "Owner".
3. Page 4, 4.2.4: Change "Five (5)" to "Three (3)".
4. Page 9, 6.6 Project Cost: change "Utility" to "Owner". Delete the last sentence.
5. Page 9, 6.6.2: Revise paragraph to read: "By signing the Bid Form (00 41 13) the Supplier certifies that if selected the Supplier will enter into a Subcontract Agreement with the Installing Contractor."

SECTION 00 41 13 – BID FORM

1. Replace Bid Form with attached Bid Form. The only change was in item 8, "2013" was changed to "2015".

SECTION 33 16 13.15 – PRESTRESSED CONCRETE TANK

1. Replace this specification section with the attached revised specification section.

DRAWINGS

DRAWINGS 01-G-12 and 01-G-13

1. These drawings have structural design criteria that apply to the storage tank.

DRAWINGS 05-C-234 and 05-C-235

1. Although site work and earthwork are not included in the scope of work, site grading drawings are provided for information.

DRAWINGS 40-SD-231, 40-SD-301

1. Replace these drawings with attached revised drawings.

DRAWINGS 40-A-241

1. Add the following Note: "TANK HATCH TO BE INSTALLED ON A CONCRETE CURB A MINIMUM 4-INCHES ABOVE THE TOP OF THE TANK. TOP OF CONCRETE CURB TO BE HORIZONTALLY LEVEL."

DETAIL 4027-601

1. Replace with new detail attached. A ball joint has been added.

DETAIL 4027-615

1. Delete this Detail.

End of Addendum 1

Subsurface Exploration and Geotechnical Engineering Analyses – 2016 Water Treatment Plant Improvements

PREPARED FOR:	Oak Creek Water and Sewer Utility
COPY TO:	Project Team
PREPARED BY:	Charles J. Winter, P.E., Senior Geotechnical Engineer
DATE:	April 24, 2015
PROJECT NUMBER:	653463.03.35.30.36
REVISION NO.:	Draft - 2

1.0 Project Overview

The project involves constructing three structures and related facilities to the north and west of the existing Oak Creek Water Treatment Facility at 9325 South 5th Avenue in Oak Creek, Wisconsin. The three structures consist of:

1. An intermediate pump station (IPS) and ultraviolet radiation (UV) treatment facility. This structure will have a rectangular footprint with approximate plan dimensions of 104 feet by 61 feet. The structure will be positioned 66 feet north of the "Filters 7 to 14" building. The southern approximate 47 feet of the facility will have a deep "wet well" structure. The wet well will have a base slab subgrade of approximate elevation 57.5[1]. The remainder of the structure will have a base slab elevation of either 87 or 96, with frequent undulations in the base slab and perimeter foundations to accommodate required subterraneous piping. The wet well will impart a net stress load to the underlying soils of approximately 3.3 kips per square foot (ksf); the remainder of the facility will be supported on building perimeter foundations imparting a net stress increase between 2.5 to 6 kips per lineal foot (klf) for dead (structure) load and 1.2 klf for snow load. Slab loads are anticipated to be in the range of 100 pounds per square foot (psf). An enclosed walkway will connect the facility south to the existing plant.

2. A 2-million-gallon storage tank. The tank will be circular in plan dimension and will be positioned approximately 250 feet north of the Administration and Filtration Facility, on land owned by the city of Oak Creek. The tank will have an inside diameter of 100 feet and have a base slab elevation of 96; this elevation is between 4 to 8 feet above existing ground surface elevation. The tank structure will be supported on a perimeter (ring) foundation with dead load of 5.4 kips per lineal foot and a liquid load of 4.4 kips per lineal foot. The base slab will be relatively thin with thickened edges and will impart a maximum hydraulic load of 35 feet of water (approximate load of 2.2 ksf) directly to the underlying subgrade.

3. A high-lift pump facility. The facility will be rectangular in plan view, with approximate dimensions of 141 by 58 feet. The structure will be positioned approximately 270 feet north of the Administration and Filtration Facility and will be approximately 15 feet east of the before-mentioned planned storage tank. The eastern and western thirds of the facility will have a base slab elevation of approximately 89 with the central third with a base slab elevation of 97.

Process piping will be installed to connect the existing facility to the proposed facilities and into the existing distribution system. The proposed piping will have diameters ranging between 24 and 42 inches and will consist of either ductile iron or precast pre-stressed concrete pipe.

1 Unless noted otherwise all elevations in this report are assumed to be positive, in units of feet and with respect to the project datum (City of Oak Creek Datum).

Significant earthwork, typically resulting in increasing grades between 2 and 4 feet above existing grade will be performed to facilitate drainage. A storm water pond will be excavated on the northern portion of the property, approximately 100 feet north of the proposed High Lift Pump Station. The base of the pond is at approximate elevation 91 resulting in as much as 6 or 7 feet of excavation below existing grade to facilitate pond construction.

Paved access paths will be constructed to connect the new facilities to both the existing facility and to a new eastern gate on 5th Avenue.

1.1 Existing Site Conditions

The project site is divided between two parcels of land; the IPS/UV facility will be positioned on land currently within security perimeter fencing associated with the existing water treatment facility. The parcel is currently grass-covered and relatively level, with surface elevations ranging between 93 and 96.

The water storage tank and the high-lift pump facility will be constructed on undeveloped land immediately north of the treatment plant; the land extends from the existing perimeter fence to American Avenue on the north and 5th Avenue on the east. The land has an undulating ground surface, with ground surface elevations ranging between 89 and 99, with the lowest elevations nearest the existing treatment plant, increasing to the north.

The parcel is covered with grass. Anecdotal information from the Client suggests that a tavern once occupied the parcel near the corner of American Avenue and South 5th Avenue. There was also recollection that some fill may have been placed to establish current grades. Small areas of concrete were exposed at the ground surface on the parcel.

2.0 Exploration Procedures

2.1 Field Exploration Procedures

The subsurface exploration program consisted of drilling 12 soil borings. The original subsurface exploration program, executed before finalization of building footprints, consisted of drilling two soil borings (denoted 2014-1 and 2014-2) in the area slated for the intermediate pump station / UV treatment facility, two soil borings (2014-3 and 2014-4) in the area slated for the storage tank, two borings (2014-5 and 2014-6) drilled for the high lift pump facility, and one soil boring (2014-7) drilled in an area slated for a proposed detention pond. Subsequent to the execution of the borings the footprint for the storage tank and the pond were significantly changed; this necessitated two additional soil borings (2014-8 for the tank, 2014-9 for the pond). Two soil borings (2014-3A and 2014-4A) were drilled, at the drilling subcontractor's expense, at borings 2014-3 and 2014-4 to obtain information that was inadvertently not collected during the original exploration. Finally one boring (2014-8PMT) was drilled to facilitate pressuremeter testing in the footprint of the storage tank.

Borings were advanced to depths ranging from 20 to 100 feet, with at least one boring of at least 70 feet drilled in the footprint of each structure. The number of borings and their respective depths were established by CH2M HILL. As-drilled boring locations are indicated on the Soil Boring Location Diagram attached to this Memoradum.

The drilling was facilitated by Terracon, Inc. of Franklin, Wisconsin (Terracon). Terracon performed drilling coordination, laboratory testing, and pressuremeter testing/data reduction. The drilling was subcontracted by Terracon to J&J Soil Testing Ltd. (J&J) of Richfield, Wisconsin. Borings 2014-1 through 2014-7 were staked by the project civil engineer, GRAEF, Inc. of Milwaukee, Wisconsin. The remaining borings were located by the driller using tape-and-stake methods referenced to available site features. Ground surface elevations at boring locations were determined based on a topographic survey map supplied by GRAEF, Inc., and are indicated on the boring logs in the attached Terracon Geotechnical Data Report.

The borings were drilled using a CME-45 drill rig and a two-person drill crew. J&J logged conditions encountered in the borings. The drilling methods used to advance the borings are noted on the boring logs.

Soil samples were obtained in the borings at 2.5-foot intervals to either 10 feet or through fill/organic/low strength soils (whichever is deeper), and at 5-foot intervals thereafter to the boring termination depth in the deeper borings. The samples were obtained in general accordance with ASTM Specification D-1586. Selected samples were obtained using 3-inch-diameter thin-walled "Shelby" tubes in accordance with ASTM D-1587.

As each soil sample was brought to the ground surface, the material was preliminarily classified by J&J. Representative portions of the split-barrel samples were then placed in glass jars. Aluminum foil was then placed at the top of each jar and a cap was used to seal each jar. Upon completion of the field exploration program, all obtained samples were delivered Terracon for further classification and laboratory testing.

During drilling operations, J&J maintained a field log for each boring which described the method(s) of borehole advancement, sample types, sample depths, lengths of sample recoveries, and observations regarding soil and groundwater conditions. These field logs were later used by the geotechnical engineer as an aid in preparing the final boring logs. Final boring logs are contained in the Terracon Geotechnical Data Report attached to this memorandum.

2.2 Laboratory Testing Procedures

Each soil sample was visually examined by a Terracon geotechnical engineer, and classified on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS). A chart describing this system of classification is included in the Terracon report attached to this memorandum. The two-letter designator following each soil description on the boring log is the group symbol using this method of classification.

Similar soils were grouped into the major zones noted on the boring logs. In some cases, strata contact lines have been estimated. Where strata changes occur between sampled depths, and the driller's field log does not indicate a strata change depth based on drilling action, the strata change depth is indicated as the midpoint between recovered sample depths. In-situ, the transition between soil types may not occur at the midpoint between sampled depths, and may be gradual in both the horizontal and vertical directions. For these reasons, for this report narrative, referenced soil-strata depths and thicknesses should be considered approximate.

The laboratory testing program consisted of performing calibrated penetrometer strength tests, and water content tests on selected cohesive soil samples, unconfined compression tests on 6 samples, Atterberg limit tests on 9 samples, and one-dimensional consolidation testing on one Shelby tube sample.

The calibrated penetrometer strength test is a method of estimating a cohesive soil's unconfined compressive strength by measuring the soil's resistance to penetration by a small, spring-calibrated plunger. The water content test is used as a qualitative indicator of the compressibility of the soil.

Photo-ionization detector (PID) readings were obtained on each sample, with the exception of samples from borings 2014-3 and 2014-4 (which was a laboratory oversight, hence requiring drilling borings 2014-3A and 2014-4A). PID readings are discussed in Section 3.5.

The laboratory test results are presented on the boring logs Consolidation results and plots of the unconfined compression and Atterberg limit results are provided in the Terracon geotechnical data report attached to this memorandum.

3.0 Exploration Results

3.1 Previous Explorations

Several previous subsurface explorations were performed, at various time periods, in conjunction with construction and subsequent expansion of the existing water treatment plant. There is considerable geotechnical information associated with design of the existing facilities, however the information was not proximate to the proposed structures. No subsurface information was available regarding the undeveloped land to the north of the existing plant.

3.2 Subsurface Conditions

The following narrative is a generalization of the subsurface conditions encountered by the borings drilled in the vicinity of the proposed addition areas, with depths approximate, and referenced to existing ground surface. For a more-detailed description of the subsurface conditions encountered at each boring location, please refer to the boring logs in the attached Terracon Geotechnical Data Report.

3.2.1 Topsoil

Topsoil was encountered at the surface at each boring location. Topsoil thicknesses varied from 2 to 18 inches.

3.2.2 Fill Soils

Fill was encountered in each soil boring. The composition and consistency of the fill was markedly different in borings 2014-1 and 2014-2 compared to the rest of the borings.

The fill encountered in borings 2014-1 and 2014-2 was comprised predominantly of stiff to hard lean clay. The fill in these two borings extended to a depth of 12 feet (elevation 82.7) in boring 2014-1 and 14 feet (elevation 79.5) in boring 2014-2. No organics or man-made matter were observed in the fill. Water contents ranged from 16 to 23 percent, with full (or near-full) recoveries on each sample. The homogeneity of this material, the lack of foreign or organic matter, and the SPT and unconfined compressive strength suggest that this material was placed in some kind of engineered manner. This material is suitable for support of lightly loaded foundations and floor slabs.

The fill encountered in the remainder of the borings (borings in the north parcel) also encountered fill, although the fill was considerably more heterogeneous and contained organics and man-made matter.

The fill in the borings on the north parcel extended the deepest in boring 2014-7 (where fill extended to elevation 79.5) and precipitously increased to the north and west, with bottom-of-fill elevations of 84 to 86 in the borings drilled proximate to the proposed tank (borings 2014-3/3A, 2014-4/4A, and 2014-8/8PMT) and bottom-of-fill elevations increasing to 90.5 in the northern-most boring (2014-9). The fill generally consisted of lean clay with sporadic occurrences of fat clay. Man-made materials including asphalt, cinders, and concrete rubble were encountered within the fill. Organic matter, including topsoil and peat were also common within the fill. The man-made and organic fill components were most-pronounced in the borings near the proposed tank. The uppermost 3 to 4 feet of clay in most borings had consistencies in the very stiff to hard range (with unconfined compressive strengths of 3 to 4.5 tons per square foot (tsf)). The underlying clay was markedly weaker, with confined compressive strengths ranging between 0.25 and 1.0 tsf. Water contents were also varied, with some borings exhibiting fill with water contents between 15 and 25 percent and other borings, particularly borings 2014-3 and 2014-7 encountering water contents ranging as high as 58 to 195 percent. The heterogeneity of the soils, the presence of man-made matter and the weak nature of the soils indicates that these fill materials were not placed in a controlled and engineered manner; these soils are considered weak and highly compressible; they are not considered suitable for support of foundations or building slabs.

3.2.3 Organic Soils

Predominantly organic soils, likely native and deposited as an estuarine deposit, were encountered in borings 2014-3/3A, 2014-4/4A, 2014-5, and 2014-8. These soils were comprised predominantly of organic silts, organic clays, and peats. These soils extended to approximate elevation 80 in borings 2014-3/3A, 2014-4/4A, and 2014-5, and elevation 74 in boring 2014-8. These soils have very low SPT values (typically 3 blows per foot (bpf) or less) and high water contents ranging from 54 to 132 percent. A consolidation test was performed on a sample of organic material in boring 2014-5. These organic soils are considered very weak and highly compressible and not suitable for support of foundations or floor slabs in their current condition.

3.2.4 Native Inorganic Soils

Inorganic native soils consisting of lean clay were consistently encountered below the above-described fill and/or organic materials in every boring. The composition of the clay and the geologic depositional history of the site suggests that these soils are glacial till deposits. These soils typically exhibited consistencies in the very stiff to hard range, with the noticeable exception of soils between elevation 72 and 76.5 in boring 2014-4, which exhibited a firm consistency[2]. Water contents were generally between 15 and 25 percent, which is typical for glacial tills of the area. These soils extended to the maximum depth of each boring. Intermittent silt and sand seams were also encountered at-depth in many borings; such seams are typical of glacial deposits in the area.

3.3 Groundwater Conditions

When possible during drilling operations, the driller observed groundwater conditions in the open boreholes. These short-term observations are summarized in the lower-left corner of the boring logs.

Groundwater was encountered, while drilling, in six borings (borings 2014-3/3A, 2014-4/4A, 2014-5, and 2014-8). The depth to groundwater ranged from 9 to 17.5 feet, with corresponding elevations ranging from 76.5 to 84.8. Please note that many borings were drilled using drilling fluid at depths below 15 feet (such borings include 2014-1 through 2014-6, sans 2014-3A and 2014-4A); the introduction of fluid, while providing for a stable borehole and more-representative SPT values, obscures observation of groundwater at greater depths and also obscures groundwater information after borehole completion. Furthermore, given the predominance of cohesive soils the occurrence of groundwater may be more indicative of a seam of permeable saturated material and not necessarily indicative of a groundwater table.

In light of the above discussion, the elevation at which groundwater was noted coincides well with the bottom of organic deposits; given the likely estuarine (marsh) deposition of these deposits it is likely that the groundwater table is between 76.5 and 84.5. For purposes of design we have assumed that the groundwater table is approximately 5 feet below existing ground surface. Please note that these elevations are approximate and fluctuations in the groundwater table can and do occur in response to precipitation, evaporation, surface runoff and localized dewatering activities in the area.

Soils with low hydraulic conductivity, such as those encountered in this investigation, generally require longer time intervals in order for groundwater equilibrium to be achieved. If a more accurate determination of the groundwater table is desired, groundwater observation wells could be installed, and groundwater observations may be obtained over an extended time period.

[2] Samples 8 and 9 of boring 2014-4, while exhibiting low compressive strength (as determined by a calibrated penetrometer) had high SPT values (36 and 33 blows per foot), which suggests that this material was highly disturbed when removed from the borehole, which may attribute to the unusually low unconfined compressive strength values.

3.4 Pressuremeter Test Results

A pressuremeter testing program was undertaken to provide in-situ soil parameters for use in foundation design of the proposed storage tank. The pressuremeter is an in-situ test device consisting of a cylindrical probe that is inserted into a pre-drilled borehole, and expanded against the soil on the sides of the borehole. The probe is then incrementally inflated at various pressures. The deformation of probe at the various pressures is recorded and used to estimate the stress-strain characteristics of the soil.

The pressuremeter tests were performed by Terracon in boring 2014-8PMT. The depths at which tests were performed were selected based on the proposed elevation of the base slab, and on the soil deposits encountered during sampling in borings 2014-8.

The results of the pressuremeter tests are presented in Table 1.

TABLE 1
Pressuremeter Test Results Summary

Boring Number	Depth, feet	Po, tsf	Pf, tsf	Pl, tsf	Ed, tsf	E+, tsf	Ed/E+, tsf
2014-8PMT	18.0-20.5	1.5	4.6	9.1	80	169	0.47
	35.0-37.5	2.6	8.4	19.2	129	243	0.53
	50.0-52.5	3.0	12.0	27.8	259	464	0.56
	78.0-80.5	4.0	13.0	32.8	233	678	0.34
						Average	0.45

The at-rest pressure, P_o, represents the pressure at which the probe has expanded into firm contact with the soil on the sides of the borehole, and the pressure at which the plot of probe volume versus pressure becomes linear. The creep pressure, P_f, represents the pressure at which the plot ceases to be linear (i.e., the pressure at which increasing deformations result from a given incremental pressure increase). The limit pressure, P_l, is the pressure at which complete failure of the soil has occurred (i.e., the plot is vertical). The deformation modulus, E_d, is the slope of the initial linear portion of the plot. The E^+ modulus is the slope of the recompression portion of the plot.

The results of the pressuremeter tests are graphically presented in the form of plots of probe volume versus applied pressure in the Terracon geotechnical data report attached to this memorandum.

3.5 Photo-Ionization Detector Readings

A Thermo 580B OVM photoionization detector (PID) was used to screen the soil cuttings on jarred samples in the lab immediately prior to classification. The unit was last serviced in October 2014 and was calibrated the same day the monitoring was performed. The instrument is capable of detecting certain volatile organic compounds (VOCs), including many of the volatile components characteristic of petroleum products and common solvents. PID readings are documented on the boring logs in the Terracon geotechnical data report attached to this memorandum.

4.0 Analyses and Recommendations

There are several components to the proposed water plant improvements. They include three structures (described in Section 1.0); each of these structures presents different issues with regard to foundation design and construction. In addition to the structures there is significant underground piping proposed and there is considerable planned earthwork, including a new stormwater detention pond on the north portion of the project site. Each of these elements is discussed below.

4.1 Immediate Pump Station (IPS) / Ultraviolet (UV) Disinfection Building

The soils in the vicinity of the footprint of the proposed IPS/UV building consist of between 12 and 14 feet of lean clay fill overlying lean clay glacial till. As described in Section 3.2.2 the fill soils were relatively homogeneous, typically exhibited very stiff consistencies, and did not contain organic or man-made matter that was typical in fills explored in borings for the other structures. The fill soils are suitable for support of shallow spread foundations (for the portions of the IPS/UV structure with footing subgrade elevations 87 and 95) as well as conventional slabs-at-grade. Shallow spread foundations bearing on inorganic soils can be proportioned for a maximum net allowable soil bearing stress of 2,000 pounds per square foot (psf). The net allowable bearing stress refers to the stress transmitted to the soil in excess of the minimum final adjacent overburden stress. We expect soils suitable for the recommended bearing stress to be present at the design foundation elevations.

Exposed subgrade soils should exhibit an unconfined compressive strength of at least 1.0 tsf. We anticipate suitable soils will exist at the proposed subgrade conditions. However, if suitable soil conditions are not encountered at the planned foundation subgrade, then the foundations should extend through the unsuitable soil and bear on the suitable soils below. In any areas where overexcavations are required, it may be desired to support those foundations at the original planned elevation. Overexcavations may be extended to suitable soils and backfilled with cementious low strength material ("CLSM"); CLSM should have sufficient Portland cement and/or fly ash content to achieve a minimum 28-day unconfined compressive strength in the range of 50 to 150 pounds per square inch (psi). If the overexcavations are backfilled using structural soil fill, the fill should consist of a reasonably well-graded select granular material containing less than 12 percent by weight passing the No. 200 sieve, and placed and compacted as described in Section 5.2. The overexcavations should extend a minimum of 1-foot horizontally from each edge of the footing for each foot of fill required below the footing base.

The wet-well portion of the IPS/UV building, extending to elevation 57.5, will be bearing in very stiff glacial soil. Foundations / mat slabs extending to this elevation can be proportioned for a maximum net allowable soil bearing stress of 4,000 psf. It is suspected that this wet-well will impart a very low net bearing stress, when the weight of the soil displaced is considered. Soils at this elevation should exhibit an unconfined compressive strength of at least 2 tsf; soils that are disturbed or do not meet the above requirement should be removed and replaced as described above.

We anticipate that the wet-well portion of the IPS/UV facility will experience relatively little settlement. However the portion of the IPS/UV supported at the higher elevations may exhibit settlement on the order of ¾ to 1 inch; so differential settlements on the order of ¾ inch may be incurred between the wet-well and adjacent portions of the building. We recommend that the structure be designed with joints to allow for the estimated differential settlement.

The wet well will require deep excavation and an excavation retention system, as discussed in Section 5.5. Regardless of the type of retention system there will be an annulus (void), likely on the order of a couple of feet between the finished wet well walls and the undisturbed adjacent soil. We recommend that this annulus be kept as minimal as practical and the annulus be backfilled with a controlled cementious material (CLSM) with minimum properties described earlier in this section.

The slab for the IPS/UV building should be able to be supported at grade, provided the subgrade is properly prepared and proofrolled as described in Section 5.1. To provide a uniform floor slab bearing surface, and to provide a barrier against the capillary rise of water, we recommend that a minimum of 6 inches of free-draining granular material be placed directly below the floor slabs. For this purpose we recommend the use of an angular aggregate meeting the gradation requirements of ASTM Specification C-33, Coarse Aggregate, Size 67 or an equivalent free-draining material. In addition, a vapor barrier should be used under slabs on which moisture-sensitive floor coverings will be used.

At a minimum, the floor slabs should be nominally (mesh) reinforced, and should be constructed independently from foundation-supported walls and columns to allow for differential movement between these elements. For lightly-loaded floor slabs, we anticipate settlements on the order of ¼ inch. This estimate assumes proper compaction of engineered fill beneath the floor slabs, and of backfill placed in foundation excavations and utility (pipe) trenches. The walls of the wet well should be designed to resist lateral earth pressure. Since the wet well walls will not be equipped with an exterior drainage layer, the walls should be designed to withstand hydrostatic pressure in addition to soil pressure. Since the structure will not allow the walls to deflect the walls should be designed for an equivalent at rest fluid pressure of 50 psf per foot of depth, above elevation 90 (above the long-term groundwater table), and 90 psf per foot of depth below elevation 90 (below the groundwater table). The higher value below the groundwater table reflects the added force due to hydrostatic water pressure. A waterproofing membrane should be applied to the exterior surface of the below-grade structure.

The lateral earth pressure acting on below-grade walls would be increased by surcharge loads acting on the ground surface adjacent to the wall. To account for typical construction surcharge loads, such as loaded concrete trucks, we recommend that the walls be designed for a uniform lateral pressure of 200 psf within 10 feet of the ground surface, and a uniform lateral pressure of 100 psf for depths between 10 and 20 feet below the ground surface. A waterproofing membrane should be applied to the exterior surface of the below-grade structure.

In order to limit frost penetration below foundations, we recommend that exterior and perimeter foundations bear at a minimum depth of 4 feet below the lowest final adjacent ground surface. For stability considerations during construction, isolated column and continuous wall foundations should have minimum widths of 30 and 18 inches, respectively.

4.2 High-Lift Pump Station

The high-lift pump station (HLPS) will have base slab subgrade elevation of 88 for the approximate eastern and western thirds and will have a subgrade elevation of 96 for the middle third. All foundations for the facility are proposed to bear at elevation 88. Several subterranean pipes will enter and exit the facility.

The soil conditions encountered in borings drilled in proximity to the footprint of the High-Lift Pump Station (2014-5 through 2014-7) encountered 6 to 10.5 feet of various fill materials, and in the case of boring 2014-5, encountered an additional 6.5 feet of highly organic matter underneath the fill. The fill and organic matter encountered in these borings is unacceptable for support of building foundations, building slabs, or pumps and other machinery. For this reason we recommend that all fill, organic materials, and soft to stiff inorganic clays be removed from the entire building footprint. This will require between 6.6 and 8.5 feet of overexcavation, as detailed in Table 2.

TABLE 2

Depths and Elevations of Suitable Bearing Soils - HLPS

Boring No.	Boring Surface Elevation, feet	Subgrade Elevation, feet	Suitable Soil Elevation, feet	Anticipated Overexcavation, feet
2014-5	94.1	88	80	8
2014-6	95.4	88	81.4	6.6
2014-7	90	88	79.5	8.5

Overexcavations may be extended to suitable inorganic soils and backfilled with either compacted fill material, lean concrete or cementious low strength material ("CLSM"). Backfill soil should be placed and compacted as described in the earthwork recommendation section (Section 5.2). CLSM, if used, should have sufficient Portland cement and/or fly ash content to achieve a minimum 28-day unconfined compressive strength in the range of 50 to 150 pounds per square inch (psi).

Foundations bearing either on the very stiff native inorganic clay (approximate surface identified in Table 1) or on properly placed and compacted soil fill (or CLSM) can be proportioned for a maximum net allowable soil bearing stress of 4,000 psf. The net allowable soil bearing stress refers to the stress transmitted to the soil in excess of the minimum final adjacent overburden stress.

The portions of the HLPS below elevation 90 should be considered to be below the groundwater table. Based on conservations with the design team the below-grade portion of the structure will not be equipped with drainage material and the structure will be designed to withstand hydrostatic pressure in addition to lateral earth pressure. Based on this the recommendation is to design the below-grade walls of the structure to withstand a combined hydrostatic and earth pressure force of 90 psf per foot depth below grade. A waterproofing membrane should be applied to the exterior surface of the below-grade structure.

It is our understanding that the floor slabs for the HLPS will be structurally tied into the walls of the structure. This includes the inner 1/3 of the building which will have a significantly higher base slab.

Some pumping equipment in the HLPS will be supported on mat foundations that are structurally isolated from the remainder of the structure. Mat foundations are typically designed using beam on elastic foundation theory. It is our opinion that a vertical modulus of subgrade reaction (Kv) of 120 pounds per cubic inch (pci) is appropriate for design of mat foundations supported on the native inorganic cohesive soils. This value is based on a 30-inch-diameter plate. The value should be adjusted, as appropriate, during final slab design.

4.3 Storage Tank

The storage tank is described in Section 1.0 and the subsurface conditions encountered in the vicinity of the proposed tank location are represented by the logs of borings 2014-3/3A, 2014-4/4A and 2014-8/8PMT. The tank will have a slab subgrade elevation of 97. The slab subgrade elevation is between 2 and 6 feet above existing site grades. The soils encountered near the surface, consisting of heterogeneous fills containing considerable man-made debris and organic soils, are not considered suitable for support of the tank. The elevation and depth (below existing ground surface) to where suitable soils exist is presented in Table 3.

TABLE 3

Depths and Elevations of Suitable Bearing Soils – Water Storage Tank

Boring No.	Boring Surface Elevation, feet	Subgrade Elevation, feet	Suitable Soil Elevation, feet	Total Fill Under Slab, feet	Overexcavation, feet
2014-3	93.8	97	80	17	13.8
2014-3A	93.8	97	80.5	16.5	13.3
2014-4	95	97	80	17	15
2014-4A	95	97	84	13	11
2014-8	91.5	97	74	23	17.5

There are two options for support of the tank. The first option is to remove the unsuitable soils under the entire tank footprint. The magnitude of overexcavation is indicated in the last column of Table 3. The soils will need to be replaced with fill placed and compacted as described in Section 5.2. This will result in between 13 and 23 feet of newly placed fill between the tank slab and the underlying native inorganic glacial till soils. Anticipated settlements under this scenario are provided in Table 4.

TABLE 4

Anticipated Settlement of Tank Assuming Poor Soils Removed and Replaced with Suitable Fill

Long-Term Settlement of Engineered Fill, inches[A]			Long-Term Settlement of Native Soils, inches[A]			Total Estimated Settlement, inches[A]		
Center	Edge	Differential	Center	Edge	Differential	Center	Edge	Differential
1.0	1.0	0.0	4.7	2.8	1.9	5.7	3.8	1.9

[A] Assumes engineered fill placed in maximum 8-inch-thick lifts and compacted to equivalent dry density equal to 95% of that obtained on representative sample of material tested to modified Proctor specifications (ASTM D-1557).

The values in Table 4 were derived using finite-element modeling using the PLAXIS software, and modeling the native cohesive till soils with moduli obtained through pressuremeter testing (Section 3.4). Compressibility of properly placed and compacted inorganic fill was estimated by reviewing research done on the topic[3].

If settlement magnitudes provided in Table 4 are unacceptable we recommend a deep foundation solution. As of issuance of this report the above settlements are considered tolerable to a typical tank foundation described above; therefore no deep foundation solution is envisioned. It is important that all piping connecting to the tank be equipped to tolerate settlement magnitudes identified in Table 4.

Similar to the other structures, the perimeter foundation for the tank should extend a minimum of 4 feet below adjacent ground surface to minimize impacts due to frost on the performance of the facility.

The ring foundation may be proportioned for a net allowable bearing stress of 3.0 ksf. The net allowable soil bearing stress refers to the stress transmitted to the soil in excess of the minimum final adjacent overburden stress.

[3] "Soil Compaction Specification Procedure for Desired Field Strength Response", produced by the Joint Highway Research Project (Purdue University, West Lafayette, IN) for the Federal Highway Administration (Report No. JHRP-78-7), June 1978.

4.4 Yard Piping

There will be many pipes connecting the existing plant to the proposed structures, and the proposed structures to the external distribution system. These lines will range in diameter between 24 and 42 inches and will consist of either ductile iron pipe (DIP) or precast pre-stressed concrete pipe (PCCP). The lines connecting between the existing filtration building and the IPS/UV building will have invert elevations between 62 and 63. Lines connecting the IPS/UV station and the tank and HLS will have invert elevations ranging from 78 to 90. Based on the subsurface information provided, we anticipate that piping extending into the lot north of the existing facility (i.e., piping connecting to the tank and HLPS, and between the tank/HLPS and external distribution lines) will run through areas containing soft organic soil. If encountered at the base of the excavation for these lines, these materials should be removed. In the case of organics extending deeper than two feet below invert the overexcavation can be stopped, a geotextile placed on the exposed (existing fill) subgrade, and backfilled with breaker run material, as described in Section 5.1.

4.5 Detention Pond

Low-permeability clayey soils were encountered in Boring 2014-9, drilled in the footprint of the proposed retention/detention pond. These soils likely have hydraulic conductivities on the order of 1×10^{-6} to 1×10^{-5} cm/sec. For long-term maintenance considerations, we recommend that the pond have a maximum side slope of 1 vertical to 2.5 horizontal.

4.6 Seismic Design Recommendations

The soils encountered at this site are considered “Site Class D” soils as defined in the Wisconsin Administrative Code Comm 62.1615 and the International Building Code Section 1615.1.

4.7 Environmental Issues

As detailed in Section 3.2.2 there was man-made debris encountered in many samples within the fill zone in the borings drilled on the north parcel. Additionally, PID readings (described in Section 3.5 and contained in the boring logs in the attached Terracon report) registered values above background levels. These test results may or may not be indicative of environmentally impacted soils. Any analyses or guidance regarding the PID values obtained or the character of the fill documented during the subsurface exploration in an environmental context is beyond our scope of the services. We advise the Oak Creek Water and Sewer Utility to consult with environmental professionals to assess the existence and/or extent of environmental issues at the site prior to construction. The result of such analyses may affect the recommendations presented in this report; CH2M HILL requests to kept appraised of the outcome of environmental analyses and given the opportunity to reassess the recommendations contained herein.

5.0 Construction Recommendations

The following sections detail construction recommendations pertinent to soil and earthwork-related aspects of the project.

5.1 Site Preparation and Proofrolling

All surficial topsoil, surface vegetation, organic matter, and debris should be removed from the areas slated for earthwork and/or structures. Snow, ice, and frozen subgrades should also be removed immediately prior to fill placement or foundation construction.

Once the stripping operations are completed, the exposed subgrades should be proofrolled. Proofrolling consists of closely spaced passages of the subgrade by a heavily loaded vehicle which is supported on pneumatic tires, such as a tandem axle dump-truck. The proofrolling operation should be performed under the observation of a geotechnical engineer or an experienced technician.

Subgrade areas either consisting of organic soils or exhibiting excessive rutting- or pumping-type deflections (¾-inch or greater) during proofrolling should be undercut to firm soils, or to a depth of 30 inches beneath the subgrade, whichever is less. The exception to this is the areas of the proposed tank and HLPS facilities, which require deep overexcavations. If yielding soils remain at the base of the overexcavation, the subgrade should be stabilized by the placement of a geosynthetic fabric, and backfilled to the subgrade elevation with breaker run aggregate, such as described in Table 4 below.

TABLE 4
Gradation Recommendations for Breaker Run Aggregate

Sieve Size	Dry Weight Passing, Percent
4 inch	100
2 inch	75 to 95
No. 4	35 to 70
No. 40	15 to 40
No. 100	10 to 25
No. 200	5 to 15

The breaker run should be properly placed and compacted as described in the Earthwork Recommendations in Section 5.1. The geofabric should meet the requirements of Wisconsin Department of Transportation Type SAS (WisDOT Standard Specification 645.2.2), as presented in Table 5.

TABLE 5
Recommended Minimum Geotextile Specifications

Design Parameter	Minimum Required Value
Grab Strength (ASTM D4632)	170 pounds
Puncture Strength (ASTM D4833)	70 pounds
Burst Strength (ASTM D3786)	210 psi
Permitivity (ASTM D4491)	0.35 seconds^{-1}
Apparent Opening Size (AOS) (ASTM D4751)	70

The geofabric should be installed in accordance to the manufacturer's specifications. All seams should be overlapped a minimum of 2 feet, or greater if specified by the manufacturer.

Structural fill should consist of inorganic soil placed and compacted as specified in Section 5.1. The structural fill should be placed a minimum of five feet beyond all edges of the building and roadway areas, and an additional foot for each vertical foot of fill to be placed. This is to provide adequate lateral confinement of the structural fill.

The inorganic soils encountered at the site are generally suitable for use as structural fill. However, clayey soils are sensitive to the moisture content at which they are compacted. Moisture conditioning should be performed as described in Section 5.1. Based on the results of the laboratory moisture content tests and our experience with similar soils, it appears that the moisture contents of the near-surface inorganic soils are likely above their optimum moisture content, and will require drying before they can be compacted to an adequate degree. Drying can be difficult to achieve during cool, wet times of the year.

We recommend that a geotechnical engineer, or an experienced technician, be present during filling or other earthwork operations. This is to confirm that only approved backfill materials are used, as well as to confirm that the soils have achieved adequate density requirements. This will also allow for observation to document that the existing subgrade is undisturbed, suitable for placement of fill or concrete, and to confirm that the site is prepared according to the intent of this report.

5.2 Earthwork Recommendations

Fill or backfill placed in this project should consist of inorganic soil which contains no debris, stones larger than 4 inches in diameter, nor frozen matter.

The natural water content of the soil should be within three percent of the optimum water content as determined by a Proctor test. If the moisture content of the fill is outside this range, it may be difficult to obtain the specified degree of compaction.

Uniform fill or backfill should be used on the project. If non-uniform soils are used, or two or more soil types are mixed, the field personnel will have to exercise judgment regarding which Proctor density standard applies. This will reduce the degree of certainty in the test results.

The fill or backfill should be placed in loose horizontal lifts, no thicker than eight inches, and compacted with a compactor appropriate for the soil type. Typically, vibratory drum or vibratory plate compactors are appropriate for the soil type. Typically, vibratory drum or vibratory plate compactors are appropriate for granular soils, while a sheepsfoot, segmented foot, jumping jack, or other compactor which kneads the soil, is appropriate for cohesive soils.

Fill or backfill placed to support floor slabs, foundations, and pavements subject to truck traffic should be compacted to a minimum of 95% of the modified Proctor test (ASTM D1557) density. Fill or backfill placed to in areas not supporting pavements or structures should be compacted to a minimum of 90% of the modified Proctor test density.

In some instances, a relatively thin stratum of weak or unsuitable soil may exist beneath a proposed foundation. It is a common practice to remove a volume of the weak soil for the full thickness of the stratum, and replace it with compacted fill to support the foundation. The weak soil commonly remains in place laterally beyond each excavated and backfilled zone. In this situation, the compacted backfill should extend laterally beyond each edge of the foundation a minimum of ¾ foot for each foot of compacted fil thickness beneath the foundation.

