APPENDIX C

ROADWAYS
GEOTECHNICAL REPORT
MINIMUM REQUIREMENT

Based on the findings of the geotechnical consultant's field and laboratory investigations, the consultant will present opinions and recommendations regarding the following:

- Geologic setting of site, the effects of the site geologic conditions and potential hazards on the proposed construction as well as means to mitigate such hazards
- Subsurface soil conditions including depth to, and consistency of, cemented deposits or bedrock, if encountered
- Groundwater levels as observed during field work, excluding quantitative determinations of flow or dewatering rates
- Site grading recommendations including a discussion of anticipated excavation requirements, stability of temporary construction excavations, treatment and/or removal of unsuitable bearing soils, if encountered, and suitability of on-site material for use as structural fill
- Construction considerations including equipment mobility, excavatability of subsurface soil and/or bedrock deposits, processing of excavated soils, etc.
- General recommendations for residential foundation design and construction
- Support of concrete slabs-on-grade and roadway pavement
- Design and construction of roadway pavement section(s)
- Moisture protection and surface drainage
- Corrosive soil conditions
- Construction observation and testing

The consultant will present his/her opinions and recommendations in a formal report, complete with logs of the explorations and laboratory test results.

<u>Boring Locations:</u>

a) Tests are required within roadways at intersections, changes of soil type, and at 750' minimum intervals. (City Code 8-2-9: Soils Report)

b) The minimum number of tests required for validating a CBR value is set by Table 3.4.1 of the *Road & Bridge Policies & Design Criteria Manual*. Failure to meet the required number of CBR values may require design for a CBR value of 3 and/or other considerations as determined by the City Engineer.

Table 3.4.1
Correlation of Range vs. Number of Tests for 90% Confidence

CBR Test Range	1	2	3	4	5	6
Number of Required Tests	2	3	4	5	6	8-9

(Source: UDOT Pavement Design Manual, Table 3A-1)

Required Design Information:

a) Soil types exposed at the ground surface

b) Soil conditions within a depth of 3 to 5 feet below the pavement subgrade including:
   - Soil classification units
   - In place soil moisture content and density
   - The occurrence of swelling soils
   - Soil plastic and liquid limits
   - Moisture-density compaction curves
   - The occurrence of moisture induced collapsing soils

c) The depth to groundwater below the pavement subgrade

d) Subgrade support variability

e) The approximate vertical distance of the pavement surface above or below the adjacent ground surface

f) Soft or weak soils that will not support or will limit the size of earthwork equipment

g) Vegetation, debris and other deleterious material that may affect pavement support

h) A hazard rating for frost damage

i) Water hazards

j) Performance of nearby pavements

k) Design CBR for road sections

Special Slope Stability Analyses:

Development in areas which meet one or more of the following criteria must submit a slope stability analysis:

a) Cut and/or fill slopes steeper than 2:1 (2 horizontal to 1 vertical).

b) Natural slopes steeper than or equal to 3:1 (3 horizontal to 1 vertical).

c) Natural and cut slopes with potentially adverse geologic conditions (e.g. bedding, foliation, or other structural features that are potentially adverse to the stability of the slope).

d) Natural and cut slopes which include a geologic hazard such as a landslide, irrespective of the slope height or slope gradient.

e) Buttresses and stability fills.

f) Cut, fill, or natural slopes of water-retention basins or flood-control channels.

g) In hillside areas, investigations shall address the potential for surface instability, debris/mudflows, rock falls, and soil creep on all slopes that may affect the proposed development.

h) When evaluating site conditions to determine the need for slope stability analyses, off-property conditions shall be considered (both up-slope to the top(s) of adjacent ascending slopes and down-slope to and beyond the toe(s) of adjacent descending slopes). Also, the consultant shall demonstrate that the proposed hillside development will not affect adjacent sites or limit adjacent property owners' ability to develop their sites.

APPENDIX D

Guidelines for Traffic Impact Studies

A. General – A Traffic Impact Study (TIS) shall be required for all developments, which meet the thresholds for peak hour trips (100 peak hour trips, AM or PM Peak). This threshold number of trips will be calculated by the City Traffic Engineer based on the size of the development (number of units, employees, square feet, etc.). This requirement may be waived by the City Engineer.

Developments that generate less than 100 peak hour trips that may impact nearby intersections, schools or neighborhoods may also be required to submit a traffic impact report that may be less rigorous than full-blown TIS.

A TIS identified existing traffic volumes and conditions, development traffic volumes and conditions and their combined impacts on the existing and future roadway systems. The TIS is a useful tool for early identification of potential traffic problems and can play an important part in the success of a development.

