Mapleton City

# City Council Staff Report

March 4, 2015

**Applicant:** Ben Peay

**Location:** 580 W Maple

**Prepared by:** Sean Conroy, Community Development Director

**Public Hearing:** Yes

**Zone:** RA-1

**Attachments:**

1. Application information.
2. OS-P Zoning Text Excerpt.
3. PC Minutes dated 2/12/15.
4. Geotech Report.
5. Correspondence.

## REQUEST

Consideration of a Resolution to approve a request for a General Plan amendment from Low Density Residential (LDR) to Public Facilities (PF) and a Rezone from Residential Agricultural (RA-1) to Open Space-Parks (OS-P) for an 8 acre property located at 580 West Maple Street.

## BACKGROUND AND PROJECT DESCRIPTION

The applicant owns three parcels totaling approximately 8 acres located at 580 West Maple Street in the RA-1 zone. The property has been used primarily for agricultural purposes. Several months ago the applicant approached staff and the City Council about the possibility of a joint venture to create a cemetery on the subject property. While the Council was supportive of the idea of a cemetery, the two parties did not come to terms on a partnership.

The applicant is now requesting a General Plan Land Use Designation amendment from Low Density Residential (LDR) to Public Facilities (PF) and a rezone amendment from Residential Agricultural (RA-1) to Open Space-Parks (OS-P) with the intent of developing a private cemetery on the property. The applicant anticipates that the cemetery will permit approximately 6,200 burial plots and will include a memorial plaza, on-site parking, landscaping, wrought iron fencing and other features.

## EVALUATION

**Process:** Prior to development of the cemetery, the following steps are required:

1) Planning Commission review and recommendation to the City Council regarding General Plan and Rezone amendments. The Planning Commission recommended approval of the requested amendments on 2/12/15.
2) Approval of General Plan and Rezone amendments by the City Council (purpose of this meeting).
3) Issuance of a Conditional Use Permit by the Planning Commission. This will occur at a future meeting and is where a more detailed discussion will take place regarding how the cemetery will operate and function. If there are items of particular concern or interest to the Council, the Council could include in its motion direction to the Planning Commission for its review of the Conditional Use Permit.
4) Applicant will submit a plat map for the subject property that includes public rights-of-way dedications and improvements (this could be done simultaneously with step 3).

5) Applicant pays impact fees and submits required water shares.
6) Applicant obtains business license and permits for construction and signage.
7) Cemetery may open for business.

**Review Criteria:** MCC Chapter 18.12.010.B outlines the guidelines that shall be used to determine whether or not a rezone request is in the interest of the public and is consistent with the General Plan. The guidelines are as follows:

*1. Public purpose for the amendment in question.*

*2. Confirmation that the public purpose is best served by the amendment in question.*

*3. Compatibility of the proposed amendment with general plan policies, goals, and objectives.*

*4. Potential adverse effects to the city by creating "leapfrog" development or areas away from the existing "core" or center of the city.*

*5. Potential of the proposed amendment to hinder or obstruct attainment of the general plan's articulated policies.*

*6. Adverse impacts on adjacent landowners.*

*7. Verification of correctness in the original zoning or general plan for the area in question.*

*8. In cases where a conflict arises between the general plan map and general plan policies, precedence shall be given to the plan policies.*

**Planning Commission Review:** The Planning Commission reviewed this application on February 12, 2015 (see attachment "3"). There were several members of the public that spoke both for and against the proposal. The primary concerns expressed included that the property has experienced a very high water table in years past, that the cemetery will create traffic impacts on Maple Street, and that a cemetery could negatively impact property values. A letter of support was also submitted that was signed by 33 residents.

**Water Table:** During the Planning Commission hearing, several residents indicated that in times past that the water table in this area has been quite high and has even included surface water. The geotech report submitted by the applicant indicated that no ground water was found at a depth of eight feet. However, the report noted that ground water can fluctuate based on a variety of circumstances. The City also has a monitoring well near the project site that has recorded water depth changes of between 12.4' to 16.5' since 2012. While the geotech report and the City's monitoring wells are a good indication of current conditions, these conditions could change in the future based on a variety of factors.

The Planning Commission determined that while a high water table may be a logistical concern for the applicant, that it was not a valid basis to deny the request.

**Traffic:** According to UDOT's most recent traffic counts, Maple Street handles approximately 4,000 trips a day. It is anticipated that Maple Street can handle between 5,000 to 8,000 trips a day and still be operating at a level of service (LOS) A. According to the Institute of Traffic Engineer's traffic

manual, a 20 acre cemetery averages approximately 150 trips a day. This is comparable to a 12 lot residential subdivision. As the cemetery will be phased over time, and at build-out will only be eight acres in size, it does not appear that it will create significant traffic impacts on Maple Street.

**Property Values:** One member of the public submitted some written studies to the Planning Commission that suggest that cemeteries can have a negative impact on property values. Staff has not performed a detailed literature review to determine if there is a substantial amount of evidence one way or the other. However, if the Council would like more information on this topic it could direct staff to provide more research.

Anecdotally, it seems clear that in Utah County cemeteries do not deter residential development on surrounding properties. While some potential buyers may not be interested in living next to a cemetery, others may welcome it due to the protected open space and amenities a cemetery provides.

It is staff's position that the requested General Plan amendment and Rezone is in the public interest and should be supported for at least the following reasons:

- General Plan Goal #16 states, *"Mapleton will encourage the acquisition and development of a cemetery."* There is a clear need for a cemetery within the City and the proposed rezone will help facilitate fulfilling that need.
- The subject property is centrally located within the City and has access on a major collector road. This will limit traffic impacts on residential neighborhoods.
- Much of the adjacent property is in agricultural use, which acts as a buffer between the proposed cemetery and surrounding residential neighborhoods.
- The proposed use would allow for the development of a cemetery without the expenditure of public funds.
- A cemetery would potentially serve the public needs better than a single family residential development, which most likely would be the alternative development proposal.

**STAFF RECOMMENDATION**

Adopt the attached Resolution.

# RESOLUTION NO. 2015-

## A RESOLUTION TO APPROVE A REQUEST FOR A GENERAL PLAN AMENDMENT FROM LOW DENSITY RESIDENTIAL (LDR) TO PUBLIC FACILITIES (PF) AND A REZONE FROM RESIDENTIAL AGRICULTURAL (RA-1) TO OPEN SPACE-PARKS (OS-P) FOR AN 8 ACRE PROPERTY LOCATED AT 580 WEST MAPLE STREET.

**WHEREAS,** The City's General Plan encourages the development of a cemetery within the City; and

**WHEREAS,** the applicant owns approximately 8 acres in the RA-1 zone; and

**WHEREAS,** the RA-1 zone does not allow for a private cemetery; and

**WHEREAS,** the OS-P zone does allow private cemeteries as a conditional use; and

**WHEREAS,** the application is requesting a General Plan amendment to PF and a rezone to OS-P to allow for the development of a private cemetery; and

**WHEREAS,** the rezone request is in the public interest of the City as it will allow for a cemetery facility as encourage in the General Plan; and

**WHEREAS,** the Planning Commission recommended approval of the request on February 12, 2015.

**NOW THEREFORE, BE IT RESOLVED** by the City Council of Mapleton, Utah, to amend the General Plan Land Use Designation from LDR to PF and the zoning designation from RA-1 to OS-P for an 8 acre parcel as described in Exhibit "A".

PASSED AND ORDERED PUBLISHED BY THE CITY COUNCIL OF MAPLETON, UTAH,

This 4th Day of March, 2015.

_____
Brian Wall
Mayor

ATTEST:

_____
Camille Brown
City Recorder
**Publication Date:**
**Effective Date:**

**Exhibit "A"**

Parcel 26:063:0171
COM N 395.57 FT & E 367.51 FT FR S 1/4 COR. SEC. 10 T8S R3E SLB&M.; N 0 DEG 36' 42" E 361.43 FT; S 89 DEG 34' 22" E 516.64 FT; S 0 DEG 18' 10" W 350.43 FT; S 89 DEG 12' 44" W 518.68 FT TO BEG. AREA 4.229 AC.

Parcel 26:063:0173
COM N 189.91 FT & E 701.1 FT FR S 1/4 COR. SEC. 10, T8S, R3E, SLB&M.; N 0 DEG 2' 40" E 210.26 FT; N 89 DEG 12' 44" E 183.97 FT; S 0 DEG 53' 41" W 215.35 FT; N 89 DEG 11' 45" W 180.77 FT TO BEG. AREA 0.891 AC.

And

Parcel 26:063:0178
COM N 10.03 FT & E 359.99 FT FR S 1/4 COR. SEC. 10, T8S, R3E, SLB&M.; N 1 DEG 6' 57" E 385.61 FT; N 89 DEG 12' 44" E 337.12 FT; S 0 DEG 2' 40" W 390.18 FT; W 344.3 FT TO BEG. AREA 3.033 AC.

Attachment "1"
Application Information

To Whom It May Concern:

The property located at: 620 West Maple Street is currently a farm, horse property and has been for several years. We are submitting this letter and paperwork with the intent to provide Mapleton residence with a Cemetery.

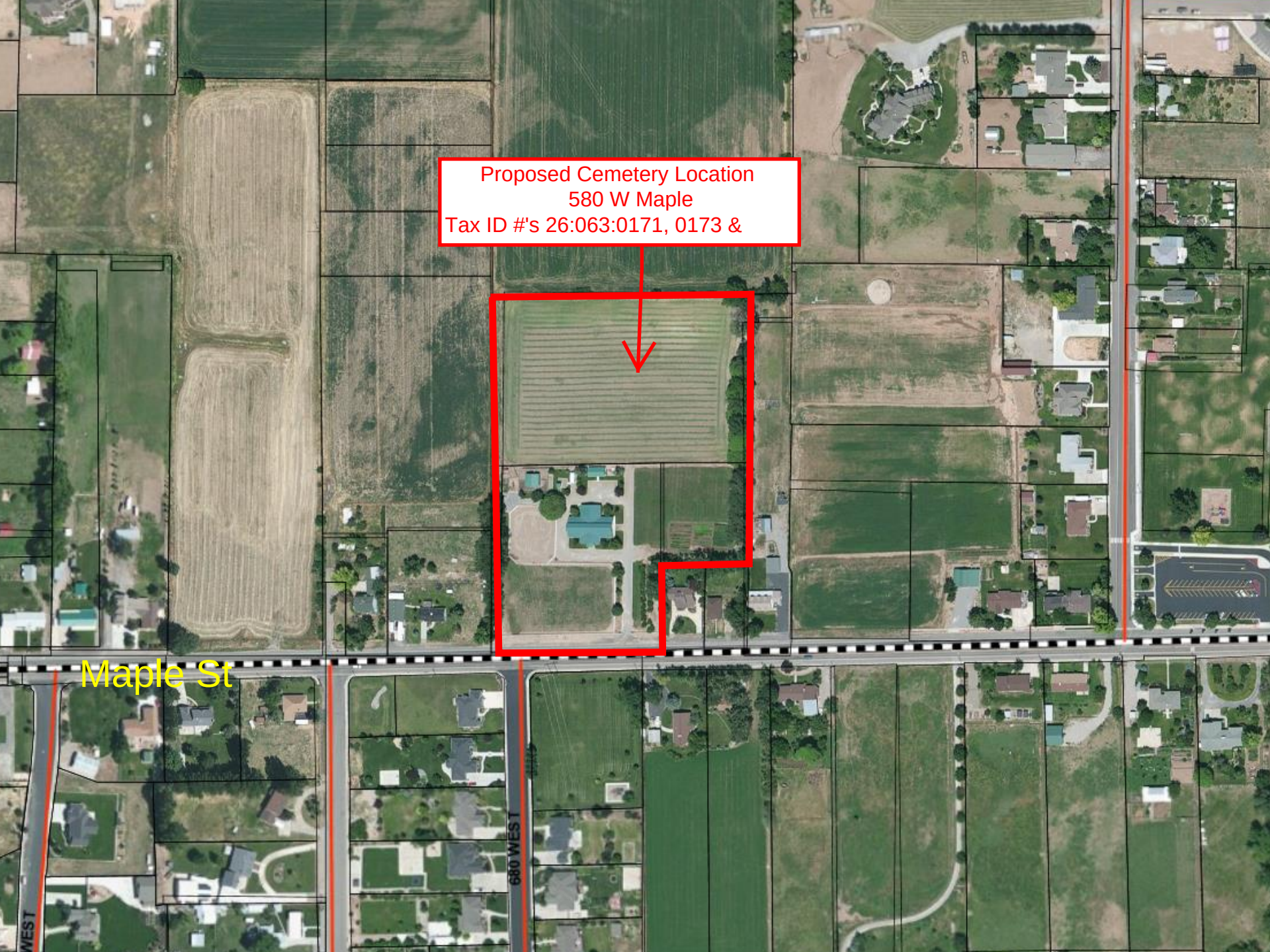
A preliminary map is attached. Approximately 6,000 burial plots would be available. The property would be enhanced with beautiful trees, a nice entry and fence as well as the proper roads, a Veterans memorial, and restroom. There has been a significant amount of time spent by the city staff in looking at the improvements to the street and infrastructure to make this a possibility.

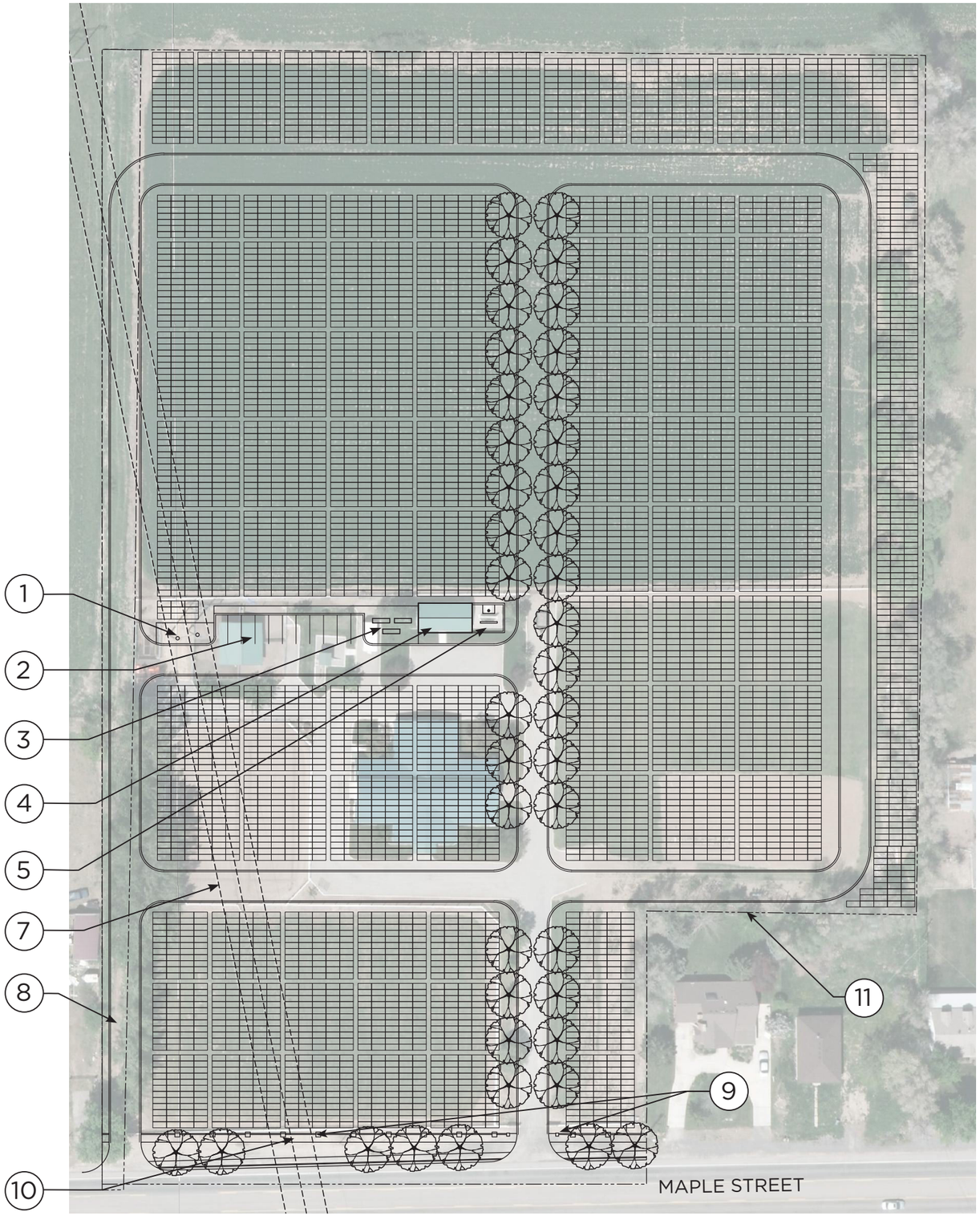
This location is a great place near the center of the city that will add to the open space and beauty of the city.