5.3 Drainage and Dewatering

Positive drainage to properly maintained ditches, culverts, and channels should be maintained to control surface water from entering the embankment, subgrade, and excavations. Water accumulating in excavations and other work areas should be removed promptly. Appropriate sediment control devices (such as silt fences) should be placed at the start of construction and periodically maintained to minimize movement of eroded soil. All ditches, slopes, and other areas susceptible to erosion and disturbed by construction activities should be protected with erosion control devices as early as possible. Erosion checks and/or riprap may be used for erosion control and should be used in areas where high flow rates are anticipated.

Although excavations to proposed subgrade elevations may intercept the groundwater table, we anticipate that inflows and perched water that may be encountered can be handled by typical trench, sump pit and pumping techniques. Subgrade exposure time to water should be minimized. If it is not possible to efficiently remove water from the subgrade a concrete “mud mat” should be placed on a suitable subgrade for protection.

5.4 Subgrade Observation

We recommend that all earthwork and foundation subgrades be observed and tested by an experienced geotechnical engineer or a qualified soils technician to determine if the soil and groundwater conditions encountered are consistent with those anticipated in this report. Foundation subgrades should be tested to check for adequate bearing conditions. Subgrades for slabs and new structural fills should be tested for conformance to specified requirements.

In determining suitable foundation subgrades, care should be given to ensure that the soils are suitable for support of the loads for which the structures have been designed. Inorganic cohesive soils that are proportioned for a net allowable soil bearing stress of 2,000 psf should have a minimum unconfined compressive strength of 1.0 ton per square foot (tsf). Inorganic cohesive soils that are proportioned for a net allowable soil bearing stress of 3,000 psf should have a minimum unconfined compressive strength of 1.5 tsf. Granular soils should have an equivalent standard penetration (SPT) value of 15 blows per foot to support 3,000 psf. Native inorganic soils that are proportioned for a net allowable soil bearing stress of 4,000 psf should have a minimum unconfined compressive strength of 2.0 tsf.

5.5 Excavation Issues

Considerable vertical excavation will be required to achieve the plan subgrade elevations for the wet well (IPS), and in the case of the HLPS and storage tanks, to achieve desired subgrade soils. In the case of the wet well (and depending on the construction sequencing for the tank and HLPS overexcavations), insufficient room may be available to adequately slope the excavation, hence requiring temporary excavation retention. Temporary shoring will be required in these instances; such systems are typically designed by the contractor. Temporary shoring systems should be designed by an experienced licensed geotechnical or structural engineer.

The Owner and Contractor should make themselves aware of, and become familiar with, applicable local, state, and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards. Construction-site safety generally is the responsibility of the Contractor, who should also solely be responsible for the means, methods, and sequencing of construction operations. We are providing this information solely as a service to our client. Under no circumstances should the information provided below be interpreted to mean that CH2M HILL assumes responsibility for construction-site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

The Contractor should be aware that slope height, slope inclination, or excavation depths should in no case exceed those specified in local, state, or federal safety regulations, (e.g. OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926), or successor regulations. Such regulations are strictly enforced, and if they are not followed, the Owner, Contractor, and/or earthwork Subcontractor(s) could be liable for substantial penalties. The overburden soils encountered by the exploratory borings through which the excavations will extend consisted of fill and natural cohesive soils. We anticipate that the existing site fill soils, and underlying organic and granular soils can be considered Type C soils when applying the OSHA regulations. The underlying native cohesive glacial soils can be considered Type B soils. OSHA requires a maximum slope inclination of 1.0 horizontal to 1.0 vertical for Type B soils, and 1.5 horizontal to 1 vertical for Type C soils. Site soils should be properly dewatered prior to excavation.

Material stockpiles or heavy equipment should not be place within a zone extend at a 1 horizontal to 1 vertical slope from the bottom of the excavation.

6.0 Limitations

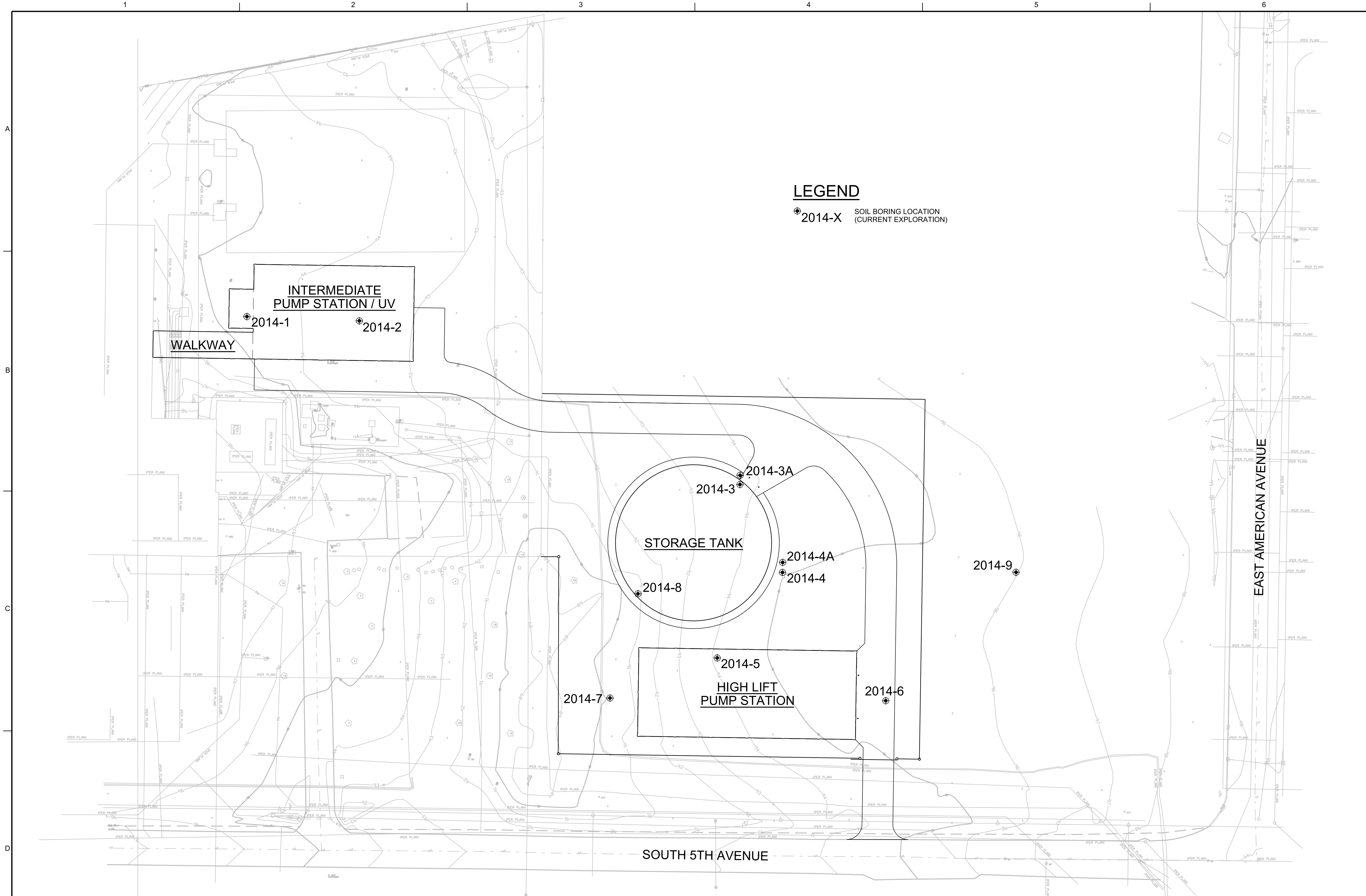
This geotechnical exploration and foundation evaluation memorandum was prepared for the Oak Creek Water and Sewer Utility for the specific project and use discussed herein. The specific project details are unique relative to their location, size, configuration, and elevations. The project plans and specifications should be coordinated with the author of this technical memorandum for review to verify that the conclusions and recommendations have been interpreted correctly. Where specific information was not available, assumptions have been made, and are noted as such. These assumptions should be reviewed by the project team to confirm that they are correct for the planned use and project. If these assumptions are not correct, the author of this technical memorandum should be informed and allowed to modify the memorandum, its conclusions, and recommendations. The accuracy and completeness of any documents or information provided by others as to project specifics or prior property uses have been reasonably relied on by CH2M HILL in providing its evaluation. In addition, if details of the project or planned construction sequencing change from that outlined in this report, the author of this report should be notified to determine if the changes affect the recommendations.

The analyses, conclusions, and recommendations in this memorandum are based on the subsurface conditions present in the borings and the engineering characteristics of the soil as determined through field and laboratory testing at this point in time, as defined in the current work scope. Subsurface conditions can change over time due to both natural and man-made forces, including changes in condition and/or use of adjacent properties.

The memorandum does not reflect variations in subsurface conditions that may exist between or beyond these borings. Variations in soil conditions should be expected between the borings, the nature and extent of which may not become evident until construction is undertaken. The construction should be monitored by the geotechnical engineer or a designated representative to determine if the subsurface conditions are as indicated in the borings.

If the conditions encountered during construction are different from those inferred by the soil borings or the project details, the author of this memorandum must be contacted to determine if modification to the recommendations presented in this report are required. The recommendations found in this report are related and are not mutually exclusive of each other. Therefore, no single portion of the report should be removed or be considered as a stand-alone recommendation.

The geotechnical engineering recommendations presented herein are an evaluation of subsoil performance based on the geotechnical engineer's experience and professional opinion. These services were performed with the degree of skill and care normally utilized by other members of the geotechnical engineering profession practicing in this location and at this time. No warranty is either expressed or implied.



SOIL BORING LOCATION PLAN

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SOIL BORING LOCATION PLAN

OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
CJ WINTER		DA KIERZEK	

1"=30'
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	MARCH 2015
PROJ	653463
DWG	05-C-410
SHEET	of

March 5, 2015

Mr. Charles Winter
CH2M HILL
9575 W. Higgins Road, Suite 700
Rosemont, IL 60018

Re: Geotechnical Engineering Data Report
Prepared for Charles Winter on behalf of Ron Pritzlaff
Oak Creek Water Utility Development
170 West Drexel Avenue
Oak Creek, WI 53154
Terracon Project No. MR145146

Dear Mr. Winter:

Terracon Consultants, Inc. (Terracon) is pleased to present this geotechnical engineering data report for the above referenced project. The attached report includes an overview of the field exploration and laboratory testing methods, as well as final electronic boring logs, laboratory test results, and pressuremeter test results.

We appreciate the opportunity to be of service to you. Please feel free to contact us at your convenience with any questions.

Sincerely,
TERRACON CONSULTANTS, INC.

Damien E. Hesse, E.I.T.
Staff Geotechnical Engineer

Paul A. Tarvin, P.E.
Geotechnical Services Manager

PROJECT OVERVIEW

The proposed project details are summarized in the following table:

Location	9325 South 5th Avenue Oak Creek, WI 53154
Existing improvements	The Oak Creek Water and Sewer Utility facilities.
Proposed construction	• A new intermediate pump station with a base slab elevation approximately 25 to 30 feet below existing grade. • A new UV facility with base slab at approximately the existing grade. • A new water storage tank with base slab elevation at approximately the existing grade. A rectangular design is expected to have plan dimensions approximately 100 feet by 150 feet and water height approximately 20 feet above existing grades. A circular design is expected to have a diameter of approximately 70 feet and water to a height of 30 feet above existing grades. • A new high lift pump station with base slab at approximately the existing grades.
Grading and Excavation	According to information provided by CH2M HILL up to 30 feet of excavation could be possible for the new intermediate pump station. Other site grading is anticipated to be less than 5 feet.
Below grade areas	The new intermediate pump station will be 25 to 30 feet below existing grades.

FIELD EXPLORATION PROCEDURES

The boring locations were selected by and located in the field by CH2M HILL. Some of the borings were relocated prior to the first mobilization by Charles Winter. Ground surface elevations were determined in the field by the driller using rod and level techniques and referenced existing building and local street features. The elevations were converted to the Oak Creek City Datum by Charles Winter of CH2M Hill and provided to Terracon for inclusion on the boring logs. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with a truck-mounted, rotary drill rig using continuous flight hollow-stemmed augers and mud rotary methods to advance the boreholes. Hollow-stemmed augers were used for borings B-2014-3A, B-2014-4A, B-2014-7, B-2014-8, and B-2014-9. Mud rotary methods were used for the remaining borings with Hollow stems used as casing ranging from 5 to 15 feet below ground surface. The originally planned borings (B-2014-1 to B-2014-9) were extended to depths of 50 to 100 feet. Please note that that all soil samples were to be preliminarily screened with a photo-ionization detector (PID); however, the PID screening was inadvertently not completed for borings B-2014-3 and B-2014-4. In discussions with CH2M Hill, we agreed to redrill these two borings to a depth of 20 feet each, and screen those samples with the PID. These borings are identified as B-2014-3A and B-2014-4A. In addition, after review by CH2M Hill of our preliminary test results, they requested that we complete an additional boring so the pressuremeter testing could be completed at select depth intervals. This boring, B-2014-8PMT, was blind drilled to the pressuremeter test depth intervals using rotary wash boring techniques, sampled, and pressuremeter tests performed.

Disturbed soil samples were generally obtained using split-barrel sampling procedures in general accordance with ASTM D 1586, in which a standard 2-inch (outside diameter) split-barrel sampling spoon is driven into the ground with a 140-pound safety hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. These values, also referred to as SPT N-values, are an indication of soil strength/relative density and are provided on the boring logs at the depths of occurrence. The samples were tagged for identification, sealed with aluminum to reduce moisture loss and retain soil vapors for laboratory PID readings (except as noted above), and taken to our laboratory for further examination, testing, and classification. Undisturbed Shelby tube samples were taken at select intervals in borings B-2014-2, B-2014-3, B-2014-4, B-2014-5, and B-2014-6 as specified by Charles Winter. The Shelby tube samples were returned our laboratory for Atterberg limits, organic content, and unconfined compressive strength tests.

After completion, the borings, except B-2014-7, were backfilled in general accordance with WDNR requirements, using auger cuttings and bentonite chips prior to the drill crew leaving the site. Boring B-2014-7 was converted into a monitoring well and was planned to be used for taking future water level measurements. However, due to changes in the locations of the proposed structures the water level readings for this well were no longer desired by CH2M HILL.

Field logs for each boring were prepared by the driller. These logs included visual classifications of the materials encountered during drilling and the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent the engineer's interpretation of the soils encountered and include modifications based on laboratory observation and tests of the samples. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. Select laboratory test results including Atterberg limits, organic content, and unconfined compressive strengths are also included on the boring logs.

PRESSUREMETER TEST PROCEDURES

A pressuremeter testing program was undertaken in one boring at the request of Charles Winter.

Pressuremeter tests were performed in Boring B-2014-8PMT at depth intervals of 18-20, 35-37, 50-52, and 78-80 feet. The borehole was drilled using the mud rotary method and the intervals were prepared using specially sized augers, roller bits, and split-barrel samplers.

The pressuremeter is an in-situ test device consisting of a cylindrical probe that is inserted into a pre-sized borehole. The probe is incrementally inflated at various pressures, and volume changes due to deformation of the borehole are measured to determine the stress-strain characteristics of the soil at the test depth. The pressuremeter data can then be used to evaluate the stress-strain characteristics of the soils so as to more accurately predict both the bearing capacity and expected settlements from foundation loads than can generally be done using standard geotechnical test data. A summary of the pressuremeter test results is provided below. The individual pressuremeter test results are also included in the Appendix.

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PRESSUREMETER TEST RESULTS

BORING NUMBER	DEPTH (ft)	P_o (tsf)	P_f (tsf)	P_l (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P_l	P_l/P_f
B-2014-8PMT	18.0-20.5	1.5	4.6	9.1	80	169	0.47	8.8	2.0
	35.0-37.5	2.6	8.4	19.2	129	243	0.53	6.7	2.3
	50.0-52.5	3.0	12.0	27.8	259	464	0.56	9.3	2.3
	78.0-80.5	4.0	13.0	32.8	233	678	0.34	7.1	2.5
					AVERAGE		0.45	8.2	2.4

In a classically-shaped pressuremeter curve, the initial portion of the curve represents the pressures at which the probe is expanding to come in contact with the soil. The pressure corresponding to the beginning of the straight-line portion of the curve represents the “at rest” earth pressure (P_o). The slope of the straight-line portion of the curve represents the initial loading modulus (E_d) of the soil. Typically, each of the tests includes one unload/reload cycle. The slope of the line representing the reload portion of the test is defined as the reload modulus (E^+). The pressure at the end of the straight-line portion of the curve is termed the creep pressure (P_f), which is the limit of the pseudo-elastic zone above which point deformation may continue without an increase in load. The limit pressure (P_l) is the pressure at which complete failure has occurred and the soil cannot carry any additional load.

In general, the pressuremeter curves included in the Appendix exhibit the classical shape normally expected for these tests. This includes a concave downward curve at low pressures, followed by the straight-line portion for intermediate pressures, and a concave upward curve at high pressures.

The parameters defined above are important in analyzing the bearing capacity and settlement characteristics of the soil. The bearing capacity of the soil is proportional to the difference between the limit pressure and the "at rest" pressure (Pl – Po), but should not exceed the creep pressure (P_f) of the soil. The settlement of foundations is related primarily to the initial loading modulus of the soils (E_d). Another parameter used in the initial settlement calculation, the soil structure coefficient, is related to the ratio of the initial loading modulus to the reload modulus (E_d/E^+).

LABORATORY PROCEDURES

Calibrated penetrometer tests were performed on cohesive samples by the driller to estimate the unconfined compressive strength. Moisture content tests were performed on all cohesive samples recovered. Organic content tests were performed on a select number of samples as well. Unconfined compressive strength, unit dry density, and Atterberg Limits tests were performed on a select number of undisturbed samples. The results of all tests performed are shown on the boring logs included in Attachment A.

The soil samples were classified in the laboratory based on visual observation, texture, plasticity, and moisture content. The soil descriptions presented on the boring logs for native soils are in accordance with the enclosed General Notes and the Unified Soil Classification System (USCS). The estimated USCS group symbols for native soils are shown on the boring logs, and a brief description of the USCS is included in this report in Appendix C. In addition, the soil samples from the borings were screened in the laboratory with a PID meter to provide volatile organic compounds in ppm isobutyl equivalents. The results of the PID screening are included on the boring logs.

Procedural standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

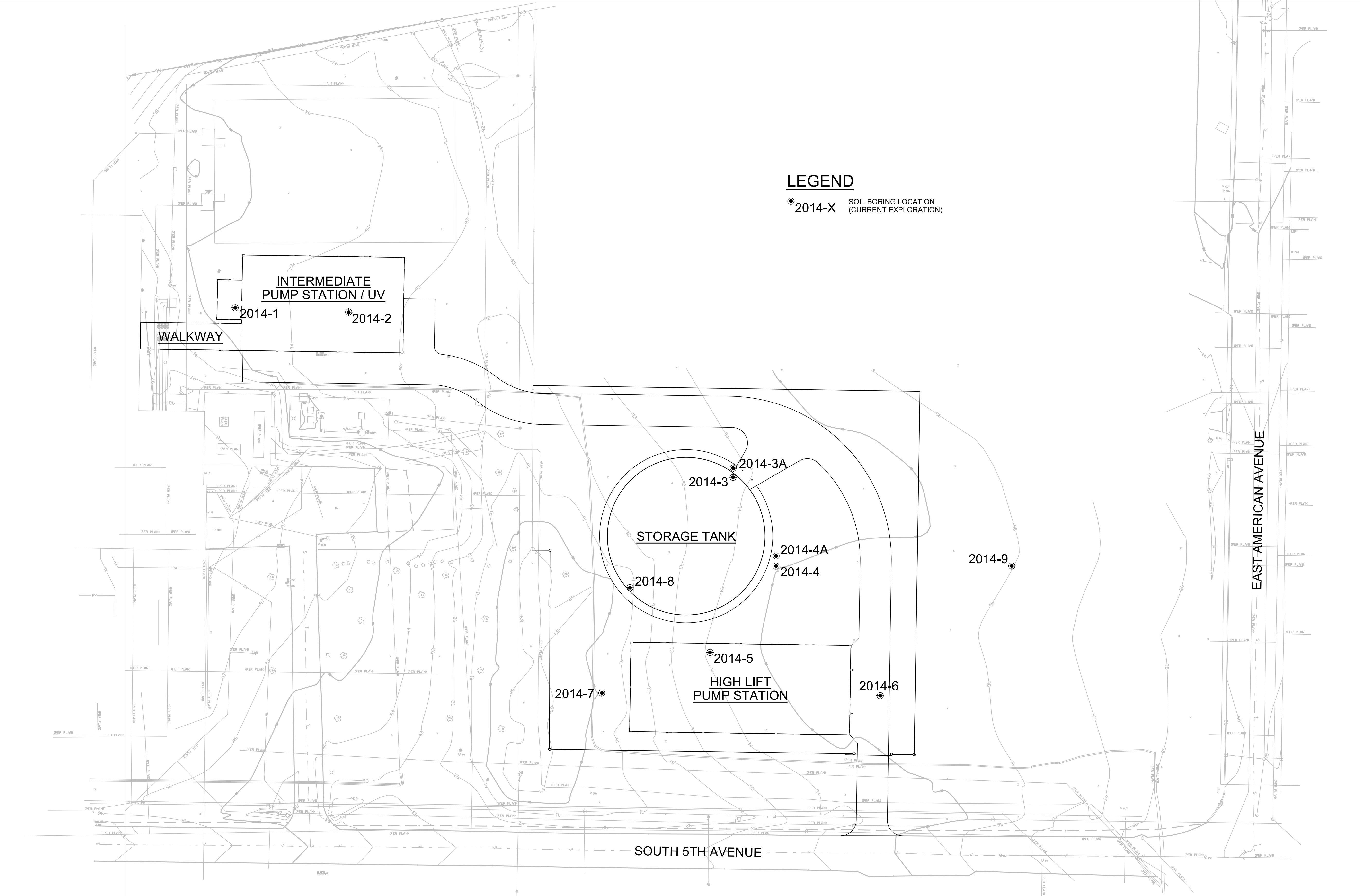
GENERAL COMMENTS

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. We have not been asked to interpret any of the data obtained; therefore, we cannot be responsible for interpretations made by others. No other warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

ATTACHMENT A

BORING LOGS



SOIL BORING LOCATION PLAN

0 30 60 90

Scale In Feet

CH2MHILL

OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

CIVIL

SOIL BORING LOCATION PLAN

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
	CJ WINTER	DA KIERZEK	

1"=30'

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.

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DATE	MARCH 2015
PROJ	653463
DWG	05-C-410
SHEET	of

FILENAME: 05-C-410_653463.dgn PLOT DATE: 3/5/2015 PLOT TIME: 10:35:53 AM

BORING LOG NO. 2014-1

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 94.7 (Ft.)

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
0.2	**FILL - LEAN CLAY TOPSOIL**, dark brown	94.5												
	FILL - LEAN CLAY (CL), trace sand, brown, hard to very stiff, moist		5		X	18	8-10-13 N=23	4.5+	1		20			<0.6
			10		X	18	4-5-8 N=13	2.5-4.25	2		23			<0.6
12.0		82.5												
	LEAN CLAY (CL), trace sand, gray, medium stiff to very stiff, moist to wet		15		X	18	3-3-5 N=8	1.75-2.25	3		26			<0.6
			20		X	18	3-3-4 N=7	1.25	4		28			<0.6
			25		X	18	2-3-3 N=6	0.75	5		27			<0.6
					X	18	3-3-4 N=7	1.25	6		23			<0.6
			30		X	18	3-3-4 N=7	0.75-1.25	7		20			<0.6
					X	18	4-5-7 N=12	2.0-2.5	8		21			<0.6
			35		X	18	4-4-6 N=10	2.0-2.5	9		21			<0.6
					X	18	6-7-9 N=16	2.25	10		19			<0.6
			40		X	18	6-7-10 N=17	2.5	11		20			<0.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 5 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/10/2014	Boring Completed: 12/10/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-1

BORING LOG NO. 2014-1

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 94.7 (Ft.)

DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
LEAN CLAY (CL), trace sand, gray, medium stiff to very stiff, moist to wet *(continued)*												
	45		X	18	6-9-9 N=18	2.5	12		21			<0.6
	50		X	18	7-8-9 N=17	2.0	13		20			<0.6
	55		X	18	6-8-9 N=17	3.0	14		24			<0.6
	60		X	18	7-7-10 N=17	3.5	15		24			<0.6
	65		X	18	8-11-14 N=25	2.0-4.0	16		24			<0.6
70.0 / 24.5	70		X	18	8-12-15 N=27	3.5	17		17			<0.6
Boring Terminated at 70 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 5 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/10/2014	Boring Completed: 12/10/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-2

BORING LOG NO. 2014-2

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 93.5 (Ft.)

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)
0.2	**FILL - LEAN CLAY TOPSOIL**, dark brown	93.5
	FILL - LEAN CLAY (CL), trace sand and gravel, brownish-gray to brown, hard to stiff, moist to wet Note: Intermittent silt seams in sample 3.	
14.0	**LEAN CLAY (CL)**, trace sand, gray, stiff to very stiff, moist to wet	79.5

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
		Split spoon	18	8-9-10 N=19	4.5+	1		16			<0.6
5		Split spoon	18	5-6-7 N=13	2.5-3.5	2		17			<0.6
		Split spoon	18	3-4-4 N=8	1.0	3		25			<0.6
10	▽	Shelby tube	20		4.5+	4	1	20	110	29-17-12	
		Split spoon	18	7-10-6 N=16	3.5-4.5+	5		21			<0.6
15		Shelby tube	24		3.0	6	3	20	111	33-18-15	
		Split spoon	18	5-6-7 N=13	2.75	7		25			<0.6
20		Split spoon	18	3-3-4 N=7	1.5	8		21			<0.6
25		Split spoon	18	4-4-6 N=10	1.75	9		22			<0.6
30		Split spoon	18	3-3-4 N=7	1.0-1.5	10		25			<0.6
35		Split spoon	18	3-4-5 N=9	1.25	11		22			<0.6
40		Split spoon	18	6-9-11 N=20	3.25	12		18			<0.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *10.6 feet after 24 hours*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/9/2014	Boring Completed: 12/10/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-3

BORING LOG NO. 2014-2

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 93.5 (Ft.)

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	LEAN CLAY (CL), trace sand, gray, stiff to very stiff, moist to wet *(continued)*													
			45		X	18	7-9-11 N=20	3.0	13		19			<0.6
			50		X	18	8-10-13 N=23	2.75	14		19			<0.6
	Note: Intermittent silt seams in sample 14 and 15.		55		X	18	6-9-13 N=22	2.75	15		18			<0.6
			60		X	18	10-12-14 N=26	2.75	16		16			<0.6
			65		X	18	7-10-14 N=24	3.75	17		21			<0.6
70.0		23.5	70		X	18	17-14-16 N=30	2.0	18		17			<0.6
	Boring Terminated at 70 Feet													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *10.6 feet after 24 hours*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/9/2014	Boring Completed: 12/10/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-4

BORING LOG NO. 2014-3

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 93.8 (Ft.)

DEPTH	Description	ELEVATION (Ft.)
1.5	**FILL - LEAN CLAY TOPSOIL (CL)**, trace gravel	92.5
3.0	**FILL - LEAN CLAY/FAT CLAY (CL/CH)**, trace gravel, sand, and asphalt, brown to dark brown, hard, moist to wet	91
9.0	**FILL - LEAN CLAY/FAT CLAY (CL/CH)**, trace gravel, sand, and asphalt, brown to dark brown, stiff to soft, moist to wet Sample 4 - Organic Content (%) = 8.9	85
11.5	**LEAN CLAY/FAT CLAY (CL/CH)**, with organics, trace sand, brown, soft, moist to wet	82.5
16.0	**LEAN CLAY (CL)**, trace sand, gray, stiff to very stiff, moist	78
18.0	**CLAYEY SAND (SC)**, gray, dense, moist to wet	76
	LEAN CLAY (CL), trace sand and gravel, gray, very stiff to hard, moist to wet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
		Split spoon	15	4-6-8 N=14	4.5+	1		18			
5		Split spoon	3	50-9-6 N=15	1.0	2		21			
		Split spoon	10	3-2-2 N=4	0.25	3		31			
	▽	Shelby tube	19			4		58	55	63-22-41	
10		Split spoon	18	1-2-1 N=3	0.25	5		132			
		Split spoon	18	3-4-6 N=10	1.0-1.5	6					
15		Shelby tube	24		2.5	7	1	22	106	32-18-14	
		Split spoon	11	10-18-23 N=41		8		4			
20		Split spoon	12	10-14-21 N=35	4.5+	9		18			
25		Split spoon	18	6-8-12 N=20	3.25	10		19			
30		Split spoon	18	6-8-11 N=19	2.0-2.75	11		19			
35		Split spoon	18	6-9-11 N=20	3.5	12		22			
40		Split spoon	18	9-11-14 N=25	3.5	13		18			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling (approx.)*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/5/2014	Boring Completed: 12/6/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-5

BORING LOG NO. 2014-3

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

GRAPHIC LOG	LOCATION See Exhibit A-2 / Surface Elev.: 93.8 (Ft.) / DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	LEAN CLAY (CL), trace sand and gravel, gray, very stiff to hard, moist to wet *(continued)*												
		45		X	18	5-8-11 N=19	3.5	14		21			
		50		X	18	8-10-14 N=24	3.25-3.75	15		17			
		55		X	18	9-12-15 N=27	2.0-2.5	16		21			
		60		X	18	9-10-11 N=21	2.25	17		23			
		65		X	18	7-9-12 N=21	2.5-3.5	18		17			
		70		X	18	8-11-14 N=25	2.5-3.25	19		16			
		75		X	18	8-12-17 N=29	3.75-4.5	20		22			
	Note: Intermittent seams of sand in sample 21.	80		X	18	22-24-25 N=49	4.5+	21		18			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling (approx.)*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/5/2014	Boring Completed: 12/6/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-6

BORING LOG NO. 2014-3

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 93.8 (Ft.)

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	LEAN CLAY (CL), trace sand and gravel, gray, very stiff to hard, moist to wet *(continued)*													
			85		X	18	10-13-15 N=28	3.25	22		24			
			90		X	18	10-13-16 N=29	3.5	23		16			
			95		X	18	8-12-16 N=28	3.0	24		16			
100.0		-6	100		X	18	21-31-39 N=70	4.5+	25		15			
	Boring Terminated at 100 Feet													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling (approx.)*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/5/2014	Boring Completed: 12/6/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-7

BORING LOG NO. 2014-3A

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 93.8 (Ft.)

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
0.4	**FILL - TOPSOIL**, clay, dark brown, moist	93.5												
	FILL - LEAN CLAY (CL), trace sand, topsoil, and gravel, brown, moist				X	8	4-5-5 N=10	2.5	1					1.6
	Note: sample 2 contained trace coal.		5		X	13	5-5-7 N=12	2.5	2					14.4
6.0		88												
8.0	**FILL - TOPSOIL**, black clay, trace green-gray clay, moist	86			X	15	2-3-3 N=6		3					29.9
	ORGANIC SILT (OL), trace shell fragments, green-gray, very loose, moist		10		X	18	1-1-1 N=2		4					4.9
13.0		81			X	18	0-1-0 N=1	0.25	5					4.4
	LEAN CLAY (CL), trace sand and gravel, gray, stiff, moist		15		X	18	2-3-4 N=7	1.5-2.0	6					3.3
17.5		76.5		▽ ▽	X	18	4-4-5 N=9	1.0-2.5	7					3
18.0	**POORLY GRADED SAND (SP)**, trace silt, gray, loose, wet	76												
20.0	**LEAN CLAY (CL)**, trace sand and gravel, gray, hard, moist	74	20		X	18	12-14-18 N=32	4.5+	8					2.8
	Boring Terminated at 20 Feet													

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *17.5 feet while drilling*

▽ *18 feet at completion of drilling*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 2/7/2015	Boring Completed: 2/7/2015
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-8

BORING LOG NO. 2014-4

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 95.0 (Ft.)

DEPTH	DESCRIPTION	ELEVATION (Ft.)
0.3	**FILL - LEAN CLAY TOPSOIL**, dark brown	94.5
9.0	**FILL - FAT CLAY (CH)**, trace gravel, sand, organics and peat, brown, hard to very stiff, moist	86
15.0	**ORGANIC CLAY (OL)**, trace sand, gray, stiff, moist to wet Sample 4 - Organic Content (%) = 13.4	80
18.5	**SANDY LEAN CLAY (CL)**, trace gravel, gray, medium stiff to hard, wet	76.5
	LEAN CLAY (CL), trace sand, gray to intermittent brownish-gray layers, medium-stiff to hard, moist to wet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
		18	5-7-8 N=15	3.0-4.5+	1		15		76-20-56	
5		18	6-7-7 N=14	2.5	2		16			
		7	3-97/5"		3		25			
10		10			4		54	50		
		18	3-4-5 N=9	1.0-1.75	5		23			
15		13		2.5	6	2	24	104		
	▽	18	6-7-9 N=16	4.5	7		10		33-14-19	
20		6	10-14-22 N=36	0.5	8		24			
		10	12-14-19 N=33	0.5	9		22			
25		18	8-11-14 N=25	4.5+	10		17			
30		18	4-6-8 N=14	2.5	11		20			
35		18	5-8-11 N=19	2.0-3.25	12		18			
40		18	7-8-9 N=17	2.5	13		17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *17.5 feet while drilling (possible pearched water)*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/6/2014	Boring Completed: 12/7/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-9

BORING LOG NO. 2014-4

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 95.0 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	LEAN CLAY (CL), trace sand, gray to intermittent brownish-gray layers, medium-stiff to hard, moist to wet *(continued)*												
		45		X	18	7-10-13 N=23	3.5	14		18			
		50		X	18	9-12-15 N=27	3.5	15		20			
		55		X	18	7-9-12 N=21	3.25-4.5	16		24			
		60		X	18	7-10-13 N=23	3.5-4.25	17		23			
		65		X	18	10-10-13 N=23	2.5-3.5	18		19			
		70		X	18	8-11-12 N=23	0.75	19		19			
		75		X	18	8-13-15 N=28	3.5	20		17			
		80		X	18	9-11-14 N=25	3.5	21		17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *17.5 feet while drilling (possible pearched water)*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/6/2014	Boring Completed: 12/7/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-10

BORING LOG NO. 2014-4

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 95.0 (Ft.)

GRAPHIC LOG	DEPTH / Description / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	LEAN CLAY (CL), trace sand, gray to intermittent brownish-gray layers, medium-stiff to hard, moist to wet *(continued)*												
		85		X	18	14-20-23 N=43	4.5+	22		19			
		90		X	18	16-19-24 N=43	3.0-4.5+	23		20			
		95		X	18	13-20-26 N=46	4.5+	24		14			
	100.0 / -5	100		X	18	13-17-17 N=34	2.0	25		16			
	Boring Terminated at 100 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *17.5 feet while drilling (possible pearched water)*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/6/2014	Boring Completed: 12/7/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-11

BORING LOG NO. 2014-4A

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave
Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 95.0 (Ft.)

DEPTH	Description	ELEVATION (Ft.)
0.4	**FILL - TOPSOIL**, clay, dark brown, moist	94.5
3.0	**FILL - LEAN CLAY (CL)**, trace sand, topsoil, and gravel, brown, moist	92
8.5	**FILL - LEAN CLAY (CL)**, trace coal, black to and green-gray, moist	86.5
11.0	**ORGANIC SILT (OL)**, trace shell fragments, green-gray, loose, moist	84
15.5	**LEAN CLAY (CL)**, trace sand and gravel, gray, stiff to very stiff, moist Note: intermittent gray silt seams.	79.5
17.0	**POORLY GRADED SAND (SP)**, trace silt and gravel, gray, medium dense, wet Note: intermittent gray sandy lean clay seams.	78
20.0	**LEAN CLAY (CL)**, trace sand and gravel, gray, hard, moist	75

Boring Terminated at 20 Feet

Sample Number	Recovery (In.)	Field Test Results	Hand Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	PID (ppm)
1	10	5-7-7 N=14						2.5
2	18	7-8-11 N=19						10.5
3	14	4-4-6 N=10						428
4	18	2-3-3 N=6						8
5	18	3-4-5 N=9	1.0-2.0					5.8
6	18	4-5-5 N=10	1.75-3.25					0.5
7	18	10-12-8 N=20						0.3-1.0
8	18	12-15-18 N=33	4.5+					1.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

▽ *14 feet while drilling*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 2/7/2015 | Boring Completed: 2/7/2015

Drill Rig: CME-45 | Driller: J&J

Project No.: MR145146 | Exhibit: A-12

BORING LOG NO. 2014-5

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 94.1 (Ft.)

Depth		Elevation (Ft.)
1.5	**FILL - LEAN CLAY TOPSOIL**, dark brown	92.5
6.0	**FILL - LEAN CLAY (CL)**, trace sand, brown to gray, hard to very stiff, moist	88
12.0	**FILL - LEAN CLAY/FAT CLAY (CL/CH)**, trace gravel, organics, and peat, dark brown to black, soft to stiff, moist	82
13.5	**SILT (ML)**, trace clay and organics, gray, loose, moist	80.5
14.5	**POORLY GRADED SAND (SP)**, gray, wet	79.5
	LEAN CLAY (CL), trace sand, gray, stiff to hard, moist Note: Intermittent silt seams noted in	

Sample Number	Approx. Depth (Ft.)	Sample Type	Recovery (In.)	Field Test Results	Hand Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	PID (ppm)
1	2.5	Split spoon	14	8-9-11 N=20	4.5+		13			<0.6
2	5	Split spoon	10	5-4-5 N=9	2.25		20			<0.6
3	7.5	Split spoon	7	2-1-5 N=6	0.25		65			<0.6
4	10	Shelby tube	12							
5	12.5	Split spoon	18	1-2-3 N=5	1.0		22			<0.6
6	15	Shelby tube	24		3.5		19	111	23-8-15	
7	17.5	Split spoon	18	8-11-13 N=24	3.75-4.5+		18			<0.6
8	20	Split spoon	18	10-12-15 N=27	4.25-4.5+		20			<0.6
9	22.5	Split spoon	18	6-8-13 N=21	3.5-4.5+		19			<0.6
10	25	Split spoon	8	9-11-12 N=23	0.25		26			<0.6
11	27.5	Split spoon	12	10-10-10 N=20	2.0		24			<0.6
12	30	Split spoon	18	5-6-8 N=14	1.75		21			<0.6
13	35	Split spoon	18	6-8-9 N=17	2.5		19			<0.6
14	40	Split spoon	18	7-10-14 N=24	2.25-3.5		21			<0.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *13.5 feet while sampling*
- ▽ *18 feet before casing removal*
- ▼ *11.5 feet at completion of drilling*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/9/2014	Boring Completed: 12/9/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-13

BORING LOG NO. 2014-5

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 94.1 (Ft.)

