

**REPORT
GEOTECHNICAL REVIEW
PROPOSED PRISON RELOCATION SITES
I-80/7200 WEST
SALT LAKE CITY, UTAH**

September 15, 2015

Job No. 003-019-15

Prepared for:
State of Utah – DFCM
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State of Utah – DFCM
Suite 4110 State Office Building
Salt Lake City, Utah 84114

Attention: Mr. Jim Russell, Assistant Director

Ladies and Gentlemen:

Re: Report
Geotechnical Review
Proposed Prison Relocation Sites
I-80/7200 West
Salt Lake City, Utah

1. INTRODUCTION

This report presents a summary of two preliminary geotechnical studies^{1, 2} which were performed at the I-80/7200 West Site as part of the Prison Location Commission study which was performed to aid in selecting a new site for the State Correctional Facility which is presently located in Draper, Utah. The I-80/7200 West Site in reality consists of two sites which we have labeled as the “East” and “West” sites. The general location of these sites on an air photo base, with respect to proposed 7200 West Street, Interstate I-80, the Salt Lake International Center, the Goggin Drain, and other features is presented on the attached figure, Proposed Prison Relocation Sites. The general location of these sites is fairly accurate. However, the boundaries of the sites, especially the “East” site, should be considered as approximate.

¹ “Preliminary Geotechnical Investigation, I-80/7200 West, State of Utah Prison Relocation Commission, Salt Lake City, Utah,” Epic Job Number: 15-MGT-004, Dated August 3, 2015. (“East” Site)

² “Preliminary Geotechnical Investigation, I-80/7200 West Expanded, State of Utah Prison Relocation Commission, Salt Lake City, Utah,” Epic Job Number: 15-MGT-004.01, Dated August 3, 2015. (“West” Site)

The two preliminary geotechnical reports prepared as part of the site selection study as requested by the Prison Relocation Commission are as follows:

- Preliminary Geotechnical Investigation, I-80/7200 West, State of Utah Prison Relocation Commission, Salt Lake City, Utah,” Epic Job Number: 15-MGT-004.01, Dated August 3, 2015. – “East” Site
- Preliminary Geotechnical Investigation, I-80/7200 West Expanded, State of Utah Prison Relocation Commission, Salt Lake City, Utah,” Epic Job Number: 15-MGT-004.01, Dated August 3, 2015. – “West” Site

“East” and “West” sites have been added to the titles of the reports to help clarify which report pertains to which of the two sites “East” and “West”.

2. GEOGRAPHICAL REFERENCES

As part of our review study, we have relied heavily on the geotechnical data and discussions and recommendations presented in the two above reference reports. In addition we have relied heavily upon the numerous detailed geotechnical studies listed below.

1. Detailed studies performed over the last 30+ years at the Salt Lake International Center.
2. Salt Lake International Airport
3. The relocation of the Goggin Drain, as part of the construction of the west primary runway at the Salt Lake International Airport.
4. Feasibility study performed for diking of the south and southeast portions of the Great Salt Lake.
5. Detailed geotechnical studies performed for recently proposed commercial developments on both the immediate south and north sides of I-80 and SR 201 in the area of 7200 West.
6. The Davis County jail in Farmington Utah.
7. Numerous high voltage transmission lines which cross the site.

As this review study progressed it became more and more evident that the geotechnical setting of both the “East” and “West” sites is very similar to the Salt Lake International Center site. In addition, the types of structures that have been and are being constructed at the International Center are very similar to the projected facilities at the new prison site.

2.1 SALT LAKE INTERNATIONAL CENTER

This writer has worked on a majority of the existing facilities since the conception of the Salt Lake International Center development. The site structures are primarily one to one-extended levels in height and established slab-on-grade and/or over dock-height fills. Except for one or two proposed structures which anticipated extremely heavy floor slab loading, 700 to 800 pounds per square foot, most floor slab loads were 150 to 200 pounds per square foot. For the 700 to 800 pounds per square foot floor load buildings preloading was considered.

To the best of our knowledge no adverse geotechnical related problems have occurred. The structures are supported upon conventional spread and continuous wall foundations established over replacement fill in order to control total and differential settlements. Differential movements associated with liquefaction have been calculated to be minor to moderate and have been handled by upgrading structural components of the structures.

The recently constructed FBI building is a two to three level structure in the west-central portion of the development. Because of security reasons the building is quite heavy and is supported upon conventional spread and continuous wall foundations established over soils improved by first installing rammed aggregate piers. Three- to four-story buildings including hotel structures are supported upon conventional spread and continuous wall foundations over replacement granular structural fill.