The City Traffic Engineer must be contacted before the study commences to agree on appropriate level of study including study area, Category type, off-site traffic to be included, peak-periods to analyze, background traffic growth rate and any special conditions to consider in the study. The City will provide the developer with a scope of work based on the development size. The study must be conducted by a firm approved by the City's "Approved Traffic Study Consultant" list. The study and study contract will be the responsibility of the developer.

See Appendix D, of the Road and Bridge Standards for more TIS requirements and guidelines.

B. TIS Evaluation - The specific analysis requirements and level of detail are determined by the following categories:

CATEGORY I Developments, which generate 100 or more peak hour, trips but fewer than 500 trips during the morning or afternoon peak hour. A Category I Traffic Impact Analysis may also be required for sites generating less than 100 trips during the morning or afternoon peak hour for any of the following reasons:

1. The existence of any current traffic problems or concerns in the local area such as an offset intersection, a high number of traffic accidents, etc.

2. The sensitivity of the adjacent neighborhoods or other areas where the public may perceive an adverse impact.

3. The proximity of project drive approaches to other drives or intersections.

4. Other specific problems or concerns that may be aggravated by the proposed development.

Should such conditions arise the City Traffic Engineer will evaluate the need for the study based on technical merit.

CATEGORY II	Developments, which generate 500 or more peak hours, trips but fewer than 1,000 trips during the morning or afternoon peak hour.
CATEGORY III	Developments, which generate 1,000 or more peak hour, trips but fewer than 1,500 trips during the morning or afternoon peak hour.
CATEGORY IV	Developments, which generate more than 1,500, trips during the morning or afternoon peak hour.

C. Analysis Approach and Methods

1. **Study Area**
The minimum study area will be determined by project type and size in accordance with the criteria in Table 2.8.1. The study area for the proposed development includes traffic signal controlled intersections; intersections without signal control and driveways to ensure their operation and level of service are adequately assessed. The City Traffic Engineer must be contacted and given a written agreement to the study at which time he may require expansion of the study area when the minimum study area identified in Table 2.8.1 do not provide sufficient information to meet the intent of the Traffic Impact Study guidelines. For example, a large (Category III) development in a rural area located two miles from a freeway interchange from which most of the trips are anticipated to access the development may require an enlarged study area to include assessment of the freeway interchange.

2. **Study Horizon Years**

The study horizon years will be determined by project type and size in accordance with the criteria below.

Table 2.8.1

Analysis Category	Development Characteristic	Study Horizons	Minimum Study Area (b)
I	Small Development 100-499 peak hour trips	1) Opening year 2) 5 years after opening	1) Site Access Drives 2) Adjacent signal controlled intersections within ¼ mile and/or major street intersections without signal control and driveways within 500 feet
II	Moderate Development 500-999 peak hour trips	1) Opening year 2) 5 years after opening	1) Site Access Drives 2) All signal controlled intersections within ½ mile and/or major street intersections without signal control and major driveways within ½ mile
III	Large Development 1,000-1,500 peak hour trips	1) Opening Year 2) 5 years after opening	1) Site Access Drives 2) All signal controlled intersections within 1 mile and/or major street intersections without signal control and major driveways within 1 mile
IV	Regional Development >1,500 peak hour trips	1) Opening Year 2) 5 years after opening 3) 20 years after opening	1) Site Access Drives 2) All signal controlled intersections within 1 mile and/or major street intersections without signal control and major driveways within 1 mile
*Assume full occupancy and build-out for single-phase developments. Multi-phase developments may require assessment of up to three (3) horizon periods corresponding to key phases as directed by the City Traffic Engineer.			

3. Analysis Time Period

a. Usually both the morning and afternoon weekday peak hours are to be analyzed. If the proposed project is expected to generate no trips or a very low number of trips during either the morning or evening peak periods the requirements to analyze one or both of these periods may be waived by the City Traffic Engineer.

b. Where the peak traffic hour in the study area occurs during a time period other than the normal morning or afternoon peak travel periods (for example midday), or occurs on a weekend, or it the proposed project has unusual peaking characteristics, these peak hours must also be analyzed. Shopping Centers or

large big box retail stores should be analyzed for peak-hour traffic during Friday evening and Saturday midday traffic.

