HR Green Responses

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SCOPE

This report presents the results of our Preliminary Geotechnical Investigation for the proposed Grandview Reserve development. The proposed development is located east of Eastonville Road, west of U.S. Highway 24, and north of Stapleton Road in Falcon, Colorado (Fig. 1). We understand you are assessing the land for the construction of single-family residences. The purpose of our investigation was to evaluate the subsurface conditions to assist in planning of residential construction. The report includes descriptions of the subsurface conditions encountered in our exploratory borings, and discussions of construction as influenced by geotechnical considerations. The scope was described in our Proposal (CS-20-0171) dated November 9, 2020. Evaluation of the property for the presence of potentially hazardous materials (Environmental Site Assessment) was not included in our scope.

This report is based on our understanding of the planned construction, subsurface conditions disclosed by exploratory borings, results of field and laboratory tests, engineering analysis, and our experience. It contains descriptions of the soil and bedrock conditions and groundwater levels found in our exploratory borings, and preliminary design and construction criteria for foundations, floor systems, and surface and subsurface drainage. The discussions of foundation and floor systems are intended for planning purposes only. As development plans progress, we recommend additional future preliminary investigations with closer spaced borings. A brief summary of our conclusions and recommendations follows, with more detailed discussion in the report.

SUMMARY OF CONCLUSIONS

1. We did not identify geotechnical or geologic constraints at this site that we believe precludes construction of single-family residences. The primary geotechnical concerns are the presence of lenses of expansive claystone layers sporadically present within the predominantly sandstone bedrock and shallow groundwater. We believe these concerns can be mitigated with proper planning, engineering, design, and construction.

2. Strata encountered in our exploratory borings consisted of natural silty to clayey sand underlain by sandstone and claystone bedrock to the maximum depths explored of 20 to 30 feet. Testing and our experience indicates the near-surface soils are generally non-expansive. The underlying bedrock is predominantly non-expansive to low swelling sandstone. Claystone layers are intermittently present within the bedrock.

3. Groundwater was encountered in six of our borings during drilling at depths between 8 and 17 feet. Groundwater was measured approximately 7 days after drilling in each of the twelve borings at depths ranging from 5.5 to 15 feet below the existing ground surface. Groundwater elevations will vary with seasonal precipitation and landscaping irrigation.

4. The presence of expansive bedrock on the site constitutes a geologic hazard. There is risk that these materials may heave and damage slabs-on-grade and foundations. We believe the risk of damage can be mitigated through typical engineering practices employed in the region. Slabs-on-grade and in some instances, foundations, may be damaged. Where claystone is encountered within excavations, sub-excavation may be appropriate.

5. We believe spread footings designed and constructed to apply a minimum deadload will be appropriate if underlain by natural sand, sandstone bedrock, or new, moisture conditioned and densely compacted fill.

6. Control of surface drainage will be critical to the performance of foundations and slabs-on-grade. Overall surface drainage should be designed to provide rapid removal of surface runoff away from the proposed residences. Conservative irrigation practices should be followed to avoid excessive wetting.

SITE CONDITIONS

The proposed Grandview Reserve development consists of approximately 768 acres of undeveloped land located east of Eastonville Road, west of U.S. Highway 24, and north of Stapleton Road in the unincorporated community of Falcon, Colorado. The site location and approximate extents are shown in Fig. 1. At the time of our investigation, the ground surface was largely undisturbed with the exception of some unimproved dirt roads and a gas line easement that traverses the western portion of the property in a general southwest to northeast direction. Additionally, a small dam is present in the southwestern portion of the site. A few natural drainages cross the property in a general northwest to southeast direction. The largest and easternmost contained drainage water (mostly frozen) at the time of our field exploration. Site topography is gently rolling with a gentle descent to the southeast. Moderate slopes are present along drainages. Historically the land has been used for agriculture and grazing. Vegetation consists of prairie grasses and weeds.

PROPOSED DEVELOPMENT

The proposed Grandview Reserve development may include primarily residential development varying from low to high density, as well as a community park, church, school and about 16 acres of commercial parcels adjacent to U.S. Highway 24. An extension of Rex Road is planned to extend through the development in a general northwest to southeast direction and intersect with U.S. Highway 24. A network of additional collector and residential streets will provide access to the various residential neighborhoods and commercial sites.

PREVIOUS INVESTIGATION BY ENTECH

In January 2019, Entech Engineering, Inc. performed a Preliminary Soil, Geology, Geologic Hazard, and Wastewater Study for the Grand Reserve site (Entech Job No. 181951). Entech advanced ten borings at the site in late November 2018.

We were provided with a copy of the Entech report for review and utilized the subsurface information to supplement the information obtained during our investigation.

INVESTIGATION

Subsurface conditions at the site were investigated by our firm by drilling 12 very widely spaced exploratory borings across the site, to depths between 20 and 30 feet. The boring locations were established by the client’s surveyor and elevations were provided to us. The approximate locations of the borings are shown in Fig. 1. Our representative observed the drilling operations, logged the subsurface conditions found in the borings, and obtained samples for laboratory testing. Graphical logs of the borings, including the results of field penetration resistance tests, and some laboratory test data are presented in Appendix A. Soil samples obtained during drilling were visually classified and laboratory testing was assigned to representative samples. Swell-consolidation and gradation test results are presented in Appendix B. Laboratory test data are summarized in Table B-1.

SUBSURFACE CONDITIONS

Strata encountered in our exploratory borings consisted of natural silty to clayey sand underlain by sandstone and claystone bedrock to the maximum depths explored of 20 to 30 feet. Some of the pertinent engineering characteristics of the soil and bedrock are described in the following paragraphs.

Natural Soils

Two to sixteen feet of natural, predominantly sand overburden soils were encountered at the surface. The sand varies from slightly silty to silty and slightly clayey to clayey and was encountered at the ground surface in ten of the twelve borings. Very sandy clay was encountered at the ground surface in the remaining two borings and was also encountered by Entech at deeper depths. The sand was medium dense to dense based on field penetration resistance testing and our observations during drilling. Six samples of the sand tested in our laboratory contained 5 to 29 percent silt and clay-sized particles (passing the No. 200 sieve). The silty sand is judged to be non-expansive. The clayey sand is judged to be stiff to very stiff, and non-expansive to low swelling.

Bedrock

Bedrock was encountered in each of the borings underlying the natural soils, at depths of between 2 and 16 feet below the ground surface. The predominate sandstone bedrock contained sporadic layers of sandy to very sandy claystone. The bedrock was hard to very hard. Eight samples of the sandstone contained 11 to 43 percent silt and clay-sized particles. Four samples of the sandstone exhibited measured swells between 1.0 to 2.0 percent, and one sample compressed 0.1 percent when wetted under estimated overburden pressure.

Sandy to very sandy claystone bedrock was encountered in six of our borings at varying depths and was also encountered by Entech in four of the ten borings advanced during their study. Three samples of the claystone tested in our laboratory contained 57 to 68 percent silt and clay-sized particles. Three samples of the claystone exhibited measured swells between 0.1 and 4.8 percent when wetted under estimated overburden pressure.

Groundwater

Groundwater was encountered in six of our borings during drilling at depths between 8 and 17 feet. Groundwater was measured on December 8, 2020 in each of the twelve borings at depths ranging from 5.5 to 15 feet below the existing ground surface. It is noted that Entech drilled ten borings at the site in November 2018 and encountered groundwater in seven of the borings at depths between 4.5 and 19 feet. Groundwater may develop and fluctuate seasonally and rise in response to development, precipitation, and landscape irrigation.

GEOLOGIC HAZARDS

Geologic hazards at the site include expansive soils and bedrock and areas of shallow groundwater. No geologic hazards that we believe would preclude development were noted. It is our opinion potential hazards can be mitigated with proper engineering, design, and construction practices, as discussed in this report.

Expansive Soils

Colorado is a challenging location to practice geotechnical engineering. The climate is relatively dry, and the near-surface soils are typically dry and comparatively stiff. These soils and related sedimentary bedrock formations react to changes in moisture conditions. Some of the soils swell as they increase in moisture and are referred to as expansive soils. Other soils can compress significantly upon wetting and are identified as compressible or collapsible soils. Much of the land available for development east of the Front Range is underlain by expansive clay or claystone bedrock near the surface. The soils that exhibit compressible behavior are more likely west of the Continental Divide; however, both types of soils occur throughout the state.

Covering the ground with structures, streets, driveways, patios, etc., coupled with lawn irrigation and changing drainage patterns, leads to an increase in subsurface moisture conditions. As a result, some soil movement due to heave or settlement is inevitable. Expansive and compressible soils and expansive bedrock (collectively referred to as expansive soils) are present at this site, which constitutes a geologic hazard. There is risk that foundations and slab-on-grade floors will experience heave or settlement and damage. It is critical that precautions are taken to increase the chances that the foundations and slabs-on-grade will perform satisfactorily. Engineered planning, design and construction of grading, pavements, foundations, slabs-on-grade, and drainage can mitigate, but not eliminate, the effects of expansive and compressible soils. Sub-excavation is a ground improvement method that can be used to reduce the impacts of swelling soils.

Shallow Groundwater

Groundwater was encountered in six of our borings during drilling at depths between 8 and 17 feet. Groundwater was measured on December 8, 2020 in each of the twelve borings at depths ranging from 5.5 to 15 feet below the existing ground surface. It is noted that Entech drilled ten borings at the site in November 2018 and encountered groundwater in seven of the borings at depths between 4.5 and 19 feet. It should be understood that the area has been in severe drought for the past couple of years and rises in groundwater should be expected.

Fluctuations up to 5 feet are considered as typical in this area. Our borings were drilled in late Fall when groundwater levels are typically starting to lower from seasonal highs. The presence of shallow groundwater can impact basement level as well as crawlspace level construction. Depending on design finish grade elevations shallow groundwater may necessitate raising grades in some areas or utilizing crawl space construction. In some cases, shallow groundwater conditions can be mitigated through use of foundation drains and active underdrains (if allowed and installed by the developer).

ESTIMATED POTENTIAL HEAVE

Based on the subsurface profiles, swell-consolidation test results and our experience, we calculated potential heave at the existing ground surface for each test hole. The analysis involves dividing the soil profile into layers and modeling the heave of each layer from representative swell tests. We estimate potential ground heave may range from less than 0.5-inch to 2.5 inches, with half of the borings exhibiting less than 0.5 inches of ground heave, one of the borings greater than 2 inches, and the remaining borings between 1 and 2 inches. A depth of wetting of 24 feet below existing grades was considered for the analysis. This depth of wetting is typically used for irrigated residential sites. Variations from our estimates should be anticipated. It is not certain whether the estimated heave will occur.

The heave estimates are summarized in the table below. We judge there is a relatively low risk of problems due to expansive soils and bedrock for much of the site; however, it should be understood that our borings were very widely spaced. As such, significant areas of moderately expansive claystone may be present

ESTIMATED POTENTIAL GROUND HEAVE BASED ON
24 FEET DEPTH OF WETTING

BORING	ESTIMATED POTENTIAL GROUND HEAVE (INCHES)
TH-1	<0.5
TH-2	<0.5
TH-3	1.5
TH-4	<0.5
TH-5	<0.5
TH-6	1.6
TH-7	<0.5
TH-8	1.1
TH-9	2.5
TH-10	1.6
TH-11	1.6
TH-12	0.7

Sub-Excavation

Our investigation indicates soils with nil to moderate expansion potential are present at shallow depths likely to influence the performance of shallow foundations and slabs-on-grade. We estimated total potential ground heave could be up to about 2.5 inches. Our experience suggests performance of structures constructed on claystone bedrock materials can be erratic. Where present near foundation levels, sub-excavation of up to 4 feet in thickness may be appropriate. Localized areas of deeper sub-excavation may be necessary. This condition is not expected to be present at most of the lots investigated, and the need for sub-excavation should be evaluated at the time of the lot specific soils and foundation investigation.

Sub-excavation has been used in the Colorado Springs area with satisfactory performance for most of the sites where this ground modification method has been completed. We have seen isolated instances where settlement of sub-excavation fill has led to damage to houses supported on footings. In most cases, the settlement was caused by wetting associated with poor surface drainage or seepage, and/or poorly compacted fill placed at the horizontal limits of excavation. Wetting of the fill may cause softening and settlement.

There can be cases where the sub-excavation limits and depth are not adequate to encompass an entire building footprint including deck, patio and porch. As a result, the building must be founded on deep foundations. Proper planning of the sub-excavation limits and depth based on the largest model plan and as-built surveying of the limits and depth during the sub-excavation is important to reduce this risk.

The excavation slopes should meet OSHA, state, and local safety standards. The bottom of the sub-excavated area should extend laterally at least 5 feet and outside the largest possible foundation footprints to ensure foundations are constructed over moisture-conditioned fill.

The excavation contractor should be chosen carefully to assure they have experience with fill placement at over-optimum moisture and have the necessary compaction equipment. In order for the procedure to be performed properly, close contractor control of fill placement to specifications is required. The sub-excavated material may be reused as backfill. Sub-excavation fill should be moisture-conditioned between 0 and 4 percent above optimum moisture content for clay or within 2 percent of optimum for sand. Fill should be compacted at least 95 percent of standard Proctor maximum dry density (ASTM D 698).

Special precautions should be taken for compaction of fill at corners, access ramps, and along the perimeters of the sub-excavation as large compaction equipment cannot easily reach these areas. Our representative should observe placement procedures and test compaction of the fill on a nearly full-time basis.

If the fill dries excessively prior to construction, it may be necessary to rework the upper drier materials just prior to constructing foundations. We estimate the fill should retain adequate moisture for about three years.

Sub-excavation will likely allow use of spread footing foundations. Sub-excavation will also enhance performance of concrete flatwork (driveways and sidewalks) and pavements, potentially reducing maintenance costs.

BUILDING CONSTRUCTION CONSIDERATIONS

Foundations

Our investigation indicates variable materials will be present at foundation elevations. Expansive claystone is present at varying depths. If claystone is encountered at foundation depths, sub-excavation will likely be appropriate to reduce the risk of poor performance. Typically, sub-excavation depths in this formation are 4 to 5 feet in thickness where these lenses are present; however, significant layers of moderately expansive claystone that extend to deeper depths could locally require sub-excavations up to 10 feet. We expect spread footing foundations designed to apply minimum deadload will likely be appropriate for the lots. We estimate maximum allowable pressures of about 3,000 psf will be appropriate for the lots included in this investigation. Detailed soils and foundation investigations should be performed to determine the appropriate foundation types and to provide design criteria on a lot-specific basis.

Floor Construction

We expect slab-on-grade basement floors and garage floors will be appropriate for the site. The site will likely have a low to moderate risk of poor slab-on-grade performance, although sub-excavation may be required where claystone lenses are identified near floor elevations. Structural floors should be used in non-basement, finished living areas. A structural floor is supported by the foundation system. Design and construction issues associated with structural floors include ventilation and lateral loads. Where structurally supported floors are installed in basements or over a crawlspace, the required air space depends on the materials used to construct the floor and the potential expansion of the underlying soils. The performance of floor slabs, driveways, sidewalks, and other surface flatwork may be poor where expansive soils are present, unless sub-excavation is performed.

Subsurface Drainage

Surface water can penetrate relatively permeable loose backfill soils located adjacent to residences and collect at the bottom of relatively impermeable foundation excavations, causing wet or moist conditions after construction. Foundation walls and grade beams should be designed to resist lateral earth pressures. Foundation drains should be constructed around the lowest excavation levels of basement and/or crawlspace areas. Where locally high groundwater is present, below slab drainage layers may be appropriate. These drains could be connected to an underdrain system (if present) to provide a gravity outlet. Sump pits should be provided so pumps can be installed as a backup if underdrains do not perform as intended.

Surface Drainage

The performance of foundations, floors, and other improvements is affected by moisture changes within the soil. This is largely influenced by surface drainage. When developing an overall drainage scheme, consideration should be given by the developer to drainage around each residence. The ground surface around the residences should be sloped to provide positive drainage away from the foundations. We recommend a slope of at least 10 percent for the first 10 feet surrounding each building, where practical. If the distance between buildings is less than 20 feet, the slope in this area should be 10 percent to the swale between houses. Variation from these criteria is acceptable in some areas. For example, for lots graded to direct drainage from the rear yard to the front, it is difficult to achieve the recommended slope at the high point behind the house. We believe it is acceptable to use a slope of about 6 inches in the first 10 feet (5 percent) at this location. A 5 percent slope can also be used adjacent to residences without basements. Roof downspouts and other water collection systems should discharge beyond the limits of backfill around structures.

Concrete

Concrete in contact with soil can be subject to sulfate attack. We measured the water-soluble sulfate concentration in two samples from this site at less than 0.1 percent. For this level of sulfate concentration, ACI 332-08 *Code Requirements for Residential Concrete* indicates there are no special requirements for sulfate resistance.

Superficial damage may occur to the exposed surfaces of highly permeable concrete, even though sulfate levels are relatively low. To control this risk and to resist freeze-thaw deterioration, the water-to-cementitious materials ratio should not exceed 0.50 for concrete in contact with soils that are likely to stay moist due to surface drainage or high water tables. Concrete exposed to freeze/thaw conditions should be air entrained. We recommend foundation walls and grade beams surrounding living areas that are in contact with the subsoils be damp-proofed.

RECOMMENDED FUTURE INVESTIGATIONS

We recommend the following investigations and services:

1. Additional targeted Preliminary Geotechnical Investigations with less widely spaced borings;
2. Pavement Subgrade Investigations;
3. Design-level Soils and Foundation Investigations for each individual lot; and
4. Foundation installation observations.

CONSTRUCTION OBSERVATIONS

This report has been prepared for the exclusive use of D.R. Horton and your team to provide geotechnical design and construction criteria for development. The information, conclusions, and recommendations presented herein are based upon consideration of many factors including, but not limited to, the type of structures proposed, the geologic setting, and the subsurface conditions encountered.

We recommend that CTL | Thompson, Inc. provide construction observation services to allow us the opportunity to verify whether soil conditions are consistent with those found during this investigation. If others perform these observations, they must accept responsibility to judge whether the recommendations in this report remain appropriate.

GEOTECHNICAL RISK

The concept of risk is an important aspect with any geotechnical evaluation primarily because the methods used to develop geotechnical recommendations do not comprise an exact science. We never have complete knowledge of subsurface conditions. Our analysis must be tempered with engineering judgment and experience. Therefore, the recommendations presented in any geotechnical evaluation should not be considered risk-free. Our recommendations represent our judgment of those measures that are necessary to increase the chances that the structures will perform satisfactorily. It is critical that all recommendations in this report are followed during construction.

LIMITATIONS

Our borings were very widely spaced to provide a general picture of subsurface conditions for due diligence and preliminary planning of residential construction. Variations from our borings should be anticipated. We believe this investigation was conducted in a manner consistent with that level of care and skill ordinarily used by geotechnical engineers practicing under similar conditions. No warranty, express or implied, is made.

If we can be of further service in discussing the contents of this report or analysis of the influence of subsurface conditions on the project, please call.

CTL | THOMPSON, INC.

COLORADO LICENSED JEFFREY MARK JONES 47539 12-23-2020 PROFESSIONAL ENGINEER

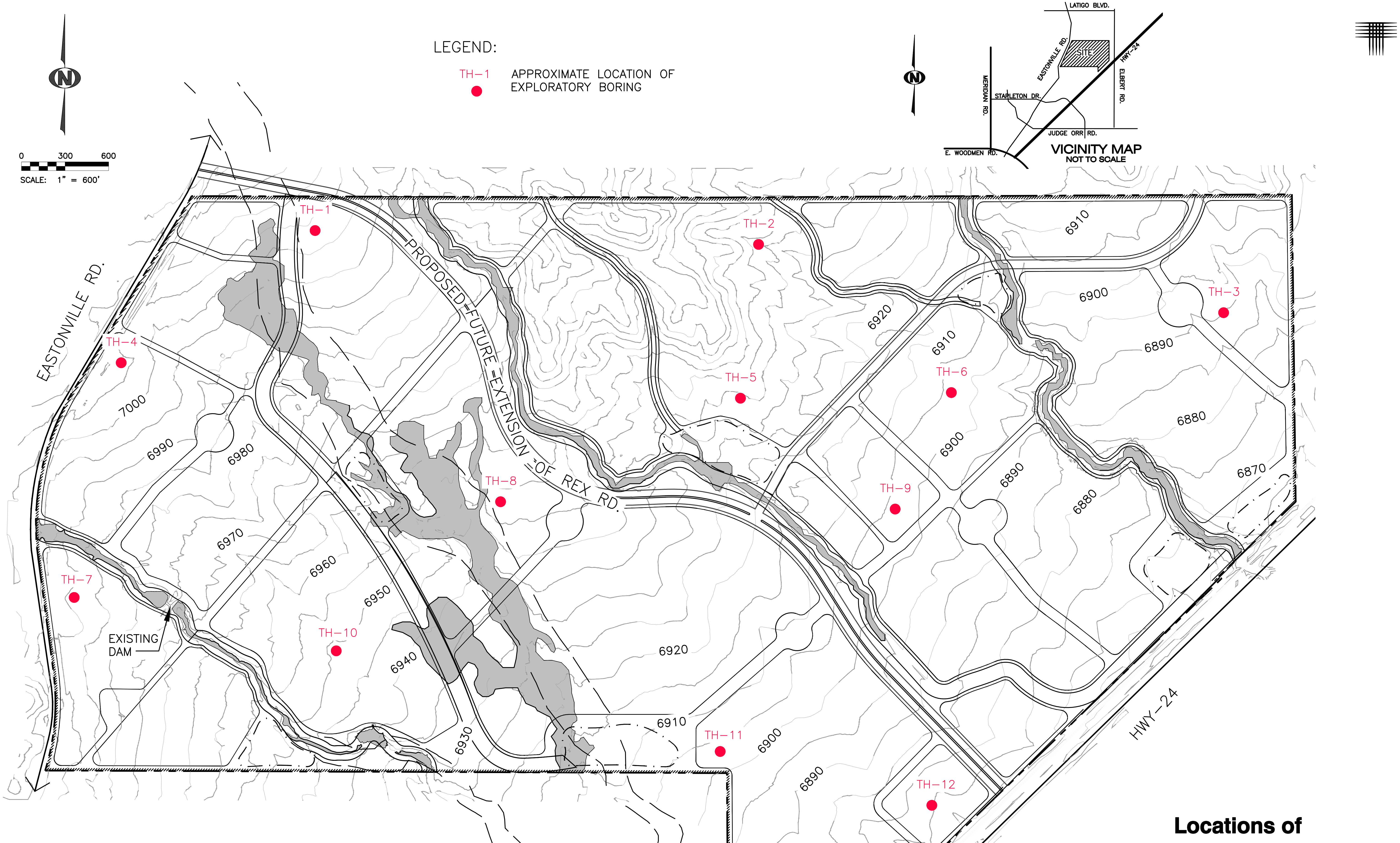
Jeffrey M. Jones, P.E.
Associate Engineer

Reviewed by

William C. Hoffmann, Jr, P.E., FACEC
Senior Engineering Consultant

JMJ:WCH:cw
(2 copies sent)

Via e-mail: mwbird@drhorton.com



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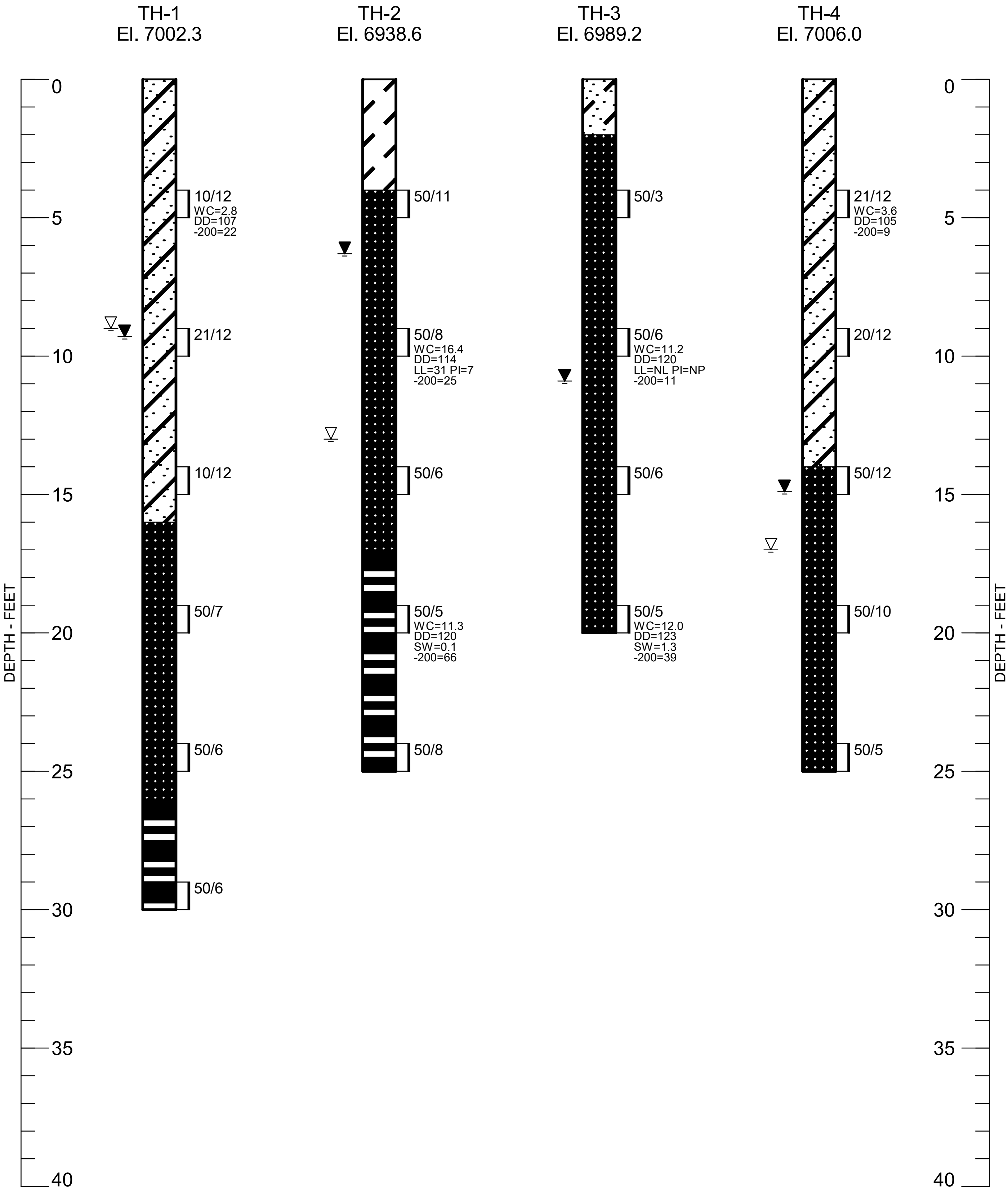
CTL|T Project No. CS19345-115

Locations of Exploratory Borings

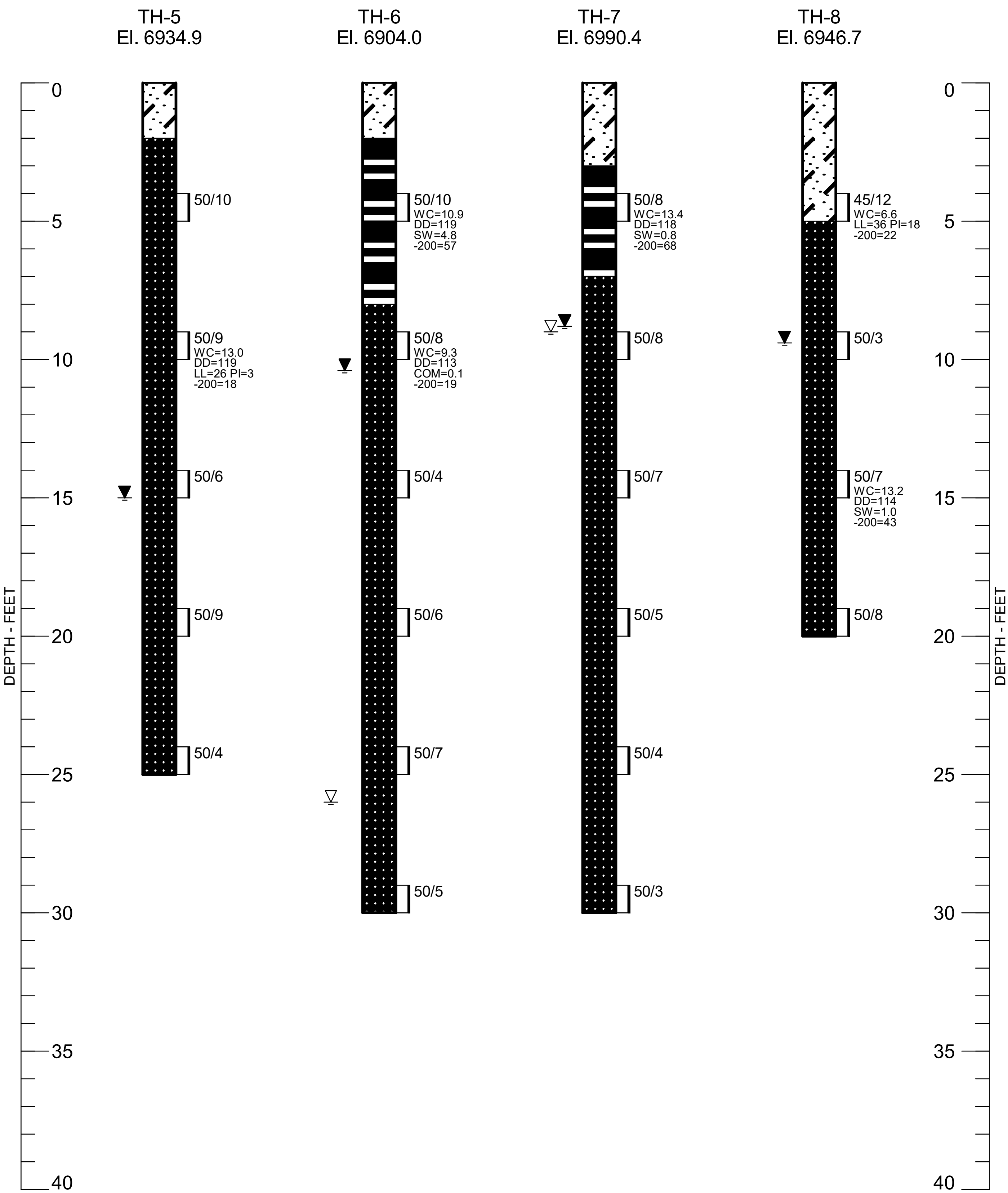
Fig. 1

APPENDIX A

SUMMARY LOGS OF EXPLORATORY BORINGS



SUMMARY LOGS OF EXPLORATORY BORINGS



SUMMARY LOGS OF EXPLORATORY BORINGS

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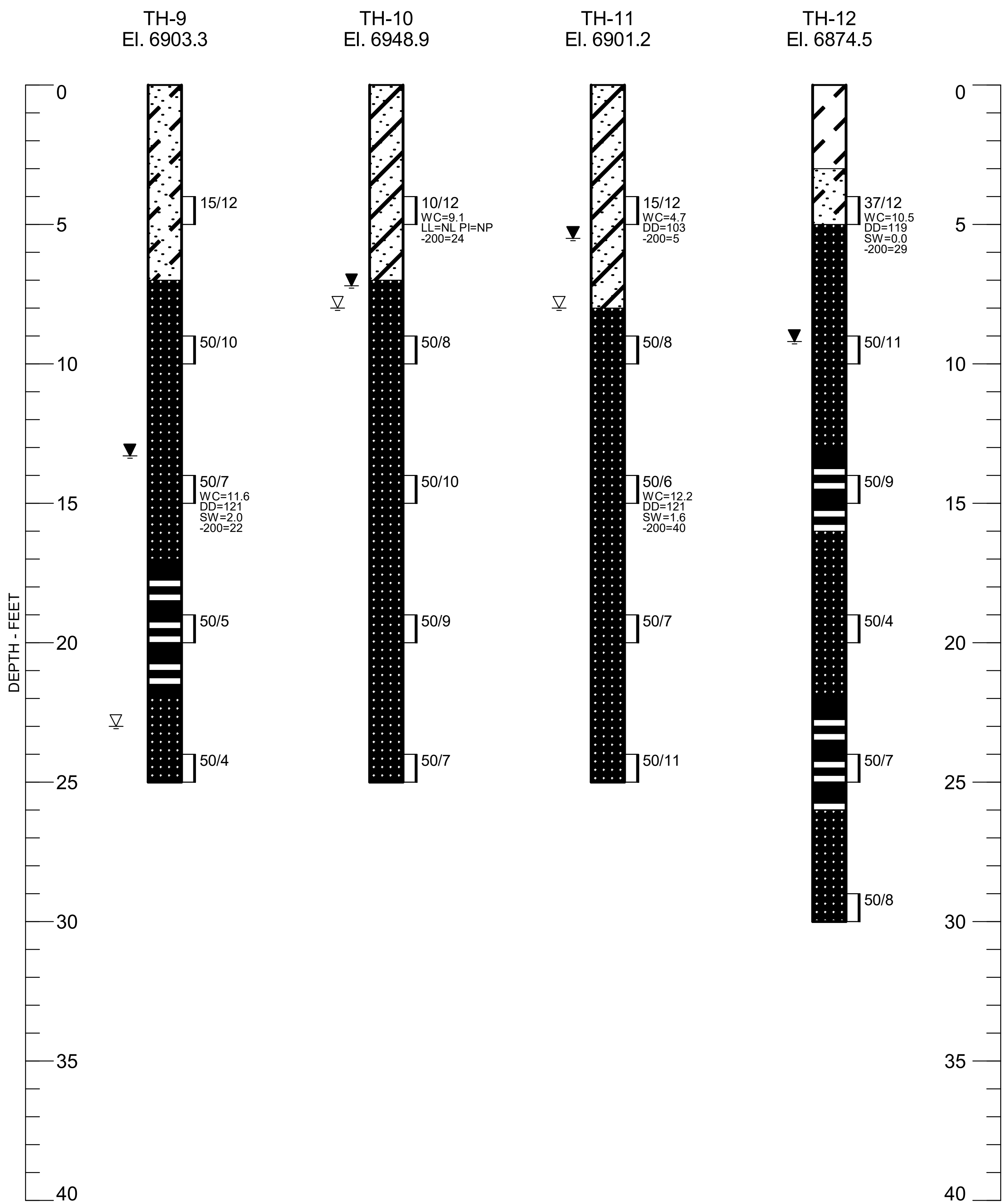
FIG. A- 2



SUMMARY LOGS OF EXPLORATORY BORINGS

LEGEND:

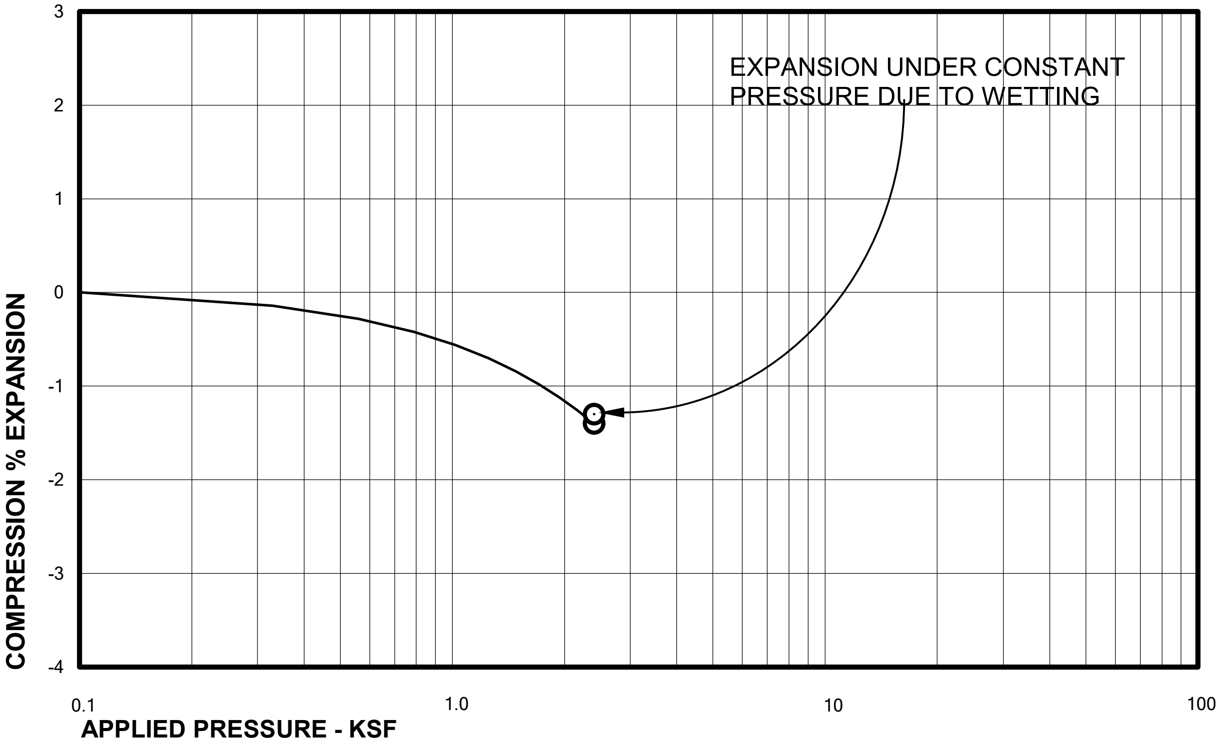
- CLAY, SANDY, STIFF, SLIGHTLY MOIST, DARK BROWN (CL).
- SAND, CLAYEY, DENSE, SLIGHTLY MOIST, BROWN, LIGHT BROWN (SC, SP-SC).
- SAND, SLIGHTLY SILTY TO SILTY, MEDIUM DENSE, SLIGHTLY MOIST TO MOIST, LIGHT BROWN, OLIVE, BROWN (SM, SP-SM).
- BEDROCK, CLAYSTONE, SANDY TO VERY SANDY, HARD, SLIGHTLY MOIST, LIGHT TO DARK GRAY.
- BEDROCK, SANDSTONE, SILTY TO CLAYEY, VERY HARD, SLIGHTLY MOIST, LIGHT BROWN TO GRAY.
- DRIVE SAMPLE. THE SYMBOL 10/12 INDICATES 10 BLOWS OF AN AUTOMATIC 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE A 2.5-INCH O.D. SAMPLER 12 INCHES.
- ▽ WATER LEVEL MEASURED AT TIME OF DRILLING.
- ▼ WATER LEVEL MEASURED AFTER DRILLING ON DECEMBER 8, 2020.

