SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers

www.speedie.net

# REPORT ON GEOTECHNICAL INVESTIGATION

Registered Professional Engineer (Civil)
CERTIFICATE NO.
14388
GREGG ALAN
CREASER
Date Signed 7/25/14
ARIZONA, U.S.A.
Expires 06/30/17

| | |
|---|---|
| **DESIGNATION:** | Skyline Regional Park - Phase I |
| **LOCATION:** | Watson Road and McDowell Road<br>Buckeye, Arizona |
| **CLIENT:** | Kimley-Horn and Associates, Inc. |
| **PROJECT NO:** | 130624SA |
| **DATE:** | July 25, 2014 |

3331 East Wood Street ▪ Phoenix, AZ 85040 ▪ Phone (602) 997-6391 ▪ Fax (602) 943-5508
4025 East Huntington Drive, Suite 140 ▪ Flagstaff, AZ 86004 ▪ Phone (928) 526-6681 ▪ Fax (928) 526-6685
3125 E. 47th Street ▪ Tucson, AZ 85713 ▪ Phone (520) 514-9411 ▪ Fax (520) 514-9474

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers

## TABLE OF CONTENTS


**1.0 INTRODUCTION ..... 1**

**2.0 GENERAL SITE AND SOIL CONDITIONS ..... 2**

2.1 Site Conditions ..... 2
2.2 Geological Conditions ..... 2
2.3 Seismic Design Parameters ..... 2
2.4 General Subsurface Conditions ..... 3

**3.0 ANALYSIS AND RECOMMENDATIONS ..... 4**

3.1 Analysis ..... 4
3.2 Site Preparation ..... 6
3.3 Excavation And Temporary Cut Slopes ..... 7
3.4 Foundation Design ..... 8
3.5 Lateral Pressures ..... 9
3.6 Pavement Design Criteria ..... 9
3.7 New Pavement Design ..... 11
3.8 Fill and Backfill ..... 14
3.9 Corrosive Test Data ..... 15
3.10 Septic Percolation Testing ..... 15
3.11 Pavement Section Pricing ..... 16

**4.0 GENERAL ..... 17**

**APPENDIX – Field and Laboratory Data**


Registered Professional Engineer (Civil)
CERTIFICATE NO.
14388
GREGG ALAN
CREASER
Date Signed 7/25/14
ARIZONA, U.S.A.
Expires 06/30/17

# 1.0 INTRODUCTION

This report presents the results of a geotechnical subsoil investigation for the Phase 1 design and construction of Skyline Regional Park. The investigation focused on the extension of Watson Road from approximately McDowell Road, north into the proposed Skyline Regional Park, located in Buckeye Arizona.

We understand that the construction will consist of the extension of Watson Road from about McDowell Road, north into the Skyline Park entrance, approximately 4,000 feet. The project will require the installation of several culverts at wash crossings and will include a new Park Loop Road and minimal park amenities, including a pedestrian bridge at the north end of the park. The Park Loop Road will be about 1 mile long and will lead to the east and northwest sides of the park area. The Watson Road extension portion of the project partially follows a currently existing dirt trail serving as an access road for off-road recreation. The project may also include small park entry kiosk type buildings or structures, restroom facilities using a septic system, parking lots for trailheads and camp grounds. No new underground utilities are anticipated at this point.

Due to this being a new roadway and facility no traffic data is available. It is anticipated that the road will act as either a low volume collector or local road and will see light to moderate passenger traffic and occasional truck traffic. Passenger traffic may include cars or trucks pulling horse trailers and campers. The preliminary plans for the main roadway call for using an asphalt surface with gravel shoulders, although lighter duty pavement areas or parking areas may consist of an unpaved surface.

This assessment was limited to visual observation of the current site conditions, a limited number of soil borings, and laboratory testing of selected samples. A site plan providing the approximate location of the borings, the laboratory testing, which included sieve analysis, Atterberg limits, standard proctor, and R-value, are attached in the Appendix of this report. The recommendations presented in this report will provide a minimum 20 year pavement life with routine maintenance. Unpaved surfaces will require additional maintenance. The ultimate design is based on the 1993 AASHTO Guide for design of pavements, the ADOT Materials Preliminary Engineering and Design Manual (MPED), Town of Buckeye Pavement Design Manual, and limited assumptions regarding the anticipated traffic volumes.

# 2.0 GENERAL SITE AND SOIL CONDITIONS

## 2.1 Site Conditions

The project is located to the north of the intersection of Watson Road and McDowell Road in Buckeye, Arizona. Included in this project will be the extension of Watson Road to the north to the proposed Skyline Park. The surrounding areas primarily consist of undeveloped desert land with the White Tank Mountains to the west. At the southern portion of the project there are a few small residential properties. The alignment of the road traverses generally rugged desert terrain with numerous small to large washes, areas of rock outcrops, and dirt off-road vehicle trails. The terrain generally slopes down to the southeast, away from the White Tank Mountains. Other than sediment deposits within the wash, minimal disturbance of the native soils was observed. There were no obvious signs of fill within the project limit. The area generally consisted of a moderate to dense covering of desert plants, weeds, and grass.

## 2.2 Geological Conditions

The site is **located well outside known areas** that have undergone considerable subsidence due to groundwater removal. Areas of subsidence are known to produce earth fissuring, which has affected areas within several miles of the site. Subsidence is a basin wide phenomenon that would result in differential elevation changes over long distances, which would not affect the type of structures proposed for this site. No evidence of earth fissures was observed on the site. Fissure gullies form over subsurface irregularities such as bedrock highs, which cause tensional stresses and differential subsidence. Where such anomalies are not present, subsidence tends to be uniform over a wide area, this having minimal effect on surficial structures. The closest known active earth fissures are located near Luke Air Force Base many miles northeast from this site.

## 2.3 Seismic Design Parameters

The project area is located in a seismic zone that is considered to have low historical seismicity. The seismicity of the Phoenix area has had only two magnitude 3.0 events in over 100 years. Liquefaction is not considered a concern as groundwater exceeds 15 meters below ground surface.

Although borings were not advanced to 100 feet, based on the nature of the subsoils encountered in the borings and geology in the area, Site Class Definition, Class D may be used for design of the structures. In addition, the following seismic parameters may be used for design (based on 2008 USGS maps adopted by 2012 IBC):

**Table 2.3.1 Seismic Parameters**

| | |
|---|---|
| MCE[1] spectral response acceleration for 0.2 second period, $S_S$: | 0.157g |
| MCE[1] spectral response acceleration for 1.0 second period, $S_1$: | 0.053g |
| Site coefficient, Fa: | 1.6 |
| Site coefficient, Fv: | 2.4 |
| MCE[1] spectral response acceleration adjusted for site class, $S_{MS}$: | 0.251g |
| MCE[1] spectral response acceleration adjusted for site class, $S_{M1}$: | 0.128g |
| 5% Damped spectral response acceleration, $S_{DS:}$ | 0.167g |
| 5% Damped spectral response acceleration, $S_{D1:}$ | 0.085g |
| NOTE 1: MCE = maximum considered earthquake | |

## 2.4 General Subsurface Conditions

The field investigation for this project consisted of several different elements and field testing procedures due to the remote location and rugged terrain. This included soil borings using truck and track mounted drill rigs for the roadway and pedestrian bridge as well as test pits using a backhoe for the percolation tests and areas of the site that were inaccessible with standard drilling equipment. The following table presents the different equipment and procedures used to complete the field investigation.

| Field Procedure | Equipment Used | Boring/Test Pit Locations |
|---|---|---|
| Auger Borings | Truck Mounted Drill Rig | B-1 through B-9 |
| Auger Borings | Track Mounted Drill Rig | B-10, B-11 |
| Test Pit Excavations | Rubber Tired Backhoe | TP-1 through TP-4, P-1 through P-3 |

The subsoils at the test locations generally comprise of interbedded layers of silty sand and well graded sand with various amounts of gravel and occasional cobble to the termination depths of the borings at up to 28 feet below existing grades. Borings B-7 and B-10 encountered auger refusal on cobbles or in the case of Boring B-10, possible bedrock. The standard penetration resistance test (SPT) values range from 5 to 50+ blows per foot generally increasing with depth. No groundwater was encountered during this investigation. Based on visual and tactile observation, the soils were in a ‘dry’ state at the time of investigation. The upper soils within the test pits near the park area were generally observed to be loose, increasing in density with depth. Refer to the individual boring logs in the Appendix for additional information regarding the findings at each test location.

Laboratory testing generally confirms the soils consist primarily of non-plastic silty sandy soils with subordinate amounts of gravel. All but two of the samples tested indicated non-plastic conditions. The liquid limit of the other two samples ranged from 24 to 27 with a plasticity index on the order of 4 to 10. In-situ dry densities of the upper soils were on the order of 114 to 119 pcf and water contents on the order of 1 to 2 percent at the time of investigation. Moisture-density relations (proctor) indicate a maximum dry density of 130.1 at an optimum moisture content of 9.9 and a maximum dry density of 123.7 at an optimum moisture content of 11.9 percent for the native soils that have been re-compacted. The average amount of soil passing the #200 sieve ranges from 7 to 21 percent. Using Table 202.02-3 from the ADOT MPED results in correlated R-values that would range from 52 to 90 with an average correlated R-value of 78 and a subgrade modulus $M_r$ of greater than 26,000 psi. Laboratory testing of a sample of the finer silty soils at the south end of the project indicated a laboratory R-value of 81, similar to the calculated correlated R-values.

## 3.0 ANALYSIS AND RECOMMENDATIONS

### 3.1 Analysis

Analysis of the field and laboratory data indicates that subsoils at the site are generally favorable for the support of the proposed roadway improvements subject to some limitations. The new roadways may be constructed using asphalt concrete, chip seals, or an unpaved gravel surface depending on the location and loading conditions. The roadway sections will be designed to support moderate passenger traffic as well as light to moderate truck traffic.

The project will also contain several wash crossing structures and a pedestrian bridge. It is assumed that the wash crossing structures will consist of either pre-cast concrete box culverts or corrugated metal pipe (CMP). The pedestrian bridge will likely be placed on shallow spread footings.

The construction of the new roadway requires crossing at least one major drainage channel (wash). Maintaining free drainage flow across the site will be of great importance. Drainage ditches which are in-filled without proper diversion and/or sealing may continue to carry significant amounts of water. This water can cause problems including subgrade failure in structures placed in these zones. Therefore it is recommended to detail a culvert system which retains the natural flow in the area and incorporates the use of headwalls that will minimize erosion of the roadway system.

Based on preliminary plans, the new pedestrian bridge will use wing-walls and spread footings for support of the bridge. The borings within this area indicate variable soil conditions. Boring B-10, on the south side of the wash, contained relatively loose soils down to a depth of at least 5 feet below

existing grades. Boring B-11 on the north side of the wash contained very dense soils at the surface. The very dense soils observed within B-11 would be adequate for support of the structure on spread footings, however the loose conditions within B-10 may not be capable of supporting the necessary loads at shallow depths without additional site preparation. However, preliminary plans indicate that the abutment footings will be placed on the order of 6 to 9 feet below the existing grades, this will place the foundations into the dense to very dense silty sand with gravel or well graded sand, gravel, and cobble layers. These soils will provide sufficient load carrying capacity for the foundations without the need to over-excavate and re-compact. If loose zones are encountered it may be necessary to over-excavate down to dense soils and replace with lean concrete slurry or 1½ sack CLSM per M.A.G. Specification 728. The passive resistance pressure in front of the abutment may need to be reduced due to the steep slope leading to the bottom of the channel.