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	samples 14, 15, 16, and 18. **LEAN CLAY (CL)**, trace sand, gray, stiff to hard, moist *(continued)*												
		45		X	18	7-10-13 N=23	3.0	15		18			<0.6
		50		X	18	6-8-10 N=18	1.75-2.75	16		26			<0.6
		55		X	18	8-10-14 N=24	3.0-4.0	17		26			<0.6
	60.0 / 34	60		X	18	11-12-16 N=28	3.75-4.5	18		22			<0.6
	Boring Terminated at 60 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

- *13.5 feet while sampling*
- *18 feet before casing removal*
- *11.5 feet at completion of drilling*

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/9/2014	Boring Completed: 12/9/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-14

BORING LOG NO. 2014-6

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 95.4 (Ft.)

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
0.2	**FILL - LEAN CLAY TOPSOIL**, dark brown	95												
3.5	**FILL - SANDY LEAN CLAY (CL)**, trace asphalt and cinders, brown, hard, moist	92			X	13	9-11-11 N=22	4.5+	1		12			<0.6
	FILL - LEAN CLAY (CL), trace sand and gravel, brown to dark brown, medium stiff to stiff, moist		5		X	10	3-4-4 N=8	0.5	2		17			<0.6
9.0		86.5			X	14	2-4-5 N=9	0.5-1.0	3		35			<0.6
	LEAN CLAY (CL), trace sand and gravel, brown, medium stiff to stiff		10		■	16		1.5	4	1	21	105	38-16-22	
14.0	Note: Intermittent silt seams noted in sample 5.	81.5			X	18	3-4-4 N=8	0.5-1.5	5		15			<0.6
	LEAN CLAY (CL), trace sand, gray, medium stiff to very stiff, moist to wet		15		■	19		2.0	6	3	18	110	29-13-16	
					X	18	5-6-7 N=13	2.5-3.75	7		23			<0.6
	Note: Intermittent silt seams noted in sample 8.		20		X	18	4-5-7 N=12	1.75	8		21			<0.6
					X	18	4-5-6 N=11	1.0-2.0	9		22			<0.6
			25		X	18	4-5-6 N=11	1.75	10		23			<0.6
			30		X	18	2-3-4 N=7	0.5-0.75	11		27			<0.6
			35		X	18	2-3-4 N=7	0.5-1.0	12		23			<0.6
			40		X	18	4-7-8 N=15	2.0-2.75	13		18			<0.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/8/2014	Boring Completed: 12/8/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-15

BORING LOG NO. 2014-6

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

GRAPHIC LOG	LOCATION See Exhibit A-2 / Surface Elev.: 95.4 (Ft.) / DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	LEAN CLAY (CL), trace sand, gray, medium stiff to very stiff, moist to wet *(continued)*												
		45		X	18	5-8-11 N=19	2.5	14		17			<0.6
	Note: Intermittent silt seams noted in sample 15.	50		X	18	7-10-12 N=22	3.0	15		18			<0.6
		55		X	18	8-11-13 N=24	3.0-3.5	16		24			<0.6
	60.0 / 35.5	60		X	18	7-11-15 N=26	3.75	17		22			<0.6
	Boring Terminated at 60 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 15 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/8/2014	Boring Completed: 12/8/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-16

BORING LOG NO. 2014-7

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave
Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 90.0 (Ft.)

Depth	Material Description	Elevation (Ft.)
0.8	**FILL - LEAN CLAY TOPSOIL**, trace gravel, dark brown	89.5
3.5	**FILL - LEAN CLAY/FAT CLAY (CL/CH)**, trace sand, gravel, organics and peat, brown and dark brown to intermittent black layers, very stiff, moist to wet	86.5
10.5	**FILL - LEAN CLAY/FAT CLAY (CL/CH)**, trace sand, gravel, organics and peat, brown and dark brown to intermittent black layers, very soft to soft, moist to wet Sample 2 - Organic Content (%) = 19.6	79.5
40.0	**LEAN CLAY (CL)**, trace sand, gray, stiff to hard, moist to wet Note: Intermittent silt seams in sample 13.	50
	Boring Terminated at 40 Feet	

Sample Number	Recovery (In.)	Field Test Results	Hand Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	PID (ppm)
1	18	5-6-7 N=13	3.75		20			<0.6
2	15	2-3-2 N=5			85			<0.6
3	18	0-1-0 N=1	0.25		195			<0.6
4	18	1-0-1 N=1	0.25-0.5		116			<0.6
5	18	2-4-4 N=8	1.5-3.0		19			<0.6
6	18	5-9-13 N=22	4.0-4.5+		16			<0.6
7	18	6-8-12 N=20	2.5-3.5		18			<0.6
8	18	7-11-14 N=25	3.5-4.25		16			<0.6
9	18	6-10-13 N=23	2.75		19			<0.6
10	18	5-6-8 N=14	2.5		19			<0.6
11	18	5-8-11 N=19	2.0-3.25		18			<0.6
12	18	7-11-13 N=24	3.5		16			<0.6
13	18	7-10-13 N=23	3.0-3.75		15			<0.6
14	18	8-10-13 N=23	3.5		15			<0.6
15	18	7-10-11 N=21	2.75		17			<0.6
16	18	8-9-11 N=20	3.0		20			<0.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA

Abandonment Method:
Installed 2" PVC monitoring well, screened from 30 to 40 feet

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 12/11/2014	Boring Completed: 12/11/2014
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-17

BORING LOG NO. 2014-8

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 91.5 (Ft.)

Depth (Ft.)	Material Description	Elevation (Ft.)
0.5	**FILL - LEAN CLAY TOPSOIL**, dark brown, moist	91
6.5	**FILL - LEAN CLAY**, trace sand, topsoil, gravel, and rubble, brown, moist	85
9.0	**PEAT (PT)**, dark brown, very loose, moist	82.5
10.5	**ORGANIC CLAY (OL)**, trace silt, tan, very loose, moist	81
14.5	**SILT (ML)**, trace shell fragments, greenish gray, very loose, moist	77
15.5	**PEAT (PT)**, trace wood fragments, dark brown, very loose, moist	76
17.5	**ORGANIC SILT (OL)**, trace sand, gray, loose, wet	74
40.0	**LEAN CLAY (CL)**, trace sand and gravel, gray, stiff to very stiff, moist	51.5

Boring Terminated at 40 Feet

Sample Type	Recovery (In.)	Field Test Results	Hand Penetrometer (tsf)	Sample Number	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	PID (ppm)
X	1	4-6-8 N=14		1		17			1.4
X	14	4-4-6 N=10	1.50	2		23			1.4
X	18	1-2-1 N=3		3		73			1.8
X	18	1-1-2 N=3		4		92			1.8-1.4
X	18	1-1-1 N=2		5		79			1.8
X	18	1-1-2 N=3	0.25	6		73			1.8-2.8
X	18	3-3-4 N=7		7		98			1.3
X	18	7-9-11 N=20	2.5-3.5	8					1.4
X	18	8-10-12 N=22	2.75-3.5	9		19			1.3
X	18	6-8-11 N=19	3.0-4.0	10		18			1.6
X	18	6-7-8 N=15	2.0	11		18			1.6
X	18	4-4-6 N=10	1.25-2.0	12		22			1.6
X	18	5-5-5 N=10	2.0	13		20			1.6
X	18	6-8-12 N=20	3.75	14		19			1.8
X	18	5-8-11 N=19	2.5-3.5	15		18			1.4
X	18	7-9-13 N=22	3.5	16		16			1.3

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

15.5 feet while sampling

31 feet at completion of drilling

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 2/6/2015	Boring Completed: 2/6/2015
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-18

BORING LOG NO. 2014-8PMT

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 91.5 (Ft.)

GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	Blind Drilled to 18 feet, see B-2014-8 for classifications.	5, 10, 15											
	18.0 — 73.5												
	LEAN CLAY (CL), trace sand and gravel, gray, very stiff, moist			X	12	6-6-9 N=15	2.5	1					
		20, 25, 30, 35		X	18	6-6-9 N=15	2.5-3.5	2					
		40											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 10 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 2/23/2015	Boring Completed: 2/23/2015
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-19

BORING LOG NO. 2014-8PMT

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 91.5 (Ft.)

DEPTH / Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
LEAN CLAY (CL), trace sand and gravel, gray, very stiff, moist *(continued)*													
Drillers Note: water loss from 47 to 48 feet, possible sand layer. After PMT 3 (50 -52 feet) could not get roller bit down hole without plugging with clay. Started new hole 2.5 feet east. Used HSA to 50 feet, used as casing, then RB to next PMT interval at 80to 82 feet.		50		X	18	8-11-13 N=24	3.5-4.25	3					
		80		X	18	11-13-17 N=30	3.5-4.0	4					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 10 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 2/23/2015	Boring Completed: 2/23/2015
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-20

BORING LOG NO. 2014-8PMT

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

GRAPHIC LOG	LOCATION See Exhibit A-2 Surface Elev.: 91.5 (Ft.) DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
	LEAN CLAY (CL), trace sand and gravel, gray, very stiff, moist *(continued)* 85.0 / 6.5	85											
	Boring Terminated at 85 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA to 10 ft, RB w/Mud below

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
9856 South 57th Street
Franklin, Wisconsin

Boring Started: 2/23/2015	Boring Completed: 2/23/2015
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-21

BORING LOG NO. 2014-9

PROJECT: Oak Creek Water Utility Site Investigation

CLIENT: Oak Creek Water and Sewer Utility

SITE: 9325 South 5th Ave, Oak Creek, Wisconsin

LOCATION See Exhibit A-2

Surface Elev.: 96.0 (Ft.)

DEPTH	Description	ELEVATION (Ft.)
0.3	**FILL - LEAN CLAY TOPSOIL**, dark brown	96
4.5	**FILL - LEAN CLAY**, trace sand, topsoil, and gravel, brown, moist	91.5
5.5	**FILL - LEAN CLAY TOPSOIL**, trace gravel, dark brown, moist	90.5
15.0	**LEAN CLAY (CL)**, trace sand and gravel, brown, very stiff to hard, moist	81
40.0	**LEAN CLAY (CL)**, trace sand and gravel, gray, stiff to very stiff, moist	56
	Boring Terminated at 40 Feet	

RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	SAMPLE NUMBER	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PID (ppm)
8	4-5-4 N=9	3.5	1		15			1.4
12	3-4-3 N=7	2.0	2		20			1.6
18	5-7-9 N=16	3.25-4.5+	3		19			1.6
18	8-11-15 N=26	4.5+	4		19			1.6
18	8-11-14 N=25	4.5+	5		19			1.6
18	5-6-5 N=11	2.5-1.0	6		23			1.8
18	3-3-4 N=7	1.0-1.5	7		19			1.6
18	3-3-4 N=7	1.0	8		25			1.6
18	4-4-4 N=8	1.0-1.5	9		20			1.6
18	4-5-5 N=10	1.25	10		20			1.6
18	4-5-6 N=11	1.25-2.0	11		19			1.6
18	4-5-5 N=10	1.25-1.75	12		19			1.6
18	3-4-4 N=8	1.0-1.5	13		12			1.4
18	3-5-6 N=11	1.25-1.75	14		19			1.6
18	6-8-10 N=18	2.5-3.5	15		19			1.8
18	7-7-9 N=16	2.5	16		16			1.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Cathead/Rope/Safety Hammer

Advancement Method:
HSA

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-1 for description of field procedures

City of Oak Creek Datum

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
9856 South 57th Street
Franklin, Wisconsin

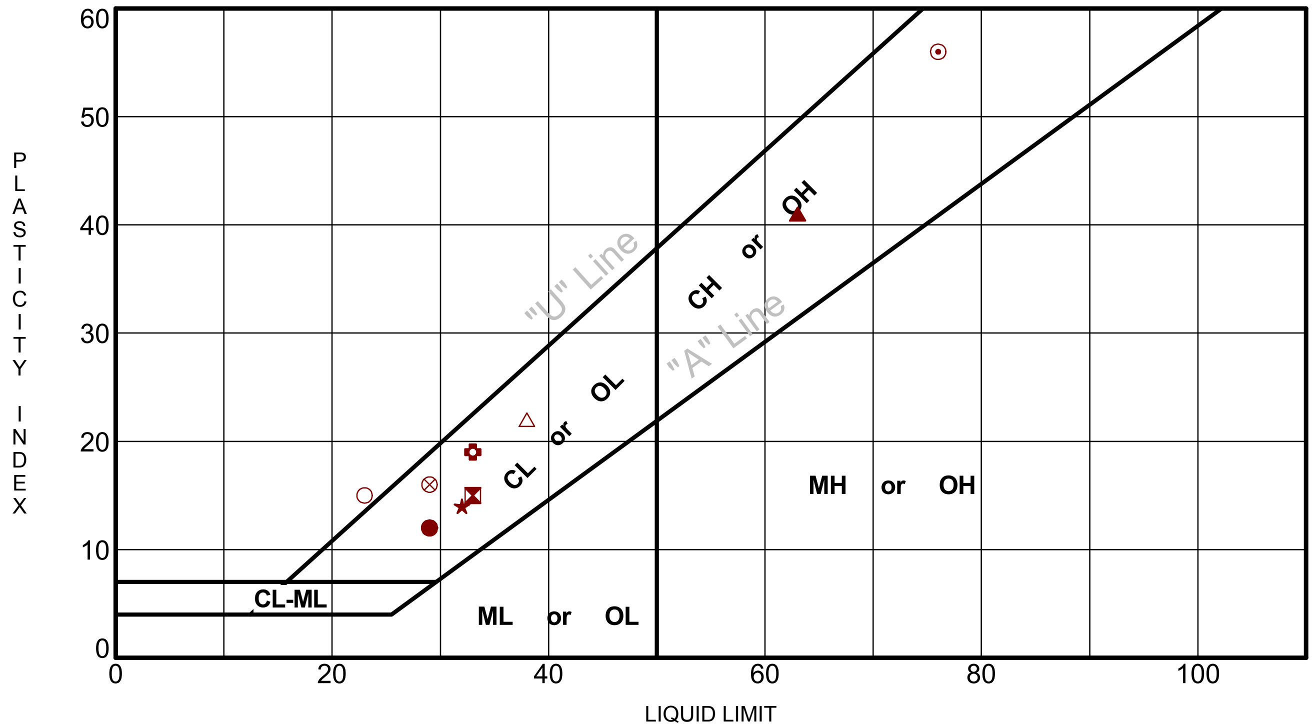
Boring Started: 2/6/2015	Boring Completed: 2/6/2015
Drill Rig: CME-45	Driller: J&J
Project No.: MR145146	Exhibit: A-22

ATTACHMENTS B

LABORATORY TEST RESULTS

ATTERBERG LIMITS RESULTS

ASTM D4318



	Sample ID	LL	PL	PI	Fines	USCS	Description
●	2014-2	29	17	12			
⊠	2014-2	33	18	15			
▲	2014-3	63	22	41			
★	2014-3	32	18	14			
⊙	2014-4	76	20	56			
✿	2014-4	33	14	19			
○	2014-5	23	8	15			
△	2014-6	38	16	22			
⊗	2014-6	29	13	16			

PROJECT: Oak Creek Water Utility Site Investigation

SITE: 9325 South 5th Ave
Oak Creek, Wisconsin

Terracon
9856 South 57th Street
Franklin, Wisconsin

PROJECT NUMBER: MR145146

CLIENT: Oak Creek Water and Sewer Utility
Oak Creek, WI

EXHIBIT: B-1

UNCONFINED COMPRESSION TEST - ASTM D2166

Terracon

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GENERAL INFORMATION

Project Number:	MR145146
Project Name:	Oak Creek Water Utility Site Investigation
Location:	9325 South 5th Ave Oak Creek, WI
Boring Number:	2014-2
Sample Number:	ST-4
Sample Depth (ft.):	9-11
Test Date:	12/22/2014
Sample Date:	12/5/2014
Sample Description:	Grayish-Brown Lean Clay, Trace Sand and Gravel

	Diameter (in)	Height (in)
1	2.842	5.975
2	2.837	5.967
3	2.836	5.969
Average	2.838	5.970

SAMPLE INFORMATION

Initial Diameter (in.):	2.838
Initial Height (in.):	5.970
Specimen Weight (gms.):	1312.40
Assumed Specific Gravity (SpG):	2.700

MOISTURE CONTENT DETERMINATION

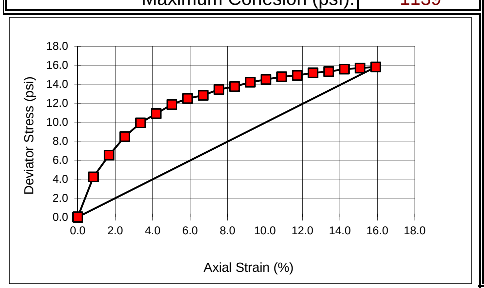
Container Number:	A-28
Wt. Container + Wet Soil (gms.):	165.30
Wt. Container + Dry Soil (gms.):	145.20
Wt. Container (gms.):	31.70

OTHER DATA

Strain Rate (in./min):	0.110
Final Strain Dial Reading (in.):	0.950

RESULTS

Wet Density (pcf):	132.35
Dry Density (pcf):	112.44
Estimated Degree of Saturation:	95.94
Moisture Content (%):	17.71
Estimated Void Ratio:	0.498
Test Duration (min.):	8.64
Time To Failure (min):	8.64
Maximum Deviator Stress (psf):	2277
Axial Strain at Failure (%):	15.91
Length / Diameter Ratio:	2.10
Maximum Cohesion (psf):	1139



TEST DATA / CALCULATIONS

Time Values Stop watch	Strain (inches)	Load (lbs)	(Zero) Corrected Load (lbs)	Strain (%)	Stress (psi)	Youngs Modulus (psi)
10:42 AM	0.000	0.0	0.0	0.00	0.000	0.0
	0.050	27.0	27.0	0.84	4.232	505.3
	0.100	42.0	42.0	1.67	6.527	389.7
	0.150	55.0	55.0	2.51	8.474	337.3
	0.200	65.0	65.0	3.35	9.929	296.4
	0.250	72.0	72.0	4.19	10.903	260.4
	0.300	79.0	79.0	5.02	11.858	236.0
	0.350	84.0	84.0	5.86	12.498	213.2
	0.400	87.0	87.0	6.70	12.829	191.5
	0.450	92.0	92.0	7.54	13.444	178.4
	0.500	95.0	95.0	8.37	13.757	164.3
	0.550	99.0	99.0	9.21	14.205	154.2
	0.600	102.0	102.0	10.05	14.501	144.3
	0.650	105.0	105.0	10.89	14.788	135.8
	0.700	107.0	107.0	11.72	14.928	127.3
	0.750	110.0	110.0	12.56	15.201	121.0
	0.800	112.0	112.0	13.40	15.329	114.4
	0.850	115.0	115.0	14.24	15.588	109.5
	0.900	117.0	117.0	15.07	15.704	104.2
	0.950	119.0	119.0	15.91	15.815	99.4
10:50 AM	1.000		0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0

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UNCONFINED COMPRESSION TEST - ASTM D2166

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GENERAL INFORMATION

Project Number:	MR145146
Project Name:	Oak Creek Water Utility Site Investigation
Location:	9325 South 5th Ave Oak Creek, WI
Boring Number:	2014-2
Sample Number:	ST-6
Sample Depth (ft.):	14-16
Test Date:	12/22/2014
Sample Date:	12/5/2014
Sample Description:	Grayish-Brown Lean Clay, Trace Sand and Gravel

	Diameter (in)	Height (in)
1	2.865	5.945
2	2.861	5.936
3	2.856	5.935
Average	2.861	5.939

SAMPLE INFORMATION

Initial Diameter (in.):	2.861
Initial Height (in.):	5.939
Specimen Weight (gms.):	1335.50
Assumed Specific Gravity (SpG):	2.700

MOISTURE CONTENT DETERMINATION

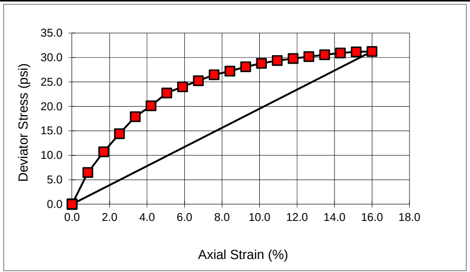
Container Number:	H6
Wt. Container + Wet Soil (gms.):	183.20
Wt. Container + Dry Soil (gms.):	158.10
Wt. Container (gms.):	30.70

OTHER DATA

Strain Rate (in./min):	0.110
Final Strain Dial Reading (in.):	0.950

RESULTS

Wet Density (pcf):	133.29
Dry Density (pcf):	111.35
Estimated Degree of Saturation:	103.69
Moisture Content (%):	19.70
Estimated Void Ratio:	0.513
Test Duration (min.):	8.64
Time To Failure (min):	8.64
Maximum Deviator Stress (psf):	4498
Axial Strain at Failure (%):	16.00
Length / Diameter Ratio:	2.08
Maximum Cohesion (psf):	2249



TEST DATA / CALCULATIONS

Time Values Stop watch	Strain (inches)	Load (lbs)	(Zero) Corrected Load (lbs)	Strain (%)	Stress (psi)	Youngs Modulus (psi)
9:57 AM	0.000	0.0	0.0	0.00	0.000	0.0
	0.050	42.0	42.0	0.84	6.480	769.6
	0.100	70.0	70.0	1.68	10.708	635.9
	0.150	95.0	95.0	2.53	14.408	570.4
	0.200	119.0	119.0	3.37	17.891	531.3
	0.250	135.0	135.0	4.21	20.120	477.9
	0.300	154.0	154.0	5.05	22.750	450.4
	0.350	164.0	164.0	5.89	24.013	407.4
	0.400	174.0	174.0	6.74	25.249	374.9
	0.450	184.0	184.0	7.58	26.459	349.2
	0.500	191.0	191.0	8.42	27.215	323.2
	0.550	199.0	199.0	9.26	28.094	303.4
	0.600	206.0	206.0	10.10	28.813	285.2
	0.650	212.0	212.0	10.95	29.374	268.4
	0.700	217.0	217.0	11.79	29.783	252.7
	0.750	222.0	222.0	12.63	30.178	239.0
	0.800	227.0	227.0	13.47	30.561	226.9
	0.850	232.0	232.0	14.31	30.930	216.1
	0.900	236.0	236.0	15.15	31.154	205.6
9:59 AM	0.950	239.0	239.0	16.00	31.237	195.3
	1.000		0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0

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GENERAL INFORMATION

Project Number:	MR145146
Project Name:	Oak Creek Water Utility Site Investigation
Location:	9325 South 5th Ave Oak Creek, WI
Boring Number:	2014-3
Sample Number:	ST-7
Sample Depth (ft.):	14-16
Test Date:	12/19/2014
Sample Date:	12/5/2014
Sample Description:	Greyish-Brown Lean Clay, Trace Sand

	Diameter (in)	Height (in)
1	2.849	5.787
2	2.862	5.783
3	2.874	5.726
Average	2.862	5.765

SAMPLE INFORMATION

Initial Diameter (in.):	2.862
Initial Height (in.):	5.765
Specimen Weight (gms.):	1271.30
Assumed Specific Gravity (SpG):	2.700

MOISTURE CONTENT DETERMINATION

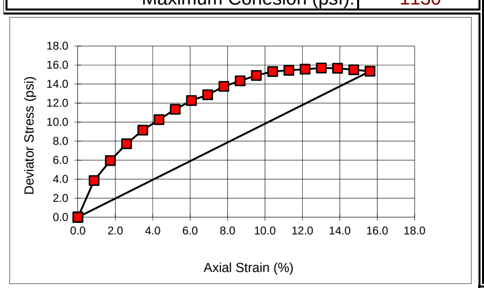
Container Number:	H12
Wt. Container + Wet Soil (gms.):	163.60
Wt. Container + Dry Soil (gms.):	139.30
Wt. Container (gms.):	30.30

OTHER DATA

Strain Rate (in./min):	0.110
Final Strain Dial Reading (in.):	0.900

RESULTS

Wet Density (pcf):	130.61
Dry Density (pcf):	106.80
Estimated Degree of Saturation:	104.22
Moisture Content (%):	22.29
Estimated Void Ratio:	0.578
Test Duration (min.):	8.18
Time To Failure (min):	8.18
Maximum Deviator Stress (psf):	2259
Axial Strain at Failure (%):	13.01
Length / Diameter Ratio:	2.01
Maximum Cohesion (psf):	1130



TEST DATA / CALCULATIONS

Time Values Stop watch	Strain (inches)	Load (lbs)	(Zero) Corrected Load (lbs)	Strain (%)	Stress (psi)	Youngs Modulus (psi)
1:24 PM	0.000	0.0	0.0	0.00	0.000	0.0
	0.050	25.0	25.0	0.87	3.853	444.3
	0.100	39.0	39.0	1.73	5.959	343.5
	0.150	51.0	51.0	2.60	7.723	296.8
	0.200	61.0	61.0	3.47	9.155	263.9
	0.250	69.0	69.0	4.34	10.263	236.7
	0.300	77.0	77.0	5.20	11.349	218.1
	0.350	84.0	84.0	6.07	12.267	202.1
	0.400	89.0	89.0	6.94	12.878	185.6
	0.450	96.0	96.0	7.81	13.761	176.3
	0.500	101.0	101.0	8.67	14.342	165.4
	0.550	106.0	106.0	9.54	14.909	156.3
	0.600	110.0	110.0	10.41	15.323	147.2
	0.650	112.0	112.0	11.27	15.450	137.0
	0.700	114.0	114.0	12.14	15.573	128.3
	0.750	116.0	116.0	13.01	15.689	120.6
	0.800	117.0	117.0	13.88	15.667	112.9
	0.850	117.0	117.0	14.74	15.509	105.2
1:32 PM	0.900	117.0	117.0	15.61	15.351	98.3
	0.950		0.0	0.00	0.000	0.0
	1.000		0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0

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GENERAL INFORMATION

Project Number:	MR145146
Project Name:	Oak Creek Water Utility Site Investigation
Location:	9325 South 5th Ave Oak Creek, WI
Boring Number:	2014-4
Sample Number:	ST-6
Sample Depth (ft.):	14-16
Test Date:	12/19/2014
Sample Date:	12/5/2014
Sample Description:	Dark Gray Lean Clay Trace Sand

	Diameter (in)	Height (in)
1	2.879	5.811
2	2.873	5.799
3	2.863	5.772
Average	2.872	5.794

SAMPLE INFORMATION

Initial Diameter (in.):	2.872
Initial Height (in.):	5.794
Specimen Weight (gms.):	1267.60
Assumed Specific Gravity (SpG):	2.700

MOISTURE CONTENT DETERMINATION

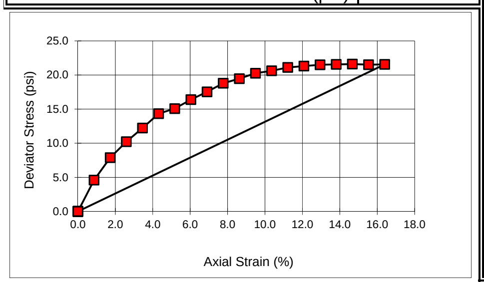
Container Number:	P2
Wt. Container + Wet Soil (gms.):	140.70
Wt. Container + Dry Soil (gms.):	119.80
Wt. Container (gms.):	31.70

OTHER DATA

Strain Rate (in./min):	0.110
Final Strain Dial Reading (in.):	0.950

RESULTS

Wet Density (pcf):	128.68
Dry Density (pcf):	104.01
Estimated Degree of Saturation:	103.33
Moisture Content (%):	23.72
Estimated Void Ratio:	0.620
Test Duration (min.):	8.64
Time To Failure (min):	8.64
Maximum Deviator Stress (psf):	3111
Axial Strain at Failure (%):	14.67
Length / Diameter Ratio:	2.02
Maximum Cohesion (psf):	1556



TEST DATA / CALCULATIONS

Time Values Stop watch	Strain (inches)	Load (lbs)	(Zero) Corrected Load (lbs)	Strain (%)	Stress (psi)	Youngs Modulus (psi)
1:48 PM	0.000	0.0	0.0	0.00	0.000	0.0
	0.050	30.0	30.0	0.86	4.592	532.1
	0.100	52.0	52.0	1.73	7.890	457.2
	0.150	68.0	68.0	2.59	10.227	395.0
	0.200	82.0	82.0	3.45	12.224	354.1
	0.250	97.0	97.0	4.31	14.330	332.1
	0.300	103.0	103.0	5.18	15.080	291.2
	0.350	113.0	113.0	6.04	16.393	271.4
	0.400	122.0	122.0	6.90	17.536	254.0
	0.450	132.0	132.0	7.77	18.798	242.0
	0.500	138.0	138.0	8.63	19.468	225.6
	0.550	145.0	145.0	9.49	20.263	213.5
	0.600	149.0	149.0	10.36	20.623	199.1
	0.650	154.0	154.0	11.22	21.110	188.2
	0.700	157.0	157.0	12.08	21.312	176.4
	0.750	160.0	160.0	12.94	21.506	166.1
	0.800	162.0	162.0	13.81	21.559	156.1
	0.850	164.0	164.0	14.67	21.607	147.3
	0.900	165.0	165.0	15.53	21.518	138.5
1:56 PM	0.950	167.0	167.0	16.40	21.557	131.5
	1.000		0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0

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UNCONFINED COMPRESSION TEST - ASTM D2166

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GENERAL INFORMATION

Project Number:	MR145146
Project Name:	Oak Creek Water Utility Site Investigation
Location:	9325 South 5th Ave Oak Creek, WI
Boring Number:	2014-6
Sample Number:	ST-4
Sample Depth (ft.):	8.5-10
Test Date:	12/19/2014
Sample Date:	12/8/2014
Sample Description:	Grayish-Brown Lean Clay, Trace Sand and Gravel

	Diameter (in)	Height (in)
1	2.852	5.630
2	2.852	5.632
3	2.852	5.650
Average	2.852	5.637

SAMPLE INFORMATION

Initial Diameter (in.):	2.852
Initial Height (in.):	5.637
Specimen Weight (gms.):	1202.00
Assumed Specific Gravity (SpG):	2.700

MOISTURE CONTENT DETERMINATION

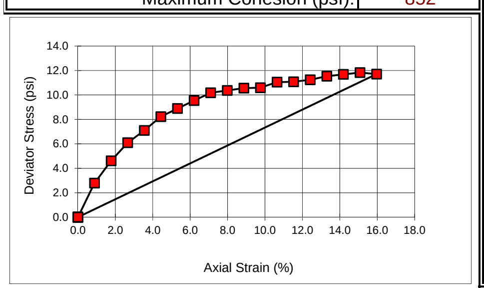
Container Number:	C32
Wt. Container + Wet Soil (gms.):	161.00
Wt. Container + Dry Soil (gms.):	138.10
Wt. Container (gms.):	29.90

OTHER DATA

Strain Rate (in./min):	0.110
Final Strain Dial Reading (in.):	0.900

RESULTS

Wet Density (pcf):	127.15
Dry Density (pcf):	104.94
Estimated Degree of Saturation:	94.38
Moisture Content (%):	21.16
Estimated Void Ratio:	0.605
Test Duration (min.):	8.18
Time To Failure (min):	8.18
Maximum Deviator Stress (psf):	1704
Axial Strain at Failure (%):	15.08
Length / Diameter Ratio:	1.98
Maximum Cohesion (psf):	852



TEST DATA / CALCULATIONS

Time Values Stop watch	Strain (inches)	Load (lbs)	(Zero) Corrected Load (lbs)	Strain (%)	Stress (psi)	Youngs Modulus (psi)
2:10 PM	0.000	0.0	0.0	0.00	0.000	0.0
	0.050	18.0	18.0	0.89	2.793	314.9
	0.100	30.0	30.0	1.77	4.613	260.0
	0.150	40.0	40.0	2.66	6.095	229.1
	0.200	47.0	47.0	3.55	7.096	200.0
	0.250	55.0	55.0	4.43	8.228	185.5
	0.300	60.0	60.0	5.32	8.892	167.1
	0.350	65.0	65.0	6.21	9.543	153.7
	0.400	70.0	70.0	7.10	10.180	143.5
	0.450	72.0	72.0	7.98	10.371	129.9
	0.500	74.0	74.0	8.87	10.556	119.0
	0.550	75.0	75.0	9.76	10.595	108.6
	0.600	79.0	79.0	10.64	11.050	103.8
	0.650	80.0	80.0	11.53	11.079	96.1
	0.700	82.0	82.0	12.42	11.242	90.5
	0.750	85.0	85.0	13.30	11.535	86.7
	0.800	87.0	87.0	14.19	11.686	82.3
	0.850	89.0	89.0	15.08	11.831	78.5
2:18 PM	0.900	89.0	89.0	15.96	11.707	73.3
	0.950		0.0	0.00	0.000	0.0
	1.000		0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0

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UNCONFINED COMPRESSION TEST - ASTM D2166

Terracon

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GENERAL INFORMATION

Project Number:	MR145146
Project Name:	Oak Creek Water Utility Site Investigation
Location:	9325 South 5th Ave Oak Creek, WI
Boring Number:	2014-6
Sample Number:	ST-6
Sample Depth (ft.):	14-16
Test Date:	12/22/2014
Sample Date:	12/8/2014
Sample Description:	Grayish-Brown Lean Clay, Trace Sand and Gravel

	Diameter (in)	Height (in)
1	2.847	5.605
2	2.825	5.606
3	2.835	5.605
Average	2.836	5.605

SAMPLE INFORMATION

Initial Diameter (in.):	2.836
Initial Height (in.):	5.605
Specimen Weight (gms.):	1202.20
Assumed Specific Gravity (SpG):	2.700

MOISTURE CONTENT DETERMINATION

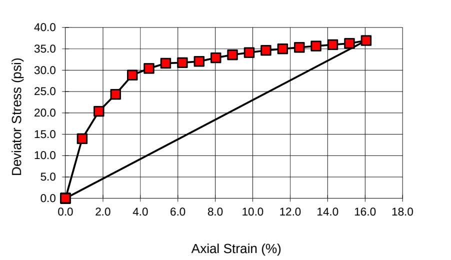
Container Number:	H3
Wt. Container + Wet Soil (gms.):	138.20
Wt. Container + Dry Soil (gms.):	122.10
Wt. Container (gms.):	30.40

OTHER DATA

Strain Rate (in./min):	0.110
Final Strain Dial Reading (in.):	0.900

RESULTS

Wet Density (pcf):	129.38
Dry Density (pcf):	110.05
Estimated Degree of Saturation:	89.29
Moisture Content (%):	17.56
Estimated Void Ratio:	0.531
Test Duration (min.):	8.18
Time To Failure (min):	8.18
Maximum Deviator Stress (psf):	5321
Axial Strain at Failure (%):	16.06
Length / Diameter Ratio:	1.98
Maximum Cohesion (psf):	2661

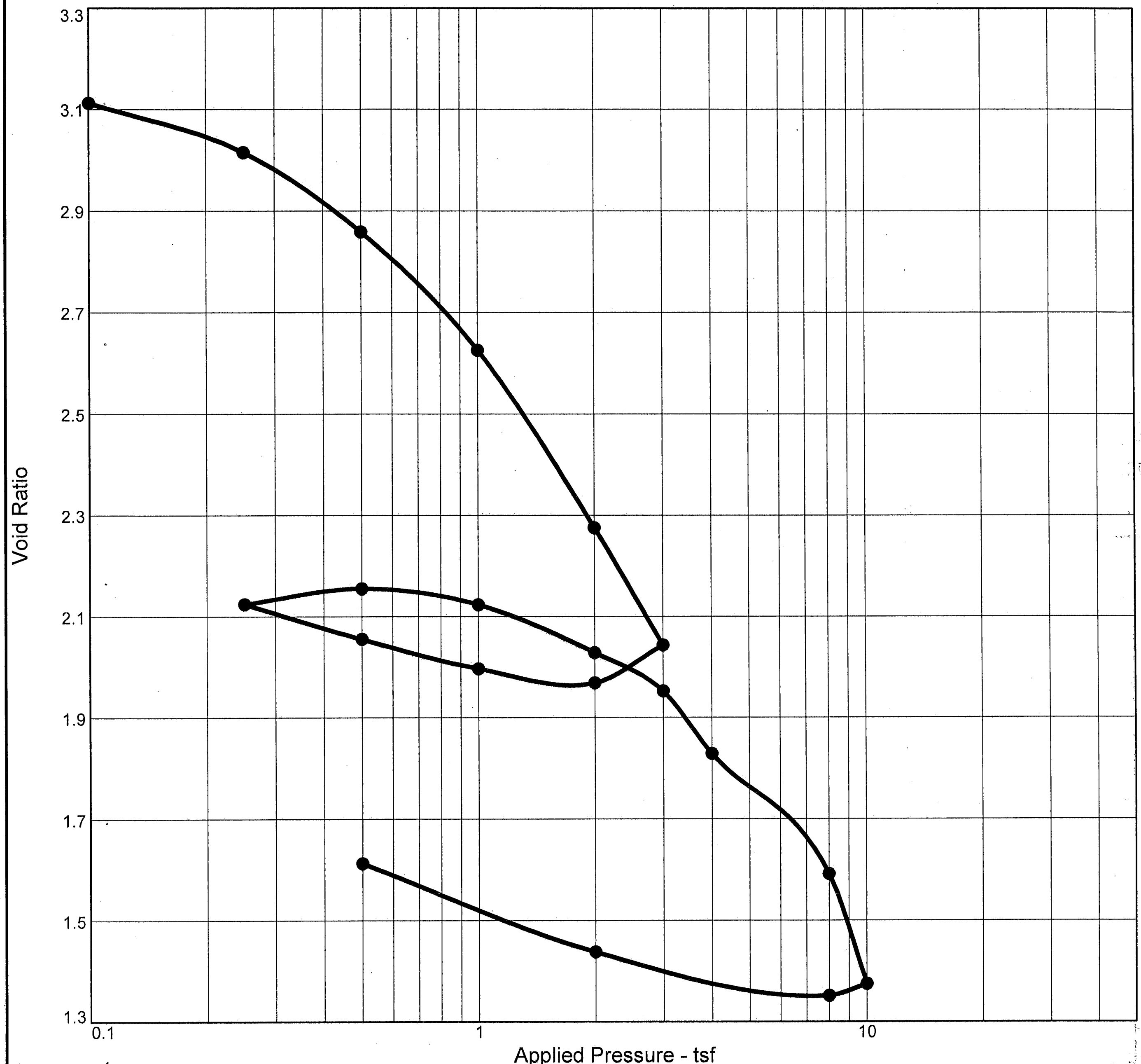


TEST DATA / CALCULATIONS

Time Values Stop watch	Strain (inches)	Load (lbs)	(Zero) Corrected Load (lbs)	Strain (%)	Stress (psi)	Youngs Modulus (psi)
10:16 AM	0.000	0.0	0.0	0.00	0.000	0.0
	0.050	89.0	89.0	0.89	13.967	1565.8
	0.100	131.0	131.0	1.78	20.373	1142.0
	0.150	158.0	158.0	2.68	24.349	909.9
	0.200	189.0	189.0	3.57	28.859	808.8
	0.250	201.0	201.0	4.46	30.408	681.8
	0.300	211.0	211.0	5.35	31.622	590.8
	0.350	214.0	214.0	6.24	31.770	508.8
	0.400	218.0	218.0	7.14	32.056	449.2
	0.450	226.0	226.0	8.03	32.913	410.0
	0.500	233.0	233.0	8.92	33.603	376.7
	0.550	239.0	239.0	9.81	34.131	347.8
	0.600	245.0	245.0	10.70	34.642	323.6
	0.650	250.0	250.0	11.60	34.995	301.8
	0.700	255.0	255.0	12.49	35.335	283.0
	0.750	260.0	260.0	13.38	35.661	266.5
	0.800	265.0	265.0	14.27	35.972	252.0
	0.850	270.0	270.0	15.16	36.270	239.2
10:25 AM	0.900	278.0	278.0	16.06	36.952	230.1
	0.950		0.0	0.00	0.000	0.0
	1.000		0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0
			0.0	0.00	0.000	0.0

Reviewed By: Pradip Tailor
Laboratory Manager
135 Ambassador Drive, Naperville, Illinois 60540
Phone: 630-717-4263, Fax: 630-357-9489

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
84.4 %	151.7 %	26.3			1.730		13.95	0.41	0.30	3.111

MATERIAL DESCRIPTION	USCS	AASHTO
ORGANIC		

Project No. MR145146 **Client:** OAK CREEK WATER AND SEWER UTILITY

Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 **Depth:** 8.5-10.5' **Sample Number:** ST-4

Remarks:

LOI - 50.0%

Terracon, Inc.