NOTES:

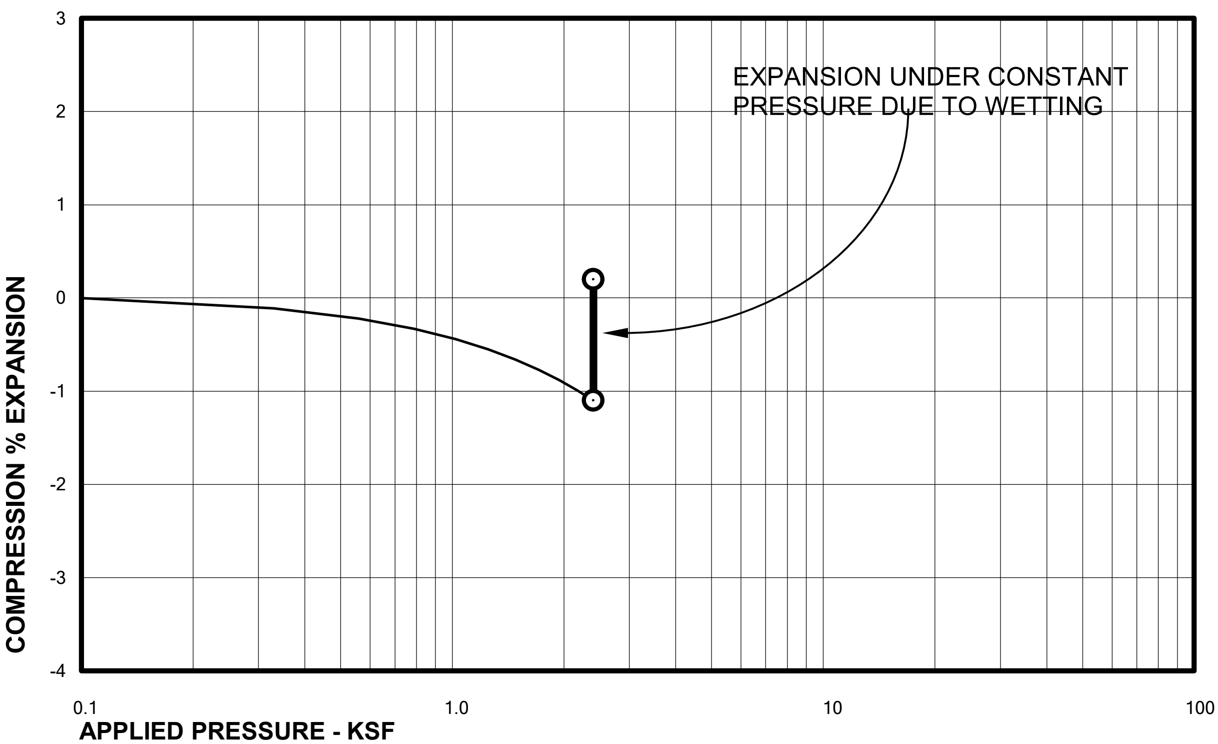
1. THE BORINGS WERE DRILLED ON DECEMBER 1 AND 2, 2020 USING 4-INCH DIAMETER, CONTINUOUS-FLIGHT SOLID-STEM AUGER AND TRUCK-MOUNTED CME-45 DRILL RIG.
2. WC - INDICATES MOISTURE CONTENT (%).
   DD - INDICATES DRY DENSITY (PCF).
   SW - INDICATES SWELL WHEN WETTED UNDER APPLIED PRESSURE (%).
   COM - INDICATES COMPRESSION WHEN WETTED UNDER APPLIED PRESSURE (%).
   LL - INDICATES LIQUID LIMIT.
   PI - INDICATES PLASTICITY INDEX.
   -200 - INDICATES PASSING NO. 200 SIEVE (%).
3. THESE LOGS ARE SUBJECT TO THE EXPLANATIONS, LIMITATIONS AND CONCLUSIONS CONTAINED IN THIS REPORT.
4. TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS WERE ESTABLISHED BY THE CLIENT'S SURVEYOR.

APPENDIX B

LABORATORY TEST RESULTS
TABLE B-I – SUMMARY OF LABORATORY TEST RESULTS



Sample of CLAYSTONE, SANDY | DRY UNIT WEIGHT= 120 PCF
From TH-2 AT 19 FEET | MOISTURE CONTENT= 11.3 %



Sample of SANDSTONE, VERY CLAYEY | DRY UNIT WEIGHT= 123 PCF
From TH-3 AT 19 FEET | MOISTURE CONTENT= 12.0 %

Swell Consolidation Test Results

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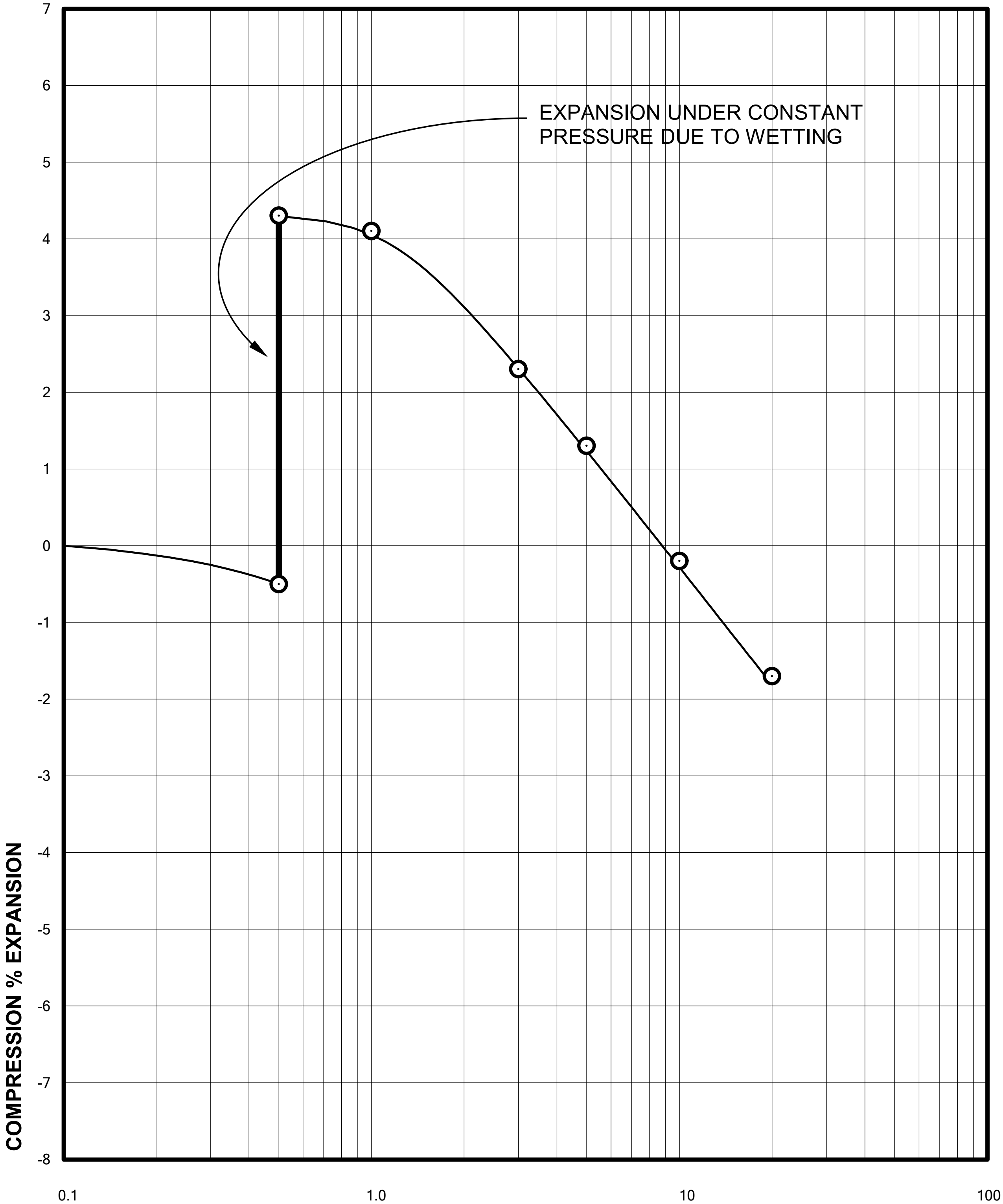
FIG. B-1



Sample of	CLAYSTONE, VERY SANDY	DRY UNIT WEIGHT=	119	PCF
From	TH-6 AT 4 FEET	MOISTURE CONTENT=	10.9	%

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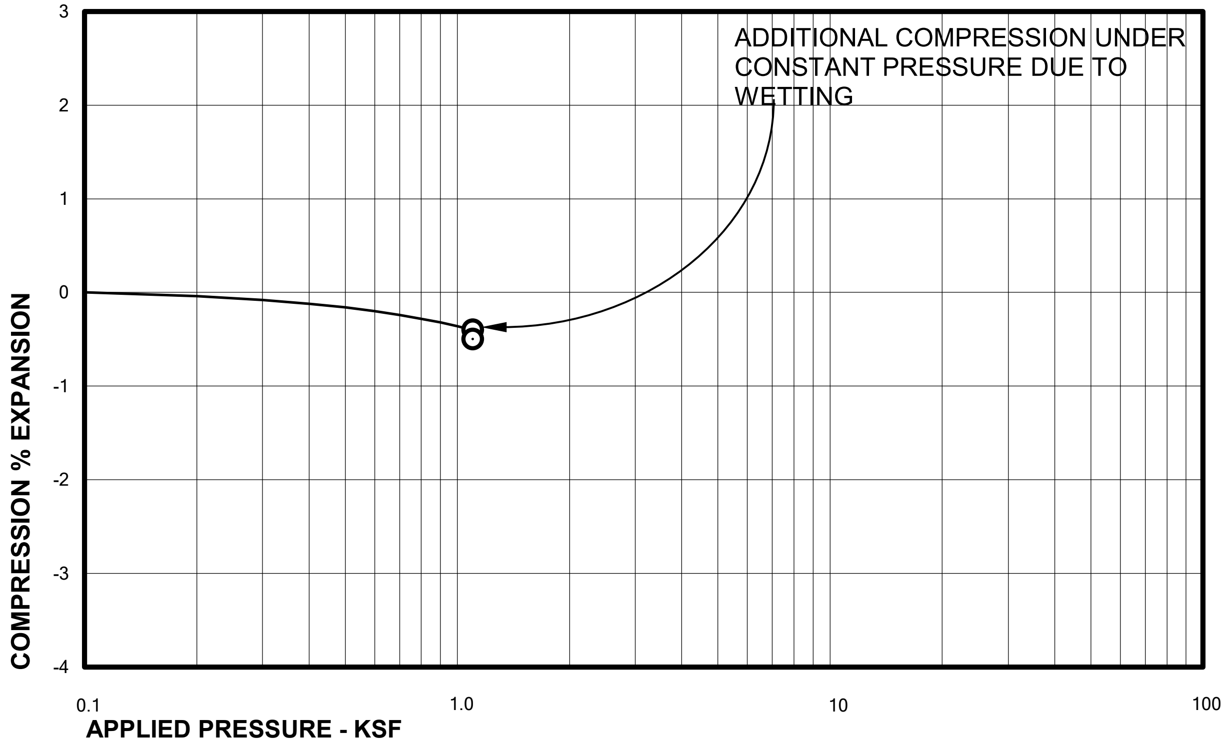
Swell Consolidation Test Results

FIG. B-2

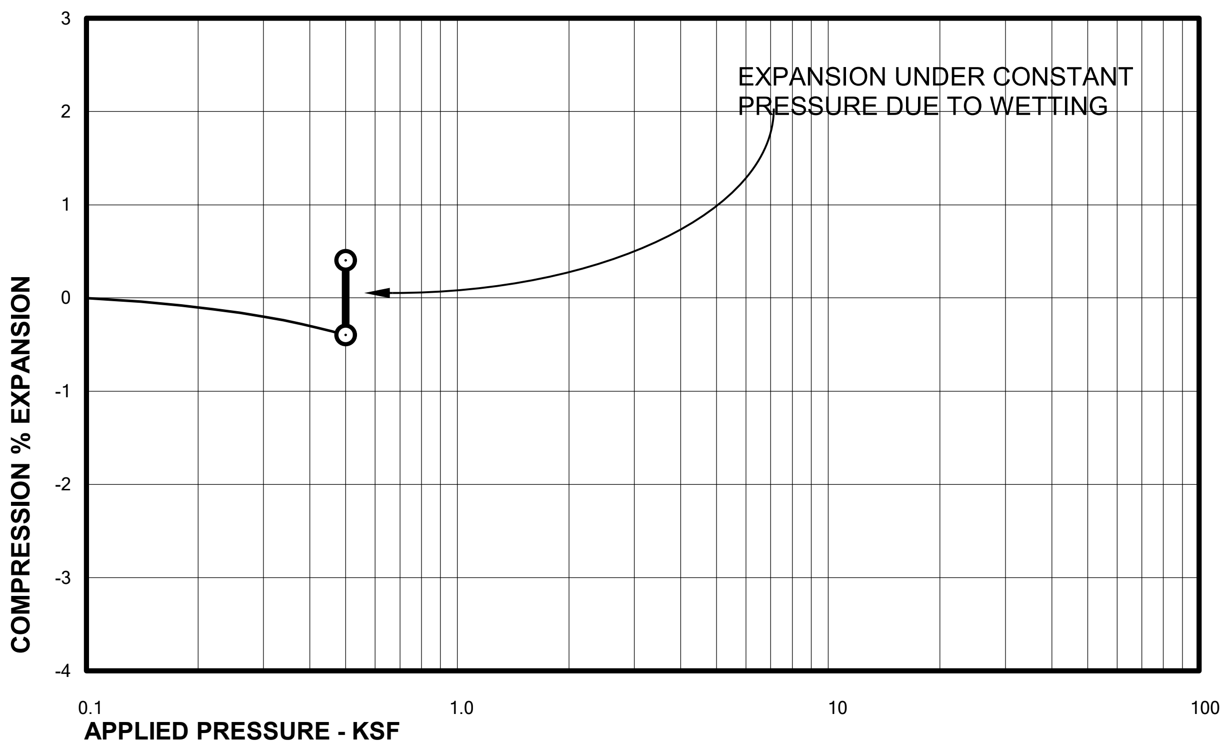


Sample of SANDSTONE, SILTY

From TH-6 AT 9 FEET

DRY UNIT WEIGHT= 113 PCF

MOISTURE CONTENT= 9.3 %



Sample of CLAYSTONE, SANDY

From TH-7 AT 4 FEET

DRY UNIT WEIGHT= 118 PCF

MOISTURE CONTENT= 13.4 %

Swell Consolidation Test Results

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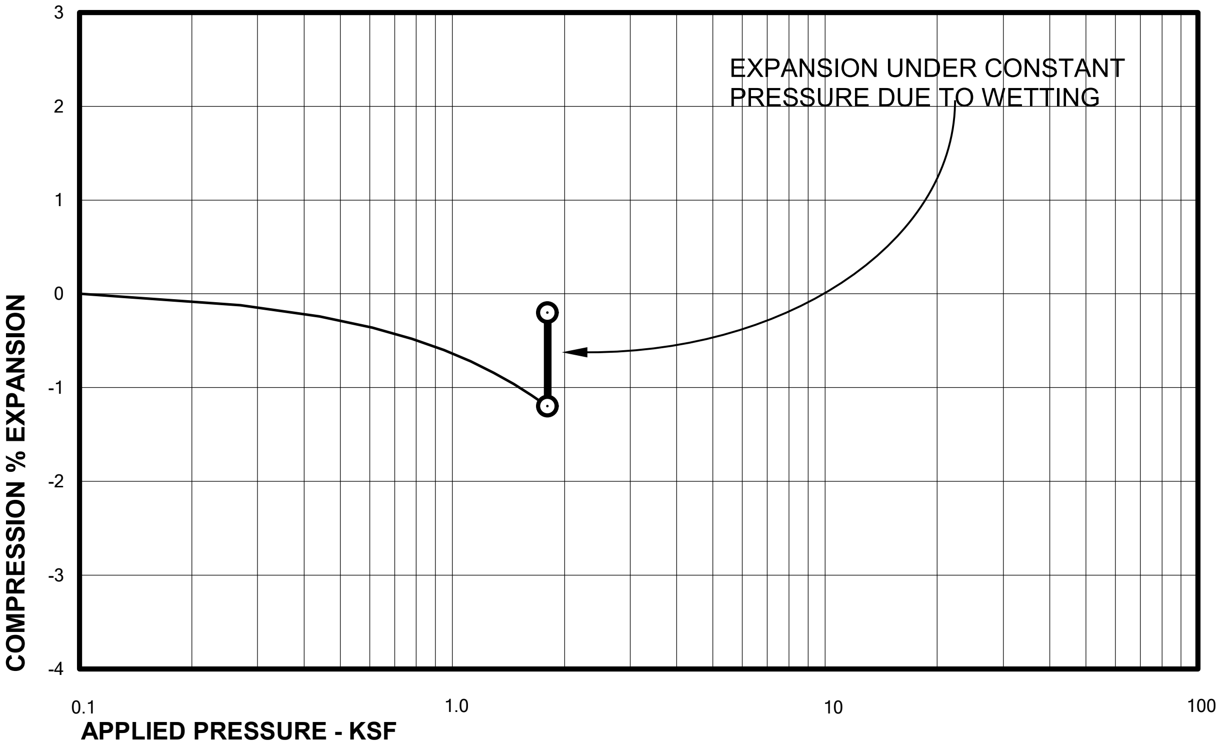
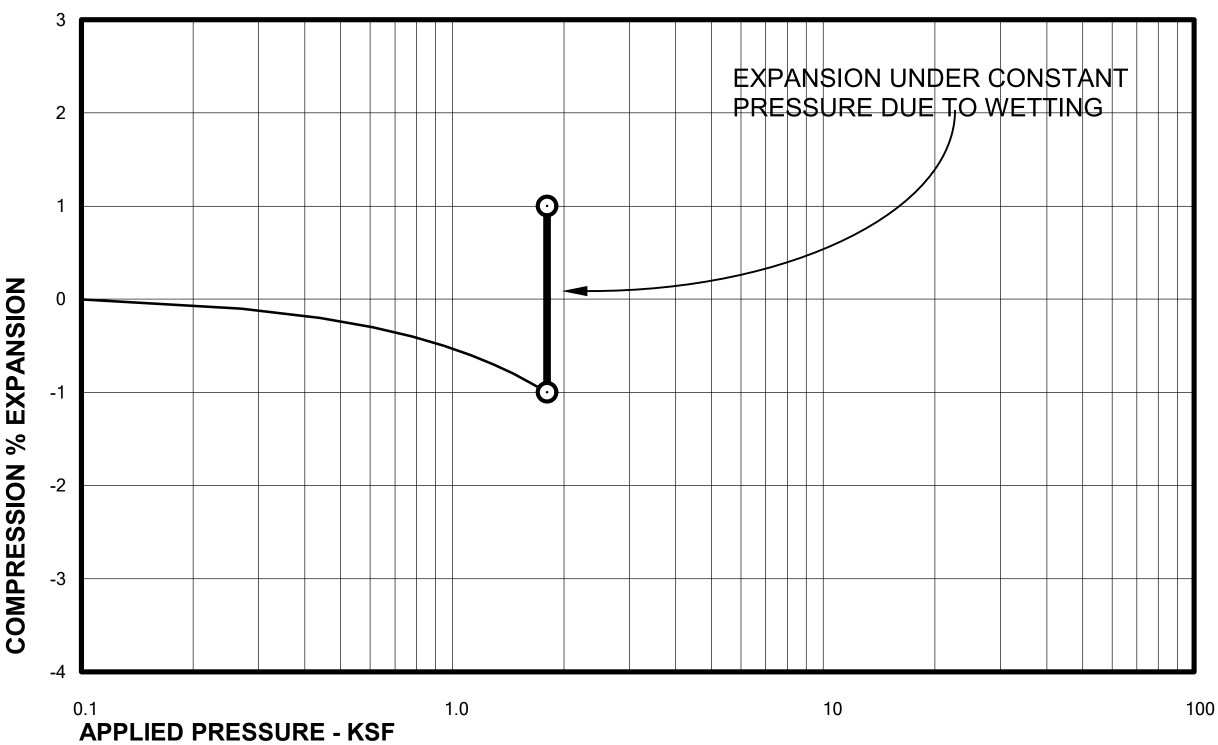
FIG. B-3



Sample of SANDSTONE, VERY CLAYEY
From TH-8 AT 14 FEET

DRY UNIT WEIGHT= 114 PCF
MOISTURE CONTENT= 13.2 %



Sample of SANDSTONE, CLAYEY
From TH-9 AT 14 FEET

DRY UNIT WEIGHT= 121 PCF
MOISTURE CONTENT= 11.6 %

Swell Consolidation Test Results

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GRANDVIEW RESERVE
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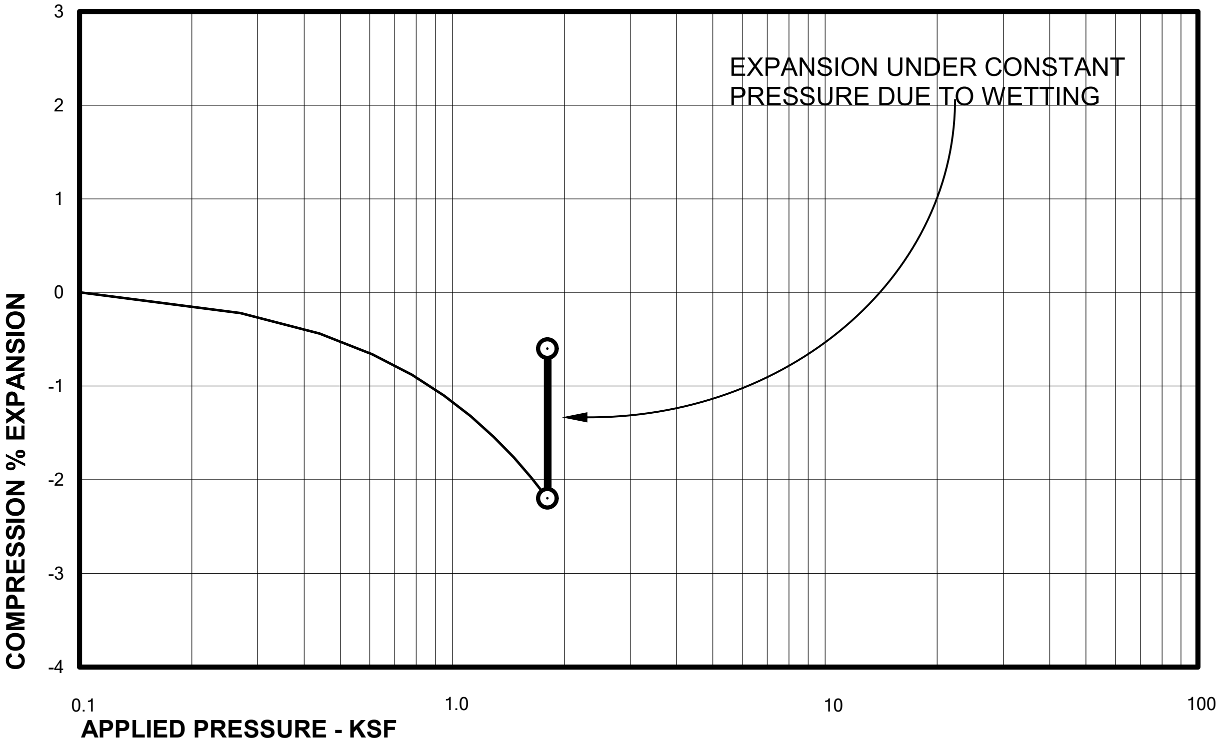
FIG. B-4

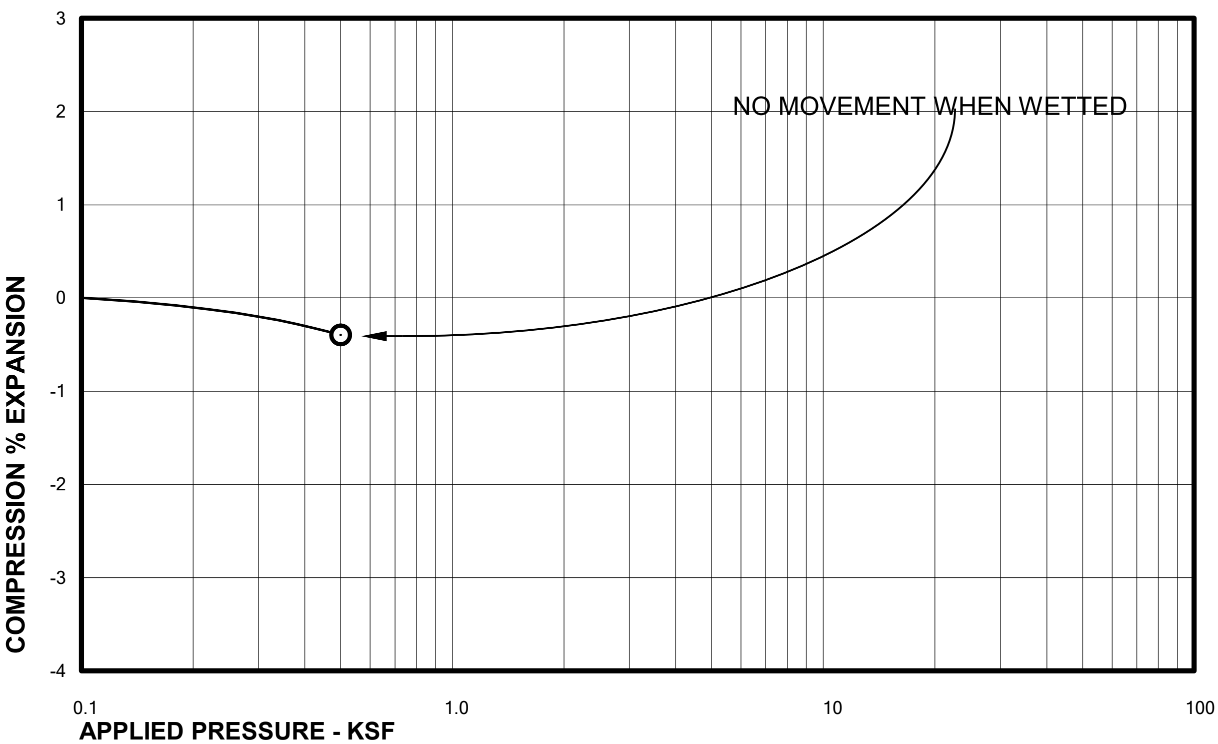


Sample of SANDSTONE, VERY CLAYEY

From TH-11 AT 14 FEET

DRY UNIT WEIGHT= 121 PCF

MOISTURE CONTENT= 12.2 %



Sample of SAND, CLAYEY (SC)

From TH-12 AT 4 FEET

DRY UNIT WEIGHT= 119 PCF

MOISTURE CONTENT= 10.5 %

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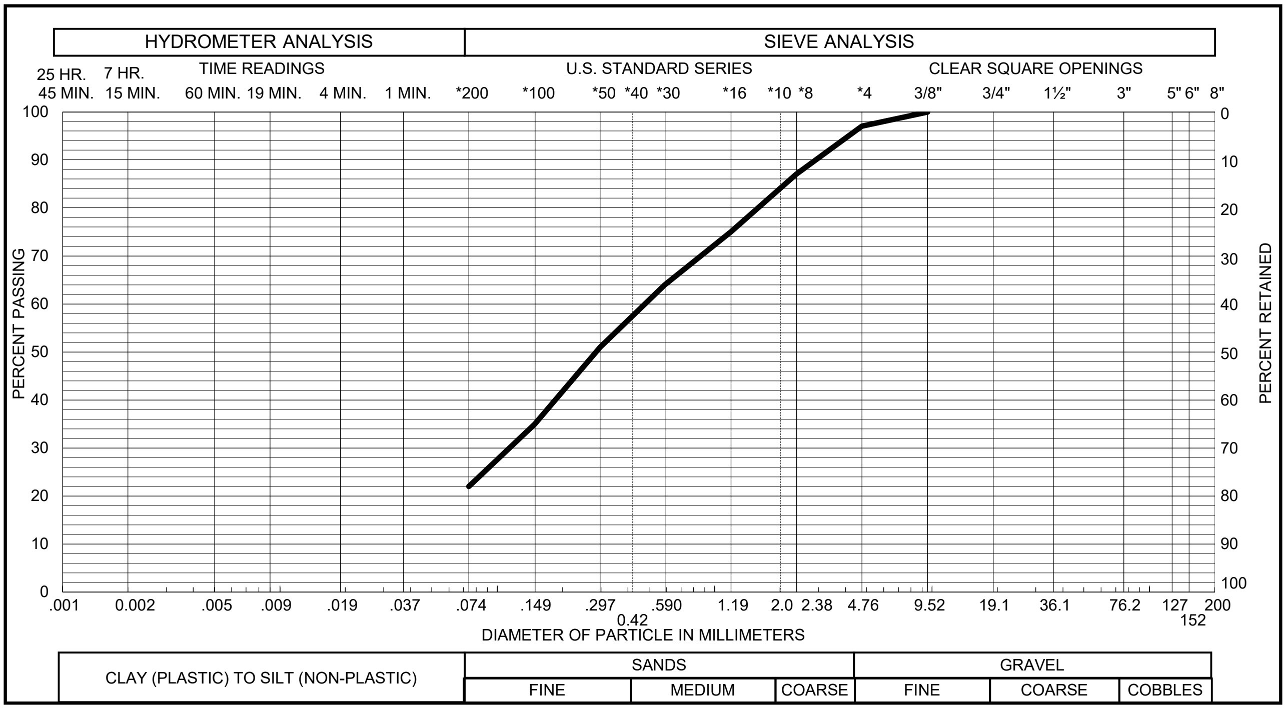
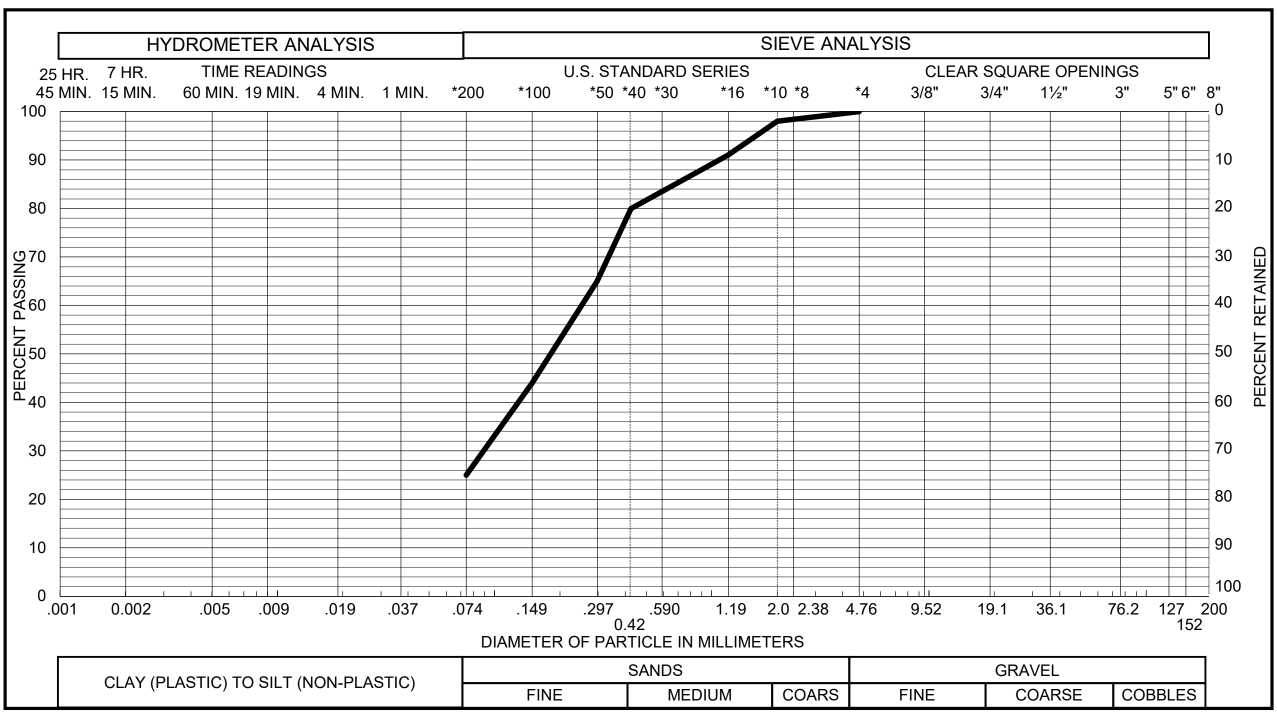
Swell Consolidation Test Results