Ground water is not expected to be a factor in the design or construction of shallow foundations or structures. Excavation operations for structures will be variable depending on the location and depth of excavation. Deeper excavations or excavations within the northern portion of the project are likely to encounter dense layers of gravel, calcareous cementation and possible bedrock. This may make **excavation operations very difficult.** It should be noted that the fact that a boring was advanced to a particular depth should not lead to the assumption that it is necessarily excavatable by conventional means. **Very dense and/or rocky conditions may require more aggressive rock removal techniques**. The contractor should be responsible for determining what equipment will be required to make excavations.

For preliminary estimation of earthwork quantities, earthwork shrinkage is estimated to be on the order of 10 to 20 percent average, across the project limits. This value is based on limited in-situ densities obtained during this investigation. These values will be variable throughout the site due to the changes in the soils and terrain. The areas at the south end of the project generally contained more fine grained soils that will increase the shrinkage value. Where gravel, rock and cobble are encountered, the shrinkage value will be significantly lower.

If the project will include crushing of over-sized material for reuse in grading the average earthwork shrinkage will be closer to 0 to 5 percent. This site is predominately native desert with several washes running through the site. A ground compaction factor will be on the order of 0.5 feet which includes the loss resulting from stripping. Shrinkage values will vary throughout the site based on local in situ densities and disturbance of the upper soils.

It must be noted that all new asphalt pavements will eventually crack. Cracking in asphalt pavement is typical and should be expected over the life of the pavement. In fact, it has been our experience

of late that the new asphalt binders that are available, we are seeing the onset or earlier aging and cracking. These require routine maintenance to prevent accelerated deterioration. Accordingly, it is highly recommended to establish a maintenance program where the cracks are routinely filled as they appear beginning at about the second year of life. It is also recommended that surface fog seal coats be considered beginning at about year 5 and every 5 years after. This will help preserve the pavements, extending the service life.

In addition this project may include using an unpaved gravel surface. The designs presented in this report address providing a sufficient section for the anticipated loading, including possible emergency response vehicles. As a result a slightly thicker section will be recommended. It should be noted that an unpaved surface will require more frequent routine maintenance. The amount of maintenance required can be reduced by providing a stabilized surface and proper drainage off of the surface.

### 3.2 Site Preparation

The areas to be occupied by the proposed roadway construction or structures should be stripped of all vegetation, debris, rubble and obviously loose surface soils. Special attention must be paid to areas where depressions from natural stream channels (washes) appear to trend. In areas where loose channel fills occur, the loose material should be removed, generally to a depth of 1 to 2 feet, be re-placed and compacted. If new fill is to be placed, it should be placed in level lifts. Within the wash areas, level benches should be cut into the sides as the fill progresses, especially where undercut to remove trash and/or loose soils. As stated above it will be necessary to provide a diversion for storm water flows on any wash in-filled to prevent undercutting of levees, roadways and structures.

The silty fine sand soils may be sensitive to excessive moisture content and will become unstable at elevated moisture content. Accordingly, it may be necessary to compact soils on the dry side of optimum, especially in asphalt pavement areas. The reduced moisture content under slabs-on-grade should only be used upon approval of the engineer in the field.

The box culverts will be constructed within the bottom of the existing washes and channels. In these areas the loose soils should be removed as described above. The pedestrian bridge and any of the park ancillary structures (restroom building, signs, and equipment pads) will likely be located outside of the wash areas, where variable soil conditions have been encountered. The soils varied from being loose silty sands to encountering very dense gravel and cobble and possible bedrock layers. Given the fact that the depth to dense soils is relatively shallow in most locations and the majority of the structures (except the pedestrian bridge) are relatively light, the foundations may be placed directly on dense native soils.

However if loose zones are encountered it is recommended that the loose soils be removed and replaced with a low strength concrete slurry or 1½ sack CLSM per M.A.G. Specification 728.

A representative of the geotechnical engineer or qualified agency inspector should examine the subgrade once sub-excavation (if any) is complete and prior to placement of new foundations or aggregate base to ensure removal of deleterious materials and proper bearing conditions. If loose soils are discovered during the construction process, partial removal or deepening of the foundations may be required to uncover the dense to very dense soils. The fill placement and quality should be as defined in the "Fill and Backfill" section of this report. Attention must be paid to provide proper drainage to limit the potential for water infiltration of deeper soils.

Prior to placing structural fill or the aggregate base, the exposed grade should be scarified to a depth of 8 inches, moisture conditioned to optimum (±2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698.

### 3.3 Excavation And Temporary Cut Slopes

Care should be taken during excavation not to endanger nearby existing structures, roadways, utilities, etc. Depending on proximity, existing structures (including utilities) may require shoring, bracing or underpinning to provide structural stability and protect personnel working in the excavation.

All excavations must comply with current governmental regulations including the current OSHA Excavation and Trench Safety Standards. Side slopes for open-cut excavation should be cut back at 1½:1 (horizontal to vertical). Steeper slopes may be possible when examined by a responsible party that is capable of evaluating soil classifications for slope stability and the effects of traffic vibration. The slopes should be protected from erosion due to run-off or long-term surcharge at the slope crest. Construction equipment, building materials, excavated soil and vehicular traffic should not be allowed within 10 feet or one-third the slope height, whichever is greater, from the top of slope. The Soils Engineer and/or the contractor’s responsible party should observe all cut slopes during excavation. Adjustments to the recommended slopes may be necessary due to wet zones, loose strata and other conditions not observed in the borings. Localized shoring may also be required. Shotcrete or soil stabilizer on the slope face may be useful in preventing erosion due to run-off and/or drying of the slope. Depending on proximity, existing elements may require shoring, bracing or underpinning to provide structural stability and protect personnel working in the excavation.

### 3.4 Foundation Design

The following bearing capacities can be utilized for design of the box culverts, pedestrian bridge and any lightly loaded ancillary support structures at the park:

**Table 3.4.1 Foundation Bearing Capacities**

| Structure | Foundation Type | Foundation Depth | Bearing Medium | Bearing Capacity | Comments |
|---|---|---|---|---|---|
| Box Culverts | Spread | 5.0 ft. | Dense Native Soils | 1,500 psf | 1 |
| | Mat | 5.0 ft. | Dense Native Soils | k = 125 pci | |
| Support Structures | Spread | 2.0 ft. | Dense Native Soils | 1,500 psf | 2 |
| Pedestrian Bridge | Spread | 5.0 ft. | Dense Native Soils | 5,000 psf | 3 |

Comments:

1. The box culverts should be deepened such that they bear on the dense native soil less susceptible to water infiltration and potential hydro-consolidation at a minimum depth of 5 feet below existing grades. It is recommended that the culverts be founded on shallow spread footings or a structural mat bearing on undisturbed native soils at a minimum depth of **2 feet below scour depth** or 5 feet below existing grades, whichever is deeper. We assume that a scour analysis has been/will be performed by others and that cutoff walls/headwalls will be provided to prevent under-cutting.
2. Any lightly loaded support structures (screen walls, restroom buildings, equipment pads) should be placed on shallow spread footings at a minimum depth of 2 feet below existing grades or below lowest adjacent grade within 5 feet of the structure, whichever is deeper. Foundations should be bearing on dense undisturbed native soils. Loose soils should be over-excavated and removed.
3. Bridge foundations consisting of spread footings bearing on the dense to very dense native soils at a minimum depth of 5 feet below existing grades or lowest adjacent grade within 5 feet of the structure. If loose soils are encountered at the bottom of footing excavation the soils should be over-excavated and replaced with a lean concrete slurry or M.A.G. 1½ sack CLSM per section 728.

These bearing capacities refer to the total of all loads, dead and live, and are net pressures. They may be increased one-third for wind, seismic or other loads of short duration. These values may be increased by one-third as the allowable toe pressure for retaining walls. All footing excavations should be level and cleaned of all loose or disturbed materials. Positive drainage away from the proposed structures **must** be maintained at all times. A representative of the Geotechnical Engineer should examine the subgrade once the footing excavation is complete and prior to placing concrete to ensure the soils are dense. If loose soils still exist at this depth some over-excavation may be required.

Estimated settlements under design loads are on the order of ½ to 1-inch, virtually all of which will occur during construction. Post-construction differential settlements will be on the order of one-half the total settlement, under existing and compacted moisture contents. Additional localized settlements of the same magnitude could occur if native supporting soils were to experience a significant

increase in moisture content as a result of seepage under the culvert or under the foundations. **Positive drainage away from structures and controlled routing of roof runoff must be provided and maintained to prevent ponding adjacent to perimeter walls.** The backside of the abutment wall should be detailed to discharge any storm water runoff away from the bridge foundations.

### 3.5 Lateral Pressures

The following equivalent fluid lateral pressure values may be utilized for the proposed construction:

| | |
|---|---|
| Active Pressures | |
| Unrestrained Walls | 35 pcf |
| Restrained Walls | 60 pcf |
| Passive Pressures | |
| Continuous Footings | 350 pcf |
| Spread Footings or Drilled Piers | 400 pcf |
| Coefficient of Friction (w/ passive pressure) | 0.35 |
| Coefficient of Friction (w/out passive pressure) | 0.45 |

All backfill must be compacted to not less than 95 percent (ASTM D-698) to mobilize these passive values at low strain. Expansive soils should not be used as retaining wall backfill, except as a surface seal to limit infiltration of storm/irrigation water. The expansive pressures could greatly increase active pressures.

### 3.6 Pavement Design Criteria

The project consists of building a new roadway and park access, as a result detailed traffic data was unavailable for this project. It is assumed based on the location of the road, the surrounding properties that may use the road, and the fact that the road is not a through street, that this road would be classified as either a ‘major local road’ or a ‘collector’ by the Town of Buckeye. The southernmost section of Watson Road will likely see the majority of the traffic and will act more as a ‘collector’ while the pavements up around the new park will experience significantly less traffic, acting more as a ‘local road’ or ‘major local’.

The roadway will likely be subjected to moderate passenger traffic accessing the park area. This will include cars and trucks possibly hauling horse trailers, RVs and campers. At this time specific percentages and frequencies are not known. The analysis was completed for a 20 year design life. The data summary is as follows and is based on the assumption the road is classified as a ‘major local road’ or a

'collector' with an estimated traffic volume of approximately 2,500 ADTs, as provided by the Town of Buckeye:

**Watson Road/Park Loop Road Traffic Analysis**

| | |
|---|---|
| ADT (2 direction) | 2,500 |
| Growth Rate | 3% |
| Percentage Trucks | 6% |
| Traffic Split | 50/50 |
| Assume 1.0 18 kip ESALs/Truck: | |
| 20 -Year Life: | 735,000 ESALs (min) |
| | 100 daily ESALs (min) |

**Pavement Design Data**

| | | |
|---|---|---|
| Level of Reliability | | 95% |
| Serviceability: | $P_o$ | 5.0 |
| | Pt | 2.5 |
| Standard Error, $S_o$ | | 0.40 (AC) |

**Pavement Materials Structural Coefficients**

| | |
|---|---|
| Asphalt Concrete | 0.42 |
| Aggregate Base | 0.12 |

**Town of Buckeye Pavement Section Minimums**

| | AC | ABC |
|---|---|---|
| Collector | 6.0" | 10.0" |
| Major Local | 3.0" | 8.0" |
| Local | 2.5" | 8.0" |

Review of the gradation and plasticity data of the soils indicates that materials are predominantly silty sands with gravels and cobbles. The majority of the soils were observed to be non-plastic. The correlated R value ranges from 52 to 90. The laboratory tested R-value was on the order of 81 at 300 psi. The following Table presents the results of the R-value analysis based on examination of the subgrade samples assuming that the subgrade will be made up of the existing shallow native soils.