Upon approval the necessary work would start immediately with availability for burial in the early summer.

Sincerely,

Mapleton Cemetery, LLC

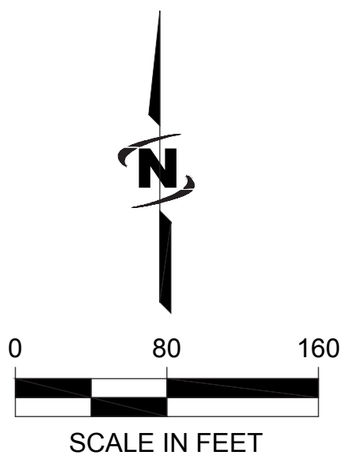

Proposed Cemetery Location
580 W Maple
Tax ID #'s 26:063:0171, 0173 &
Maple St
680 WEST




# MAPLETON CEMETERY
## CONCEPTUAL MASTER PLAN

**Grave Size: 4’x9’**
**Total number of graves: 6,200**

1. POWER LINE POLE BUFFER AREA
2. PARKING LOT (11 SPACES)
3. COLUMBARIUM WALLS
4. EXISTING PAVILION
5. MEMORIAL PLAZA
6. CEMETERY ROAD (TYP.) (21’ WIDE)
7. POWER LINES
8. EASEMENT
9. WROUGHT IRON FENCE
10. PLANT BED ALONG OUT-SIDE FENCE FOUNDATION
11. PROPERTY LINE




*Plan is based on county parcel data and is intended to be conceptual. Survey data is in not included as part of this plan. Plan is subject to change based on final survey data.

J-U-B ENGINEERS, INC.

THE LANGDON GROUP a J-U-B Company

GATEWAY MAPPING INC. a J-U-B Company

OTHER J-U-B COMPANIES

Attachment "2"
OS-P Zoning Text Excerpt

# Chapter 18.80
# OS-P OPEN SPACE AND PARKS ZONE



## 18.80.010: PURPOSE AND INTENT:

The purpose and intent of the OS-P open space and parks zone is to establish areas anywhere in Mapleton City where only open space and generally undeveloped lands are to be encouraged. Development of a comprehensive network of permanent, multifunctional, and publicly owned open spaces shall be encouraged. All parks owned by the city may be given the OS-P zone designation. Land that has been legally deeded to the city or land that has had a conservation easement recorded on it as part of a transferable development right sending site, may be rezoned to the OS-P zone. (Ord. 2003-16, 6-4-2003, eff. 6-11-2003)

## 18.80.015: DEFINITIONS:

OPEN SPACE: Any area or parcel of property dedicated to the city, within a recorded conservation easement, either public or private, or United States forest service land, that would be kept in its natural state for perpetuity, due to its inability to be used for typical recreational or residential uses.

PARKS: Any area or parcel of property dedicated to the city or within a conservation easement that is to be used for, or is currently developed for, recreational uses, such as, but not limited to, playgrounds, athletic fields, picnicking, or group gatherings. These areas would be landscaped and maintained in the same manner as other parks within the city. All park areas may be deeded to or dedicated to the city with the exception of a private cemetery or private park, as approved by Mapleton City and maintained by a private homeowners' association. (Ord. 2003-16, 6-4-2003, eff. 6-11-2003)

## 18.80.020: PERMITTED USES:

The following uses are permitted in the OS-P zone:

City initiated parks, open spaces, trails, museums, cemeteries or other city related activities.

City owned accessory structures for storage of equipment.

City owned buildings and structures for recreation.

City owned or city initiated water detention and/or debris basins.

City owned water well, water storage tank and all related equipment.

Conservation areas including, but not limited to, wilderness areas, watershed areas, wildlife refuges and wetlands.

Forests and urban forests. (Ord. 2003-16, 6-4-2003, eff. 6-11-2003)

## 18.80.030: CONDITIONAL USES:

The following uses are conditional in the OS-P zone:

Horse stable or horse arena and related structures and equipment.

Private cemetery.

Private golf courses (except clubhouse, concessions and other commercial uses that will require a commercial zone, and project plan approval).

Private water detention and/or debris basin.

Private water well or at grade storage tank and related equipment

Attachment "3"
PC Minutes

# MAPLETON CITY
## PLANNING COMMISSION MINUTES
February 12, 2015

**PRESIDING AND CONDUCTING:** Vice-Chairman Golden Murray

**Commissioners in Attendance:** Thomas Quist
Justin Schellenberg
Keith Stirling

**Staff in Attendance:** Sean Conroy, Community Development Director

**Minutes Taken by:** April Houser, Executive Secretary

Vice-Chairman Murray called the meeting to order at 6:30pm. Justin Schellenberg gave the invocation and Keith Stirling led the Pledge of Allegiance.

***Items are not necessarily heard in the order listed below.***

Alternate Commissioner Thomas Quist was seated as a voting member this evening.

**Item 3.** **Consideration of a request for a General Plan amendment from Low Density Residential (LDR) to Public Facilities (PF) and a rezone from Residential Agricultural (RA-1) to Open Space-Parks (OS-P) for an 8 acre property located at 580 West Maple Street. The intent of the rezone is to allow for the construction of a private cemetery on the property. The applicant is Ben Peay.**

**Sean Conroy**, Community Development Director, went over the Staff Report for those in attendance. The property currently has a nice white split rail fence with a barn on it, and has been primarily used for agricultural purposes. At one time the applicant approached the City about a 13 lot subdivision on the property, but has since decided to pursue a private cemetery, which is the reason for the zone change tonight. In order for this use to be allowed, a General Plan and Rezone would be required. The cemetery would still need to be approved for a Conditional Use Permit (CUP) in the future if the City Council approved this request. Tonight the only items being proposed are the General Plan and Rezone. The applicant would predict approximately 6,200 cemetery plots on the property if approved for the OS-P Zone. There is a very obvious public service that could be gained with this type of request. Neighboring properties are mainly agricultural at this time. The City will not gain any funds from this request, as it is a private cemetery being requested. There have been reports about high groundwater elevations in the past. The applicant did prepare a Geotechnical Report, and no water was found at the depth of 8', but did note that the groundwater can fluctuate depending on the time of year. The City does have a test well about 1500 feet from this property. Since 2012 the depths of water have been as shallow as 12.4' to 16.5'. The concern of traffic on Maple Street would provide for a level of service (LOA) of 5,000-8,000 per day and is currently running at approximately 4,000. Cemeteries are not a cause for significant traffic increases. It is likely that a 13 lot subdivision would increase traffic in the area more than a cemetery at the full 6,200 plot build out. With the concept proposed the cemetery would be similar to the Salem City Cemetery, which has serviced them for over 100 years. **Commissioner Stirling** had a concern with the super high density of plots, and wondered if there would be fencing around the perimeter of the property, which Sean stated that there would.

**Ben Peay**, applicant, stated that they are here to look at the General Plan and Rezone. Gateway Mapping has done this design, which is located out of Utah. Mr. Peay feels this will be the nicest cemetery in Utah County. He feels this density is actually lower than most in the area. The applicant feels they are meeting a need that has been desired in Mapleton for many years. The plan right now is to keep the front 4 acres as the first phase, then extend north

from there as needed. They plan to have a mausoleum as part of the cemetery as well, as it is becoming more popular now than it was in the past. **Commissioner Stirling** stated that back in 2006 when he was on the City Council they discussed the need for a cemetery, but was not sure why they did not continue with these discussions. Ben Peay stated that approximately 50% of the cemeteries in the United States are privately owned.

**Vice-Chairman Murray** opened the Public Hearing. **Gaye Law** has lived here for 60 years, and seen a lot of water in her basement during this time. Their gardens would be full of water, so she wants to lie that out. It is a serious issue and she knows the people will be in water that are buried here. She feels this would be a real mess for Mapleton if they let it go in. Mrs. Law hopes they will not approve this item. It is too bad when it comes to this and she feels there are better areas in Mapleton for a cemetery. **Mark Beutler** lives across the street, south of the proposed cemetery. He has lived there since 1976 and worked as an engineer for many years. He visited with Mr. Peay about his proposal. In the 1980's and early 1990's the water table at times was at the surface of the ground in this area. Mr. Beutler stated that in the last 6-7 years we have been in a dry cycle, but that this land is very capable of high water in the future. Mark read over some articles that were done back east regarding how homes within a 2 block radius of a cemetery can decrease property values. **Chad Warren** has seen groundwater on this property for years. He has lived here all his life and is a full time farmer. Mr. Warren said this property has had water over it in its entirety. Mapleton Irrigation has told Ben Peay about this groundwater problem, and Mr. Warren feels he is nuts and is asking for problems if he moves forward with this. There is a deeded easement to the north of this ground which is 16.6' wide, and Mr. Warren is concerned if this cemetery would fall within this right-of-way (ROW). He does not want his easement to be affected by this proposal. **Calvin Gabbitas** has owned the property by this for about 20 years. He has had 3 renters move because of the water in the basement of his home. The groundwater comes up out of the ground. Mr. Gabbitas sees this as being a real concern for the City. He feels the vaults should be leak proof. He stated that Ben Peay offered him $80,000 for his property and feels it is extremely unrealistic. The bottom line is money and he is not very happy with the applicant. **Michelle Estes** has not been in her home very long but can understand why her home is built up. She feels the water table and cemetery discussions have taken place many times over the years. Mrs. Estes does not feel that anyone who grew up in Mapleton would want to be buried on Maple Street, feeling it is one of the busiest streets in the City. She would really hope that the Planning Commission would take into consideration what the citizens have said this evening. **Jesse Warren** feels the City should look at the Holley property for a cemetery. His father farmed this property and that it had water table issues from the middle of June through September. Mr. Warren does not feel this should be approved. **Gary Nelson** has watched people drain their basement in this area for 20 years. He feels if they are thinking about putting a cemetery there, knowing the history with the water table, there is not a chance he would buy a plot there. **Denise Maingot** knows nothing about water tables but wanted to address the desires for cemetery in Mapleton. She likes the idea of accessing a cemetery off a main road, such as Maple Street, over those of a private area. Mrs. Maingot feels the builders would likely come up with a way to prevent water table issues, as they would want the business to succeed. She is an advocate for the cemetery if it is feasible. **Stacy Betts** has been a resident of Mapleton for over 30 years. He would like to be buried here. Mr. Betts feels if there is a private owner willing to take the risk of putting in a private cemetery they would suggest that they give him the opportunity to try and do just that. **Candice Carter** is not completely for or against the cemetery. She has only been here for two years and cannot speak against the water table issue. She feels the offer Mr. Peay gave her for their property was an honest one and that he was fair in the discussions he had with them. Mrs. Carter feels this is a noble thing to do, but has concerns with the life that is happening right next door to a cemetery. She trusts the City and the Planning Commission to do what is best. **Jim Salisbury** feels the applicant is a good person and that he knows a lot more about the water table than he is being given credit for. **Barbara Jensen** stated that the water table is dreadful in this area, and that Mapleton does need a cemetery, just not at this location. She feels this would be putting people in a well. **Rick Maingot** feels the largest concerns are water table and property values. He does not feel property values will be as affected as people feel, and that any location within the City would have this same response if it were proposed elsewhere. Mr. Maingot feels the standards could be put on the cemetery at time of Conditional Use Permit request. The zoning at this time would not really address the water table, but would be discussed more at the development level. If homes go in this area instead of a cemetery there would still be the water table issue mentioned this evening. **Ben Peay** stated that there is a big difference between and mausoleum verses a crematorium. He feels it is 50/50 outcome on all of the studies done in regards to property values next to cemeteries. As a developer and investor Ben Peay has looked at everything in regards to cemeteries. He feels Mapleton is a different place now than it was years ago. They have looked at everything and are very aware of the property. **Lawrence Haines** has been hoping for a cemetery in this area for a long time. He is familiar with all of the problems the Planning Commission faces. He admires those who have worked with the land themselves. Many of the problems in the past were caused by the

irrigation water itself as a result of irrigating. Since Mapleton is now being built out more, he questions if the problem of flooding may subside somewhat. He feels the City needs a cemetery, and feels private cemeteries work very well. Lawrence feels Mr. Peay is an honest man, and hopes as a City we will work for the achievement of a cemetery. No additional comments were given and the Public Hearing was closed.

Staff would recommend that the Planning Commission look at the General Plan and Zone change this evening, and look for a recommendation based off of that. **Commissioner Stirling** appreciates all the public input, and wonders if there is some type of mitigation the applicant could do to keep the property from flooding. **Commissioner Schellenberg** feels the water table issue is more of an emotional reaction to mix in with the cemetery. A cemetery is not a unique thing. They are regulated, and if the property can meet these regulations, he has confidence that these guidelines will ensure its safety. He realizes there is a human nature component, but could find that the component is there regardless of the water table. Commissioner Schellenberg feels that the applicant has the greatest risk here. For the purpose of the meeting tonight he is in favor of the zone change. There will be questions and logistics when the Conditional Use Permit request comes around. **Commissioner Quist** feels a lot of the citizens would like a cemetery. He is also concerned about the water table, but feels for what is being done for right now this is strictly a General Plan and Rezone. Commissioner Schellenberg feels this is a choice for people, and that no one is forced to purchase a plot there. He does not feel this will harm the potential for additional cemeteries if they were requested in the future.

**Motion:** Commissioner Schellenberg moved to recommend approval to the City Council of an ordinance amending the Mapleton City General Plan from Low Density Residential (LDR) to Public Facilities (PF) and a rezone from Residential Agricultural (RA-1) to Open Space-Parks (OS-P) for an 8 acre property located at 580 West Maple Street.
**Second:** Commissioner Quist
**Vote:** Unanimous

**Item 4.** **Adjourn.**

_____ _____

April Houser, Executive Secretary Date

Attachment "4"
GeoTech Report

Intermountain GeoEnvironmental Services, Inc.
12429 South 300 East, St. 100, Draper, Utah 84020
Phone (801) 748-4044 | Fax (801) 748-4045
www.igesinc.com

# GEOTECHNICAL INVESTIGATION
## Proposed Cemetery
## 580 West Maple Street
## Mapleton, Utah

Prepared for:

**Ben Peay**

IGES Job No. 01987-001

November 5, 2014

Intermountain GeoEnvironmental Services, Inc.
12429 South 300 East St. 100, Draper, Utah 84020
~ T: (801) 748-4044 ~ F: (801) 748-4045

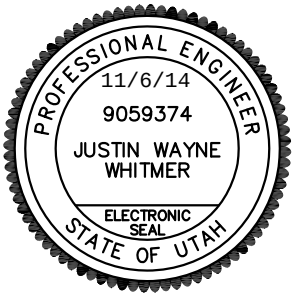
Prepared for:

Ben Peay
921 South 1300 East
Mapleton, Utah 84664

# Geotechnical Investigation
# Proposed Cemetery
# 580 West Maple Street
# Mapleton, Utah

IGES Project No. 01987-001

Prepared by:




Justin W. Whitmer, P.E.
Staff Engineer

Reviewed by:

Kent A. Hartley, P.E.
Principal

**IGES, Inc.**
12429 South 300 East, Suite 100
Draper, Utah 84020
(801) 748-4044

November 5, 2014

## TABLE OF CONTENTS

## APPENDIX

## 1.0 EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation conducted for the proposed Cemetery located at 580 West Maple Street in Mapleton, Utah. Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are complied with. A brief summary of the critical recommendations is included below:

- Native soils at the site consisted primarily of topsoil underlain by alternating layers of Silty SAND (SM), Sandy SILT (ML) and Poorly Graded GRAVEL (GP).
- Potentially collapsible soils were observed within the fine-grained soil in the upper 4 feet.
- Flexible pavement section of 3/8 (inches of asphalt/road base) constructed over 12 inches of reworked native soils is recommended for the cemetery.
- A rigid pavement section of 4/6 (inches of concrete/road base respectively) constructed on 12 inches of reworked and compacted native soils is recommended for the heavier traffic areas.

**NOTE: The scope of services provided within this report is limited to the assessment of the subsurface conditions at the subject site. The executive summary is provided solely for purposes of overview and is not intended to replace the report of which it is part and should not be used separately from the report.**

# 2.0 INTRODUCTION

## 2.1 PROJECT UNDERSTANDING AND DESCRIPTION

This report presents the results of a Geotechnical Investigation conducted for the proposed Cemetery located at 580 West Maple Street in Mapleton, Utah (Figure A-1, *Site Vicinity Map*). The property is located on the north side of 580 West Maple Street, with a total area of approximately 8 acres. The project site is bounded to the south by Maple Street and to the north, east and west by open land.