FIG. B-5



Sample of	SAND, SILTY (SM)	GRAVEL 3 %	SAND 75 %
From	TH - 1 AT 4 FEET	SILT & CLAY 22 %	LIQUID LIMIT
		PLASTICITY INDEX	

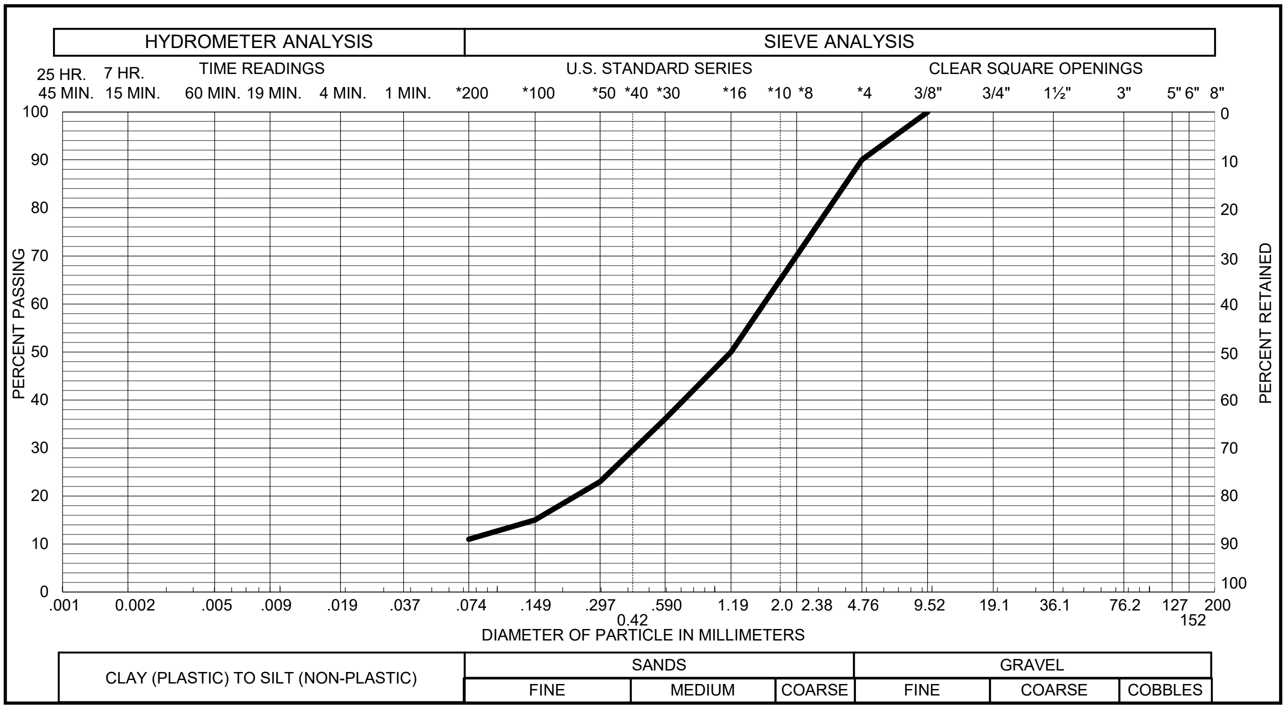


Sample of	SANDSTONE, SILTY	GRAVEL 0 %	SAND 75 %
From	TH - 2 AT 9 FEET	SILT & CLAY 25 %	LIQUID LIMIT 31
		PLASTICITY INDEX 7	

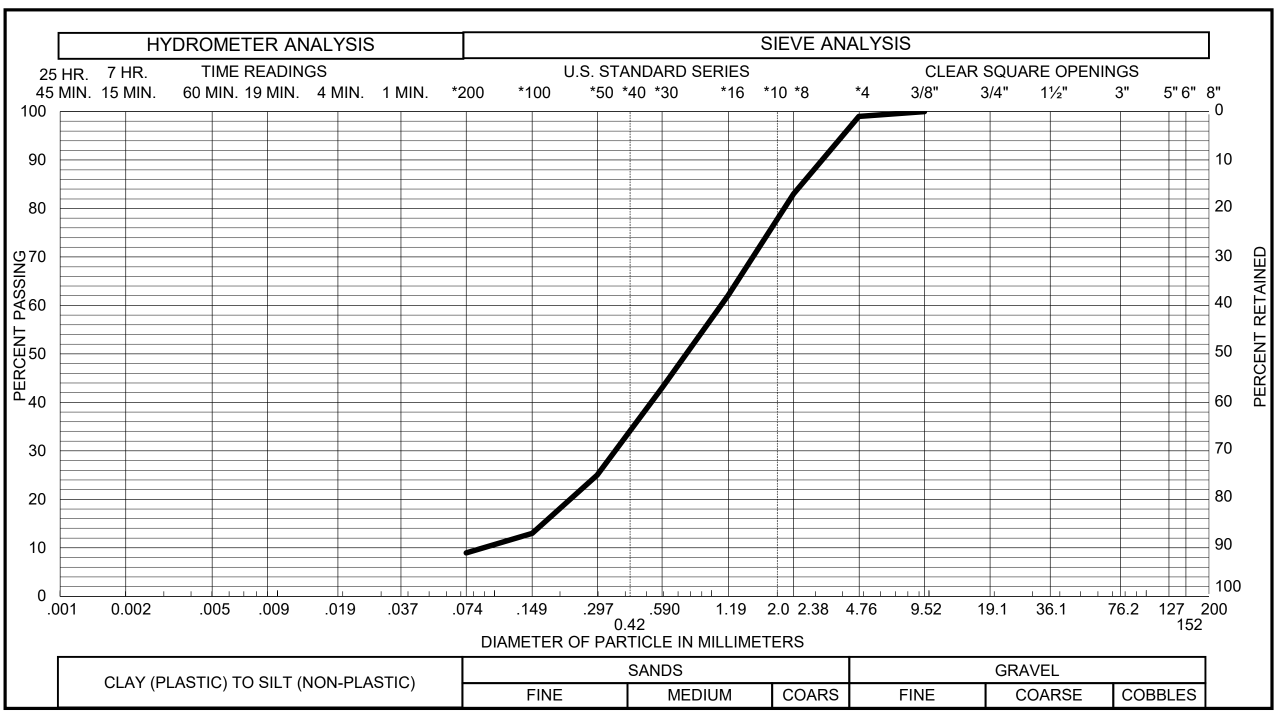
Gradation Test Results

FIG. B-6

D.R. HORTON
GRANDVIEW RESERVE
CTL|T PROJECT NO. CS19345-115



Sample of	SANDSTONE, SLIGHTLY SILTY	GRAVEL 10 %	SAND 79 %
From	TH - 3 AT 9 FEET	SILT & CLAY 11 %	LIQUID LIMIT NL
		PLASTICITY INDEX	NP

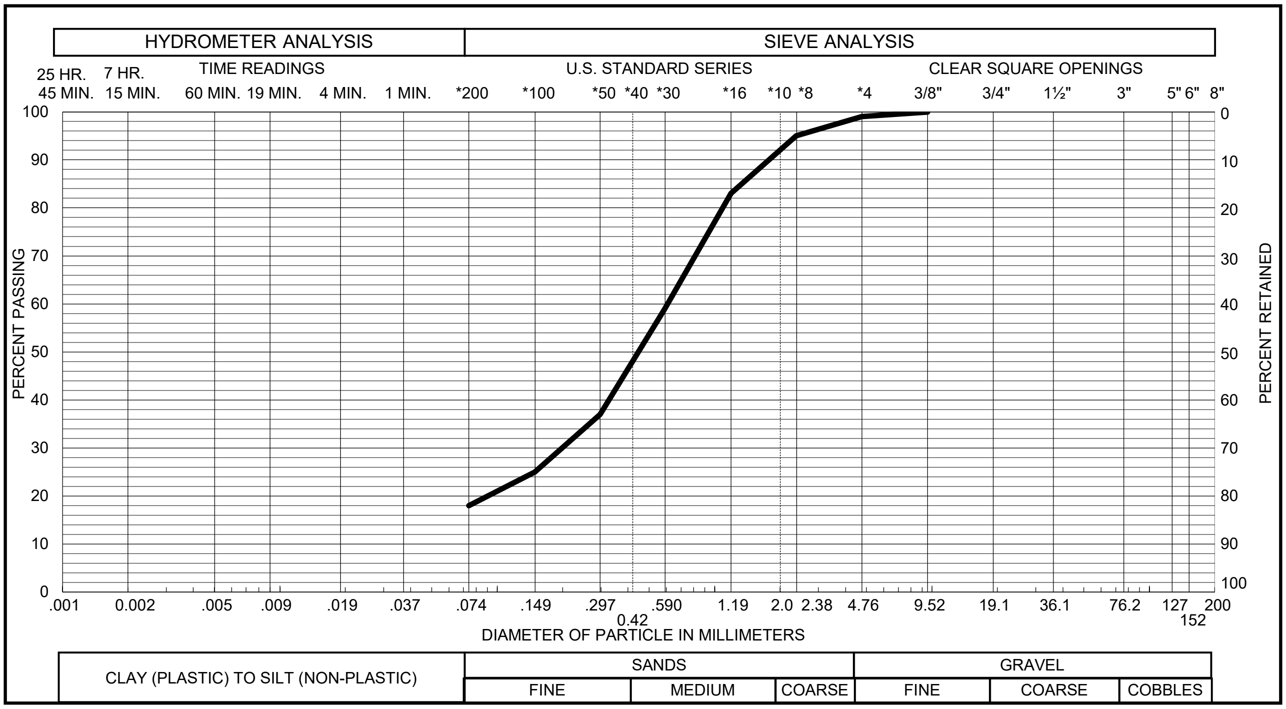


Sample of	SAND, SLIGHTLY SILTY (SP-SM)	GRAVEL 1 %	SAND 90 %
From	TH - 4 AT 4 FEET	SILT & CLAY 9 %	LIQUID LIMIT
		PLASTICITY INDEX	

Gradation Test Results

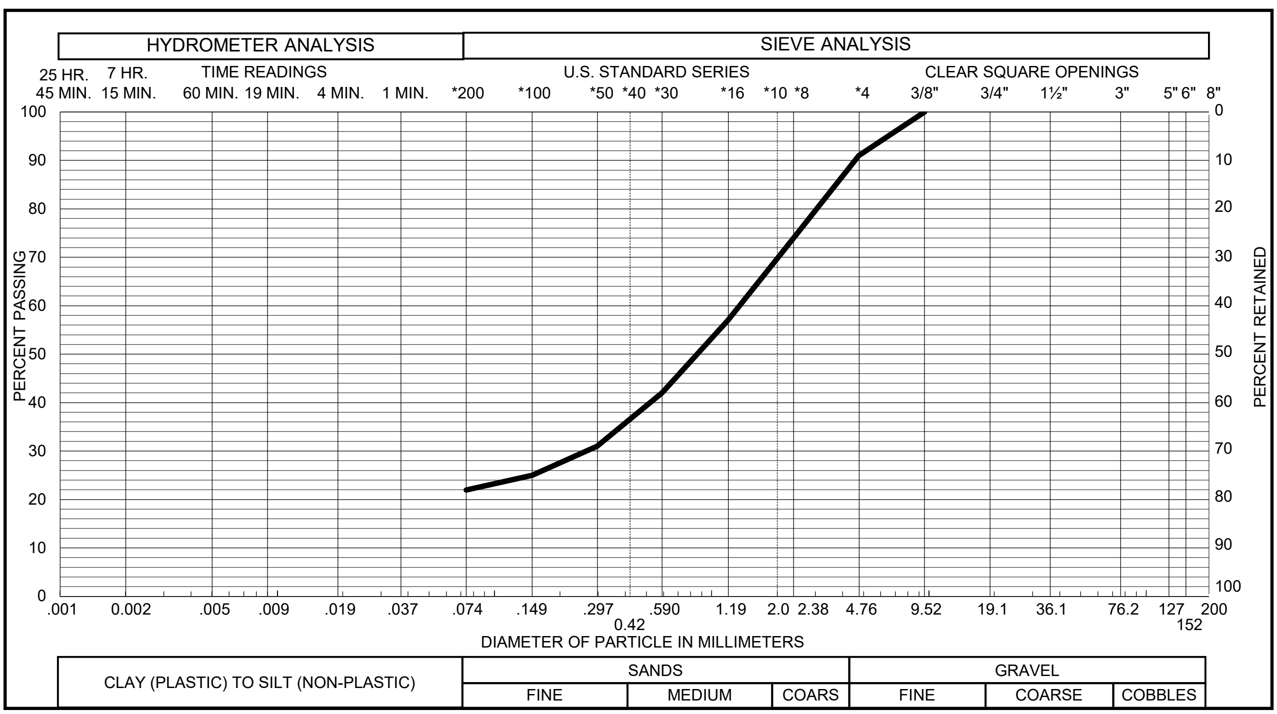
FIG. B-7

D.R. HORTON
GRANDVIEW RESERVE
CTL|T PROJECT NO. CS19345-115



Sample of SANDSTONE, SILTY
From TH - 5 AT 9 FEET

GRAVEL 1 % SAND 81 %
SILT & CLAY 18 % LIQUID LIMIT 26
PLASTICITY INDEX 3



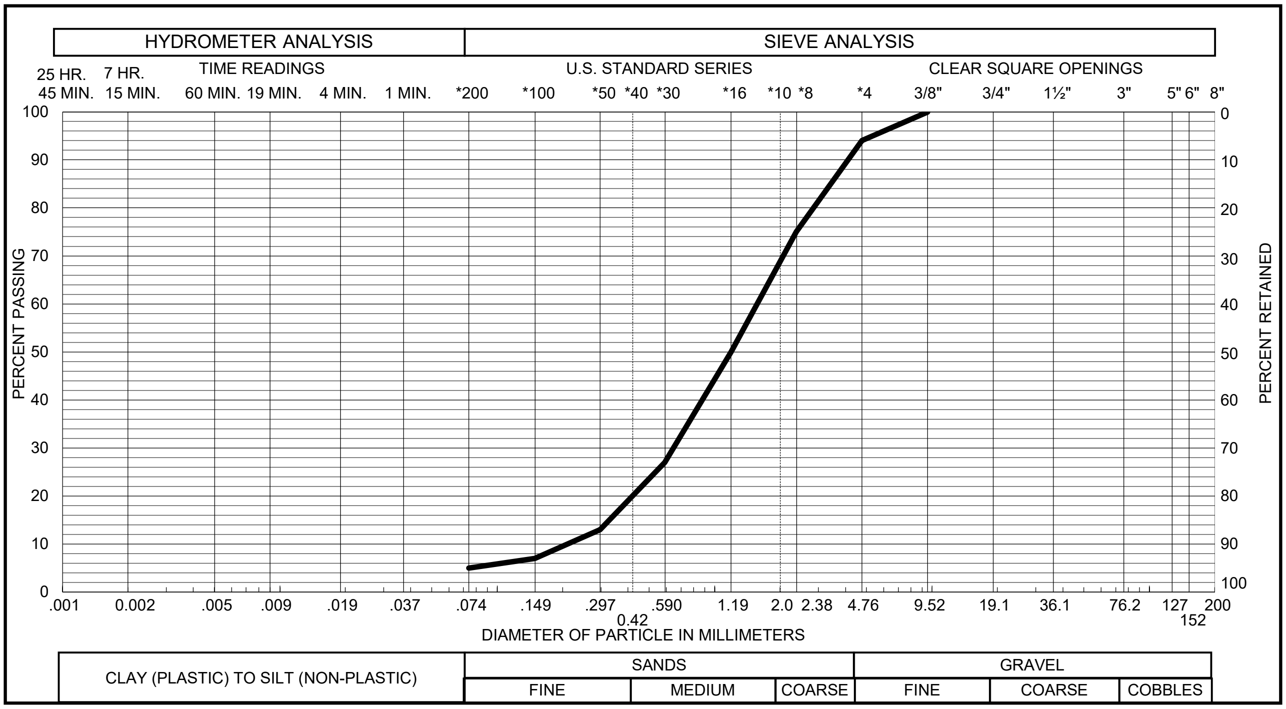
Sample of SAND, CLAYEY (SC)
From TH - 8 AT 4 FEET

GRAVEL 9 % SAND 69 %
SILT & CLAY 22 % LIQUID LIMIT 36
PLASTICITY INDEX 18

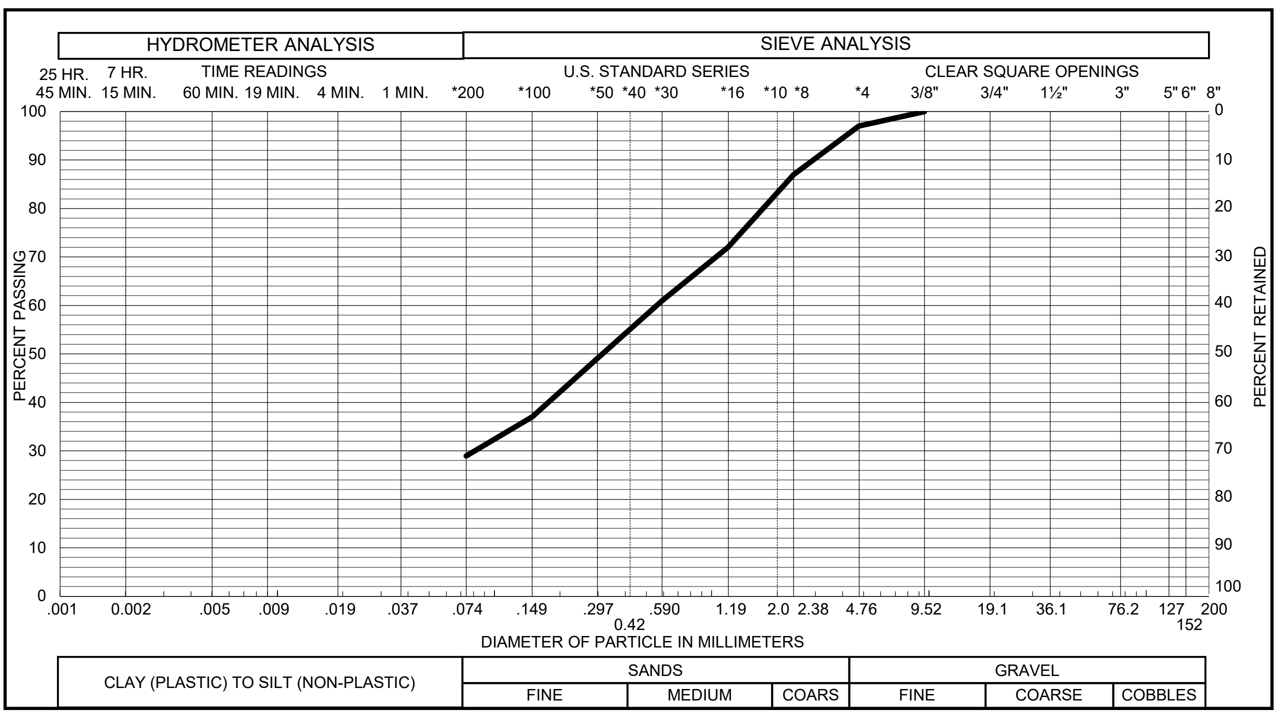
Gradation Test Results

FIG. B-8

D.R. HORTON
GRANDVIEW RESERVE
CTL|T PROJECT NO. CS19345-115



Sample of	SAND, SLIGHTLY SILTY (SP-SM)	GRAVEL	6 %	SAND	89 %
From	TH - 11 AT 4 FEET	SILT & CLAY	5 %	LIQUID LIMIT	
		PLASTICITY INDEX			



Sample of	SAND, CLAYEY (SC)	GRAVEL	3 %	SAND	68 %
From	TH - 12 AT 4 FEET	SILT & CLAY	29 %	LIQUID LIMIT	
		PLASTICITY INDEX			

Gradation Test Results

FIG. B-9

D.R. HORTON
GRANDVIEW RESERVE
CTL|T PROJECT NO. CS19345-115

TABLE B - I

SUMMARY OF LABORATORY TEST RESULTS

BORING	DEPTH (ft)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	SWELL TEST DATA: SWELL (%)	SWELL TEST DATA: COMPRESSION (%)	SWELL TEST DATA: APPLIED PRESSURE (psf)	SWELL TEST DATA: SWELL PRESSURE (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	PASSING NO. 200 SIEVE (%)	SOIL TYPE
TH-1	4	2.8	107							22	SAND, SILTY (SM)
TH-2	9	16.4	114					31	7	25	SANDSTONE, SILTY
TH-2	19	11.3	120	0.1		2,400				66	CLAYSTONE, SANDY
TH-3	9	11.2	120					NL	NP	11	SANDSTONE, SLIGHTLY SILTY
TH-3	19	12.0	123	1.3		2,400				39	SANDSTONE, VERY CLAYEY
TH-4	4	3.6	105							9	SAND, SLIGHTLY SILTY (SP-SM)
TH-5	9	13.0	119					26	3	18	SANDSTONE, SILTY
TH-6	4	10.9	119	4.8		500	12,000			57	CLAYSTONE, VERY SANDY
TH-6	9	9.3	113		0.1	1,100				19	SANDSTONE, SILTY
TH-7	4	13.4	118	0.8		500				68	CLAYSTONE, SANDY
TH-8	4	6.6						36	18	22	SAND, CLAYEY (SC)
TH-8	14	13.2	114	1.0		1,800				43	SANDSTONE, VERY CLAYEY
TH-9	14	11.6	121	2.0		1,800				22	SANDSTONE, CLAYEY
TH-10	4	9.1						NL	NP	24	SAND, SILTY (SM)
TH-11	4	4.7	103							5	SAND, SLIGHTLY SILTY (SP-SM)
TH-11	14	12.2	121	1.6		1,800				40	SANDSTONE, VERY CLAYEY
TH-12	4	10.5	119	0.0		500				29	SAND, CLAYEY (SC)

EXHIBIT V: GROUNDWATER QUALITY REPORTS

El Paso County Groundwater Quality Study
Phase 1

PREPARED FOR:
El Paso County Groundwater
Quality Study Committee

For Presentation to
El Paso County Board of
County Commissioners

PREPARED BY:
Ralf Topper
Andy Horn
Colorado Geological Survey

March 2011

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Executive Summary

This report documents the work, findings, analysis, and recommendations of the Colorado Geological Survey (CGS) in executing the scope of work commissioned by El Paso County, through the Groundwater Study Committee, established in reference to Resolution No. 09-202. The subject of this report is the groundwater quality of the alluvial aquifer within the Upper Black Squirrel Creek (UBSC) basin (Figure 1.1). The Phase 1 study objectives are to characterize the current groundwater quality in the alluvial aquifer and determine whether there is a correlation between existing and future land uses and groundwater quality. The scope of work for Phase 1 was finalized in January 2010, and the County contracted with CGS to perform the work.

The current study is limited to evaluation of existing water quality data for groundwater in the alluvial aquifer system of the Upper Black Squirrel Creek Designated Groundwater basin (UBSC basin) of east-central El Paso County, Colorado. As part of the study a literature review identified 34 relevant publications and an annotated bibliography was prepared. Previous published studies indicated that the groundwater was of good quality, but identified nitrate as a contaminant of concern. Water quality data was acquired from a variety of public sources (county, state, and federal) and study cooperators. The data represent 150 samples collected from 72 different wells between 1954 and 2009. Samples collected for water quality analysis within the study area have a limited spatial and temporal distribution. Approximately 80% of the data were collected in the 1980s and 1990s, and the great majority of wells are within three miles of the Ellicott Highway. One of the most important characteristics of this data is the lack of multiple samples from individual locations. The northern and western portions of the UBSC basin where rapid development has occurred and is expected to continue are not represented in the data.

Groundwater chemical analysis data for inorganic compounds, total dissolved solids (TDS), nitrate, metals, organic compounds, and radionuclides were evaluated to characterize the UBSC basin alluvial aquifer's water quality. The groundwater sample data indicate that, where sampled, the water is generally acceptable with respect to drinking water standards; of moderate hardness; and free of pesticides, herbicides, and regulated organic contaminants. At certain times and locations, some water quality parameters were detected at concentrations in violation of primary and secondary drinking water standards including: arsenic, nitrate, pH, TDS, sulfate, and iron. Nitrate values greater than 5.0 mg/L are common in the basin, and suggest that the alluvial water quality has been influenced by sources of nutrient loading.

No clear relationship between land uses and groundwater quality was evident from the available data. Existing UBSC basin land uses evaluated include residential, agricultural, urban, commercial, industrial, military, and unregulated industrial waste disposal. Elevated nitrate concentrations are distributed over parcels associated with residential, dry land farming/grazing, and irrigated agriculture, suggesting localized sources rather than being impacted from categorical land use. Groundwater quality data are lacking in the northwest portion of the basin where the majority of the development is occurring. Consequently, information regarding nitrate concentrations in areas with higher density ISDSs is missing. Elevated TDS values are associated with both dryland farming/grazing land and rural residential land use. Potential contaminant sources associated with future land uses have been summarized in Table 5.1. Anticipated future land uses within the basin are a continuation and expansion of current land uses, primarily consisting of residential development in urban, rural residential and rural development densities with accompanying commercial development. Figure 5.2 summarizes activity nodes and transportation corridors where future development is expected to be concentrated.

Due to the spatial and temporal limitations of the compiled water quality data, this study was only partially successful in meeting the objectives established by the study committee. Unfortunately, there is no groundwater quality data available in the northwest portion of the basin, where urban land uses and ISDSs are concentrated and continued development is expected. Decision makers in El Paso County attempting to assess the vulnerability of the groundwater resource currently lack a complete understanding of the hydrogeology of the aquifer system and the associated anthropogenic effects controlling the source, transport, and fate of potential contaminants. To address this gap, we recommend implementing a Phase 2 investigation focusing on refining our understanding of the groundwater flow system and acquiring the water quality data needed to support and scientifically defend land use planning decisions.

1. Introduction

This report documents the work, findings, analysis, and recommendations of the Colorado Geological Survey in executing the Phase 1 scope of work commissioned by El Paso County, through the Board of County Commissioners, to study the groundwater quality of the alluvial aquifer within the Upper Black Squirrel Creek (UBSC) basin (Figure 1.1). The objectives of this initial phase were to document and characterize the historic and current groundwater quality in the alluvial aquifer and determine whether the water quality was influenced by existing land uses or may be influenced by future land uses. Depending upon the results of this phase of study, a Phase 2 may be necessary consisting of additional data collection and analysis. Phase 3, if warranted, would include additional land use analysis and development of land use regulations.

1.1. Background and Need

In early 2009, the El Paso County Board of County Commissioners held work sessions regarding potential changes to the El Paso County Land Development Code, including those related to groundwater protection. In May 2009, the Board adopted Resolution No. 09-202 which directed staff to initiate a groundwater contamination study, and provided for the formation of a groundwater quality study committee (Committee). A press release was issued on May 26, 2009, inviting participation on the Committee. The Committee consists of 14 voting members representing areas of the scientific community, developmental industry, building industry, agricultural community, and the community at-large. Additionally, the Committee includes 5 non-voting members from the El Paso County staff and the El Paso County Planning Commission. The study objective is to evaluate potential groundwater contamination issues to help participants make informed land use decisions.

Development Services Division staff were directed to report back to the Board with a stakeholder process and list of potential stakeholders. They also provided a study coordinator, Elaine Kleckner, to manage the process. Staff consulted with a number of individuals with technical knowledge of groundwater contamination issues including U.S. Geological Survey (USGS), Colorado Geological Survey (CGS), groundwater management districts, special districts, and governmental agencies and presented a preliminary work plan to the Board on July 9, 2009. The Committee met through the summer and fall of 2009 to refine the scope of work and identify funding partners. Pat Edelmann of the USGS Colorado Water Science Center and Ralf Topper of CGS participated in a technical advisory role.

1.2. Scope of Work

The scope of work for Phase 1 was finalized in January 2010 and the Committee voted to recommend to the Board contracting with the Colorado Geological Survey (CGS) to perform the study. USGS personnel would continue to participate in the committee meetings and assist in a technical advisory capacity. Recognizing the diversity of groundwater resources in El Paso County, the Board's desire to obtain results quickly, and the limited funds available, the Committee and the Board of County Commissioners decided to focus the study on the alluvial aquifer of the Upper Black Squirrel Creek (UBSC) basin (Figure 1.2). The approved scope of work was divided into five tasks:

1. Project management, committee coordination and public participation
2. Literature review and data compilation/analysis
3. Identification of potential contaminant sources based on land use
4. Summary of results of Phase 1
5. Report compilation and presentation

In consultation with CGS, the Committee modified the scope of work by addendum; largely to clarify the providers and contractor deliverable requirements. In May 2010, El Paso County entered into agreement with CGS to conduct the study and executed a Memorandum of Understanding to identify the funding commitments for the study. In addition to the county and CGS's match of in-kind services, funding was provided by Cherokee Metropolitan District, Meridian Service Metropolitan District, Sunset Metropolitan District, Upper Black Squirrel Creek Ground Water Management District, and Accretive Investments, Inc. The El Paso County Development Services and Information Technologies departments were instrumental in providing data related to land use and the presence of individual sewage disposal systems (ISDSs).

1.3. Study Limitations

The current study is limited to evaluation of existing water quality data for groundwater in the alluvial aquifer system of the Upper Black Squirrel Creek (UBSC) Designated Groundwater basin of east-central El Paso County, Colorado. The study is intended to document and evaluate the current groundwater quality in the UBSC basin alluvial aquifer and assess the potential for groundwater contamination from existing and future land use. To accomplish this, the CGS has collected existing groundwater quality data from publicly available sources and from study cooperators. The CGS then evaluated the data with respect to water quality and potential water quality impacts that current and future land uses have had, or are likely to have.

In addition to data provided by the study's utility cooperators, Cherokee Metropolitan District and Meridian Service Metropolitan District, CGS searched publicly available databases and reports for site-specific water quality information. Local, state, and U. S. government sources were queried for relevant data or information. Also, El Paso County issued a press release soliciting water quality data from private landowners and any other interested parties.

All public entities contacted agreed to share relevant groundwater quality data, if available, and the authors are not aware of any other sources of significant data relevant to the current study. No new water-quality sample collection and analysis was performed. CGS collected data from numerous sources, documenting some inconsistencies between data sources. Consequently, it is important to recognize that we discuss and evaluate the chemistry of common constituents in natural groundwater without the benefit of knowing or having documentation of the quality of the data presented. For example, original laboratory reports were seldom available. We complied the date collected into an internally consistent data set for the analyses presented herein.

1.4. Understanding Water Quality Data

Laboratory analysis of chemical constituents in natural waters is commonly conducted on both the suspended and dissolved solids in the fluid. Suspended solids being insoluble particles remaining dispersed in a liquid. Suspended solids are common in surface water but not in groundwater, as subsurface materials (soil and rock) act as good filters. Consequently, analysis of groundwater and the water quality standards upon which those standards are based focus on concentrations of dissolved constituents. Most of the dissolved constituents in native groundwater are the result of chemical interactions between the water and the geologic materials with which groundwater has been in contact.

Dissolved solids in water come from a variety of sources including the atmosphere and earth materials. The chemical processes occurring between water and its contact environment can also be strongly influenced by biologic activity. In natural systems, precipitation is the source of groundwater. Rain or snow fall may pick up and incorporate atmospheric particles and gases. As the rain or snowmelt flow over the land and percolate into the soil, some of the soil minerals and surface materials, such as decaying leaves or wood, dissolve into the water and become part of the water's chemistry. As the water percolates to the underlying water table, and moves through pores, within the soil or rock, the dissolved solids content will usually increase until, given enough time, the groundwater reaches a state of chemical equilibrium with the aquifer materials it flows through. The major dissolved constituents in groundwater include: calcium, magnesium, sodium, potassium, chloride, sulfate, bicarbonate, carbonate, and silica. Minor constituents may include: iron, manganese, fluoride, nitrate and other trace elements. Typically the dissolved solids content is relatively low in natural groundwater systems and the types and concentrations of dissolved solids reflect the dominant mineralogy of the aquifer through which the water has flowed. From a land use perspective, poor water quality is typically attributed to contamination from anthropogenic (man-made) sources such as road salt, excess fertilizer, storage tank leaks, or wastewater effluent.

Over the years, a wide variety of units have been used in reporting water analyses. Understanding the units and conventions used in the past is helpful when using the data available in the published literature. Because water is a liquid, concentrations are typically reported as the mass of a given solute per unit volume of water. For example, if one were to stir ten grams, or about 1 and 2/3 teaspoons, of table salt (sodium chloride), into one liter of pure water the mixture would have a salt concentration of "ten grams per liter." Since the concentration of dissolved constituents in most natural waters is generally low, the standard practice in water quality interpretation is to report units of one thousandths of a gram, or milligrams per liter (mg/L). These units can also be considered in terms of a weight basis to obtain "parts per million" values. Historically, the U.S. Geological Survey, and other labs throughout the U.S., reported concentrations in "parts per million (ppm)" (Hem, 1985). The assumption of equivalence between mg/L and ppm is based on unit density for water and is considered reasonable by hydrologists for waters with low dissolved mineral matter and ambient temperatures. For the purposes of this report, dissolved constituent concentrations are reported in the accepted convention of milligrams per liter.

Some metals or organic compounds, such as arsenic or benzene, respectively, have been shown to impact human health at much lower concentrations than one milligram per liter. Such constituents are often measured in concentrations of micrograms per liter (ug/L), or the approximation "parts per billion" (ppb).

1.5. Evaluating Contaminant Concentrations

The quality of public drinking water is regulated by the US Environmental Protection Agency (US EPA) and enforced by the Colorado Department of Environmental Health and Environment (CDPHE). These agencies have developed rules and regulations intended to ensure the safety of drinking water supplies by setting numerical standards for the amount of certain constituents (bacteria, dissolved metals, organic chemicals and other compounds) considered harmful. When these constituents are found in water, at concentrations greater than the regulatory Maximum Contaminant Levels (MCLs), they are considered contaminants. MCLs are enforceable health based standards. The MCL is established to be protective of human health as determined by toxicological research.

Some dissolved constituents found in drinking water are not concerns with respect to health but rather produce nuisance issues such as poor taste, offensive odor, skin or tooth discoloration, or staining of laundry and plumbing fixtures. The EPA has set non-enforceable aesthetic guidelines regulating concentration of these contaminants, known as the Secondary Maximum Contaminant Levels (SMCLs). While contaminants have also been defined as an unwanted substance or a substance occurring in concentrations above background levels, the data presented herein are compared with the regulatory limits for both MCLs and SMCLs.

1.6. Sample Location (well) Identification System

Data tables presented in this report use a site identification numbering system based on the U.S. Bureau of Land Management system of land subdivision. The system identifies the survey meridian and the quadrant of the principal meridian in which the well is located, and then identifies the township, range, section and the well's location within the 160-acre quarter section, the 40 acre quarter-quarter section, and the 10 acre quarter- quarter- quarter section. As an example, the location of well SC01306230ACC1 can be determined by reading the identification number from left to right, the (S) indicates the Sixth Principal Meridian Survey, in the southwest quadrant (C), in Township 13 South (013) and Range 62 West (062) , section 30 (30). The last three letters of the well identification indicate the well is located in the southwest quarter (C) of the southwest (C) quarter of the northeast quarter (A). The last three letters of the well identification ("ACC") represent, from left to right, the largest to the smallest area. If more than one well is present in the 10-acre quarter-quarter-quarter section each well is given a numbered suffix. The well in this example is designated as the Number 1 well in the 10-acre quarter-quarter-quarter section. A graphical depiction of the well identification system is shown in Appendix A.

2. Previous Studies and Literature Review

In the Committee's preliminary work plan a number of publications and data sources were identified for review. Task 2 of the scope of work included the compilation of an annotated bibliography. The annotation includes abstracts for publications, or a short paragraph summary if an abstract is not available. Our literature review identified 34 publications relevant to the current study and an annotated bibliography is presented in Appendix B. Table 2.1 presents a list of the publications and their relevance to this study. Both Table 2.1 and the annotated bibliography are presented in reverse chronological order, under the assumption that the more recent publications have greater relevancy to current land uses and water quality.

Documents reviewed were grouped into the following categories:

1) Studies containing data specifically from groundwater sampling performed in the UBSC basin,
2) Studies containing research relevant to physical, biological and chemical processes that may affect groundwater quality in the UBSC basin,
3) Studies containing research on the general relationship between land use and the potential for groundwater contamination, and
4) Studies containing data relevant to USBC basin groundwater quantity and supply.