**Table 3.6.1 R-Value Analysis**

| R-Value Analysis | | | |
|---|---|---|---|
| | **No. of Samples** | **Average R-Value** | **Std. Dev.** |
| Correlated Values | 10 | 78 | 10.9 |
| Lab Values | 1 | 81 | - |

A Seasonal Variation Factor (SVF) of 1 was used for the calculation of the correlated R-values. Using the formulas from the ADOT MPED manual to calculate the design $R_{MEAN}$ and $M_R$ results in the following:

$R_{MEAN}$: 78
$M_R$: 26,000 psi (maximum recommended value)

The pavement designs presented in this report are based on these values. Based on the Town of Buckeye Pavement Design Manual, a minimum asphalt surface of 2.5 inches is required for the Local roadway classification.

### 3.7 New Pavement Design

If earthwork in paved areas is carried out to finish subgrade elevation as set forth herein, the subgrade will provide adequate support for pavements. The following table provides several different pavement sections for consideration. The section capacity is reported as daily ESALs, Equivalent 18 kip Single Axle Loads. Typical heavy trucks impart 1.0 to 2.5 ESALs per truck depending on load. It takes approximately 1,200 passenger cars to impart 1 ESAL. The designer/owner should choose the appropriate sections to meet the anticipated traffic volume, life expectancy, and agency requirements. Several of the sections provided may be less than the minimum requirements by Town of Buckeye. Given the anticipated usage of the roadway, low to moderate volume traffic, there may be a cost savings by going with a slightly thinner section of pavement. As stated, the main roadways will be designated as ‘local roads’ and ‘collectors’.

**Table 3.7.1 – Pavement Section Alternatives**

| Area of Placement | Daily 18-kip (ESALs) | Pavement Sections | | |
|---|---|---|---|---|
| | | Double Chip Seal | AC (0.42) | ABC (0.12) |
| Unpaved Surface(2) | 6 | - | - | 8.0” |
| | 15 | - | - | 10.0” |
| Chip Seal Surface(3) | 12 | 0.5” | - | 10.0” |
| | 28 | 0.5” | - | 12.0” |
| Local(5) | **84** | **-** | **2.5”** | **8.0”** |
| | 170 | - | 2.5” | 10.0” |
| Major Local(5) | 76 | - | 3.0” | 6.0” |
| | **156** | **-** | **3.0”** | **8.0”** |
| Collector(5) | 483 | - | 4.0” | 8.0” |
| | **5,186** | **-** | **6.0”** | **10.0”** |

Notes:
1. Designs are based on AASHTO design equations, ADOT correlated R-values, and tested R-values.
2. For the unpaved surface options, consideration should be given to completing the surface with 2 to 3 inches of decomposed granite stabilized with Soilshield-LS™ applied at a rate of at least 1 gallon per 80 square feet or other D.G. stabilizer. This will help protect the surface and reduce the amount of maintenance required. The surface should be maintained and/or repaired in the event of any damage.
3. Install a double chip seal per MAG Section 330 or local standards on top of the compacted aggregate base.
4. Estimated maximum daily ESALs for the main roadway access is anticipated to be on the order of 100.
5. Bolded sections represents the minimum pavement section for the given roadway classification.
6. Full depth asphalt or increased asphalt thickness can be increased by adding 1.0-inch asphalt for each 3 inches of base course replaced.

Given the intended use of the roadway and amount of anticipated traffic, the Collector section provided in the Buckeye pavement design guides would likely be excessive. The roadway will act more as a Local or Major Local and these pavement sections are more in line with the anticipated traffic.

These designs assume that all subgrades are prepared in accordance with the recommendations contained in the "Fill and Backfill" section of this report, and paving operations carried out in a proper manner. If pavement subgrade preparation is not carried out immediately prior to paving, the entire area should be proof-rolled at that time with a heavy pneumatic-tired roller to identify locally unstable areas for repair.

Pavement base course material should be aggregate base per M.A.G. Section 702 Specifications. Asphalt concrete materials and mix design should conform to M.A.G. 710 using a 3/4-inch or 1/2-inch Marshall Mix high volume designation based on final selected section and pavement lift thickness requirements. It is also recommended to use a PG 70-10 asphalt binder for this location with an estimated 5 percent binder content and 147 pcf unit weight.

Pavement installation should be carried out under applicable portions of M.A.G. Section 321 and local municipality standards. The asphalt supplier should be informed of the pavement use and required to provide a mix that will provide stability and be aesthetically acceptable. Some of the newer M.A.G. mixes are very coarse and could cause placing and finish problems. A mix design should be submitted for review to determine if it will be acceptable for the intended use. If there is a desire to provide some patterns or color to the asphalt surface, there are a number of different procedures available, including stamping and painting the asphalt surface to make it appear like red brick pavers. The City of Gilbert has a draft MAG specification for this type of work. See photo example.

For any unpaved roadway or parking lot surface, adequate drainage will be critical for long-term performance and will help reduce the amount of maintenance required. Special attention must be paid to proper crowning (crossfall) and/or longitudinal slope to prevent ponding on the roadway and adequate drainage provisions for the subgrade. A minimum cross slope of 2 percent is recommended for unpaved areas.

It may be possible to reduce the required aggregate base thickness in the chip seal and unpaved roadway sections by including geogrid, which will create a mechanically stabilized aggregate base. Products such as Tensar TX-5 or BX-1200 can often reduce the aggregate base section by several inches. However a minimum of 6 inches of aggregate base is recommended to maintain performance in the geogrid.

For sidewalks and other areas not subjective to vehicular traffic a 4-inch section of concrete will be sufficient. For pavement areas with anticipated vehicular automobile traffic, including parking areas, a minimum section of 5 inches of concrete on 4 inches aggregate base will provide adequate service.

Portland Cement Concrete Pavement (PCCP) for traffic areas must have a minimum 28-day flexural strength 550 psi (compressive strength of approximately 3,700 psi). It may be cast directly on the prepared subgrade with proper compaction (reduced) and the elevated moisture content as recommended in

the report. Lacking an aggregate base course, attention must be paid to using low slump concrete and proper curing, especially on the thinner sections. No reinforcing is necessary. Joint design and spacing should be in accordance with ACI recommendations. Construction joints should contain dowels or be tongue and grooved to provide load transfer. Tie bars are recommended on the joints adjacent to unsupported edges. Maximum joint spacing in feet should not exceed 2 to 3 times the thickness in inches. Joint sealing with a quality silicone sealer is recommended to prevent water from entering the subgrade allowing pumping and loss of support.

Proper subgrade preparation and joint sealing will reduce (but not eliminate) the potential for slab movements (thus cracking) on the expansive native soils. Frequent jointing will reduce uncontrolled cracking and increase the efficiency of aggregate interlock joint transfer.

### 3.8 Fill and Backfill

Native soils are considered suitable for use in general roadway grading fills provided material greater than 3 inches are screened and removed or there are sufficient fines to prevent nesting and voids. Large material should not be placed within 6 inches of finished grade to help prevent fine grading issues or an uneven surface for the new pavement. The silty fine sand soils may be sensitive to excessive moisture content and will become unstable at elevated moisture content. Accordingly, it may be necessary to compact soils on the dry side of optimum, especially in the asphalt pavement areas. The reduced moisture content should only be used upon approval of the engineer in the field.

If imported common fill for use in site grading is required, it should be examined by a Soils Engineer to ensure that it is of low swell potential and free of organic or otherwise deleterious material. In general, the fill should have 100 percent passing the 3-inch sieve and a combination of percent passing the 200 sieve and plasticity index that would result in a correlated R-value (per ADOT method) of equal to, or better than 70 in order to stay within the parameters used for the design of the roadways. It should exhibit less than 1.5 percent swell potential when compacted to 95 percent of maximum dry density (ASTM D-698) at a moisture content of 2 percent below optimum, confined under a 100 psf surcharge, and inundated.

Fill should be placed on subgrade, which has been properly prepared and approved by a Soils Engineer. Fill must be wetted and thoroughly mixed to achieve optimum moisture content, ±2 percent (optimum to +3 percent for under-slab fill). Fill should be placed in horizontal lifts of 8-inch thickness (or as dictated by compaction equipment) and compacted to the percent of maximum dry density per ASTM D-698 set forth as follows. M.A.G. Standard Specification as modified by the local agency will apply where more stringent.

| | | | |
|---|---|---|---|
| A. | Asphalt Pavement Subgrade or Fill | | 95 |
| B. | Dikes/Embankments | | 95 |
| C. | Aggregate Base Course | | |
| | 1. | Below exterior slabs | 95 |
| | 2. | Pavement Areas | 100 |
| D. | Utility Trench Backfill | | |
| | 1. | More than 2.0' below finish S/G | 95 |
| | 2. | Within 2.0' of finish S/G | 95 |
| E. | Sidewalks | | 95 |

### 3.9 Corrosive Test Data

Laboratory testing of the native soil concluded a pH of 7.8 to 8.1 and a laboratory minimum resistivity ranging from 1860 to 5570 ohm-cm. Chloride concentrations were on the order of 31 to 140 ppm. These results indicate a **low to severe degree** of corrosivity to direct buried metal. The laboratory resistivity test is conducted under a saturated condition. In the field, saturation of the soils should not be expected which would thereby increase the resistivity. Accordingly, suitable pipe wall thickness and corrosion protection should be selected per the lifetime requirements of the project. Sulfate concentrations were on the order of 4 to 6 ppm. This indicates a negligible degree for sulfate attack. Subsurface concrete should use Type I or II cement, which is readily available and used in the area. These results should be used to determine what, if any additional protection is required for any buried utility or structure.

### 3.10 Septic Percolation Testing

The project will include the installation of a restroom facility. Due to the site's remote location an on-site waste water septic system will likely be required. The final location for the septic field has not been determined. Based on discussions with the design team preliminary percolation testing was conducted at the pre-designated locations as shown on the Test Location Plan in the Appendix.

A total of three shallow percolation tests were performed in the areas surrounding the park, as shown on the Test Location Plan. The tests were setup in the bottom of 4 foot deep excavated test pits. At the bottom of the test pit a 15 inch diameter hole was excavated. Each of the test areas were initially allowed to pre-soak, however due to the rapid drainage rate the tests were run the same day. Following the typical test procedures the hole was left 'unlined', which allowed for water to penetrate both the sides and the bottom of the excavation. The soils at the test locations generally consisted of silty sands with gravel and

cobble. The following stabilized percolation rates were obtained with a 6 inch head of water. For detailed data and readings refer to the results in the Appendix.

**Table 3.10.1 Septic Percolation Results**

| Location | Stabilized Percolation Rate | |
|---|---|---|
| | Test Depth | minutes/inch |
| P-1 | 4.0’ | 1.1 |
| P-2 | 4.0’ | 3.3 |
| P-3 | 4.0’ | 2.2 |

Based on the soil classifications, these rates may deteriorate over time. Accordingly, a conservative factor of safety should be applied.

### 3.11 Pavement Section Pricing

Several different pavement methods and sections are provided in this report. In order to help in the selection process an economic analysis will likely be conducted to assess cost to construct each of the different sections. In addition to the economic analysis consideration will have to be given to the operation and maintenance costs of the roadways and parking lots. For example an unpaved surface will be less costly to install but will require more routine maintenance, especially after heavy rain events. To aid in the economic analysis the following table is provided from the Maricopa County DOT Roadway Design Manual.