## 2.2 PURPOSE AND SCOPE OF WORK

The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the site and to provide recommendations for general site grading and pavement sections. In addition, we were looking for any geotechnical concerns that may significantly impact cost and construction of the project.

The scope of work completed for this study included a site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analyses, and preparation of this report. Our services were performed in accordance with our proposal and signed authorization.

The recommendations contained in this report are subject to the limitations presented in the **Limitations** section of this report (Section 7.1).

# 3.0 METHODS OF STUDY

## 3.1 FIELD INVESTIGATION

As a part of this investigation, subsurface soil conditions were explored by completing 5 exploratory test pits to depths ranging from 8 to 11 feet below the existing site grade. The approximate locations of the explorations are shown on Figure A-2 (*Geotechnical Map*) in Appendix A. Exploration points were placed to provide optimum coverage of the site. Logs of the subsurface conditions as encountered in the explorations were recorded at the time of excavation by a member of our technical staff and are presented as Figures A-3 through A-7 in Appendix A. A *Key to Soil Symbols and Terminology* used on the boring logs is included as Figure A-8.

The test pits were completed using a CASE 580 rubber tired backhoe. Soil sampling was completed to collect representative samples of the various layers observed at the site. Disturbed samples were placed in plastic baggies and relatively undisturbed soil samples were collected with the use of a 6-inch long brass tube attached to a hand sampler driven with a 2-lb sledge hammer. All samples were transported to our laboratory to evaluate the engineering properties of the various earth materials observed. The soils were classified according to the *Unified Soil Classification System* (USCS) by the Geotechnical Engineer. Classifications for the individual soil units are shown on the attached Test Pit Logs (Figures A-3 through A-7).

## 3.2 LABORATORY INVESTIGATION

Geotechnical laboratory tests were conducted on selected relatively undisturbed and bulk soil samples obtained during our field investigation. The laboratory testing program was designed to evaluate the engineering characteristics of onsite earth materials. Laboratory tests conducted during this investigation include:

- No. 200 Sieve Wash (ASTM D1140)
- Particle size distribution (ASTM D6913)
- One-dimensional collapse ( ASTM D4546 & 5333)
- Direct shear test (ASTM D3080)
- Maximum dry density and optimum moisture content (ASTM D698)
- California Bearing Ratio (CBR) (ASTM D1883)
- Resistivity, soluble chloride, and pH to evaluate corrosion potential of ferrous metals in contact with site soils

The results of the laboratory tests are presented in the test pit logs in Appendix A (Figures A-3 through A-7) and the laboratory test results presented in Appendix B.

## 3.3 ENGINEERING ANALYSIS

Engineering analyses were performed using soil data obtained from the laboratory test results and empirical correlations from material density, depositional characteristics and classifications. Analyses were performed using formulas, calculations and software that represent state-of-the-art methods accepted by the geotechnical industry. These methods include trench stability and pavement design. Appropriate factors of safety were applied to the results consistent with industry standards and the accepted standard of care.

# 4.0 GENERALIZED SITE CONDITIONS

## 4.1 SURFACE CONDITIONS

The subject site is located at an elevation of approximately 4,725 feet above mean sea level. At the time of our subsurface investigation the site existed as open land with a barn and a few out buildings. The ground surface is covered with grass, weeds and native soils.

## 4.2 SUBSURFACE CONDITIONS

The subsurface soil conditions were explored at the site by excavating 5 test pits at representative locations throughout the site. The subsurface conditions encountered during our investigation are discussed below.

### 4.2.1 Soils

Subsurface soils were sampled in the 5 test pits excavated across the proposed site during the field investigation conducted by IGES. Based on our observations, the majority of the site was overlain by a 12- to 24-inch layer of topsoil, with approximately 6 inches of heavy roots, composed of Sandy SILT (ML) and Silty SAND (SM). The topsoil was underlain by Sandy SILT (ML), Silty SAND (SM) and Poorly Graded GRAVEL (GP). The silt was generally medium stiff to stiff and slightly moist to wet. The sand was relatively medium dense and slightly moist to wet. The gravel was generally dense and slightly moist.

The stratification lines shown on the enclosed test pit logs represent the approximate boundary between soil types (Figures A-3 to A-7). The actual in-situ transition may be gradual. Due to the nature and depositional characteristics of the native soils, care should be taken in interpolating subsurface conditions between and beyond the exploration locations.

### 4.2.2 Groundwater

Groundwater was not encountered in the test pits excavated at the time of our investigation. However, the soils were wet at approximately 8 feet in depth below existing site grade in test pits 1, 3 and 4. Due to the season of our investigation, we anticipate groundwater levels to be near their seasonal average. Groundwater elevations could rise several feet during wet years and are expected to vary due to seasonal conditions and runoff from on-site or off-site sources. A groundwater study was not completed as part of this investigation, which would include installing piezometers and monitoring groundwater elevations for an extended period of time. IGES is unaware of and was not given any historical data regarding the subject property's history of groundwater elevations at the site.

# 5.0 GEOLOGIC CONDITIONS

## 5.1 GEOLOGIC HAZARDS

Geologic hazards and conditions can be defined as naturally occurring geologic conditions or processes that could present a danger to human life and property or result in impacts to conventional construction procedures. These hazards and conditions must be considered before development of the site. There are several hazards and conditions in addition to seismicity and faulting that if present at a site, should be considered in the design of critical and essential facilities. The other geologic hazard considered for this site is liquefaction.

### 5.1.1 Liquefaction

Certain areas within the Intermountain region possess a potential for liquefaction during seismic events. Liquefaction is a phenomenon whereby loose, saturated, granular soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. The primary factors affecting liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth to groundwater.

Referring to the *Liquefaction-Potential Map for Utah County, Utah* published by the Utah Geological Survey, the site is located within an area currently designated as "low" for liquefaction potential. The upper 11 feet are not considered liquefiable based on our field observations, laboratory testing and lack of groundwater.

### 5.1.2 Collapsible Soils

Collapse is a phenomena where undisturbed native soils under increased loading can exhibit volumetric strain and consolidation upon wetting. Collapsible soils can cause differential settling of structures and roadways. Collapsible soils do not necessarily preclude development and can be mitigated by over-excavating porous, potentially collapsible soils and replacing with engineered fill and by controlling surface drainage and runoff. Collapsible soils are typically characterized by a pinhole structure and relatively light in-situ density. Pinholes were observed in several test pits in the upper 4 feet of the native soils. Collapse testing was completed on two samples collected as part of this investigation with test results indicating a collapse potential of approximately 0.2% to 2.0%; which indicates a low potential within the upper 4 feet.

# 6.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

## 6.1 GENERAL CONCLUSIONS

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed cemetery provided that the recommendations contained in this report are incorporated into the design and construction of the project. We recommend that as part of the site grading process any undocumented fill, although not encountered at the time of our field investigation, or otherwise unsuitable soils currently present at the site be removed from beneath proposed pavements. We also recommend that IGES be on site at key points during construction to see that the recommendations in this report are implemented.

Potentially collapsible soils were observed within the fine-grained soil in the upper 4 feet; however, the potentially collapsible soils are not expected to have a major impact on development of the site. We understand there may be a concern regarding areas where graves will be excavated and then compacted back to site grade next to areas where there will not be compacted soil. In this condition, the potentially collapsible soils in the upper 4 feet will not impact the adjacent landscaping elements at the site.

Groundwater was not observed in any of the test pits at depths that would impact grave sites. However, IGES is aware that flood irrigation practices in this area can raise groundwater elevations several feet. As mentioned in Section 4.2.2 of this report, a groundwater study could be performed, which would include installing piezometers and monitoring them for at least one year.

The following sub-sections present our recommendations for general site grading, pavement design and lateral earth pressures.

## 6.2 EARTHWORK

Prior to the placement of pavements, general site grading is recommended to provide proper support for pavements. Site grading is also recommended to provide proper drainage and moisture control on the subject property.

### 6.2.1 General Site Preparation

Within the areas to be graded (pavement sections), any existing surface vegetation, debris, asphalt, and concrete should be removed and the upper 8 to 12 inches should be grubbed to remove the majority of the roots and organic matter. Any existing utilities should be re-routed or protected in-place. The exposed native soils should then be proof-rolled with heavy rubber-tired equipment such as a loader. Any soft/loose areas identified during proof-rolling should

be removed and replaced with structural fill. Although not observed at the time of our investigation, if undocumented fill soils exist (i.e. no record of compaction tests) they should be over excavated. Over-excavated soils can be used as structural fill if relatively free of deleterious material and compacted in accordance with the recommendations presented in this report (Section 6.2.3).

An IGES representative should observe the site preparation and grading operations to assess whether the recommendations presented in this report have been complied with.

### 6.2.2 Excavation Stability

The contractor is responsible for site safety, including all temporary slopes and trenches excavated at the site and design of any required temporary shoring. The contractor is responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Based on our observations and laboratory testing, the onsite native granular soils classify as OSHA Type C soils, and the onsite native fine-grained soils classify as OSHA Type B soils. Close coordination between the competent person and IGES, Inc. should be maintained to facilitate construction while providing safe excavations.

Based on Occupational Safety and Health (OSHA) guidelines for excavation safety, trenches with vertical walls up to 5 feet in depth may be occupied. Where very moist soil conditions or groundwater is encountered, or when the trench is deeper than 5 feet, we recommend a trench-shield or shoring be used as a protective system to workers in the trench. Sloping the sides of the trench at one horizontal to one vertical (1H: 1V) (45 degrees) may be used as an alternative to shoring or shielding. However, the presence of very moist soils or undocumented fill soils may require the slope walls to be further flattened to increase the safety to workers on site at the time of construction.

The contractor is ultimately responsible for trench and site safety. Pertinent OSHA requirements should be met to provide a safe work environment. If site specific conditions arise that require engineering analysis in accordance with OSHA regulations, IGES can respond and provide recommendations as needed.

### 6.2.3 Structural Fill and Compaction

All fill placed for the support of pavements should consist of structural fill. Structural fill may consist of on-site native granular soils or an approved imported material. Imported soil used as structural fill should be a relatively well-graded granular soil with a maximum of 50 percent passing the No. 4 sieve and a maximum fines content (minus No.200 mesh sieve) of 25 percent. Structural fill should be free of vegetation and debris, and contain no rocks larger

than 4 inches in nominal size (6 inches in greatest dimension). All structural fill soils should be approved by the geotechnical engineer prior to placement.

All structural fill should be placed in maximum 6-inch loose lifts if compacted by small hand-operated compaction equipment, maximum 8-inch loose lifts if compacted by light- to medium-duty rollers, and maximum 10-inch loose lifts if compacted by heavy duty compaction equipment that is capable of efficiently compacting the entire thickness of the lift. Thinner lifts may be necessary to achieve proper compaction. We recommend that all structural fill be compacted on a horizontal plane, unless otherwise approved by IGES. Structural fill placed beneath footings and pavements should be compacted to at least 95 percent of the MDD as determined by ASTM D-1557. The moisture content should be at or slightly above the OMC for all structural fill – compacting dry of optimum is discouraged. Any imported fill materials should be approved prior to importing. Also, prior to placing any fill, the excavations should be observed by IGES to confirm that unsuitable materials have been removed. In addition, proper grading should precede placement of fill, as described in the General Site Preparation and Grading subsection of this report.

Specifications from governing authorities having their own precedence for backfill and compaction should be followed where applicable.

### 6.2.4 Utility Trench Fill and Compaction

All utility trenches backfilled below pavement sections, curb, gutter and sidewalks, should be backfilled with structural fill that is at or slightly above the OMC when placed and compacted to at least 95 percent of the MDD as determined by ASTM D-1557. All other trenches in landscape areas should be backfilled and compacted to a minimum of approximately 90 percent of the MDD (ASTM D-1557). Utility trenches should be backfilled with structural fill as discussed in Section 6.2.3 of this report. Prior to backfilling the trench, pipes should be bedded in and covered with a uniform granular material that has a Sand Equivalent (SE) of 30 or greater. Alternatively, pipe bedding and shading may consist of clean ¾-inch gravel, which generally does not require compaction. All utility trenches backfilled below pavement sections, curb and gutter, and sidewalks, should be backfilled with structural fill compacted to at least 95% of the MDD as determined by ASTM D-1557. All other trenches, including landscape areas, should be backfilled and compacted to approximately 90 percent of the MDD (ASTM D-1557). Specifications from governing authorities having their own precedence for backfill and compaction should be followed where applicable.

## 6.3 MOISTURE PROTECTION AND SURFACE DRAINAGE

Over wetting the soils prior to or during construction may result in increased softening and pumping, causing equipment mobility problems and difficulty in achieving compaction.

Precautions should be taken during and after construction to minimize the potential for saturation of sidewalks and roadways. We recommend the following be implemented after construction is complete:

- If any detention/retention basins are used at the site we recommend that they be placed as far away from sidewalks and pavement as possible.
- Prior to backfilling trenches that have been excavated for utilities or other purposes, we recommend that a clay dam, or other relatively impermeable barrier be constructed to prevent water from flowing towards structures. The clay dam or other relatively impermeable barrier could include concrete, lean concrete, compacted fine-grained soils such as silt or clay with a high percentage of fines (a minimum of 85% passing the #200 sieve). The dam should be a minimum of 18 inches thick and extend 12 inches beyond the edge of the utility excavation.

## 6.4 ASPHALT CONCRETE PAVEMENT DESIGN

A laboratory-determined CBR value of 18.3 was obtained from a representative sample of the near-surface soils during our investigation. No traffic information was available at the time this report was prepared, therefore, we have assumed an equivalent single axle load (ESAL) value of approximately 175,000 for a 20-year design life assuming an annual growth rate of 0%.

Prior to placing the road base, the exposed subgrade should be proof-rolled as recommended in Section 6.2.1. After grading has taken place as recommended in Section 6.2.1, placement and compaction of the road base may take place.

**Table 6.8.1 - Flexible Pavement Section**

| Asphalt (in.) | Base Course (in.) | Reworked Native Soils (in.) |
|---|---|---|
| 3 | 8 | 12 |

Asphalt has been assumed to be a high stability plant mix; base course material should be composed of crushed stone with a minimum CBR of 70. The asphalt should be compacted to a minimum density of 96% of the Marshall value and the base course should be compacted to at least 95% of the MDD of the modified proctor at or slightly above the OMC as determined by ASTM D1557.

Pavement in areas where trucks frequently turn around, backup, or load and unload, including service areas, dumpster areas, and entrances/exits to the site, often experience more distress. If the owner wishes to prolong the life of the pavement in these areas, consideration should be given to using a Portland cement concrete (rigid) pavement. For these conditions, the following rigid pavement section is recommended:

**Table 6.8.2 - Rigid Pavement Section**

| Concrete (in.) | Base Course (in.) | Reworked Native Soils (in.) |
|---|---|---|
| 4 | 6 | 12 |

Concrete should consist of a low slump, low water cement ratio mix with a minimum 28-day compressive strength of 4,000 psi. Base course and pit-run should be compacted to at least 95% of the MDD and at or above the OMC as determined by ASTM D-1557.

If traffic conditions vary significantly from our stated assumptions, IGES should be contacted so we can modify our pavement design parameters accordingly. Specifically, if the traffic counts are significantly higher or lower, we should be contacted to revise the pavement section design as necessary. The pavement section thicknesses above assumes that the majority of construction traffic including cement trucks, cranes, loaded haulers, etc. has ceased. If a significant volume of construction traffic occurs after the pavement section has been constructed, the owner should anticipate maintenance or a decrease in the design life of the pavement area.

The pavement section thicknesses presented above assume that there is no mixing over time between the road base and the fine-grained native layers below. In order to prevent mixing or fines migration, and thereby prolonging the life of the pavement section, placing a geosynthetic such as NW-601 between the native soils and the road base is recommended.

# 7.0 CLOSURE

## 7.1 LIMITATIONS

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, we should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, IGES should be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

## 7.2 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during construction. IGES staff should be on site to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and structural fill placement.
- Observation of soft/loose soils over-excavation.
- Observation of temporary excavations and shoring.
- Consultation as may be required during construction.
- Quality control and observation of concrete placement.

We also recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience at (801) 748-4044.

## 8.0 REFERENCES CITED

International Building Code [IBC], 2012, International Code Council, Inc.

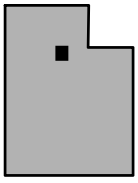
Utah Geological Survey, 1994, "Liquefaction-Potential Map for a Part of Utah County, Utah", Public Information Series 28.