4. Seasonal Adjustments

The traffic volumes for the analysis hours should be adjusted for the peak season if appropriate. The City Traffic Engineer should approve use of seasonal adjustment factors. The intent is not to assess maximum peak hourly volumes, such as the day after Christmas for a retail development, but to address peak seasonal volumes. For example, if traffic counts were collected in a retirement community in July, and the peak traffic period occurs during the winter months, the counts should be adjusted to winter months.

5. Data Collection Requirements

All data is to be collected in accordance with the latest edition of the ITE *Manual of Transportation Engineering Studies* or as directed by the City Traffic Engineer if not specifically covered in the ITE Manual.

a. Turning movement counts shall be obtained for all existing cross-street intersections to be analyzed during the morning and afternoon peak periods. Available turning movement counts may be extrapolated a maximum of two years with concurrence of the City Traffic Engineer.

b. The current and projected daily traffic volumes shall be presented in the report.

c. Traffic accident data shall be obtained for the most current three-year period available where existing traffic signals are being studied.

d. Roadway geometric information shall be obtained including roadway width, number of lanes, turning lanes, vertical grade, and location of nearby parking, driveways, and lane configuration at intersections.

e. The location and type of existing traffic controls shall be identified.

6. Trip Generation

a. The latest edition of ITE's *Trip Generation* shall be used for selecting trip generation rates.

b. Site traffic shall be generated for daily; AM and PM peak hour periods. Adjustments made for "passer-by", "Transit Oriented Development", and "Mixed-use" traffic volumes shall follow the methodology outlined in the latest edition of ITE's *Trip Generation*. A "passer-by" traffic volume discount for commercial centers shall not exceed twenty five percent unless approved by the City Traffic Engineer. Estimates of "Internal Capture" of traffic in "Mixed-use" developments should be documented.

c. Required table for Trip Generation shall include Site trip generation, Off-site trip generation, existing zoning, and proposed zoning as applicable.

7. Trip Distribution and Assignment

a. Site generated trips shall be distributed and added to the projected non-site traffic on the roadways and intersections under study. The specific assumptions and data sources used in deriving trip distribution and assignment shall be documented in the report. The trip distribution figure shall be reviewed by the City Traffic Engineer for approval before completing the study.

b. Future background traffic volumes shall be estimated using information from transportation models, or applying an annual growth rate to the base line traffic volumes. The estimated growth rate shall be documented and approved by the City Traffic Engineer before completing the study. The future traffic volumes shall be representative of the horizon year for the project development.

c. In addition, any nearby proposed "Off-site" development projects should be taken into consideration when forecasting future traffic volumes. The increase in traffic from the proposed "Off-site" projects shall be compared to the increase in traffic by applying the annual growth rate. If modeling information is unavailable, the greatest traffic increase form either the "Off-site" developments, the application of an annual growth rate, or a combination of an annual growth rate and "Off-site" developments, shall be used to forecast the future traffic volumes. The City Traffic Engineer shall be consulted as to which "Off-site" developments to include in the study.

d. The site-generated traffic shall be assigned to the street network in the study area based on the approved trip distribution percentages. The site traffic shall be combined with the forecasted traffic volumes to show the total traffic conditions estimated at development completion. A figure will be required showing daily and peak period turning movement volumes for each traffic study intersection. In addition, a figure shall be prepared showing the base-line volumes with site-generated traffic added to the street network.

8. Capacity Analysis

a. Level of service shall be computed for signal controlled and non-signal controlled intersections as identified in the Study Area in Table 2.8.1, in accordance with the latest edition of the *Highway Capacity Manual*.

b. For signal-controlled intersections, operational analyses shall be performed for time horizons up to 5 years. Operational analyses shall also be performed for street sizing. The planning method will be acceptable for time horizons beyond 5 years and is also acceptable for Traffic Impact Studies prepared at the Development Master Plan level, unless used for street sizing. For roundabout intersections, operational analyses shall be performed for time horizons at 5 and 20 years. Analysis shall be made using either SIDRA or RODEL software for the applicable peak periods.

c. For urban roadways, and rural highways where signal controlled intersections are at or less than 1 mile apart, the capacity of the roadway is generally dominated by the capacity of the adjacent signal controlled intersections. Roadway levels of service need to be computed for these facilities.

d. For rural highways where the signal controlled intersections are more than 1 mile apart, the level of service on the highway shall be estimated in accordance with the latest edition of the *Highway Capacity Manual*.

9. Traffic Signal Needs

A traffic signal needs study shall be conducted for all arterial / arterial, arterial / collector, and collector / collector intersections within the Study Area for the opening year. If the warrants are not met for the opening year, they should be evaluated for a 5 year horizon for Categories II, III, and IV. Roundabouts may be substituted at intersections where All-Way stop conditions are proposed or where traffic signals will not be warranted for several years.