**Table 3.11.1 MCDOT Prices for Pavement Materials**

| Prices for Pavement Materials | | | | | | |
|---|---|---|---|---|---|---|
| Item | Price Basis | | | | Unit Wt. (psf) | Factor (sy/in/ton) |
| | Cost ($/sy/in) | | Cost ($/ton) | | | |
| | low | high | low | high | | |
| Asphalt Concrete (½-in.) | $3.81 | $4.35 | $70.00 | $80.00 | 145 | 18.39 |
| Asphalt Concrete (¾-in.) | $3.81 | $4.35 | $70.00 | $80.00 | 145 | 18.39 |
| Asphalt Rubber Concrete (¾-in.) | $3.85 | $4.62 | $75.00 | $90.00 | 137 | 19.46 |
| Asphalt Rubber Concrete (½-in.) | $3.85 | $4.62 | $75.00 | $90.00 | 137 | 19.46 |
| Aggregate Base Course | $0.71 | $0.81 | $14.00 | $16.00 | 135 | 19.75 |
| Soil Cement Base (3-4% cement) | $0.50 | $0.70 | | | 130 | 20.51 |
| Lime Stabilized Subgrade (5% lime) | $0.35 | $0.40 | | | 125 | 21.33 |
| Asphalt Milling (1-in. to 3-in.) | $0.85 | $1.00 | $16.80 | $19.75 | 135 | 19.75 |
| Asphalt Milling (3-in. to 6-in.) | $1.00 | $1.35 | $19.75 | $26.70 | 135 | 19.75 |
| Asphalt Pulverizing (> 4-in.) | $0.50 | $0.50 | | | | |

# 4.0 GENERAL

The scope of this investigation and report includes only regional published considerations for seismic activity and ground fissures resulting from subsidence due to groundwater withdrawal, not any site specific studies. The scope does not include any considerations of hazardous releases or toxic contamination of any type.

Our analysis of data and the recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific sample locations. Our work has been performed in accordance with generally accepted engineering principles and practice; this warranty is in lieu of all other warranties expressed or implied.

We recommend that a representative of the Geotechnical Engineer observe and test the earthwork and paving portions of this project to ensure compliance to project specifications and the field applicability of subsurface conditions which are the basis of the recommendations presented in this report. If any significant changes are made in the scope of work or type of construction that was assumed in this report, we must review such revised conditions to confirm our findings if the conclusions and recommendations presented herein are to apply.

Respectfully submitted,
SPEEDIE & ASSOCIATES, INC.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
43813
TODD B.
HANKE
Date Signed 7/25/14
ARIZONA, U.S.A.
Expires 03/31/15

Todd B. Hanke, P.E.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
14388
GREGG ALAN
CREASER
Date Signed 7/25/14
ARIZONA, U.S.A.
Expires 06/30/17

Gregg A. Creaser, P.E.

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers

# APPENDIX

FIELD AND LABORATORY INVESTIGATION

PROJECT LOCATION PLAN

SOIL LEGEND

LOG OF TEST BORINGS

LOG OF TEST PITS

TABULATION OF TEST DATA

CONSOLIDATION TEST DATA

MOISTURE DENSITY RELATIONS

CORROSIVE TEST DATA

R-VALUE

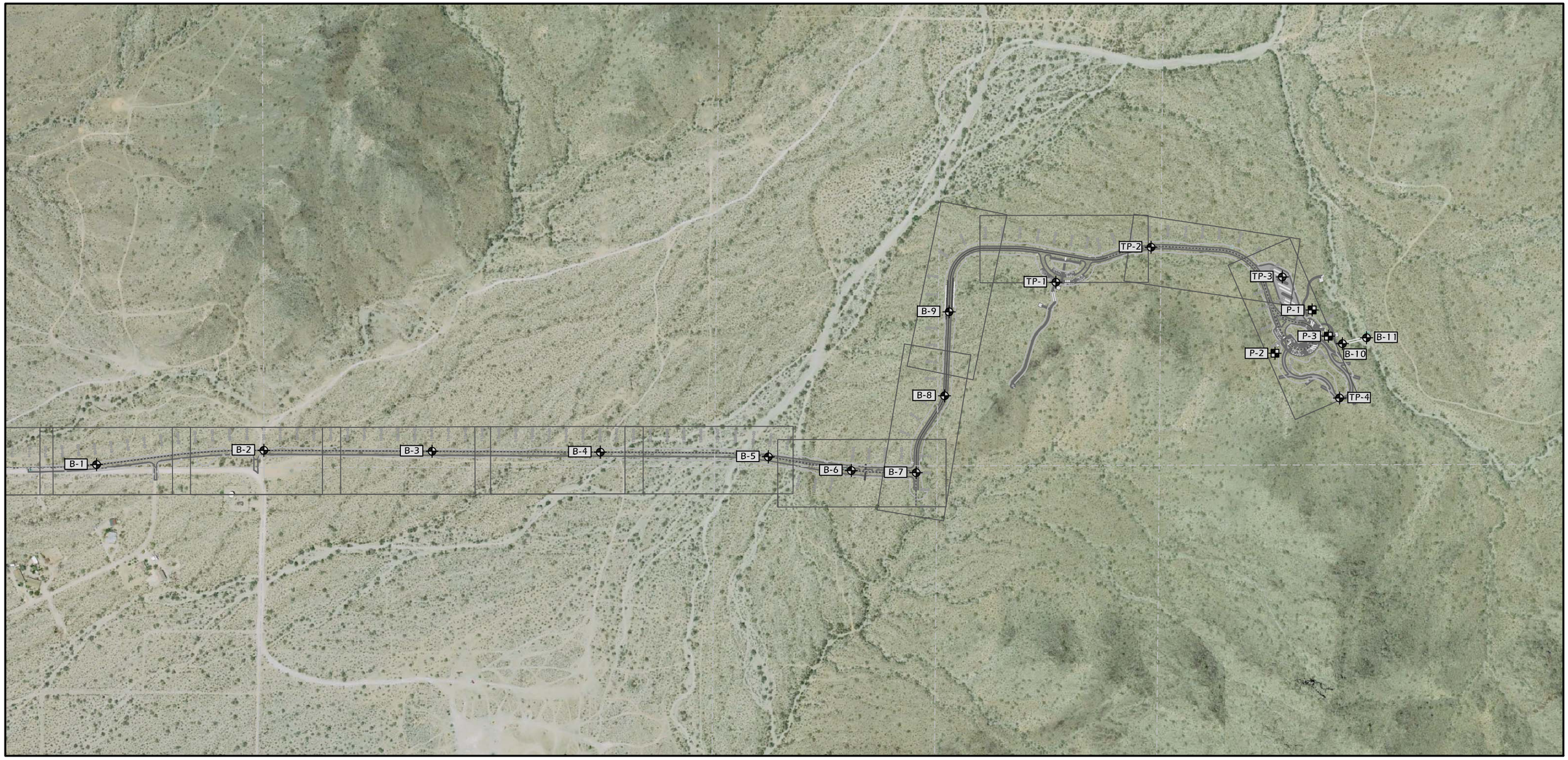
PERCOLATION TEST FIELD DATA

BORING COORDINATES

## FIELD AND LABORATORY INVESTIGATION

Between May 27, 2014 and July 1, 2014 a geotechnical field investigation was conducted for this project. The investigation consisted of a combination of auger borings and test pit excavations. The approximate locations are shown on the attached Project Location Plan. All exploration work was carried out under the full-time supervision of our staff engineer, who recorded subsurface conditions and obtained samples for laboratory testing. The soil borings were advanced with both a truck-mounted CME-75 drill rig and a track-mounted CME-75 drill rig utilizing 7-inch diameter hollow stem flight augers. The test pits were excavated using a rubber tired backhoe utilizing a 24 inch bucket. Detailed information regarding the borings, test pits and samples obtained can be found on an individual Log of Test Boring prepared for each drilling location. In addition three percolation tests were conducted to aid in the design of the onsite septic system.

Laboratory testing consisted of moisture content, dry density, grain-size distribution, plasticity (Atterberg Limits), and R-value tests for classification and pavement design parameters. Compression tests were performed on a selected ring sample in order to estimate settlements and determine effects of inundation. All field and laboratory data is presented in this appendix.




- APPROXIMATE SOIL BORING / TEST PIT LOCATIONS

- APPROXIMATE PERCOLATION TEST LOCATIONS

N

0' 200' 500' 1000'
SCALE

IMAGE COURTESY OF: MARICOPA COUNTY ASSESSOR

# PROJECT LOCATION PLAN

| SHEET: 1 OF 1 | DR: TSW | CHK: XXX | REV: XXX | DATE: 07/03/2014 | PROJECT NO. 130624SA |
|---|---|---|---|---|---|

SKYLINE REGIONAL PARK PHASE I
WATSON ROAD & MCDOWELL ROAD
BUCKEYE, ARIZONA

SPEEDIE AND ASSOCIATES
GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS
3331 E. WOOD ST. PHOENIX, ARIZONA 85040 (602) 997-6391

# SOIL LEGEND

| SAMPLE DESIGNATION | | DESCRIPTION | |
|---|---|---|---|
| | AS | **Auger Sample** | A grab sample taken directly from auger flights. |
| | BS | **Large Bulk Sample** | A grab sample taken from auger spoils or from bucket of backhoe. |
| | S | **Spoon Sample** | Standard Penetration Test (ASTM D-1586) Driving a 2.0 inch outside diameter split spoon sampler into undisturbed soil for three successive 6-inch increments by means of a 140 lb. weight free falling through a distance of 30 inches. The cumulative number of blows for the final 12 inches of penetration is the Standard Penetration Resistance. |
| | RS | **Ring Sample** | Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42-inch inside diameter, 1-inch long brass rings, into undisturbed soil for one 12-inch increment by the same means of the Spoon Sample. The blows required for the 12 inches of penetration are recorded. |
| | LS | **Liner Sample** | Standard Penetration Test driving a 2.0-inch outside diameter split spoon equipped with two 3-inch long, 3/8-inch inside diameter brass liners, separated by a 1-inch long spacer, into undisturbed soil by the same means of the Spoon Sample. |
| | ST | **Shelby Tube** | A 3.0-inch outside diameter thin-walled tube continuously pushed into the undisturbed soil by a rapid motion, without impact or twisting (ASTM D-1587). |
| | -- | **Continuous Penetration Resistance** | Driving a 2.0-inch outside diameter "Bullnose Penetrometer" continuously into undisturbed soil by the same means of the spoon sample. The blows for each successive 12-inch increment are recorded. |