# APPENDIX A


Base Maps:
USGS Springville
7.5-Minute Quadrangle Topographic Map

0’ 1000’ 2000’

SCALE 1:24,000



MAP LOCATION

IGES®

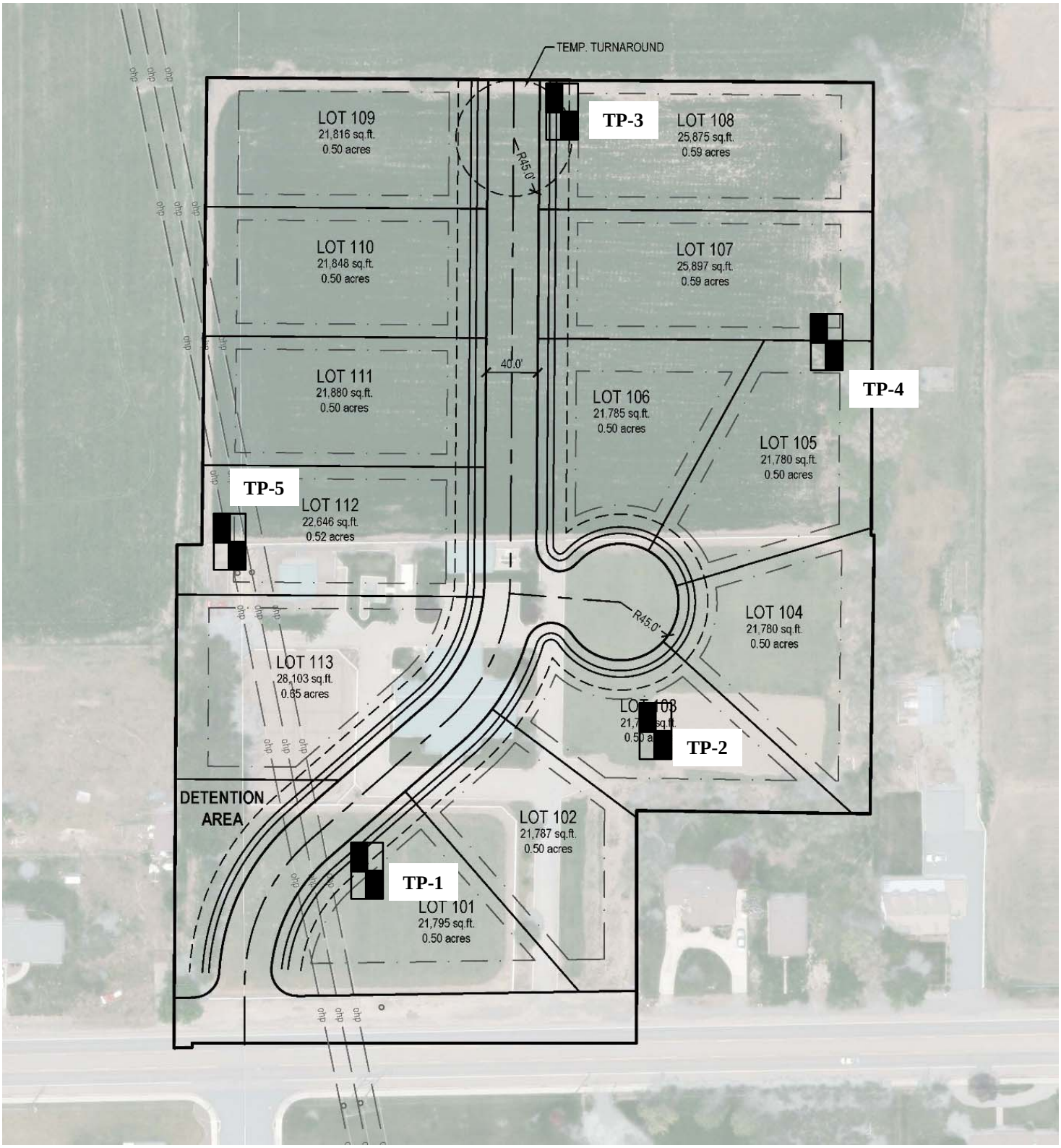
Project Number 01987-001

Geotechnical Investigation
Residential Subdivision
580 West Maple Street
Mapleton, Utah

**SITE VICINITY MAP**

**Figure**

**A-1**




**TP-1** Approximate TP Location

*Site Map provided by Client

N

NTS

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Project Number – 01987-001

Geotechnical Investigation
Residential Subdivision
580 West Maple Street
Mapleton, Utah

**GEOTECHNICAL MAP**

**Figure**

**A-2**

DATE
STARTED: 8/14/14
COMPLETED: 8/14/14
BACKFILLED: 8/14/14

# Geotechnical Investigation
Residential Subdivision
580 West Maple Street
Mapleton, Utah
Project Number 01987-001

IGES Rep: JWW/TBL
Rig Type: Case 580 - Backhoe

TEST PIT NO: TP-1
Sheet 1 of 1

LOCATION
LATITUDE LONGITUDE ELEVATION

| DEPTH ELEVATION | DEPTH FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION | MATERIAL DESCRIPTION | Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index | Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit; 10 20 30 40 50 60 70 80 90) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil - Sandy SILT - medium stiff to stiff, dry to slightly moist, dark brown | | | | | | |
| | | | | | ML | Sandy SILT - stiff to very stiff, dry to slightly moist, medium brown - fine pinholes throughout | | | 62.0 | | | |
| | | | | | SM | Silty SAND - medium dense, slightly moist, light brown | | | | | | |
| | 5 | | | | | - medium dense, moist, medium brown | 90.8 | 19.4 | | | | ● |
| | | | ▽ | | | - wet | | | | | | |
| | | | | | | | | | 33.4 | | | |
| | 10 | | | | | Bottom of Test Pit @ 10 Feet | | | | | | |



SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

**FIGURE A - 3**

LOG OF TEST PITS (A) -(4 LINE HEADER W ELEV) 01987-001.GPJ IGES.GDT 9/8/14

DATE
STARTED: 8/14/14
COMPLETED: 8/14/14
BACKFILLED: 8/14/14

# Geotechnical Investigation
Residential Subdivision
580 West Maple Street
Mapleton, Utah
Project Number 01987-001

IGES Rep: JWW/TBL
Rig Type: Case 580 - Backhoe

TEST PIT NO: TP-2
Sheet 1 of 1

LOCATION
LATITUDE LONGITUDE ELEVATION

| DEPTH ELEVATION | DEPTH FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION | MATERIAL DESCRIPTION | Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil - Silty SAND - medium dense, dry to slightly moist, dark brown | | | | | |
| | | | | | ML | Sandy SILT - medium stiff to stiff, slightly moist to moist, medium brown | | | 52.3 | | |
| | 5 | | | | GP | Poorly Graded GRAVEL - very dense, moist, gray to brown<br>-gravel and cobbles were subrounded, up to 6 inches in diameter with 1 to 3 inch diameters typical | | | 1.9 | | |
| | | | | | | No groundwater encountered<br><br>Bottom of Test Pit @ 8 Feet | | | | | |
| | 10 | | | | | | | | | | |

Moisture Content and Atterberg Limits
Plastic Limit | Moisture Content | Liquid Limit
10 20 30 40 50 60 70 80 90

LOG OF TEST PITS (A) -(4 LINE HEADER W ELEV) 01987-001.GPJ IGES.GDT 9/8/14

IGES



SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:
piezometer placed

**FIGURE**
**A - 4**

DATE
STARTED: 8/14/14
COMPLETED: 8/14/14
BACKFILLED: 8/14/14

Geotechnical Investigation
Residential Subdivision
580 West Maple Street
Mapleton, Utah
Project Number 01987-001

IGES Rep: TBL
Rig Type: Case 580 - Backhoe

TEST PIT NO:
TP-3
Sheet 1 of 1

LOCATION
LATITUDE LONGITUDE ELEVATION

| ELEVATION | DEPTH FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION | MATERIAL DESCRIPTION | Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index | Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit; 10 20 30 40 50 60 70 80 90) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil - Silty SAND - stiff, dry to slightly moist, dark brown | | | | | | |
| | | | | | SM | Silty SAND - medium dense, slightly moist, medium brown | | | | | | |
| | | | | | | - light brown | | | | | | |
| | | | | | ML | Sandy SILT - stiff, moist, medium brown with orange staining<br>-wet at 8.5 Feet<br>-fine pinholes throughout | | | | | | |
| | 5 | | | | | | 80.8 | 28.0 | | | | ● |
| | | | ▽ | | | - stiff, wet, gray to light brown with iron-oxide staining | | | | | | |
| | 10 | | | | | | | | 87.6 | | | |
| | | | | | | Bottom of Test Pit @ 11 Feet | | | | | | |

SAMPLE TYPE
▯ - GRAB SAMPLE
▮ - 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

**FIGURE**
**A - 5**



LOG OF TEST PITS (A) -(4 LINE HEADER W ELEV) 01987-001.GPJ IGES.GDT 9/8/14

DATE
STARTED: 8/14/14
COMPLETED: 8/14/14
BACKFILLED: 8/14/14

# Geotechnical Investigation
Residential Subdivision
580 West Maple Street
Mapleton, Utah
Project Number 01987-001

IGES Rep: TBL
Rig Type: Case 580 - Backhoe

TEST PIT NO: TP-4
Sheet 1 of 1

LOCATION
LATITUDE LONGITUDE ELEVATION

| ELEVATION | DEPTH FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION | MATERIAL DESCRIPTION | Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil - Sandy SILT - stiff, slightly moist, dark brown | | | | | |
| | | | | | ML | Sandy SILT - stiff, slightly moist, medium brown<br>-fine pinholes throughout, occasional large roots | | | | | |
| | | | | | SM | Silty SAND - medium dense, slightly moist to moist, light brown | | | | | |
| | | | | | | - moist | | | 41.7 | | |
| | 5 | | | | | - medium dense, moist, gray with iron-oxide staining | | | | | |
| | | | | | | | | | 43.1 | | |
| | | | ▽ | | | - wet | | | | | |
| | 10 | | | | | Bottom of Test Pit @ 9.5 Feet | | | | | |

Moisture Content and Atterberg Limits
Plastic Limit | Moisture Content | Liquid Limit
10 20 30 40 50 60 70 80 90

LOG OF TEST PITS (A) -(4 LINE HEADER W ELEV) 01987-001.GPJ IGES.GDT 9/8/14

IGES®



SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼- MEASURED
▽- ESTIMATED

NOTES:

**FIGURE A - 6**

DATE
STARTED: 8/14/14
COMPLETED: 8/14/14
BACKFILLED: 8/14/14

Geotechnical Investigation
Residential Subdivision
580 West Maple Street
Mapleton, Utah
Project Number 01987-001

IGES Rep: TBL
Rig Type: Case 580 - Backhoe

TEST PIT NO: TP-5
Sheet 1 of 1

LOCATION
LATITUDE LONGITUDE ELEVATION

| ELEVATION | DEPTH FEET | SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION | MATERIAL DESCRIPTION | Dry Density(pcf) | Moisture Content % | Percent minus 200 | Liquid Limit | Plasticity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil - Sandy SILT - stiff, dry to slightly moist, dark brown | | | | | |
| | | | | | ML | Sandy SILT - medium stiff, slightly moist to moist, brown<br>-moist at 3' | 105.7 | 16.9 | | | |
| | | | | | GP | Poorly Graded GRAVEL - very dense, moist, gray<br>-gravel was subrounded up to 4" in diameter with 1" to 3" diameters typical | | | 4.3 | | |
| | 5 | | | | | | | | | | |
| | | | | | | No groundwater encountered | | | | | |
| | | | | | | Bottom of Test Pit @ 8 Feet | | | | | |
| | 10 | | | | | | | | | | |

Moisture Content and Atterberg Limits

Plastic Limit | Moisture Content | Liquid Limit

10 20 30 40 50 60 70 80 90

LOG OF TEST PITS (A) -(4 LINE HEADER W ELEV) 01987-001.GPJ IGES.GDT 9/8/14

IGES



SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

**FIGURE A - 7**

## UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | | USCS SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|
| COARSE GRAINED SOILS (More than half of material Is larger than the #200 sieve) | GRAVELS (More than half of coarse fraction Is larger than the #4 sieve) | CLEAN GRAVELS WITH LITTLE OR NO FINES | GW | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | | GP | POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | GRAVELS WITH OVER 12% FINES | GM | SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES |
| | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| | SANDS (More than half of coarse fraction Is smaller than the #4 sieve) | CLEAN SANDS WITH LITTLE OR NO FINES | SW | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | | SP | POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | SANDS WITH OVER 12% FINES | SM | SILTY SANDS, SAND-GRAVEL-SILT MIXTURES |
| | | | SC | CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES |
| FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve) | SILTS AND CLAYS (Liquid limit less than 50) | | ML | INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | | OL | ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS (Liquid limit greater than 50) | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT |
| | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS |
| | | | OH | ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY |
| HIGHLY ORGANIC SOILS | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

## LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

## CEMENTATION

| DESCRIPTION | DESCRIPTION |
|---|---|
| WEAKELY | CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE |
| MODERATELY | CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE |
| STRONGLY | WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE |

## OTHER TESTS KEY

| | | | |
|---|---|---|---|
| C | CONSOLIDATION | SA | SIEVE ANALYSIS |
| AL | ATTERBERG LIMITS | DS | DIRECT SHEAR |
| UC | UNCONFINED COMPRESSION | T | TRIAXIAL |
| S | SOLUBILITY | R | RESISTIVITY |
| O | ORGANIC CONTENT | RV | R-VALUE |
| CBR | CALIFORNIA BEARING RATIO | SU | SOLUBLE SULFATES |
| COMP | MOISTURE/DENSITY RELATIONSHIP | PM | PERMEABILITY |
| CI | CALIFORNIA IMPACT | -200 | % FINER THAN #200 |
| COL | COLLAPSE POTENTIAL | Gs | SPECIFIC GRAVITY |
| SS | SHRINK SWELL | SL | SWELL LOAD |

## MODIFIERS

| DESCRIPTION | % |
|---|---|
| TRACE | <5 |
| SOME | 5 - 12 |
| WITH | >12 |

## MOISTURE CONTENT

| DESCRIPTION | FIELD TEST |
|---|---|
| DRY | ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH |
| MOIST | DAMP BUT NO VISIBLE WATER |
| WET | VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE |

## STRATIFICATION

| DESCRIPTION | THICKNESS | DESCRIPTION | THICKNESS |
|---|---|---|---|
| SEAM | 1/16 - 1/2" | OCCASIONAL | ONE OR LESS PER FOOT OF THICKNESS |
| LAYER | 1/2 - 12" | FREQUENT | MORE THAN ONE PER FOOT OF THICKNESS |

## GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

## APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

| APPARENT DENSITY | SPT (blows/ft) | MODIFIED CA. SAMPLER (blows/ft) | CALIFORNIA SAMPLER (blows/ft) | RELATIVE DENSITY (%) | FIELD TEST |
|---|---|---|---|---|---|
| VERY LOOSE | <4 | <4 | <5 | 0 - 15 | EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND |
| LOOSE | 4 - 10 | 5 - 12 | 5 - 15 | 15 - 35 | DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND |
| MEDIUM DENSE | 10 - 30 | 12 - 35 | 15 - 40 | 35 - 65 | EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER |
| DENSE | 30 - 50 | 35 - 60 | 40 - 70 | 65 - 85 | DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER |
| VERY DENSE | >50 | >60 | >70 | 85 - 100 | PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER |

| CONSISTENCY - FINE-GRAINED SOIL | | TORVANE | POCKET PENETROMETER | FIELD TEST |
|---|---|---|---|---|
| CONSISTENCY | SPT (blows/ft) | UNTRAINED SHEAR STRENGTH (tsf) | UNCONFINED COMPRESSIVE STRENGTH (tsf) | |
| VERY SOFT | <2 | <0.125 | <0.25 | EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND. |
| SOFT | 2 - 4 | 0.125 - 0.25 | 0.25 - 0.5 | EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE. |
| MEDIUM STIFF | 4 - 8 | 0.25 - 0.5 | 0.5 - 1.0 | PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE. |
| STIFF | 8 - 15 | 0.5 - 1.0 | 1.0 - 2.0 | INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT. |
| VERY STIFF | 15 - 30 | 1.0 - 2.0 | 2.0 - 4.0 | READILY INDENTED BY THUMBNAIL. |
| HARD | >30 | >2.0 | >4.0 | INDENTED WITH DIFFICULTY BY THUMBNAIL. |