Previous studies containing data, from groundwater sampling performed in the UBSC basin, were published between 1966 and 2009. These publications range from regional water- resource assessments, which include the UBSC basin, to research specifically focused on the water quality in the UBSC basin. To establish a foundation of previous work conducted specific to the UBSC basin, we provide a brief summary of the results and conclusions published by other investigators.

- The earliest study considered here was by McGovern and Jenkins (1966) who evaluated conditions in the alluvial aquifer in 1964 with respect to future groundwater development. Analyses from three groundwater samples were presented that included results for nitrate and other general chemistry parameters. McGovern and Jenkins predicted declines in water levels due to overdraft pumping of the aquifer and stated *the water quality as being generally good and of a mixed cation bicarbonate type*. The prediction of declining water levels has been validated historically and the water quality finding agrees with the current study.

- Bingham and Klein (1973) evaluated water level declines and groundwater quality in the UBSC basin and observed water level declines of 20 to 35 feet, in part of the UBSC basin, over a seven-year period between 1964 and 1971. They described *overall water quality as good and total dissolved solids (TDS) were observed to increase laterally from the main alluvial channel*. These results agree with what is known about the UBSC basin and what has been observed in the current study.

- Livingston, Klein and Bingham (1976) evaluated water resources of El Paso County including multiple watersheds and estimated the amount of available groundwater in the UBSC basin alluvial aquifer at 350,000 acre-feet. They found the TDS content of groundwater in the UBSC basin to be far lower than other alluvial aquifers in El Paso County. The storage estimate is conservative in comparison with a more recent study indicating approximately 475,000 acre-feet available in the alluvial aquifer (Topper, 2008). *Their conclusions with respect to water quality generally agree with the current study and other more recent studies*.

- Buckles and Watts (1988) evaluated water quality and performed preliminary groundwater flow modeling of the UBSC basin alluvial aquifer. They documented continuing decline of alluvial aquifer water levels and simulated the future effects of groundwater pumping. In 1984, they sampled 36 wells for water quality parameters including nitrate. The report documents that five wells, in the UBSC basin, had nitrate concentrations exceeding drinking water standards. However, at three of these wells, nitrate concentrations were interpreted to be anomalously high because the wells were located near local sources of nitrate loading. *The water quality results of Buckles and Watts (1988) are generally consistent with other studies and the current study*.

- Watts (1995) evaluated the hydraulic connection between the alluvial and bedrock aquifers, documented water level declines in the alluvial and underlying bedrock aquifers, and simulated the physical groundwater flow system. Watts (1995) considered water quality only as an indicator of flow between the two types of aquifers and did not focus on issues relevant to this study. His report, however, provides water quality data for a limited number of wells.

- Brendle (1997) compared nitrate concentrations from two time periods at specific wells to determine whether an observed increasing nitrate concentration trend was localized or typical of the UBSC basin alluvial aquifer in general. Brendle resampled 28 of the 36 wells sampled in 1984 by Buckles and Watts (1988) and performed statistical evaluation of changes in nitrate concentrations over the 12 years. *Brendle found nitrate concentrations to have decreased at eight wells and to have increased at 20 wells*. The average difference in nitrate concentrations over the 12-year period between the two sampling events was -0.18 mg/L. He documented anomalously high decreases in nitrate concentrations (-8 mg/L and -10 mg/L) in two wells. Removal of these two samples from the data set results in an average nitrate concentration difference among the remaining 26 wells of +0.55 mg/L over the 12-year period. *A statistical analysis using a paired t-test found there to be no significant difference in overall nitrate concentrations over the entire UBSC basin. However, if the geographic distribution is considered and the UBSC basin is divided into its northern one-third (10 wells in the north) and southern two-thirds (18 wells in the south), a statistically significant increase in the southern two-thirds of the UBSC Basin is indicated*.

- The Colorado Water Resources Research Institute (CWRRI, 2008) published generalized results of the Agricultural Chemicals and Groundwater Protection Program, a cooperative program between the Colorado Department of Agriculture (CDA), Colorado State University Extension Services (CSUES), and the Water Quality Control Division (WQCD). This program systematically monitored for the presence of agricultural related chemicals in vulnerable aquifers throughout Colorado. As part of the evaluation, the CDA sampled 49 wells in El Paso County, including seven alluvial wells in the UBSC basin, for a range of agricultural chemicals, metals, and general water quality parameters including nitrate. Data from the UBSC basin wells are not presented in the report; however, the data was provided to CGS for the current study by the CDA (Mauch, 2010). *A sample from one well yielded a nitrate concentration of 11.5 mg/L which exceeds the MCL for nitrate. Other than this single nitrate exceedance, sample results indicate generally good water quality for the aquifer at the locations sampled*. The analysis of the seven wells also reported concentrations below laboratory detection limits for 47 different pesticides and agricultural chemicals, and metals concentrations below primary (MCL) and secondary (SMCL) regulatory levels.

- The Colorado Geological Survey (Topper, 2008) performed a study of the UBSC basin alluvial aquifer to evaluate and refine the existing knowledge of the hydrogeology of the alluvial aquifer system for the purposes of assessing the potential for aquifer recharge and storage implementation. Water quality samples were obtained from new monitoring wells installed and hydrogeologic and geologic characterization was performed. The results indicate water from the alluvial aquifer in the UBSC basin is classified as either a sodium calcium-mixed anion or a sodium calcium bicarbonate type. *With few exceptions, the alluvial groundwater was determined to be of very good quality with total dissolved solids concentrations below 500 milligrams per liter*. In four samples cited from the literature, nitrogen compounds were observed to exceed the MCL. Subsequent reevaluation of the nitrate data indicates that data from the original source (McGovern and Jenkins 1966) were uncorrected with respect to reporting nitrate concentrations as nitrogen. This distinction is further discussed in Section 3.

- The Water Quality Control Division of the Colorado Department of Public Health and Environment publishes a status of water quality in Colorado (CDPHE, 2008) on a bi-annual basis. Groundwater monitoring results are collected through the Agricultural Chemicals and Groundwater Protection Program cited previously. The program collaborated with the CSU Cooperative Extension in eastern El Paso County to conduct a reconnaissance investigation of groundwater quality with respect to agricultural chemicals. CSU sampled forty-nine domestic, irrigation, stock watering, and municipal wells in El Paso County. These wells were completed in both the alluvial aquifer and the shallow portions of the Denver Basin bedrock aquifers. *The report concludes "that nitrate contamination does not appear to be a widespread problem based on the results of the reconnaissance investigation".* However, the report warns against drawing site-specific conclusions due to a lack of sample distribution. *The program did not recommend a follow-up investigation and gave El Paso County a low priority with respect to vulnerability to agricultural chemicals and nitrate.*

Table 2.1

Literature Review Summary

Reference (by date)[1]	UBSC Basin Groundwater Studies	Processes Relevant to Groundwater Quality	Relationship Between Land Use and Groundwater Quality	UBSC Basin Groundwater Quantity and Supply
Rupert and Plummer, 2009		X	X	
CDPHE, 2008	X			
Topper, 2008	X			X
Conn, Segrist and Barber, 2007		X		
Paul, 2007		X		
Paul, Poeter, and Lewis, 2007		X		
Topper, 2007				X
Miller and Ortiz, 2007		X		
CWRRI 2008	X		X	
Dano, Poeter, and Thyne, 2006		X		
Wakida and Lerner, 2006		X		
Gardner and Vogel, 2005			X	
Heatwold, McCray, and Lowe, 2005		X		
Brendle, 2004		X		
Poeter and Thyne, 2004		X		
Oritz, 2004		X		
Thyne, Guler and Poeter, 2004		X		
PPACG, 2003			X	
Poeter et al, 2003		X		
Trojan, et al., 2003			X	
Halapaska and Associates, 2002				X
Martin, Bassinger and Steele, 2002		X		
CWQCC, 2002		X		
Wakida and Lerner, 2002		X		
USGS, 2000		X		
Brendle, 1997	X			
Eckhardt and Strackleberg, 1995			X	
Watts, 1995	X			X
Buckles and Watts, 1988	X			X
Edlemann and Cain, 1985		X		
Livingston, Klein and Bingham, 1976	X			X
CDWR, 1974		X		
Bingham and Klein, 1973	X			X
McGovern and Jenkins, 1966	X			X

1. Full citations available in Reference Section

3. Existing Water Quality Data

CGS acquired data from a variety of public sources, in both electronic and “hard copy” formats, compiled the data into an internally consistent database, and processed it for use in the analyses presented herein.

3.1 Water Quality Data Sources, Format and Limitations

CGS obtained site-specific information from publicly available databases, published reports, individuals, special and metropolitan districts, and government agencies at the local, regional, state, and federal level. We compiled all relevant and available data. Entities queried or providing data include:

- U.S. Environmental Protection Agency (STORET, SDWIS, UCMR, NCOD)
- U.S. Geological Survey (NWIS, CWQDR)
- Colorado Department of Public Health & Environment, Water Quality Control Division
- Colorado Department of Public Health & Environment, Solid Waste Unit
- Colorado Department of Public Health & Environment, Hazardous Waste Enforcement Unit
- Colorado Department of Agriculture
- Colorado Department of Labor & Employment, Division of Oil & Public Safety
- Colorado Department of Wildlife, Riverwatch Program
- Colorado State University Extension Service
- Pikes Peak Area Council of Governments
- El Paso County
- Cherokee and Meridian Metropolitan Districts
- Waste Management Inc.
- Scheiver Air Force Base
- Schubert Sod Farms
- Mr. Charles Barber

Publications with relevant water quality data include:

- McGovern and Jenkins, 1966
- Bingham and Klein, 1973
- Buckles and Watts, 1988
- Watts, 1995
- Brendle, 1997

- Topper, 2008

El Paso County also issued a press release calling for any data held by private well owners; no responses were received. The authors are not aware of any other sources of groundwater quality data relevant to the current study.

All data presented herein is preexisting and collected by others; as new water quality sampling and analysis was not included in the current study's scope. CGS created a master water-quality database that included chemical constituents, common to natural waters, and relevant to the use of the alluvial aquifer as a drinking and irrigation water source. CGS staff converted reported data into common units, manually entered data from paper documents, and combined all data into a master database. All values reported as either "parts per million" or in mass per volume units were converted to milligrams per liter (mg/L). CGS staff, other than those performing data entry, checked the accuracy of data entered into the master data set. The water-quality master database, organized into seven tables, is attached as Appendix C.

In some cases, different published and/or electronically available sources reported different sets of analytes for the same well and sampling event. We combined different data sets and removed duplicate records. In other cases, two different analytical results were available for the same parameter from the same sample. In these cases, the project team used the most recently published value, presuming newer data to have undergone additional quality assurance evaluation since publication of the older value.

We did not include or analyze all available water-quality data in this study. First, we believe that surface water samples collected from streams and lakes were not relevant to the current study's groundwater priority. These data, while representative of a portion of the water that percolates to the water table and recharges the aquifer, are not representative of water quality within the aquifer due to chemical and biological reactions occurring in the unsaturated zone, and dilution of the water once it reaches the aquifer. Secondly, most water supply analyses come from municipal water distribution systems. These samples are generally not representative of native groundwater quality because water providers treat the water and may blend it other water sources. Therefore, we did not use these sampling data, often provided to the public in Consumer Confidence Reports, in the current study. Any "new source" water quality data made available are representative of the groundwater quality and are included in the current report.

In general, the details of the sampling methods, laboratory analytical procedures and case narratives, well construction information, or other factors often indicative of sample bias were not available to the current study. The majority of the data was provided as summary data sheets from consultant reports or other secondary sources such as published reports or electronic databases.

Concentrations reported for many parameters were below the laboratory detection limits, but the detection limits were not quantified. Older data reports often used terms such as “BDL” (“below detection limit”) or “ND” (“not detected”) to describe parameters analyzed but not detected. We qualify these entries as “detection limit not quantified” (“DLNQ”) in the data tables provided.

The respective studies and sampling events from which the data are derived produce inconsistencies with regard to issues such as sampling protocol, the selection of analytes, methodologies and laboratories used, reporting criteria, and the design, construction, or original purpose of the well sampled. The lack of original laboratory reports and a consistent set of analytes precluded the ability to perform rigorous quality assurance and control. Despite these differences, CGS compiled the data into an internally consistent data set for the analyses presented.

3.2 Spatial and Temporal Characteristics of the Data

Samples collected for water quality analysis within the alluvial aquifer of the Upper Black Squirrel Creek basin have a limited areal distribution. Most sample locations are concentrated along the main alluvial channel, which follows a general north-south alignment within about three miles on either side of the Ellicott Highway. The locations of all 72-sample sites used in this study are displayed in Figure 3.1. To facilitate cross-referencing of the well locations with the well site identification numbers used in the subsequent data tables, a simplified reference table is presented in Appendix C, Table 1. No alluvial aquifer samples are available in the northwest portion of the basin that contains the urban corridor along US Highway 24. The limited spatial distribution of the data is portrayed as a histogram of water quality data by township and range. Figure 3.2 presents the number of available data points by township from north to south in the basin. Only 12 individual data points are available north of Judge Orr Road (township 12 south). The greatest number of data points, in township 13 south, is deceiving as 48 of the 61 reported are from a single sampling location.

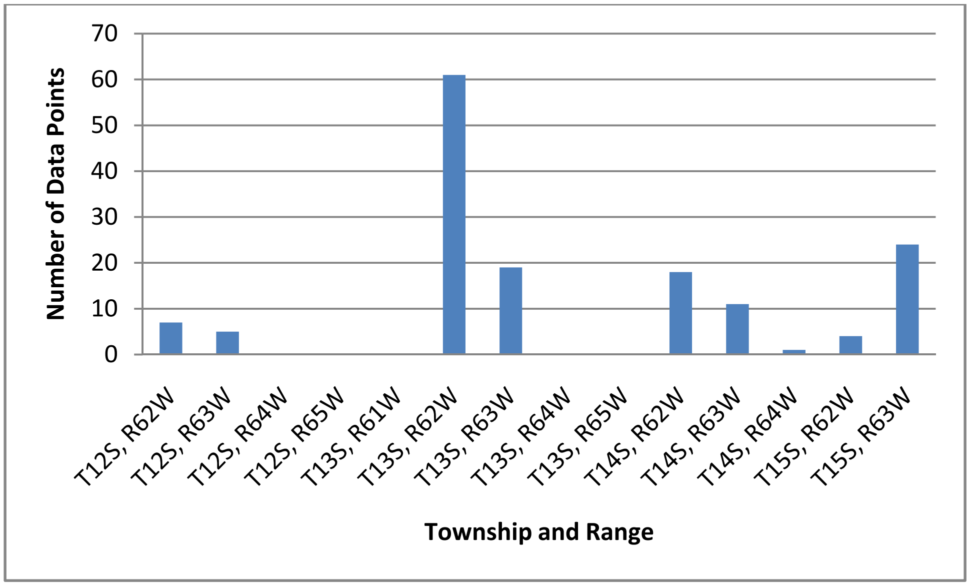


Figure 3.2 – Spatial distribution of water quality data

The groundwater quality data used in the current study consists of 150 samples collected from 72 wells between December 20, 1954 and Nov. 5, 2009. Table 3.1 present a summary of the data. The table provides statistics for the overall data set and in each of four periods: pre-1980, the 1980s, the 1990s, and the 2000s. Seventy-nine percent of the water quality data included in the current study was collected during the 1980s and 1990s. Data from prior to 1980 include only 11 samples and data from only 21 samples are available from the 2000s. One of the most important characteristics of this data is the lack of multiple samples from individual locations. Only four well sites have been sampled three or more times, with only one well reporting more than four sampling events. Consequently, the data's temporal irregularity limit the evaluation of groundwater constituent trends to "snapshot" maps showing distribution of respective constituents during different decadal periods.

CGS used data from 72 wells in the current study area. Of these 72 wells, 25 wells were sampled twice, three wells were sampled three times and one well (SC01306230ACC1) was sampled 48 times. The resulting data set contains analytical results from a total of 150 samples collected from the 72 different wells (Table 3.1). Well SC01306230ACC1 provides almost one third of the nitrate concentration data available to the current study.

Table 3.1

Water Quality Data Summary Information

	Overall Data Set	Pre_1980	1980s	1990s	2000s
Number Records with Laboratory Parameters	150	11	65	53	21
Number of Wells Sampled	72[1]	11	47	28	19
Earliest Record	12/21/1954				
Latest Record	11/5/2009				
Number of pH Data Values	121	10	63	27	21
Number of NO_3 Data Values	142	10	65	53	14
Number of TDS Data Values	77	10	45	2	20
Number Pesticide Analyses	21	0	6	2	13
Number of VOC Analyses	3	0	0	0	3
Number of Inorganic Analyses (Cations)[2]	51	9	22	2	18
Number of Inorganic Analyses (Anions)[3]	37	10	19	2	6
Number of Metals Analyses[4]	8	0	0	0	8
Number of Iron Analyses	43	7	22	2	12
Number of Radioactivity Analyses[5]	12	0	2	2	8

Notes:
1 – Number of wells sampled in overall data set may be less than the sum of individual time periods due to multiple sampling events in the same well
2 - Analyses include Mg, Na, K, and Ca
3 - Analyses include HCO_3, SO_4, and Cl
4 - Metals included are Ba, Cd, Cr, Cu, Pb, and Zn
5 - Gross Alpha and Gross Beta Emitter Analyses

3.3. Data Analysis

The data have limitations described above in Section 3.1. We can only assume that the data have been collected by trained personnel using valid methods, subjected to quality assurance evaluation, evaluated by the original data users, and deemed representative of the alluvial groundwater quality at the wells sampled.

CGS compiled the data into a MS Excel spreadsheet. This format allowed for statistical analysis of the data, the creation of tables, and allowed us to utilize the chemical analysis tools in Rockware's® Aq•QA software to convert units, check for internal consistency, and create graphs and diagrams. We then imported information derived from our data analysis into GIS (ESRI ArcMap 9.3) software to allow display and presentation with respect to other geospatially referenced information and land use layers provided by

El Paso County. Project staff mapped wells or sample locations, lacking precise location coordinate data, at the center of the most refined public land survey system (PLSS) subdivision available.

As a method of evaluating the data set, CGS attempted a charge balance calculation for water samples for which major ion data were available; however, for many samples, the calculation indicates a charge balance discrepancy exceeding the standard analysis reliability criterion of 5% for chemical data. This discrepancy indicates several possibilities (Hounslow 1995), the most likely of which include:

- Inaccurate laboratory analyses
- Presence of ions not indicated in laboratory data sheets

Despite the potential for a discrepancy in the charge balance, sufficient data are present to characterize the overall water quality within the UBSC basin alluvial aquifer.

The spatial, temporal, and technical limitations of the available groundwater-quality data influence the objectives of the current study. Spatially, the data are unevenly distributed across the UBSC basin. There are no groundwater data available where dense residential development is a significant land use, primarily in the northwestern portion of the basin. Temporally the data cluster around particular time periods even though the data set spans more than five decades. Due to the chemical and physical changes that may occur in the groundwater environment over time, the age of much of the data precludes its application for characterizing the current groundwater quality in the study area. A number of technical aspects limit the usefulness of the data in the current study. Investigators typically sampled wells only once or twice; only one well was the subject of more than four sampling events during the period of record. Consequently, evaluation of water quality trends over the period of record is limited.

4. Alluvial Groundwater Quality in the Upper Black Squirrel Creek Basin

Groundwater chemical analysis data for inorganic compounds, total dissolved solids, nitrates, metals, volatile organic compounds, and radionuclides were evaluated to characterize the UBSC basin alluvial aquifer water quality. Natural waters obtain a chemical signature as a result of weathering, a process whereby water in the form of precipitation dissolves atmospheric gases and reacts with minerals on the surface of the earth. The interaction of geologic materials with the atmosphere and hydrosphere determines the native chemical signature of the groundwater. This chemical signature can be further modified by human activities and the release of chemicals into the environment. Regulatory agencies such as the US EPA have established numerical standards for drinking water supplies that are protective of human health. We evaluate the water quality of the alluvial aquifer of the UBSC basin with respect to naturally occurring compounds and chemicals that may be introduced by various land uses. A copy of all the groundwater chemical analysis data utilized in this study is attached as Appendix C. Illustration of water quality analyses is used to plot the geographic distribution of the parameter of interest and evaluate the presence of chemical trends.

4.1 Total Dissolved Solids Concentrations

The most common indicator of water quality is the determination of the total dissolved solids (TDS) content. This analysis quantifies the amount of major ions in solution. Pure waters have very low TDS concentrations while brines have extremely high concentrations. The US EPA established a Secondary Maximum Contaminant Level (SMCL) of 500 milligrams/liter (mg/L) for drinking water. Seventy-seven TDS values were available to us from 72 wells. Concentrations ranged from a low of 165 mg/L to a high of 842 mg/L (Table 4.1). The distribution of TDS values by number of wells sampled is presented in Figure 4.1.

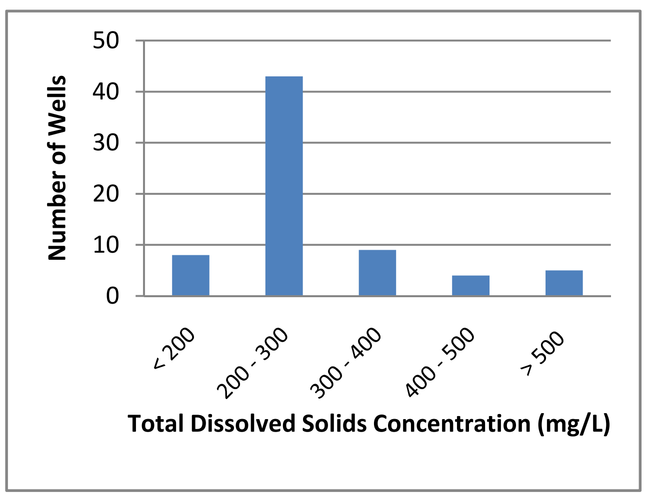


Figure 4.1 – Distribution of TDS

For presentation, we averaged values collected from the same well over the period of record. As can be seen in the TDS histogram (Fig. 4.1), 51 of the 72 wells sampled for TDS have values of less than

300 mg/L; indicating groundwater is generally of good quality. Six wells reported concentrations exceeding the SMCL of 500 mg/L.

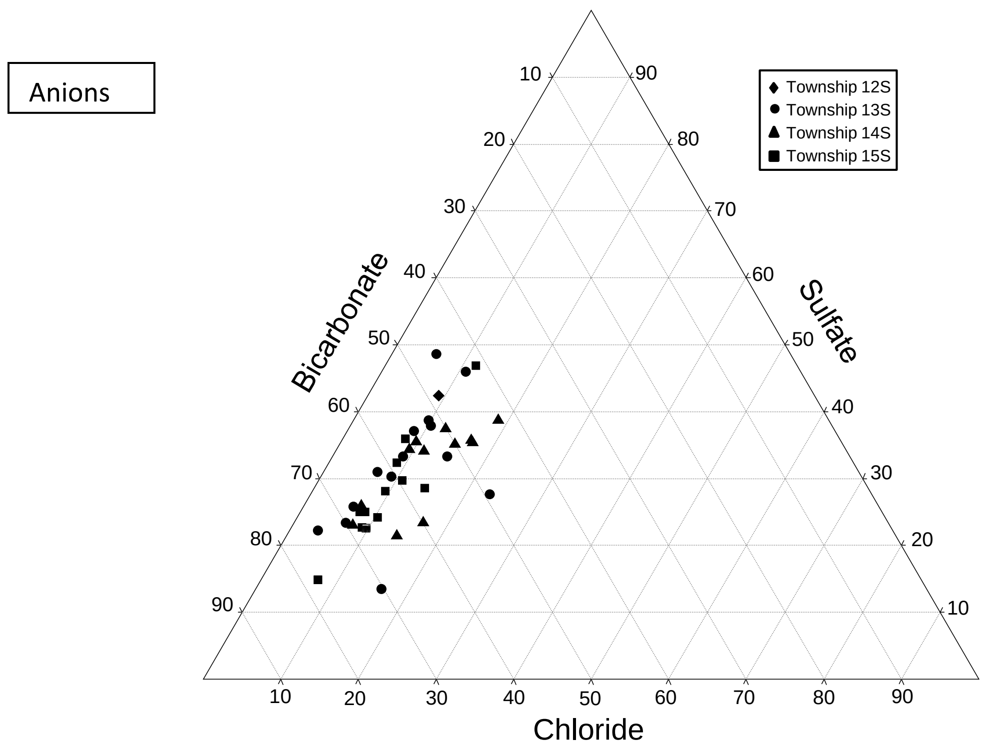
The locations of the sampling points for these data are presented in Figure 4.2. Generally, lower TDS values are present along and to the west of the main alluvial channel of Black Squirrel and Brackett Creeks in areas of the thickest saturated alluvium. Samples with higher TDS values were collected from wells generally to the east of Black Squirrel and Brackett Creeks and in areas of thinner alluvium such as the northern and eastern portions of the UBSC basin alluvial aquifer. The TDS values compiled for this study indicate that in the majority of the areas where sample data are available, TDS values are typically less than 300 mg/L.

In some cases, higher TDS values are reported adjacent to wells with low values (e.g. southern portion of the basin). The reason for the increased TDS concentrations in areas of thinner saturated alluvium is unknown. Possible sources of higher TDS concentrations include runoff, irrigation return flow, and discharge of underlying bedrock aquifers.

4.2 Major Ion Ratios

The total dissolved solids concentration in a water sample can be divided into the individual constituents present. These constituents are usually referred to as the major ions and their ratios can be used to classify the water by general chemical type. These constituents usually include the positively charged ions (cations) calcium, magnesium, sodium and potassium, and the negatively charged ions (anions) chloride, sulfate, and bicarbonate. Commonly, in natural waters, the electrical charge associated with the combined cations will be equal to the combined charge of the anions resulting in a charge balance. As water migrates through an aquifer, the chemistry can evolve along the flow path from one water type to another due to dissolution of minerals within the aquifer, infiltration of water from other sources, upward migration of water from underlying aquifers (Watts, 1995) or reactions resulting from changes in the aquifer mineralogy (Hounslow, 1995).

The major ion ratios for all water samples, with sufficient data, are presented in Figure 4.3. Due to the weathering process, major ion chemistry may vary between different aquifers. Watts (1995) used major ion ratios as an indication of how water was flowing between the alluvial aquifer and underlying bedrock aquifers in the UBSC basin. The percentages of the different ions are plotted on triangular or



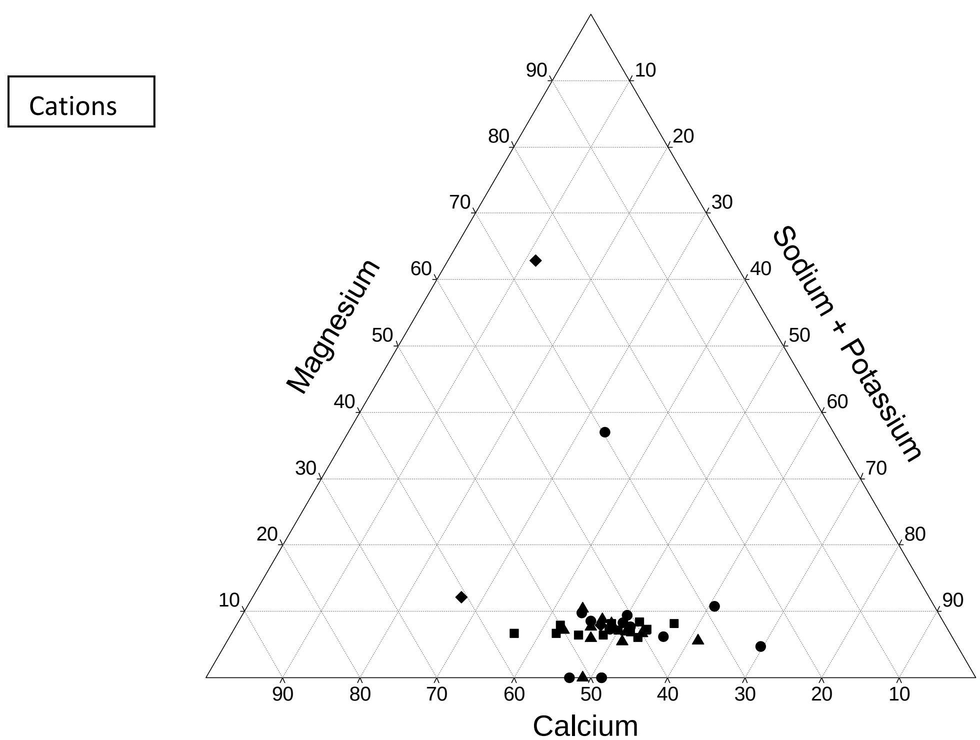


Figure 4.3 - Relative proportions of dissolved anions and cations in water from the alluvial aquifer in the Upper Black Squirrel Creek Basin.

(Units along axes are percentage of total milliequivalents per liter)

Ternary diagrams to evaluate water chemistry trends and sources. Overall, in charge balanced units of milliequivalents per liter, the proportions of cations generally range from approximately 35% - 55% calcium, 35% - 55% sodium and 5% - 10% magnesium, while anions generally fall within ranges of 20% - 50% sulfate, 55% to 70% bicarbonate and 5% - 15% chloride. These analyses indicate that the alluvial groundwater within the study area is a mixed cation bicarbonate water, containing a mixture of the cations calcium and sodium, with an anion content consisting predominantly of bicarbonate. The use of different symbols, in Figure 4.3, for each of the different townships in the study area allows for evaluation of geographic trends in the major ion proportions. No significant geographic zonation in water chemistry is evident from this analysis.

Two outliers are evident in the cation ratio ternary plot of Figure 4.3, samples SC01306230ACC3 and SC01306219CDB. These samples are skewed by relatively high magnesium concentrations of 12 and 54 mg/L, respectively. The water supply wells from which the samples were collected are within one mile of each other and both draw water from the bottom portion of the alluvial aquifer in a location underlain by the Denver aquifer which may contribute to water captured by the two wells and explain the different water chemistry.

4.3 Hardness

Water hardness is a measure of the dissolved metallic ions in water that can react with soaps to produce a residual scum (bath tub ring), result in plumbing fixture scaling, and hamper the efficiency of detergents. The calcium and magnesium constituents represented by hardness values also react with other dissolved constituents in water to form mineral scale in boilers and other appliances using hot water. Eventually, mineral scale is capable of rendering boilers inefficient and fouling appliances that heat water. Hardness data represent a combination of dissolved constituents and for simplicity are generally expressed as “mg/L as $CaCO_3$” or “mg/L equivalent calcium carbonate” (Freeze and Cherry, 1979). Soft water has concentrations less than 60 mg/L, while very hard water is classified by values greater than 150 mg/L.

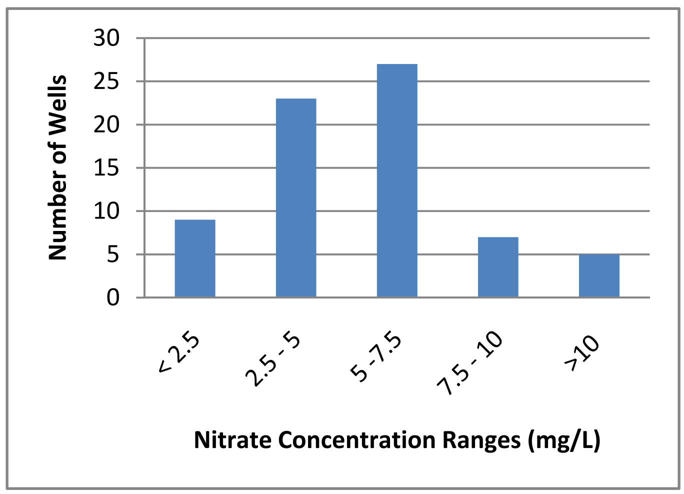
Available hardness data are mapped in Figure 4.4. The data indicate that groundwater in the UBSC basin alluvial aquifer is generally classified as “moderately hard” with isolated areas containing water classified as “hard” or “very hard.” Locations with hard and very hard water coincide with locations containing the highest TDS values, and are generally in the shallower portions of the aquifer outside of the main alluvial channel. This indicates that water hardness is associated with the TDS concentrations.

4.4 Flouride

Flouride is found naturally in low concentrations in groundwater. Flouride compounds are salts that form when the element fluorine combines with minerals in soils and rocks. Flourine is derived from the weathering of fluoride minerals, such as flourite. Many water suppliers add fluoride to their drinking water to promote dental health. The US EPA has established an SMCL for fluoride at 2.0 mg/L. Fourteen samples contained an analysis for fluoride. Flouride concentrations in groundwater, for the data available, ranged from 0.3-1.0 mg/L, with the majority of values ranging from 0.4-0.5 mg/L.

4.5 Nitrate Concentrations

The Committee has identified nitrate as a contaminant of concern in the UBSC basin. Common sources of nitrate in groundwater include: runoff from improper application of fertilizer or manure spreading, leaching from septic tanks, sewage and weathering of geologic units. Nitrate concentration values in the basin at individual sample locations were averaged and a histogram prepared to show a frequency distribution of nitrate values (Figure 4.5). The majority of nitrate concentrations range between 2.5-7.5 mg/L. The MCL for nitrate is 10 mg/L. For the current study, all nitrate values are expressed in terms of nitrate as nitrogen. For graphical presentation of nitrate data, we assumed concentration values were less than 2.5 mg/L for samples in which nitrate was not detected, regardless of the laboratory detection limits.



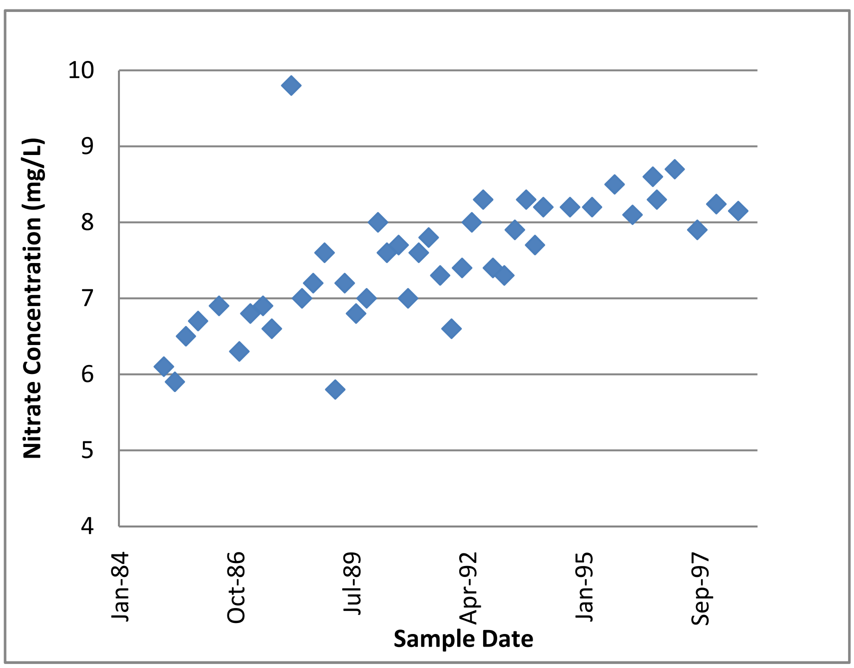
4.5 - Frequency Distribution of Nitrate Values

Nitrate values represent one of the largest data sets in our database, 142 samples with detectable values. The availability of this data allowed us to analyze the potential changes in nitrate concentrations over time. Four decadal time periods, pre-1980, the 1980s, the 1990s, and the 2000s were evaluated using average decadal nitrate concentrations at individual sampling sites and mapped to display potential changes over time (Figures 4.6 through 4.9). Information on nitrate concentrations in the alluvial aquifer pre-1980 is sparse.