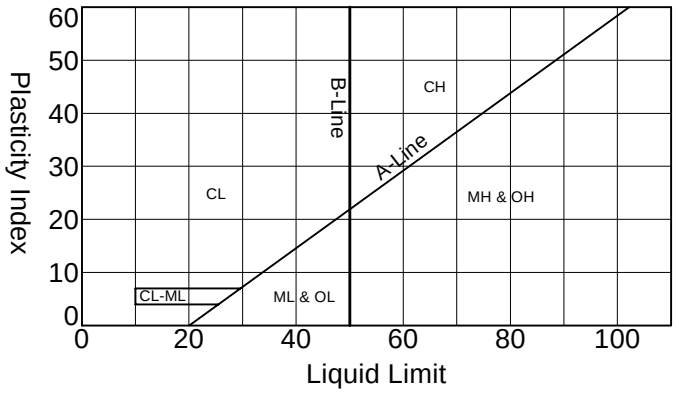
| CONSISTENCY | | | RELATIVE DENSITY | |
|---|---|---|---|---|
| Clays & Silts | Blows/Foot | Strength (tons/sq ft) | Sands & Gravels | Blows/Foot |
| Very Soft | 0 - 2 | 0 - 0.25 | Very Loose | 0 - 4 |
| Soft | 2 - 4 | 0.25 - 0.5 | Loose | 5 - 10 |
| Firm | 5 - 8 | 0.5 - 1.0 | Medium Dense | 11 - 30 |
| Stiff | 9 - 15 | 1 - 2 | Dense | 31 - 50 |
| Very Stiff | 16 - 30 | 2 - 4 | Very Dense | > 50 |
| Hard | > 30 | > 4 | | |

| MAJOR DIVISIONS | | | SYMBOLS GRAPH | SYMBOLS LETTER | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS<br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS<br>(LITTLE OR NO FINES) | | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | | | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | GRAVELS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) | | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | | | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| | SAND AND SANDY SOILS<br>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | CLEAN SANDS<br>(LITTLE OR NO FINES) | | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | | | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | | SANDS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) | | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | | | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 | | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | | | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | | | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

NOTE: DUAL OR MODIFIED SYMBOLS MAY BE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS OR TO PROVIDE A BETTER GRAPHICAL PRESENTATION OF THE SOIL

| MATERIAL SIZE | PARTICLE SIZE Lower Limit mm | Lower Limit Sieve Size ◆ | Upper Limit mm | Upper Limit Sieve Size ◆ |
|---|---|---|---|---|
| SANDS | | | | |
| Fine | 0.075 | #200 | 0.42 | #40 |
| Medium | 0.420 | #40 | 2.00 | #10 |
| Coarse | 2.000 | #10 | 4.75 | #4 |
| GRAVELS | | | | |
| Fine | 4.75 | #4 | 19 | 0.75" × |
| Coarse | 19 | 0.75" × | 75 | 3" × |
| COBBLES | 75 | 3" × | 300 | 12" × |
| BOULDERS | 300 | 12" × | 900 | 36" × |

◆U.S. Standard ×Clear Square Openings



Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Loose Light Brown SILTY SAND (SM-Dry) with Some Gravel | S-1 | 2.5 | NT | NT | |
| | | BS-2 | 5.0 | NT | NT | |
| 5 | Dense | S-3 | 6.5 | NT | NT | |
| 10 | Very Dense | S-4 | 10.6 | NT | NT | 50/1" |
| | End of Boring (10.6) | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **6-2-14**
Field Engineer/Technician: **K. Euge II**
Driller: **R. Quezada**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 1**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Medium Dense Light Brown SILTY SAND (SM-Dry) with Little Gravel | S-1 | 2.5 | NT | NT | |
| | | BS-2 | 5.0 | NT | NT | |
| 5 | Very Dense, Some Gravel | S-3 | 5.4 | NT | NT | 50/5" |
| 10 | Dense | | | | | |
| 11.5 | End of Boring | S-4 | 11.5 | NT | NT | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **6-2-14**
Field Engineer/Technician: **K. Euge II**
Driller: **R. Quezada**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 2**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/26/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Medium Dense Light Brown WELL GRADED SAND with SILT (SW/SM-Dry) with Some Gravel | S-1 | 2.5 | NT | NT | |
| | | BS-2 | 5.0 | NT | NT | |
| 5 | Very Dense, Weak Calcareous Cementation, Occasional Cobble | S-3 | 6.0 | NT | NT | 50/6" |
| 10 | Dense | | | | | |
| 11.5 | | S-4 | 11.5 | NT | NT | |
| | End of Boring | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **5-27-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **T. Crain**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 3**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Medium Dense Light Brown WELL GRADED SAND with SILT (SW/SM-Dry) with Some Gravel, 1-10% Cobble | RS-1 | 2.0 | NT | NT | |
| 5 | Very Dense, Weak Calcareous Cementation | S-2 | 6.5 | NT | NT | 54/12" |
| 10 | | S-3 | 11.5 | NT | NT | 51/12" |
| 11.5 | End of Boring | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **5-27-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **T. Crain**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| ***Free Water was Not Encountered*** | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 4**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Medium Dense Brown WELL GRADED SAND with SILT (SW/SM-Dry) with Gravel, 1-10% Cobble | RS-1 | 2.0 | NT | NT | |
| 5 | | S-2 | 6.5 | NT | NT | |
| | | BS-3 | 10.0 | NT | NT | |
| 10 | Very Dense | S-4 | 11.5 | NT | NT | 55/12" |
| 15 | Medium Dense | S-5 | 16.5 | NT | NT | |
| 20 | Very Dense | S-6 | 21.5 | NT | NT | 50/12" |
| 21.5 | End of Boring | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **5-27-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **T. Crain**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 5**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Very Dense Reddish Brown WELL GRADED SAND with SILT (SW/SM-Dry) with Gravel, 1-10% Cobble | RS-1 | 2.0 | NT | NT | 56/12" |
| 4.0 | | | | | | |
| 5 | Very Dense Gray WELL GRADED SAND (SW-Dry) with Gravel | S-2 | 5.5 | NT | NT | 50/6" |
| 10 | | S-3 | 10.6 | NT | NT | 50/1" |
| 10.6 | End of Boring | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **5-27-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **T. Crain**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 6**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/26/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Very Dense Brown SILTY SAND (SM-Dry) with Some Gravel | S-1 | 2.5 | NT | NT | 51/12" |
| 4.0 | Very Dense Gray WELL GRADED GRAVEL with SAND (GW-Dry) with 5-15% Cobble | BS-2 | 5.0 | NT | NT | |
| 5 | | S-3 | 6.5 | NT | NT | 79/12" |
| 9.0 | Auger Refusal on Cobbles | | | | | |
| 10 | | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **5-27-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **T. Crain**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 7**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Medium Dense Brown CLAYEY SAND (SC-Dry) with Little Gravel | RS-1 | 2.0 | NT | NT | |
| 3.0 | Loose Brown WELL GRADED SAND with SILT (SW/SM-Dry) with Gravel | | | | | |
| 5 | | S-2 | 6.5 | NT | NT | |
| 10 | Very Dense | S-3 | 10.4 | NT | NT | 50/5" |
| 10.4 | End of Boring | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **5-27-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **T. Crain**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 8**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/26/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Medium Dense Brown WELL GRADED SAND with SILT (SW/SM-Dry) with Gravel, 5-15% Cobble | S-1 | 2.5 | NT | NT | |
| 5 | Very Dense | S-2 | 5.5 | NT | NT | 50/6" |
| 10 | | S-3 | 11.5 | NT | NT | 50/12" |
| 11.5 | End of Boring | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **5-27-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **T. Crain**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B- 9**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

_SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Loose Brown SILTY SAND (SM-Dry) with Little Gravel, 1-10% Cobbles | S-1 | 2.5 | NT | NT | |
| 3.0 | Medium Dense Light Brown SILTY GRAVEL with SAND (GM-Dry) with 1-10% Cobble | BS-2 | 5.0 | NT | NT | |
| 5 | | RS-3 | 6.0 | 1.5 | 117.8 | |
| 9.0 | Medium Dense Brownish Grey WELL GRADED SAND with GRAVEL (SW-Dry) with Little Silt | S-4 | 11.5 | NT | NT | |
| 10 | | | | | | |
| 14.0 | Very Dense Brownish Grey SILTY SAND (SM-Dry) with Gravel (Possible Weathered Bedrock) | RS-5 | 16.0 | 2.2 | 114.5 | 69/12" |
| 15 | | | | | | |
| 20 | | | | | | |
| 21.0 | Very Dense Bownish Grey WELL GRADE GRAVEL with SAND (GW-Dry) with Weak Calcareous Cementation & 5-15% Cobble (Possible Weathered Bedrock) | S-6 | 21.0 | NT | NT | 50/6" |
| 25 | | S-7 | 25.3 | NT | NT | 50/3" |
| 28.0 | Auger Refusal on Cobbles or Possible Bedrock | | | | | |
| 30 | | | | | | |

Boring Date: **7-1-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **G. Midkiff**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| ***Free Water was Not Encountered*** | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B-10**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

| Depth (feet) | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|
| 0 | Dense Light Brown SILTY, CLAYEY SAND (SC/SM-Dry) with Little Gravel | RS-1 | 2.0 | 1.8 | 118.7 | |
| 3.5 | Very Dense Light Brown SILTY SAND with GRAVEL (SM-Dry) with 5-15% Cobble | S-2 | 5.3 | NT | NT | 50/4" |
| 5 | | | | | | |
| 10 | | S-3 | 11.3 | NT | NT | 72/10" |
| 12.0 | Dense Brownish Grey SILTY GRAVEL with SAND (GM-Dry) with 10-20% Cobble | | | | | |
| 15 | | S-4 | 16.5 | NT | NT | |
| 20 | Very Dense | S-5 | 20.5 | NT | NT | 50/6" |
| 20.5 | End of Boring | | | | | |
| 25 | | | | | | |
| 30 | | | | | | |

Boring Date: **7-1-14**
Field Engineer/Technician: **T. Wilmsen**
Driller: **G. Midkiff**
Contractor: **Geomechanics SW**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Boring Number: **B-11**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

SPEEDIE 130624SA.GPJ GENGEO.GDT 7/25/14

Equipment Type: **Backhoe**
**Excavation**

Surface Elevation: **N/A**

| Depth (feet) | Graphic Log | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|---|
| 0 | | Loose Brown WELL GRADED GRAVEL with SILT (GW-Dry) with 10-20% Cobble | | | | | |
| 3.0 | | Loose Brown SILTY SAND with GRAVEL (SW-Dry) | | | | | |
| 5 | | End of Test Pit (5.0) | | | | | |

Excavation Date: **6-18-14**
Field Engineer/Technician: **T. Wilmsen**
Excavator: **C. Litmer**
Contractor: **Diggin' Dog**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **P-1**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

TEST PIT 130624SA.GPJ GENGEO.GDT 7/25/14

Equipment Type: **Backhoe**
**Excavation**
Surface Elevation: **N/A**

| Depth (feet) | Graphic Log | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|---|
| 0 | | Loose Brown WELL GRADED GRAVEL with SILT (GW-Dry) with 10-20% Cobble | | | | | |
| 3.0 | | Loose Brown SILTY SAND with GRAVEL (SW-Dry) | | | | | |
| 5 | | 5.0 End of Test Pit | | | | | |

Excavation Date: **6-18-14**
Field Engineer/Technician: **T. Wilmsen**
Excavator: **C. Litmer**
Contractor: **Diggin' Dog**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **P-2**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

TEST PIT 130624SA.GPJ GENGEO.GDT 7/25/14

Equipment Type: **Backhoe Excavation**

Surface Elevation: **N/A**

| Depth (feet) | Graphic Log | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|---|
| 0 | | Loose Brown WELL GRADED GRAVEL with SILT (GW-Dry) with 10-20% Cobble | | | | | |
| 3.0 | | Loose Brown SILTY SAND with GRAVEL (SW-Dry) | | | | | |
| 5 | | 5.0 End of Test Pit | | | | | |

Excavation Date: **6-18-14**

Field Engineer/Technician: **T. Wilmsen**

Excavator: **C. Litmer**

Contractor: **Diggin' Dog**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **P-3**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

TEST PIT 130624SA.GPJ GENGEO.GDT 7/25/14

Equipment Type: **Backhoe**
**Excavation**
Surface Elevation: **N/A**

| Depth (feet) | Graphic Log | Visual Classification | | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|---|---|
| 0 | | Medium Dense Brown SILTY SAND (SM-Dry) with Gravel, 5-15% Cobble | | | | | | |
| | | | 5.0 | BS-1 | 5.0 | NT | NT | |
| 5 | | End of Test Pit | | | | | | |