IGES

# Key to Soil Symbols and Terminology

Figure A-8

# APPENDIX B

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

**(ASTM D6913)**



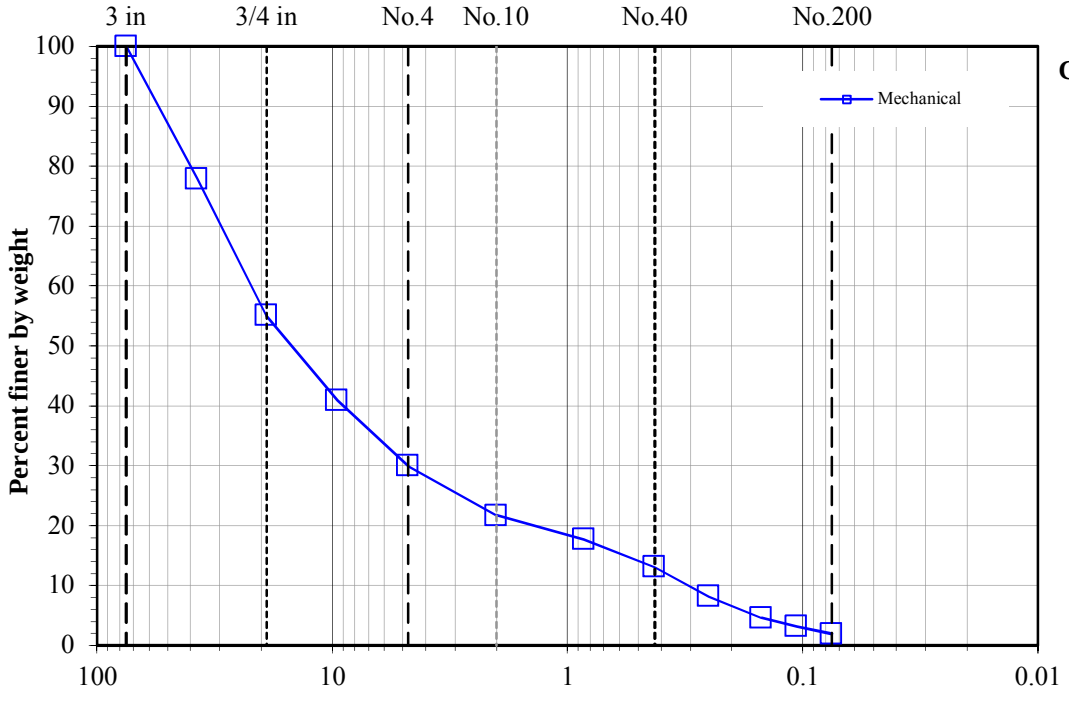
**Project:** 580 West Maple Street Subdivision
**No:** 01987-001
Location: Mapleton, Utah
Date: 8/20/2014
By: MP

**Boring No.:** TP-2
**Sample:**
**Depth:** 5.0'
Description: Brown gravel with sand

| | Moist | Dry |
|---|---|---|
| Split: | Yes | |
| Split sieve: | 3/4" | |
| Total sample wt. (g): | 4899.14 | 4755.69 |
| +3/4" Coarse fraction (g): | 2177.49 | 2137.16 |
| -3/4" Split fraction (g): | 642.96 | 618.60 |
| Split fraction: | 0.551 | |

| Water content data | C.F.(+3/4") | S.F.(-3/4") |
|---|---|---|
| Moist soil + tare (g): | 2640.42 | 953.53 |
| Dry soil + tare (g): | 2600.09 | 929.17 |
| Tare (g): | 462.92 | 310.57 |
| Water content (%): | 1.9 | 3.9 |

| Sieve | Accum. Wt. Ret. (g) | Grain Size (mm) | Percent Finer | |
|---|---|---|---|---|
| 8" | - | 200 | - | |
| 6" | - | 150 | - | |
| 4" | - | 100 | - | |
| 3" | - | 75 | 100.0 | |
| 1.5" | 1053.01 | 37.5 | 77.9 | |
| 3/4" | 2137.16 | 19 | 55.1 | ←Split |
| 3/8" | 159.32 | 9.5 | 40.9 | |
| No.4 | 282.45 | 4.75 | 29.9 | |
| No.10 | 375.38 | 2 | 21.6 | |
| No.20 | 420.55 | 0.85 | 17.6 | |
| No.40 | 471.96 | 0.425 | 13.1 | |
| No.60 | 527.33 | 0.25 | 8.1 | |
| No.100 | 567.37 | 0.15 | 4.6 | |
| No.140 | 583.35 | 0.106 | 3.1 | |
| No.200 | 597.07 | 0.075 | 1.9 | |




**Gravel (%):** 70.1
**Sand (%):** 28.0
**Fines (%):** 1.9

Entered by:_____
Reviewed:_____

# Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

**(ASTM D6913)**



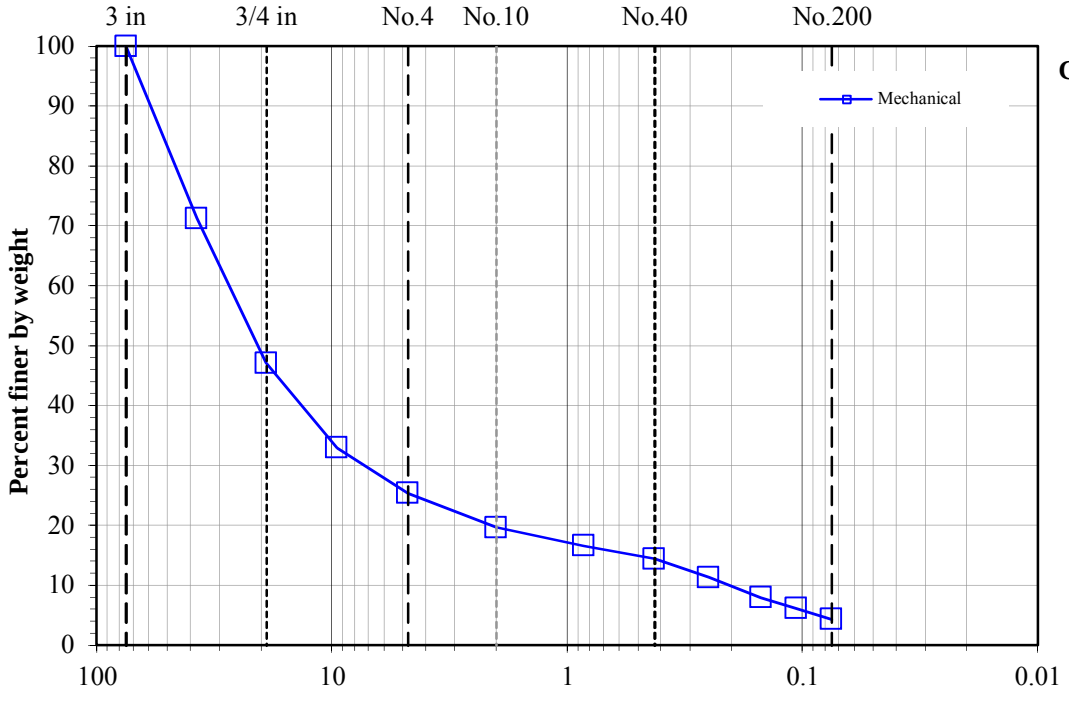
**Project:** 580 West Maple Street Subdivision
**No:** 01987-001
Location: Mapleton, Utah
Date: 8/20/2014
By: MP

**Boring No.:** TP-5
**Sample:**
**Depth:** 5.5'
Description: Brown gravel with sand

| | Moist | Dry |
|---|---|---|
| Split: | Yes | |
| Split sieve: | 3/4" | |
| Total sample wt. (g): | 4331.28 | 4139.21 |
| +3/4" Coarse fraction (g): | 2252.60 | 2190.67 |
| -3/4" Split fraction (g): | 992.55 | 930.41 |
| Split fraction: | 0.471 | |

| Water content data | C.F.(+3/4") | S.F.(-3/4") |
|---|---|---|
| Moist soil + tare (g): | 2699.16 | 1316.73 |
| Dry soil + tare (g): | 2637.23 | 1254.59 |
| Tare (g): | 446.57 | 324.18 |
| Water content (%): | 2.8 | 6.7 |

| Sieve | Accum. Wt. Ret. (g) | Grain Size (mm) | Percent Finer | |
|---|---|---|---|---|
| 8" | - | 200 | - | |
| 6" | - | 150 | - | |
| 4" | - | 100 | - | |
| 3" | - | 75 | 100.0 | |
| 1.5" | 1189.92 | 37.5 | 71.3 | |
| 3/4" | 2190.67 | 19 | 47.1 | ←Split |
| 3/8" | 279.82 | 9.5 | 32.9 | |
| No.4 | 429.59 | 4.75 | 25.3 | |
| No.10 | 542.27 | 2 | 19.6 | |
| No.20 | 602.47 | 0.85 | 16.6 | |
| No.40 | 645.52 | 0.425 | 14.4 | |
| No.60 | 707.42 | 0.25 | 11.3 | |
| No.100 | 774.05 | 0.15 | 7.9 | |
| No.140 | 809.46 | 0.106 | 6.1 | |
| No.200 | 845.88 | 0.075 | 4.3 | |




**Gravel (%):** 74.7
**Sand (%):** 21.1
**Fines (%):** 4.3

Entered by:_____
Reviewed:_____

## Laboratory Compaction Characteristics of Soil

**(ASTM D698 / D1557)**



**Project:** 580 West Maple Street Subdivision
**No:** 01987-001
Location: Mapleton, Utah
Date: 8/20/2014
By: ET

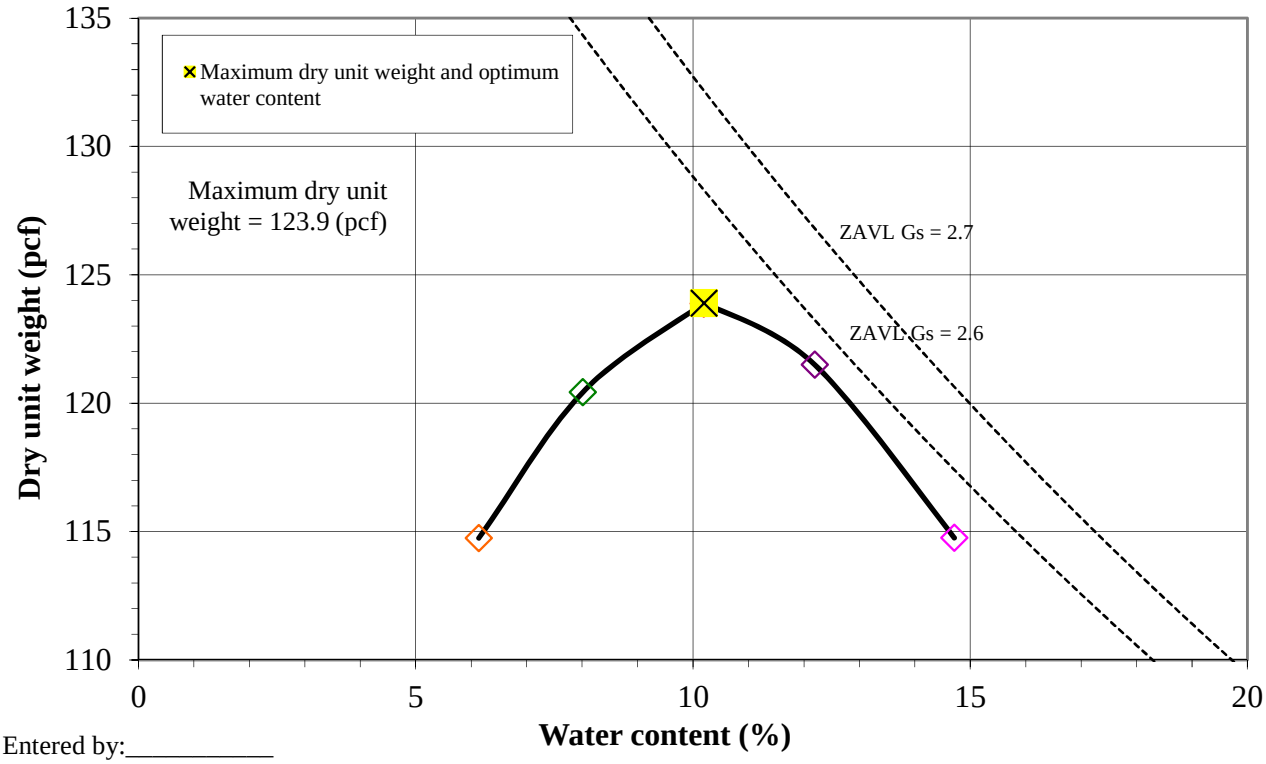
**Boring No.:** TP-5
**Sample:**
**Depth:** 2.5'
Sample Description: Brown silt
Engineering Classification: Not requested
As-received water content (%): Not requested

Method: ASTM D1557 C
Mold Id. Inc 6
Mold volume ($ft^3$): 0.0751

Preparation method: Moist
Rammer: Mechanical-sector face
Rock Correction: No

**Optimum water content (%): 10.2**
**Maximum dry unit weight (pcf): 123.9**

| Point Number | As Is | -2% | -4% | +2% | -6% | | | |
|---|---|---|---|---|---|---|---|---|
| Wt. Sample + Mold (g) | 11224.2 | 11231.1 | 11011.7 | 11064.8 | 10729.1 | | | |
| Wt. of Mold (g) | 6578 | 6578 | 6578 | 6578 | 6578 | | | |
| Wet Unit Wt., $\gamma_m$ (pcf) | 136.3 | 136.5 | 130.1 | 131.6 | 121.8 | | | |
| Wet Soil + Tare (g) | 1649.01 | 1755.48 | 1907.88 | 1777.88 | 1627.10 | | | |
| Dry Soil + Tare (g) | 1487.73 | 1612.99 | 1782.62 | 1577.42 | 1545.84 | | | |
| Tare (g) | 165.38 | 215.43 | 219.40 | 215.03 | 221.72 | | | |
| Water Content, w (%) | **12.2** | **10.2** | **8.0** | **14.7** | **6.1** | | | |
| Dry Unit Wt., $\gamma_d$ (pcf) | **121.5** | **123.9** | **120.4** | **114.8** | **114.7** | | | |




Entered by:_____

Reviewed:_____

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## California Bearing Ratio

**(ASTM D 1883)**



**Project:** 580 West Maple Street Subdivision
**Number:** 01987-001
Location: Mapleton. Utah
Date: 8/26/2014
By: ET

**Boring No.:** TP-5
**Sample:**
**Depth:** 2.5'
Original Method: ASTM D1557 C
Engineering Classification: Not requested
Condition of Sample: Soaked
Scalp and Replace: No

Maximum Dry Unit Weight (pcf): 123.9
Optimum Water Content (%): 10.2
Relative Compaction (%): 95.2
**0.1 in. Corrected CBR (%): 20.8**
**0.2 in. Corrected CBR (%): 18.3**

| As Compacted Data | | | Before | After |
|---|---|---|---|---|
| Mold Id. | B | Wet Soil + Tare (g) | 743.37 | 825.73 |
| Wt. of Mold + Sample (g) | 11649.6 | Dry Soil + Tare (g) | 685.21 | 757.34 |
| Wt. of Mold (g) | 7221.1 | Tare (g) | 117.94 | 127.61 |
| Dry Unit Weight (pcf) | 117.9 | Water Content (%) | 10.3 | 10.9 |
| **After Soaking Data** | | | **Average** | **Top 1 in.** |
| Wt. of Mold + Sample (g) | 11784.7 | Wet Soil + Tare (g) | 959.69 | 816.13 |
| Dry Unit Weight (pcf) | 117.5 | Dry Soil + Tare (g) | 862.28 | 731.84 |
| | | Tare (g) | 128.34 | 124.1 |
| | | Water Content (%) | 13.3 | 13.9 |