2.2 SALT LAKE INTERNATIONAL AIRPORT

This writer has performed numerous detailed geotechnical studies across the airport site for runways, taxiways, roadways, small to large hangars, terminals and parking lot structures. Majority of the light to moderately loaded structures have been supported upon conventional spread and continuous wall foundations established over replacement fill with no adverse geotechnical related problems. The more heavily loaded structures have been supported upon closed-end pipe piles.

We anticipate that the new proposed terminal will be supported upon conventional foundations established over soils improved utilizing compacted aggregate piers in lieu of replacement fill.

2.3 GOGGIN DRAIN

I have performed geotechnical related services for the relocation and construction of new structures associated with the Goggin Drain which was relocated between Salt Lake International Center and the new west runway. The drain extends northwest through the undeveloped areas north and west of the Salt Lake International Center.

2.4 PERIMETER DIKING SOUTH AND SOUTHEAST SIDES OF GREAT SALT LAKE

In anticipation of the rise in the level of the Great Salt Lake, numerous conceptual studies were performed with regard to constructing protection embankment dikes along the north and southeast shoreline of the Great Salt Lake and a pumping station west of the lake. The embankment dikes were considered to protect I-80 and anticipated commercial developments.

The reports provided foundation, anticipated settlement, material sources, wave, and wind run-up discussions.

2.5 RECENT COMMERCIAL DEVELOPMENTS

During the past few years, numerous commercial developments for typical one to two level structures in the high water table, soft and compressible flatland areas within the western portion of the valley adjacent to both the north and west sides of State Route 201 and Interstate 80 have been performed. All of the structures have been supported upon conventional spread and continuous wall foundations upon replacement granular fill.

No unusual geotechnical problems were uncovered.

2.6 DAVIS COUNTY JAIL

Davis County jail was constructed in a high groundwater and compressible soil area adjacent to the Farmington lateral spread area on the west side of Interstate I-15. The one to two level structures were established over a granular structural fill sequence reinforced with a Tensor reinforced fabric system in order to reduce differential static and seismic related (liquefaction) settlements. Conventional spread and continuous wall foundations were used.

2.7 HIGH VOLTAGE TRANSMISSION LINES

The high voltage transmission lines which cross the area are all supported upon pile foundations. The tower-foundations are subject to high wind induced uplift loads.

No foundation problems have been recorded. A few towers have sustained structural damage under extremely heavy wind loadings.

3. SUPPLEMENTAL CONCERNS

3.1 GENERAL

Two items which have come up in conjunction with this writers past experience related to studies near the prison sites.

The first is related to the maximum anticipated level of the Great Salt Lake. Studies that were performed previously lead to the establishment of the large pumping facility on the west side of the Great Salt Lake. The primary purpose was to monitor the Great Salt Lake's level below a specified elevation during periods of prolong heavy precipitation, climate change, etc. In conjunction with the pumping station, the feasibility of installing low-height dikes on the south and southeast sides of the Lake was evaluated to project facilities further to the south and southeast against wind tides, wave run-up, and even upon the remote possibility of a tsunami developing on the Great Salt Lake. The probability of a tsunami was considered as being extremely remote. Wind tides and wave run-up are a very specific and definite concern. Past experiences indicated that during periods of sustained north-northwesterly winds that a wind tide at the south harbor of at least two feet can develop. This is in addition to the large waves associated with the sustained northwest winds. The diking system was evaluated to aid in controlling short-term wind tide and high wave run-up situations.

As a minimum, it is our opinion that the general grade of the site selected would be at least one foot or so above the maximum anticipated level of the Great Salt Lake even when controlled by pumping and that depending upon location distance, present shoreline, etc. that a low-height berm possibly be constructed on the western portion of the selected site in order to control wind tide and wave run-up situations.

The second concern relates to Kennecott's tailings pond. Many years ago as part of detailed seismic stability studies there were scenarios where the pond could fail resulting in quite extensive lateral washouts to the south, east, and northeast of the original confining embankments. Over the years, it is my understanding that Kennecott has initiated numerous procedures with regard to the embankment stability especially under seismic conditions and thus has reduced or eliminated this potential concern. It is, however, our opinion that this potential scenario must be discussed with appropriate Kennecott Cooper personnel.

3.2 PROPOSED CONSTRUCTION

The proposed construction discussed in the preliminary geotechnical reports in our opinion reasonably represents the type of structures to be constructed and matches the configuration and loadings associated with the Davis County facility.

3.3 EXPLORATIONS

The numbers of borings and test pits extended and cone penetration test (CPT) sounding probes performed were more than adequate for the preliminary studies that were performed.