10. Accident Analysis

Where applicable, an analysis of the three year accident data shall be conducted to determine if the level of safety will deteriorate due to the addition of site traffic.

11. Speed Considerations

Vehicle speed is used to estimate safe stopping and cross-corner sight distances. Study should consider the posted speeds on existing streets and proposed design speeds for proposed streets.

12. Improvement Analysis

The roadways and intersections within the study area shall be analyzed with and without the proposed development to identify any projected impacts in regard to level of service and safety. Recommendations shall include proposed improvements by City or UDOT, by the project developer, or by others.

13. Certification

The Traffic Impact Analysis shall be prepared under the supervision of a Professional Engineer (Civil) with at least three years of preparing similar size traffic impact studies and licensed by the State of Utah.

14. Traffic Simulation

The major intersections and streets impacted by the proposed development should be modeled using SYNCHRO and SIMTRAFFIC or software approved by the City Traffic Engineer. Copies of all figures and simulation files shall be provided to the City on a compact disc.

D. Study and Report Format

1. Introduction and Summary
   - Purpose of report and study objectives
   - Executive Summary
     - Site location and study area
     - Development description
     - Principal findings
     - Conclusions / Recommendations

2. Proposed Development
   - Site location (Vicinity Map)
   - Land use and intensity
   - Proposed Development Details
   - Site Plan
   - Access locations and geometry
   - Development phasing and timing

3. Study Area Conditions
   - Study area
     - Area of significant traffic impact (roadways, intersections, and driveways)
     - Influence area
   - Land use
     - Existing land use
     - Anticipated future development
   - Site accessibility
     - Existing and future area roadway system

4. Analysis of Existing Conditions
   - Physical characteristics
     - Roadway characteristics
     - Traffic Control devices
     - Transit / Pedestrian / bicycle facilities
   - Traffic volumes
     - Daily, morning and afternoon peak periods
   - Level of service
     - Morning peak hour, afternoon peak hour, and other hours as required
   - Safety related deficiencies
   - Data Sources

5. Projected Traffic
   - Site traffic forecasts (each horizon year)
     - Trip generation
     - Mode split (if applicable)
     - Pass-by traffic (if applicable)
     - Internal capture traffic (if applicable)
     - Trip distribution
     - Trip assignment
   - Off-site traffic
   - Background traffic forecasting (each horizon year)
   - Total traffic (each horizon year)

6. Traffic and Improvement Analysis
   - Site access
   - Level of service analysis
     - Without project (include programmed improvements for each horizon year)
     - With project (include programmed improvements for each horizon year)
     - Existing zoning
     - Proposed zoning
     - Roadway improvements
     - Improvements by the City of West Jordan, UDOT or others to accommodate off-site traffic
     - Additional alternative improvements to accommodate site traffic
   - Traffic safety
     - Sight distance
     - Acceleration / deceleration lanes, left-turn lanes
     - Adequacy of location and design of driveway access
   - Pedestrian considerations
   - Speed considerations
   - Traffic control needs
   - Traffic signal needs (base 5 year horizon)

7. Internal Project Site Circulation (if applicable)
   - Conflict points
     - Vehicle/vehicle
     - Vehicle / pedestrian
     - Sight distances
     - Building access delivery points
     - Drive – through lanes
   - Design features
     - Widths of internal circulation roadways
     - Fire lanes
     - Access to waste containers

8. Conclusions

9. Recommendations
   - Roadway improvements
     - Phasing
     - By developer and by others
   - Site access
   - Internal site circulation
   - Other

10. Appendices
    - Traffic Counts
    - Capacity analyses worksheets
    - Roundabout analyses
    - Traffic signal warrant studies
    - Accident data summaries

11. Figures and Tables – The following information should be provided:
    - Site location
    - Site plan
    - Existing transportation system(s)
    - Existing and future area development
    - Existing daily (ADT)
    - Existing peak hour turning volumes (vehicles per hour)
    - Future transportation system
    - Estimated site traffic generation (ADT, daily and peak period, existing and proposed zoning)
    - Directional distribution of site traffic (daily and peak period)
    - Site traffic (ADT and peak periods)
    - Off-site traffic (ADT and peak periods)
    - Background traffic (ADT and peak periods)
    - Total future traffic (ADT and peak periods)
    - Protected levels of service including existing, horizon year non-site and total horizon year (with site development) conditions
    - Recommended improvements
    - Category I Figures and Tables may be documented within the text