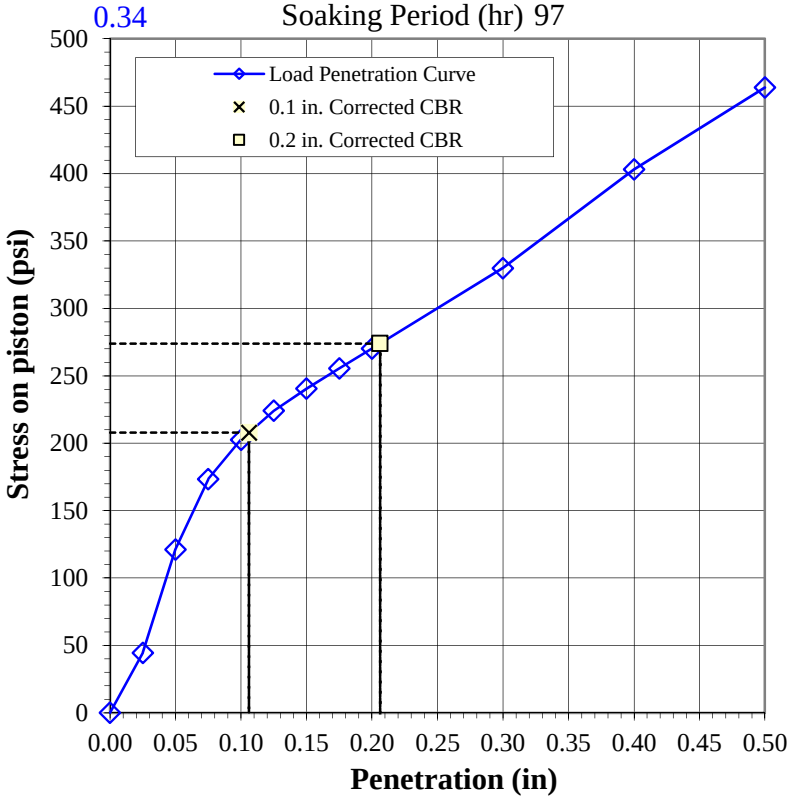
**Swell Data**

| Date | Time | Dial | |
|---|---|---|---|
| 8/21/2014 | 07:51 | 0.322 | Surcharge (psf) 50 |
| 8/25/2014 | 08:19 | 0.34 | Swell (%) 0.39 |
| | | | Soaking Period (hr) 97 |

**Penetration Data**

Zero load (lb) = 0
Area of Piston ($in^2$) = 3.0

| Penetration (in.) | Raw Load (lb) | Piston Stress (psi) | Std. Stress (psi) |
|---|---|---|---|
| 0.000 | 0 | 0 | |
| 0.025 | 133 | 45 | |
| 0.050 | 362 | 121 | |
| 0.075 | 518 | 173 | |
| 0.100 | 605 | 203 | 1000 |
| 0.125 | 669 | 224 | 1125 |
| 0.150 | 718 | 240 | 1250 |
| 0.175 | 763 | 255 | 1375 |
| 0.200 | 807 | 270 | 1500 |
| 0.300 | 985 | 330 | 1900 |
| 0.400 | 1204 | 403 | 2300 |
| 0.500 | 1385 | 464 | 2600 |




Entered By:_____
Reviewed:_____

## Collapse/Swell Potential of Soils

**(ASTM D4546 Method B)**



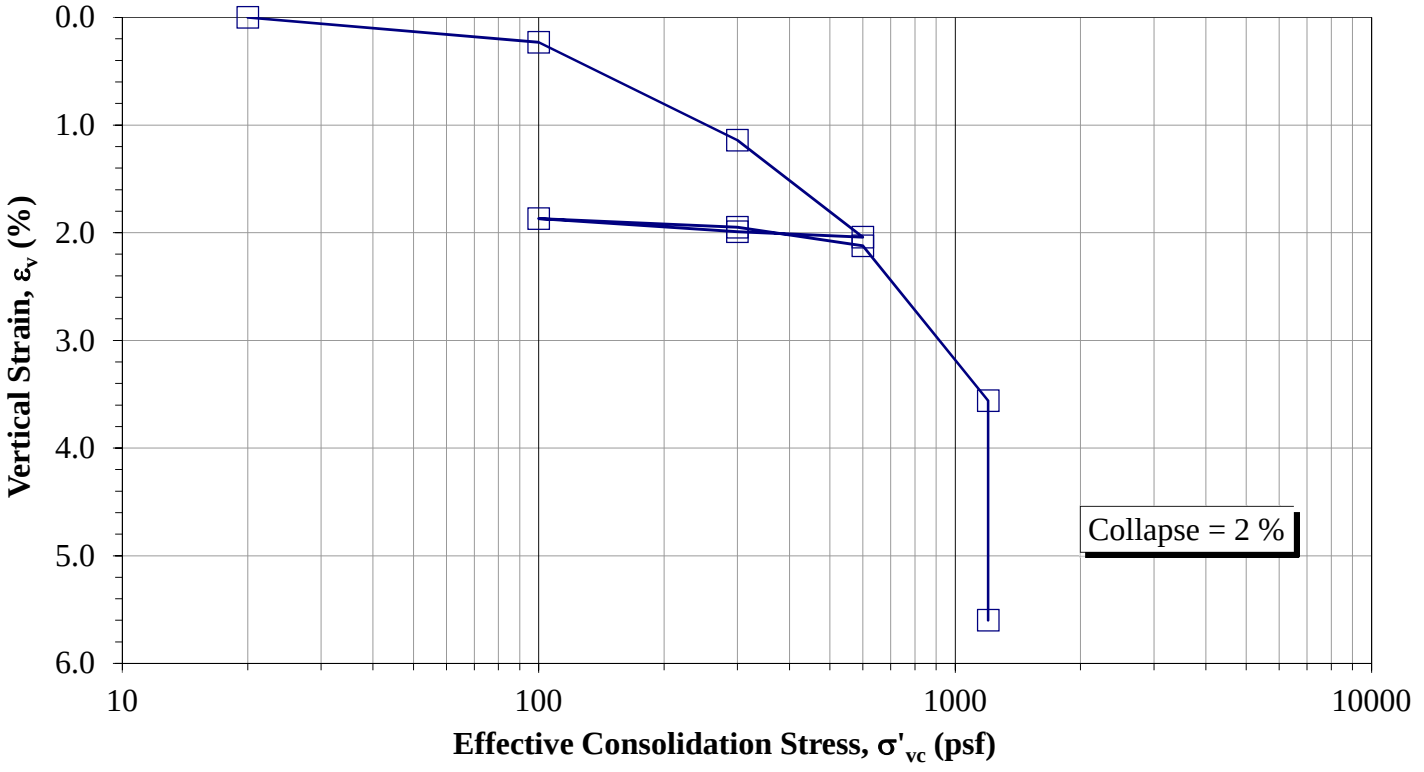
**Project:** 580 West Maple Street Subdivision
**No:** 01987-001
Location: Mapleton, Utah
Date: 8/21/2014
By: MP/JDF

**Boring No.:** TP-3
**Sample:**
**Depth:** 5.0'
Sample Description: Brown silt
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

| | | |
|---|---|---|
| Consolidometer No.: | 2 | |
| Specific gravity, $G_s$ | 2.67 | Assumed |
| Collapse (%) | 2.0 | |
| Collapse stress (psf) | 1200 | |
| Water type used for inundation | Tap | |

| | Initial (o) | Final (f) |
|---|---|---|
| Sample height, H (in.) | 1.000 | 0.9440 |
| Sample diameter, D (in.) | 2.416 | 2.416 |
| Mass rings + wet soil (g) | 170.96 | 176.29 |
| Mass rings/tare (g) | 46.44 | 46.44 |
| Moist unit wt., $\gamma_m$ (pcf) | 103.47 | 114.30 |
| Wet soil + tare (g) | 468.81 | 252.69 |
| Dry soil + tare (g) | 394.00 | 220.44 |
| Tare (g) | 126.75 | 124.09 |
| Water content, w (%) | 28.0 | 33.5 |
| Dry unit wt., $\gamma_d$ (pcf) | 80.84 | 85.64 |
| Saturation | 70.39 | 94.44 |

| Stress (psf) | Dial (in.) | 1-D $\varepsilon_v$ (%) | $H_c$ (in.) | e |
|---|---|---|---|---|
| Seating | 0.0695 | 0.00 | 1.0000 | 1.062 |
| 20 | 0.0695 | 0.00 | 1.0000 | 1.062 |
| 100 | 0.0718 | 0.23 | 0.9977 | 1.057 |
| 300 | 0.0809 | 1.14 | 0.9886 | 1.038 |
| 600 | 0.0899 | 2.04 | 0.9796 | 1.020 |
| 300 | 0.0894 | 1.99 | 0.9801 | 1.021 |
| 100 | 0.0882 | 1.87 | 0.9813 | 1.023 |
| 300 | 0.0890 | 1.95 | 0.9805 | 1.022 |
| 600 | 0.0907 | 2.12 | 0.9788 | 1.018 |
| 1200 | 0.1051 | 3.56 | 0.9644 | 0.988 |
| 1200 | 0.1255 | 5.60 | 0.9440 | 0.946 |




Entered: _____
Reviewed: _____

# Collapse/Swell Potential of Soils

**(ASTM D4546 Method B)**



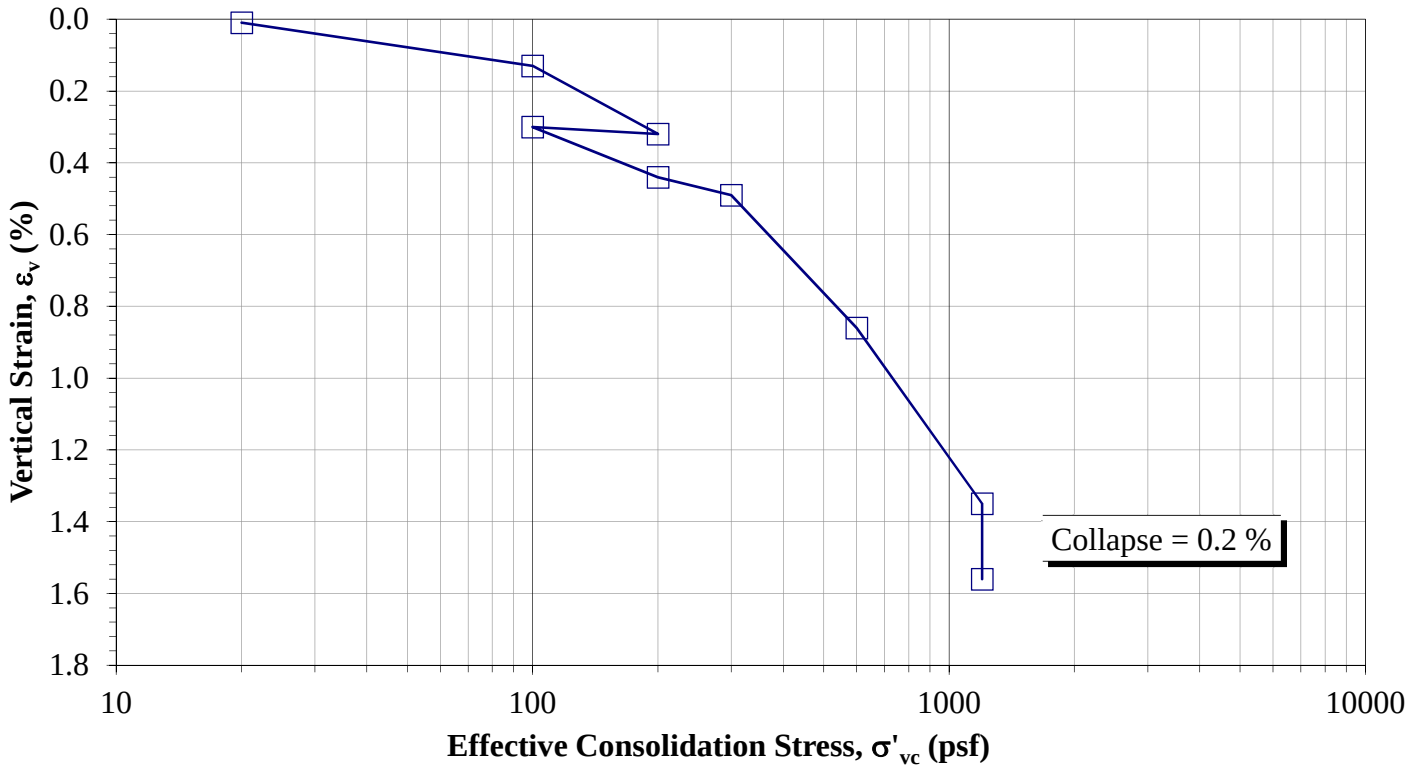
**Project:** 580 West Maple Street Subdivision
**No:** 01987-001
Location: Mapleton, Utah
Date: 8/21/2014
By: JDF

**Boring No.:** TP-5
**Sample:**
**Depth:** 2.0'
Sample Description: Brown silt
Engineering Classification: Not requested
Sample type: Undisturbed-trimmed from thin-wall

| | | |
|---|---|---|
| Consolidometer No.: | 3 | |
| Specific gravity, $G_s$ | 2.67 | Assumed |
| Collapse (%) | 0.2 | |
| Collapse stress (psf) | 1200 | |
| Water type used for inundation | Tap | |

| | Initial (o) | Final (f) |
|---|---|---|
| Sample height, H (in.) | 1.000 | 0.9844 |
| Sample diameter, D (in.) | 2.416 | 2.416 |
| Mass rings + wet soil (g) | 191.63 | 194.26 |
| Mass rings/tare (g) | 43.02 | 43.02 |
| Moist unit wt., $\gamma_m$ (pcf) | 123.49 | 127.67 |
| Wet soil + tare (g) | 583.34 | 277.79 |
| Dry soil + tare (g) | 517.11 | 253.69 |
| Tare (g) | 124.74 | 126.50 |
| Water content, w (%) | 16.9 | 18.9 |
| Dry unit wt., $\gamma_d$ (pcf) | 105.66 | 107.33 |
| Saturation | 78.03 | 91.49 |

| Stress (psf) | Dial (in.) | 1-D $\varepsilon_v$ (%) | $H_c$ (in.) | e |
|---|---|---|---|---|
| Seating | 0.0222 | 0.00 | 1.0000 | 0.578 |
| 20 | 0.0223 | 0.01 | 0.9999 | 0.577 |
| 100 | 0.0235 | 0.13 | 0.9987 | 0.576 |
| 200 | 0.0254 | 0.32 | 0.9968 | 0.573 |
| 100 | 0.0252 | 0.30 | 0.9970 | 0.573 |
| 200 | 0.0266 | 0.44 | 0.9956 | 0.571 |
| 300 | 0.0271 | 0.49 | 0.9951 | 0.570 |
| 600 | 0.0308 | 0.86 | 0.9914 | 0.564 |
| 1200 | 0.0357 | 1.35 | 0.9865 | 0.556 |
| 1200 | 0.0378 | 1.56 | 0.9844 | 0.553 |




Entered: _____
Reviewed: _____

# Direct Shear Test for Soils Under Drained Conditions

**(ASTM D3080)**



**Project:** 580 West Maple Street Subdivision
**No:** 01987-001
Location: Mapleton, Utah
Date: 8/26/2014
By: MP/NB

**Boring No.:** TP-1
**Sample:**
**Depth:** 6.0'
Sample Description: Brown sand with clay
Sample type: Undisturbed-trimmed from thin-wall

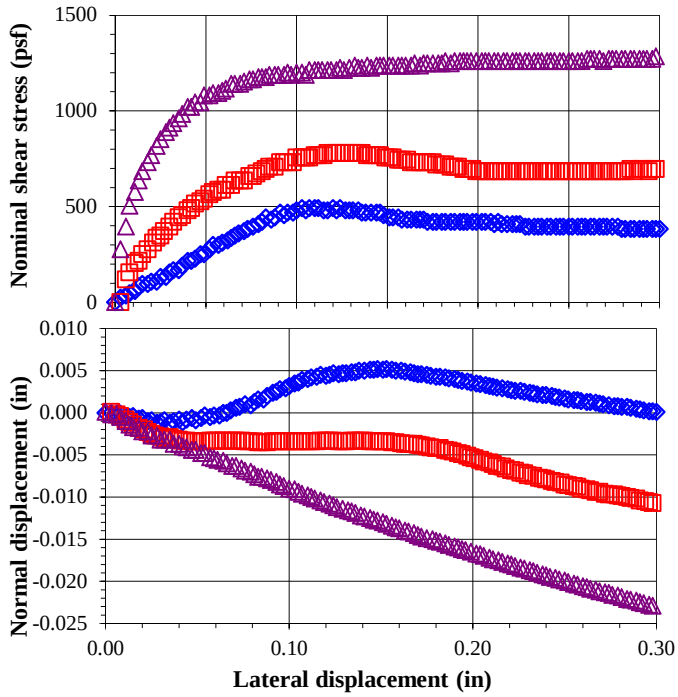
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0172
Specific gravity, Gs: 2.65 Assumed