Figure 4.6 shows two locations with elevated concentrations associated with irrigated agriculture along the mainstem of Black Squirrel Creek in the southern portion of the basin. The sampling data for nitrate increased significantly in the 1980s with five locations exceeding the MCL (Fig. 4.7). Four of these locations are in the upper reaches of Brackett Creek. Groundwater in the main alluvial channel was characterized by nitrate concentrations of 7.5 mg/L or less. Less sampling occurred in the 1990s, but available data indicate similar concentrations as observed in the 1980s with portions of Brackett Creek experiencing higher values (Fig. 4.8). The 2000s data suggest that the area around Brackett Creek continues to experience elevated nitrate concentrations in groundwater (Fig. 4.9). It should be recognized, however, that most of these data represent different well/sample locations for the periods evaluated. These conclusions generally support those of Brendle (1997) who resampled 28 wells throughout the UBSC Basin that had been sampled in August 1984 by Buckles and Watts (1988). However, as Brendle (1997) states, "…two samples from each of the 28 wells are not sufficient to definitively determine trends in nitrate concentrations…".

The geographic distribution of nitrate data in the UBSC Basin is greatly skewed toward the main alluvial paleochannel, which follows a general north-south alignment along the Ellicott Highway (Topper, 2008). Groundwater has historically been sampled from locations in the mainly agricultural portion of the UBSC Basin. Data are not available to determine whether ISDS's associated with large residential developments in the northwestern portion of the UBSC Basin have impacted groundwater quality.

We previously mentioned in Section 3 that few wells have multiple sampling events associated with them. The exception being well SC01306230ACC1, a monitoring well associated with Cherokee Metropolitan District production well #4. At that location, a series (from February 1985 through August 1998) of nitrate concentration data has been reported (Fig. 4.10). The well



4.10 - Nitrate Concentrations with Time at Well SC01306230ACC1 shows an increasing trend in nitrate concentrations, from the mid 1980s to the mid 1990s. This trend was the impetus for Brendle's (1997) study.

Elevated nitrate (>10 mg/L) in drinking water is a significant health issue for infants below the age of six months. The risk known as methemoglobinemia is commonly referred to as "blue baby syndrome" due to the afflicted baby's bluish skin color, particularly around the eyes and mouth (Jennings and Sneed, 1996).

Nitrate is often naturally present in groundwater at concentrations of less than 2-3 mg/L due to decomposition of proteins and other organic nitrogen compounds present in vegetation and animal wastes. Nitrate contamination from wastewater effluent has been observed to persist for decades in groundwater and can travel from its source for miles through an aquifer (LeBlanc, 2006).

4.6 Metals

Dissolved metals can be derived from weathering of natural deposits, from waste, or chemical spills. These include common elements like iron, lead, copper, and zinc, and less familiar elements like selenium, barium, arsenic, and beryllium. Drinking water containing high dissolved metal concentrations can be harmful to human health and the EPA has established various numeric standards for different metals. The data summary table 3.1 indicates that we acquired 43 samples with iron analysis and 8 samples with results of other metals. The dissolved metals concentrations indicate that only one detection of a regulated metal has been at, or greater than, that metal's respective MCL. During January of 1987, arsenic was detected at a concentration of 0.01 mg/L, equal to the recently established arsenic MCL, in a sample from well SC01306301DCB.

Iron has been detected in three samples at concentrations exceeding the SMCL (0.3 mg/L). In September 1980, iron was detected at a concentration of 1 mg/L in a sample from wellSC01306219CDB and in March 2006; iron was detected at concentrations of 2.8 and 0.48 mg/L in samples from well SC01206219CC and SC01206230BB, respectively. The limited and/or inconsistent values for dissolved metals do not lend itself to meaningful graphical presentation.

4.7 Organic Chemicals

Organic chemicals include a wide range of petroleum products, solvents, pesticides, herbicides, and other carbon containing compounds. These chemicals are often associated with internal organ damage and consequently have very low MCLs. We acquired data for 21 independent samples with pesticide analyses and 3 samples with analyses of volatile organic compounds. All reported concentrations of volatile organic compounds were below the laboratory detection limits. The pesticides and herbicides are common agricultural chemicals used on crops and pastures to control weeds and other threats to crops. The concentrations for these chemicals were also below the laboratory's detection limit.

4.8 Radioactivity

Water quality sampling requirements for municipal water providers includes analysis of radioactivity. This typically includes quantification of radioactive particle (gross alpha and beta) activity as a trigger for additional analysis of radioactive elements such as radon and uranium. The US EPA has established action levels of 15 picocuries per liter (pCi/L) for gross alpha emitters and a gross beta particle dose of 4 millirems per year. The beta emitter concentration, expressed in millirems per year, is calculated from a detailed laboratory analysis that is generally not performed on routine water samples and only required when gross beta radioactivity exceeds 50 pCi/L (U. S. EPA, 2001). Thirteen data points were acquired with gross alpha and beta analyses. Radioactivity, in the context of the UBSC basin alluvial aquifer, is an indicator of naturally occurring dissolved constituents that emit alpha and beta particles. Low levels of alpha and beta particle activity were detected in groundwater sample analysis presented in the current study. The highest detections of both alpha and beta particle activity were 3.6 and 6.0, respectively, well below the regulatory action levels.

4.9 Summary of Groundwater Quality Standard Exceedences

Exceedence of Maximum contaminant levels (MCL) or Secondary maximum contaminant levels (SMCL) are presented in bold text in data tables herein. Table 4.1 summarizes the samples from which the reported values exceed those standards. A total of 22 groundwater quality values reported concentrations that equal or exceed the regulatory standards. MCL or SMCL exceedences were observed for arsenic, nitrate, pH, sulfate, and iron:

- Only one sample, collected in 1987, reported an elevated arsenic concentration of 0.01 mg/L, which is the MCL.
- Nine samples, with collection dates from 1971 to 2006, reported nitrate concentrations in excess of the 10 mg/L MCL. Most of these samples reported concentrations of 11 mg/L, with three having significantly higher concentrations. The two well sites with the highest nitrate concentrations were documented as being near likely nitrate point source (Buckles and Watts, 1988).

- Two samples collected in 1984, reported pH values below (6.3) and above (9.2) the SMCL standard range of 6.5-8.5.
- The SMCL (500 mg/L) for total dissolved solids was exceeded in six samples, collected in 1971 and 1984, with a maximum concentration of 842 mg/L reported.
- One sample, collected in 1971, reported a sulfate concentration at the SMCL of 250 mg/L.
- Three samples, from municipal production wells, exceeded the SMCL (0.3 mg/L) for iron

The locations of these samples are illustrated in Figure 4.11. Three wells in particular, SC01206314DDC, SC01306209BBB and SC01506325ABA, provided samples where multiple parameters exceeded MCLs or SMCLs. A sample collected from well SC01206314DDC in August of 1984 was observed to have 72 mg/L nitrate and 650 mg/L TDS. The nitrate concentration reported is the highest groundwater nitrate concentration available to the current study and is consequently suspect. The water sample also contained relatively high concentrations of other dissolved solids and yielded the highest value for hardness (510 mg/L as $CaCO_3$) observed in the current study. More recent groundwater sample data are not available for this well, described by Buckles and Watts (1988) as being at a point source of nitrate contamination. This information, combined with a comparison of TDS, hardness, and all other nitrate concentration observed indicates the groundwater quality observed at well SC01206314DDC represents localized groundwater conditions and is not representative of the aquifer as a whole.

Table 4.1
Samples Exceeding Regulatory Standards

Site ID	Sample Date	Local Well Name	Reported Value	Data Source	Comments
Arsenic (As), MCL = 0.01 mg/L					
SC01306301DCB	1/1/1987	CMD-08	**0.01**	3	Reported as 0.01 in data summary sheet[3]
Nitrate (NO_3), MCL = 10 mg/L					
SC01206314DDC	8/9/1984		**72**	2	TDS exceedence also, well at nitrate point source[2]
SC01306209BBB	8/10/1984		**33**	5	Well at nitrate point source[2], TDS exceedence also
SC01306209BBB	8/22/1996		**25**	5	Well at nitrate point source[2]
SC01306229DAC	11/30/06	PP-D-039	**11.5**	4	Farm animals watered by well, turf farms in area
SC01206230CDC	8/8/1984		**11**	5	Resampled in 1996, nitrate below MCL
SC01206230BDB	8/9/1984		**11**	5	Resampled in 1996, nitrate below MCL
SC01306334ABB	8/10/1984		**11**	5	Resampled in 1996, well nitrate point source[2]
SC01306334ABB	8/21/1996		**11**	5	Sampled in 1984, well at nitrate point source[2]
SC01506325ABA	9/8/1971		**11**	5	Sulfate and TDS exceedences also
pH, SMCL defined as outside range between 6.5 and 8.5					
SC01306221BDD	8/10/1984		**9.2**	5	NA
SC01206336ACC	8/8/1984		**6.3**	5	NA
Total Dissolved Solids (TDS), SMCL = 500 mg/L					
SC01306209BBB	8/10/1984		**842**	5	Nitrate exceedence also, well at nitrate point source[2]
SC01506325ABA	9/8/1971		**767**	1	NA
SC01206314DDC	8/9/1984		**650**	2	Nitrate exceedence also
SC01406228CCB	9/8/1971		**596**	1	NA
SC01406220DBC	8/10/1984		**548**	2	NA
SC01406216CCC	8/10/1984		**546**	5	NA
Sulfate (SO_4), SMCL = 250 mg/L					
SC01506325ABA	9/8/1971		**250**	1	Nitrate exceedence also
Iron (Fe), SMCL = 0.3 mg/L					
SC01206219CC	March 2006	Guthrie Well #2	**2.8**	6	NA
SC01206230BB	March 2006	Guthrie Well #1	**0.48**	6	NA
SC01306219CDB	9/10/1980	CMD-05	**1.0**	3	NA

Notes: MCL= Maximum Contaminant Level; SMCL= Secondary Maximum Contaminant Level

Data Source: 1 – Bingham and Klein, 1973 2 - Buckles and Watts, 1988 3 – CMD, Curt Well's Reports
4 – CO Dept. of Agriculture 5 – USGS NWIS/WQR database 6 – Woodman Hills Metro

5. Potential Land Use Impacts on Groundwater Quality

As discussed in Section 1, the objective of this study is to evaluate groundwater contamination issues to help participants make informed land use decisions. The El Paso County Board of County Commissioners is considering potential changes to the El Paso County Land Development Code, including those related to groundwater protection. The El Paso County Development Services Division and Information Technology Division have provided GIS analysis and mapping services to portray existing and future land uses within the study area. The County also provided parcel-based well and septic data derived from the Assessor's database. Existing land use was integrated with the groundwater quality data to identify potential sources of contamination associated with land uses that may negatively influence groundwater quality. Future land use scenarios were also considered to focus efforts of any proposed Phase 2 investigations.

The existing land uses within the study area are presented as Figure 5.1. Land uses are classified as industrial, commercial, urban residential, rural residential, vacant land, irrigated and dry land agricultural and other (forest land, parks, federal and institutional properties). The vast majority of land uses, within the UBSC basin, are agricultural and rural residential. Urban residential is concentrated within and north of Falcon, in Peyton, and at several isolated small developments throughout the basin. Only two industrial parcels exist within the study area and these are located north of Highway 24 in the Falcon area. A number of commercial land uses exist largely along the Highway 24 corridor near Ellicott.

5.1 Potential Contamination Sources Related to Land Use.

Groundwater quality can be degraded by a variety of naturally occurring and anthropogenic (man-made) processes. Groundwater quality changes can also result from materials in the aquifer matrix such as organic matter, minerals, salts or metals that leach into groundwater as it flows through the aquifer. Examples of anthropogenic groundwater contaminant sources include: fuel or chemical spills, stormwater runoff from roads and parking areas, road deicing, or improper application of pesticides, herbicides or fertilizers. Other potential sources include improper disposal of industrial wastes, landfill leakage, wastewater treatment plant effluent, feedlot waste, and improperly designed or maintained individual sewage disposal systems (ISDS).

The relationship between land use and groundwater quality has been documented in a variety of settings (Eckhard and Strackleberg, 1995, USGS, 1999, Gardner and Vogel, 2005, Dano and Poeter, 2004, Dano, et al., 2006, Brendle 1997). Land use has been referred to as the dominant factor affecting shallow groundwater quality by Trojan, et al. (2003). Since high-density urban and industrial land uses are limited in the UBSC basin; commercial, agricultural, and residential activities present the greatest potential to impact groundwater quality.

Table 5.1 provides a summary of common types of groundwater contaminants and land uses often associated with them. Land uses present in the UBSC Basin having the potential to contaminate groundwater include retail fuel distribution, agricultural operations, automotive salvage yards, residential ISDSs, feedlots, landfills, military facilities, and industrial waste/wastewater disposal. Potential sources of groundwater contamination related to existing and future land uses in the UBSC basin are discussed in detail below.

Table 5.1
Groundwater Contaminants Commonly Associated with Various Land Uses

Groundwater Quality Constituents	**Total Dissolved Solids**	**pH**	**Major Ions**	**Nutrients (nitrate / phosphate)**	**Pathogens**	**Pesticides / Herbicides**	**Semi-Volatile Organic Compounds**	**Volatile Organic Compounds**	**Petroleum Hydrocarbons**	**Heavy Metals**	**Radioactivity**
Land Use											
Agriculture / Cultivation	X	X	X	X	X	X					
Animal Feedlot	X	X	X	X	X						
Residential	X	X	X	X	X	X					
Industrial / Commercial	X	X	X	X		X	X	X	X	X	
Fuel Distribution	X	X	X				X	X	X	X	
Industrial Waste Disposal	X	X	X	X	X	X	X	X	X	X	X
Landfill	X	X	X	X		X	X	X	X	X	X
Military	X	X	X	X	X	X	X	X	X	X	X
Mining	X	X	X							X	X
Metal Plating	X	X	X					X		X	
Commercial Property	X	X	X	X		X					
Automotive Salvage	X	X	X				X	X	X	X	

After USGS (1997) and CDPHE (2006).

Residential: Typical groundwater contaminants from residential land use are primarily associated with ISDSs and lawn care chemicals such as pesticides, herbicides and fertilizers. Contaminants from ISDSs generally include nutrients such as nitrates and phosphorus, and bacteria such as fecal coliform (Fetter 1994, Brendle 1997). Other contaminants that may result from residential ISDSs are personal care products and medications that are not metabolized. Pesticides, herbicides and fertilizers, used in lawn and garden applications, can be a potential contaminant when improperly used or disposed. Excess irrigation can cause these products to leach to the water table and impact groundwater quality. Common brand name pesticides often contain organophosphates, carbamates, and organochlorines. Commonly available herbicides may contain metolachlor glyphosate, and atrazine. Fertilizers often contain concentrated nitrogen and phosphorous.

Agricultural Activities: Improper storage and/or application of agricultural pesticides and herbicides can result in groundwater being contaminated by organic chemicals and their breakdown products. Common agricultural pesticides contain lindane and endrin. Chemicals, such as toxaphane and methoxychlor, which have been banned, may persist in the environment. Agricultural herbicides include such chemicals as 2,4-Dichlorophenoxyacetic acid (2,4-D), glyphosate (Roundup ®), and atrazine. The herbicide 2 (2,4,5-Trichlorophenoxy) propionic acid (2,4,5-TP or Silvex) has been banned but may persist in the environment.

Improper storage and application of agricultural fertilizers can result in nutrient loading to the aquifer. Nutrient loading to groundwater can also result where manure is spread or is concentrated such as in fields, feedlots, and corrals, respectively (Brendle 1997).

Leaks from fuels or fluids used in agricultural machinery may pose a threat to groundwater resources depending upon the volume spilled and surface conditions. Typically, fuel storage tanks for agricultural activities are often smaller than those used in retail fueling facilities and installed aboveground where leakage can be observed and quickly mitigated.

Unregulated Industrial Waste Disposal: Improper disposal of industrial wastes can result in a wide variety of contaminants being introduced to the groundwater. Common groundwater contaminants include heavy metals, volatile and semi-volatile organic compounds, highly acidic or basic solutions, solvents and nutrients.

Urban and Commercial: As an area is urbanized, the amount of paved and impermeable surfaces increases and so does the volume of stormwater runoff. Stormwater can pick up chemicals from spills, leaks, or those inherent in the surface materials over which it passes. Stormwater runoff is often contained and conveyed from streets, parking lots, rooftops, and other impervious surfaces to detention basins or discharged to streams and other surface water bodies. These engineered features represent areas in which chemical contaminants may be concentrated. If stormwater is released to ephemeral drainages or allowed to infiltrate, the dissolved chemicals can impact groundwater quality. Runoff percolating into the subsurface from dry or low-flow stream channels can carry dissolved and microscopic contaminants to the water table. Contaminants present in stormwater runoff that degrade groundwater quality include pathogens, metals, nutrients, PCBs, pesticides, road de-icing solutions, and volatile- and semi-volatile organic compounds (US EPA, 1994).

In addition to potential contaminants in stormwater, urban and commercial land uses may involve industrial processes or other activities using chemicals that can directly contaminate groundwater if spilled or disposed of improperly. ISDSs associated with commercial, industrial and manufacturing facilities may impact groundwater with a variety of chemicals used at the facility that cannot be degraded by the septic system.

Older or improperly designed municipal solid waste landfills have been known as sources for a wide variety of groundwater contaminants including nutrients, volatile and semi-volatile organic compounds, heavy metals, pesticides, herbicides, and PCBs.

Retail fueling facilities (gas stations) carry petroleum fuels, oils, and lubricants that can migrate to the water table through leaks or spills. Gasoline contains volatile organic compounds such as benzene, ethylbenzene, toluene and xylenes, while diesel fuels contain naphthalene and a variety of semi-volatile hydrocarbons. These common groundwater contaminants are typically released to the environment by leaking underground storage tanks (USTs) and piping. Spills from fueling facilities can have a significant impact on groundwater quality in the immediate vicinity of the retail fueling facility.

Automotive salvage yards may also result in contamination of soil and groundwater. Commonly observed contaminants include petroleum fuels, oils, lubricants, heavy metals including mercury, antifreeze, lead, battery acid, plasticizers, and solvents (CDPHE, 2006).

Military: Facilities associated with military activities have been the source of a wide variety of groundwater contaminants due to the improper storage and disposal of wastes from diverse activities ranging from vehicle fueling and maintenance to ordnance training and chemical weapon storage. Groundwater contaminants historically associated with military bases include pathogens, petroleum fuels, heavy metals, radioactive materials, explosives, chemical weapons, and PCBs.

5.2 Anticipated Future Land Use

El Paso County Development Services Division provided GIS layers representing future land use or build out. The Falcon/Peyton Small Area Master Plan, Black Forest Preservation Plan, Highway 94 Comprehensive Plan, and Ellicott Valley Comprehensive Plan were the basis for future land uses. The result of that synthesis is presented in Figure 5.2. The future land uses anticipated within the UBSC basin are a continuation and expansion of current land uses, primarily consisting of residential development in urban, rural residential and rural development densities corresponding to lot sizes of less than 2.5 acres, 2.5 to 5 acres, and greater than 5 acres, respectively. Commercial development is expected to accompany residential development and is identified as activity nodes (Fig. 5.2).

Future development is expected to occur primarily in the northern and western portions of the UBSC basin along major transportation corridors and where infrastructure is expected to be concentrated. Specifically, these areas include corridors along Highway 24, Judge Orr Road, the Peyton Highway and Curtis Road. Additionally, activity node development is expected to occur at locations such as at the intersection of Highway 94 and the Ellicott Highway, Peyton Highway, Curtis Road, Enoch Road, and at locations where Enoch and Blue Roads enter Schriever Air Force Base. The future land use plans do not propose significant industrial development; however, some industrial uses are expected to develop in areas proposed for urban density. Conversion of agricultural land to urban use is expected to occur.

The potential impacts to groundwater quality associated with expected future land uses primarily consist of contaminants associated with stormwater runoff and wastewater disposal facilities. Currently only a small portion of urban and rural residential development in the UBSC basin is served by sanitary sewers and municipal wastewater facilities. If future development continues to rely on ISDSs then the potential contaminants associated with these systems could negatively impact groundwater quality. Impacts to groundwater are expected to be more pronounced in areas with higher density of ISDSs and in particular, where lot size is less than one acre (WQCD 2008). Currently, county regulations and development codes require central sewer service for urban development, commercial and industrial development, and residential lots less than 2.5 acres.

6. Results Summary

This section summarizes the results of the current study and addresses specific questions presented in the Scope of Work. The Colorado Geological Survey has attempted to compile all publicly available water quality data associated with the alluvial aquifer of the UBSC basin. These data were analyzed in conjunction with current land uses in the basin to meet the objectives for the groundwater quality study. Thirty-four relevant publications were identified and reviewed, some of which contained water quality data incorporated into this study. In addition to data compiled from the published literature, information was acquired from public water providers, regional and local government agencies, and state and federal regulatory and scientific agencies. A total of 150 records with laboratory analysis were collected from 72 wells.

Most of the sampling locations are concentrated along the Black Squirrel Creek and Brackett Creek alluvial valleys (Fig. 1.1). The data are limited in its spatial distribution with no groundwater quality data available in the northwest portion of the basin where the majority of development is occurring. The sampling frequency or temporal distribution of the data is also limited with the majority of samples collected in the 1980s and 1990s. Only four sampling locations have been sampled more than three times. Consequently, continuous water quality trends are discernible at only one location. The data could not be subjected to rigorous quality control or analysis reliability due to absence of comprehensive laboratory analyses, lack of sampling method details, laboratory analytical procedures and case narratives, well construction information, or other factors often indicative of potential sample bias.

Groundwater chemical analysis data for inorganic compounds, total dissolved solids, nitrate, metals, organic compounds, and radionuclides were evaluated to characterize the UBSC basin alluvial aquifer's water quality. Based on major ion ratios, the alluvial groundwater within the study area is a calcium/sodium bicarbonate water type. The groundwater is generally classified as moderately hard with isolated areas of harder water. Total dissolved solids concentrations, being an overall indicator of water quality, are generally at 300 mg/L or less indicating good water quality. Fluoride concentrations are well below the EPA's SMCL. Nitrate has been identified as a contaminant of concern in the UBSC basin due to the predominance of individual sewage disposal systems associated with residential development. Nitrate values greater than 5.0 mg/L are common in the basin, and suggest that the alluvial water quality has been influenced by sources of nutrient loading. Limited analyses of dissolved metals indicate concentrations below regulatory levels with three locations reporting higher iron values. Organic chemical analyses were available for a few source water supply wells. We focused on the more common compounds in this group of chemicals representing volatile and semi-volatile compounds, i.e. pesticides and herbicides. No concentrations above the laboratory's detection limit were reported for these chemicals. Available analysis of radioactivity indicated particle activity counts well below the regulatory action levels also.

The data were compared with regulatory drinking water standards established by the US EPA. A total of 22 groundwater quality exceedences were observed in data from 18 samples collected from 16 different wells. MCL or SMCL exceedences were reported for arsenic, nitrate, pH, sulfate, TDS and iron. Nine samples, with collection dates from 1971 to 2006, reported nitrate concentrations in excess of the 10 mg/L MCL, with most reporting concentrations of 11 mg/L.

6.1 Relationship between Land Use and Water Quality

To assess the relationship of current land uses to nitrate concentrations in the UBSC basin, we present nitrate analyses from the past two decades (1990-2009) on a map of current land use (Fig. 6.1). The resulting data set contains 47 groundwater nitrate data values. Analyses from wells at which nitrate was detected more than once during the evaluation period were averaged. As presented in Figure 6.1, the data are distributed along the central portion of the basin where rural residential, dry land farming/grazing, and irrigated agriculture are the dominant the land uses. Elevated nitrate concentrations are distributed over all three of these land uses. In general, however, where data are associated with parcels classified as irrigated agriculture, nitrate concentrations exceed 5.0 mg/L. Sample locations with the highest nitrate concentrations are not associated with irrigated agriculture and suggest a local source such as cattle pens. Additionally, some locations with elevated concentrations are in close proximity to locations with low concentrations. This may be an artifact of the longer period of evaluation, localized sources of nutrient loading or sampling bias. While it appears that the alluvial aquifer has historically been impacted by nitrate loading, the data is insufficient to determine whether the impact is regional.

To further assess the relationship between nitrate concentration in the basin and land use, we have plotted these same nitrate values (Fig. 6.1) with land parcels listed as having ISDSs in the El Paso County assessor's database. This relationship is presented as Figure 6.2 which portrays the locations of the 4,887 parcels listed as having ISDSs by El Paso County. This analysis does not indicate a direct correlation with elevated nitrate concentrations, where data are present. However, most of the locations where groundwater data are available have residential developments with lots greater than 35 acres and thus a low ISDS density. Elevated nitrate concentrations also occur in areas with no septic systems. It is unlikely that low-density residential septic systems are contributing significantly to the nitrate loading as the subsurface materials act as sand filters. Areas of higher density residential septic systems lack water quality monitoring information.

A similar analysis was conducted to assess total dissolved solids concentrations with respect to current land use. Twenty-one TDS values are available; 2 values from the 1990s and 19 values from between 2000 and 2010. This relationship is presented as Figure 6.3. TDS concentrations are classified into three categories. Of the 21 values presented in Figure 6.3, all but 5 are in the lowest category of 200-300 mg/L. Elevated TDS values are associated with both dryland farming/grazing land and rural residential land use. As with nitrate, the limited data indicate there is no regional trend in the aquifer that may be associated with particular land uses.

Table 5.1 listed common groundwater contaminants that were associated with certain land uses. During this investigation, we were made aware of operations and facilities within the UBSC basin that could pose a greater potential for impacts to groundwater quality. These include animal feedlots, retail fueling facilities, unpermitted industrial waste treatment/disposal, a permitted landfill and a military base. Where known, the locations of these facilities are shown on Figure 6.4.

- A former animal feedlot has been reported south of Judge Orr Road and west of the Ellicott Highway (Kleckner, 2010). Details regarding the exact location, size and period(s) of operation are unavailable to the current study.
- Five retail-fueling facilities with registered underground storage tanks (USTs) are present in the UBSC basin. According to the Colorado Division of Oil and Public Safety, there are currently no sites with documented groundwater contamination within the study area (Noel 2010). Fuel components have also not been observed in groundwater sample data evaluated for the current study.
- Improper industrial waste treatment has been documented in the UBSC basin. This unpermitted operation occurred at a location (the Cordova property) where metal wastes were discharged into an unregulated waste evaporation pond for the stated purpose of concentrating the waste for metals recovery. The primary contaminants identified in the waste are nickel, copper, cadmium and zinc. Currently, the Colorado Department of Public Health and Environment is overseeing assessment and cleanup activities and monitoring results have not been made available (Henderson, 2010). Indications of elevated metal concentrations have not been observed in groundwater sample data evaluated for the current study.

- The Colorado Springs Landfill is the only regulated landfill known to exist within the current study area and straddles the southwestern boundary of the UBSC basin. This facility accepts municipal solid waste and conducts regular groundwater monitoring for a wide range of groundwater contaminants including metals, organic compounds, and major ions. Groundwater monitoring at well MWG-15 does not indicate elevated concentrations of these constituents.
- The southwest boundary of the UBSC basin is straddled by Schriever Air Force Base (Schriever). This military facility was constructed in the 1980s and known operations at this facility have little potential impact to groundwater quality. Interviews with environmental management staff (Olsen et. al., 2010) and review of documents provided to the CGS by Schriever AFB environmental staff indicate that only minor spills have occurred and have been appropriately mitigated (Schriever AFB, 2007).

Due to the predominance of water supply wells, residents using groundwater may be the first to be influenced by impacts to groundwater quality associated with various land use activities and operations. El Paso County provided information on water supply wells in the basin from the assessor's database. Figure 6.5 presents the 4,955 parcels listed by El Paso County as containing water supply wells in comparison with the location of potential alluvial wells registered with the Office of the State Engineer as determined the CGS study (Topper, 2008). This figure indicates that groundwater is used extensively throughout the basin. The difference between these data is that the county assessor's database data does not differentiate the well depths or aquifer supply water to individual parcels. This information is presented so that stakeholders may assess specific parcel/well locations with respect to the water quality data presented herein.

6.2 Questions from Scope of Work

The Scope of Work for the current study includes a list of specific questions that the Committee wanted to address. These are answered below and expanded upon as needed.

Substantive Scope

- **What is the status of existing groundwater quality, focusing initially on the alluvium of the Upper Black Squirrel Creek Basin?** Overall the groundwater quality is good and the groundwater is suitable for existing beneficial uses. Historically, elevated nitrate concentrations have been observed with some samples exceeding drinking water standards. Water quality data is lacking in those portions of the basin experiencing the most development pressure. The Colorado Department of Public Health and Environment (CDPHE, 2008) gave El Paso County a low priority with respect to vulnerability to agricultural chemicals and nitrate.
- **What groundwater pathways exist? (Understanding how the groundwater system functions is important in determining groundwater contamination migration potential, impacts and solutions.)** The dominant surficial geologic deposits in the UBSC basin are unconsolidated aeolian and alluvial materials that are more vulnerable to contamination than the underlying Denver Basin bedrock aquifers. In general, the UBSC basin alluvial aquifer is characterized by ancient channels carved into the underlying bedrock into which clay, silt, sand and gravel have been deposited. These channels generally follow streambeds currently present in the UBSC basin, but may diverge from the main channels of modern-day streams. Figure 1.2 displays the thickness and distribution of the alluvial deposits and the locations of modern streams. Areas with thicker alluvium, indicated by the cooler colors on the map, are generally the main groundwater pathways. The direction of groundwater flow is from the edges of the basin towards the central main alluvial channel and from north to south. Groundwater flow velocity is estimated by Topper (2008) as 3.1 feet per day resulting in approximately two miles of travel per decade.
- **What is the groundwater age? (Groundwater age can help determine contamination potential according to published reports.)** No age-dating has been reported for the alluvial aquifer within the basin. Water table aquifers such as those present in the UBSC basin are influenced and replenished by precipitation, and the correlation of water levels with precipitation indicate the qualitative age of the water is more modern than "fossil" waters found in the Denver Basin bedrock aquifers.

- **What are potential sources of contamination now and in the future (per drinking water and agricultural standards), relating contaminants to land uses and land use patterns, specifically addressing septic systems and other nitrate sources?** Table 5.1 lists common groundwater contaminants that are associated with certain land uses. Land uses present in the UBSC Basin having the potential to contaminate groundwater include retail fuel distribution, agricultural operations, automotive salvage yards, residential ISDSs, feedlots, landfills, military facilities, and industrial waste/wastewater disposal. Analysis of the 4,887 parcels listed as having ISDSs by El Paso County does not indicate a direct correlation with elevated nitrate concentrations, where data are present. However, most of the locations where groundwater quality data are available have residential developments with lots greater than 35 acres and thus a low ISDS density. Elevated nitrate concentrations also occur in areas with no septic systems. The temporal and spatial limitations of the data available for this study precluded identification of potential sources for the elevated concentrations observed.

- **What is the probability of groundwater contamination (now and in the future)?** The water quality data collected for this study indicate that some parameters (arsenic, nitrate, pH, sulfate, TDS and iron) have exceeded regulatory drinking water standards at certain locations and times. The data available to this study are not sufficient to indicate whether regional impact to water quality from existing land uses or operations have occurred. However, over half of the samples analyzed for nitrate exceeded 5 mg/L suggesting that historic land uses or operations have likely increased nitrate concentrations in the alluvial aquifer. This also indicates groundwater quality is susceptible to future land use activities. An assessment of the vulnerability of the groundwater resource to contamination depends both on the physical and chemical factors influencing the aquifer as well as the associated anthropogenic effects.

  The probability of groundwater contamination in the future is dependent upon the type of development anticipated and occurrence of unpermitted or illegal activities. High density ISDS development, improper disposal of commercial and industrial wastes, focused discharge of stormwater runoff, and discharge of wastewater treatment plant effluent all have the potential to negatively impact groundwater quality in the future.

- **What and where are the data gaps?** Significant geographic and temporal limitations of existing water quality data have been identified. There has been no consistent basin-wide, long-term groundwater monitoring program and the available data are insufficient to reliably evaluate specific land use impacts on groundwater quality. There are no data indicative of groundwater age which could then be used to determine whether contamination is the result of historic, recent or ongoing activities. The most significant geographic data gap is in the northern and western portion of the UBSC basin where the more intensive current development is occurring. The most significant temporal data gap is the lack of regularly-acquired groundwater quality data from a consistent set of wells that would allow determination of trends throughout the UBSC basin.

- **What are appropriate constituents and locations for further testing in Phase 2 to support development of recommendations in Phase 3?** Recommendations for a Phase 2 study are presented in Section 7. The Committee should consider incorporating a vulnerability index assessment tool and defining clear water-resource management objectives before committing to more comprehensive and contaminant specific studies.

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7. Phase 2 Study Recommendations

The Phase 1 study objectives were to characterize the current UBSC basin alluvial aquifer groundwater quality and determine whether there is a correlation between existing and future land uses and groundwater quality. This study was only partially successful in meeting those objectives. The data collected indicates that groundwater is generally of good quality. The study Committee identified nitrate as a contaminant of concern and concentrations exceeding the regulatory drinking water standards have been documented in the basin. Unfortunately, there is no groundwater quality data available in the northwest portion of the basin, where urban land uses and ISDSs are concentrated and continued development is expected. Therefore, we could not correlate groundwater quality with land use and land use patterns.

The vulnerability of the groundwater resource to contamination depends not only on the properties of the groundwater flow system but also on the locations and types of sources of naturally occurring and anthropogenic contaminants, physical and chemical characteristics of the contaminant, and locations of sensitive receptors. Decision makers in El Paso County attempting to assess the vulnerability of the groundwater resource currently lack a complete understanding of the hydrogeology of the aquifer system and the associated anthropogenic effects controlling the source, transport, and fate of potential contaminants. The lack of comprehensive knowledge founded on scientifically defensible data often leads to a choice of deciding whether to manage the groundwater resource based on existing knowledge of the groundwater flow system and the known associations of water quality and land use or to commission more comprehensive and contaminant specific assessments.

The path forward and components of a Phase 2 investigation are very dependent upon the water-resource/land use management objectives to be met. This Phase 1 investigation addressed the concerns about water quality impacts and land use by compiling and quantifying potential contaminants to provide an assessment of current and historic groundwater quality. It did not further our understanding of the groundwater flow system or the geochemical system that determines fate and transport of contaminants. A determination of land use impacts on water quality necessitates a scientific assessment of groundwater vulnerability that can assess both the groundwater flow system and geochemical system. To provide a balance between management and scientific objectives, in addressing the county's concerns, we recommend that a Phase 2 study be implemented focusing on the following primary goals:

1. Further refine our understanding of the groundwater flow system by mapping the geometry and extent of the alluvial aquifer, in the northern and western portions of the basin, and the shallow bedrock aquifers most vulnerable to contamination from surficial sources, investigate interactions with surface water, well pumping and other stresses that influence advective transport of contaminants; and
2. Acquire the data needed to support land-use planning decisions by establishing a long-term groundwater monitoring program throughout the basin.

Groundwater monitoring is a critical component of water-resource management. Specifics of the groundwater monitoring program will be dependent upon the objectives to be achieved and need to be determined in the scoping process of the Phase 2 program. With respect to addressing the county's concerns, the monitoring program should focus on assessing the impact from contaminant sources that are related to specific land uses.

7.1 Further Refine the Hydrogeology of Vulnerable Alluvial and Shallow Bedrock Aquifers

The water resources in the UBSC basin alluvial sediments and the shallow portions of the Denver Basin bedrock aquifers are both vulnerable to contamination from surface activities. The current study has documented the water quality of the alluvial aquifer in the UBSC basin based on limited data availability. Due to the distribution of the available data, our results are limited to the central and southern portions of the basin where the alluvium is thicker. Mapping by the Colorado Geological Survey (Topper, 2008) indicates that thinner alluvial deposits extend into the northern and western portions of the UBSC basin as tributary channels. The degree of saturation in these thinner exterior portions of alluvium is unknown as is their usefulness for water supply. However, these thinner portions of the alluvium are pathways for potential contaminant migration to the greater aquifer. In the northern portions of the basin the Denver Basin bedrock aquifers are also present either at the surface or overlain by relatively thin alluvial or aeolian deposits.