Cincinnati, Ohio

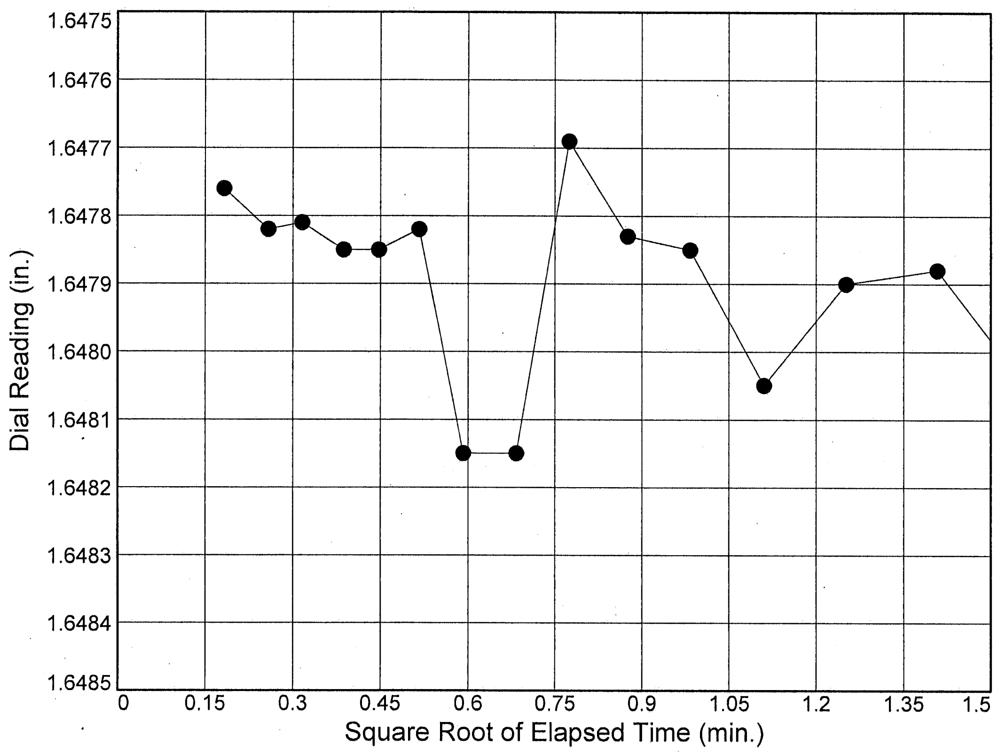
Exhibit

Checked By: GS

Dial Reading vs. Time

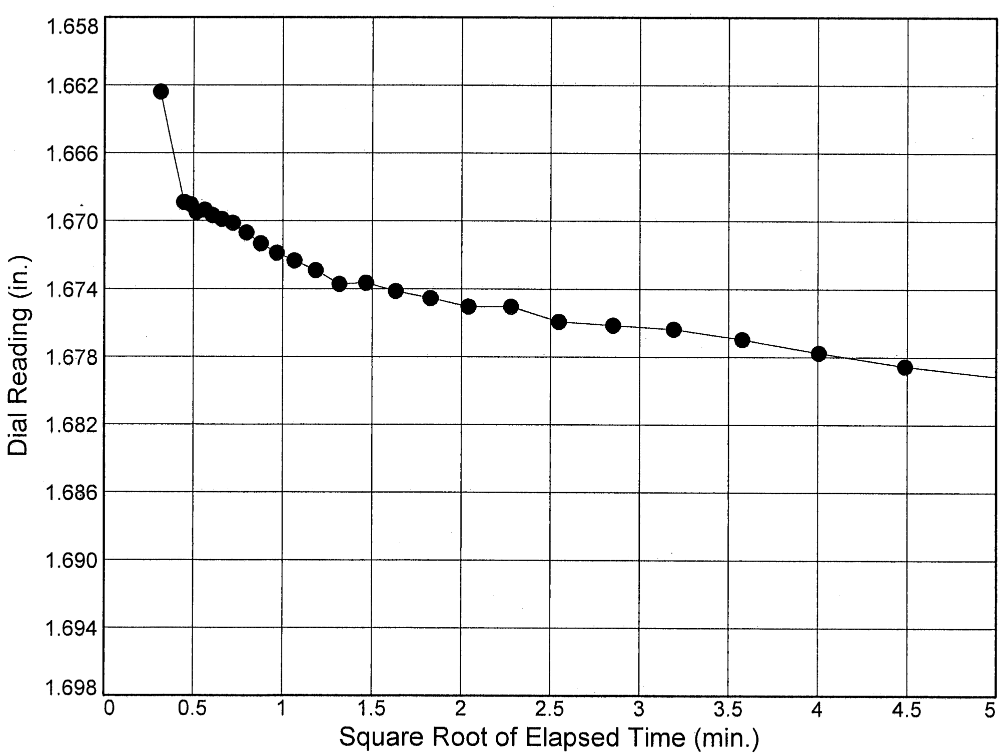
Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 1
Load= 0.10 tsf
D_0 = 1.6491
D_{90} = 1.6478
D_{100} = 1.6477
T_{90} = 0.86 min.

C_V @ T_{90}
2.451 ft.^{2}/day



Load No.= 2
Load= 0.25 tsf
D_0 = 1.6510
D_{90} = 1.6694
D_{100} = 1.6714
T_{90} = 0.32 min.

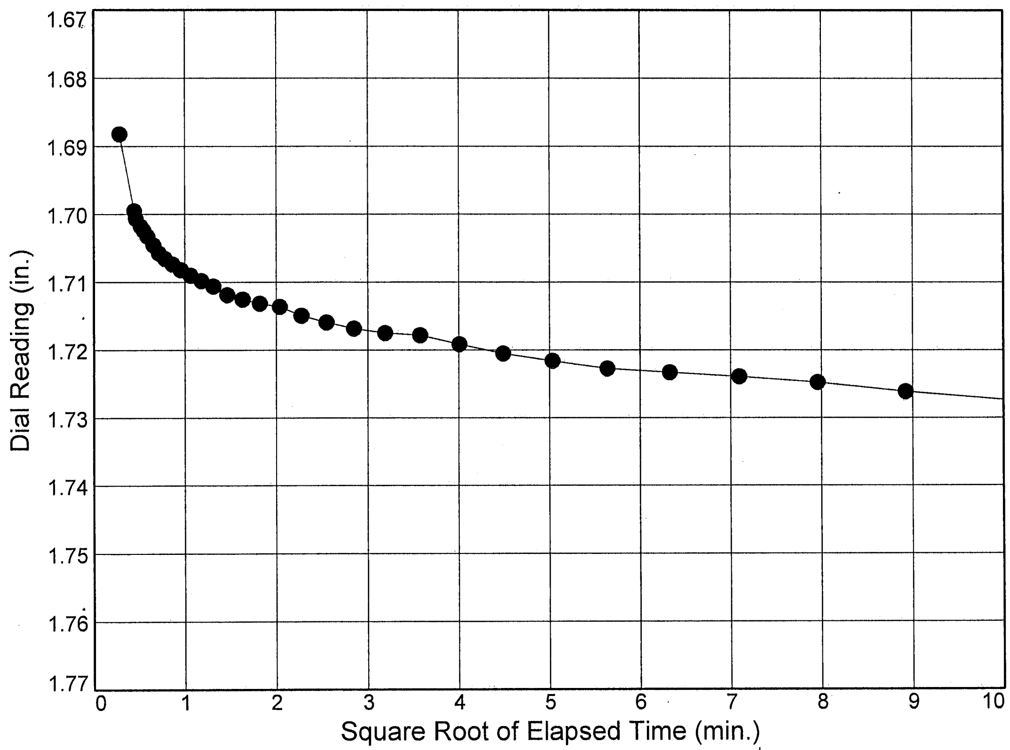
C_V @ T_{90}
6.445 ft.^{2}/day

Exhibit

Dial Reading vs. Time

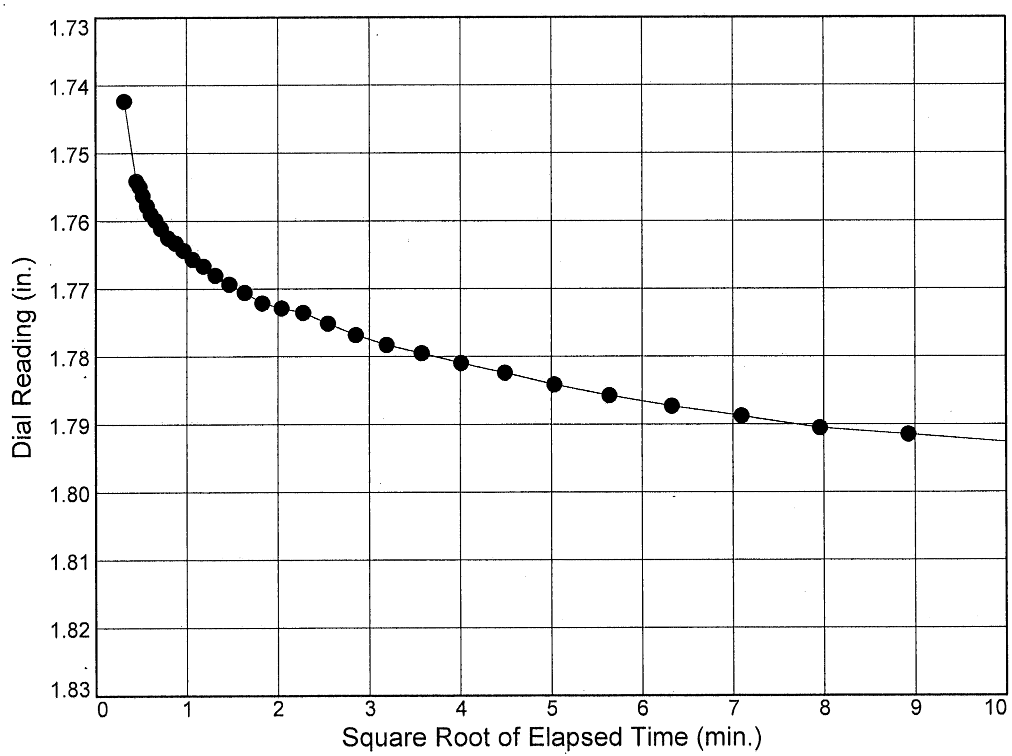
Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 3
Load= 0.50 tsf
D_0 = 1.6808
D_{90} = 1.7066
D_{100} = 1.7094
T_{90} = 0.62 min.

C_v @ T_{90}
3.122 ft.^{2}/day



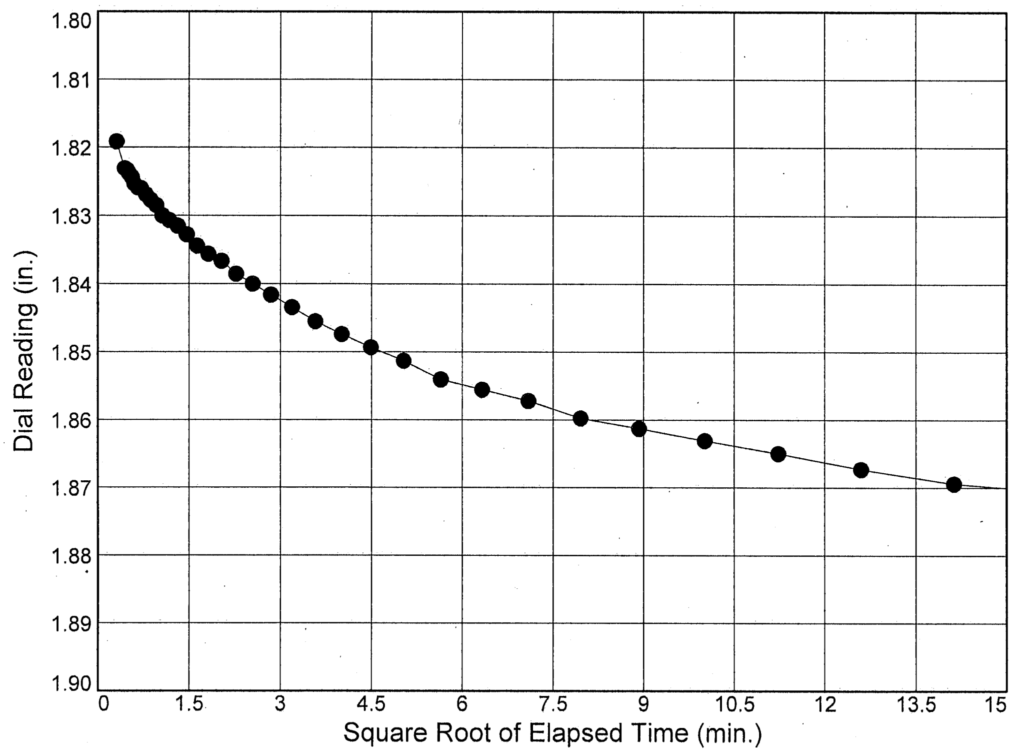
Load No.= 4
Load= 1.00 tsf
D_0 = 1.7352
D_{90} = 1.7630
D_{100} = 1.7661
T_{90} = 0.73 min.

C_v @ T_{90}
2.336 ft.^{2}/day

Dial Reading vs. Time

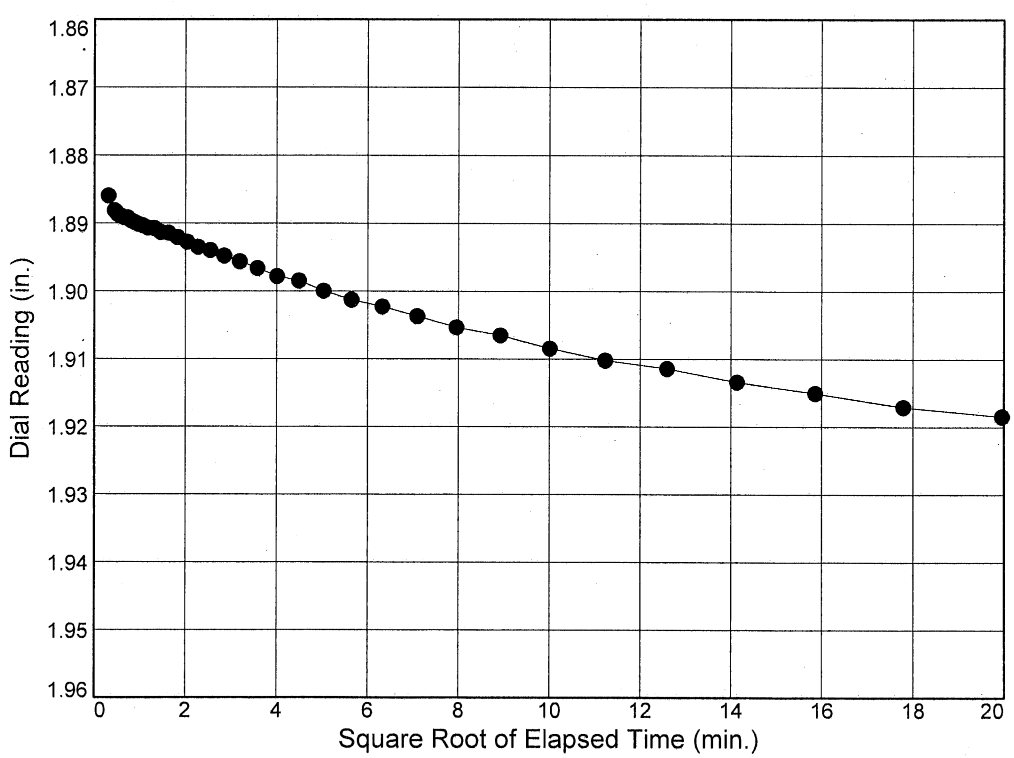
Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 5
Load= 2.00 tsf
D_0 = 1.8207
D_{90} = 1.8483
D_{100} = 1.8513
T_{90} = 17.76 min.

C_v @ T_{90}
0.079 ft.^{2}/day



Load No.= 6
Load= 3.00 tsf
D_0 = 1.8873
D_{90} = 1.9057
D_{100} = 1.9078
T_{90} = 68.63 min.

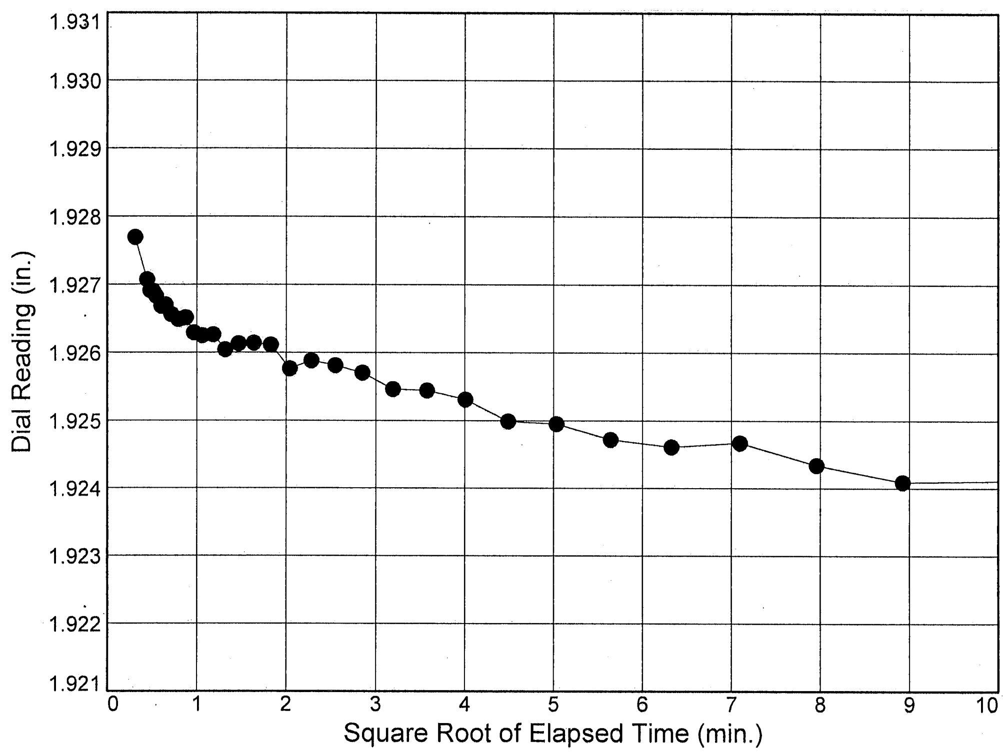
C_v @ T_{90}
0.017 ft.^{2}/day

Exhibit

Dial Reading vs. Time

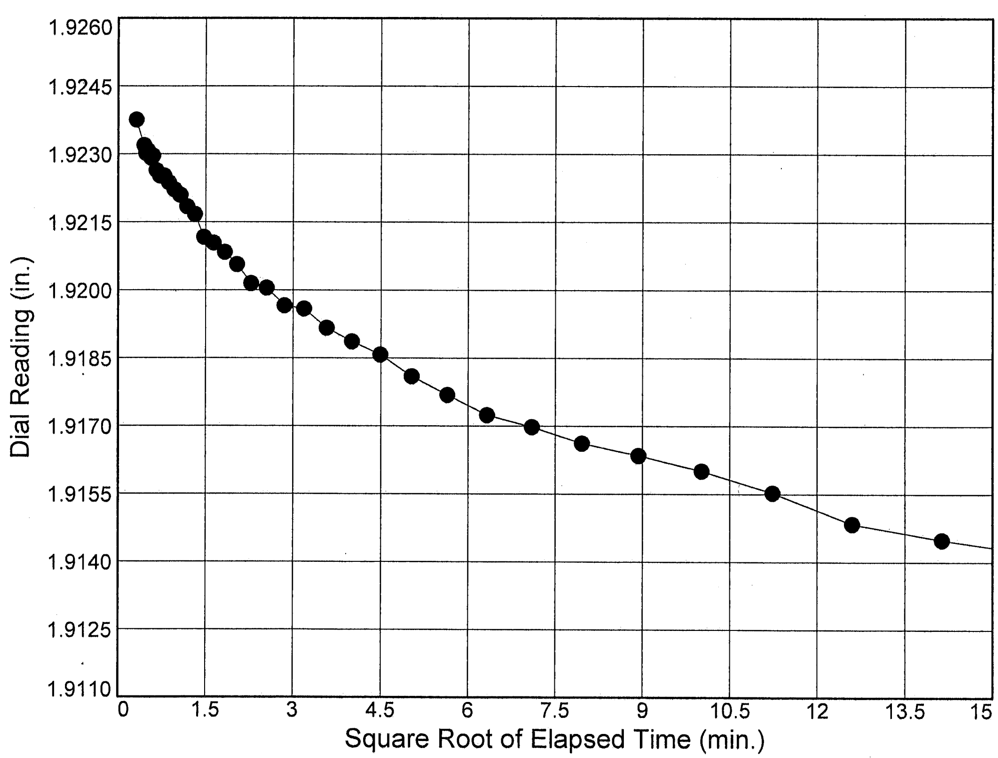
Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 7
Load= 2.00 tsf
D_0 = 1.9279
D_{90} = 1.9263
D_{100} = 1.9261
T_{90} = 1.15 min.

C_v @ T_{90}
0.957 ft.^{2}/day



Load No.= 8
Load= 1.00 tsf
D_0 = 1.9238
D_{90} = 1.9196
D_{100} = 1.9191
T_{90} = 9.50 min.

C_v @ T_{90}
0.118 ft.^{2}/day

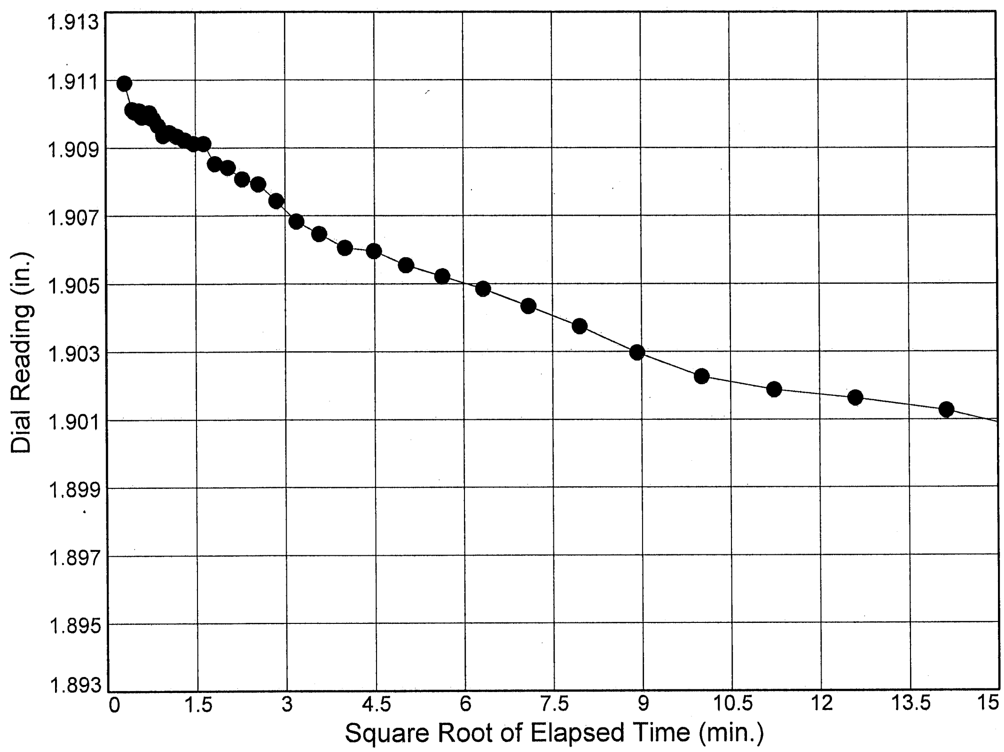
Exhibit

Terracon, Inc.

Dial Reading vs. Time

Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 9

Load=0.50 tsf

D_0 = 1.9108

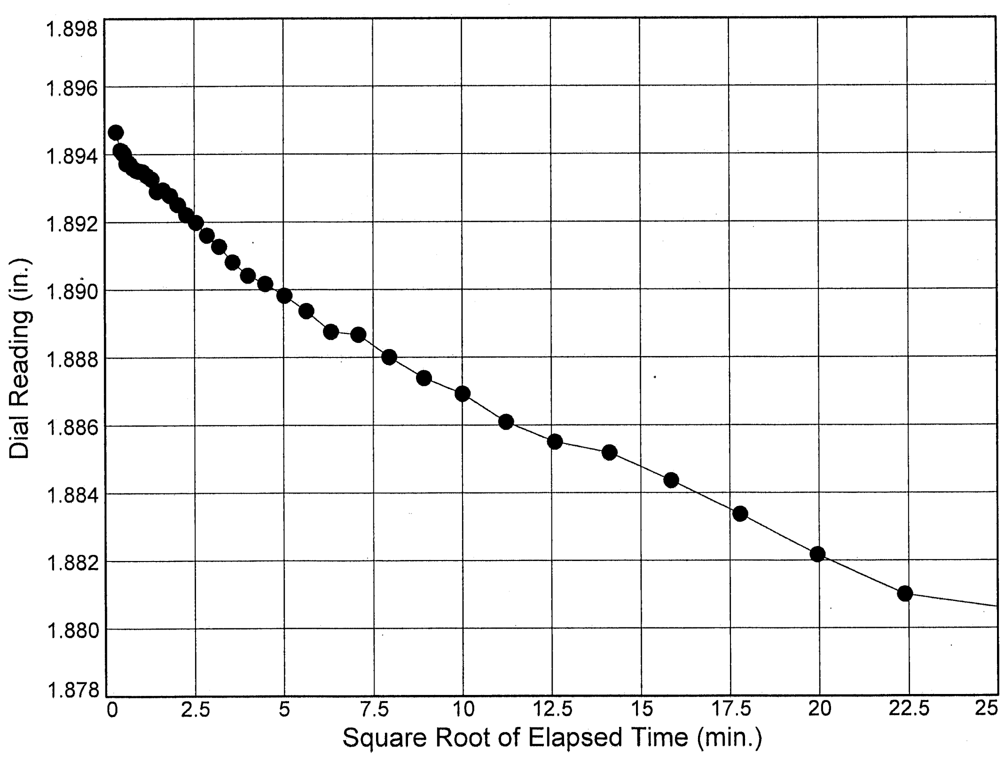
D_{90} = 1.9055

D_{100} = 1.9049

T_{90} = 26.04 min.

C_v @ T_{90}

0.045 ft.^{2}/day



Load No.= 10

Load=0.25 tsf

D_0 = 1.8945

D_{90} = 1.8887

D_{100} = 1.8881

T_{90} = 45.74 min.

C_v @ T_{90}

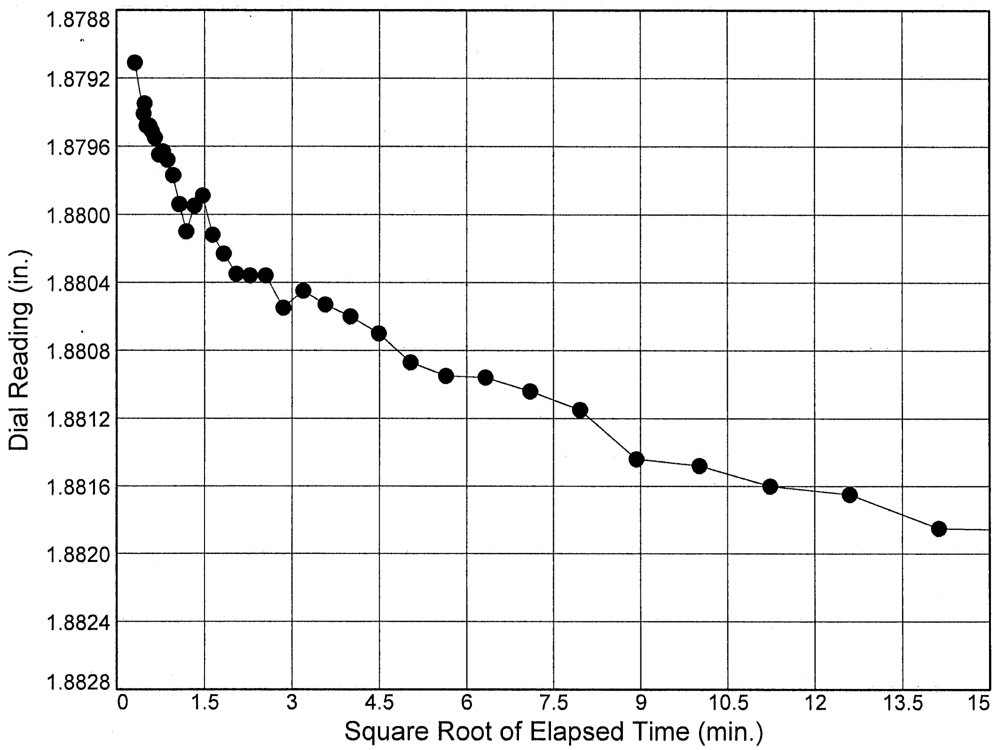
0.027 ft.^{2}/day

Exhibit

Dial Reading vs. Time

Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 11

Load= 0.50 tsf

D_0 = 1.8791

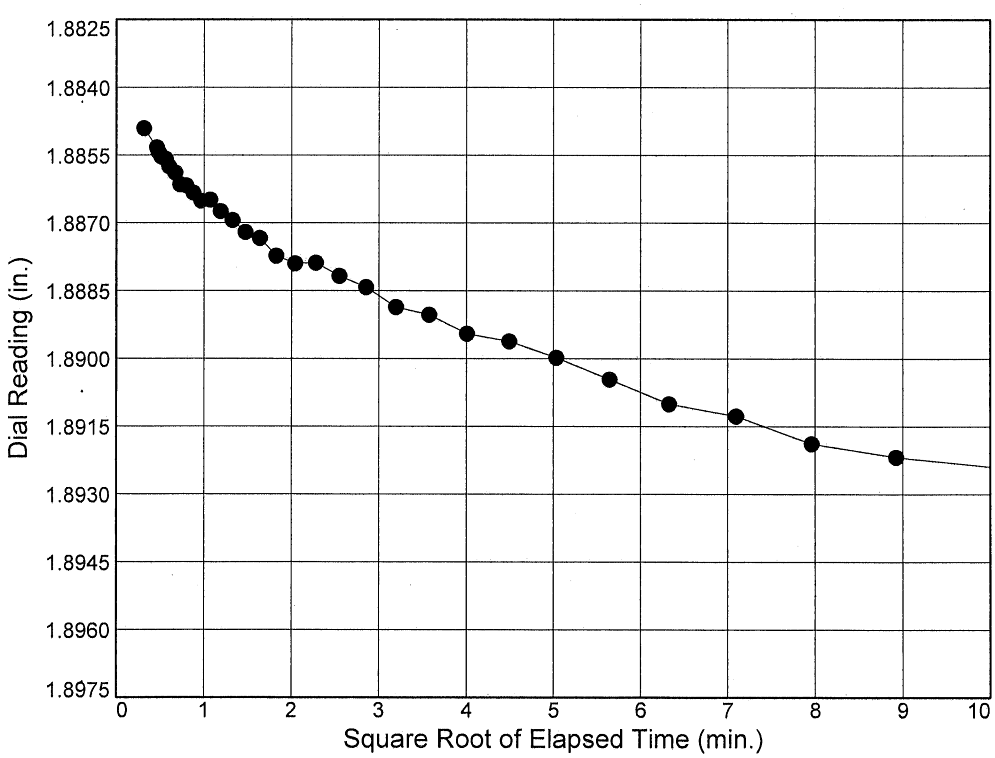
D_{90} = 1.8804

D_{100} = 1.8805

T_{90} = 5.12 min.

C_v @ T_{90}

0.245 ft.^{2}/day



Load No.= 12

Load= 1.00 tsf

D_0 = 1.8847

D_{90} = 1.8879

D_{100} = 1.8883

T_{90} = 4.60 min.