Excavation Date: **6-18-14**
Field Engineer/Technician: **T. Wilmsen**
Excavator: **C. Litmer**
Contractor: **Diggin' Dog**

Water Level

| Depth | Hour | Date |
|---|---|---|
| ***Free Water was Not Encountered*** | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-1**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

TEST PIT 130624SA.GPJ GENGEO.GDT 7/25/14

Equipment Type: **Backhoe Excavation**

Surface Elevation: **N/A**

| Depth (feet) | Graphic Log | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|---|
| 0 | | Medium Dense Brown SILTY SAND (SM-Dry) with Gravel, 10-20% Cobble | | | | | |
| 3.5 | | Medium Dense Brown SILTY SAND (SM-Dry) with Some Gravel & 5-15% Cobble | | | | | |
| 5 | | | | | | | |
| 6.0 | | End of Test Pit | | | | | |

Excavation Date: **6-18-14**

Field Engineer/Technician: **T. Wilmsen**

Excavator: **C. Litmer**

Contractor: **Diggin' Dog**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-2**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

TEST PIT 130624SA.GPJ GENGEO.GDT 7/25/14

Equipment Type: **Backhoe Excavation**

Surface Elevation: **N/A**

| Depth (feet) | Graphic Log | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|---|
| 0 | | Loose Brown SILTY SAND (SM-Dry) with Gravel, 15-30% Cobble | | | | | |
| | | 5.0 | BS-1 | 5.0 | NT | NT | |
| 5 | | End of Test Pit | | | | | |

Excavation Date: **6-18-14**

Field Engineer/Technician: **T. Wilmsen**

Excavator: **C. Litmer**

Contractor: **Diggin' Dog**

Water Level

| Depth | Hour | Date |
|---|---|---|
| ***Free Water was Not Encountered*** | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-3**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

TEST PIT 130624SA.GPJ GENGEO.GDT 7/25/14

Equipment Type: **Backhoe**
**Excavation**

Surface Elevation: **N/A**

| Depth (feet) | Graphic Log | Visual Classification | Sample Number | Depth of Sample | Natural Water Content (%) | In-place Dry Density (P.C.F.) | Penetration Resistance Blows per Foot (0 – 25 – 50) |
|---|---|---|---|---|---|---|---|
| 0 | | Loose Brown SILTY GRAVEL with SAND (GM-Dry) with 15-30% Cobble | | | | | |
| 5 | | End of Test Pit (5.0) | | | | | |

Excavation Date: **6-18-14**
Field Engineer/Technician: **T. Wilmsen**
Excavator: **C. Litmer**
Contractor: **Diggin' Dog**

Water Level

| Depth | Hour | Date |
|---|---|---|
| *Free Water was Not Encountered* | | |
| | | |

NT = Not Tested

**SPEEDIE AND ASSOCIATES**

Log of Test Pit Number: **TP-4**

**Skyline Regional Park Phase I**

**Watson Road & McDowell Road**

**Buckeye, Arizona**

Project No.: **130624SA**

TEST PIT 130624SA.GPJ GENGEO.GDT 7/25/14

# TABULATION OF TEST DATA

| SOIL BORING or TEST PIT NUMBER | SAMPLE NUMBER | SAMPLE TYPE | SAMPLE INTERVAL (ft) | NATURAL WATER CONTENT (Percent of Dry Weight) | IN-PLACE DRY DENSITY (Pounds Per Cubic Foot) | PARTICLE SIZE DISTRIBUTION (Percent Finer) | | | | | ATTERBERG LIMITS | | | UNIFIED SOIL CLASSIFICATION | SPECIMEN DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | #200 SIEVE | #40 SIEVE | #10 SIEVE | #4 SIEVE | 3" SIEVE | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | | |
| B- 1 | BS-2 | BULK | 0.0 - 5.0 | NT | NT | 15 | 36 | 72 | 87 | 100 | NP | NP | NP | SM | SILTY SAND |
| B- 3 | BS-2 | BULK | 0.0 - 5.0 | NT | NT | 10 | 31 | 72 | 85 | 100 | NP | NP | NP | SW-SM | WELL-GRADED SAND with SILT and GRAVEL |
| B- 5 | RS-1 | RING | 1.0 - 2.0 | NT | NT | 7 | 21 | 49 | 63 | 100 | NP | NP | NP | SW-SM | WELL-GRADED SAND with SILT and GRAVEL |
| B- 7 | BS-2 | BULK | 0.0 - 5.0 | NT | NT | 18 | 39 | 67 | 79 | 100 | NP | NP | NP | SM | SILTY SAND with GRAVEL |
| B- 8 | RS-1 | RING | 1.0 - 2.0 | NT | NT | 19 | 38 | 79 | 95 | 100 | 27 | 17 | 10 | SC | CLAYEY SAND |
| B-10 | BS-2 | BULK | 0.0 - 5.0 | NT | NT | 21 | 43 | 73 | 85 | 100 | NP | NP | NP | SM | SILTY SAND |
| B-10 | RS-3 | RING | 5.0 - 6.0 | 1.5 | 117.8 | NT | NT | NT | NT | NT | NT | NT | NT | | |
| B-10 | RS-5 | RING | 15.0 - 16.0 | 2.2 | 114.5 | 13 | 40 | 74 | 84 | 100 | NP | NP | NP | SM | SILTY SAND with GRAVEL |
| B-11 | RS-1 | RING | 1.0 - 2.0 | 1.8 | 118.7 | 14 | 33 | 67 | 84 | 100 | 24 | 20 | 4 | SC-SM | SILTY, CLAYEY SAND with GRAVEL |
| TP-1 | BS-1 | BULK | 0.0 - 5.0 | NT | NT | 13 | 29 | 52 | 61 | 100 | NP | NP | NP | SM | SILTY SAND with GRAVEL |
| TP-3 | BS-1 | BULK | 0.0 - 5.0 | NT | NT | 20 | 38 | 63 | 74 | 100 | NP | NP | NP | SM | SILTY SAND with GRAVEL |

**Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.**

**NT=Not Tested**

Sheet 1 of 1

Skyline Regional Park Phase I
Watson Road & McDowell Road
Buckeye, Arizona
Project No. 130624SA

SPEEDIE AND ASSOCIATES

# CONSOLIDATION TEST

PROJECT: Skyline Regional Park Phase I

PROJECT NO.: 130624SA

LOCATION: Watson Road & McDowell Road

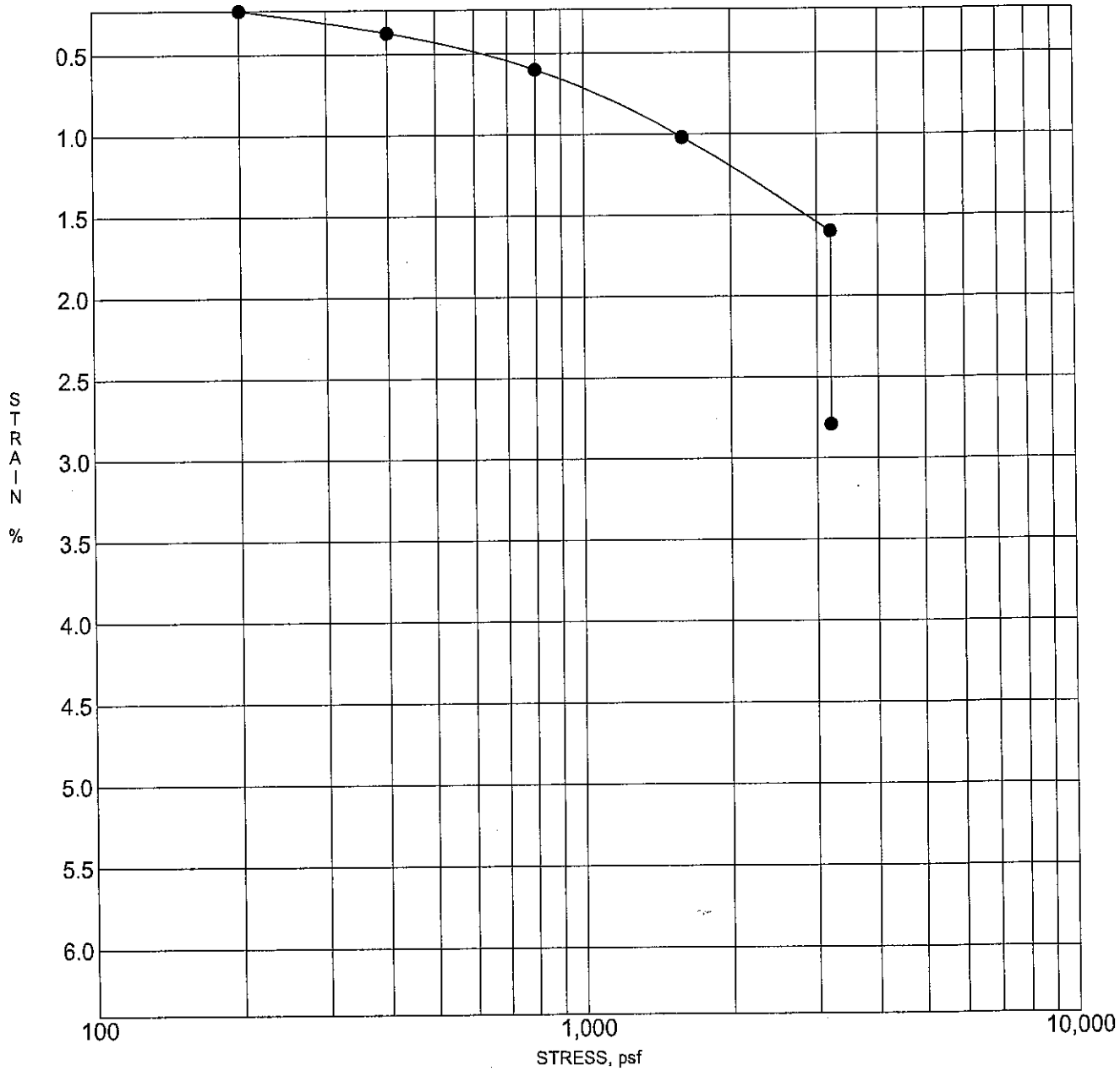
DATE: 7/1/14

BORING NO.: B-10 SAMPLE NO.: RS-3 SAMPLE DEPTH: 5 to 6

LABORATORY NO.:

LIQUID LIMIT: PLASTIC LIMIT: PLASTICITY INDEX:

CLASSIFICATION: ASTM SOIL DESCRIPTION:




Sample inundated at end of test at 3200 psf

SPEEDIE AND ASSOCIATES

GEOTECH CONSOLIDATION 130624SA.GPJ GENGEO.GDT 7/24/14

# CONSOLIDATION TEST

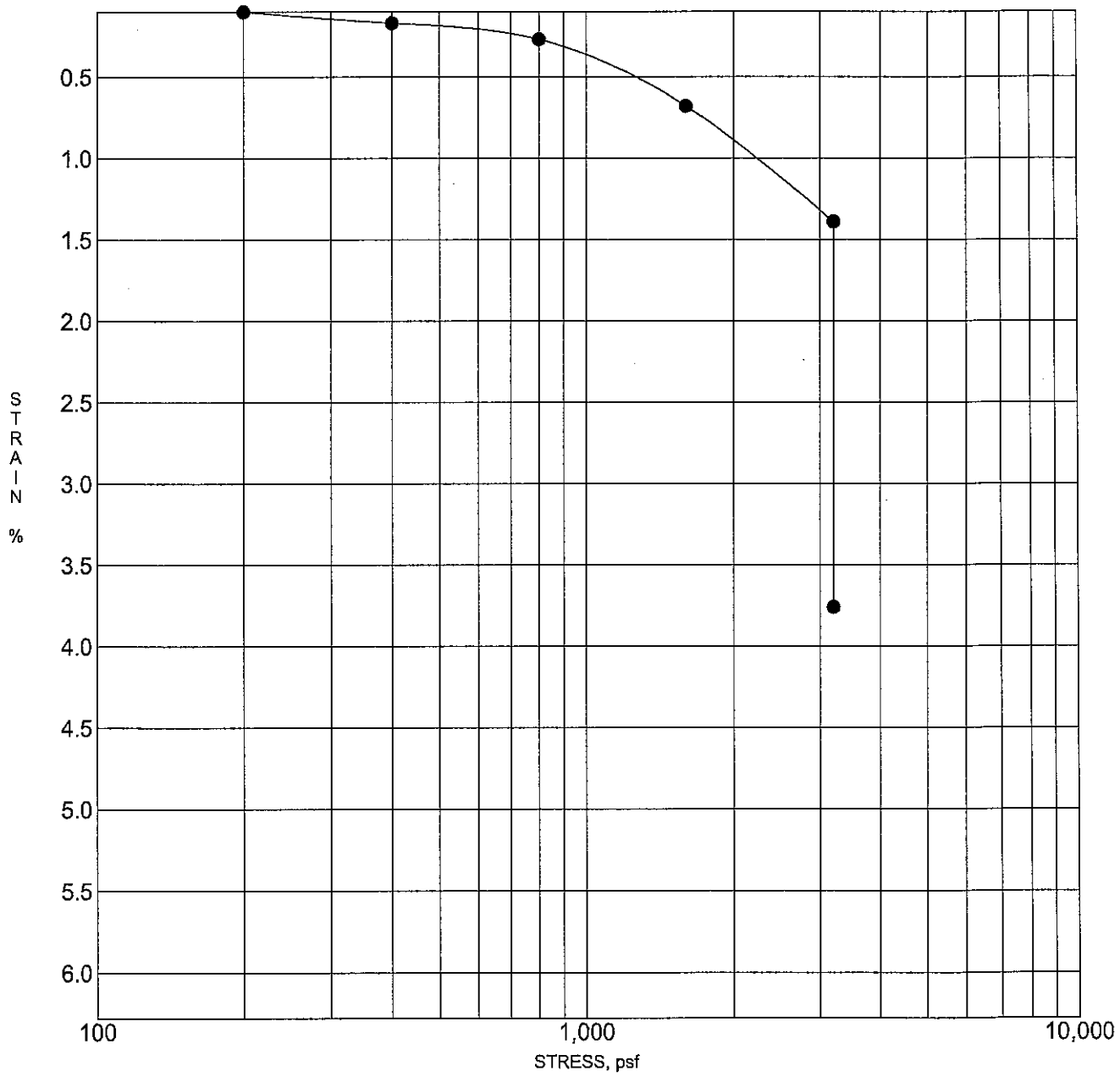
PROJECT: Skyline Regional Park Phase I | PROJECT NO.: 130624SA

LOCATION: Watson Road & McDowell Road | DATE: 7/1/14

BORING NO.: B-11 | SAMPLE NO.: RS-1 | SAMPLE DEPTH: 1 to 2 | LABORATORY NO.:

LIQUID LIMIT: 24 | PLASTIC LIMIT: 20 | PLASTICITY INDEX: 4

CLASSIFICATION: SC-SM | ASTM SOIL DESCRIPTION: SILTY, CLAYEY SAND with GRAVEL




Sample inundated at end of test at 3200 psf

SPEEDIE AND ASSOCIATES

GEOTECH CONSOLIDATION 130624SA.GPJ GENGEO.GDT 7/17/14

# MOISTURE-DENSITY RELATIONS

PROJECT: Skyline Regional Park Phase I — PROJECT NO.: 130624SA

LOCATION: Watson Road & McDowell Road — DATE: 6/2/14

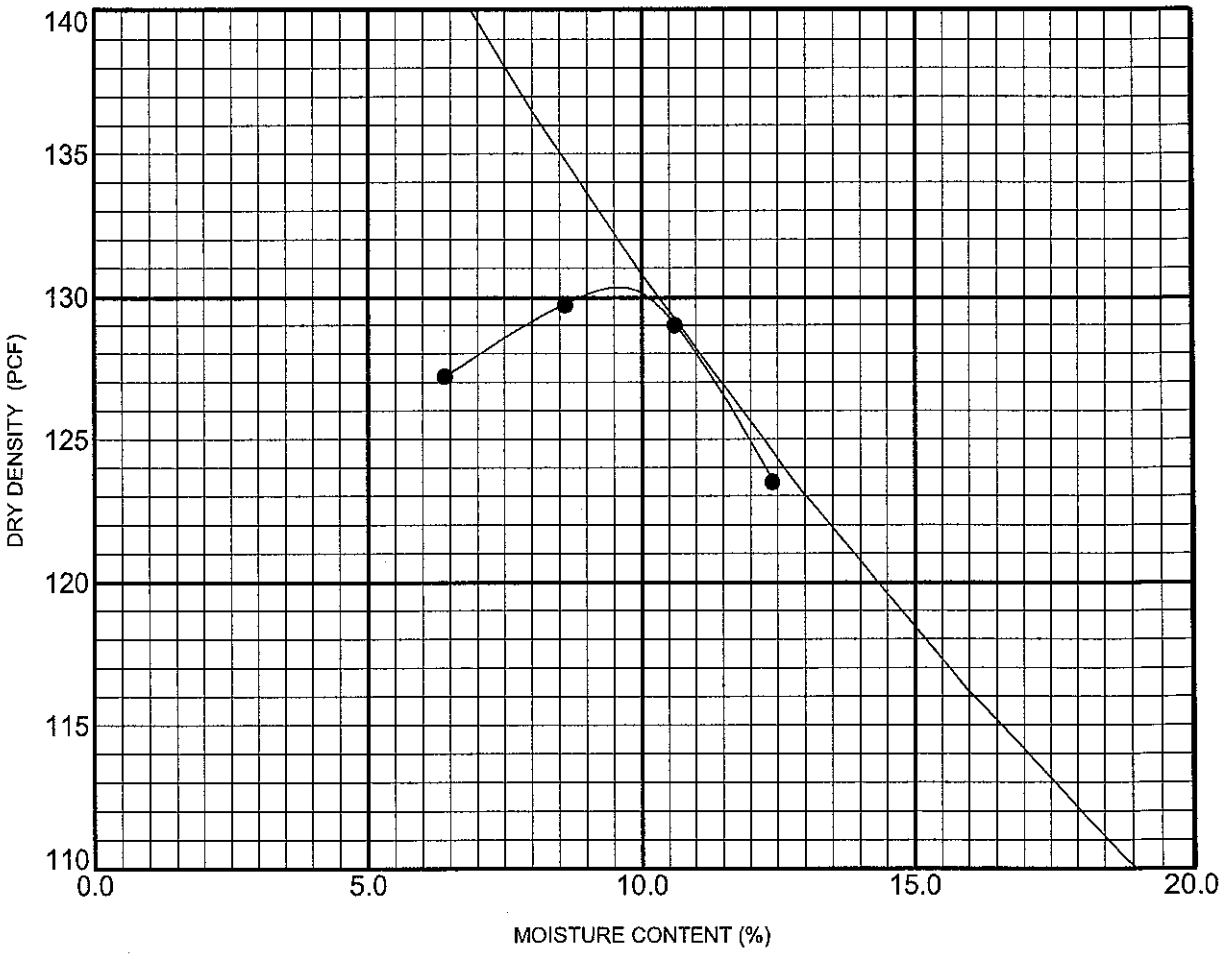
BORING NO.: B- 1 SAMPLE NO.: BS-2 SAMPLE DEPTH: 0 to 5 — LABORATORY NO.:

METHOD OF COMPACTION: D698A

LIQUID LIMIT: NP PLASTIC LIMIT: NP PLASTICITY INDEX: NP

CLASSIFICATION: SM ASTM SOIL DESCRIPTION: SILTY SAND

MAXIMUM DRY DENSITY: **130.1 PCF** OPTIMUM MOISTURE CONTENT: **9.9%**




SPEEDIE AND ASSOCIATES

GEOTECH PROCTOR 130624SA.GPJ 7/17/14

# MOISTURE-DENSITY RELATIONS

PROJECT: Skyline Regional Park Phase I

PROJECT NO.: 130624SA

LOCATION: Watson Road & McDowell Road

DATE: 5/27/14

BORING NO.: B- 3 SAMPLE NO.: BS-2 SAMPLE DEPTH: 0 to 5

LABORATORY NO.:

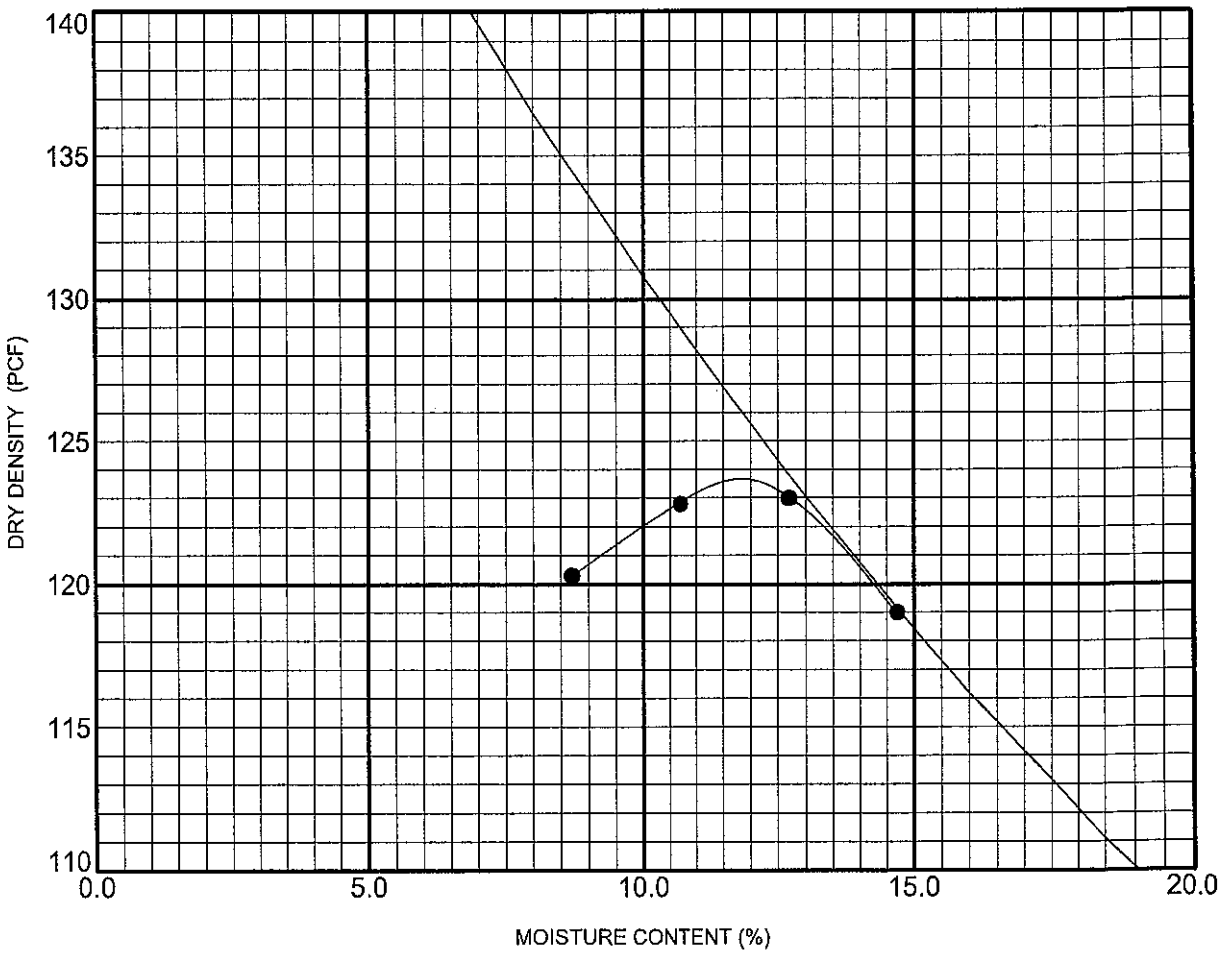
METHOD OF COMPACTION: D698A

LIQUID LIMIT: NP PLASTIC LIMIT: NP PLASTICITY INDEX: NP

CLASSIFICATION: SW-SM ASTM SOIL DESCRIPTION: WELL-GRADED SAND with SILT and GRAVEL

MAXIMUM DRY DENSITY: **123.7 PCF**

OPTIMUM MOISTURE CONTENT: **11.9%**




SPEEDIE AND ASSOCIATES

GEOTECH PROCTOR 130624SA.GPJ 7/17/14

# CORROSIVE TEST DATA

| SOIL BORING or TEST PIT NUMBER | SAMPLE NUMBER | SAMPLE TYPE | SAMPLE INTERVAL (ft) | PERCENT FINER #200 SIEVE | pH | RESISTIVITY (Ohm-Centimeters) | PPM SULFATE (SO4) | PPM CHLORIDE (CL) | SULFIDE (+ or -) | REDOX (millivolts) | UNIFIED SOIL CLASSIFICATION | SPECIMEN DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B- 7 | BS-2 | BULK | 0.0 - 5.0 | 18 | 8.1 | 1860 | 6 | 140 | NT | NT | SM | SILTY SAND with GRAVEL |
| TP-1 | BS-1 | BULK | 0.0 - 5.0 | 13 | 7.8 | 5570 | 4 | 32 | NT | NT | SM | SILTY SAND with GRAVEL |
| TP-3 | BS-1 | BULK | 0.0 - 5.0 | 20 | 7.8 | 4940 | 4 | 31 | NT | NT | SM | SILTY SAND with GRAVEL |

Sheet 1 of 1

Skyline Regional Park Phase I
Watson Road & McDowell Road
Buckeye, Arizona
Project No. 130624SA

SPEEDIE AND ASSOCIATES

TABOFLAB REDOX-SULFIDE 130624SA.GPJ GENGEO.GDT 7/17/14

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers
3331 EAST WOOD STREET • PHOENIX, ARIZONA 85040

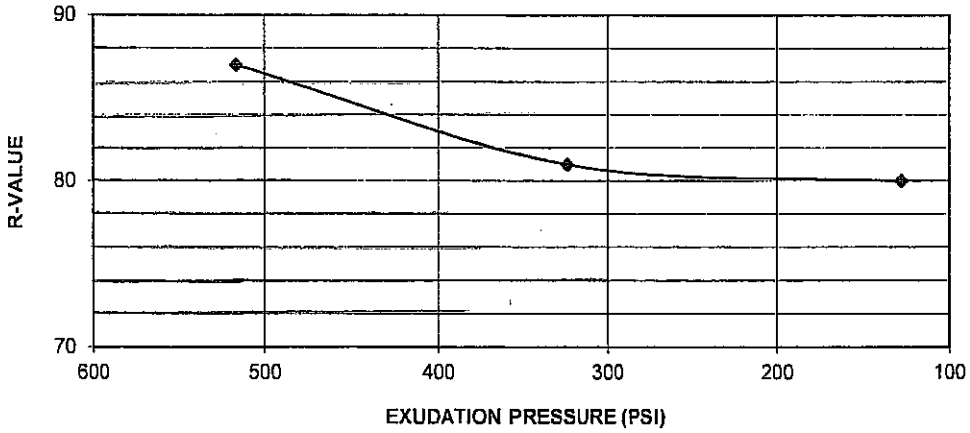
# Resistance R-Value and Expansion Pressure of Compacted Soils

| | | | |
|---|---|---|---|
| CLIENT: | Kimley-Horn and Associates, Inc. | JOB NO: | 130624SA |
| ATTN: | Raj Christian | LAB NO: | NR750 |
| | 7740 North 16th Street, 300 | REPORT DATE: | 6/11/2014 |
| | Phoenix, AZ 85020 | | |

| | |
|---|---|
| PROJECT: | Watson Road Extension |
| LOCATION: | Roosevelt to Skyline Park |
| SOURCE/ID: | B-3 BS-2 @ 0' |

## R-VALUE CALCULATION - AASHTO T190

| SPECIMEN I.D. | A | B | C |
|---|---|---|---|
| Moisture Content | 7.9% | 8.3% | 9.0% |
| Compaction Pressure (psi) | 350 | 350 | 350 |
| Specimen Height (inches) | 2.41 | 2.39 | 2.43 |
| Dry Density (pcf) | 131.3 | 133.2 | 131.3 |
| Ph @ 1000 (lb) | 7.0 | 11.0 | 9.0 |
| Ph @ 2000 (lb) | 11.0 | 17.0 | 18.0 |
| Displacement | 4.64 | 4.61 | 4.52 |
| Expansion Pressure (psi) | 0.0 | 0.0 | 0.0 |
| Exudation Pressure (psi) | 516 | 325 | 128 |
| R Value | 88 | 82 | 81 |
| Corrected R-Value | 87 | 81 | 80 |




**R-VALUE AT 300 PSI = 81**

SPEEDIE AND ASSOCIATES

## Septic Percolation Testing
## Field Test Data

Project Name: **Skyline Regional Park Phase I**
Test Location **P-1**
Depth of Liquid: **6"-12"**

Project Number: **130624SA**
Date of Test: **06/18/14**
Liquid Used: **H20**

| Trial # | Start Time | End Time | Δ Time (min:sec) | Initial Depth of Water (in) | Final Depth of Water (in) | Δ Water (in) | Perc Rate (min/in) |
|---|---|---|---|---|---|---|---|
| 1 | 10:33 AM | 10:39 AM | 06:00.0 | 12 | 0 | 12 | 0.50 |
| 2 | 10:39 AM | 10:47 AM | 08:30.0 | 12 | 0 | 12 | 0.71 |
| 3 | 10:48 AM | 10:58 AM | 10:00.0 | 12 | 0 | 12 | 0.83 |
| 4 | 10:59 AM | 10:59 AM | 00:57.0 | 6 | 5 | 1 | 0.95 |
| 5 | 11:01 AM | 11:02 AM | 01:00.0 | 6 | 5 | 1 | 1.00 |
| 6 | 11:03 AM | 11:04 AM | 01:02.0 | 6 | 5 | 1 | 1.03 |
| 7 | 11:05 AM | 11:06 AM | 01:04.0 | 6 | 5 | 1 | 1.07 |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | | | | | | | |

SPEEDIE AND ASSOCIATES

## Septic Percolation Testing
## Field Test Data

Project Name: **Skyline Regional Park Phase I**
Test Location: **P-2**
Depth of Liquid: **6"-12"**

Project Number: **130624SA**
Date of Test: **06/18/14**
Liquid Used: **H20**

| Trial # | Start Time | End Time | Δ Time (min:sec) | Initial Depth of Water (in) | Final Depth of Water (in) | Δ Water (in) | Perc Rate (min/in) |
|---|---|---|---|---|---|---|---|
| 1 | 11:10 AM | 11:29 AM | 19:00.0 | 12 | 0 | 12 | 1.58 |
| 2 | 11:29 AM | 11:58 AM | 29:00.0 | 12 | 0 | 12 | 2.42 |
| 3 | 11:58 AM | 12:31 PM | 33:00.0 | 12 | 0 | 12 | 2.75 |
| 4 | 12:32 PM | 12:35 PM | 03:14.0 | 6 | 5 | 1 | 3.23 |
| 5 | 12:36 PM | 12:39 PM | 03:18.0 | 6 | 5 | 1 | 3.30 |
| 6 | 12:40 PM | 12:43 PM | 03:21.0 | 6 | 5 | 1 | 3.35 |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | | | | | | | |

SPEEDIE AND ASSOCIATES

## Septic Percolation Testing
## Field Test Data

Project Name: **Skyline Regional Park Phase I**
Test Location: **P-3**
Depth of Liquid: **6"-12"**

Project Number: **130624SA**
Date of Test: **06/18/14**
Liquid Used: **H20**

| Trial # | Start Time | End Time | Δ Time (min:sec) | Initial Depth of Water (in) | Final Depth of Water (in) | Δ Water (in) | Perc Rate (min/in) |
|---|---|---|---|---|---|---|---|
| 1 | 11:14 AM | 11:28 AM | 14:00.0 | 12 | 0 | 12 | 1.17 |
| 2 | 11:28 AM | 11:48 AM | 20:00.0 | 12 | 0 | 12 | 1.67 |
| 3 | 11:48 AM | 12:11 PM | 23:00.0 | 12 | 0 | 12 | 1.92 |
| 4 | 12:12 PM | 12:14 PM | 02:08.0 | 6 | 5 | 1 | 2.13 |
| 5 | 12:15 PM | 12:17 PM | 02:10.0 | 6 | 5 | 1 | 2.17 |
| 6 | 12:18 PM | 12:20 PM | 02:12.0 | 6 | 5 | 1 | 2.20 |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | | | | | | | |

SPEEDIE AND ASSOCIATES

| WATSON ROAD EXTENSION BORING COORDINATES | | |
|---|---|---|
| LOCATION | DMS North | DMS North |
| B-1 | 33° 27' 43" N | 112° 33' 24" W |
| B-2 | 33° 27' 53" N | 112° 33' 25" W |
| B-3 | 33° 28' 2" N | 112° 33' 25" W |
| B-4 | 33° 28' 12" N | 112° 33' 25" W |
| B-5 | 33° 28' 22" N | 112° 33' 25" W |
| B-6 | 33° 28' 27" N | 112° 33' 24" W |
| B-7 | 33° 28' 31" N | 112° 33' 24" W |
| B-8 | 33° 28' 33" N | 112° 33' 29" W |
| B-9 | 33° 28' 33" N | 112° 33' 35" W |
| B-10 | 33° 28' 56" N | 112° 33' 33" W |
| B-11 | 33° 28' 58" N | 112° 33' 33" W |
| TP-1 | 33° 28' 40" N | 112° 33' 39" W |
| TP-2 | 33° 28' 45" N | 112° 33' 40" W |
| TP-3 | 33° 28' 51" N | 112° 33' 38" W |
| TP-4 | 33° 28' 56" N | 112° 33' 29" W |
| P-1 | 33° 28' 54" N | 112° 33' 35" W |
| P-2 | 33° 28' 52" N | 112° 33' 34" W |
| P-3 | 33° 28' 53" N | 112° 33' 34" W |