3.4 LABORATORY TESTING

In conjunction with both sites, a very large number of laboratory tests were performed. The majority of index tests define the general overall characteristics of the site soils and aid in

correlating more sophisticated tests. These tests include moisture and density, partial and full gradation, and Atterberg Limits tests. The large amounts of index tests performed minimize the amount of similar testing required in conjunction with future detailed studies.

3.5 SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

Subsurface soil conditions encountered at both the “East” and “West” sites are very similar to those which have been encountered at the Salt Lake International Center. As previously discussed relatively standard typical construction has been utilized at the Salt Lake International Center site. The only exception is the FBI building which was constructed in the last five years. At that site ground improvement through the utilization of rammed aggregate piers/Geopiers[®] was incorporated. Standard conventional spread and continuous wall foundations were established over the improved soil. This was necessary because of national security precautions, etc.

The groundwater levels at the “East” site are somewhat deeper and again very similar to those encountered at Salt Lake International Center. From an overall geotechnical/subsurface soil and groundwater condition standpoint the “East” site is in our opinion somewhat more favorable. However, conditions at the “West” site would not significantly alter the discussions and recommendations provided herein.

4. DISCUSSION AND RECOMMENDATIONS

4.1 AREAL SETTLEMENTS

In order to establish the base grade of either site, a significant amount of areal structural fill will be required. As a minimum, it is anticipated that at least one and one-half to two feet of granular structural site grading fill will need to be placed over the majority of either site in order to improve trafficability for subsequent construction and to facilitate the overall drainage plan. Somewhat thicker base fill may be required depending upon studies comparing the maximum anticipated level of the Great Salt Lake and items as previously discussed.

In addition to the one and one-half to two feet of general site grading fill, building pads will be established an additional one and one-half to two feet above the general grade of the overall prison site.

Based upon review of the laboratory data provided in the preliminary geotechnical reports and our experience in the area, it is our opinion that the majority of the underlying fine-grained cohesive soils are over-consolidated to a point where five to six feet or more of structural site grading granular fill can be placed over large portions of the site and still impose loads less than the preconsolidation pressures of the clays. This will result in elastic settlement which will occur almost instantaneously with application of load.

As a general statement preloading of either site should not be required unless extremely heavy areal loads are realized. To be affective, preloading would require two to three months.

If subsequent studies indicate that protection berms are necessary along the western limit of the site to control potential wind tide and heavy wave run-up action under maximum lake levels protection embankments possibly another six to eight feet in height could trigger what we would call normal consolidation settlements. Locations of these dikes, however, would be such that larger magnitude areal settlements associated with the embankment would not affect the overall performance of the prison site.

4.2 FOUNDATIONS

4.2.1 Spread and Continuous Wall Foundations

It is our opinion that the majority, if not all, of the proposed facilities associated with the proposed prison may be supported upon spread and continuous wall foundations. In order to control total and differential settlements, it should be anticipated that as much as approximately three to three and one-half feet of replacement granular fill may be required beneath the more heavily loaded foundations. In some cases, if the foundation loads are quite heavy and extremely positive settlement control is required, the soils beneath the spread and continuous wall foundations may be improved with rammed aggregate piers/Geopiers[®]. This occurred under portions of the recently constructed FBI building at the Salt Lake International Center. At this time we see no need for preloading; that is, surcharging, either of the sites or for specific buildings. The only preloading that we considered within the Salt Lake International Center was for two buildings were extremely heavy floor slab loads in the range of 700 to 800 pounds per square foot where anticipated.

4.2.2 Pile Foundations

Based on the subsurface conditions identified and projected loading, we do not anticipate the need for utilization of driven piles or drilled piers. The previous preliminary geotechnical studies discussed utilization of piles in order to support the proposed structure as part of site development. In particular, the reports discussed wood piles. I have not seen the utilization of wood piles in the Salt Lake City area in my 40+ year career.

4.2.3 Mat Foundations

In some circumstances, utilization of a mat foundation established essentially at-grade could be considered in order to control total and differential settlements, especially relating to potential liquefaction. It is our opinion that there are other less costly means of mitigating the liquefaction problem including soil improvement and/or tying conventional spread and continuous wall foundations laterally together.

Over the years there have been many sites selected for schools, especially in Davis County, where liquefaction potential would be considered as moderate. In order to provide the appropriate structural control of these critical facilities conventional spread and continuous wall foundations have been utilized but they have been tied together laterally. This provided life safety. Establishment of conventional spread and continuous wall foundations over laterally reinforced granular fill pads such as the Davis Jail can also be considered.

4.3 GEOSEISMIC SETTING

4.3.1 General

As of July 2013, the State of Utah has adopted the International Building Code (IBC) 2012. The IBC 2012 code determines the seismic hazard for a site based upon 2008 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

The structures must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2012 edition.