C_v @ T_{90}

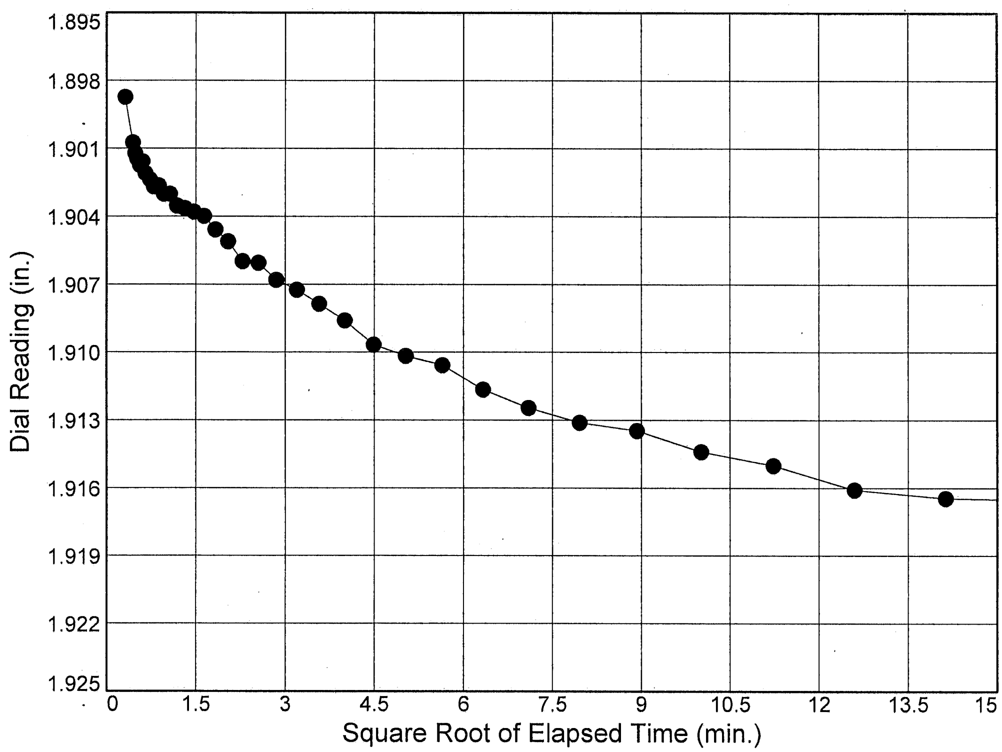
0.267 ft.^{2}/day

Exhibit

Dial Reading vs. Time

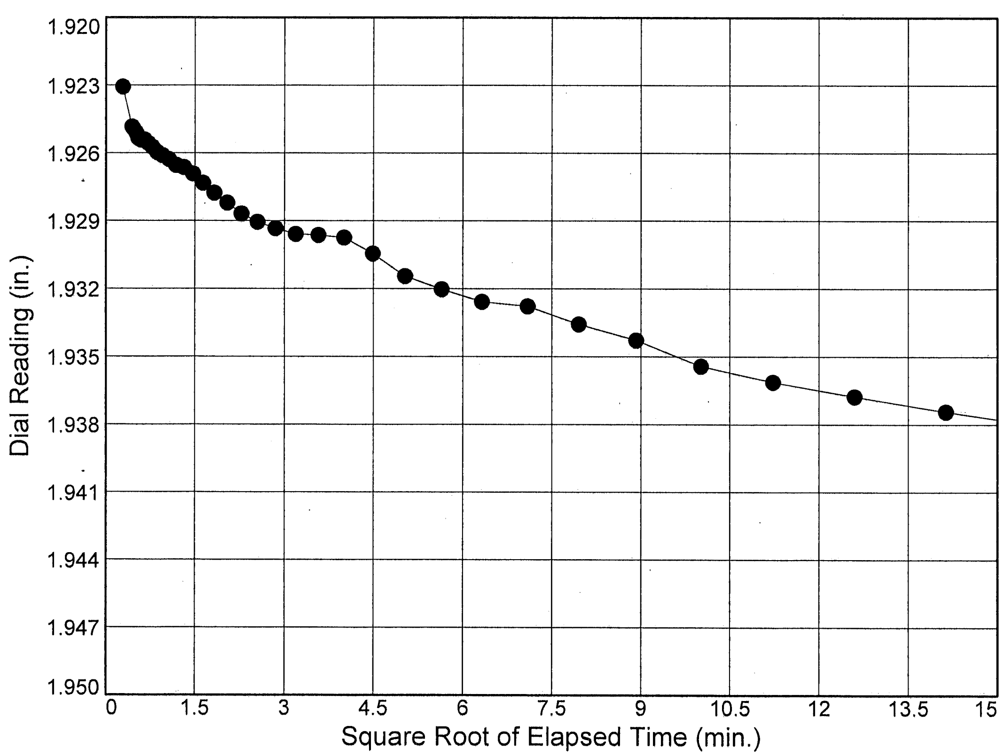
Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 13
Load= 2.00 tsf
D_0 = 1.9004
D_{90} = 1.9103
D_{100} = 1.9114
T_{90} = 27.74 min.

C_v @ T_{90}
0.042 ft.^{2}/day



Load No.= 14
Load= 3.00 tsf
D_0 = 1.9238
D_{90} = 1.9294
D_{100} = 1.9300
T_{90} = 8.50 min.

C_v @ T_{90}
0.130 ft.^{2}/day

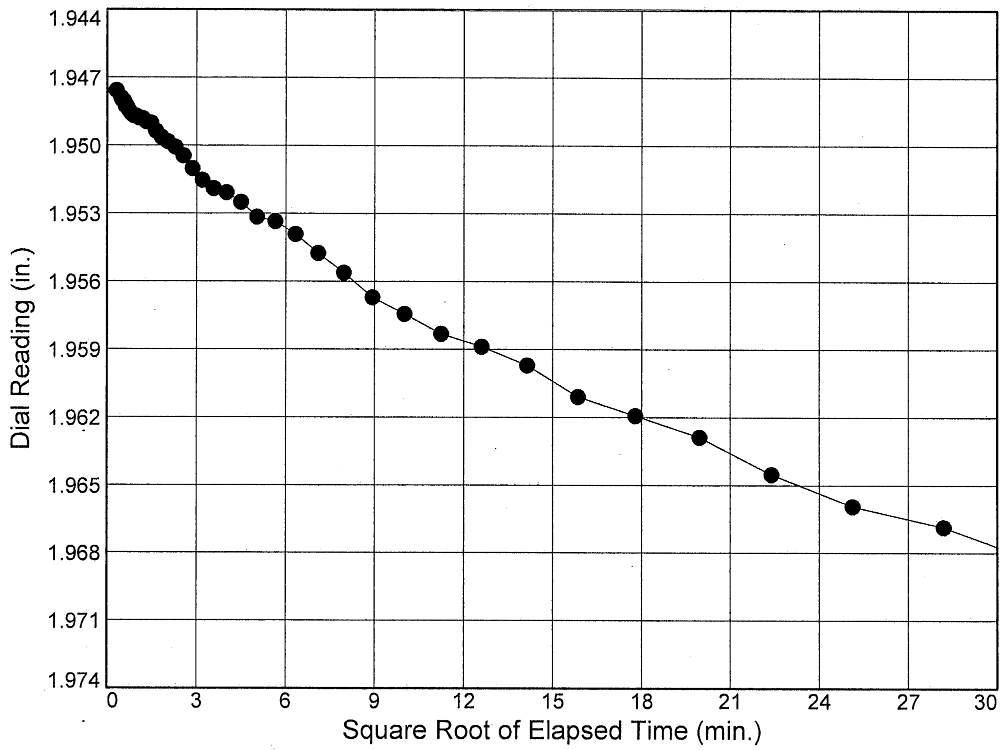
Exhibit

Terracon, Inc.

Dial Reading vs. Time

Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 15

Load= 4.00 tsf

D_0 = 1.9477

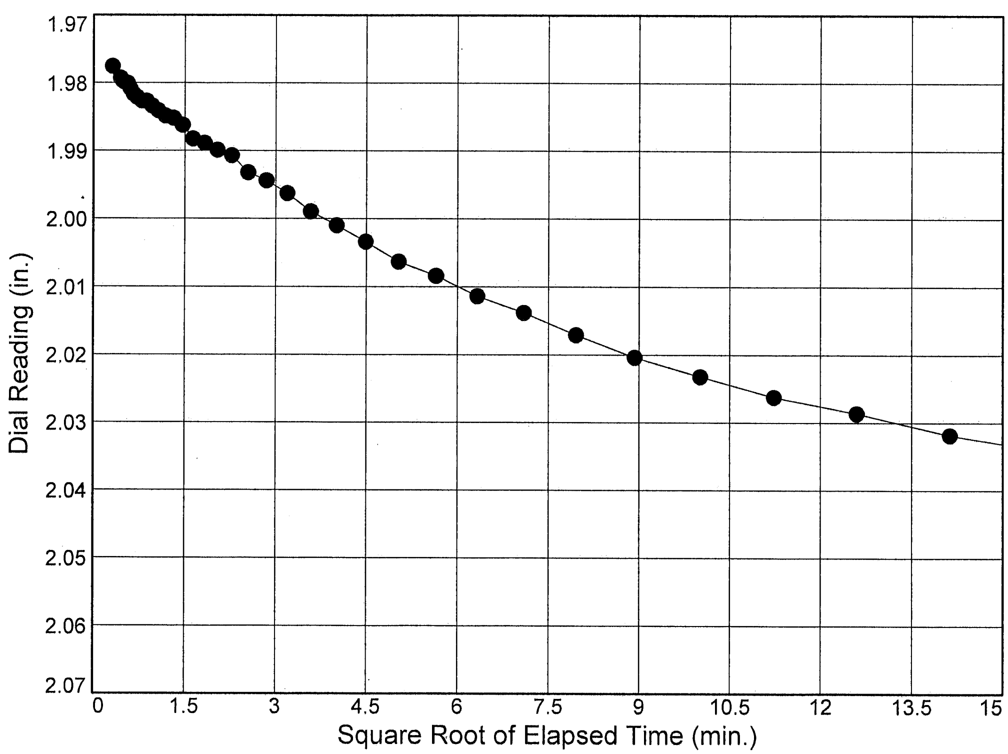
D_{90} = 1.9588

D_{100} = 1.9600

T_{90} = 153.28 min.

C_v @ T_{90}

0.007 ft.^{2}/day



Load No.= 16

Load= 8.00 tsf

D_0 = 1.9774

D_{90} = 2.0136

D_{100} = 2.0176

T_{90} = 49.32 min.

C_v @ T_{90}

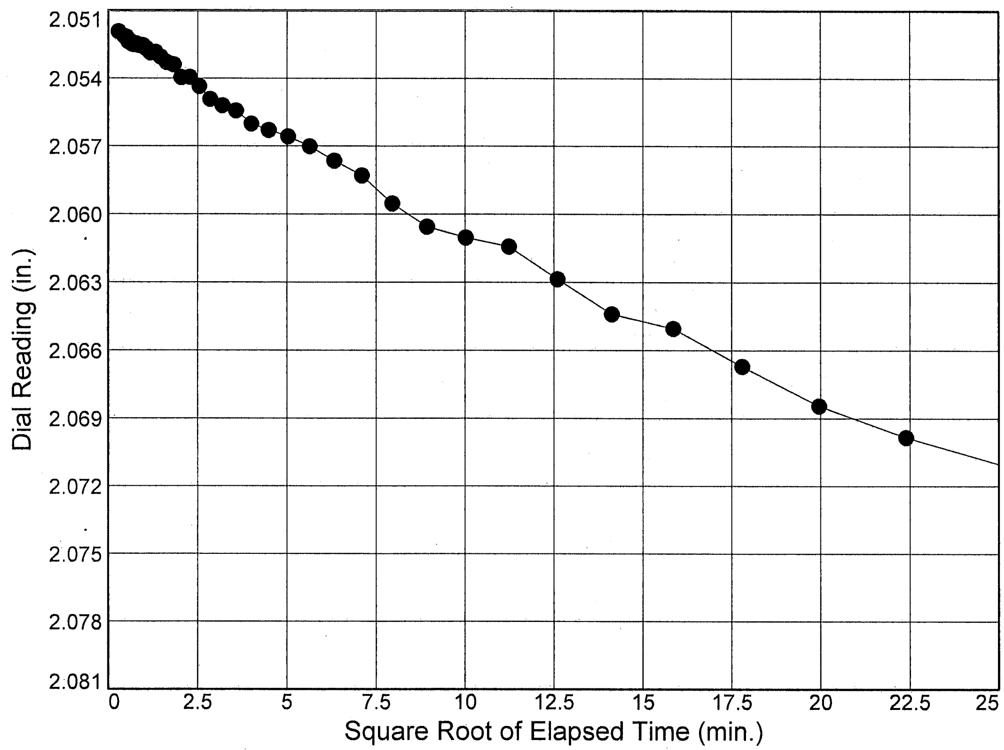
0.018 ft.^{2}/day

Exhibit

Dial Reading vs. Time

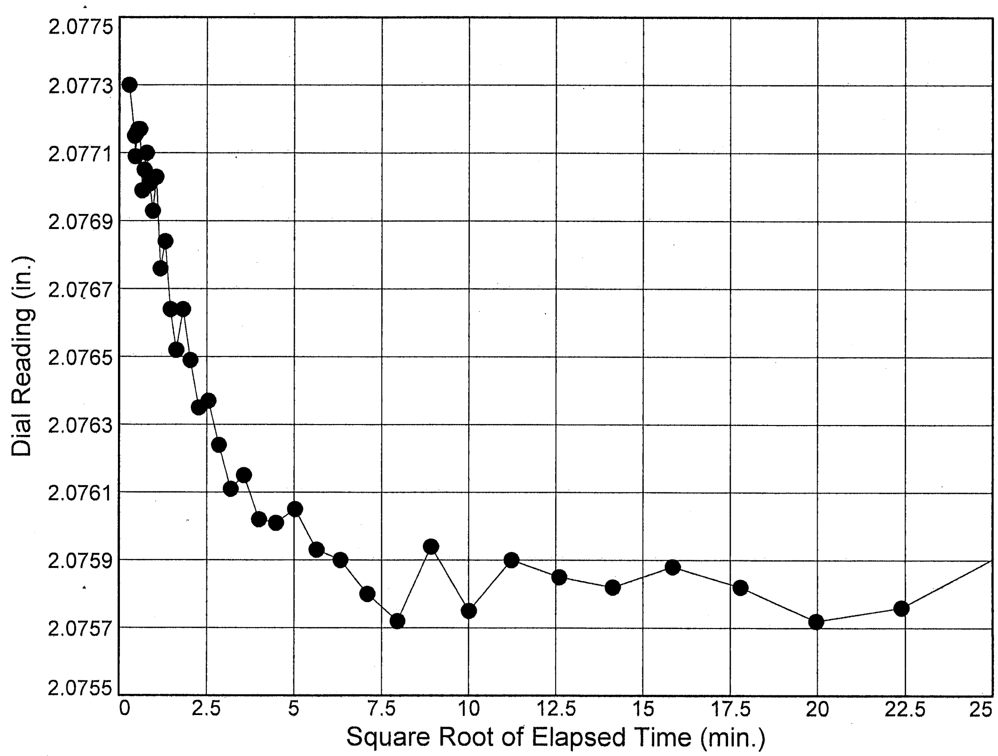
Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 17
Load= 10.00 tsf
D_0 = 2.0518
D_{90} = 2.0685
D_{100} = 2.0704
T_{90} = 401.71 min.

C_v @ T_{90}
0.002 ft.^{2}/day



Load No.= 18
Load= 8.00 tsf
D_0 = 2.0773
D_{90} = 2.0761
D_{100} = 2.0760
T_{90} = 11.78 min.

C_v @ T_{90}
0.059 ft.^{2}/day

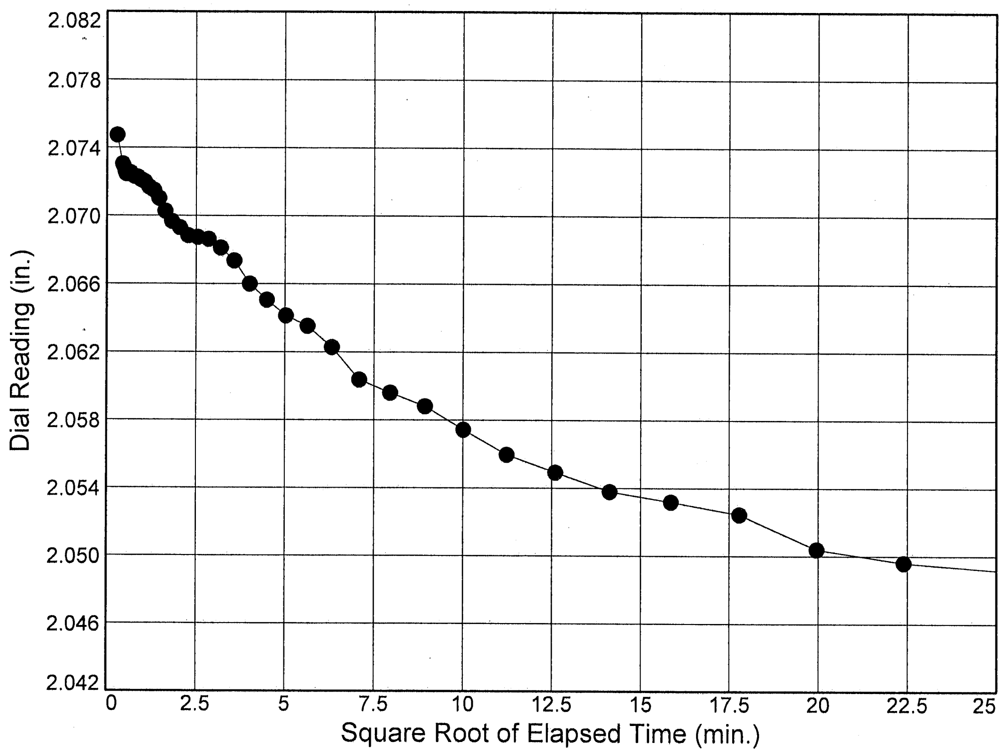
Exhibit

Terracon, Inc.

Dial Reading vs. Time

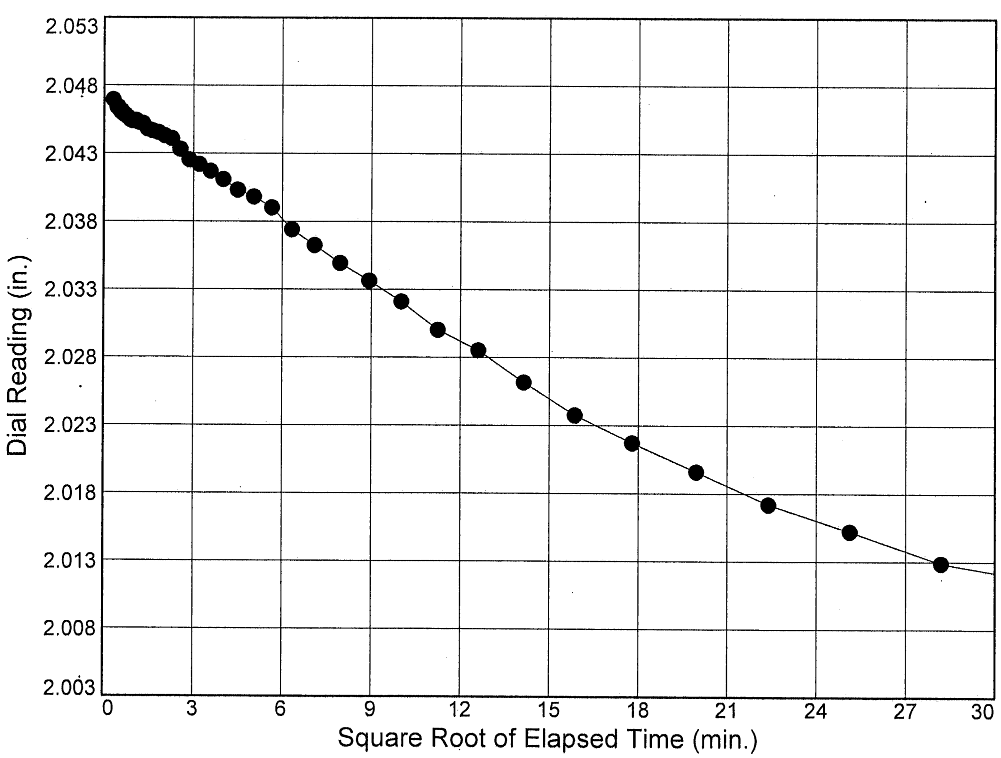
Project No.: MR145146
Project: OAK CREEK WATER PLANT EXPANSION

Source of Sample: 2014-5 Depth: 8.5-10.5' Sample Number: ST-4



Load No.= 19
Load= 2.00 tsf
D_0 = 2.0737
D_{90} = 2.0569
D_{100} = 2.0551
T_{90} = 108.90 min.

C_v @ T_{90}
0.007 ft.^{2}/day

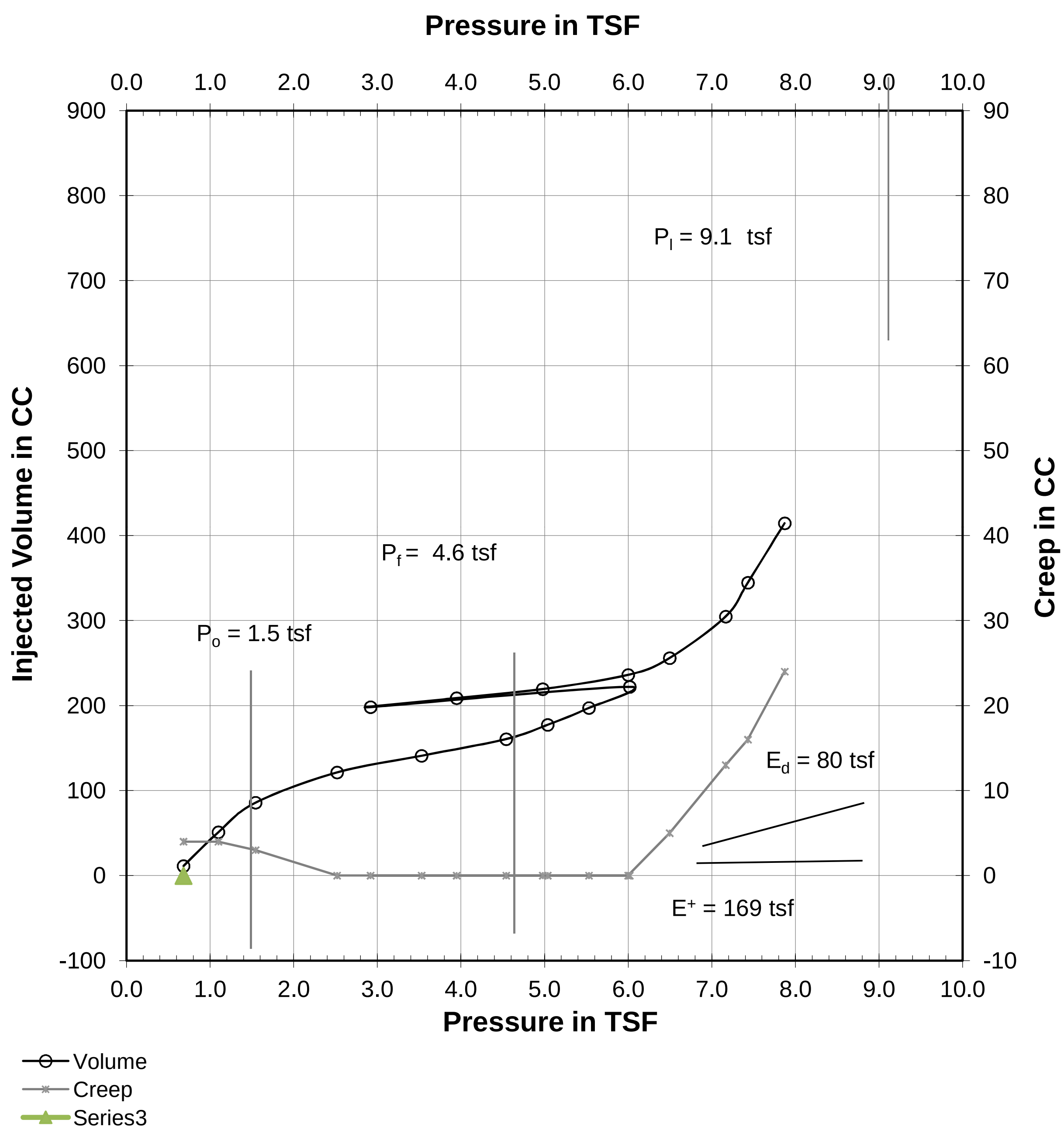


Load No.= 20
Load= 0.50 tsf
D_0 = 2.0470
D_{90} = 2.0160
D_{100} = 2.0125
T_{90} = 579.45 min.

C_v @ T_{90}
0.001 ft.^{2}/day

Exhibit

Job Number: MR145146 Date: 2-24-15
Boring No.: B-8PMT
Test Depth: 18.0-20.5 Feet



Pressuremeter Data Reduction (BX)

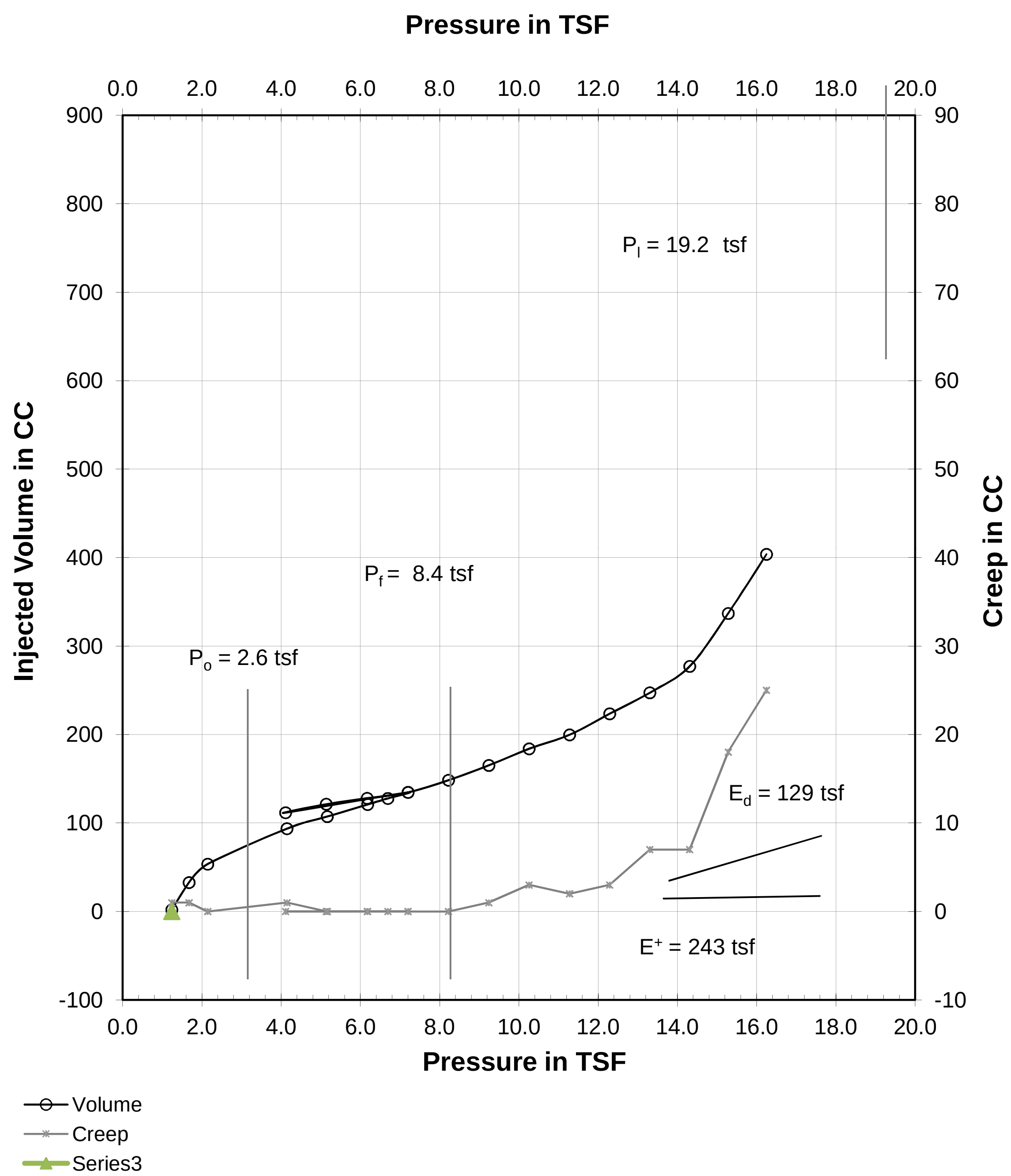
Job No.: MR145146
Boring No.: B-8PMT
Test Depth: 18.0-20.5 Feet

Water Correction: 0.69 Bars

No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.00	0.03	0.7	8	12	4	7.3	11.2	
2	0.50	0.13	1.1	48	52	4	47.0	51.0	16
3	1.00	0.21	1.5	84	87	3	82.8	85.8	21
4	2.00	0.28	2.5	123	123	0	121.4	121.4	47
5	3.00	0.31	3.5	143	143	0	140.9	140.9	91
6	4.00	0.34	4.5	163	163	0	160.6	160.6	94
7	4.50	0.36	5.0	180	180	0	177.4	177.4	55
8	5.00	0.39	5.5	200	200	0	197.2	197.2	48
9	5.50	0.43	6.0	225	225	0	222.1	222.1	39
10	2.50	0.39	2.9	200	200	0	198.2	198.2	257
11	3.50	0.41	3.9	211	211	0	208.8	208.8	191
12	4.50	0.42	5.0	222	222	0	219.4	219.4	193
13	5.50	0.44	6.0	239	239	0	236.1	236.1	124
14	6.00	0.47	6.5	254	259	5	250.9	255.9	52
15	6.70	0.53	7.2	295	308	13	291.7	304.7	30
16	7.00	0.57	7.4	332	348	16	328.7	344.6	15
17	7.50	0.65	7.9	394	418	24	390.5	414.5	15

E_d= 80 TSF E^+= 169 TSF P_l= 9.1 TSF

Job Number: MR145146 Date: 2-24-15
Boring No.: B-8PMT
Test Depth: 35.0-37.5 Feet



Pressuremeter Data Reduction (BX)

Job No.: MR145146
Boring No.: B-8PMT
Test Depth: 35.0-37.5 Feet

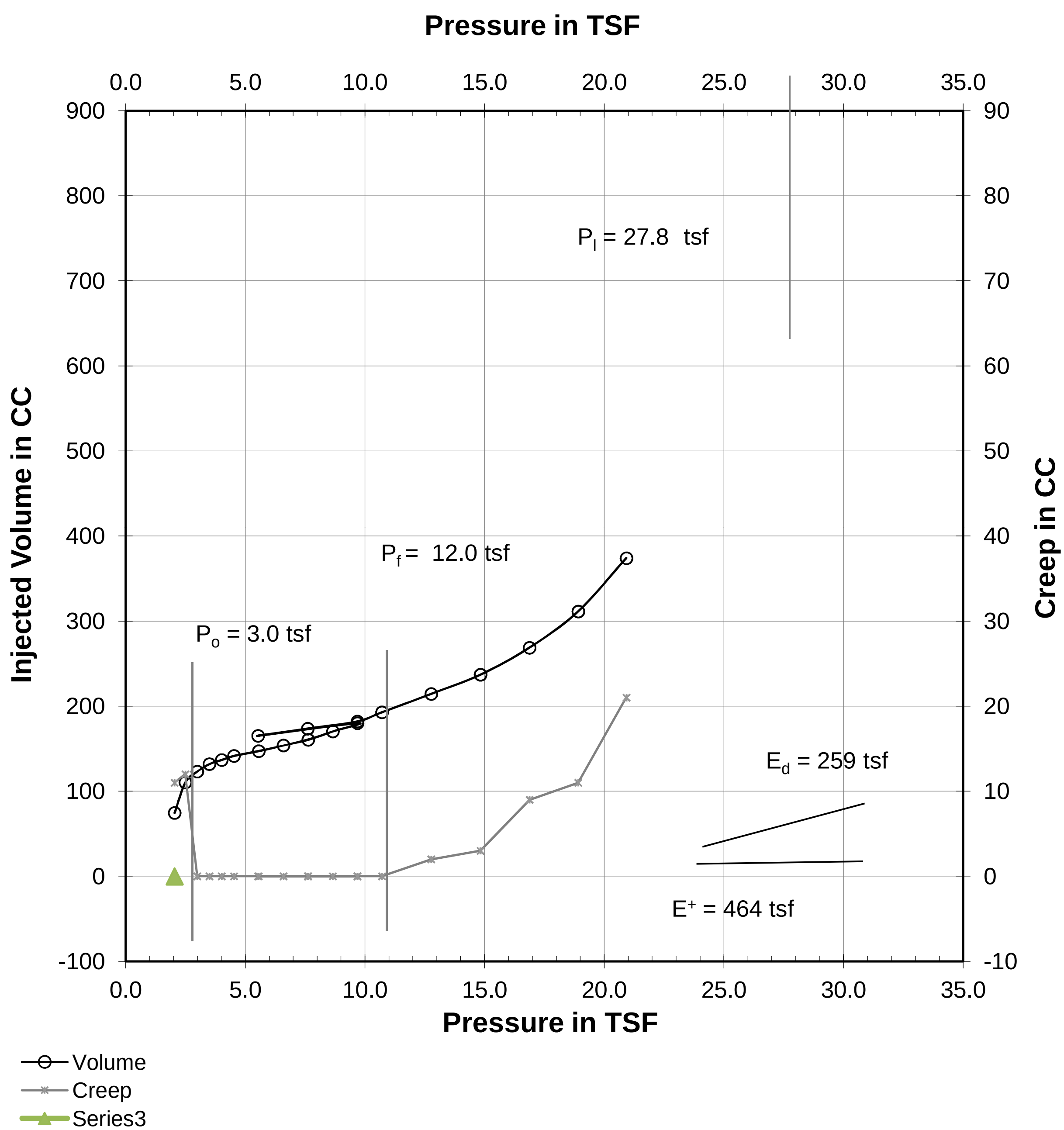
Water Correction: 1.19 Bars

No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.00	0.01	1.2	2	3	1	1.0	2.0	
2	0.50	0.09	1.7	33	34	1	31.8	32.7	21
3	1.00	0.14	2.1	55	55	0	53.5	53.5	35
4	3.00	0.23	4.1	95	96	1	92.7	93.7	81
5	4.00	0.25	5.2	110	110	0	107.3	107.3	126
6	5.00	0.28	6.2	124	124	0	121.0	121.0	129
7	5.50	0.29	6.7	131	131	0	127.9	127.8	131
8	6.00	0.30	7.2	138	138	0	134.7	134.7	132
9	3.00	0.26	4.1	114	114	0	111.7	111.7	235
10	4.00	0.28	5.1	124	124	0	121.4	121.3	185
11	5.00	0.29	6.2	131	131	0	128.0	128.0	272
12	6.00	0.30	7.2	138	138	0	134.7	134.7	273
13	7.00	0.32	8.2	152	152	0	148.4	148.4	134
14	8.00	0.35	9.2	168	169	1	164.2	165.2	112
15	9.00	0.38	10.3	185	188	3	181.0	183.9	102
16	10.00	0.40	11.3	202	204	2	197.7	199.7	125
17	11.00	0.43	12.3	225	228	3	220.5	223.5	84
18	12.00	0.46	13.3	245	252	7	240.3	247.3	87
19	13.00	0.50	14.3	275	282	7	270.2	277.1	72
20	14.00	0.56	15.3	324	342	18	319.0	336.9	36
21	15.00	0.64	16.2	384	409	25	378.8	403.8	35

E_d= 129 TSF E^+= 243 TSF P_l= 19.2 TSF

Job Number: MR145146
Boring No.: B-8PMT
Test Depth: 50.0-52.5 Feet

Date: 2-24-15



Pressuremeter Data Reduction (BX)

Job No.: MR145146
Boring No.: B-8PMT
Test Depth: 50.0-52.5 Feet

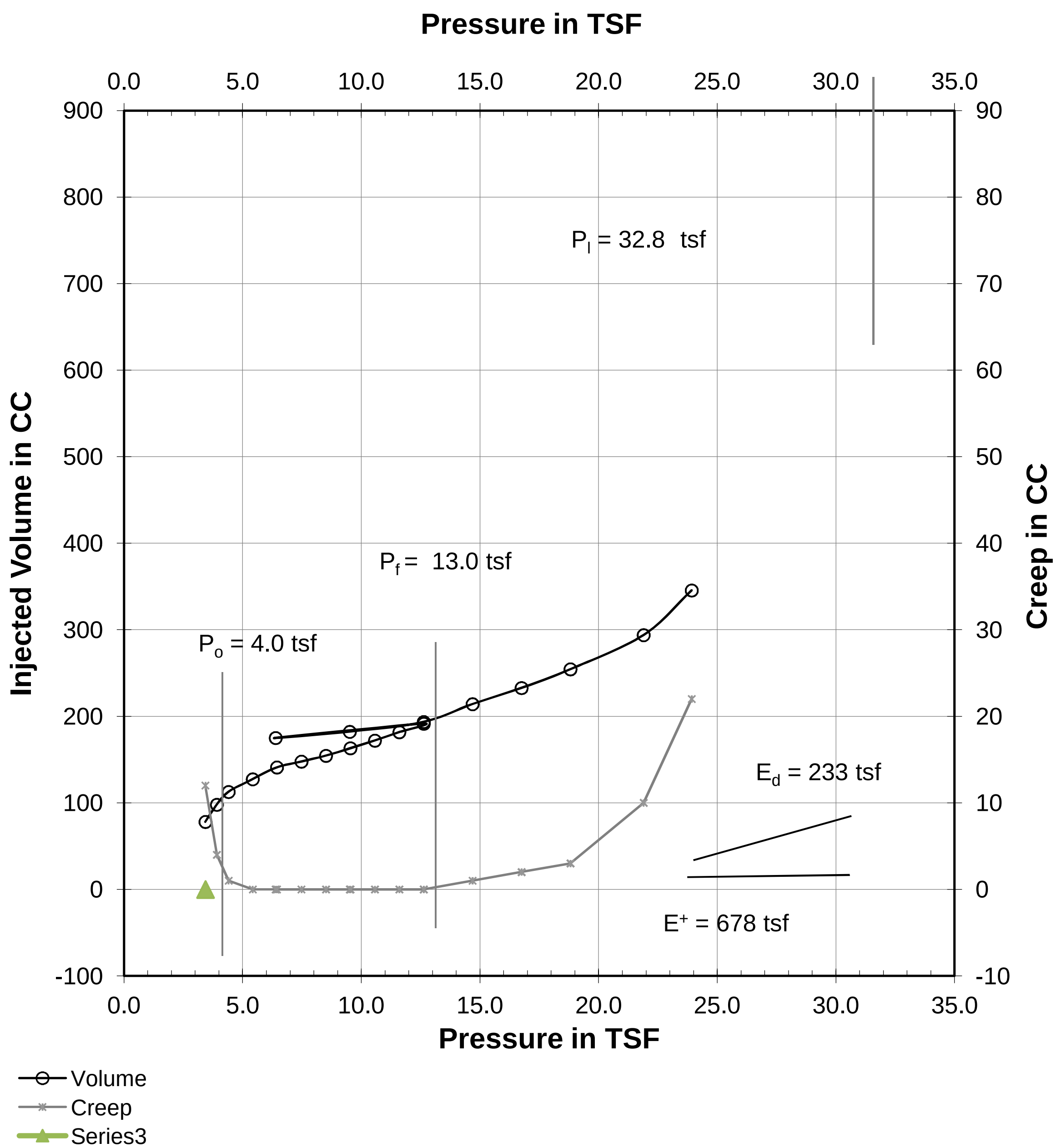
Water Correction: 1.64 Bars

No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.19	2.0	65	76	11	63.6	74.6	
2	1.00	0.26	2.5	100	112	12	98.4	110.4	21
3	1.50	0.28	3.0	125	125	0	123.2	123.2	68
4	2.00	0.29	3.5	134	134	0	132.0	131.9	102
5	2.50	0.30	4.0	139	139	0	136.8	136.7	191
6	3.00	0.31	4.5	144	144	0	141.6	141.6	192
7	4.00	0.32	5.6	150	150	0	147.2	147.2	331
8	5.00	0.33	6.6	157	157	0	153.9	153.9	282
9	6.00	0.34	7.6	164	164	0	160.6	160.6	284
10	7.00	0.36	8.7	174	174	0	170.3	170.3	197
11	8.00	0.37	9.7	184	184	0	180.1	180.1	199
12	4.00	0.35	5.5	168	168	0	165.2	165.2	526
13	6.00	0.36	7.6	177	177	0	173.6	173.6	464
14	8.00	0.37	9.7	186	186	0	182.1	182.1	464
15	9.00	0.39	10.7	197	197	0	192.9	192.8	184
16	11.00	0.42	12.8	217	219	2	212.4	214.4	187
17	13.00	0.45	14.8	239	242	3	234.1	237.0	184
18	15.00	0.49	16.9	265	274	9	259.7	268.7	136
19	17.00	0.54	18.9	306	317	11	300.4	311.3	105
20	19.00	0.61	20.9	359	380	21	353.0	374.0	75

E_d= 259 TSF E^+= 464 TSF P_l= 27.8 TSF

Pressuremeter Data Reduction (BX)

Job Number: MR145146 Date: 2-24-15
Boring No.: B-8PMT
Test Depth: 78.0-80.5 Feet



Pressuremeter Data Reduction (BX)

Job No.: MR145146
Boring No.: B-8PMT
Test Depth: 78.0-80.5 Feet

Water Correction: 2.48 Bars

No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	1.00	0.19	3.4	68	80	12	66.0	78.0	
2	1.50	0.23	3.9	96	100	4	93.8	97.8	40
3	2.00	0.26	4.4	114	115	1	111.6	112.6	57
4	3.00	0.29	5.4	130	130	0	127.3	127.2	121
5	4.00	0.31	6.4	144	144	0	140.9	140.9	133
6	5.00	0.32	7.5	151	151	0	147.6	147.6	278
7	6.00	0.33	8.5	158	158	0	154.4	154.4	280
8	7.00	0.35	9.5	167	167	0	163.1	163.1	217
9	8.00	0.36	10.6	176	176	0	171.9	171.9	220
10	9.00	0.37	11.6	186	186	0	181.7	181.6	199
11	10.00	0.39	12.6	196	196	0	191.5	191.4	202
12	4.00	0.36	6.4	178	178	0	175.0	174.9	722
13	7.00	0.37	9.5	186	186	0	182.1	182.1	827
14	10.00	0.39	12.6	198	198	0	193.5	193.4	529
15	12.00	0.42	14.7	218	219	1	213.1	214.1	196
16	14.00	0.44	16.7	236	238	2	230.7	232.7	223
17	16.00	0.47	18.8	257	260	3	251.4	254.3	197
18	19.00	0.52	21.9	290	300	10	283.9	293.8	168
19	21.00	0.58	23.9	330	352	22	323.5	345.5	89

E_d= 233 TSF E^+= 678 TSF P_l= 32.8 TSF

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- **Water Initially Encountered**
- **Water Level After a Specified Period of Time**
- **Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 8,000	> 30	> 42			

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

Bid Questions and Answers – Oak Creek Water and Sewer Utility - Prestressed Concrete Storage Tank Pre-Selection

April 27, 2015

1. Please provide the design overflow/draw down flow rate.

   A: 30 million gallons per day.