A Phase 2 investigation should include additional hydrogeologic characterization of the alluvial and aeolian sediments in the northern and western portions of the UBSC basin, as well as the shallow portions of Denver Basin bedrock aquifers. Characterization of these aquifers can be performed by evaluating both subsurface and surface geologic information through available geologic mapping, drill logs, and geotechnical reports. Incorporation of current geologic mapping of the Falcon Quadrangle by the CGS would benefit this effort. In addition to refining the geology, the Phase 2 investigation should also study hydraulic stresses that could influence groundwater flow and surface water interactions. This additional information would provide a better characterization of the hydrogeology in the areas of the basin where the majority of development is occurring or being planned. Details of the Phase 2 Investigation are expected to be refined in Phase 2 Scoping activities.

7.2 Basin-Wide Long-Term Groundwater Monitoring Program

The current data set is highly inconsistent and hampers any analysis to understand potential land use impacts on alluvial aquifer groundwater quality. A long-term groundwater monitoring program will help planners, developers and water suppliers better understand natural and anthropogenic factors affecting groundwater quality throughout the UBSC basin alluvial aquifer. The new data will also provide a scientific basis to support regulators and policy makers regarding potential policy and / or regulatory changes that may result from Phase 3 activities or provide input for statistical and process-based methods used in groundwater vulnerability assessments.

The proposed long-term, groundwater monitoring program will fill data gaps in the current study and help evaluate impacts related to specific land uses. Objectives and specific details (well locations, monitoring parameters, monitoring frequency, etc.) of the monitoring program should be determined as part of the Phase 2 scoping process. In designing a monitoring program or sampling strategy, it is important to have specific goals/objective in mind. Depending on the ultimate study objectives other alternate approaches to long-term monitoring may be appropriate.

For guidance, and assuming a long-term, groundwater monitoring program is the preferred approach, we provide a general framework and considerations for implementing such a program. The Phase 2 groundwater monitoring program should incorporate select sampling locations (wells) previously sampled by the USGS (e.g. Brendle, 1997) and CGS (e.g. Topper, 2008) to provide continuity and repeatability of long-term concentration trends. To assess trends and determine current water quality, wells from which samples have exceeded water quality standards should be resampled during the first two years for the respective parameter(s) that have exceeded standards. Existing wells considered for inclusion in a monitoring network should be assessed and construction details evaluated to determine the suitability for meeting the programs objective.

Based on the finding of the Phase 1 study, we offer suggested locations for groundwater quality monitoring that fill data gaps and provide for assessment of potential contaminant sources. The general locations of proposed monitoring wells are presented in Figure 7.1. While generalized, these proposed locations address spatial data gaps, consider surface water interactions and flow pathways, are downgradient of potential nitrate sources, and include areas where new development is anticipated. These locations are predominantly along stream channels and at the confluence of alluvial channels. Figure 7.1 also shows those wells that have been included in previous USGS and CGS monitoring well sampling programs with existing water quality data.

Design of the monitoring plan will be dependent upon the objectives and scope of the project. Considerations include: hydrogeologic units to be monitored; analytes of concern; well types and sampling intervals; land use; timeframe for the program; financial, personnel, and analytical considerations; and data management considerations. We suggest semi-annual monitoring for the first two years of the program with a focus on contaminants of concern and those commonly associated with existing and future land uses. The following general groups of indicator parameters should be considered for inclusion in the groundwater monitoring program:

- Field measurements (water level, pH, specific conductance, temperature, dissolved oxygen)
- Total dissolved solids (TDS)
- Major Inorganic Ions (calcium, magnesium, sodium, potassium, chloride, sulfate, and bicarbonate)
- Nitrate and Phosphate
- Coliform bacteria
- Total petroleum hydrocarbons (gasoline and diesel range)
- Total organic carbon (TOC)

The above parameters are either contaminants of concern previously identified in the UBSC basin alluvial aquifer or indicators of potential groundwater quality impacts associated with current and expected land uses in the UBSC basin. The use of indicator parameters establishes baseline water quality at each sample location and an early warning system of potential contamination can guide the selection of additional, more specific sampling parameters to monitor for potential contaminants. Following establishment of baseline conditions, the monitoring program may be revised as needed to change sampling frequency and/or list of parameters either for the entire program or at individual wells.

The Committee may desire to design a specific stratified network based on land use and other important variables that could impact groundwater quality, and sample that network for specific constituents needed for data analysis. It may also consider adding emerging contaminants such as pharmaceuticals and personal care products. Conn, Siegrist and Barber (2007) have identified such compounds in residential and commercial wastewater and describe negligible removal of these compounds by ISDS treatment alone. Should more quantitative groundwater age data than the estimates provided herein be desired, Rupert and Plummer (2009) provide a template for age determination sampling and analysis. Details of the Phase 2 program are dependent upon the ultimate study objectives, which are expected to be clarified in the Phase 2 scoping activities.

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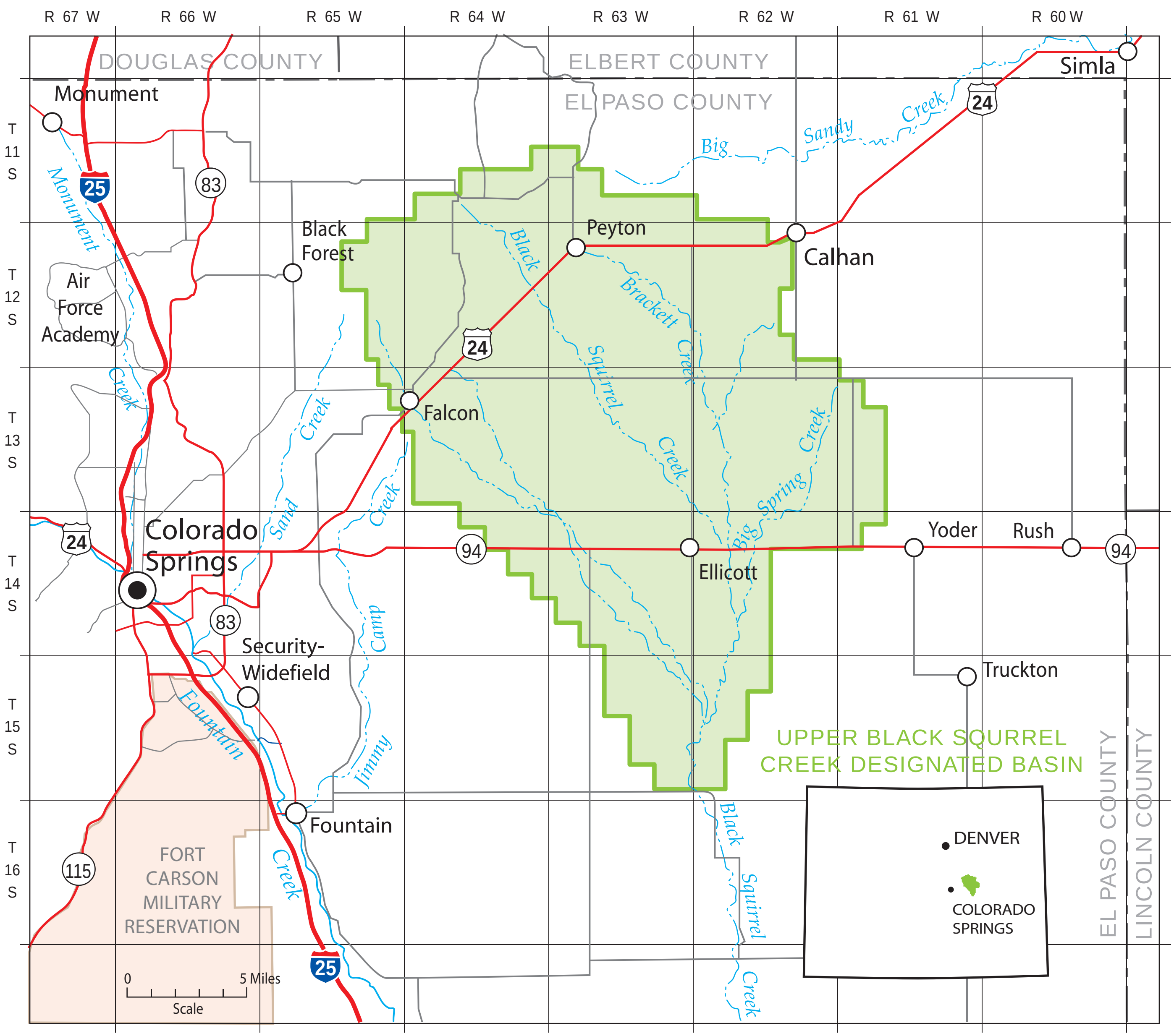

Figure 1.1 Location of the Upper Black Squirrel Creek Basin and Study Area

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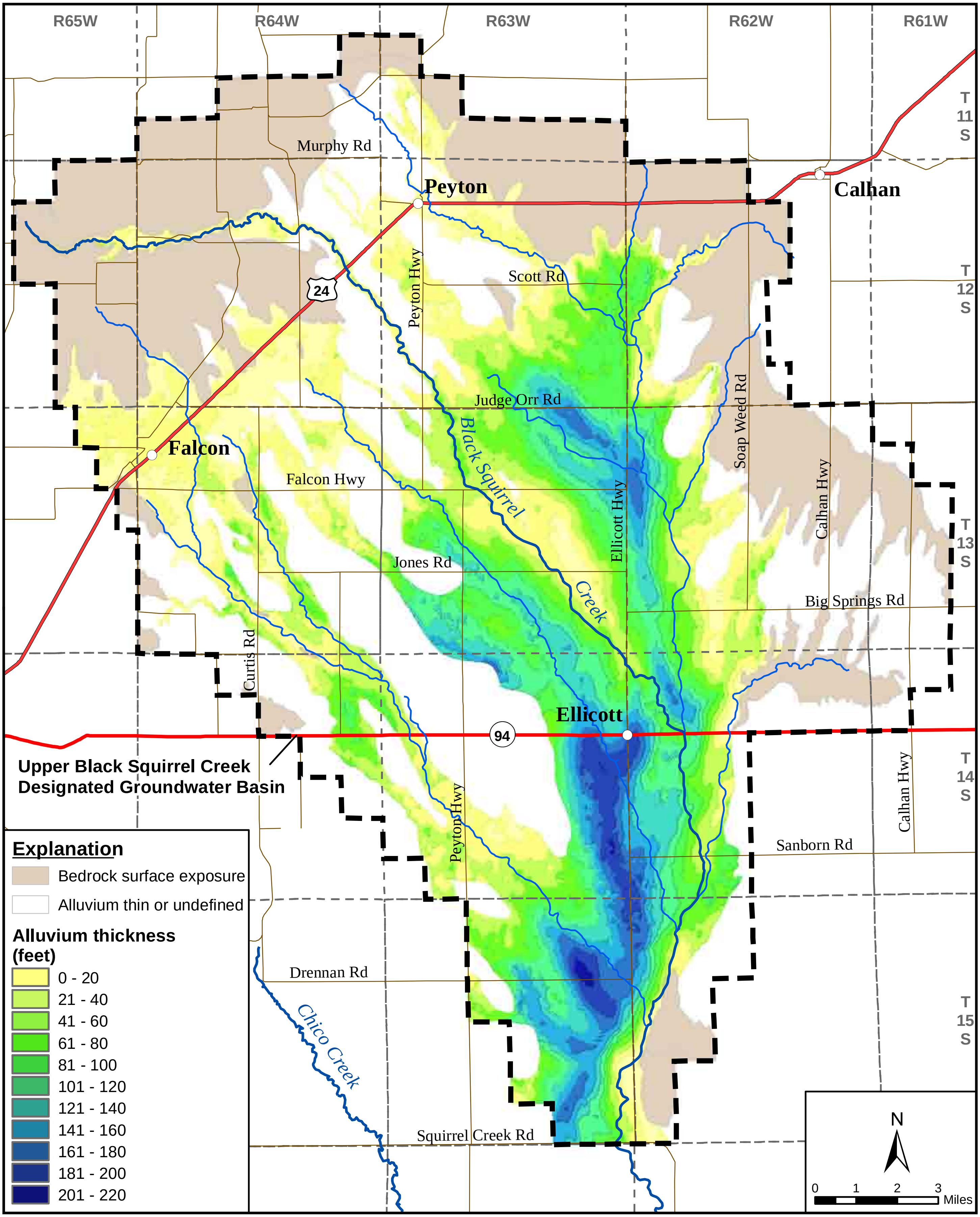

Figure 1.2 Extent and Thickness of the Alluvial Aquifer System in the Upper Black Squirrel Creek Basin

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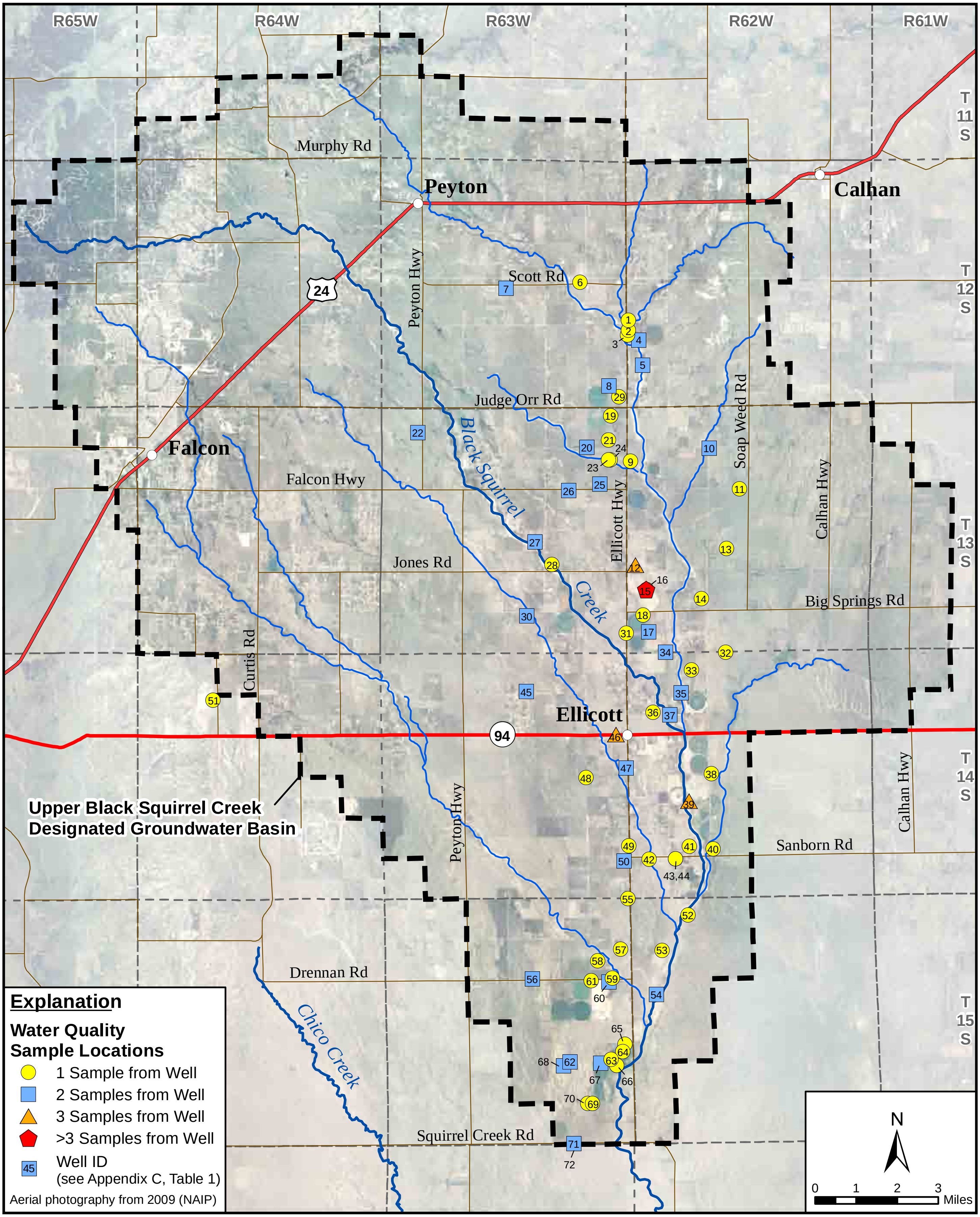

Figure 3.1 Water Quality Sample Location Map

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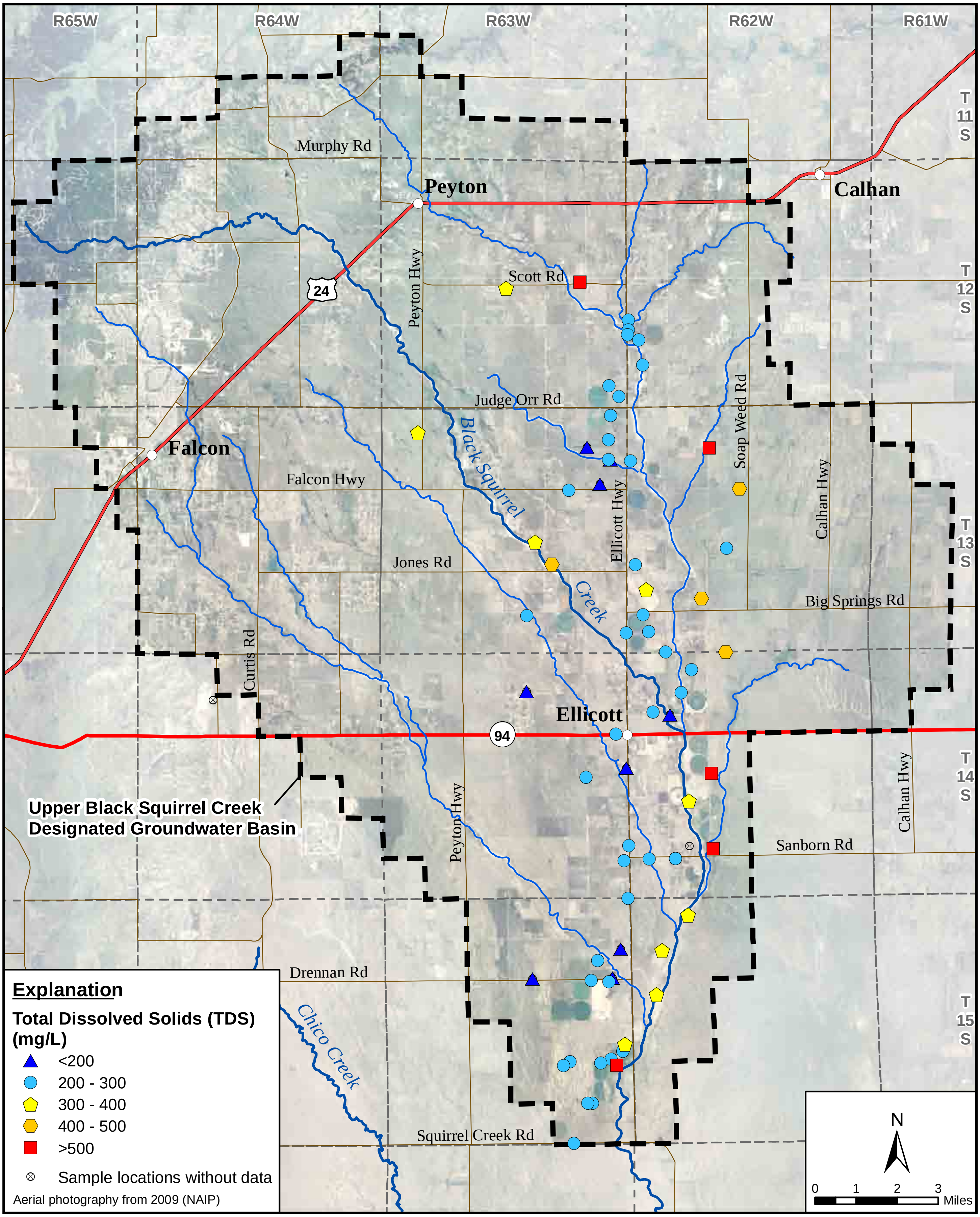

Figure 4.2 Total Dissolved Solids Distribution, 1954-2009

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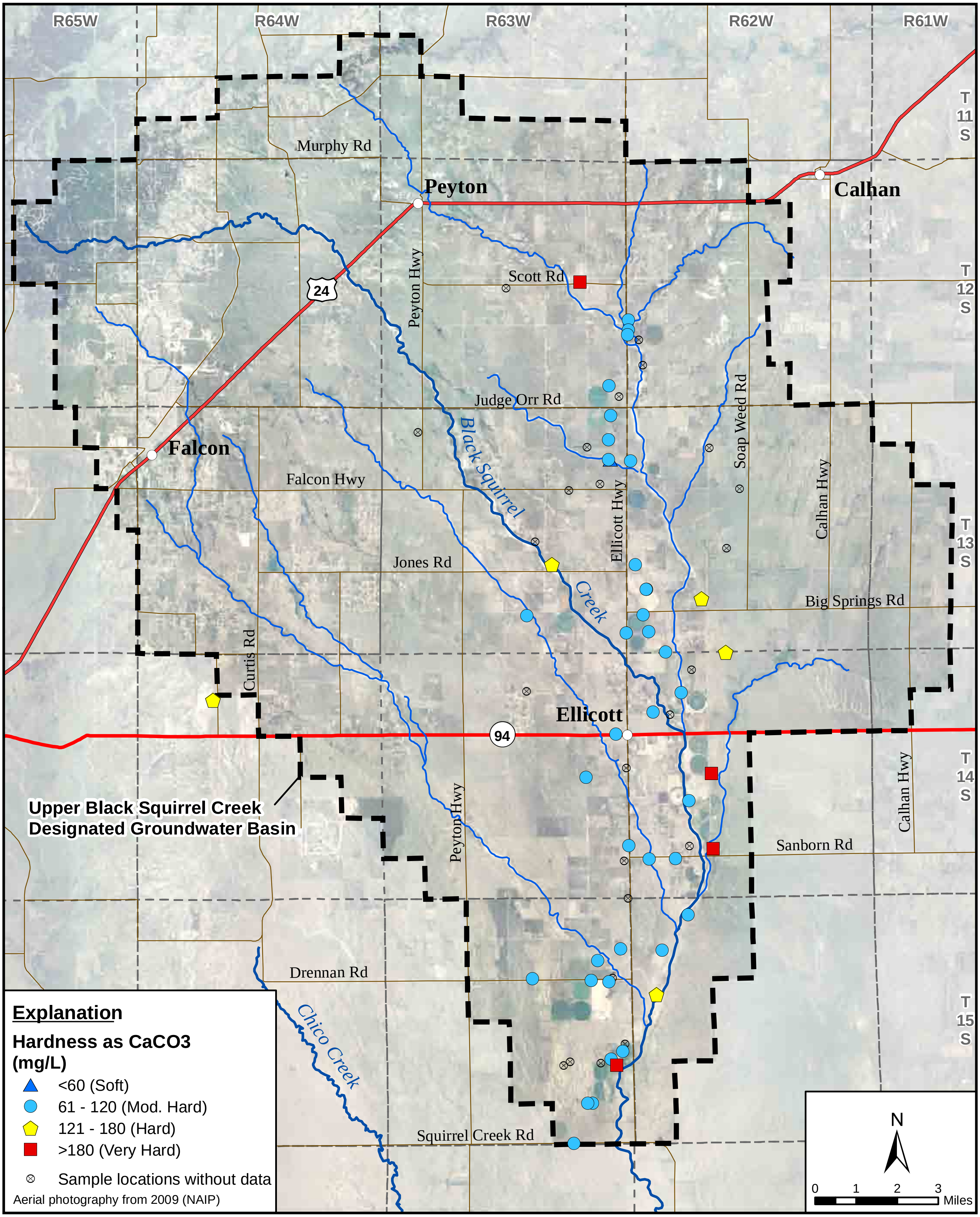

Figure 4.4 Hardness Value Distribution, 1954-2009

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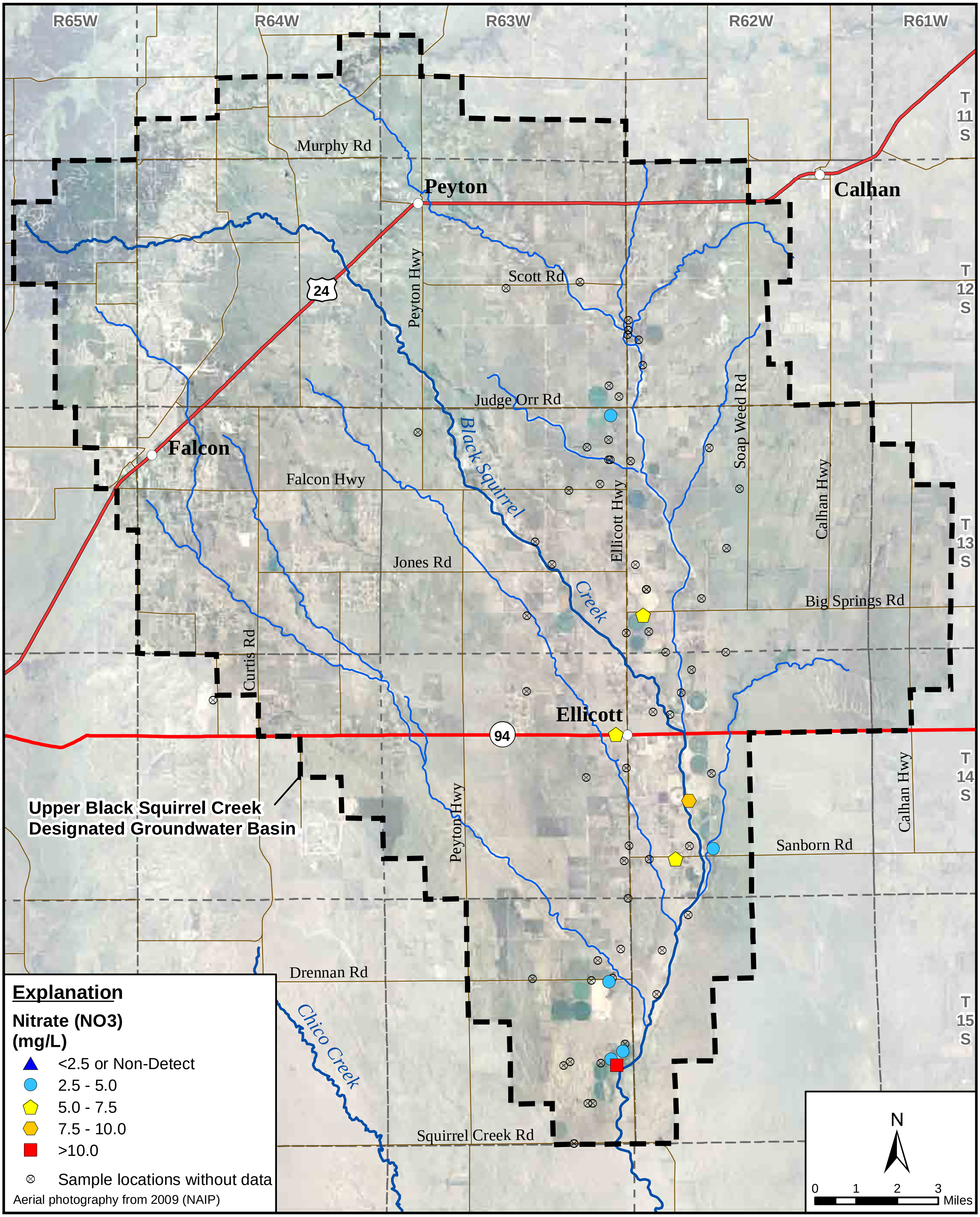

Figure 4.6 Nitrate Distribution, Pre-1980

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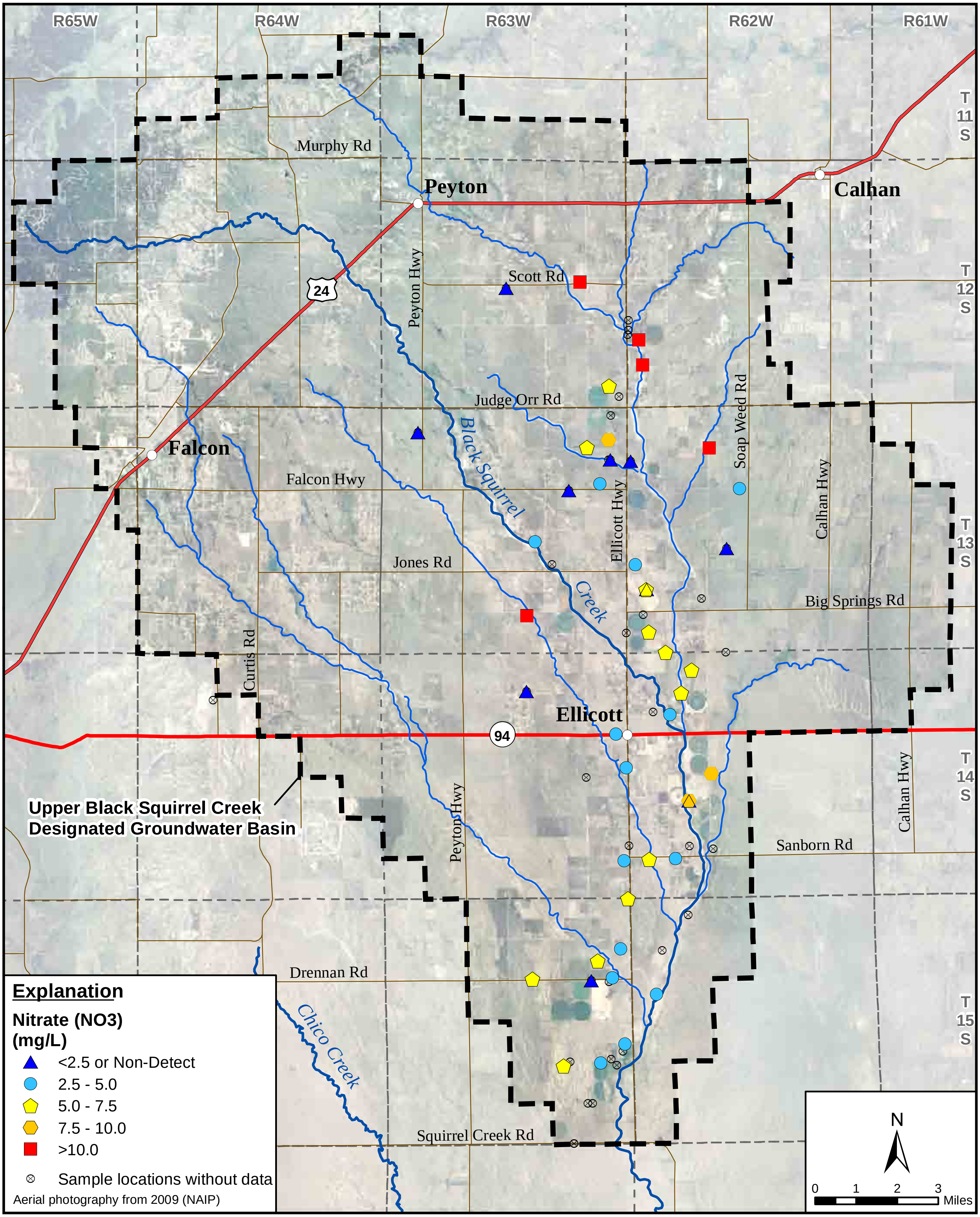

Figure 4.7 Nitrate Distribution, 1980s

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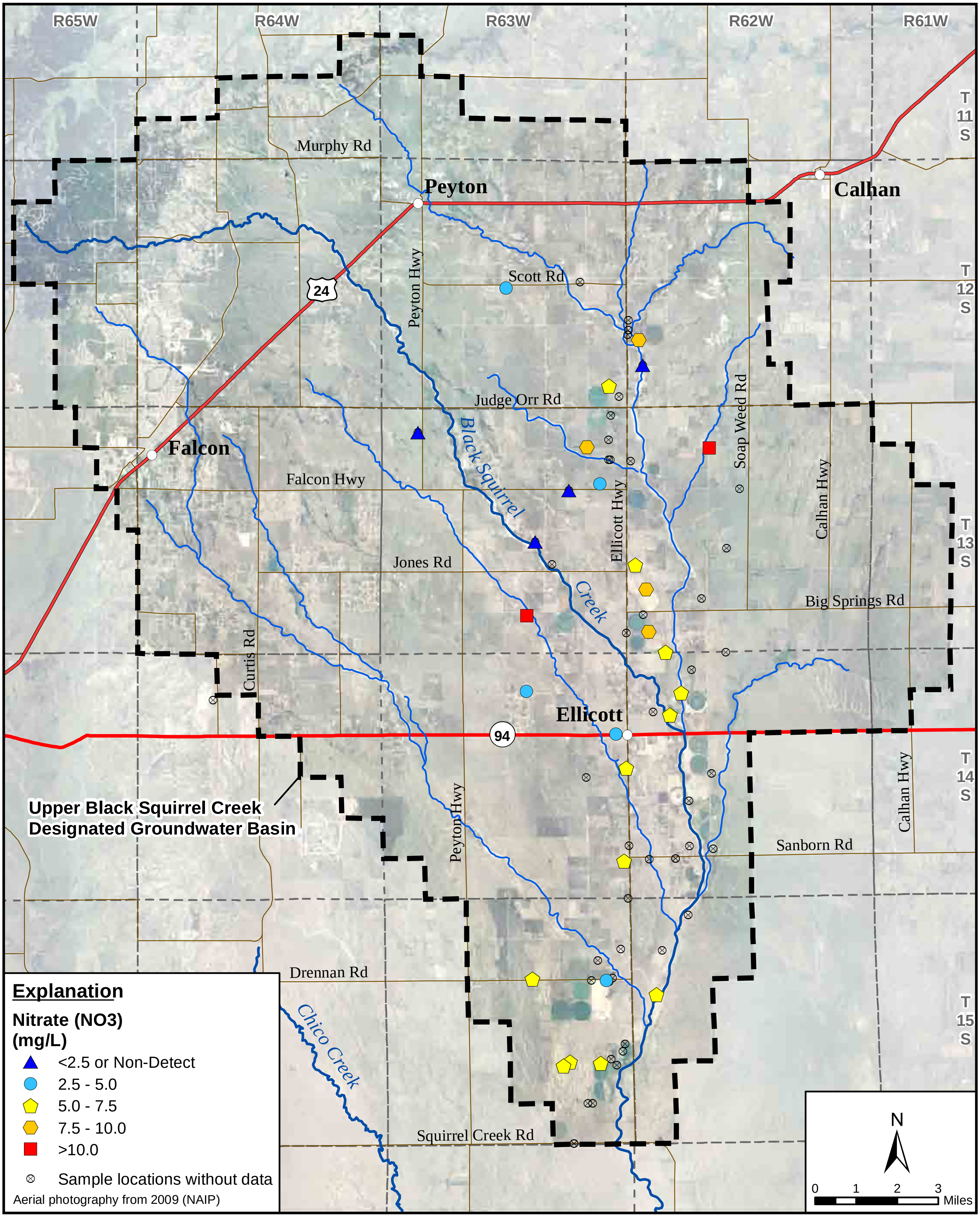