4.3.2 Faulting

Based on our review of available literature, no active faults pass through or immediately adjacent to the site. The nearest known active fault is the Granger fault which is located approximately one mile east of the "East" site and three miles east of the "West" site. The Wasatch fault zone with controlled groundwater and is considered capable of generating earthquakes as large as magnitude 7.0.

4.3.3 Soil Class

For dynamic structural analysis and where liquefaction will not be a major factor, Site Classes D or E as defined in Table 20.3-1, Site Classification, of ASCE 7-10 April 6, 2011 can be utilized.

Since the saturated soils could liquefy during the design seismic event. According to the IBC 2009 Table 1613.5.2, "Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils..." are designated under Site Class F. The potential settlements due to liquefaction can be generally controlled to a range of one to two inches by installing rammed aggregate/Geopiers[®] for liquefaction. Under this condition liquefaction-induced settlements would be deep and it may be possible to utilize Site Classes E or D. This magnitude of settlement can typically be tolerated by an adequately designed structure to provide life safety.

4.3.4 Liquefaction

The site is located within an area that has been identified by Salt Lake County as having “high” liquefaction potential. Preliminary analysis also indicates that the potential for liquefaction is relatively high. Our experience, however, indicates that the magnitude of liquefaction-induced settlements provided in the preliminary reports and the concern of lateral spread are over emphasized. The liquefaction associated with near-surface soil can be eliminated or drastically reduced by soil improvement, such as installing rammed aggregate/Geopiers[®]. Ground rupture is not anticipated to be a high concern.

4.4 CORROSION

Our experience in the area indicates that concrete utilizing standard Type I or IA cement can be utilized at the sites.

This is strongly affected by the fact that the majority of the concrete will be established over or within essentially “chemically inert” granular structural fill.

5. FUTURE DETAILED GEOTECHNICAL STUDY

5.1 GENERAL

In the near future, either the “East” or “West” sites will be selected for the proposed prison. We anticipate that the siting of the actual prison facilities will also be determined shortly. At that time and prior to initiation of a detailed geotechnical investigation we strongly recommend that the State discuss with, even on a consulting basis, top level prison design firms who would work with the State in determining a reasonably accurate “model” for the proposed facility. The “model” would include type of construction, susceptibility and functionality to total and differential settlements, security and function of the various facilities under both static and dynamic loading.

As previously discussed in detailed, the overall elevation of the site considering the Great Salt Lake and other factors must also be determined at this time. Once this information is provided, reviewed, and developed, a detailed geotechnical study can be performed.

Costly and time consuming procedures such as preloading and pile utilization do not appear to be required at either the “East” and “West” sites. More conventional construction, such as utilized at the Salt Lake International Center, appears to be more appropriate.

Based upon the results of the studies performed to date, it is our opinion that the most critical geotechnical aspect of the site will be liquefaction; that is, the probability of liquefaction, its magnitude, whether ground rupture will occur, and the probability of lateral spread. Although detailed evaluations have not been performed, there is no evidence of past ground rupture and/or extensive lateral spread at the sites. This is in consideration that the site area has been

subjected to at least two and probably three, 7.0+ magnitude earthquakes in the past 10,000 to 12,000 years.

Determination of the overall liquefaction potential and associated seismically-induced settlement will aid in determining if a Site Class F must be used. To date at the Salt Lake International Center Classes E and D have been used. Based upon the above factors, we recommend that the following items be part of the detailed geotechnical study:

1. Two CPT sounding probes to a depth of 100 feet. To provide data in evaluating the liquefaction potential and to aid in developing a specific-site response spectra (Site Class F).
2. Drilling, logging, and sampling of approximately 15 to 20 borings (development upon prison layout) mostly ranging in depth from 20 to 45 feet. One boring to approximately 100 feet is recommended near one of the deep CPT sounding probes again to aid in liquefaction analysis and develop a site repose spectra.

Shallow borings will be required so that high quality undisturbed samples primarily of the fine-grained cohesive soils can be obtained for detailed laboratory testing.

3. A laboratory testing program consisting primarily of high quality one dimension consolidation and chemical tests. Consolidation testing is necessary for an accurate projection of total and differential settlements under the anticipated loading range. Chemical tests would be performed primarily to provide appropriate parameters to be utilized in providing corrosion protection for the facility which we project will have a design life in excess of 50 years.
4. Detailed engineering analysis directed towards determining the potential and magnitude of liquefaction including discussions pertaining to the potential for ground rupture and lateral spread.
5. Detailed discussions regarding mitigation of the magnitude of liquefaction-induced settlement when considering the design accepts of the proposed facilities.
6. Discussions and design parameters for anticipated foundation systems. At this time conventional spread and continuous wall foundations over replacement fill or soils improved by rammed aggregate piers/Geopiers[®] the primary candidates for an acceptable foundation system.
7. Pavement recommendations for various traffic load categories.