2. The project drawings do not show any backfill around the tank. We estimate the frost depth in Wisconsin to be about 4′ to 5′. It appears that 4′ of backfill should be provided for frost protection. Please confirm the backfill depth is at least 4′.

   A: The addition of berms to the side walls of the tank are not acceptable. See Drawings.

3. Drawing # 40-SD-301 shows a grout pad on top of the 6″ concrete floor with the thickness of grout varying from 15″ to 2″ to develop the slope across the tank floor. It is our experience and opinion that the floor slope is best achieved by sloping the granular leveling base below the 6″ floor, instead of using a grout topping. The grout topping, especially one15″ thick, is likely to crack and may not have the required durability. We request that our alternative method of building the floor slope be permitted. Please clarify.

   A: The grout is deleted. See revised drawings.

4. Sketch 0330-016 shows the underfloor pipe encasement tied to the tank floor with reinforcement. Our standard practice is to separate the pipe encasement from the tank floor by providing a construction joint. In order to reduce restraint shrinkage stresses and associated floor cracking, we use a 30 mil polyfilm on top of the pipe encasement before pouring the tank floor. No reinforcement is provided across this construction joint so as to permit movement of tank floor relative to the encasement. We request that this alternative method of design and construction of pipe encasement/floor, without any reinforcement in the encasement and across the construction joint, be permitted. Please clarify.

   A: Tie the encasement to the floor slab. See revised drawings.

5. According to Section 1.03.F of the tank specs, a number of Design Loads and Foundation Criteria are to be found in the Structural Drawings. However, there were no structural drawings included in the bid package; and the drawings that *are* included pertain mostly to the baffle walls and exterior architectural treatment.

   A: Drawings are in Addendum 1

6. Section 1.03C- The minimum reinforcement required is either 0.0025% or 0.12 square inches. For a 3″ dome, 0.0025% is 0.09 square inches. We generally provide #3@12″ which is 0.11<0.12. We request the section be changed to show 0.11 square inches instead of 0.12.

   A: Leave as is.

7. Section 3.04J requires plastic wrapping wall after applying final coat. This is not a standard practice for Type III tanks and we request this requirement be removed for Type III tanks.

   A: Leave as is.

8. 3.08A-Dome Curing – Our standard practice is to cure the dome with curing compound. We request this section be modified to include curing the dome with a curing compound.

   A: Curing compound has been added. See revised specification.

9. As we discussed please include the project site drawing in an Addendum.

   A: Included in Addendum 1.

10. Also we recommend removing the AWWA D110 Type I (cast-in-place wall) and Type II (shotcrete wall) from the specification as these tanks are typically not built in Wisconsin. In particular the Type II shotcrete wall tank is generally considered unacceptable in cold weather climates due to the possibility of freeze/thaw action which can cause delaminating of the shotcrete surfaces.

    A: We will leave the spec as is, but the benefits of a Type 1 or 2 tank, if submitted, will be considered in the evaluation.

11. Bid Form, Page 3, Item 8. The Bid form date is specified as 2013. We believe this should read 2015. Please clarify.

    A: New Bid Form included in Addendum 1.

12. There are minority percentages noted in the advertisement, but, nothing further mentioned in the specifications. Are minority percentages required for this project? Please clarify.

    A: No minority percentages are required.

13. The Bid form is required to be submitted with 5 copies. Given the nature of this bid, can we submit one copy on bid day and then the low bidder submits the other four within 24 hours? Please clarify.

    A: Addendum 1 modified to three (3) copies.

14. According to Table 3, Section 4.3 of the Geotechnical Report, the excavation elevation varies between 74′ and 84′, with a weighted average of 80′. We believe it advisable to excavate instead to a uniform elevation of about 80′ in order to ensure uniform support conditions under the entire tank footprint. Please clarify.

    A: Required over-excavation is necessary to remove compressible materials from the zone of influence of the tank. The materials slated for removal must be adequately removed and backfilled. The contractor may elect to remove additional material to form a fill of uniform thickness.

15. Section 4.3 of the Geotechnical Report recommends a net allowable soil bearing pressure of 2,000 psf, which however, is not enough to design the tank foundations inasmuch as it is lower than the actual contact pressure under both the tank floor and

tank footing; and it is over conservative when considering that the tank will be founded on nearly 16 feet of select fill – which will in turn bear on substantially high-capacity subgrade. The attached sketch (Fig. 1) shows the actual contact pressures under the tank. Please note that to properly design the footing, we need nearly 3,000 psf. Can the footing be designed for 3,000 psf? Please clarify.

A: The attached geotechnical report was revised to reflect maximum allowable bearing pressure of 3,000 pounds per square foot (psf). The project documents will be modified to require select granular fill materials to allow for efficient dissipation of stresses in the vicinity of the tank foundation.

16. Subfooting clarification. Drawing 40-SD-103 shows 4′ of concrete fill under the tank footing. We recognize the 4-ft "concrete fill" is for frost protection, but we discourage this detail and instead recommends a "bermed" backfill as shown in the attached sketch (Fig. 1). Is a bermed backfill acceptable? Please clarify.

    A: No. Site grading and hydraulic considerations make this undesirable.

17. The material for the baffle wall brace is not specified. Is it acceptable to use aluminum braces? Please clarify.

    A: See Drawings in Addendum 1. 316 stainless steel is specified.

18. Please provide the invert elevation of all underfloor piping.

    A: See revised drawings.

19. Drawing 40-SD-231 only shows an expansion joint for the 42″ outlet pipe. Please clarify if an expansion joint is required for other underfloor piping such as inlet pipe, overflow pipe and drain.

    A: See revised drawings.

20. Our normal practice in moderate to low seismic areas is to provide two flexible couplings, instead of expansion joints because of the anticipated movement under non-seismic loading is in the order of 3″+/- vertical and minimum along axis of the pipe as well as transverse direction. Accordingly, we recommend replacing one expansion joint with two flexible couplings. Is the acceptable? Please clarify.

    A: See revised drawings.

21. Can you please confirm whether the tank construction will take place in spring/summer of 2016?

    A: It is anticipated that the General Contractor can begin work in the first quarter of 2016. Exact timing of the tank construction will need to be determined between the General Contractor and Tank Supplier.

22. Can you please confirm the Tank Design drawings to be included with the Proposal shall be "Preliminary Design Drawings" and will not require a Professional Engineering Seal?

    A: Correct.

23. Specification 00 11 57, pg. 9, Article 6.6.2 indicates by Signing the Bid Form the Supplier certifies that if selected the Supplier will sign the Agreement provided in the Request for Proposals and Statement of Qualifications. Can you please provide the Agreement for our review?

    A: See Addendum 1 for modifications.

24. The Contract Documents discuss Liquidated Damages in several places. Can you please provide the Liquidated Damage amounts?

    A: The liquidated damaged in the General (Installing) Contractors documents is currently $3,000 per day.

25. Can you please confirm that the Owner will provide all construction and testing water required for the project?

    A: Yes, they will.

26. Specification 33 16 13.15, section 1.03.C indicates the tank roof must be a cast-in-place dome. Can you please confirm a **precast** dome is also acceptable?

    A: Precast dome is not acceptable.

27. Specification 33 16 13.15, section 1.03.E - Generally penetrations are provided through the wall for overflow pipes and temporary construction access. We would recommend the specification be changed to allow for these wall penetrations.

    A: The overflow pipe exits through the tank floor, as shown in the Drawings. Temporary construction access can be provided by Tank Supplier through the floor, but must be properly sealed afterwards.

28. Specification 33 16 13.15, section 1.03.F – Will you please provide the overflow rate for the proposed tank so the tank contractor can size the overflow weir appropriately?

    A: 30 million gallons per day.

29. Specification 33 16 13.15, section 1.03.F – Please note we were unable to locate the snow load, wind load or maximum foundation bearing pressure on the structural drawings as indicated in this section. Can you please provide these design values?

    A: See Addendum 1 Drawings.

30. Specification 33 16 13.15, section 1.05.A.2 does not appear to match the requirements of specification 00 11 57, section 6.4.2 with regards to the suppliers experience. Can you please confirm the requirements of 00 11 57, 6.4.2 are required for the proposal?

    A: See Addendum 1 for revised specifications.

31. Specification 33 16 13.15, section 2.01 requires concrete be in accordance with section 03 30 00. Can you please confirm it will be acceptable for the tank contractors to submit their standard mix designs in lieu of the ones listed in section 03 30 00 for use in constructing the tank as long as the mix designs will achieve the strength and durability requirements specified?

    A: No. Concrete mix designs will be evaluated during the submittal process.

32. Specification 33 16 13.15, section 2.01.B.3 – Please note, AWWA D110 requires a minimum 3,500 psi compressive strength for membrane floor systems. Can you please confirm the 3,500 psi floor concrete strength is acceptable for the tank floor?

    A: Concrete strength for the floor slab is 4500 psi. See revised specification.

33. Specification 33 16 13.15, section 2.02.E – Please note AWWA D110 requires a minimum 4,500 psi compressive strength for shotcrete. Can you please confirm 4,500 psi strength shotcrete will be required? Additionally, we recommend ¼″ polypropylene fibers be required for the shotcrete covercoat. Polypropylene fibers aid in controlling plastic shrinkage cracking and has proven to be very effective. Can you please confirm it is acceptable to utilize ¼″ polypropylene fibers for the shotcrete covercoat?

    A: Shotcrete compressive strength is 4500 psi. See revised specification. Yes polypropylene fibers may be added to the shotcrete.

34. Specification 33 16 13.15, section 2.04.A – Can you please confirm it will be acceptable to use grade 60 mild reinforcing bars and the allowable stresses should be in accordance with ACI 350 in lieu of the 18,000 psi outlined?

    A: Yes. See revised specification.

35. Specification 33 16 13.15, section 2.05.D.3 – Please note AWWA D110 requires a minimum residual compression of 200 psi within the prestressed tank wall. Can you please confirm a 200 psi residual will be required in lieu of the 100 psi outlined within this section?

    A: 100 psi has been changed to 200 psi. See revised specification.

36. Specification 33 16 13.15, section 2.07, please note ASTM A366 has been withdrawn and updated to ASTM A1008. Can you please confirm steel diaphragm should be in accordance with ASTM A1008?

    A: A366 has been changed to A1008. See revised specification.

37. Specification 33 16 13.15, section 2.09.C.2 requires a stainless steel hatch. Can you please confirm that an aluminum hatch would be acceptable in lieu of the stainless steel hatch, which will be significantly higher in cost? We have quite a long, successful history using aluminum hatches with excellent results.

    A: The specification is not changed, but an aluminum hatch can be proposed as a cost saving alternative in your proposal.

38. Specification 33 16 13.15, section 3.02.A requires the corewall to achieve a compressive strength of 4,000 psi or higher prior to beginning prestressing. AWWA D110 allows the prestressing operation to begin after the corewall has attained a strength of at least 1.8 times the stress being applied. Can you please confirm prestressing operations can begin once the corewall and dome have achieved a stress greater than 1.8 of that being applied?

    A: Prestressing may begin at a concrete compressive strength of 4000 psi as the specification states.

39. Specification 33 16 13.15, section 3.03.D requires the minimum spacing to be 3/8 inches or 1.5 unit diameters whichever is larger as well as limits the number of wires per foot to 22. Can you please confirm the minimum spacing can be 5/16 inches or 1.5 unit diameters in accordance with AWWA D110 and allow 24 wires per foot on this project?

    A: The minimum spacing has been changed to 5/16" or 1.5 unit diameters, with a maximum of 24 wires per foot.

40. Specification 33 16 13.15, section 3.04.B requires the prestressing to applied from the bottom to the top of the wall. Can you please confirm the tank contractor can begin applying prestressing from the top to the bottom of the tank wall at their option?

    A: This paragraph is referring to the progression of shotcreting and not prestressing.

41. Specification 33 16 13.15, section 3.04.J requires plastic sheeting upon final application of shotcrete to maintain moisture for curing. Can you please confirm if water methods of curing at the contractors' option as an alternative to plastic sheeting and as allowed in AWWA D110?

    A: Plastic sheeting is required.

42. Can you please confirm the following concrete finishes for the prestressed tank will be acceptable for this project:

    Fresno Finish for the tank floor slab

    Light broom finish for the interior of the precast wall panels

    Light broom finish for the exterior of the dome with a form finish on the interior of the dome

    Exterior shotcrete shall receive a natural gun/nozzle finish.

    A: Yes.

43. Specification 33 16 13.15, section 3.08.A requires the dome to be water cured for 7 days and scheduling wire wrapping and application of shotcrete so curing is not interrupted and water from curing shall not wash or damage shotcrete wire coats. Can you please confirm if curing compounds can be used in lieu of water curing the dome? This will allow for more efficient construction schedule on the project and has been Industry standard for several decades.

    A: Curing compound has been added as an alternative. See revised specification.

44. Drawing 40-SD-301, we have concerns that the grout topping will restrict the tank wall movement and induce additional stresses into the tank wall and would like to discuss with you other means of accomplishing the desired drainage of the tank floor.

    A: See Drawings in Addendum 1.

45. Can you please provide the centerline elevation of all the under slab piping?

    A: See revised Drawings in Addendum 1.

46. We recommend fully concrete encasing the under slab piping up to the underside of the tank concrete floor/foundation. Can you please confirm this will be acceptable?

A: Yes this is acceptable.

47. Drawing 40-A-241 depicts the hatch and interior ladder aligned with the straight baffle wall. Can you please confirm it would be acceptable to install the hatch and ladder radial to the tank and connect the interior ladder to the tank wall?

48. Can you please confirm the required length of the straight precast baffle walls?

A: See Drawing 40-A-231.

49. Please note the allowable bearing capacity of 2.0 ksf listed on page 11 of the Subsurface Exploration and Geotechnical Engineering Analyses memorandum dated March 18th, 2015 is less than even the liquid column load indicated on page 1 of the memorandum. This does not take into account the structure dead load; indicating the soils may not provide adequate support for the tank. Can you please provide additional recommendations to improve the allowable bearing capacity to a minimum 3 ksf for this project or discuss with the geotechnical engineer this information for his input on how this should be resolved?

A: The attached geotechnical report was revised to reflect maximum allowable bearing pressure of 3,000 pounds per square foot (psf). The project documents will be modified to require select granular fill materials to allow for efficient dissipation of stresses in the vicinity of the tank foundation.

NOTE TO BIDDER: Use typewriter or BLACK ink for completing this Bid Form.

BID FORM

To:	Oak Creek Water and Sewer Utility (Owner)
Mailing Address:	Attn: Ron J. Pritzlaff, P.E., Utility Engineer Oak Creek Water and Sewer Utility 170 West Drexel Avenue Oak Creek, WI 53154
Project Identification:	Prestressed Concrete Storage Tank for the Oak Creek Water and Sewer Utility 2016 Water Treatment Plant Improvements Project

1. BIDDER'S DECLARATION AND UNDERSTANDING

1.1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm, or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm, or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over the Utility.

1.2. In submitting this Bid, Bidder certifies Bidder is qualified to do business in the State of Wisconsin as required by laws, rules, and regulations at the time the Bid Form is submitted to the Utility.

1.3. The undersigned Bidder understands and agrees that this Proposal shall form the basis for a subcontract with the Installing Contractor that is selected by the Owner. Therefore, the undersigned agrees to enter into an agreement to perform and furnish all Work as specified or indicated in these Specifications for the amount indicated in this Bid Form and in accordance with the other terms and conditions of this Request for Proposal and Statement of Qualifications.

1.4. The undersigned accepts all of the terms and conditions of this Request for Proposals and Statement of Qualifications including, without limitation, those dealing with the disposition of Bid security, and the penalties that may be imposed based on results from the Performance Testing. This Proposal shall remain subject to acceptance for a period of 90 days after the day of Bid opening.

BIDDER’S NAME ____

1.5. The Bidder understands and agrees that the Owner may assign all of its rights and obligations under these Contract Documents to the Installing Contractor for the installation of the prestressed concrete storage tank.

1.6. The Bid Price of the selected Supplier will be assigned by the Owner to the Installing Contractor.

1.7. Notwithstanding this assignment, the guarantees and warranties specified in the Contract Documents are intended for the benefit of the Owner and the Installing Contractor, and may be enforced by either party.

2. CONTRACT EXECUTION

2.1. The undersigned Bidder agrees, if this Bid is accepted, to enter into an Agreement with the Installing Contractor to perform and furnish Work as specified or indicated in the Bidding Documents for the Contract Price derived from the Bid, and in accordance with the other terms and conditions of the Bidding Documents.

2.2. Bidder accepts the terms and conditions of the Bidding Documents.

3. INSURANCE

3.1. Bidder further agrees that the Bid amount(s) stated herein includes specific consideration for the specified insurance coverages.

4. ADDENDA

4.1. Bidder hereby acknowledges that it has received Addenda

Nos. ____________, ____________, ____________, ____________,

(Bidder shall insert number of each Addendum received) and agrees that Addenda issued are hereby made part of the Bidding Documents, and Bidder further agrees that this Bid includes impacts resulting from said Addenda.

5. STATE AND LOCAL SALES AND USE TAXES

5.1. Taxes shall not be included in this Bid Form.

6. BID SCHEDULE

6.1. Bidders shall use only the Bid Schedule provided. All blank spaces in the Bid Schedule must be filled in, preferably in BLACK ink, in both words and figures where required. No

BIDDER’S NAME ____ changes shall be made in the phraseology of the forms. Written amounts shall govern in case of discrepancy between the amounts stated in writing and the amounts stated in figures.

6.2. Prices quoted shall be f.o.b. with freight and full insurance paid by Bidder, to the Oak Creek Water and Sewer Utility Water Treatment Plant, 9325 S. 5th Avenue, Oak Creek, WI 53154.

6.3. Bidder shall provide required information by filling in all blanks following the Bid Schedule.

6.1. Bidder shall complete the Work in accordance with the Contract Documents for the following price(s):

6.1.1. **Lump Sum Bid Price:**

____ Dollars
(words)

and _____________________________ Cents $________________________
(numerals)

7. SURETY

7.1. If Bidder is awarded the Work from this Bid, the surety providing the Performance Bond is:

____ whose address is

____
Street City State Zip

8. BIDDER

SUBMITTED on ______________________, 2015.

State Contractor License No. _________________________. (If applicable)

If Bidder is:

An Individual

Name *(typed or printed)*: ____

By *(signature)*: ____

BIDDER'S NAME ____

Doing business as:____

Business address: ____

____

Phone No.:____________________ FAX No.:_____________________

A Partnership

Partnership Name: ____(SEAL)

By: ____
(Signature of general partner – attach evidence of authority to sign)

Name *(typed or printed)*: ____

Business address: ____

____

Phone No.:____________________ FAX No.:_____________________

A Corporation

Corporation Name: _______________________________________(SEAL)

State of Incorporation: _____________________

Type (General Business, Professional, Service, Limited Liability):_________

By: ____
(Signature – attach evidence of authority to sign)

Name *(typed or printed)*: ____

Title:____________________________ (CORPORATE SEAL)

Attest: ____
(Signature of Corporate Secretary)

Business address: ____

____

Phone No.:____________________ FAX No.:_____________________

BIDDER'S NAME ____

Date of Qualification to do business is: ______________________________

A Joint Venture

Joint Venturer Name: _____________________________________(SEAL)

By: ____
(Signature of joint venture partner – attach evidence of authority to sign)

Name *(typed or printed)*: ____

Title:___________________________

Business address: ____

____

Phone No.:___________________ FAX No.:_____________________

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Phone and FAX Number, and Address for receipt of official communications:

____

____

END OF SECTION

BIDDER'S NAME ____

SECTION 33 16 13.15
PRESTRESSED CONCRETE TANK

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
2. American Concrete Institute (ACI):
   a. 506R, Guide to Shotcrete.
   b. 506.2, Specification for Shotcrete.
   ~~b.~~c. 350-06, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
   ~~c.~~d. 372R-13, Guide to Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures.
3. ASTM International (ASTM):
   a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   b. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
   ~~c. A366, Standard Specification for Commercial Steel (CS) Sheet, Carbon, (0.15 Maximum Percent) Cold-Rolled.~~
   ~~d.~~c. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   d. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   e. A1008, Standar Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
   f. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   g. C144, Standard Specification for Aggregate for Masonry Mortar.
   h. C150, Standard Specification for Portland Cement.
   i. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
   j. C216, Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
   k. C270, Standard Specification for Mortar for Unit Masonry.
   l. C920, Standard Specification for Elastomeric Joint Sealants.

m. D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

4. American Water Works Association (AWWA): D110-13, Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks.
5. Federal Specifications: FS TT-P-0035 (1), Paint, Cementitious, Powder, White and Colors (for Interior and Exterior Use).
6. NSF International (NSF): NSF/ANSI 61, Drinking Water System Components - Health Effects.
7. Occupational Safety and Health Administration (OSHA): 29 CFR 1910.27, Fixed Ladders.
8. Precast/Prestressed Concrete Institute (PCI): MNL-120, PCI Design Handbook-Precast and Prestressed Concrete.
9. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 1793, Architectural Sheet Metal Manual.
10. Wisconsin Department of Natural Resources (WDNR): Wisconsin Administrative Code Chapter NR 811.

1.02 DEFINITIONS

A. Prestressed Tank System: Consists of a cast-in-place concrete floor slab, a core wall, baffle walls, and roof.

B. Shotcrete: Mortar projected directly upon intended surface.

1.03 DESIGN REQUIREMENTS

A. Obtain services of a qualified design engineer, as defined in Article Quality Assurance, to design Prestressed Tank System in accordance with AWWA D110-13 and other ~~conforming to~~ attributes specified in this section.

B. Floor Slab: Cast-in-place concrete, minimum reinforcing in slab equals 0.005 times concrete section.

C. Roof: Cast-in-place concrete dome with minimum thickness of 3 inches and minimum reinforcing of 0.0025 times concrete section with a minimum area of reinforcing steel each way equal to 0.120 inch squared.

D. Exterior Wall~~s~~: Cast-in-place concrete core wall with plastic water stops at construction joints or shotcrete core wall with continuous internal steel diaphragm or precast concrete core wall with steel diaphragm, vertical joint seals, and shotcrete coverings. Walls placed on elastomeric bearing pads, free to move radially, and plastic water stop connection between wall and footing. Satisfy allowable stress requirements when calculating wall thicknesses.

E. Baffle Walls: Precast concrete, laterally braced with diagonal braces attached to baffle wall and tank floor. Baffle walls and diagonal bracing shall be designed to resist seismic forces.

D.

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E.F. Openings and Penetrations: Except for access manholes, other openings or penetrations through wall not permitted. Pipe penetrations shall be through floor slab and under footings. Pipe sleeves are allowed through footing for shotcrete equipment.

F.G. Design Loads and Foundation Criteria:

1. Dead Loads: Self Weight.
2. Roof Live Load: 20 psf for dome roof.
3. Snow Load: See structural drawings.
4. Wind Load: See structural drawings.
5. Differential Drying Allowance: 10 degrees F shall be additive to temperature differential during winter.
6. Maximum Foundation Bearing Pressure: See structural drawings.
7. Maximum Differential Settlement: See geotechnical report.
8. Seismic Design Criteria: See structural drawings.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Design Data:
      1) Proposed details, concepts, stress calculations, and manhole opening for prestressed tank walls.
      2) For design loads and foundation criteria, show calculations and details based on the seismic forces.
      3) Details of vertical post-tensioning system.
      4) Details for sealing vertical joints of steel diaphragm shell.
      5) Details of prestressed tank accessories.
      6) Calculations stamped by professional engineer registered in the state of Wisconsin.Details of baffle walls and bracing.
      7) Design drawings stamped by a professional engineer.
   b. Curing methods for dome concrete.
   c. Description of construction method and materials.
   d. Manufacturer's literature showing compliance with specification.
2. Samples: Vertical joint of steel diaphragm shell together with integral pumped epoxy material or other approved method to show evidence of satisfactory seal.

B. Informational Submittals:

1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements:
   a. Shotcrete sand.
   b. Concrete and shotcrete admixtures do not contain chlorides or other corrosive chemicals.
   c. Vertical Post-Tensioning System: Manufacturer's load strain curves certifying physical properties of steel and standard test data that components of anchorage units conform to specified requirements.
2. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
3. Certificates of Inspection: Vertical post-tensioning units have been inspected prior to shipment and contain no apparent defects.
4. Statements of Qualification:
   a. Registered professional engineer registered in the state of Wisconsin.
   b. Prestressed tank installer.
5. Calculations stamped by a professional engineer registered in the state of Wisconsin.

~~5.~~6. Written Test Reports of Each Test and Inspection:
   a. Shotcrete.
   b. Mill test data of chemical composition for vertical post-tensioning system.
   c. Test reports for prestressing steel components.
   d. Mill test data for circumferential prestressing material regardless of manufacture. Include chemical composition, physical properties, and dimensions of steel prior to galvanizing. Mill test data for at least three samples of final prestressing material taken from material delivered to Site. Identify each roll that Samples were taken from. Identify packages or rolls of prestressing material with mill and heat number.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Qualified Design Engineer: Registered in the state of Project.
2. Prestressed Tank Installer: Company specializing in design and construction of prestressed tanks. Minimum 20~~5~~ years' experience on tanks of similar size (1~~.5~~MG to 3~~2.5~~MG) and type required for Project. Company has designed and built no less than twenty five comparable prestressed (wire or strand wrapped) tanks now in use and are giving

satisfactory service. Tanks shall have been constructed within the last ~~5~~ 10 years. Include name, address, and phone number of owners with proposal.

B. Shotcrete Panel Mockups:

1. When not using automated equipment, assemble test panel at least 30 inches by 30 inches for each mix being considered.
2. Assemble test panels to same thickness as structure, but not less than 3 inches.
3. Take minimum three cubes or cores from panels for strength testing of shotcrete.
4. Cut or broken surfaces shall be dense and free from laminations and sand pockets.
5. Retain and maintain test panels during construction to establish standards by which completed shotcrete Work will be judged.
6. Independent Testing Laboratory Services will:
   a. Test proposed materials, including water.
   b. Test proposed mix proportions.
   c. Test specimens.
   d. Secure production samples of materials at plants or stockpiles during construction and test.
   e. Test strength of shotcrete as Work progresses.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Materials delivered prior to time required, store in a dry, ventilated building, heat if necessary to prevent accumulation of moisture on materials or in wrapping. Do not store on ground or expose to weather.

B. Do not bend vertical post-tensioning bars during handling and storage. Replace bent bars, bars with surface damage, and bars with excessive rusting.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Delay Work under the following conditions:

1. During high winds, when shotcreting, which may cause sand to separate at the nozzle.
2. When placing concrete, or shotcrete, as weather approaches freezing defined as below 40 degrees F when temperature is falling, or until temperature is 35 degrees F when temperature is rising.
3. During rains of high intensity which can wash cement out of fresh material.

B. Cold Weather: Take precautions to avoid low temperatures detrimental to epoxy grout or the ability to pump. If grouting procedure cannot be postponed, keep wall temperatures within the required temperature range.

C. Hot Weather: When temperatures exceed 90 degrees F, obtain approval for method used to protect shotcrete from excessive heat and drying.

D. Do not expose circumferential prestressing on walls to weather for more than 72 hours. Exercise precautions during adverse weather conditions.

PART 2 PRODUCTS

2.01 CONCRETE

A. In accordance with Section 03 30 00, Cast-in-Place Concrete, except that a 3/8-inch maximum size aggregate may be used for dome concrete if designed for strength and maximum density.

B. Minimum Design (28 day) Strengths:

1. Dome Roof: 4,~~0~~500 psi (Class 4500F2S1P1C1).
2. Core Wall: 4,~~0~~500 psi (Class 4500F2S1P1C1).
3. Floor Slab: ~~3~~4,~~0~~500 psi (Class 4500F2S1P1C1).

C. Admixtures: As specified in Section 03 30 00, Cast-in-Place Concrete.

2.02 SHOTCRETE

A. Fine Aggregates (Sand):

1. Saturated, surface dry, hard, dense, uncoated rock fragments free from injurious amounts of foreign or deleterious substances as specified in Section 03 30 00, Cast-in-Place Concrete.
2. Fineness Modulus for Sand: Range from 2.70 to 3.00 with maximum particle size of 1/4 inch.
3. Maintain sand at 3 to 6 percent moisture content; dampen or dry with sand dryers if necessary.
4. Gradation:

Sieve Size	Percent Passing by Weight
No. 4	97 - 100
No. 8	90 - 98
No. 16	70 - 85

Sieve Size	Percent Passing by Weight
No. 30	35 - 55
No. 50	12 - 25
No. 100	2 - 8

B. Screen sand for finish coat to produce uniform dense surface in texture and appearance.

C. Water and Cement: As specified in Section 03 30 00, Cast-in-Place Concrete.

D. Admixtures: As specified in Section 03 30 00, Cast-in-Place Concrete.

E. Minimum design (28 day) strength 4,~~0~~500 psi.

2.03 WELDED WIRE FABRIC

A. In accordance with ASTM A82 and ASTM A185.

2.04 MILD STEEL REINFORCING

A. Deformed ~~Grade 40 bars with maximum service load design, allowable stress of 18,000 psi in accordance with ASTM A615.~~bars, Grade 60 in accordance with ASTM A615. Allowable stresses in accordance with ACI 350.

2.05 CIRCUMFERENTIAL PRESTRESSING STEEL

A. High Tensile Wire:

1. Diameter Tolerance of Wire: Plus or minus 0.002 inch.
2. Tensile Strength: Minimum 210,000 psi.
3. Yield Strength at 1 Percent Extension: Minimum 170,000 psi.
4. Elongation in 10 Inches at Fracture: Minimum 4 percent.
5. Bending (R equals 5D): Minimum 6 bends per 90 degrees.

B. Hot-Dipped Galvanized Seven-Wire Continuous Strand:

1. Strand Diameter Tolerance: Plus or minus 1/32 inch.
2. Pitch: 12-16 (strand diameter).
3. Tensile Strength: Minimum 240,000 psi.
4. Yield Strength at 1 Percent Extension: Minimum 180,000 psi.
5. Elongation in 24-inch fracture minimum 4.5 percent.
6. Zinc Coating Weight: Minimum 0.75 ounce per square foot.

C. Anchorage: Prestressing manufacturer’s standard and capable of safely developing full strength of units, and not susceptible to galvanic action with prestressed steel.

D. Prestressing Steel Requirements:

1. Initial prestress force in circumferential prestressing units after anchoring shall not exceed 70 percent of guaranteed ultimate strength. Coordinate value with tolerance requirements and reflect values in calculations.
2. Final prestress force in circumferential prestressing units, when using nonelectronic or electronic wrapping machine, not capable of close stress tolerance, shall be determined by using stress loss of 25,000 psi for concrete shrinkage, plastic flow, and creep in steel plus 6 percent of initial wire stress system tolerances.
3. Calculate final circumferential prestress force and location on wall. Final prestress force shall provide for minimum residual compression in wall, above that required to resist internal water pressure of 2~~1~~00 psi. Maximum compression in core wall limited to 0.45 times design strength of core wall when using final prestress force after all losses. Maximum initial compression in core wall limited to 0.55 times design strength of core wall. Calculate wall thickness to comply with these requirements and bending requirements.

2.06 VERTICAL TENDONS

A. Solid High Strength Alloy Steel Bar:

1. Minimum Ultimate Tensile Strength: 145,000 psi.
2. Minimum Yield Stress at 0.2 Percent Offset: 125,000 psi.
3. Approximate Modulus of Elasticity: 30,000,000 psi.
4. Minus Elongation in 20 Diameters After Rupture: 4 percent.
5. Minimum Reduction of Area After Rupture: 20 percent.

B. Tendon Ducts:

1. Rigid galvanized metallic sheath or tubing or PVC pipe.
2. Sufficient strength to maintain its shape under potential forces created during handling, placing, and vibrating of concrete.
3. Inside diameter of grout and vent pipe 3/8 inch larger than diameter of vertical tendon.

C. Anchorage:

1. Furnish anchor plates of steel to dimensions which will show no permanent physical distortion when tested with a unit of size required, together with standard anchorage devices, and to 100 percent of ultimate tensile strength of unit.
2. Size plate so concrete stresses shall meet allowable concrete bearing stresses in accordance with PCI MNL-120.

2.07 STEEL DIAPHRAGM SHELL

A. Tank diaphragm in accordance with ASTM A1008~~366~~ ~~for Commercial Quality~~ cold-rolled steel sheet. Minimum of 26-gauge sheet and form corrugations of a pattern to form a continuous positive watertight seal and a strong mechanical key between shotcrete and steel. Furnish steel sheets in one continuous length to full height of wall. Vertical joints between sheets.

2.08 SHOTCRETE MIX PROPORTIONS

A. Adjacent to Steel Diaphragm and Over Wires: 1 part cement to 3 parts sand.

B. All Other: 1 part cement to 4 parts sand.

2.09 ACCESSORIES

A. Manway:

1. Liquid tight quick-opening manway that opens into drinking water storage tank, anchored into tank per manway manufacturer's recommendations.
2. Material: Type 316 stainless steel.
3. Size: 48 inch clear opening with 55 inch outside diameter.
4. Gasket: EPDM gasket all around manway hatch.
5. Hardware: Heavy-duty stainless steel hinges and handwheel release mechanism.
6. Lock: Provide keyed cut resistant padlock to prevent entry.
7. Paint: Paint exterior of manway to match tank wall color.
8. Manufacturer and Model: Chase Associated, Inc.; CM-1.

B. Vent:

1. Mushroom cap vent with an automatically resetting pressure-vacuum relief frost proof mechanism in accordance with WDNR NR 811.
2. Material: Type 316 stainless steel.
3. Size: 24 inch diameter vent pipe with a 50 inch diameter dome.
4. Screen: 16x16 removable stainless steel screen. The skirted sides of mushroom cap shall totally cover screens from view from side.