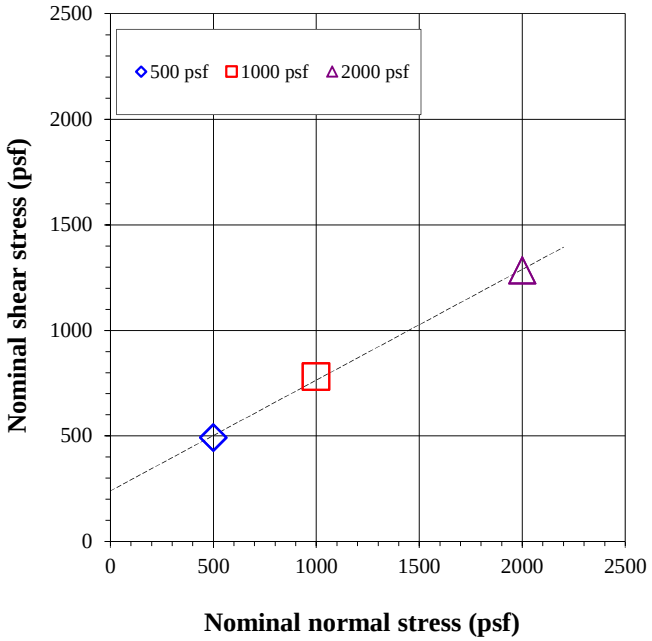
| | Sample 1 | | Sample 2 | | Sample 3 | |
|---|---|---|---|---|---|---|
| Nominal normal stress (psf) | 500 | | 1000 | | 2000 | |
| Peak shear stress (psf) | 492 | | 780 | | 1284 | |
| Lateral displacement at peak (in) | 0.103 | | 0.117 | | 0.298 | |
| Load Duration (min) | 1193 | | 1289 | | 289 | |
| | Initial | Pre-shear | Initial | Pre-shear | Initial | Pre-shear |
| Sample height (in) | 1.0000 | 0.9897 | 1.0000 | 0.9829 | 1.0000 | 0.9662 |
| Sample diameter (in) | 2.416 | 2.416 | 2.416 | 2.416 | 2.416 | 2.416 |
| Wt. rings + wet soil (g) | 173.45 | 185.33 | 170.30 | 182.97 | 176.92 | 186.08 |
| Wt. rings (g) | 42.92 | 42.92 | 42.48 | 42.48 | 44.40 | 44.40 |
| Wet soil + tare (g) | 453.88 | | 453.88 | | 453.88 | |
| Dry soil + tare (g) | 399.83 | | 399.83 | | 399.83 | |
| Tare (g) | 121.45 | | 121.45 | | 121.45 | |
| Water content (%) | 19.4 | 30.3 | 19.4 | 31.2 | 19.4 | 27.7 |
| Dry unit weight (pcf) | 90.8 | 91.7 | 88.9 | 90.5 | 92.2 | 95.4 |
| Void ratio, e, for assumed Gs | 0.82 | 0.80 | 0.86 | 0.83 | 0.79 | 0.73 |
| Saturation (%)* | 62.6 | 100.0 | 59.8 | 100.0 | 64.8 | 100.0 |

| | |
|---|---|
| ϕ' (deg) | 28 |
| c' (psf) | 240 |

| Average of 3 samples | Initial | Pre-shear |
|---|---|---|
| Water content (%) | 19.4 | 29.7 |
| Dry unit weight (pcf) | 90.7 | 92.5 |

*Pre-shear saturation set to 100% for phase calculations




Entered by:_____
Reviewed:_____

**Direct Shear Test for Soils Under Drained Conditions**

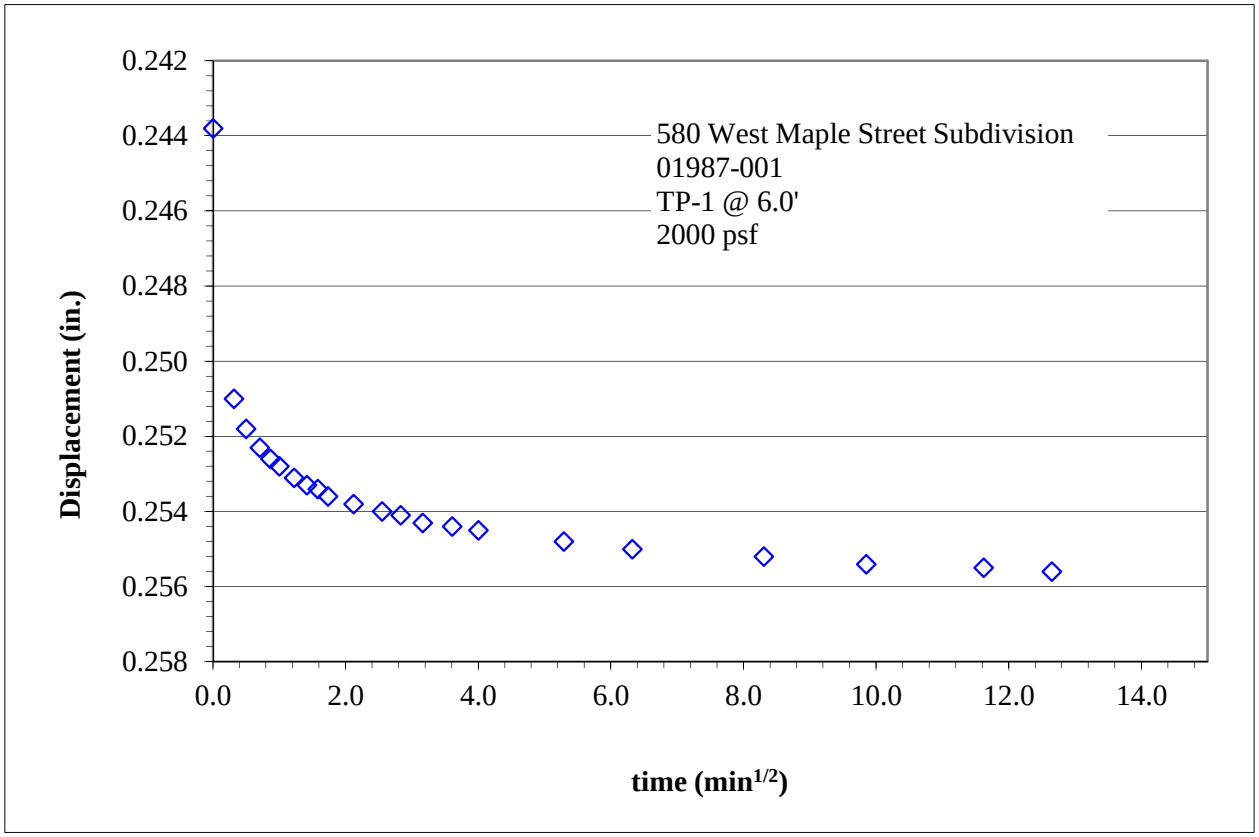
**(ASTM D3080)**

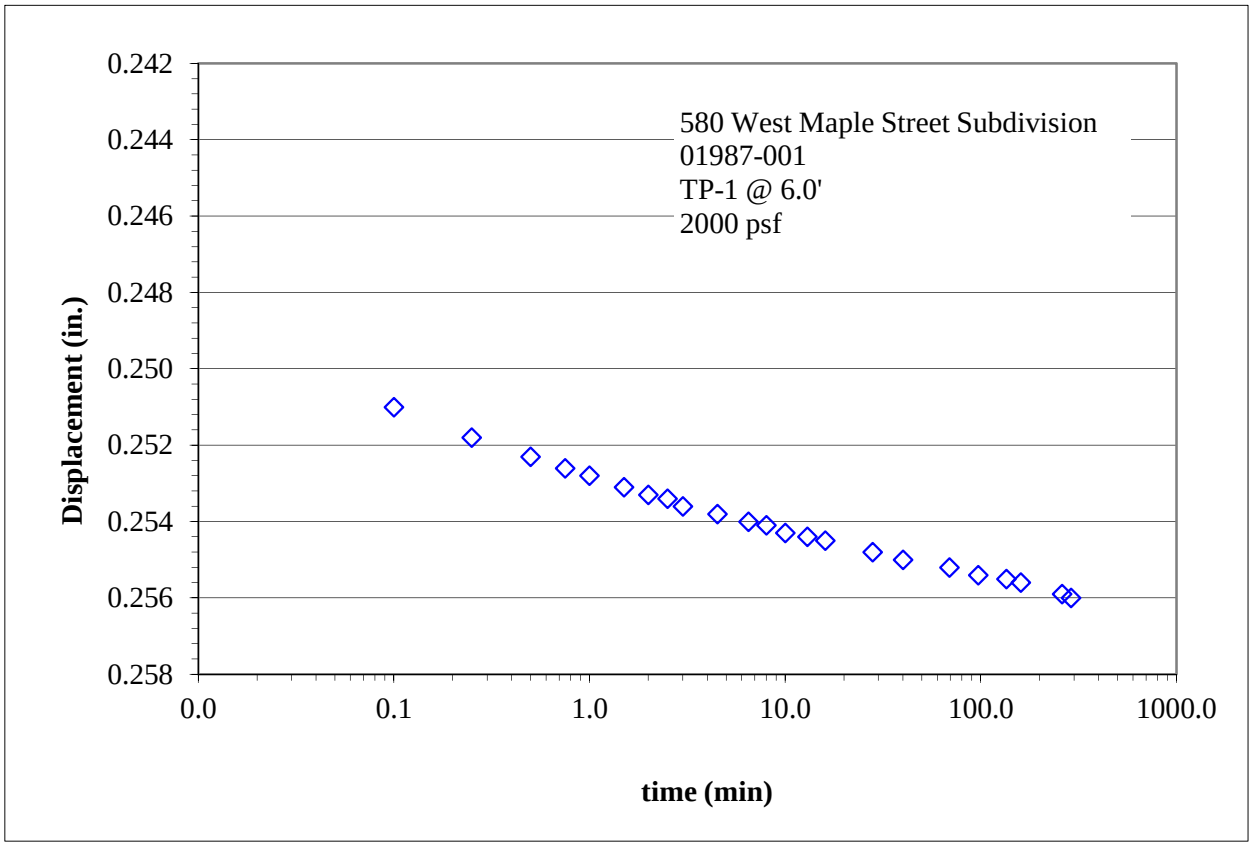


**Project:** 580 West Maple Street Subdivision **Boring No.:** TP-1

**No:** 01987-001 **Sample:**

Location: Mapleton, Utah **Depth:** 6.0'



**Minimum Laboratory Soil Resistivity, pH of Soil for Use in Corrosion Testing, and Ions in Water by Chemically Suppressed Ion Chromatography** *(AASHTO T 288, T 289, ASTM D4327, and C1580)*



**Project:** **580 West Maple Street Subdivision**
**No:** **01987-001**
Location: Mapleton, Utah
Date: 8/25/2014
By: ET

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample info. | Boring No. | TP-1 | | | | | | | |
| | Sample | | | | | | | | |
| | Depth | 6.0' | | | | | | | |
| Water content data | Wet soil + tare (g) | 117.46 | | | | | | | |
| | Dry soil + tare (g) | 110.18 | | | | | | | |
| | Tare (g) | 37.13 | | | | | | | |
| | Water content (%) | 10.0 | | | | | | | |
| Chem. data | pH | 7.60 | | | | | | | |
| | Soluble chloride* (ppm) | 31.0 | | | | | | | |
| | Soluble sulfate** (ppm) | 19 | | | | | | | |
| | | | | | | | | | |
| Resistivity data | Pin method | 2 | | | | | | | |
| | Soil box | Miller Small | | | | | | | |
| | | Approximate Soil condition (%) | Resistance Reading (Ω) | Soil Box Multiplier (cm) | Resistivity (Ω-cm) | Approximate Soil condition (%) | Resistance Reading (Ω) | Soil Box Multiplier (cm) | Resistivity (Ω-cm) |
| | | As Is | 16440 | 0.67 | 11015 | | | | |
| | | +3 | 14760 | 0.67 | 9889 | | | | |
| | | +6 | 11950 | 0.67 | 8007 | | | | |
| | | +9 | 9350 | 0.67 | 6265 | | | | |
| | | +12 | 8340 | 0.67 | 5588 | | | | |
| | | +15 | 7490 | 0.67 | 5018 | | | | |
| | | +18 | 7230 | 0.67 | 4844 | | | | |
| | | +21 | 7260 | 0.67 | 4864 | | | | |
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| | | | | | | | | | |
| | **Minimum resistivity (Ω-cm)** | **4844** | | | | | | | |

* Performed by AWAL using EPA 300.0

** Performed by AWAL using ASTM C1580

Entered by:_____
Reviewed:_____

Attachment "5"
Corresondence

**Lawrence A Haines**
1000 South 800 East Mapleton, Utah 84664 USA
Telephone 1-801-489-6600 Cell Phone 1-801-376-8281
Email lhaines@digis.net

Dear Mapleton Citizen

For many years there has been a feeling by a number of residents that we should have a cemetery here in Mapleton. I know this has been my desire as well. The city officers have been working toward that end for some time now. I would appreciate your signing the attached document indicating, if you agree, that it would be desirable to have a cemetery in our own town. I am suggesting this, since a plan will be presented to the Planning Commission on February 12th for the construction of such a facility.

Two of our residents, will be presenting a plan for the Mapleton Cemetery to be located at 620 West Maple Street. In order to get things going it will be privately owned, similar to Provo's large East Lawn Cemetery. It will allow everyone who desires such a place, to have a beautiful and well cared for facility right here in town for many, many years.

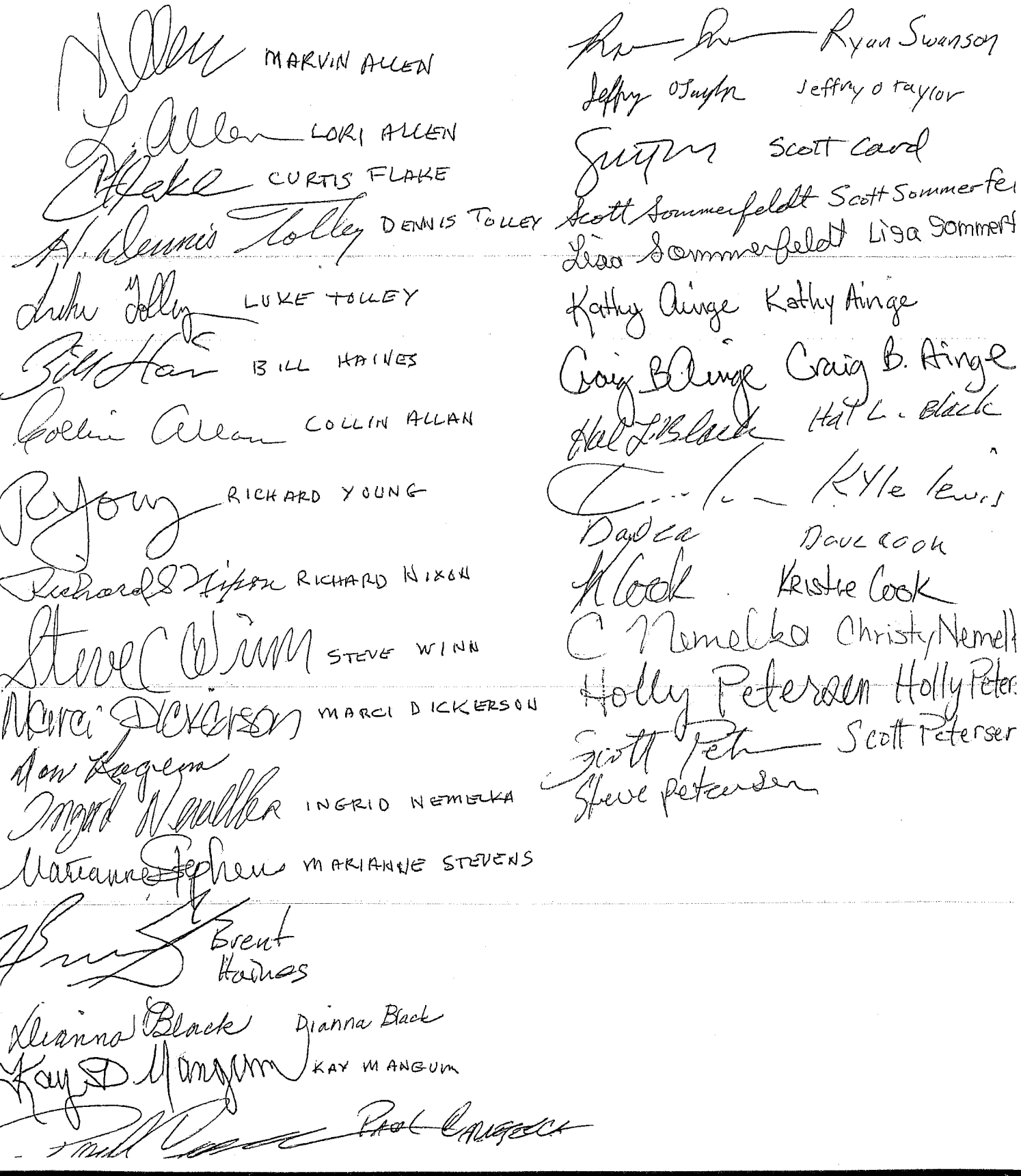
I hope you have the same enthusiasm that I feel about this dream becoming a reality. I would appreciate your helping this along with your signature. I am sure the city will take care to insure that the project is well done.