8. Other geotechnical parameters which could affect the design and construction of the proposed facility.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

Gordon Geotechnical Engineering, Inc.

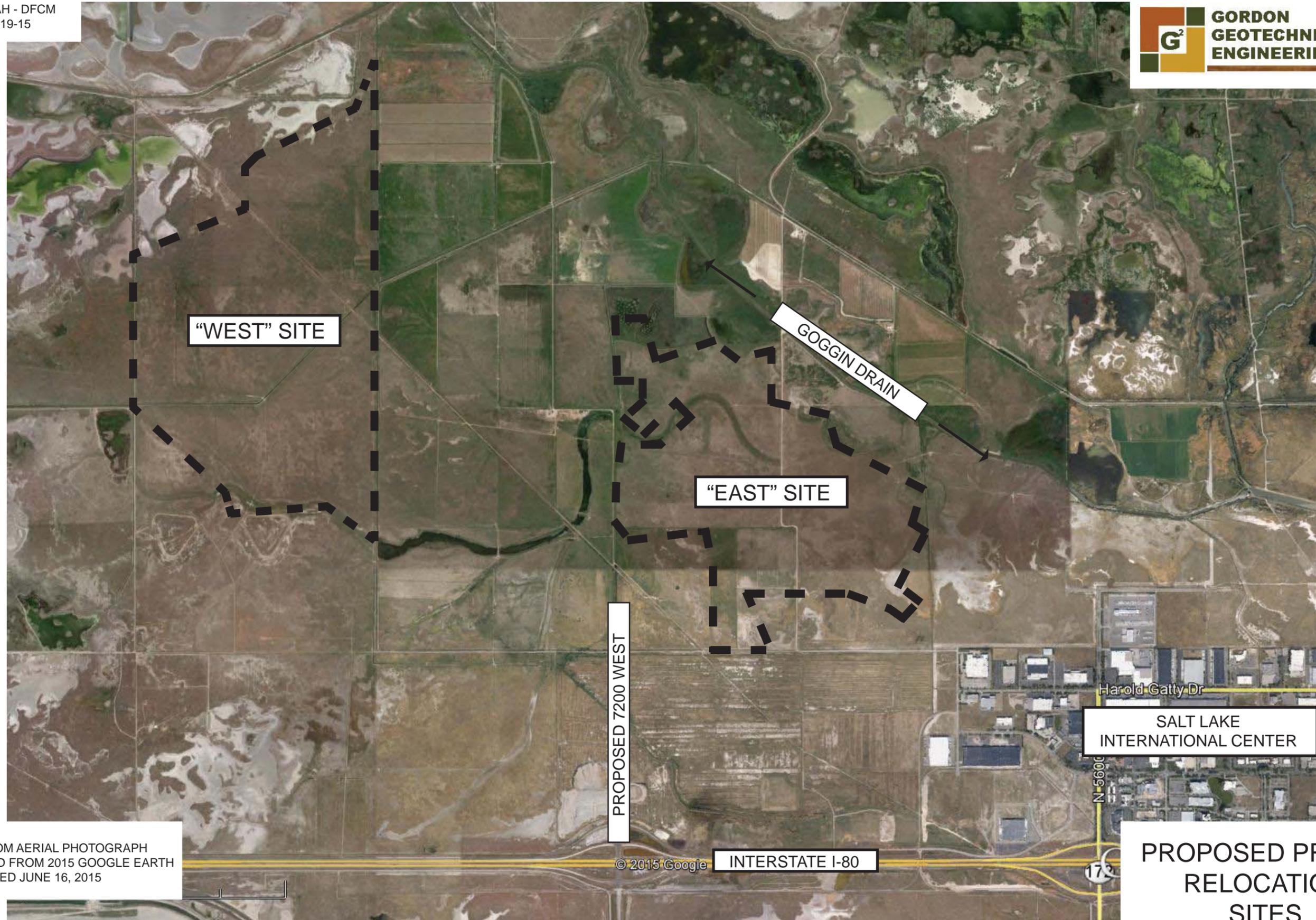


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WJG:sn

Encl. Proposed Prison Relocation Sites

Addressee (3 + email)



REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM 2015 GOOGLE EARTH
IMAGERY DATED JUNE 16, 2015



**PROPOSED PRISON
RELOCATION
SITES**