5. Lock: Provide keyed padlock to prevent entry.
6. Paint: Paint exterior of manway to match tank roof color.
7. Manufacturer: Omega Vent Security Shroud.

C. Hatch with Safety Chains and Posts:

1. Roof hatch mounted to concrete curb with watertight cover which overlaps the framed opening and extends down around the frame a minimum of 2 inches in accordance with WDNR NR 811.
2. Material: Type 316 stainless steel.
3. Size: 48 inch by 48 inch.
4. Gasket: EPDM gasket between hatch frame and concrete curb and between roof hatch and frame, all around.
5. Safety Chains and Posts: Stainless steel safety posts and chains to provide areaway fall protection when the cover is in the open position.
6. Hardware: Heavy-duty stainless steel hinges, latch and lifting mechanism.
7. Lock: Provide keyed cut resistant padlock to prevent entry.
8. Paint: Paint exterior of manway to match tank roof color.

D. Baffle Wall Lateral Bracing:

1. Material: Type 316 stainless steel.

E. Overflow Pipe Bracing:

1. Material: Type 316 stainless steel.

~~D.~~F. Gutters, Collectors, and Downspouts:

1. Stainless Steel: ASTM A666, Type 304 or Type 316, soft temper; No. 2D, dull finish, 0.018 inch minimum thickness for collectors and downspouts and 0.125 inch minimum thickness for gutter angles.
2. Fabrication:
   a. Field measure prior to fabrication.
   b. Fabricate in accordance with SMACNA 1793 that applies to design, dimensions, metal, and other characteristics of item indicated.
   c. Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   d. Rigid Joints and Seams: Make mechanically strong. Solder stainless steel metal joints. Do not use solder to transmit stress.
   e. Neutralize soldering flux.
   f. Form downspouts and gutters in maximum lengths as practicable to sizes and shapes indicated on Drawings:

1) Telescope end joints 1-1/2 inches and lock longitudinal joints of downspouts.
2) Provide elbows at bottom where downspouts empty onto concrete foundation and sidewalk.

3. Paint: Paint gutter angles to match tank roof color. Paint exterior of collectors and downspouts to match brick and wall colors.

2.10 FRP LADDER

A. Fabricate ladders with rails, rungs, and safety climb device to meet applicable requirements of OSHA, CFR Part 1910.27 and ALI A14.3

B. Fiberglass Reinforced Plastic (FRP) Ladder:

1. Ladder Criteria:
   a. Capable of supporting a 250-pound concentrated load plus 30 percent impact at midspan of rung.
   b. Side Rails: 1-3/4-inch square tubes, 0.25 inch thick.
   c. Rungs: Minimum 1-inch diameter thermal cure rod with pigmented epoxy, nonskid grit surface, or 1-1/4-inch minimum diameter pultruded, fluted, nonslip surface of vinyl ester resin.
2. Manufacturers:
   a. Strongwell Corp., Bristol, VA.
   b. Fibergrate Composite Structures, Inc., Addison, TX.

C. Safety Climb Device:

1. General:
   a. Belt and harness shall withstand minimum drop test of 250 pounds in 6-foot free fall.
   b. Fall Prevention System Material: Stainless steel, AISI Type 316.
2. Components and Accessories:
   a. Main Components: Sleeve or trolley, safety harness, and carrier or climbing rail.
   b. Ladder rung clamps with stainless steel, AISI Type 316, mounting brackets and hardware.
   c. Removable extension kit with tiedown rod or trolley gate, mandrel, and carrier rail for ladders under manholes and hatches.
3. Manufacturers and Products:
   a. Miller Equipment, Franklin, PA; Sure Track Rail System.
   b. TS Products, St. Charles, IL; TS Safety Rail System

D. Ladder Safety Post: Stainless steel telescoping tubular, spring balanced and automatically locking in raised position, with release lever for unlocking.

2.11 CEMENTITIOUS COATINGS

A. Cement-based, polymer-modified coating to protect and decorate concrete.

B. Manufacturer: The Euclid Chemical Company.

C. Products:

1. Concrete Roof Base Coat: Tamoseal mixed with Akkro-7T admixture.
2. Concrete Wall Base Coat: Tammscoat.
3. Concrete Roof and Wall Finish Coat: Tammscoat

D. Colors: See Storage Tank Architectural Drawings. Color and texture as selected by Engineer or Owner.

E. Surface preparation and installation in accordance with manufacturer's instructions.

2.12 MASONRY VENEER

A. Color, Texture, and Pattern: Match existing Administration and Filtration Facility as approved by the Engineer or Owner.

B. Facing Brick: ASTM C2l6, Grade SW, Type FBX. Minimum compressive strength for individual brick: 2,500 psi; nominal size: 4-inch by 2-2/3-inch by 8-inch.

C. Mortar Materials:

1. Portland Cement: ASTM C150, Type I, low alkali content (0.60 percent maximum).
2. Lime: ASTM C207, Type S.
3. Mortar: ASTM C270, Type S. Consisting of one part portland cement, from 1/4 to 1/2 part lime putty or hydrated lime, and clean well-graded sand in the proportion of three times the sum of the cementitious material; or 1/2 part portland cement, one part masonry cement, and clean well-graded sand in the proportion of three times the sum of the cementitious material.
   a. Add color in a consistent manner to provide final uniformity.
   b. No antifreeze liquid, salts, or other substances are allowed to lower the freezing point. No calcium chloride is allowed in the mortar.
   c. Color: Match existing as approved by the Engineer or Owner.
4. Tuck-Pointing Mortar: Prehydrated Type N, one part portland cement, one part Type S hydrated lime, and six parts sand, by volume.

5. Sand: ASTM C144, in addition not less than 5 percent passes the No. 100 sieve.
6. Water: Fresh, clean, and free of deleterious acids, alkalies, chlorides, and organic materials.

D. Masonry Accessories:

1. Wall Ties: 22 gauge stainless steel corrugated wall ties spaced 16 inches on center in both directions anchored into shotcrete with stainless steel Tapcon anchors, maximum 2 inch embedment.
2. Weep Holes:
    a. Cell vent and weep hole head joints to weep and vent masonry cavity wall.
    b. Nominal Size: 3/8-inch by 3-3/8-inch by 2-1/2-inch.
3. Mortar Dropping Control Device:
    a. Manufacturers and Products:
        1) Dur-O-Wall, Inc.; Mor-Control.
        2) Form and Building Supply, Inc.; Mortar Maze.
4. Premolded Joint Filler: ASTM D1056, closed cell neoprene sponge, 3 inches wide by 3/8 inch thick.

E. Joint Sealant:

1. Multipart Polyurethane, Nonsag, Immersible: Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
2. Capable of being continuously immersed in water.
3. Approved for potable water contact and conforming to NSF/ANSI 61, where required.
4. Manufacturers and Products:
    a. Pecora; DynaTrol II.
    b. Tremco; Dymeric 240.
    c. BASF; Sonneborn NP-2.
    d. Sika Chemical Corp.; Sikaflex 2c NS.
5. Backer Rod: Nongassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. Foundation: Encase tank piping under foundations in concrete.

B. Welded Wire Fabric: Adequately support prior to placement of concrete.

3.02 CORE WALL

A. Do not begin prestressing until core wall has obtained a compressive field strength of 4,000 psi or higher as determined by tests. Exterior surface of core wall, if of cast-in-place or precast concrete, sand or water blasted prior to application of prestressing wire.

B. Sand or water blasting Core Wall:

1. Sand or water blast exterior surfaces of core wall after inspecting patches for corrosive chemicals, to remove traces of original surface smoothness and original surface color, form oil, and laitance.
2. Complete sand or water blasting prior to installation of circumferential prestressing.
3. Use dry type method of sandblasting with No. 16 silica sand.
4. Sand or water blast far enough in advance of prestressing operation not to interfere with other operations.
5. Leave wall clean, heavily pitted, and uniform in appearance.
6. Sand or water blasting operation shall not prevent satisfactory curing of wall.

3.03 CIRCUMFERENTIAL PRESTRESSING

A. Apply uniformed stressed steel wire or strand to core wall using a wrapping machine to provide the final prestressing force per linear foot of wall height. Electronic servo controlled wrapping systems with automatic electronic recording shall be used. Nonelectronic wrapping machines may also be used.

B. Stress Measurement and Recording:

1. Apparatus capable of measuring stress of circumferential prestressing units accurately.
2. Gauges or other stress measuring apparatus calibrated by a recognized gauge manufacturer or testing laboratory on wire or strand samples taken from prestressing steel delivered to Site to be used in the Work.
3. Perform calibration work performed within 15 days prior to prestressing.
4. Recalibrate stress measuring apparatus during progress of Work.
5. If stresses measured exceed values specified, discontinue operation and make satisfactory adjustments prior to proceeding with wrapping.
6. Apply additional wire or strand to compensate for understressed wire or strand.
7. Base measurements of wire or strand stress on a continuous sensing of applied force on wire between tensioning drum and wall when, and as, wire is being wrapped and laid on wall.

C. Splicing of Wire or Strand:

1. Do not weld splice wire or strand, except when terminating one complete coil or in event of a defect.
2. Join ends of wire or strand with steel sleeves or splicing devices which will develop full strength of wire or strand without slippage or loss of stress.
3. Anchor stressed prestressing steel, or tie off at frequent intervals as stressing proceeds to minimize loss of stress in event of breakage.
4. Remove from Work, coils of prestressing steel which have broken three or more times.
5. Stress prestressing steel only once.
6. Anchor wrapped prestressing steel to wall at least once for every coil or reel.
7. Do not permanently anchor one wire or strand to previously wrapped wire.

D. Spacing:

1. Space at minimum five wires of 0.162 to 0.192 inch in diameter, or four strands of 0.375 inch in diameter, per foot of wall height, and maximum 2~~2~~4 wires or 12 strands per foot.
2. Minimum clear spacing between units not less than 1.5 unit diameters or ~~3/8~~5/16 inch, whichever is larger.
3. Spread or remove from Work prestressing steel wrapped closer together.
4. Space wire or strand of other diameters.

3.04 SHOTCRETING OF CIRCUMFERENTIAL PRESTRESSING STEEL

A. In accordance with ACI 506.2 and ACI 506R. Application of dry or wet mix is acceptable.

B. Cover each layer and outer layer of prestressing steel with a coating of shotcrete. Work from bottom to top of wall.

C. Completely embed the prestressing steel without voids. Maintain uniform flow and uniform thickness of material from nozzle.

D. Cut out slugs, sand spots, or wet sloughs resulting from nonuniform material flow and repair as Work progresses.

E. Time the intervals between successive applications to allow for initial set to develop. After initial set, stiff broom shotcrete layers receiving another coat to remove laitance and to provide a bond with succeeding applications.

F. Adjust amount of water in shotcrete placed on vertical surfaces. Thickness of shotcrete application shall be approximately 3/4 inch.

G. Remove deposits of loose sand before placing succeeding layers of shotcrete. Clear rebound away continuously from the Work, and do not reuse rebounded sand. Clear rebound away from Work before initial set occurs.

H. Slope construction joints or day's work joints off to thin, clean, and to regular feathered slope edge. Thoroughly clean sloped portion and adjacent shotcrete with mortar film coating. Wet and scour with air jet, or sandblast with silica sand before placing adjoining Work.

I. Where more than one layer of circumferential prestressing units are required, maintain minimum 1/4-inch cover over each underlayer. Shotcrete cover over outer layer shall be a minimum of 1-inch thickness applied in a minimum of three coats. Provide 1/4-inch minimum cover over prestressing unit for first coat. Apply finish coat approximately 1/4-inch thickness. Layers of shotcrete shall be broomed after initial set except finish coat.

J. Cover the reservoir with plastic sheeting upon final application of shotcrete to maintain moisture for curing.

3.05 VERTICAL POST-TENSIONING

A. Install post-tensioning units level and plumb in tank wall, tie units securely in position.

B. Tendon Ducts:

1. Encase vertical post-tensioning units in rigid grout-tight tendon ducts to prevent mortar from entering and hindering free movement of bars.
2. Maintain shape of ducts during handling, placing, and vibrating of concrete.
3. Attach by threads, vent pipe to tubing for venting and grouting.
4. Thread end of grout tube at bottom and project from concrete.
5. Thread bottom of vent pipe at both ends, attach pipe securely during construction and remove after grouting.

C. Connections shall be tight between anchors, tubing or pipe, and forms to prevent movement or leakage of grout into units during pouring operations. Provide threaded hose connections to threaded vent pipe and connections shall be tight to keep water from entering forms below.

D. Tension units from top ends.

E. Flush the tendon ducts with water through top vent pipe several times during wall pour allowing water to drain from bottom grout pipe, extending through wall form.

F. After completion of pour and flushing operation, give pipes a short burst of air at top pipe to clear out accumulated water at bottom of tendon duct. Do not clean tendon ducts with air or water connected to bottom grout pipe.

G. Allowable Stresses:

1. Determine initial post-tensioning force for vertical bar units by using a 25,000-psi stress loss allowance for concrete shrinkage, plastic flow, and steel relaxation.
2. Temporary jacking stresses up to 80 percent of ultimate strength for unit are acceptable to overcome losses due to tendon friction, anchorage seating, and elastic shortening.
3. Initial stress in bar unit after anchorage losses have occurred shall not exceed 70 percent of ultimate strength of unit.
4. Do not stress units before the 28-day concrete field strength has been obtained.

3.06 GROUTING VERTICAL TENDONS

A. Provide neat cement for grouting vertical post-tensioning units after stressing. Mix neat cement and screen through fine screen. Provide enough water to obtain a creamy consistency to ensure cement and water do not separate in tendon ducts.

B. Introduce grout through bottom grout pipe until it flows from a 3-foot extension attached to upper end of tendon ducts. Valve off bottom grout pipe no earlier than the day following grouting operation and remove bottom tube. Secure tendon duct tight enough to allow grout to enter the extension pipe without leakage in vicinity of top baseplate.

C. After tensioning units, flush tendon ducts out with water and blow out with air. Provide machine capable of 150 psi to clear obstructions in tendon ducts. Fill tendon ducts with grout under pressure of approximately 80 psi.

3.07 FINISHING OF SHOTCRETE

A. Underlayers or Exposed Surfaces:

1. On completing surfaces, bring shotcrete to an even plane and to well-formed corners by working up to ground wires or other thickness or alignment guides, using lower placing velocity than normal.
2. Screed exposed surfaces or underlayers by working upward against gravity with thin-edged screed using a slicing motion to trim off high spots and expose low spots.
3. Avoid pulling and breaking surface with subsequent checking.

B. Finish Coat:

1. Apply coat to remove rough areas after ground wires have been removed.
2. Carefully screen sand for finish coat to remove oversize particles which rebound and mar surfaces.
3. Surface of finish coat shall be; of natural texture and coloration; free from spotting, cement or dust streaking, lap lines, uneven surfaces, and rebounded material.
4. Do not hand-patch.
5. Check coatings for bond by tapping lightly to test for hollow sounding spots.
6. Cut out areas where bond is not fully developed and repair.

C. Corrosion Protection:

1. Inspect core wall and patched surfaces.
2. Test surfaces for chlorides or other chemicals that cause corrosion of prestressing.
3. Remove corrosive chemicals from surfaces prior to sandblasting.
4. Patch surfaces by building out in uniform circular area level with surface.
5. Sandblast patches and core wall surfaces prior to application of prestressing and shotcrete.

3.08 CURING

A. Dome Concrete:

1. Water cure dome concrete for 7 days by keeping surface continuously wet, or use curing compound.

2. Schedule wire wrapping and application of shotcrete so water curing shall not be interrupted, and water from curing shall not wash or damage shotcrete wire coats.
3. Begin curing after initial concrete set has occurred.

B. Shotcrete:

1. Keep shotcrete between layers of wire and cover damp by hand watering or fine mist spray.
2. Continuously water cure completed shotcrete surfaces for period of 7 days after application, or until subsequent shotcrete coats are applied prior to end of the 7-day curing period.
3. Remove laitance from wall by light sandblasting after curing period.
4. Do not use curing compounds.

3.09 TESTS

A. Shotcrete Panel Field Tests:

1. When length of core is less than twice diameter, apply correction factors in accordance with ASTM C42 to obtain compressive strength of individual cores.
2. Average compressive strength of three cores taken from test panel equal or exceed 0.85 f'c with no individual core less than 0.75 f'c. Average of three cubes taken from a panel equal or exceed f'c with no individual cube less than 0.88 f'c.
3. Shotcrete will be based on results obtained from cores or sawed cubes.
4. Use of data obtained from impact hammers, ultrasonic equipment, or nondestructive testing devices is not permitted. However, these devices may be used for determining uniformity of shotcrete.
5. Remove and replace shotcrete found not meeting tests, or cut cores and further test shotcrete, or repair and replace as approved by Engineer.

B. Water test tank as specified in Section 03 30 00, Cast-in-Place Concrete.

END OF SECTION

1 2 3 4 5 6

DESIGN CRITERIA

1. APPLICABLE CODE: 2009 INTERNATIONAL BUILDING CODE (IBC), AS AMENDED BY THE STATE OF WISCONSIN AND ALL OTHER APPLICABLE LOCAL AGENCIES.

2. REFER TO THE DRAWINGS FOR ADDITIONAL AND SPECIFIC STRUCTURE LOADINGS AND REQUIREMENTS.

3. ALL LOADS SHOWN ARE SERVICE LEVEL (UNFACTORED) UNLESS SPECIFICALLY NOTED OTHERWISE.

SEPTAGE SCREEN FACILITY 205

4. ROOF LOADS:
   - GROUND SNOW LOAD, Pg — 30 PSF
   - TERRAIN CATEGORY — B
   - SNOW EXPOSURE FACTOR, Ce — 1.0
   - THERMAL FACTOR, Ct — 1.1
   - SLOPE REDUCTION FACTOR, Cs — 1.0
   - IMPORTANCE FACTOR, Is — 1.1
   - MINIMUM FLAT ROOF SNOW LOAD, Pf — 25.0 PSF

   SEE SNOW DRIFT DIAGRAMS ON ROOF PLAN. FOR AREAS WITH INCREASED DRIFT LOADS.

   - LIVE LOADS — 20 PSF
   - COLLATERAL LOADS — 20 PSF
   - ROOF SUPPORTED EQUIPMENT AND PIPING ADDITIONAL

5. FLOOR LIVE LOADS:
   - OFFICE — NA
   - ELECTRICAL ROOM — 300 PSF
   - MECHANICAL ROOM — 200 PSF
   - CORRIDORS, EXITS, STAIRS — 100 PSF
   - WALKWAYS AND ELEVATED PLATFORMS — 100 PSF
   - OTHER AREAS — 200 PSF

6. EQUIPMENT LOADS ON FLOOR:
   - THERMAL OIL ECONOMIZER
   - BIOSOLIDS DRYER
   - CENTRIFUGE

7. LATERAL FORCE-RESISTING SYSTEMS: ORDINARY PRECAST SHEAR WALLS

   - RESPONSE MODIFICATION FACTOR, R — 3
   - SEISMIC RESPONSE COEFFICIENT, Cs — 0.034
   - EFFECTIVE SEISMIC WEIGHT, W — ASCE 7-05
   - SEISMIC BASE SHEAR, V — V = Cs*W

8. WIND LOADS:
   - BASIC WIND SPEED (3-SECOND GUST) = 90 MPH
   - EXPOSURE CATEGORY = B
   - INTERNAL PRESSURE COEFFICIENT, GCpi = +0.18
   - OCCUPANCY CATEGORY = IV
   - IMPORTANCE FACTOR, Iw = 1.15

9. SEISMIC LOADS:
   MAPPED SPECTRAL RESPONSE ACCELERATIONS
   - S_S = 0.112g
   - S_1 = 0.046g

   DESIGN SPECTRAL RESPONSE ACCELERATIONS
   - S_{DS} = 0.119g
   - S_{D1} = 0.074g

   - SITE CLASS = D
   - OCCUPANCY CATEGORY = IV
   - SEISMIC DESIGN CATEGORY = C
   - IMPORTANCE FACTOR, Ie = 1.50

   STRUCTURES HAVE BEEN ANALYZED USING THE EQUIVALENT LATERAL FORCE PROCEDURES OF ASCE 7.

10. SPECIAL LOADS:
    BIOGAS BUILDING FACILITY 265: 2 TON HOIST HOOK

11. EQUIPMENT LOADS:
    HIGH LIFT PUMP STATION: BRIDGE CRANE 5 TON CAPACITY

12. SOIL DESIGN PARAMETERS:
    A. NET ALLOWABLE SOIL BEARING PRESSURES: (1)
       - BUILDING FOUNDATION — 4 KSF
       - TANK FOUNDATION — 3 KSF
    B. VERTICAL SURCHARGE: 2 FT OF SOIL WEIGHT
    C. NATIVE SOIL UNIT WEIGHT: 120 PCF
    D. GROUND WATER (GW) ELEVATION:
       - 100 YEAR FLOOD — EL 101.91 FT
       - 500 YEAR FLOOD — EL 106.00 FT

13. FROST DEPTH: 4 FT

14. ICE LOADS:
    A. NOMINAL ICE THICKNESS: 1 INCH

GENERAL INFORMATION

1. FOR ABBREVIATIONS NOT LISTED, SEE ASME Y14.38 "ABBREVIATIONS AND ACRONYMS: PUBLICATION AS DISTRIBUTED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME).

2. DESIGN DETAILS ARE INTENDED TO BE TYPICAL AND SHALL APPLY TO SIMILAR SITUATIONS OCCURRING THROUGHOUT THE PROJECT, WHETHER OR NOT THEY ARE INDIVIDUALLY CALLED OUT.

3. VERIFY FINAL OPENING DIMENSIONS IN WALLS, SLABS, AND DECKS WITH OTHER DISCIPLINE DRAWINGS PRIOR TO CONSTRUCTION OF THESE ELEMENTS.

4. FOR NUMBER, TYPE, SIZE, ARRANGEMENT, AND/OR LOCATION OF EQUIPMENT PADS, SEE OTHER DISCIPLINE DRAWINGS. COORDINATE WITH EQUIPMENT SUPPLIER PRIOR TO PLACING SLABS, WALLS AND FOUNDATIONS. COORDINATE PIPING OPENINGS WITH OTHER DISCIPLINE DRAWINGS.

5. DO NOT CUT OR MODIFY STRUCTURAL MEMBERS FOR PIPES, DUCTS, ETC, UNLESS SPECIFICALLY DETAILED OR APPROVED IN WRITING BY THE ENGINEER.

6. VISITS TO THE JOB SITE BY THE ENGINEER TO OBSERVE THE CONSTRUCTION DO NOT IN ANY WAY MEAN THAT ENGINEER IS GUARANTOR OF CONSTRUCTOR'S WORK, NOR RESPONSIBLE FOR THE COMPREHENSIVE OR SPECIAL INSPECTIONS, COORDINATION, SUPERVISION, OR SAFETY AT THE JOB SITE.

7. INFORMATION (DETAILING, DIMENSIONS, CONFIGURATIONS, AND ELEVATIONS, ETC.) OF EXISTING CONSTRUCTION SHOWN REFLECTS AVAILABLE EXISTING DESIGN DOCUMENTS, AND DOES NOT NECESSARILY REPRESENT THE AS-CONSTRUCTED CONDITIONS. THE CONTRACTOR SHALL FIELD VERIFY DIMENSIONS, ELEVATIONS AND DETAILING OF THE EXISTING STRUCTURES PRIOR TO UNDERTAKING ANY WORK THAT IS AFFECTED BY THE EXISTING STRUCTURE.

FOUNDATIONS

1. REFER TO GEOTECHNICAL DATA REPORT SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION BY AECOM DATED APRIL 25, 2013.

2. EXCAVATIONS SHALL BE SHORED TO PREVENT SUBSIDENCE OR DAMAGE TO ADJACENT EXISTING STRUCTURES, ROADS, UTILITIES, ETC.

3. FOUNDATION SLABS, SLABS-ON-GRADE AND WALL AND COLUMN FOUNDATIONS SPECIFICALLY NOTED TO BE ON FILL SHALL BEAR ON UNDISTURBED NATIVE SOIL.

4. FOUNDATION BEARING SURFACES SHALL BE OBSERVED BY THE GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF FORMWORK OR REINFORCING STEEL. THE OBSERVATION SHALL VERIFY IF THE ACTUAL EXPOSED SUBGRADE IS AS ANTICIPATED BY THE SITE SPECIFIC BORINGS AND DATA REPORTS.

5. NO BACKFILL SHALL BE PLACED BEHIND WALLS UNTIL THE WALLS HAVE ATTAINED 100 PERCENT AND TOP SUPPORTING SLAB'S CONCRETE HAS ATTAINED 80 PERCENT OF THEIR SPECIFIED 28 DAY COMPRESSIVE STRENGTH, OR UNTIL TOP-OF-WALL FRAMING SYSTEMS, INCLUDING STEEL OR WOOD DIAPHRAGMS, HAVE BEEN COMPLETED.

6. NO BACKFILL SHALL BE PLACED BEHIND CANTILEVERED, FREE TOP WALLS UNTIL THE CONCRETE HAS ATTAINED 100 PERCENT OF ITS SPECIFIED 28 DAY COMPRESSIVE STRENGTH.

7. USE UTMOST CARE TO AVOID DAMAGE TO EXISTING STRUCTURES WHEN USING EXPLOSIVES FOR EXCAVATION OF ROCK.

FORMWORK, SHORING, AND BRACING

1. STRUCTURES SHOWN ON THE DRAWINGS HAVE BEEN DESIGNED FOR STABILITY UNDER FINAL CONDITIONS ONLY. DESIGN SHOWN DOES NOT INCLUDE NECESSARY COMPONENTS OR EQUIPMENT FOR STABILITY OF THE STRUCTURES DURING CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR WORK RELATING TO CONSTRUCTION ERECTION METHODS, BRACING, SHORING, RIGGING, GUYS, SCAFFOLDING, FORMWORK, AND OTHER WORK AIDS REQUIRED TO SAFELY PERFORM THE WORK SHOWN.

2. TEMPORARY SHORING SHALL REMAIN IN PLACE UNTIL ELEVATED CONCRETE FLOOR OR SLABS HAVE REACHED 80 PERCENT OF THE 28 DAY COMPRESSIVE STRENGTH AS DETERMINED BY FIELD CYLINDER BREAKS.

3. "BURY" BARS OR "CARRIER" BARS ARE NOT ALLOWED FOR THE BOTTOM MATS OF REINFORCING IN ALL ELEVATED SLABS AND ARE NOT ALLOWED FOR THE TOP MATS OF REINFORCING IN ELEVATED SLABS LESS THAN 12 INCHES THICK.

CONCRETE REINFORCING

1. REINFORCING STEEL:
   - TYPICAL: ASTM A615, GRADE 60
   - WELDED: ASTM A706, GRADE 60 (WELDING IS ONLY PERMITTED WITH WRITTEN PERMISSION FROM ENGINEER)

2. FABRICATION AND PLACEMENT OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH CRSI MSP-1 "MANUAL OF STANDARD PRACTICE"AND ACI 301 "SPECIFICATIONS FOR STRUCTURAL CONCRETE".

3. MINIMUM REINFORCING FOR CONCRETE WALLS AND SLABS SHALL BE AS FOLLOWS:

THICKNESS	REINF EACH WAY	LOCATION
6"	#4@12"	CENTERED
8"	#5@12"	CENTERED
10"	#4@12"	EACH FACE
12"	#5@12"	EACH FACE

   PROVIDE LARGER SIZES AND MORE REINFORCING IN SECTIONS OF CONCRETE WHERE REQUIRED BY THE DETAILS ON THE DRAWINGS OR BY THE SPECIFICATIONS.

4. CONCRETE COVER FOR REINFORCING, UNLESS SHOWN OTHERWISE, SHALL BE:
   - WHEN PLACED ON GROUND: 3"
   - INTERIOR, FINISHED, HUMIDITY CONTROLLED AREAS:
     - WALLS, SLABS AND JOISTS: 3/4"
     - BEAM STIRRUPS AND COLUMN TIES: 1 1/2"
   - OTHER CONCRETE SURFACES: 2"

5. 90 DEGREE BENDS, UNLESS OTHERWISE SHOWN, SHALL BE ACI 318 STANDARD HOOKS.

6. WALL FOOTING CORNER AND INTERSECTION REINFORCEMENT BARS SHALL BE EXTENDED INTO CONNECTING FOOTINGS AND LAPPED ON THE OPPOSITE FACE OF THE CONNECTING FOOTING. OUTSIDE FACE WALL FOOTING REINFORCEMENT SHALL BE LAPPED WITH CORNER BARS. ALL WALL FOOTING REINFORCEMENT SHALL BE CONTINUOUS THROUGH COLUMNS OR PILASTERS FOOTINGS.

7. LAP VERTICAL WALL BARS WITH DOWELS FROM BASE SLABS AND EXTEND INTO TOP FACE OF ROOF SLABS AND LAP WITH TOP SLAB REINFORCEMENT.

8. LOCATE ELEVATED SLAB AND BEAM TOP BAR SPLICES AT MIDSPAN AND BOTTOM BAR SPLICES AT SUPPORTS.

9. REINFORCING STEEL FOR FOOTINGS AND SLABS ON GRADE SHALL BE ADEQUATELY SUPPORTED ON BAR SUPPORTS WITH SPACERS TO KEEP REINFORCING ABOVE THE PREPARED GRADE. LIFTING REINFORCING OFF GRADE DURING CONCRETE PLACEMENT IS NOT PERMITTED.

CONCRETE REINFORCING (CONTINUED)

12. PROVIDE ADDITIONAL REINFORCING AT ALL OPENINGS PER (0330-001) PROVIDE ADDITIONAL REINFORCING AT ALL HORIZONTAL CONSTRUCTION JOINTS PER (0330-004). DETAIL ALL CORNER AND INTERSECTING WALL REINFORCEMENT PER (0330-003). PROVIDE VERTICAL WALL REINFORCING AND DOWEL PLACEMENT PER (0330-005). PROVIDE WALL CONSTRUCTION JOINT SPACING PER (0315-131). PROVIDE SLAB CONSTRUCTION JOINT PER (0315-142).

13. PROVIDE WATERSTOP IN WALL PER DETAIL (0315-001), (0315-011) AND (0315-012).

14. FOR CONDUIT EMBEDMENTS IN WALL OR SLABS, SEE (0330-084).

15. REINFORCEMENT BENDS AND LAPS, UNLESS OTHERWISE NOTED, SHALL SATISFY THE FOLLOWING MINIMUM REQUIREMENTS:

CONCRETE DESIGN STRENGTH = 4,000 PSI AT 28 DAYS[3] GRADE 60 REINFORCING STEEL										
BAR SIZE		#3	#4	#5	#6	#7	#8	#9	#10	#11
LAP SPLICE LENGTH										
SPACING = 3"	TOP BAR [2]	1'-4"	1'-8"	2'-1"	3'-0"	5'-2"	6'-8"	8'-6"	10'-10"	`13'-4"
	OTHER BAR	1'-4"	1'-4"	1'-8"	2'-4"	4'-0"	5'-2"	6'-7"	8'-4"	10'-3"
SPACING = 4"	TOP BAR [2]	1'-4"	1'-8"	2'-0"	2'-5"	3'-10"	5'-0"	6'-5"	8'-1"	10'-0"
	OTHER BAR	1'-4"	1'-4"	1'-7"	1'-10"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"
SPACING ≥ 6"	TOP BAR [2]	1'-4"	1'-8"	2'-0"	2'-5"	3'-6"	4'-0"	5'-0"	6'-2"	7'-5"
	OTHER BAR	1'-4"	1'-4"	1'-7"	1'-10"	2'-9"	3'-1"	3'-10"	4'-9"	5'-8"
EMBEDMENT LENGTH										
SPACING = 3"	TOP BAR [2]	1'-0"	1'-3"	1'-8"	2'-4"	4'-0"	5'-2"	6'-7"	8'-4"	10'-3"
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-10"	3'-1"	4'-0"	5'-1"	6'-5"	7'-11"
SPACING = 4"	TOP BAR [2]	1'-0"	1'-3"	1'-7"	1'-10"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-5"	2'-4"	3'-0"	3'-10"	4'-10"	5'-11"
SPACING ≥ 6"	TOP BAR [2]	1'-0"	1'-3"	1'-7"	1'-10"	2'-9"	3'-1"	3'-10"	4'-9"	5'-8"
	OTHER BAR	1'-0"	1'-0"	1'-3"	1'-5"	2'-1"	2'-5"	3'-0"	3'-8"	4'-5"

1. LAP LENGTHS ARE BASED ON MINIMUM CONCRETE COVER OF 2". LONGER LENGTHS ARE REQUIRED FOR CONCRETE COVER LESS THAN 2".
2. TOP BARS SHALL BE DEFINED AS ANY HORIZONTAL BARS PLACED SUCH THAT MORE THAN 12 INCHES OF CONCRETE IS CAST IN THE MEMBER BELOW THE BAR IN ANY SINGLE POUR. HORIZONTAL WALL BARS ARE CONSIDERED TOP BARS.
3. WHERE 3000 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 16 PERCENT. WHERE 3500 PSI CONCRETE IS USED, INCREASE ABOVE LENGTHS BY 7 PERCENT.

CAST IN PLACE CONCRETE

1. 28-DAY COMPRESSIVE STRENGTHS:
   - BUILDING STRUCTURES TYPICAL: 4500 PSI
   - WALL SLURRY MIXTURE: SAME AS WALL CONCRETE
   - CONCRETE FILL: 3000 PSI
   - CURBS AND SIDEWALKS: 5000 PSI
   - DUCT BANKS AND PIPE ENCASEMENTS NOT INTEGRAL WITH FOUNDATIONS: 3000 PSI

2. DESIGN STRENGTHS ARE SAME AS 28-DAY COMPRESSIVE STRENGTHS.

3. CONTINUOUS WATERSTOP AS SPECIFIED SHALL BE INSTALLED IN CONSTRUCTION JOINTS OF WATER HOLDING BASINS, CHANNELS, AND BELOW GRADE STRUCTURES, EXCEPT WHERE SPECIFICALLY NOTED OTHERWISE.

4. CONSTRUCTION JOINTS INDICATED ARE SUGGESTED LOCATIONS. CONTRACTOR MAY REVISE LOCATION OF JOINTS, SUBJECT TO SPECIFIED REQUIREMENTS. LAYOUT SHOWING ALL CONSTRUCTION JOINT LOCATIONS SHALL BE SUBMITTED FOR REVIEW BY ENGINEER.

5. ROUGHEN AND CLEAN CONSTRUCTION JOINTS IN WALLS AND SLABS AS SPECIFIED PRIOR TO PLACING ADJACENT CONCRETE.

6. COORDINATE PLACEMENT OF OPENINGS, CURBS, DOWELS, SLEEVES, CONDUITS, BOLTS AND INSERTS PRIOR TO PLACEMENT OF CONCRETE.

7. NO ALUMINUM CONDUIT OR PRODUCTS CONTAINING ALUMINUM OR ANY OTHER MATERIAL INJURIOUS TO THE CONCRETE SHALL BE EMBEDDED IN THE CONCRETE.

8. DO NOT PLACE CONDUIT PARALLEL TO BEAM OR COLUMN REINFORCEMENT UNLESS SPECIFICALLY INDICATED IN DRAWINGS.

9. PATCH FORM TIE HOLES IN ACCORDANCE WITH DETAILS (0310-051) AND/OR (0310-052).

NO.	DATE	REVISION	BY	APVD
1	04 27 15	ADDENDUM NO. 1 - REVISED NOTE	PAK	DRL

DSGN DR LANGE — DR GH BURLEY — CHK — APVD

OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT
IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

CH2MHILL®

GENERAL

STRUCTURAL NOTES 1

NO SCALE
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH 2015
PROJ	653463
DWG	01-G-012
SHEET	of

CONCRETE UNIT MASONRY

1. MASONRY WALL TYPE: ORDINARY
2. DESIGN COMPRESSIVE STRENGTH, f'm, OF THE FINISHED ASSEMBLY AND MATERIAL PROPERTIES SHALL BE PER THE TABLE BELOW.
3. MORTAR: ASTM C270, TYPE S, HYDRATED.
4. GROUT: ASTM C476 COARSE GROUT. USE OF WATER REDUCERS OR SUPERPLASTICIZERS IS NOT PERMITTED.
5. CONCRETE MASONRY UNITS: ASTM C90, MEDIUM WEIGHT, LINEAR SHRINKAGE SHALL NOT EXCEED 0.065 PERCENT.
6.

DESIGN COMPRESSIVE STRENGTH f'm (PSI)	UNIT STRENGTH (PSI)	GROUT STRENGTH (PSI) MIN / MAX	MORTAR PROPERTIES
1,500	1,900	2,000 / 3500	Type S

7. PLACE COURSES IN WALLS, COLUMNS, AND PILASTERS IN RUNNING BOND PATTERN WHERE SHOWN ON DRAWINGS, PROVIDE SOLID GROUTED STACK BOND PATTERN USING OPEN END UNITS.
8. PROVIDE MATCHING FOUNDATION DOWELS FOR ALL TYPICAL AND ADDITIONAL VERTICAL BARS.
9. LAP VERTICAL REINFORCING BARS 48 BAR DIAMETERS WITH FOUNDATION DOWELS, EXCEPT BARS PLACED EACH FACE IN CMU SHALL BE LAPPED 60 BAR DIAMETERS. LAP ALL OTHER VERTICAL BARS 72 BAR DIAMETERS.
10. LAP ALL VERTICAL BARS IN CANTILEVER WALLS, INCLUDING FOUNDATION DOWELS, 72 BAR DIAMETERS.
11. STAGGER ADJACENT LAP SPLICES BY 24 INCHES WHEN SEPARATED BY 3 INCHES OR LESS.
12. PROVIDE NUMBER OF FULL HEIGHT VERTICAL BARS AT EDGES OF OPENINGS AS SHOWN IN DETAIL 0422-004
13. PROVIDE FULL HEIGHT VERTICAL BARS IN 3 CELLS AT WALL CORNERS AND INTERSECTIONS AS SHOWN IN DETAIL 0422-001 .
14. PROVIDE HORIZONTAL CORNER AND INTERSECTION BARS WITH LAP LENGTHS AS SHOWN IN DETAIL 0422-001.
15. PROVIDE REINFORCED LINTELS ABOVE AND REINFORCED BOND BEAMS BELOW OPENINGS AS SHOWN IN DETAIL 0422-003 .
16. PROVIDE FULL HEIGHT VERTICAL BARS WITH MATCHING DOWELS IN CELLS ADJACENT TO OPENINGS AS SHOWN IN DETAIL 0422-003 .
17. THE MINIMUM REINFORCING FOR INTERMEDIATE REINFORCED CONCRETE BLOCK WALLS SHALL BE AS FOLLOWS. PROVIDE LARGER SIZES AND MORE REINFORCING IN SECTIONS OF WALLS WHERE REQUIRED BY THE DETAILS ON THE DRAWINGS OR BY THE SPECIFICATIONS.