Sincerely,

Larry

# Mapleton Cemetery

The following few signatures are from citizens in Mapleton who would like to see a cemetery located in Mapleton.



www.msu.edu/~sta/Anderson open space thesis.pdf

# The Effect of Open Space on Residential Property Values in St. Paul, MN

**Soren Tyler Anderson**
**Advisor: Sarah West**

**Macalester College**
Department of Economics
1600 Grand Avenue
St. Paul, MN 55105

**May 2001**

# The Effect of Open Space on Residential Property Values in St. Paul, MN


## Abstract

In order to make informed policy decisions regarding the preservation of open space areas, communities need knowledge of individuals' preferences *for* and the value *of* open space amenities. There is no explicit market for these amenities, but the benefits of open space may be reflected in nearby home values. Using home transaction data from the St. Paul, MN area, I employ hedonic regression analysis to estimate the effect of proximity to open space (parks, golf courses, and cemeteries) on home sales price, controlling for home structural attributes, neighborhood characteristics, home location, and other amenities. Proximity measures were derived from regional land use data using geographic information systems (GIS) software. Overall, I find that proximity to parks and cemeteries has a negative effect on home value, while proximity to golf courses has a positive effect. As the first open space study to do so, however, I also compare how these spatial relationships differ within city and suburban sub-markets. Within the city of St. Paul, I find that proximity to parks has a *positive* effect on home value of $354 (0.25%) per 100 meters. In the suburbs, proximity to parks has a *negative* effect of $252 (0.18%) per 100 meters. These results confirm the importance of considering context when modeling complex spatial relationships in residential housing markets.


Key words: open space, hedonic, geographic information systems (GIS)

The coefficient estimates on the accessibility variables are all statistically significant and imply that proximity to the CBD (LCBD), job centers (LJOB), and major highways (LHWY) decreases home value by $280, $280, and $1910 dollars per kilometer, respectively. While it makes sense that proximity to highways may be a disamenity, the coefficient estimates on LCBD and LJOB are unexpected.[42] The coefficient estimate on LCOM implies that proximity to a shopping center or commercial area increases home value by $650 per kilometer.

Finally, I turn to the coefficient estimates measuring the effect of open space and other environmental amenities on home value. The coefficient on LPARK implies that proximity to a park decreases home value by approximately $240 per 100 meters.[43] Though less significant, the coefficient on LGOLF suggests that proximity to a golf course increases home values by $33 per 100. Proximity to cemeteries has a statistically significant negative impact of $70 per 100 meters, as measured by LCEM. Not surprisingly, proximity to rivers increases home value by $45 per 100 meters, as measured by LRIVER. Finally, though statistically insignificant, the coefficient on LLAKE implies that proximity to lakes has the unexpected effect of decreasing home value by $17 per 100 meters.

I also estimated a second version of Model I in which I replaced the environmental amenity proximity variables with "adjacent" dummy variables. For each observation, these dummies were set equal to one if the home was within 200 meters of the amenity (i.e. PARKADJ = 1 if PARK < 200). The results of this regression can be found in Appendix II. With few exceptions, this regression's estimates for the structural, neighborhood, and accessibility coefficients are consistent with the estimates of the original Model I (Table VIII). The coefficient estimates on the amenity variables are all statistically significant. A park within 200 meters decreases home value by approximately $4,700. A golf course within 200 meters increases home value by $2,900. A cemetery within 200 meters decreases home value by $12,300. A river within 200 meters increases home value by $30,300, and a lake increases home value by $8,100. These estimates corroborate the results above.[44]

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[42] Although, since many people hate to work, the coefficient on JOB may make sense, after all (ha ha).

[43] This does not necessarily mean that parks *cause* home values to decrease. In fact, the causal relationship may be reversed. As Leggett (1999) discusses, parks may be "*placed* in geographic areas that are less desirable for residential use...that there may be something inherently undesirable about the area" (p. 8) in which a park is located.

[44] And reassure me by showing that a lake has a positive effect on home value.

Comparing this map to its counterpart from Model I (see Figure 7), it is clear that there is less spatial autocorrelation in the segmented model. This improvement is especially evident within the city of St. Paul itself. Model I consistently under-predicts home values on the west side of St. Paul and over-predicts home values on the east side. In Model III, this pattern of autocorrelation is less distinct. Outside the city of St. Paul, it is difficult to see any improvement. This is not surprising. There are significantly more observations outside the city of St. Paul than within, so the suburbs are less likely to be affected by the segmentation. Thus, Model III is probably superior for predicting home values within the city of St. Paul. Model III may also be superior for predicting suburban home values, though only slightly so.

There are two possible explanations for the improvement demonstrated by Model III. First, it may be that the ability of the neighborhood variables to control for spatial relationships is hindered in the full sample by the relative homogeneity of the suburbs. Overall, neighborhood characteristics are of little importance in Model I, since the suburban observations dominate the full sample. But this leads to spatial autocorrelation in the city of St. Paul due to its relative spatial heterogeneity. In the segmented model, the neighborhood characteristics adequately control for spatial heterogeneity, as they are unhindered by the homogeneity of the suburbs. A second explanation is that there actually *is* city/suburban segmentation in the housing market.[55] The differences in marginal implicit prices between the city and suburban sub-market regressions in Model III support this hypothesis.

## C. Comparison and Discussion of Results

The estimated effects of open space on home value in this study are fairly consistent with prior research (see Table II). My estimates for the effect of adjacency to a golf course range from 2.1 – 2.5%.[56] These estimates are slightly lower than the 5.2 – 7.6% range set forth by the previous literature. I estimate that proximity to golf courses increases home value by 6.3E-5 – 0.001% per meter. This is within the 0.001 – 0.03% range of previous estimates. I estimate that adjacency to cemeteries decreases home by 3.95 – 8.64%. This is effect is stronger than the previous estimate of a negative 0.008%.[57] In the case of parks, I

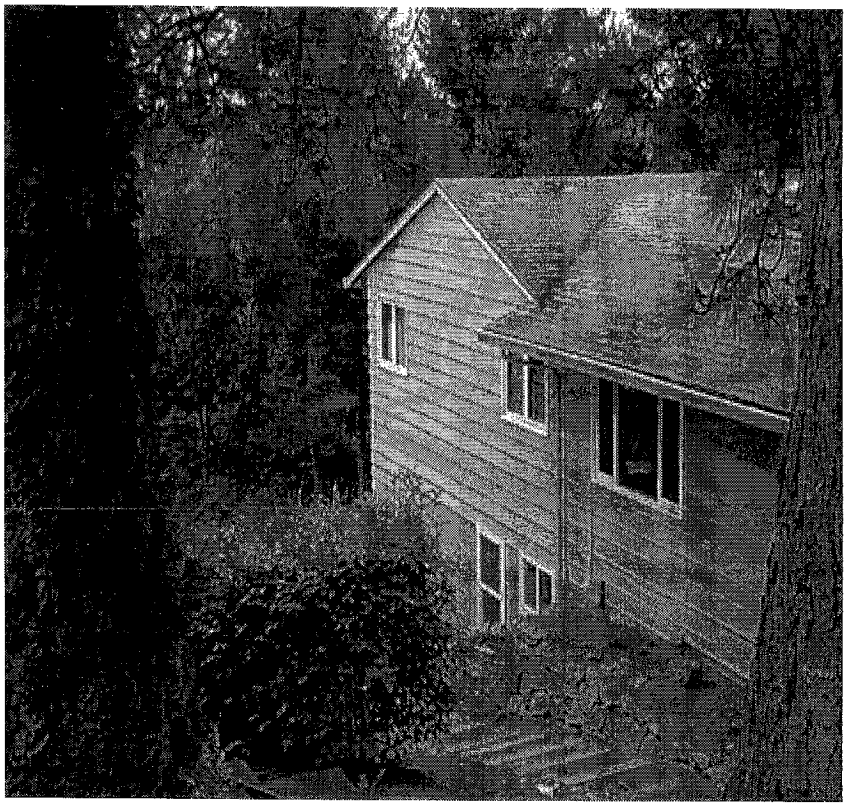
[55] The existence of city/suburban market segmentation does not imply that there is not a more complex pattern of market segmentation, which may in fact be the case.

[56] I convert my coefficient estimates to "percent effects" in order to compare to previous studies. Estimate ranges come from Model I and Model III.

[57] No previous studies estimate the effect of proximity to a cemetery. But, at a distance of 500 meters, my proximity estimates imply an *adjacency* range of negative 0.24% to negative 042%, which is a stronger effect than the previous adjacency estimate.

I further submit, that sale of a residence next to a cemitary substatially reduces the number of interested buyers, making the property that much more difficult to sale.

# SUMMARY REPORT and WORKING PAPER



# *The Effect of Environmental Zoning and Amenities on Property Values: Portland, Oregon*

*Prepared for the Portland Bureau of Planning by Dr. Noelwah Netusil, Associate Professor of Economics, Reed College, April 21, 2003*

Summary Report prepared by the
City of Portland, Bureau of Planning
Portland, Oregon - May 2003

RIVER RENAISSANCE

Streams (HPS), is intended to ensure that environmental zoning and non-regulatory tools are effective in conserving significant riparian and wildlife habitat resources. The HPS project is also intended to advance Portland's compliance with Metro's natural resources program and the federal Endangered Species Act and Clean Water Act.

In response to the initial HPS proposal, many property-owners expressed concern that environmental zoning may negatively affect their property values. Property owners expressed concern that environmental zones can constrain development potential and may be perceived as problematic to a prospective buyer. Some residents expressed a belief that environmental overlay zones may positively affect their property values by protecting trees and greenspaces in their neighborhoods.

In light of the questions raised, the Portland City Planning Bureau contacted Dr. Noelwah Netusil, Associate Professor of Economics at Reed College, to see if it would be possible to determine the effects of environmental overlay zoning on property values. Dr. Netusil has demonstrated expertise in this area by publishing several studies that examine the relationships between natural resources and property values in the Portland area. She also serves on Metro's Regional Economic Technical Advisory Committee. Based on Dr. Netusil's project proposal and strong qualifications in this area of study, and Reed College's reputation for academic excellence, the City contracted with Reed College to conduct the study. Reed College assigned Dr. Netusil to serve as principal investigator for the project.

The Planning Bureau distributed the project scope to a targeted set of stakeholders for review, including the broad-based Healthy Portland Streams Citizen Review Committee, several staff members from other City bureaus and Metro, and staff of the Association for Portland Progress. Dr. Netusil and Planning Bureau staff briefed Metro's Economic Advisory Committee on the research project. Planning Bureau staff also informed Portland's River Economic Advisory Committee about the project. Staff received some helpful questions and input on the project purpose and scope. Several people expressed interest in the study and asked to be provided the results when the work was completed.

## II. STUDY APPROACH

### Methodology

Dr. Netusil used the Hedonic Price Method for this study. The Hedonic Price Method allows a researcher to estimate, on average, how specific factors (called "explanatory," or "independent variables") affect the price of a good (called the "dependent variable"), holding other key factors constant. Using the Hedonic Price Method, Dr. Netusil was able to estimate the effect of environmental zoning and resource amenities on the sale price of single-family residential properties.

- Slopes and streams combined – The combination of slopes and streams on a property was estimated to have a 12% negative effect on property sales price.

- Streams and Tree Canopy combined - Properties with both trees and streams were found to sell for 9.41% more than properties without a stream and tree canopy.

- Parks and Trails- Specialty parks (e.g., Oaks Park), trails, and cemeteries within 200 feet of a property were found to have a statistically significant effect on a property's sales price. Specialty parks were estimated to increase sales price by 1.75% while trails and cemeteries were estimated to decrease a property's sale by 6.81% and 4.36%, respectively. The report suggests that the negative trail effect might reflect the types of trails included in this study. These were primarily large regional trails, many of which are along rail rights-of-way that are located in or close to industrial areas.

  Specialty parks, urban parks, and golf courses located within 200 feet to ¼ mile from a property, were estimated to effect sales price positively, while the estimated effect of trails and cemeteries remained negative.

  Located ¼ - ½ mile from a property, golf courses were found to have a positive effect on sales price, while cemeteries were estimated to have a negative effect. Trails are estimated to have a positive effect at ¼ - ½ mile from a property. Natural areas were found to have a negative effect if located ¼ - ½ mile from a property. This finding is counter to previous literature showing that property values are higher for properties located near natural areas (Lutzenhiser, M. and N.R. Netusil. 2001. The Effect of Open Space Type on a Home's Sale Price: Portland, Oregon Contemporary Economic Policy, 19 (1): 291-298).

- Oversize Lots - The sale price of oversize (potentially subdividable based on zoning) lots that have environmental zones was not found to be statistically different than oversize lots that do not have environmental zones.

## IV. FUTURE RESEARCH OPPORTUNITIES

The study raises a number of questions that may warrant additional research:

- Why were the effects of environmental overlay zones found to not be statistically significant in most situations, but were found to be significant and strongly negative in Northwest area, and significant and strongly positive in the North area? A study to analyze the effect of views on home sales price could potentially help explain these results.

10:12 am ET
Oct 31, 2011 FLORIDA

# Selling Homes Near Dead People



*By Maya Pope-Chappell*

Today's housing market is scary enough. Who needs a home that might actually spook someone?

But it's Halloween, so Developments decided to see how homes fit for a fright do when it comes to courting real live buyers. Cemeteries seemed like a good place to start since nothing says Halloween like gravestones.

— Natalie Keyssar for The Wall Street Journal The view from Patrick Bombino's studio overlooking the Washington Cemetery in Brooklyn.

Of course, this is a hard question to answer since lots of competing factors could affect any price differential. But given that, here are two interesting examples:

A sampling of recorded sales from the real-estate data firm **StreetEasy** shows that homes within about a two-block radius of the Mount Olivet Cemetery in Queens, N.Y. have a median sales price of $355,000. The median sales price for homes within a roughly 10-block radius of the cemetery is $388,000.

Property devaluation of $33,000

This increase in the median sales price of homes farther from the cemetery can also be found surrounding the New York City Marble Cemetery in the East Village neighborhood of Manhattan. There, the median sales price within a roughly two-block radius is $695,000, whereas the median sales price for homes within a roughly 10-block radius is $800,000

Conclusive? Not really. So what do people say who actually live next to cemeteries? Does it hurt their price, or perhaps even help it among the fans of Halloween?

Patrick Bombino wasn't spooked when he purchased his studio in a luxury high-rise in Brooklyn that overlooks a cemetery. On the contrary, he said, 'I loved it.'

The reason: because of the unobstructed views, the ease of parking and the, well, peace and quiet.

"Another advantage is if I have to drop dead, I can jump out the window and I'm there," joked Mr. Bombino, a Philadelphia resident who uses the studio during business trips to New York City.

Mr. Bombino's studio, which has a sleeping alcove and a windowed kitchen, has been on the market since April. It was initially listed for $75,000, but the price was reduced to $68,000.

His broker, Marguerite Stasek of Bridgeview Realty of NY Inc., said that while some potential homebuyers are superstitious, many are not fazed by the cemetery. As for the home's value, she said, "I don't think it's affected it that much."

While Mr. Bombino enjoys staying next to a cemetery, not everyone is keen on the idea of living next to a grassy field full of headstones, wilted flowers and dead people.

"It's probably not the best place to buy," said agent Lisa Cannata of Today Real Estate in Massachusetts, who warns her clients against purchasing property next to a burial ground. "It's not a great idea for the resale value because people find it eerie."

A couple of years ago, she said she had a client who was trying to sell a newly built home with a backyard that abutted a cemetery. "It had everything going for it, but it was hard to sell because it was next to a graveyard. The price was reduced considerably before they could sell it."

That said, some say a cemetery doesn't look so bad when compared with other types of neighbors.

Bill Eckler, a real estate agent in Southwest Florida, said living near a landfill or an airport is more of a headache. "Those locations have a much greater impact on the current and future value of the property," Mr. Eckler said. "And then to a lesser degree, being located in proximity to a school—and then cemeteries."

While owning and selling a home next to a cemetery may not be for everyone, Mr. Bombino said there's no reason to be frightened by the investment—at least most days. When it comes to spending Halloween at the studio, he said, "That one day is a little eerie for me."

Work?

Property devaluation of $105,000

'Leaks' Imperil Retirement Savin

Sh

DEVELOPMENTS HOME PAGE

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