Figure 4.8 Nitrate Distribution, 1990s

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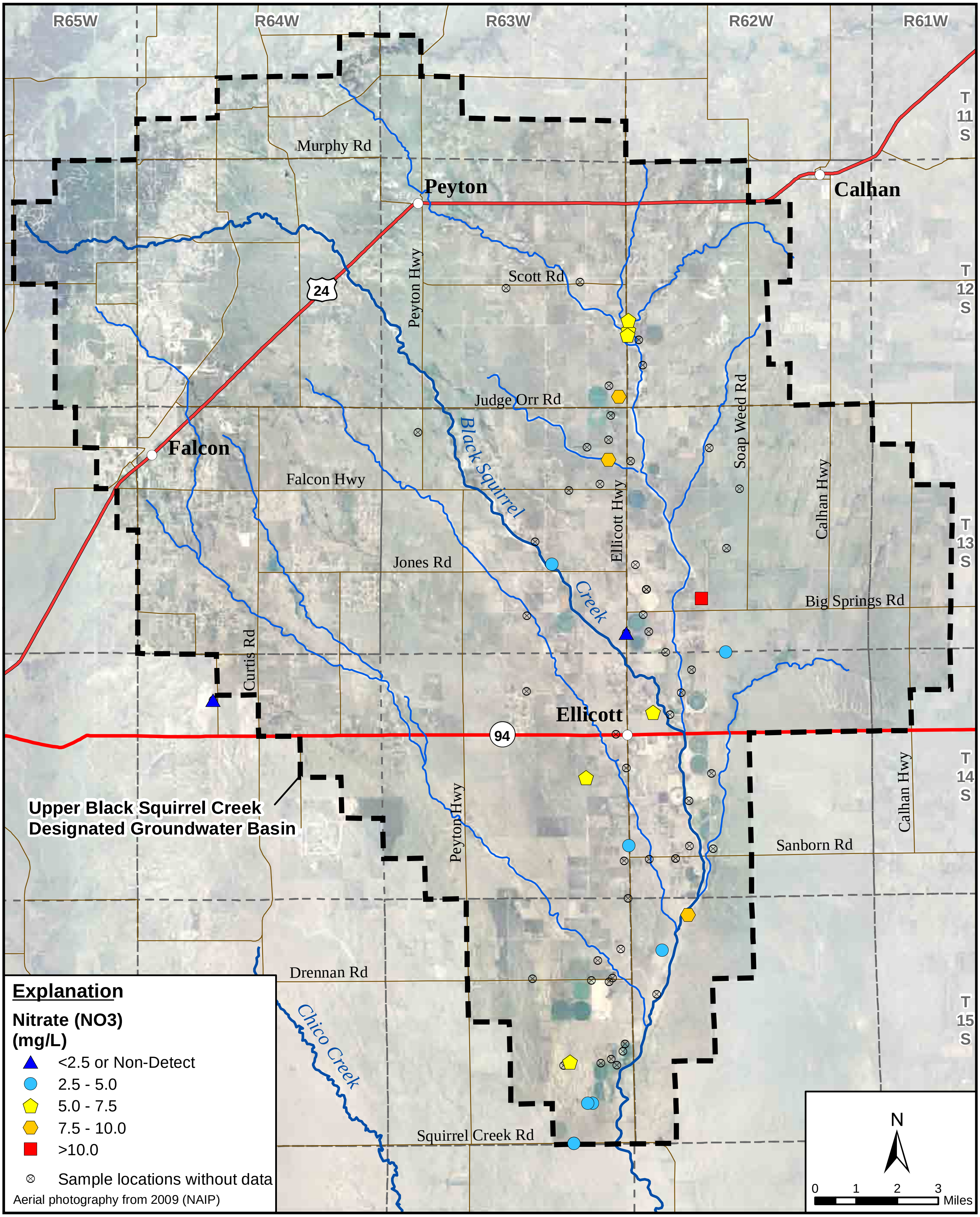

Figure 4.9 Nitrate Distribution, 2000s

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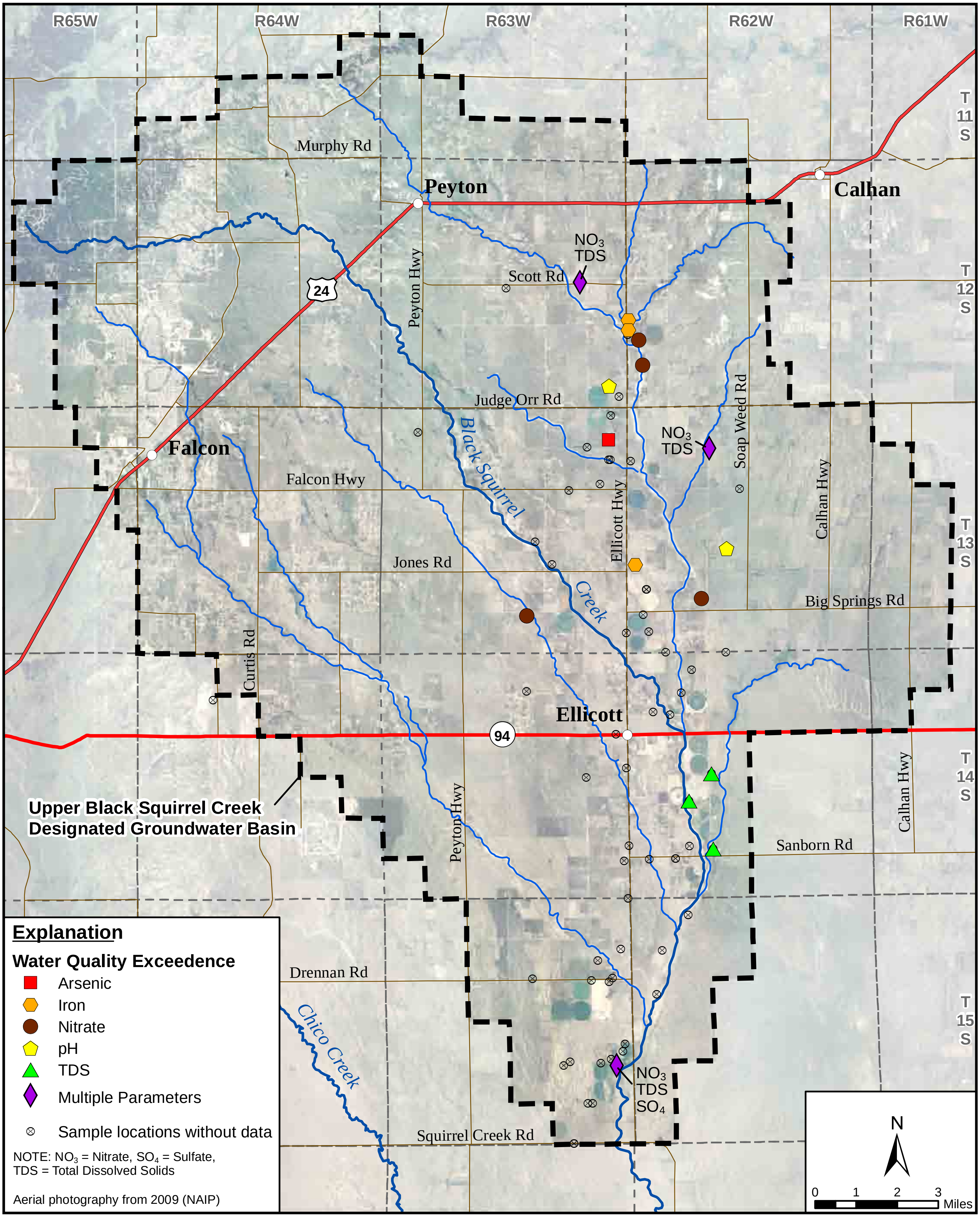

Figure 4.11 Groundwater Quality MCL and SMCL Exceedences, 1954-2009

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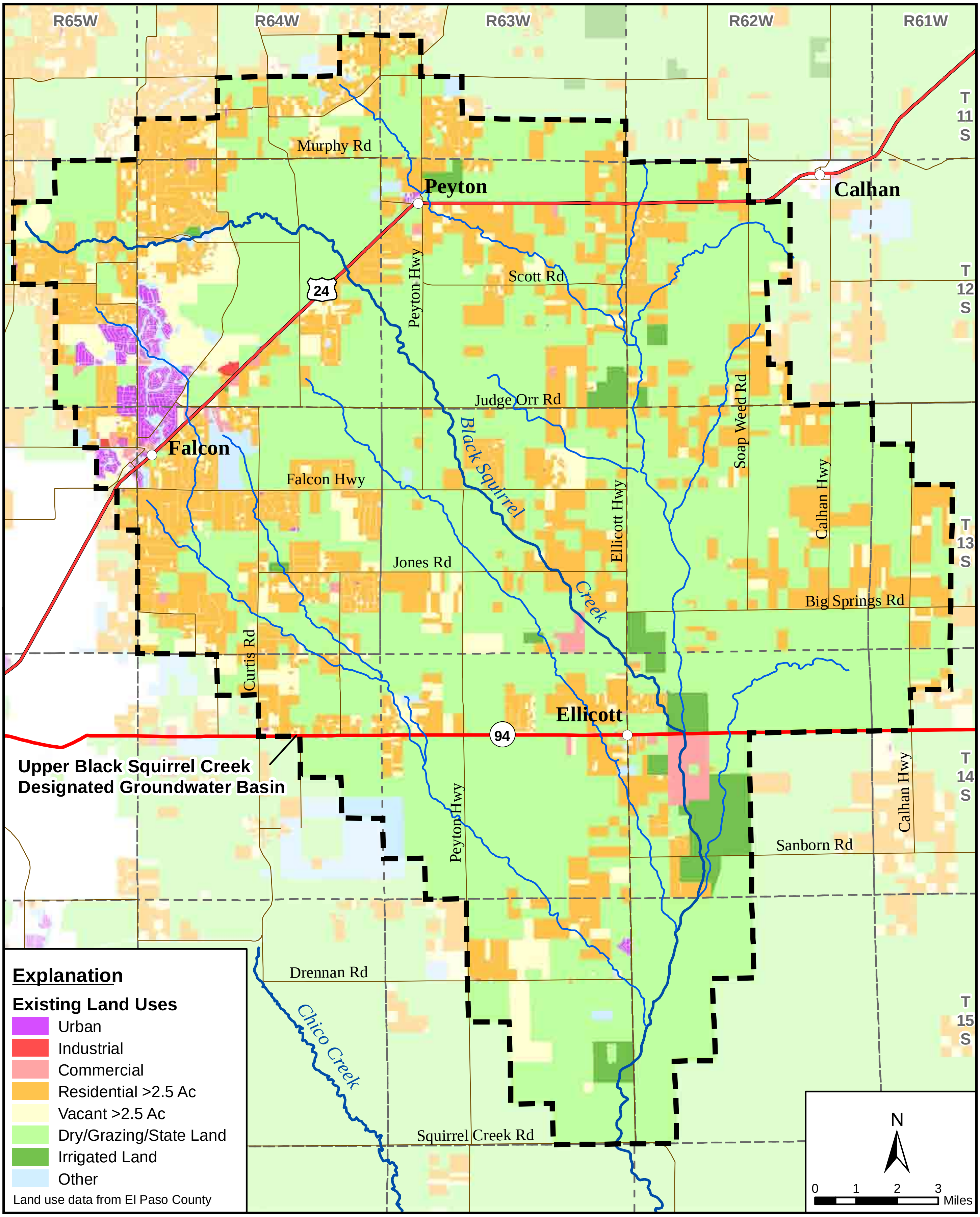

Figure 5.1 Existing Land Use

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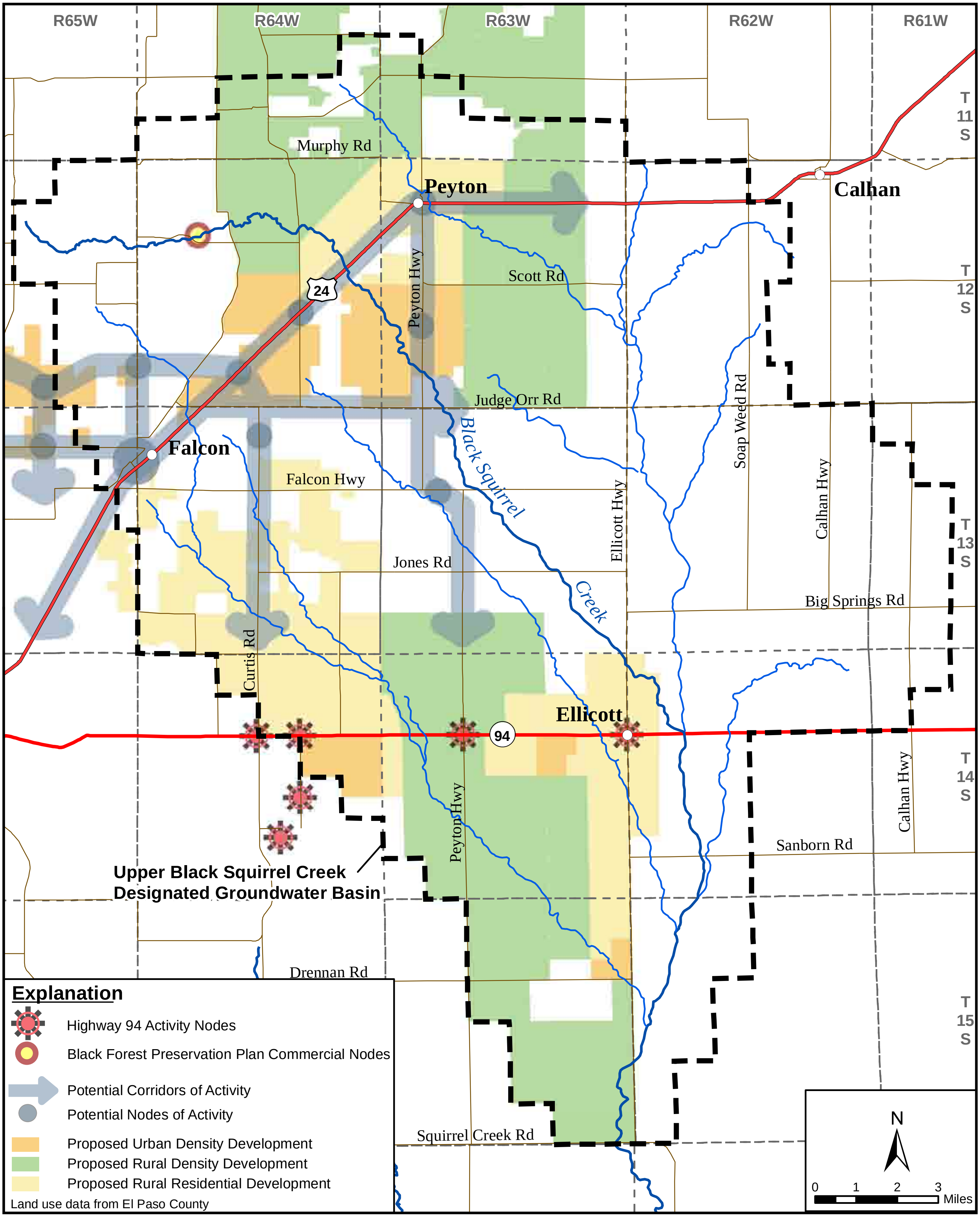

Figure 5.2 Anticipated Future Land Use

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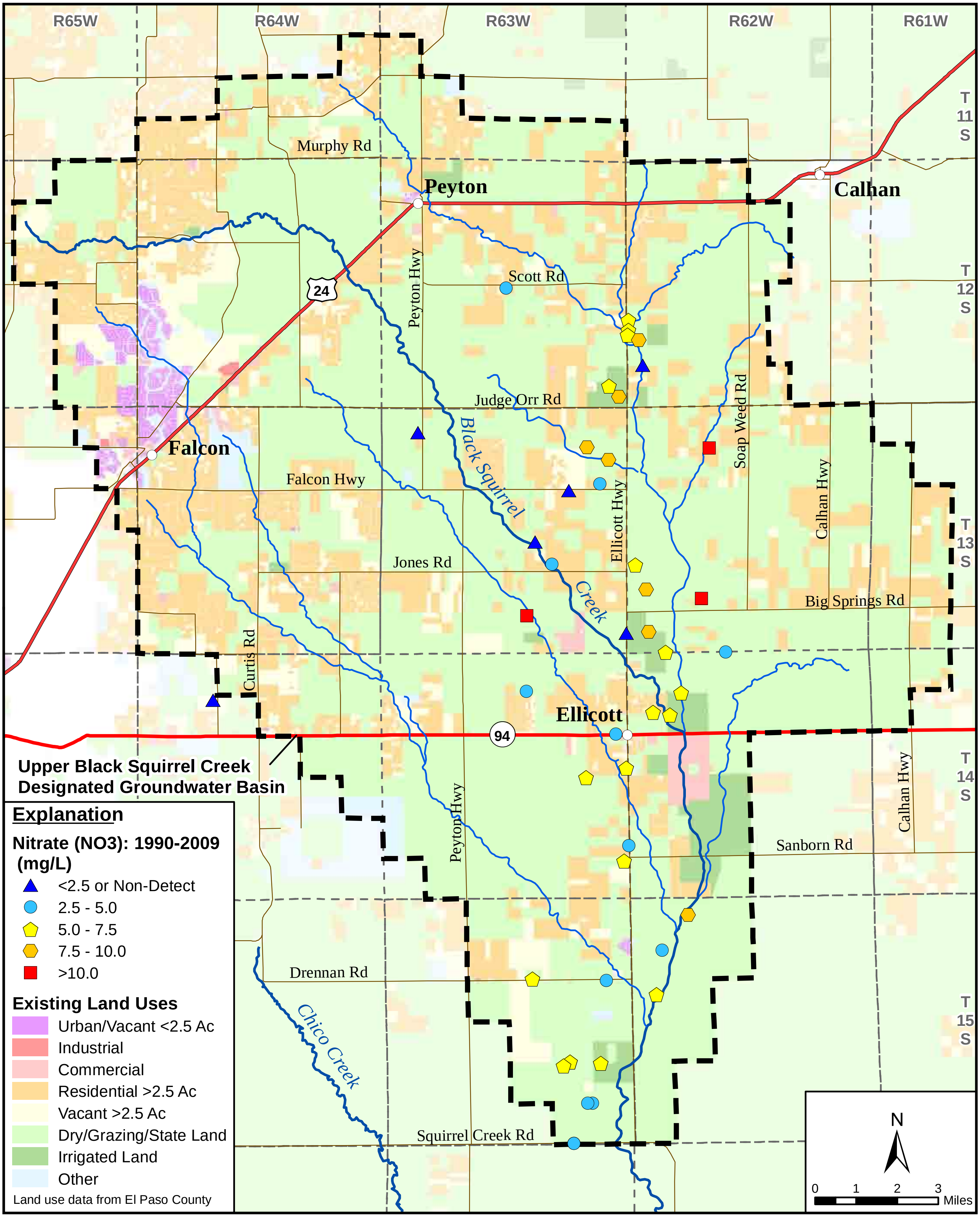

Figure 6.1 Relationship of Nitrate Concentrations to Existing Land Use

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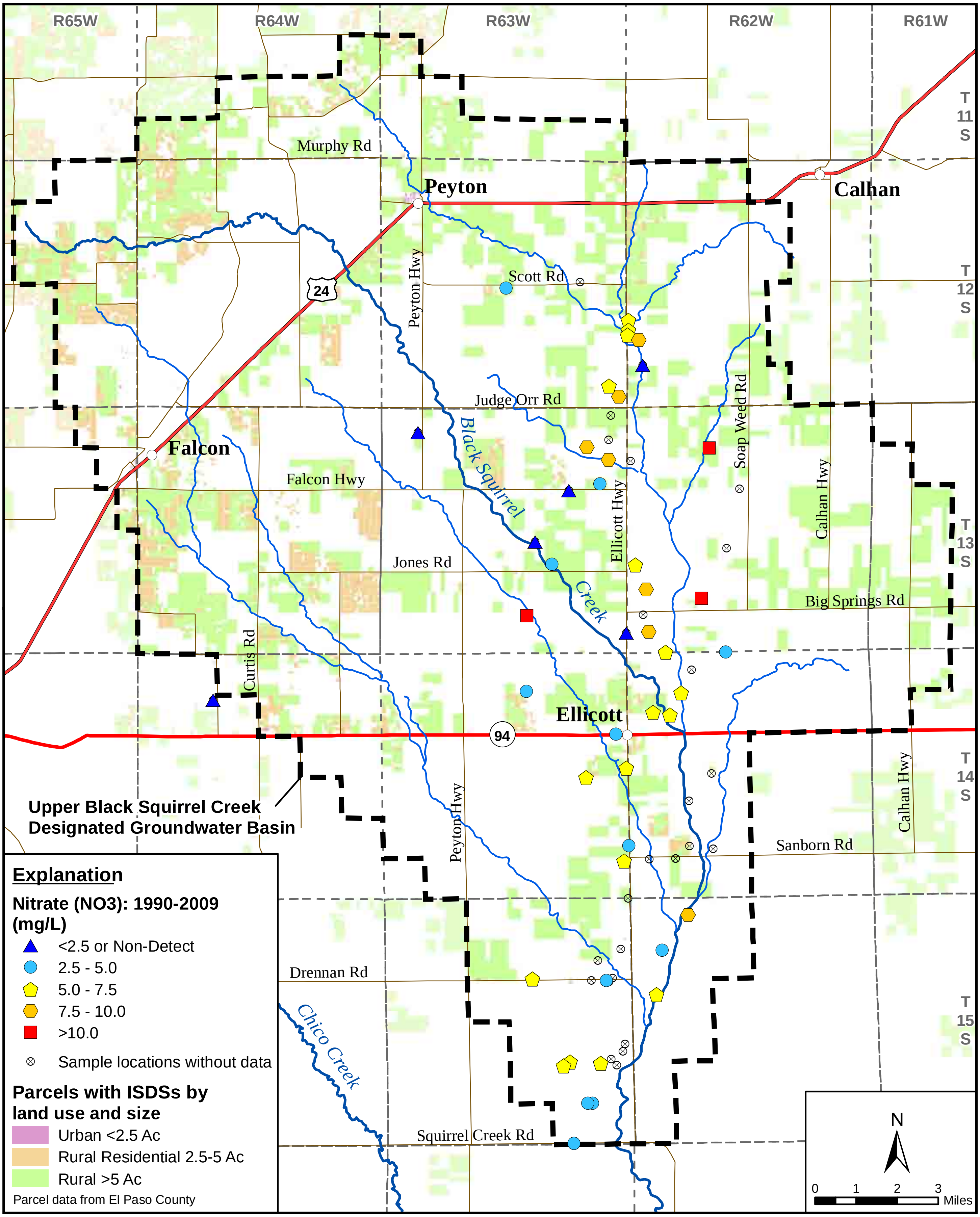

Figure 6.2 Relationship of Nitrate Concentrations with Parcels Containing ISDSs

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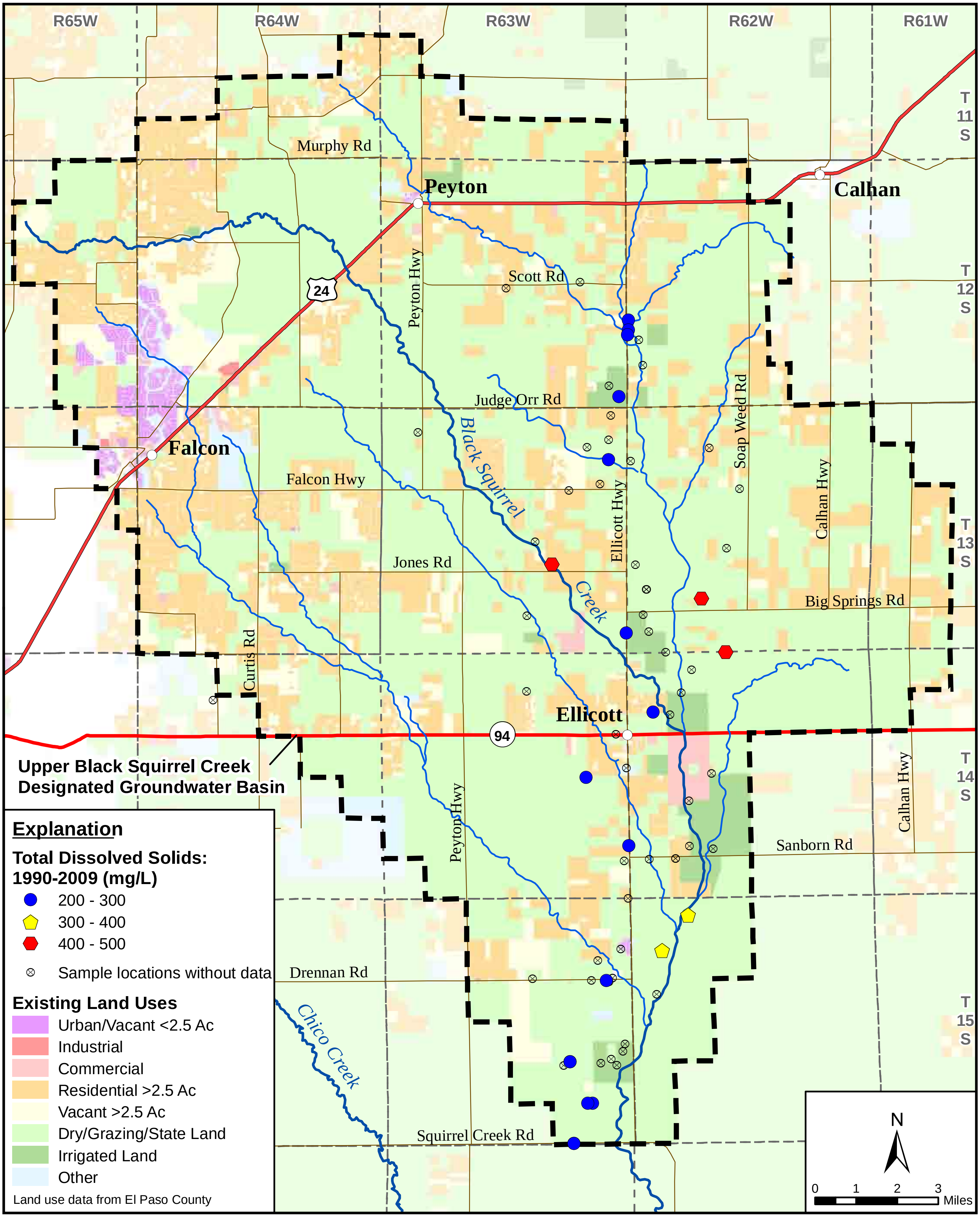

Figure 6.3 Relationship of Total Dissolved Solids Concentrations to Existing Land Use

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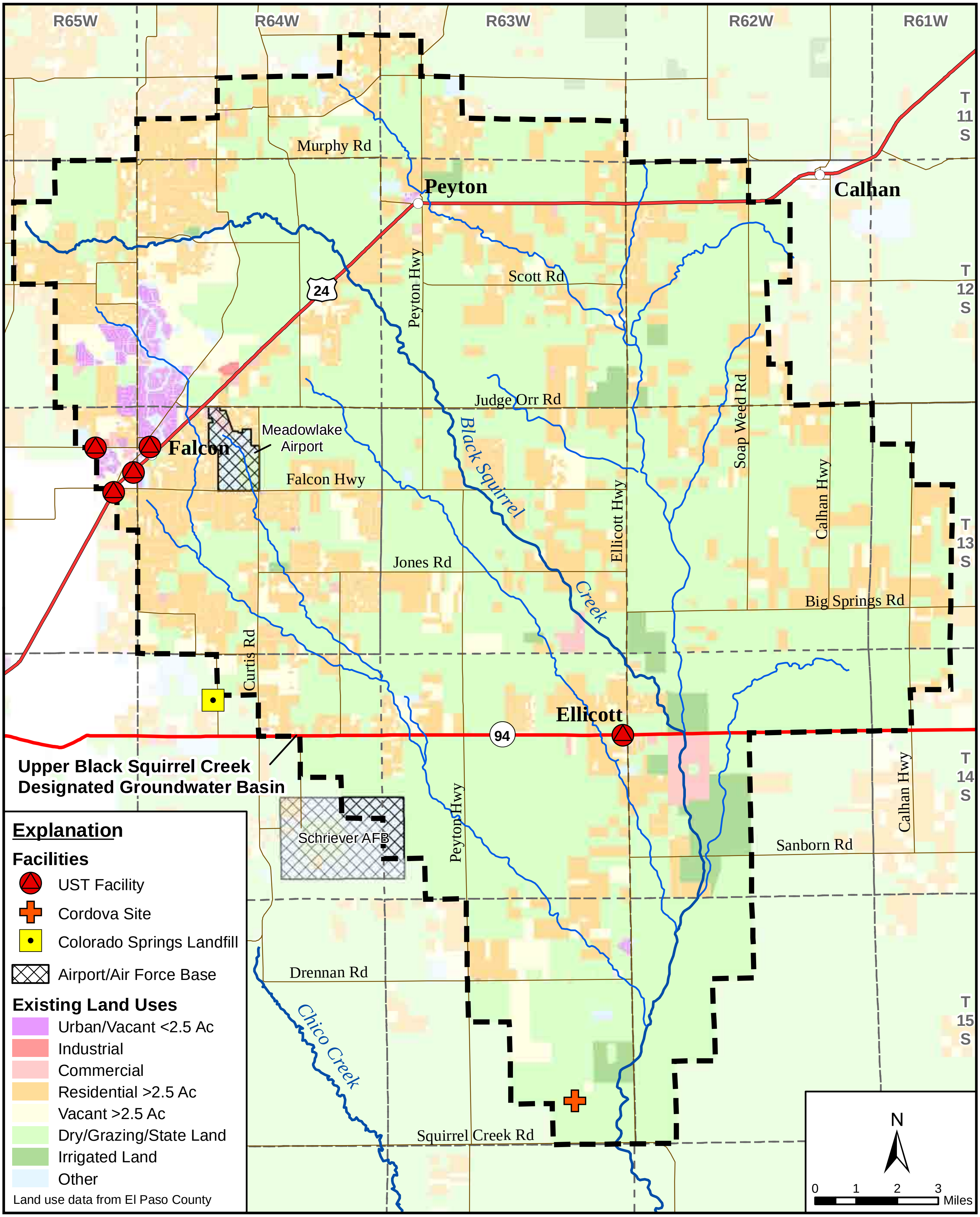

Figure 6.4 Select Facilities in the Upper Black Squirrel Creek Basin

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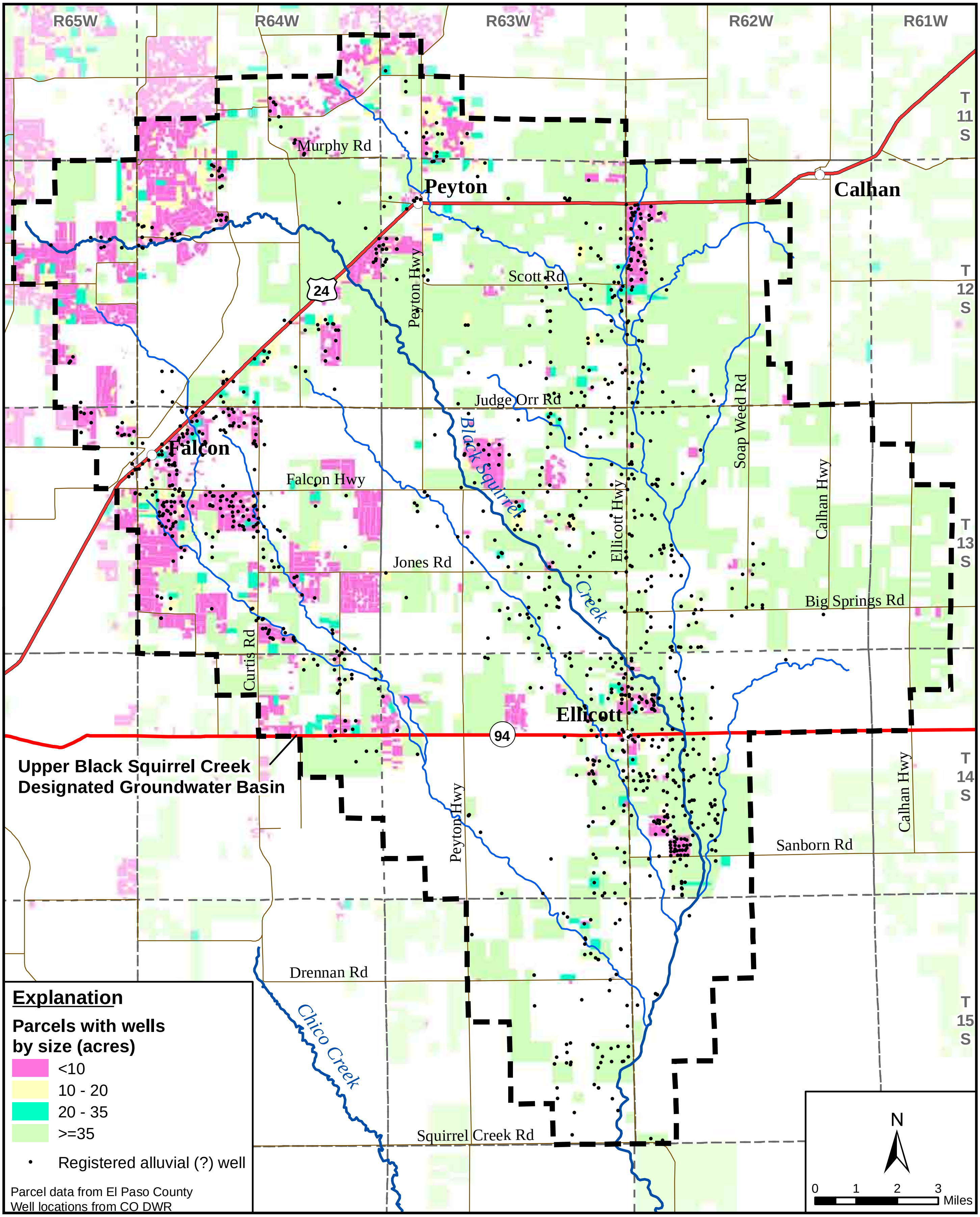

Figure 6.5 DWR Well Locations and Parcels Listed with Wells

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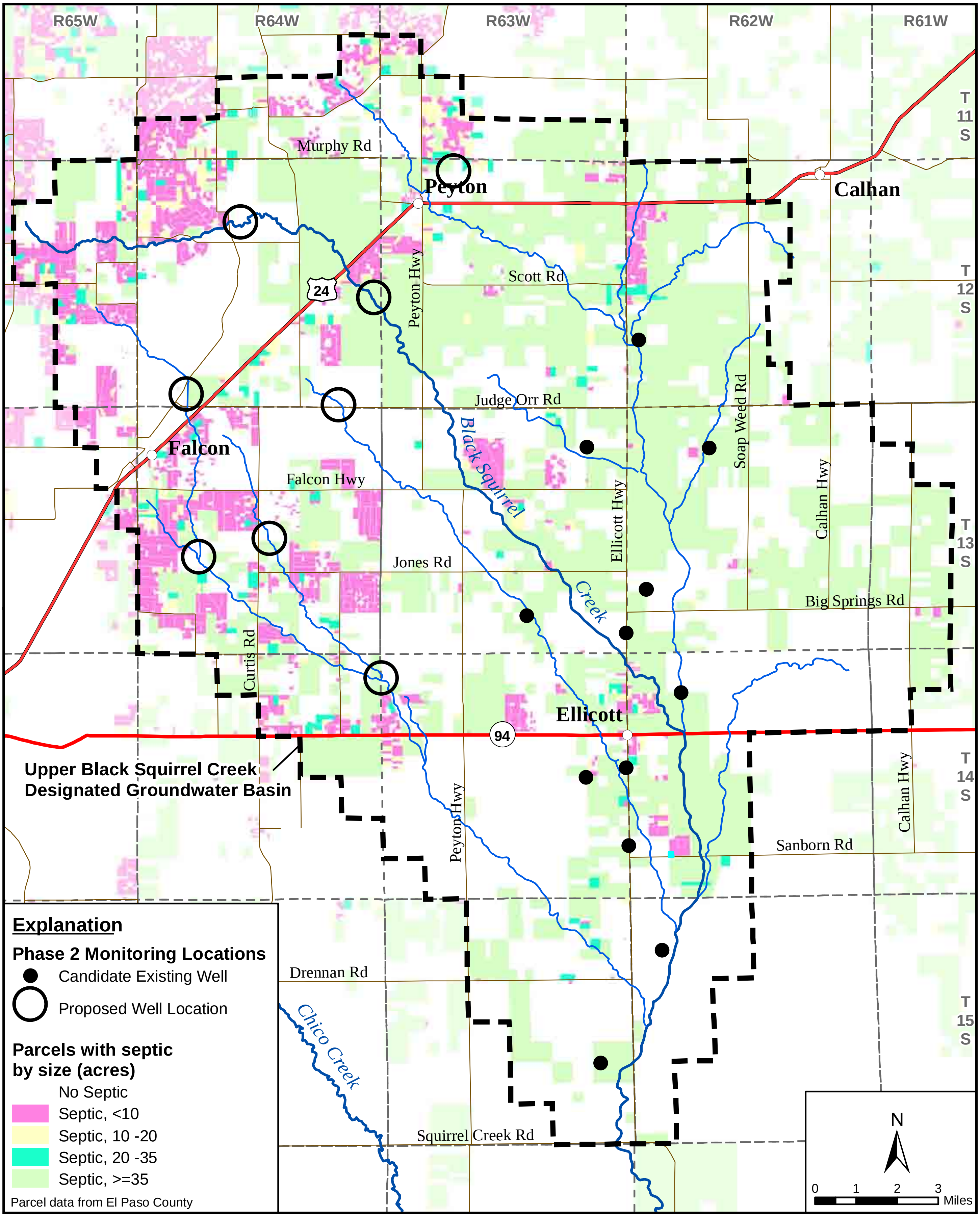