WALL THICKNESS	VERTICAL REINFORCING	VERTICAL BAR LOCATION	HORIZONTAL JOINT REINFORCING*
8"	#5@48"	CENTERED	EVERY OTHER COURSE
12"	#5@48	EACH FACE	EVERY OTHER COURSE

* EXCEPT WITH BOND BEAMS AT TOP OF WALL AND BOTTOM OF WALL

18. DO NOT PLACE CONDUIT IN CELLS CONTAINING PARALLEL REINFORCEMENT.

WELDING

1. WELDS SHALL CONFORM TO AMERICAN WELDING SOCIETY (AWS):
   D1.1, STRUCTURAL WELDING CODE STEEL
   D1.2, STRUCTURAL WELDING CODE ALUMINUM
   D1.3, STRUCTURAL WELDING CODE SHEET STEEL
   D1.4, STRUCTURAL WELDING CODE REINFORCING STEEL
   D1.6, STRUCTURAL WELDING CODE STAINLESS STEEL
2. REPAIR WELDS FOUND DEFECTIVE IN ACCORDANCE WITH AWS D1.1 SECTION 5.26.
3. USE INTERMITTENT WELDS AT FIELD WELDS OF EMBED PLATES AND ANGLES TO AVOID SPALLING OR CRACKING OF THE EXISTING CONCRETE.
4. BUTT JOINT WELDS SHALL BE COMPLETE JOINT PENETRATION (CJP) UNLESS INDICATED OTHERWISE.

STRUCTURAL STEEL AND METAL FABRICATIONS

1. STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING ASTM STANDARDS:

W-SHAPES	A992
MISCELLANEOUS SHAPES INCLUDING ANGLES, CHANNELS, PLATES, ETC.	A36
HOLLOW STRUCTURAL SECTIONS (HSS)	A500, GRADE B
STEEL PIPE	A53, GRADE B
STAINLESS STEEL SHAPES	A276

2. ALUMINUM SHALL CONFORM TO THE FOLLOWING ASTM STANDARDS:

STRUCTURAL SHAPES	B308
PLATES	B209

3. STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN CONFORMANCE WITH THE AISC MANUAL OF STEEL CONSTRUCTION, CURRENT EDITION, AND CURRENT OSHA STANDARDS.
4. FASTENERS SHALL BE HIGH STRENGTH BOLTS CONFORMING TO THE FOLLOWING ASTM STANDARDS EXCEPT WHERE SPECIFICALLY INDICATED OTHERWISE:

UNLESS SHOWN OTHERWISE	A325-N
SLIP CRITICAL	A325-SC
DIRECT TENSION INDICATORS OR LOAD INDICATOR WASHERS	ASTM F959
TENSION CONTROL (TC) BOLTS	ASTM A325 AND ASTM F1852
ANCHOR BOLTS (AB)	
STAINLESS STEEL	F593, AISI TYPE 316, CONDITION CW
STEEL OR GALVANIZED STEEL	F1554, GR 36 / A153
MACHINE BOLTS (MB)	
STEEL	A307
STAINLESS STEEL	F593, AISI TYPE 316, CONDITION CW
GALVANIZED STEEL	A307 / A153
ALUMINUM	F468, ALLOY 2024-T4

5. ITEMS TO BE EMBEDDED IN CONCRETE SHALL BE CLEAN AND FREE OF OIL, DIRT AND PAINT.
6. NO HOLES OTHER THAN THOSE SPECIFICALLY DETAILED SHALL BE ALLOWED THROUGH STRUCTURAL STEEL MEMBERS. NO CUTTING OR BURNING OF STRUCTURAL STEEL IS PERMITTED WITHOUT THE APPROVAL OF THE ENGINEER..

STEEL DECKING

1. FOR DECK SIZE, GAGE, AND FASTENING CONFIGURATIONS, SEE FRAMING PLANS. FASTENING CONFIGURATIONS SHOWN ARE SPECIFIC TO THE DECK PRODUCT USED AS BASIS OF DESIGN. CONTRACTOR SHALL FASTEN THE DECKING IN ACCORDANCE WITH INSTALLED DECK MANUFACTURER'S RECOMMENDATIONS TO MEET SPECIFIED CAPACITY REQUIREMENTS.
2. WELDING SHALL BE IN ACCORDANCE WITH AWS D1.3 "STRUCTURAL WELDING CODE SHEET STEEL".
3. DECKING SHALL HAVE A MINIMUM 1 1/2 INCHES BEARING ON SUPPORTS.
4. DECKING SHALL BE CONTINUOUS OVER THREE SPANS MINIMUM, EXCEPT WHERE SHOWN OTHERWISE.
5. FLOOR DECK RECEIVING CONCRETE FILL SHALL BE COMPOSITE TYPE.
6. WELD DECK TO DRAG STRUTS AND TOP OF WALL ANGLE TIES WITH 5/8 INCH PUDDLE WELDS AT 0'-6" ON CENTER, UNLESS NOTED OTHERWISE. LOCATE ANGLE IN DECK VALLEY.
7. LOCATE OPENINGS FOR EQUIPMENT PER OTHER DISCIPLINE DRAWINGS.
8. REINFORCE DECK FOR LARGER OPENINGS PER DETAIL 0531-021. REINFORCE SMALL OPENINGS AS SPECIFIED.
9. COMPOSITE STRUCTURAL STEEL BEAMS HAVE BEEN DESIGNED FOR "UNSHORED CONDITION" DURING CONSTRUCTION, AND WILL DEFLECT UNDER WET CONCRETE LOADS. TO ACHIEVE THE FINISHED TOP OF CONCRETE INDICATED ON THE DRAWINGS, THE CONTRACTOR SHALL, AT NO ADDITIONAL COST TO THE OWNER, PROVIDE THE ADDITIONAL CONCRETE.
10. FOR STEEL MEMBERS RECEIVING DECKING 0536-005 .

DEFERRED SUBMITTALS

1. DEFERRED SUBMITTALS ARE THOSE PORTIONS OF THE DESIGN WHICH ARE NOT SUBMITTED AT THE TIME OF PERMIT APPLICATION AND WHICH ARE TO BE SUBMITTED TO THE PERMITTING AGENCY FOR ACCEPTANCE PRIOR TO INSTALLATION OF THAT PORTION OF THE WORK OR ARE REQUIRED TO BE SUBMITTED FOR REVIEW ONLY BY THE ENGINEER.
2. THE FOLLOWING IS A LIST OF DEFERRED SUBMITTALS THAT ARE EXPECTED TO CONTAIN STRUCTURAL CALCULATIONS OR SAFETY RELATED SYSTEM INFORMATION FOR REVIEW TO MEET BUILDING PERMITTING REQUIREMENTS FOR DESIGNED SYSTEMS. PRIOR TO INSTALLATION OF THE INDICATED STRUCTURAL ELEMENT, EQUIPMENT, DISTRIBUTION SYSTEM, OR COMPONENT OR ITS ANCHORAGE, THE CONTRACTOR SHALL SUBMIT THE REQUIRED CALCULATIONS AND SUPPORTING DATA AND DRAWINGS FOR REVIEW AND ACCEPTANCE BY THE ENGINEER. ADDITIONALLY, ACCEPTANCE INDICATED ON THE ENGINEER'S COMMENT FORM, ALONG WITH THE COMPLETED, FINAL SUBMITTAL SHALL THEN BE FILED BY THE CONTRACTOR AND ACKNOWLEDGED AS ACCEPTED BY THE PERMITTING AGENCY PRIOR TO INSTALLATION OF THESE ITEMS.

SPEDIFICATION SECTION	CODE REQUIRED DEFERRED SUBMITTLAS FOR REVIEW BY PERIMITNG AGENCY
05 52 00	METAL RAILINGS
05 82 00	GLASS-FIBER-REINFORCED PLASTIC
33 16 13.15	PRESTRESSED CONCRETE TANK WITH STEEL DIAPHRAGM
40 05 15	PIPING SUPPORT SYSTEMS
41 22 13.23	OVERHEAD CRANES
OTHER	ANY EQUIPMENT OR COMPONENT IN WHICH A TECHNICAL SPECIFICATION REQUIRES SUBMITTTAL OF EQUIPMENT OR ANCHORAGE SYSTEM CALCULATIONS

NO.	DATE	REVISION	BY	APVD

DSGN DR LANGE DR GH BURLEY CHK APVD

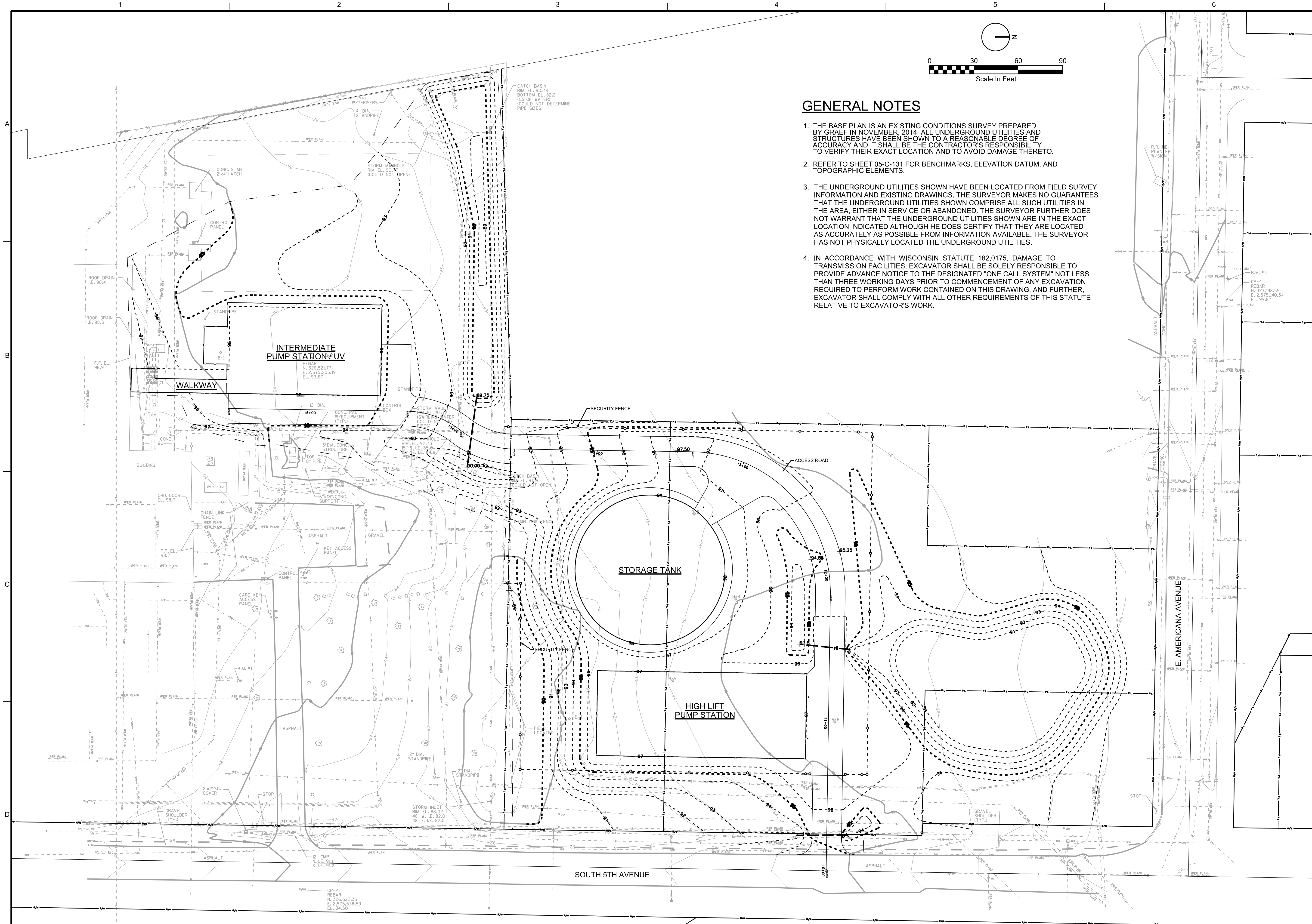
OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT
IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

CH2MHILL®

GENERAL
STRUCTURAL NOTES 2

NO SCALE
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH 2015
PROJ	653463
DWG	01-G-013
SHEET	of



GENERAL NOTES

1. THE BASE PLAN IS AN EXISTING CONDITIONS SURVEY PREPARED BY GRAEF IN NOVEMBER, 2014. ALL UNDERGROUND UTILITIES AND STRUCTURES HAVE BEEN SHOWN TO A REASONABLE DEGREE OF ACCURACY AND IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THEIR EXACT LOCATION AND TO AVOID DAMAGE THERETO.
2. REFER TO SHEET 05-C-131 FOR BENCHMARKS, ELEVATION DATUM, AND TOPOGRAPHIC ELEMENTS.
3. THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.
4. IN ACCORDANCE WITH WISCONSIN STATUTE 182.0175, DAMAGE TO TRANSMISSION FACILITIES, EXCAVATOR SHALL BE SOLELY RESPONSIBLE TO PROVIDE ADVANCE NOTICE TO THE DESIGNATED "ONE CALL SYSTEM" NOT LESS THAN THREE WORKING DAYS PRIOR TO COMMENCEMENT OF ANY EXCAVATION REQUIRED TO PERFORM WORK CONTAINED ON THIS DRAWING, AND FURTHER, EXCAVATOR SHALL COMPLY WITH ALL OTHER REQUIREMENTS OF THIS STATUTE RELATIVE TO EXCAVATOR'S WORK.

CH2MHILL®

GRAEF

OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT
IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

CIVIL

OVERALL SITE GRADING PLAN

NO.	DATE	REVISION	BY	APVD
DSGN	DR	CHK	APVD	
	JAL	SRK	CHECKED	APPROVED

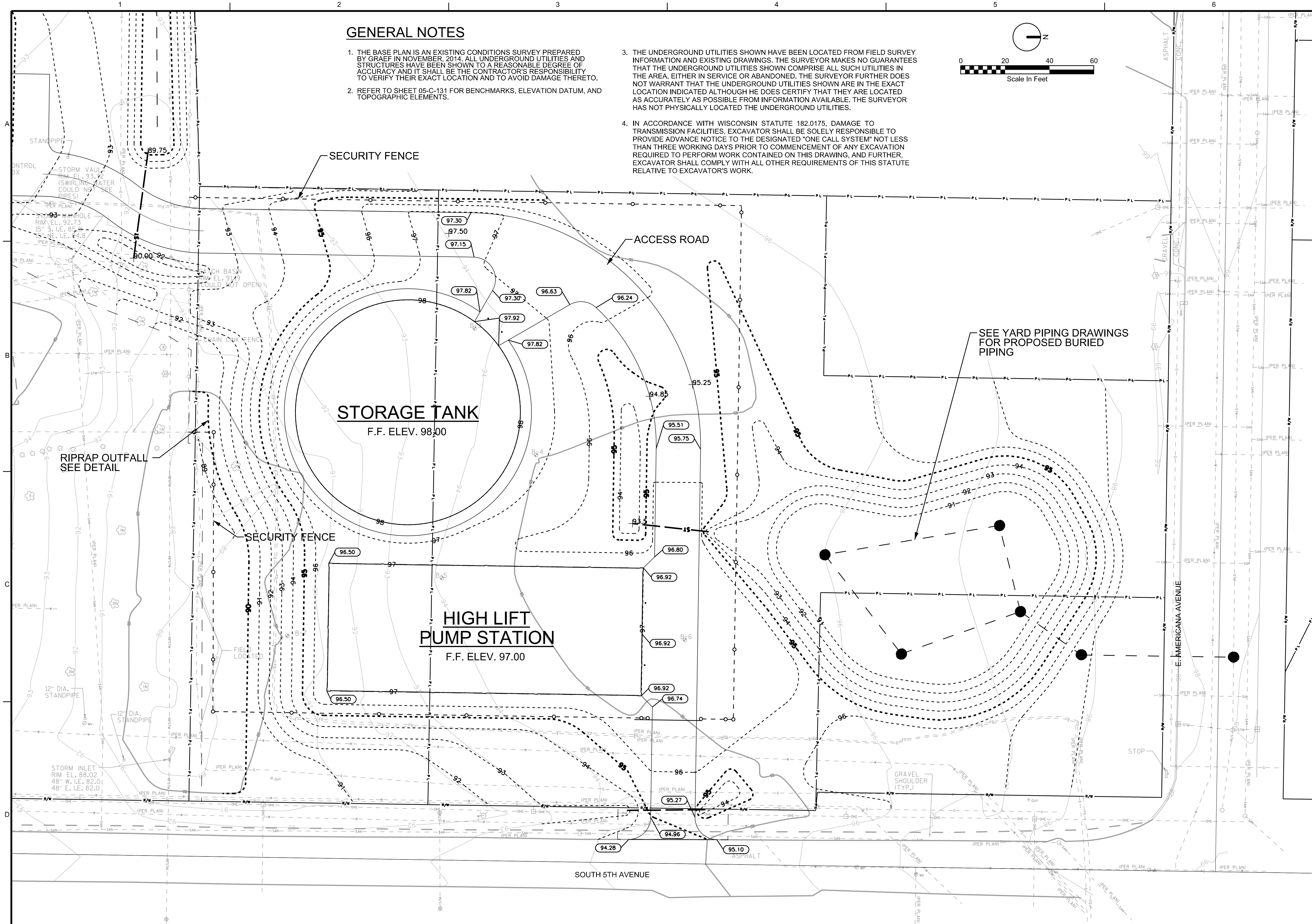
1"=30'
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH 2015
PROJ	653463
DWG	05-C-234
SHEET	of

FILENAME: L:\Jobs2014\20140254\CAD\Site\dgn\00\05-C-234_653463.dgn PLOT DATE: 3/25/2015 PLOT TIME: 10:00:53 AM

GENERAL NOTES

1. THE BASE PLAN IS AN EXISTING CONDITIONS SURVEY PREPARED BY GRAEF IN NOVEMBER, 2014. ALL UNDERGROUND UTILITIES AND STRUCTURES HAVE BEEN SHOWN TO A REASONABLE DEGREE OF ACCURACY AND IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THEIR EXACT LOCATION AND TO AVOID DAMAGE THERETO.
2. REFER TO SHEET 05-C-131 FOR BENCHMARKS, ELEVATION DATUM, AND TOPOGRAPHIC ELEMENTS.
3. THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.
4. IN ACCORDANCE WITH WISCONSIN STATUTE 182.0175, DAMAGE TO TRANSMISSION FACILITIES, EXCAVATOR SHALL BE SOLELY RESPONSIBLE TO PROVIDE ADVANCE NOTICE TO THE DESIGNATED "ONE CALL SYSTEM" NOT LESS THAN THREE WORKING DAYS PRIOR TO COMMENCEMENT OF ANY EXCAVATION REQUIRED TO PERFORM WORK CONTAINED ON THIS DRAWING, AND FURTHER, EXCAVATOR SHALL COMPLY WITH ALL OTHER REQUIREMENTS OF THIS STATUTE RELATIVE TO EXCAVATOR'S WORK.



NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
JAL		SRK	

CHECKED / APPROVED

OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

GRAEF

CH2MHILL®

CIVIL

DETAILED SITE GRADING PLAN

1"=20'

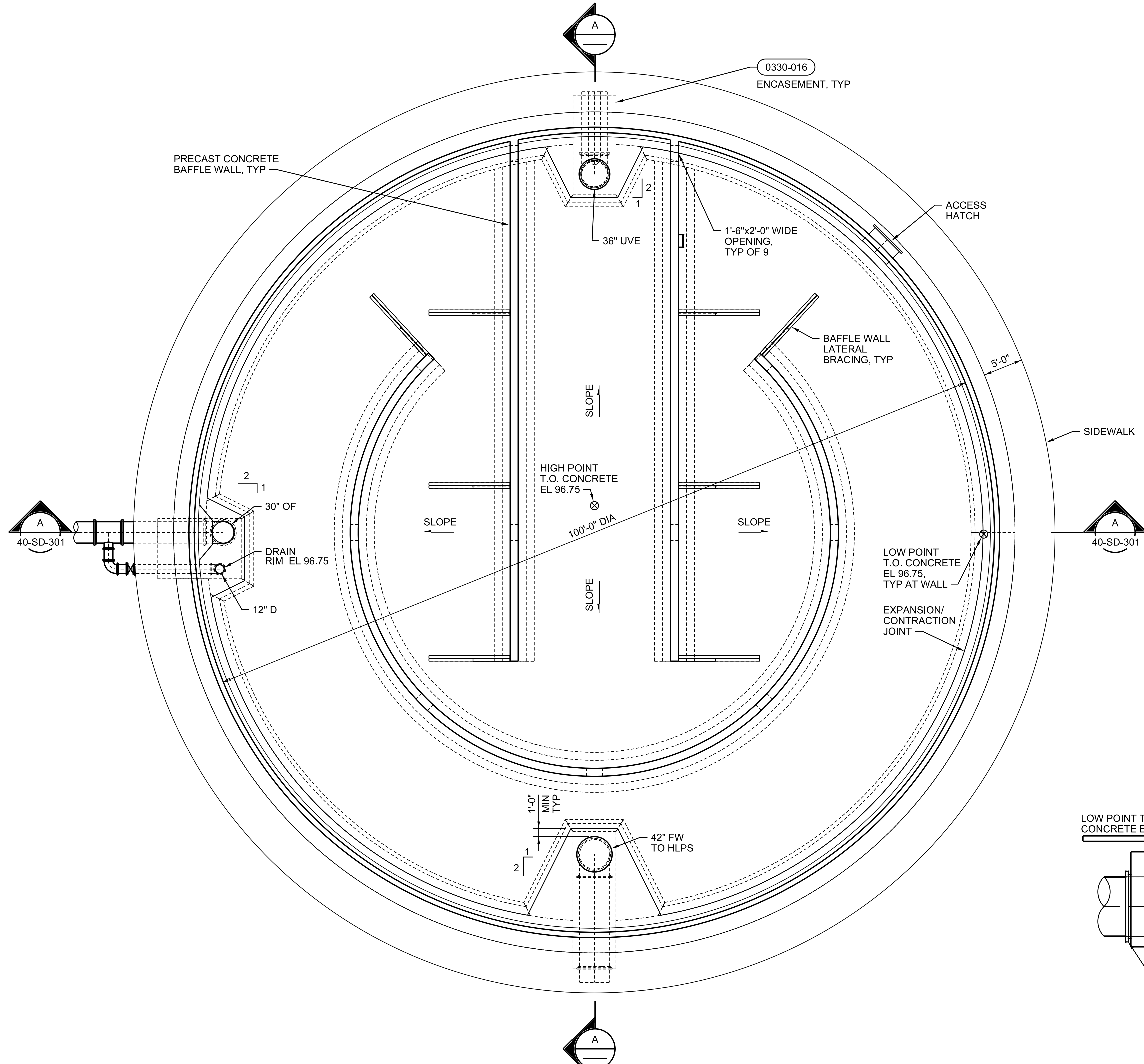
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH 2015
PROJ	653463
DWG	05-C-235
SHEET	of

FILENAME: L:\Jobs2014\20140254\CAD\Site\dgn\00\05-C-235_653463.dgn PLOT DATE: 3/25/2015 PLOT TIME: 10:00:54 AM

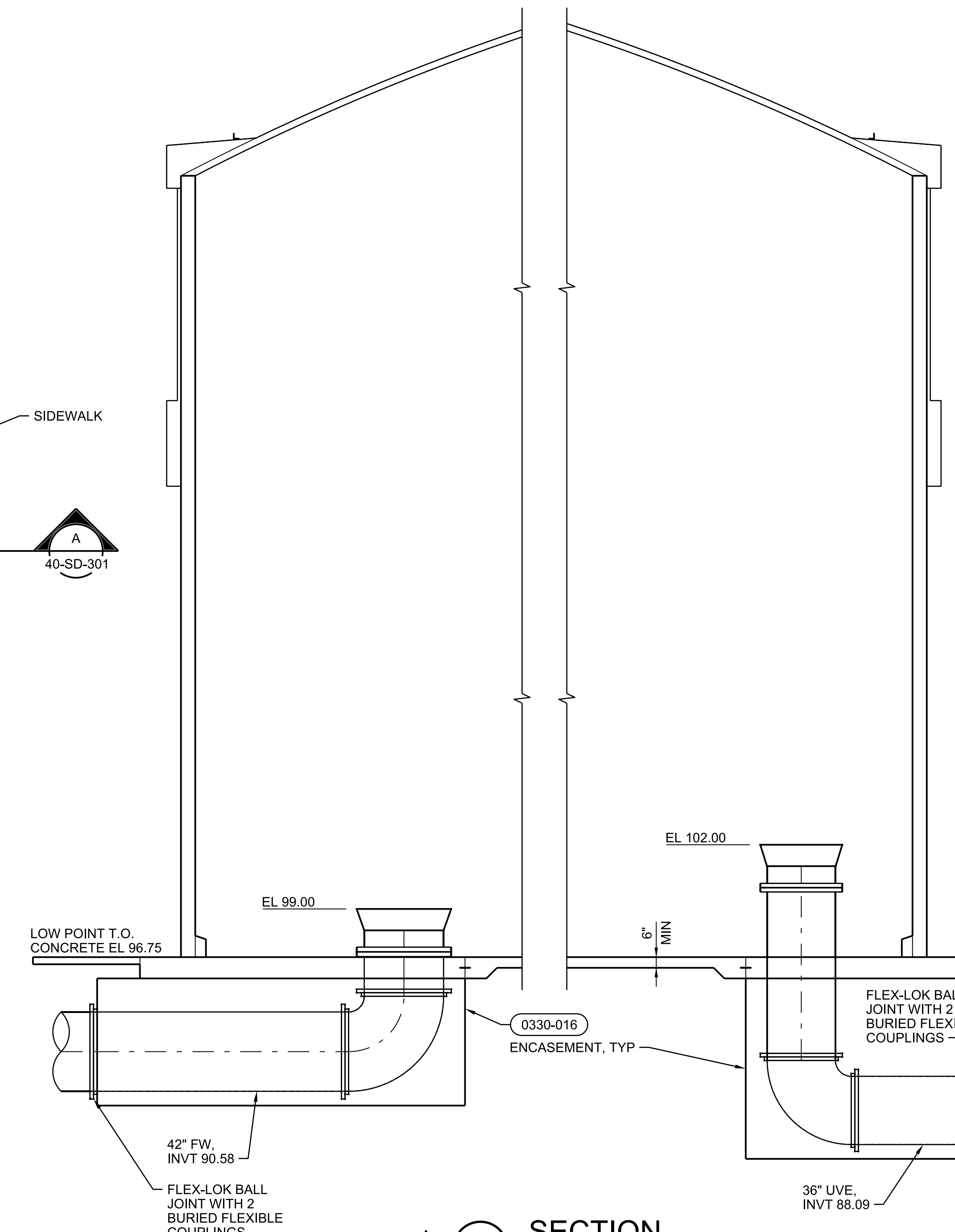
1 2 3 4 5 6

A B C D



PLAN AT GRADE LEVEL

1/8"=1'-0"



A SECTION

1/4"=1'-0"

NO.	DATE	REVISION	BY	APVD
1	04 27 15	ADDENDUM NO. 1 - REISSUE ENTIRE DRAWING	PAK	DRL

DSGN DR LANGE DR PA KARABAN CHK APVD

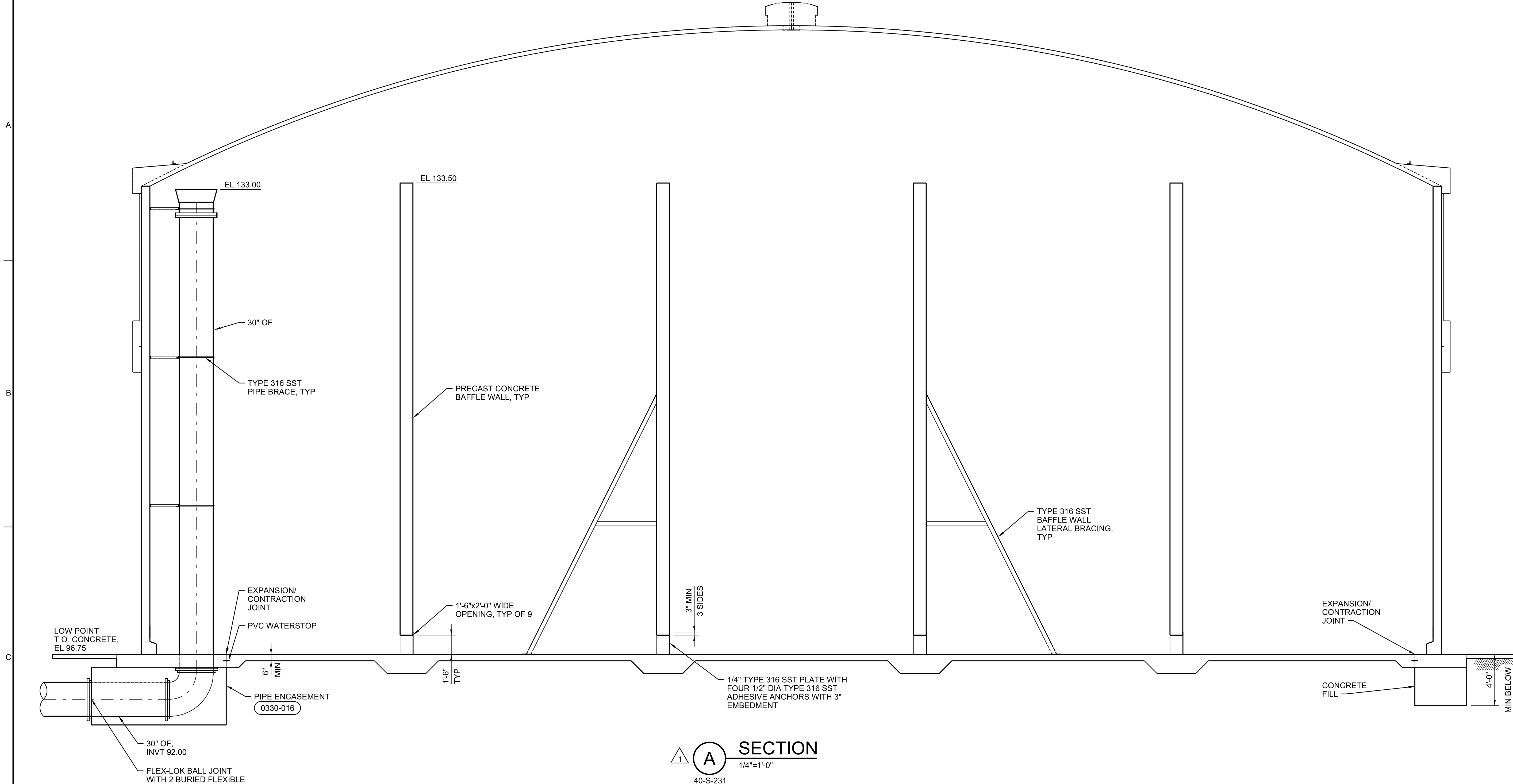
OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT
IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

CH2MHILL®

STRUCTURAL/PROCESS MECHANICAL
STORAGE TANK
PLAN AT GRADE LEVEL AND SECTION

1/8"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH 2015
PROJ	653463
DWG	40-SD-231
SHEET	of



A SECTION
1/4"=1'-0"
40-S-231

NO.	DATE	REVISION	BY	APVD
1	04 27 15	ADDENDUM NO. 1 - REISSUE ENTIRE DRAWING	PAK	DRL

DSGN DR LANGE | DR PA KARABAN | CHK | APVD

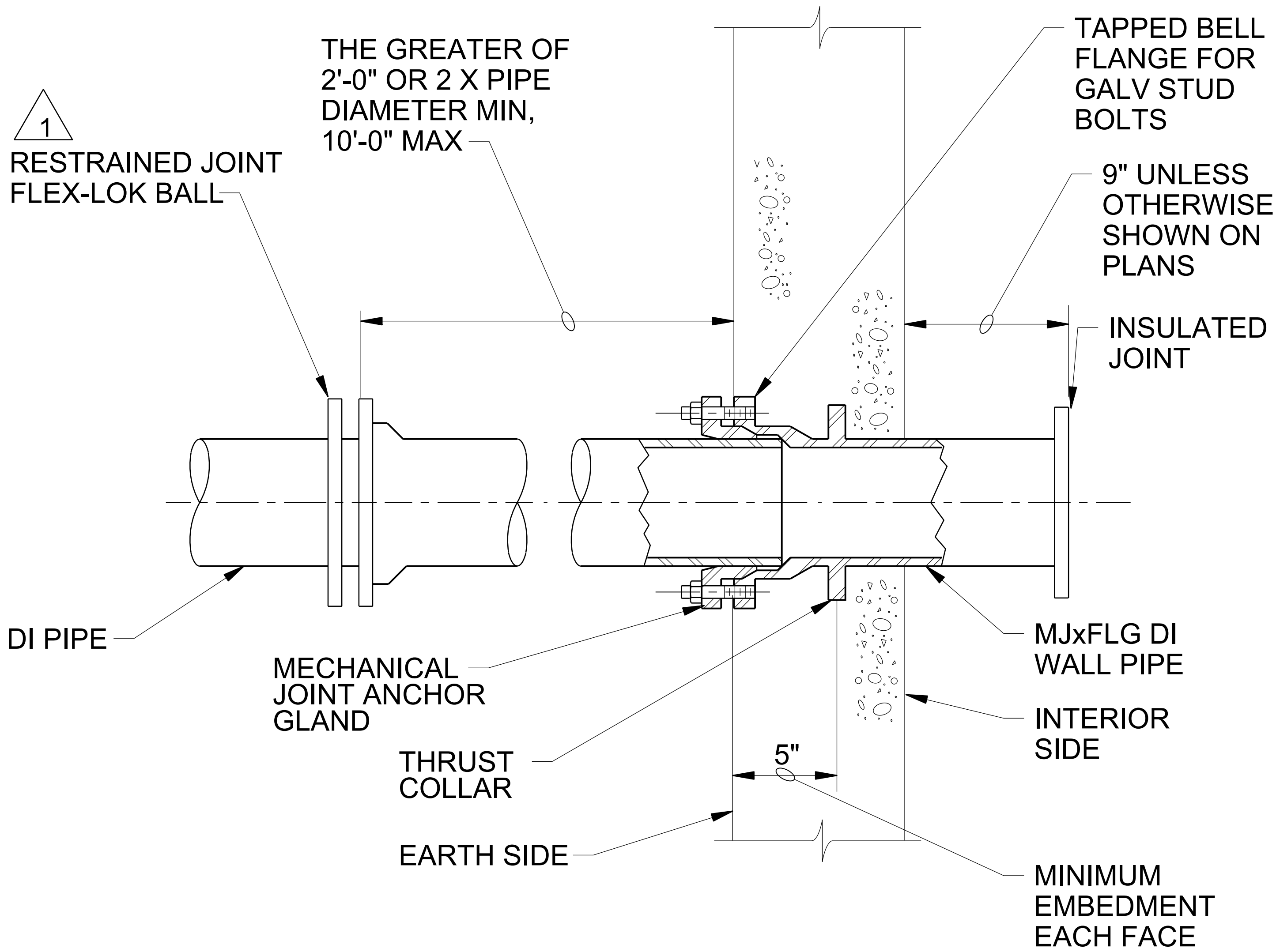
OAK CREEK WATER AND SEWER UTILITY
2016 WATER TREATMENT PLANT IMPROVEMENTS
CITY OF OAK CREEK, WISCONSIN

CH2MHILL

STRUCTURAL/ PROCESS MECHANICAL
STORAGE TANK SECTION

1/4"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MARCH 2015
PROJ	653463
DWG	40-SD-301
SHEET	of



NOTES:

1. COAT WALL PIPE WITH SPECIFIED PAINT SYSTEM PRIOR TO CONCRETE PLACEMENT.

NO.	DATE	REVISION	BY	APVD
1	04 27 15	ADDENDUM NO. 1 - REVISED NOTE	PAK	DRL

MECHANICAL JOINT WALL PIPE FOR DIP

NTS

NOTE TO DESIGNER:

1. USE THIS DETAIL WHERE UNEQUAL SETTLING OF BUILDING AND EXTERIOR PIPE CAN OCCUR.
2. THE DESIGNER SHALL VERIFY THAT USING THIS STANDARD DETAIL FOR THE PROJECT SPECIFIC DIFFERENTIAL SETTLEMENT WILL NOT RESULT IN PIPE JOINT ANGULAR ROTATION THAT EXCEEDS THE PIPE MANUFACTURER'S RECOMMENDATIONS.

4027-601

DATE 12-APR-10
TDC MATZEN
TDR CLEGG
LCT OLSON