Figure 7.1 Proposed Phase 2 Monitoring Locations

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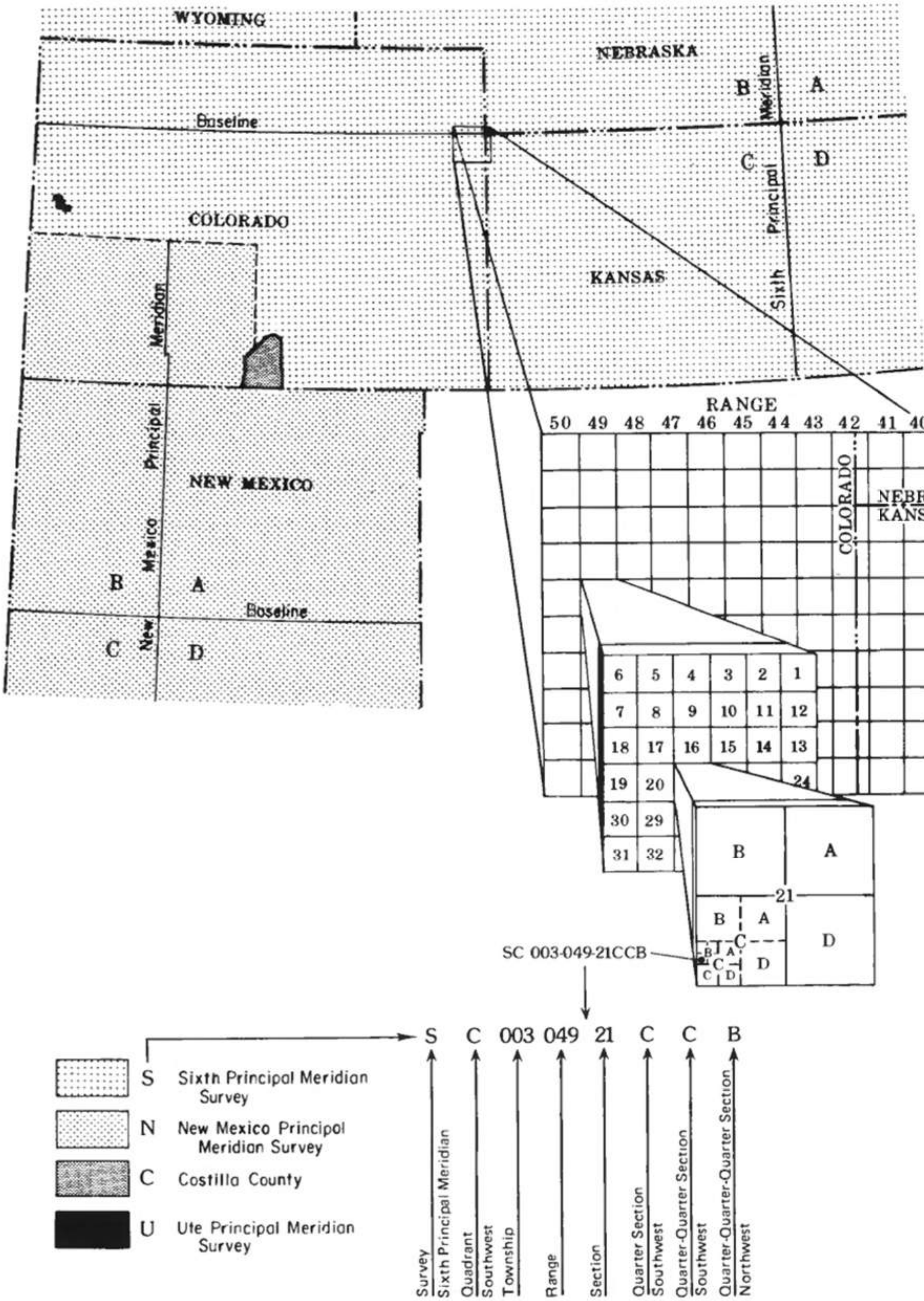
Appendix A

Bureau of Land Management Well Identification System
El Paso County Groundwater Quality Study

Appendix A
Bureau of Land Management Well Identification System
El Paso County Groundwater Quality Study



Appendix B

Annotated Bibliography
El Paso County Groundwater Quality Study

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2009

Rupert, M.G., and Plummer, L.N., 2009, Groundwater Quality, Age, and Probability of Contamination, Eagle River Watershed Valley-Fill Aquifer, North- Central Colorado, 2006-2007: U.S. Geological Survey Scientific Investigations Report 2009-5082, 59 p.

The Eagle River watershed is located near the destination resort town of Vail, Colorado. The area has a fast growing permanent population, and the resort industry is rapidly expanding. A large percentage of the land undergoing development to support that growth overlies the Eagle River watershed valley-fill aquifer (ERWVFA), which likely has a high predisposition to groundwater contamination. As development continues, local organizations need tools to evaluate potential land-development effects on ground- and surface-water resources so that informed land-use and water management decisions can be made. To help develop these tools, the U.S. Geological Survey (USGS), in cooperation with Eagle County, the Eagle River Water and Sanitation District, the Town of Eagle, the Town of Gypsum, and the Upper Eagle Regional Water Authority, conducted a study in 2006-2007 of the groundwater quality, age, and probability of contamination in the ERWVFA, north-central Colorado.

Ground- and surface-water quality samples were analyzed for major ions, nutrients, stable isotopes of hydrogen and oxygen in water, tritium, dissolved gases, chlorofluorocarbons (CFCs), and volatile organic compounds (VOCs) determined with very low-level laboratory methods. The major-ion data indicate that ground waters in the ERWVFA can be classified into two major groups: groundwater that was recharged by infiltration of surface water, and groundwater that had less immediate recharge from surface water and had elevated sulfate concentrations. Sulfate concentrations exceeded the USEPA National Secondary Drinking Water Regulations (250 milligrams per liter) in many wells near Eagle, Gypsum, and Dotsero. The predominant source of sulfate to groundwater in the Eagle River watershed is the Eagle Valley Evaporite, which is a gypsum deposit of Pennsylvanian age located predominantly in the western one-half of Eagle County.

Nitrite plus nitrate as nitrogen (nitrate) concentrations in groundwater in the ERWVFA were generally low, with the median nitrate concentration about 0.74 milligram per liter (mg/L) and a maximum concentration of 5.4 mg/L. More than 50 percent of the nitrate concentrations in the ERWVFA were less than 1 mg/L, indicating that more than 50 percent of the wells tested in the ERWVFA had nitrate concentrations similar to precipitation. Most groundwater in the ERWVFA was under oxidized geochemical conditions, indicating that nitrate from anthropogenic sources (caused or produced by humans) could persist for several decades in groundwater of the ERWVFA.

The groundwater age-dating data indicated that most groundwater in the ERWVFA was recently recharged water and had a high probability of contamination if anthropogenic compounds were released to the environment. Based upon the CFC concentrations and tritium activities in groundwater, the median groundwater recharge date was 1989 and the standard deviation was about 9 years, indicating that most groundwater in the ERWVFA that was sampled was young water.

VOCs were detected in all water samples at or above the low-level laboratory reporting limit concentrations, but VOC concentrations in all samples were at least one order of magnitude less than their USEPA Maximum Contaminant Level.

Logistic regression statistical modeling techniques were used to develop statistical models that predict the probability of elevated nitrate concentrations, the probability of unmixed young water (using chlorofluorocarbon-11 concentrations and tritium activities), and the probability of elevated VOC concentrations. These three models used different compounds such as nitrate and VOCs to provide an indication of the probability of groundwater contamination under a variety of conditions and contaminant inputs. Although the groundwater age dating indicates that most areas of the ERWVFA have a high probability of contamination, the probability maps help to show areas with a particularly high probability of contamination if compounds of concern are released to the environment.

2008

Colorado Department of Public Health and Environment, Status of Water Quality in Colorado – 2008 (Update to the 2002, 2004, and 2006 305(b) Reports), Water Quality Control Division, 2008

Section 305(b)(1) of the Clean Water Act (CWA) requires that each state submit a biennial report to the United States Congress through the United States Environmental Protection Agency (EPA). The 305(b) Report is required to include the following:

- *an assessment of water quality of the State*
- *an analysis of the extent to which the waters of the State provide protection for the propagation of aquatic life and recreation in and on the water*
- *a report of the water pollution control programs*
- *a description of the nonpoint source pollution control programs, ground water and drinking water programs*

In 2007, the Water Quality Control Commission (WQCC) conducted a triennial review hearing to address Colorado's Basic Standards for Ground Water (Regulation 41). During the hearing the WQCC updated and revised the numeric ground water standards for toluene, ethylene dibromide (1,2-dibromoethane), and fecal coliform. The WQCC also adopted new standards for four pesticides; acetochlor, dicamba, metribuzin, and prometon. The WQCC also elected to implement the ground water narrative standards on a statewide basis.

The Agricultural Chemicals and Groundwater Protection Program (Program), a cooperative program between the Colorado Department of Agriculture (CDA), Colorado State University Extension Services (CSUCE), and the Water Quality Control Division (WQCD), has been systematically monitoring for the presence of agricultural related chemicals in vulnerable aquifers throughout Colorado. Forty-nine wells were selected for sampling in the reconnaissance survey of El Paso County in 2006. Most samples were located in alluvial aquifers or in the shallow bedrock aquifers of the Denver Basin in the northern portion of the county. Tables and figures provide site-specific information.

In El Paso County in 2006, the average nitrate concentration was 2.74 ppm, and 50% of all samples had a nitrate concentration less than approximately 4 ppm. Seven wells had nitrate concentrations above 5.0 ppm, with only four of those exceeding 7.5 ppm. Six samples were below detection limit. One sample had a nitrate concentration of 11.5 ppm, and was the only sample greater than the ground water standard of 10 ppm. No pesticides were detected in any of the samples from El Paso County. The majority of the wells with nitrate concentrations greater than 5.0 ppm were located in alluvial aquifers. Of the six wells located in alluvial aquifers, with concentrations greater than 5.0 ppm, all were located in *areas that have numerous potential non-point sources for nitrate contamination including septic leach field discharge, agricultural runoff and leaching, or urban runoff. Nitrate contamination does not appear to be a widespread problem based on the results of the reconnaissance investigation. Given the results of the sampling, the Program has not found anything that would necessitate a follow up investigation. El Paso County therefore, is a low priority, with respect to additional monitoring for potential agricultural chemical impacts to ground water.*

Colorado Water Resources Research Institute, 2008. Agricultural Chemicals & Groundwater Protection in Colorado 1990 – 2006. Special Report No. 16.

This document describes the activities of the Colorado Department of Agriculture (CDA) and other entities in helping ensure compliance with Colorado's Agricultural Chemicals and Groundwater Protection Act which took effect in 1990. The CDA is the lead agency and is accompanied by Colorado State University Extension and the Colorado Department of Public Health and Environment. The purpose of the Agricultural Chemicals and Groundwater Protection Act is to reduce agricultural chemicals' negative impacts on groundwater and the environment. Agricultural chemicals covered under this legislation include commercial fertilizers and all pesticides. The goal is to prevent groundwater contamination before it occurs by improving agricultural chemical management. This report summarizes the first 15 years of the Agricultural Chemicals and Groundwater Protection Act and provides an overview of activities and monitoring data. The report describes pesticide facility inspections, waste agricultural chemical collection, and education and training efforts to reduce the impacts of agricultural chemicals on the environment. Also described are the program's groundwater monitoring efforts which have sampled 1,096 wells and analyzed 1,956 samples statewide as of December 2006. The program has included sampling in the UBSC Basin and detailed results were made available to CGS by the CDA.

Topper, Ralf, 2008, Upper Black Squirrel Creek Basin Aquifer Recharge and Storage Evaluation, Colorado Geological Survey report prepared for El Paso County Water Authority.

The objective of this project is to evaluate and refine the existing knowledge of the hydrogeology of the alluvial aquifer system in the Upper Black Squirrel Creek basin for the purposes of assessing the potential for aquifer recharge and storage implementation. Geographic, geologic, hydrologic and water quality data were collected and analyzed to evaluate the recharge potential, storage capacity, and ambient water quality in the study area. The study area encompasses the entire Upper Black Squirrel Creek drainage basin and coincides with the designated ground water basin boundary.

The report contains a section on water quality. Water quality data from 123 wells was compiled from five different literature sources. Based on the analytical data, water from the alluvial aquifer in the basin is classified as either a sodium calcium-mixed anion or a sodium calcium bicarbonate type. With few exceptions, the alluvial groundwater is of very good quality with total dissolved solids concentrations below 500 milligrams per liter. In four wells, nitrogen compounds exceeded the state drinking water standard.

2007

Conn, K., Siegrist, R.L., and Barber, L.B., 2007, Colorado School of Mines (CSM) Research Regarding Occurrence and Fate of Organic Wastewater Contaminants During Onsite Wastewater Treatment: pg. 12-14.

Organic wastewater contaminants (OWCs) such as pharmaceuticals and personal care products have received increasing attention in the last decade due to their possible adverse effects on ecosystems and human health. Several studies have identified wastewater as a primary contributing source of OWCs to the environment, but few have quantified their occurrence and fate in onsite wastewater treatment systems and associated receiving environments. A substantial portion of the wastewater generated in the United States is processed by onsite wastewater treatment systems before discharge to the environment.

Between 2002 and 2005, the CSM/USGS research team quantified the occurrence and OWCs in 30 Colorado onsite wastewater treatment systems serving different homes, businesses, institutions, and varied types of confined treatment systems. Concentrations of OWCs in effluents before and after septic tank treatment were usually similar, suggesting low to negligible removal of OWCs during septic tank treatment alone. **.** *Results from the reconnaissance survey of 30 onsite wastewater treatment systems suggest that OWCs are being applied to onsite system soil treatment units at environmentally relevant concentrations. To help understand the fate of OWCs in wastewater effluents during soil treatment, a tracer test was conducted at the CSM Mines Park Test Site using a conservative tracer (potassium bromide) and a pharmaceutical surrogate (rhodamine WT). The results suggest that OWCs with similar properties as the pharmaceutical surrogate may be retarded and/or removed during onsite system soil treatment depending on the site-specific soil characteristics. Understanding the additional treatment that occurs during soil infiltration and percolation through the vadose zone and within the groundwater and surface water receiving environments is critical to aid in defining potential adverse effects to ecosystem and human health due to OWCs being discharged from onsite wastewater treatment systems.*

Paul, W., 2007. Water budget of a mountain residence, Jefferson County, Colorado. Thesis (M.Sc.) -- Colorado School of Mines, 65 pg.

A water budget for an individual sewage disposal system (ISDS) located at a mountain residence near Evergreen, Colorado, was calculated using field data as inputs to a continuity equation. Water pumped from the fractured, unconfined aquifer was metered. A pressure transducer in the dosing chamber of the septic tank monitored waste water flow from the home into the ISDS system. A tipping-bucket rain gauge measured precipitation. Actual evapotranspiration (AET) was measured at various times of year during the study using a plastic, hemisphere-shaped chamber that monitored humidity. Potential evapotranspiration (PET) was continuously calculated by an on-site meteorological station with a half hour frequency. Using multiple, linear regression, a model of continuous PET based on meteorological data was calibrated with the intermittent AET data to estimate continuous AET throughout the study period. Lateral flow was negligible during the majority of the year. Vertical flow to the fractured bedrock was estimated using two methods. The first method based on measurements of vertical hydraulic conductivity and gradient yielded unreasonable results with large uncertainty and are not presented. The second method determined vertical

flow as the unknown in the continuity equation and resulted in reasonable values. Calculated water loss in the residence and AET of ISDS effluent were combined to estimate the percent of pumped water available to recharge the underlying fractured bedrock. At this residence, an average of 84.4 % (with an uncertainty ranging from 83.5 to 85.2 %) of water pumped into the residence was estimated to be available to recharge the underlying aquifer.

Paul, W., Poeter, E., and Laws, R., 2007, Consumptive Loss from an Individual Sewage Disposal System in a Semi-Arid Mountain Environment: in Colorado Water, v.24, issue 4, pg. 4-9

Consumptive loss from an individual sewage disposal system (ISDS) located at a residence in the foothills of the Rocky Mountains near Evergreen, Colorado, was calculated using field data. Water pumped from the fractured crystalline bedrock unconfined aquifer was metered, and the volume of effluent dosed to the infiltration area was monitored. Actual evapotranspiration (AET) was measured intermittently using a plastic, hemisphere-shaped chamber that monitored humidity. Potential evapotranspiration (PET) was calculated using data from an on-site meteorological station. A model of continuous PET based on meteorological data was calibrated with the intermittent AET data to estimate continuous AET throughout the study period. Calculated water loss in the residence and AET of ISDS effluent were combined to estimate the percent of pumped water available to recharge the underlying fractured bedrock. At this site, an average of 84.4% of water pumped to the residence was estimated to be available to recharge the underlying aquifer. This is comparable to the potential amount of return flow (87.7%) inferred from the 12.3% consumptive loss of water estimated by the Colorado Division of Water Resources in 1974 (Van Slyke and Simpson, 1974). This loss may not be representative of loss from ISDS sites throughout the foothills. Future study is recommended to characterize the average amount of water lost in and around the ISDS infiltration area throughout the foothills.

Topper, R., 2007, Consumptive Use Estimates for Return Flows from Individual Sewage Disposal Systems: in Colorado Water, v.24, issue 4, pg. 10-11

Article summarizes the historical and current knowledge of the consumptive use of water related to Individual Sewage Disposal Systems in Colorado. Compares the consumptive use value of 12.3% given by the State Engineer in the mid 1970's to more recent studies on the subject of ISDS consumptive use. The conclusion is that recent studies have found similar values (±5%) to that determined by the State Engineers Office. However, few Colorado site-specific studies have been done on the matter of ISDS consumptive use so additional investigations are warranted to better understand the issue.

Miller, L.D., and Ortiz, R.F., 2007, Ground-Water Quality and Potential Effects of Individual Sewage Disposal Effluent on Ground-Water Quality in Park County, Colorado, 2001-2004: U.S. Geological Survey Scientific Investigations Report 2007-5220, 48 p.

In 2000, the U.S. Geological Survey, in cooperation with Park County, Colorado, began a study to evaluate ground-water quality in the various aquifers in Park County that supply water to domestic wells. The focus of this study was to identify and describe the principal natural and human factors that affect ground-water quality. In addition, the potential effects of individual sewage disposal system (ISDS) effluent on ground-water quality were evaluated.

Ground-water samples were collected from domestic water-supply wells from July 2001 through October 2004 in the alluvial, crystalline-rock, sedimentary-rock, and volcanic-rock aquifers to assess general ground-water quality and effects of ISDS's on ground-water quality throughout Park County. Samples were analyzed for physical properties, major ions, nutrients, bacteria, and boron; and selected samples also were analyzed for dissolved organic carbon, human-related (wastewater) compounds, trace elements, radionuclides, and age-dating constituents (tritium and chlorofluorocarbons).

Drinking-water quality is adequate for domestic use throughout Park County with a few exceptions. Only about 3 percent of wells had concentrations of fluoride, nitrate, and (or) uranium that exceeded U.S. Environmental Protection Agency national, primary drinking-water standards. These primary drinking-water standards were exceeded only in wells completed in the crystalline-rock aquifers in eastern Park County. Escherichia coli bacteria were detected in one well near Guffey, and total coliform bacteria were detected in about 11 percent of wells sampled throughout the county. The highest total coliform concentrations were measured southeast of the city of Jefferson and west of Tarryall Reservoir. Secondary drinking-water standards were exceeded more frequently. About 19 percent of wells had concentrations of one or more constituents (pH, chloride, fluoride, sulfate, and dissolved solids) that exceeded secondary drinking-water standards. Radon concentrations in about 91 percent of ground-water samples were greater than or equal to 300 pCi/L, and about 25 percent had radon concentrations greater than or equal to 4,000 pCi/L. Generally, the highest radon concentrations were measured in samples collected from wells completed in the crystalline-rock aquifers.

Analyses of ground-water-quality data indicate that recharge from ISDS effluent has affected some local ground-water systems in Park County. Because roughly 90 percent of domestic water used is assumed to be recharged by ISDS's, detections of human-related (wastewater) compounds in ground water in Park County are not surprising; however, concentrations of constituents associated with ISDS effluent generally are low (concentrations near the laboratory reporting levels).

ISDS density (average subdivision lot size used to estimate ISDS density) was related to ground-water quality in Park County. Chloride and boron concentrations were significantly higher in ground-water samples collected from wells located in areas that had average subdivision lot sizes of less than 1 acre than in areas that had average subdivision lot sizes greater than or equal to 1 acre. No significant increases in constituent concentrations were observed in wells completed in the sedimentary-rock aquifers for any lot-size category, and *too few samples were collected from wells completed in the alluvial aquifers to do statistical tests.*

The year of ISDS installation also was related to ground-water quality in Park County. For example, significantly higher nitrite-plus-nitrate concentrations were measured between wells with ISDS's installed in the 1970's and those installed in the 1980's. Significantly higher nitrite-plus-nitrate concentrations were not measured between wells with ISDS's installed in the 1980's and those installed in the 1990's. However, significantly higher nitrite-plus-nitrate concentrations were measured between wells with ISDS's installed in the 1990's and those installed after 1999. The lowest overall nitrite-plus-nitrate concentrations were measured in wells that had ISDS's installed after 1999, and the highest concentrations were measured in wells with ISDS's installed before 1980. Nitrate concentrations may be less in samples collected from wells with ISDS's installed after 1980 because effluent has not had enough time to move through the unsaturated zone to the ground-water table in sufficient quantities to significantly affect ground-water quality.

2006

Dano, K., Poeter, E., Thyne, G., 2006, Fate of individual sewage disposal system wastewater in mountainous terrain: in Colorado Ground-Water Association Newsletter, Colorado Groundwater Association, March 2006 pg. 1, 4-9

While the fate of individual sewage disposal system (ISDS) effluent is relatively well understood in soils, less is known about its fate in regolith overlying fractured-rock aquifers. Effluent from an ISDS was tracked via geophysical, geochemical, and hydrological methods. Under typical precipitation conditions, the effluent entered the fractured bedrock within 5 meters of the boundary of the constructed infiltration area. Mass balance models of the surface water chemistry near the mouth of the basin require an anthropogenic component very similar to effluent to account for the decline in water quality suggesting a causative relationship.

Wakida, F.T., and Lerner, D.N, 2006, Potential nitrate leaching to groundwater from house building: in Hydrological Processes, 2006, Vol. 20 pg. 2077-2081 http://www3.interscience.wiley.com/journal/112556371/abstract?CRETRY=1&SRETRY=0).

Nitrate pollution has been identified as a major water quality issue in the UK. This study aimed to determine the potential additional loading of nitrate that could arise from the disturbance caused by house construction. The study is centered around the towns of Nottingham and Mansfield, UK, which are situated on a Triassic Sandstone aquifer. Soil samples up to a depth of 2·70 m were taken from seven sites under construction and other land uses. The average nitrogen load was 59 kg ha-1, which is slightly higher than the nitrate leaching observed when temporary grassland is ploughed in temperate climates. The most important factors involved in nitrogen loss from house building are expected to be previous land use, quantity of total nitrogen after topsoil stripping, and seasonal timing of construction.

2005

Gardner, K. K., and Vogel, R. M., 2005. Predicting ground water nitrate concentration from land use. Ground Water, Vol. 43, No. 3, pg. 343 – 352.

Ground water nitrate concentrations on Nantucket Island, Massachusetts, were analyzed to assess the effects of land use on ground water quality. Exploratory data analysis was applied to historic ground water nitrate concentrations to determine spatial and temporal trends. Maximum likelihood Tobit and logistic regression analyses of explanatory variables that characterize land use within a 1000-foot radius of each well were used to develop predictive equations for nitrate concentration at 69 wells. The results demonstrate that historic nitrate concentrations downgradient from agricultural land are significantly higher than nitrate concentrations elsewhere. Tobit regression results demonstrate that the number of septic tanks and the percentages of forest, undeveloped, and high-density residential land within a 1000-foot radius of a well are reliable predictors of nitrate concentration in ground water. Similarly, logistic regression revealed that the percentages of forest, undeveloped, and low-density residential land are good indicators of ground water nitrate concentration >2 mg/L. The methodology and results outlined here provide a useful tool for land managers in communities with shallow water tables overlain with highly permeable materials to evaluate potential effects of development on ground water quality.

Heatwole, K.K., McCray, J., and Lowe, K., 2005, Predicting Nitrogen Transport From Individual Sewage Disposal Systems for a Proposed Development in Adams County, Colorado: Eos Trans. AGU, 86(52), Fall Meet. Suppl., Abstract, January 21, 2010 10

Individual sewage disposal systems (ISDS) have demonstrated the capability to be an effective method of treatment for domestic wastewater. They also are advantageous from a water resources standpoint because there is little water leaving the local hydrologic system. However, if unfavorable settings exist, ISDS can have a detrimental effect on local water-quality. This presentation focuses on assessing the potential impacts of a large housing development to area water quality. The residential development plans to utilize ISDS to accommodate all domestic wastewater generated within the development. The area of interest is located just west of Brighton, Colorado, on the northwestern margin of the Denver Basin. Efforts of this research will focus on impacts of ISDS to local groundwater and surface water systems. The Arapahoe Aquifer, which exists at relatively shallow depths in the area of proposed development, is suspected to be vulnerable to contamination from ISDS. Additionally, the local water quality of the Arapahoe Aquifer was not well known at the start of the study. As a result, nitrate was selected as a focus water quality parameter because it is easily produced through nitrification of septic tank effluent and because of the previous agricultural practices that could be another potential source of nitrate. Several different predictive tools were used to attempt to predict the potential impacts of ISDS to water quality in the Arapahoe Aquifer. The objectives of these tools were to 1) assess the vulnerability of the Arapahoe Aquifer to nitrate contamination, 2) predict the nitrate load to the aquifer, and 3) determine the sensitivity of different parameter inputs and the overall prediction uncertainty. These predictive tools began with very simple mass-loading calculations and progressed to more complex, vadose-zone numerical contaminant transport modeling.

2004

Brendle, D.L., 2004, Potential Effects of Individual Sewage Disposal System Density on Ground-Water Quality in the Fractured-Rock Aquifer in the Vicinity of Bailey, Park County, Colorado, 2001-2002: U.S. Geological Survey Fact Sheet 2004-3009, 5 p.

This fact sheet discusses the relationship between the number of individual sewage disposal systems (ISDS) and the potential to affect groundwater quality in the fast growing community of Bailey in Park County. The report provides a preliminary assessment of water-quality data collected in 2001 from domestic wells completed in the fractured-rock aquifer. Water samples were collected from 57 domestic wells during 2001, once in July and once in September. Samples were analyzed for chemicals and bacteria that might indicate whether ISDS effluent has caused degradation of ground-water quality.

Because the rate of recharge and flow in the vicinity of each well can vary, it is not known whether ISDS effluent can reach the ground water before chemical and biological contaminants are removed from the effluent or reduced in concentration. Samples collected from wells were analyzed for chemicals and bacteria that can originate from an ISDS. Candidate wells were classified into one of the three density categories that represent areas of 1 acre, 3 acres, or 5 acres.

- *Bacteria were present in samples from wells in the low-, medium-, and high-density categories. Detections of bacteria did not appear to be correlated with ISDS density.*
- *Samples from four wells in the low-density and background categories contained organic chemicals that can originate only from an ISDS.*
- *nitrate concentrations tended to be higher in the high- and medium-density categories than in the low-density or background categories. The comparisons also indicate a higher probability of transport of nitrate to the ground water in areas with a higher density of houses and their associated ISDSs. However, in the high-density category only 7 percent (two samples) of the samples had nitrate concentrations greater than the primary drinking-water standard.*
- *chloride concentrations tended to be higher in the high- and medium-density categories than in the low-density or background categories. The comparisons also indicate that there may be a higher probability of transport of chloride to the ground water in areas with higher density of houses and their associated ISDSs. However, in the high-density category only 7 percent (two samples) of the samples had chloride concentrations greater than the USEPA secondary drinking-water standard.*
- *Significant differences as determined by the Wilcoxon rank-sum test for the boron data were found only between the high- and low-density categories for September 2001 data.*
- *Five tritium samples indicate that recharge to the groundwater system occurred after 1954*

Dano, K, Poeter, E., and Thyne, G, 2004, Investigation of the Fate of Individual Sewage Disposal system Effluent in Turkey Creek Basin, Colorado: Colorado Water Resources Research Institute, May 2004 Completion Report No. 200, 150 p.

With rapid development and population growth in the Turkey Creek Basin (TCB) of Jefferson County, Colorado, the degradation of water quality has become a pressing issue. Residents of TCB are served by a fractured, crystalline-rock-aquifer, typical of those in the western US that provide water to residential users through individual domestic wells and treat wastewater with individual sewage disposal systems (ISDSs). Comparison of basin-scale geochemical data from the 1970s and recent geochemical data from TCB reveals that Specific Conductivity (an indicator of water quality) in the surface water has increased by a factor of 3.3 over the past 30 years. Specific Conductivity in the majority of the ground water has increased by a factor of only 1.2 over the same time period. However, Specific Conductivity of ground water in localized areas has increased by a larger factor. This study investigates the role of ISDS effluent in the degradation of the basin's water quality by investigating the flow path and chemical evolution of ISDS effluent after it leaves the infiltration area of one individual sewage treatment system.

Geophysical methods located the ISDS effluent plume of a single home at the regolith-bedrock interface beneath and adjacent to an ISDS infiltration area. Shallow piezometers were installed to measure hydraulic properties and monitor water level and quality. A water budget was calculated for the ISDS system, to estimate the bedrock infiltration rate. The home had a typical household pumpage of 644 L/day (170 gallons/day) of which ~72%, an average of 466L/day (123 gallons/day), was dosed into the infiltration area from the septic tank. The low return rate is unexpected; an ongoing study is evaluating this finding.

Under typical conditions, the effluent infiltrates the fractured bedrock within 5 meters of the infiltration area, rather than migrating laterally through the regolith to the closest surface water, North Turkey Creek, which is 500 m away. During an unusually high spring runoff the plume migrated 50 to 100 m within the regolith before infiltrating the fractured bedrock. The chemical fingerprint of the effluent is similar to the anthropogenic component required to account for the ground water quality decline as indicated by other studies. The chemical fingerprint of the effluent has a chemical signature similar to surface water near the mouth of the basin suggesting that it contributes to the decreased surface water quality.

Ortiz, R.F., 2004, Ground-Water Quality of Alluvial and Sedimentary-Rock Aquifers in the Vicinity of Fairplay and Alma, Park County, Colorado, September-October 2002: U.S. Geological Survey Fact Sheet 2004-3065, 6 p.

This report summarizes the ground-water quality of samples collected in September or October 2002 from domestic wells completed in alluvial and sedimentary-rock aquifers in the vicinity of Fairplay and Alma, Colorado. Additionally, this report provides an initial assessment of the potential effects of ISDSs on ground-water quality in sedimentary-rock aquifers in the vicinity of Fairplay and Alma, Colorado.

Water samples were collected from 53 domestic wells during September and October of 2002; 13 of the wells were completed in alluvial aquifers, and 40 were completed in sedimentary-rock aquifers. Water samples were analyzed for various chemical groups *including major ions, nitrogen species, phosphorus species, selected trace metals, and radiochemical constituents. Additionally, water samples at selected wells were analyzed for an extensive list of organic chemicals that are indicative of contamination from ISDS effluent.*

This report provides a general assessment of ground-water quality and an initial assessment of whether contamination of ground water has occurred. The water quality was similar in samples collected from the alluvial and sedimentary-rock aquifers. Generally, most chemicals associated with ISDS contamination were not detected in the water samples collected during this study. However, quantification of even small concentrations of bacteria and chemicals associated with ISDS effluent can indicate a potential for contamination. Only one sample had detectable concentrations of total coliform bacteria, and none of the 43 ground-water samples analyzed had detectable concentrations of E. coli. Boron was detected in 23 percent of the samples collected from wells completed in the alluvial aquifer and in 27 percent of the samples collected from wells completed in the sedimentary-rock aquifer. Only one of the seven samples analyzed for selected organic chemicals associated with contamination from human activities had detectable concentrations of an organic chemical.

Comparisons using Wilcoxon rank-sum tests did not identify significant differences between ISDS density categories for any constituent with the exception of phosphorus. Significant differences for phosphorus were observed between the high-density category and both the low-density category and the background wells. Overall, the data did not indicate major effects of ISDS on ground-water quality.

Thyne, G., Guler, C., and Poeter, E., 2004. Sequential analysis of hydrochemical data for watershed characterization. Ground Water, Vol. 42 (5), p. 711- 723.

A methodology for characterizing the hydrogeology of watersheds using hydrochemical data that combine statistical, geochemical, and spatial techniques is presented. Surface water and ground water base flow and spring runoff samples (180 total) from a single watershed are first classified using hierarchical cluster analysis. The statistical clusters are analyzed for spatial coherence confirming that the clusters have a geological basis corresponding to topographic flowpaths and showing that the fractured rock aquifer behaves as an equivalent porous medium on the watershed scale. Then principal component analysis (PCA) is used to determine the sources of variation between parameters. PCA analysis shows that the variations within the dataset are related to variations in calcium, magnesium, SO4, and HCO3, which are derived from natural weathering reactions, and pH, NO3, and chlorine, which indicate anthropogenic impact. PHREEQC modeling is used to quantitatively describe the natural hydrochemical evolution for the watershed and aid in discrimination of samples that have an anthropogenic component. Finally, the seasonal changes in the water chemistry of individual sites were analyzed to better characterize the spatial variability of vertical hydraulic conductivity. The integrated result provides a method to characterize the hydrogeology of the watershed that fully utilizes traditional data. The integrated statistical/spatial/geochemical analysis showed that some locations (groups 1 and 2) have water chemistry due to natural water-rock interactions, while other locations (group 3) were impacted by an anthropogenic source or sources. In this case, the source of degradation of water quality is strongly associated with increasing populations that employ ISDS.

2003

Pikes Peak Area Council of Governments, 2003. Water Quality Management Plan 2003 Update, 314 p.

The Pikes Peak Area Council of Governments (PPACG) was designated by the Governor of the State of Colorado and the EPA in 1974 as the regional water quality management planning agency for the Pikes Peak Region (Figure 1-1). This is referred to as Colorado State Management Region IV and is a three-county region containing El Paso, Teller and Park Counties. The Pikes Peak Region is unique because it includes portions of two different drainage Basins – South Platte and Arkansas River Basins. As the designated planning agency, PPACG is required to prepare and update a Regional Water Quality Management Plan to address regional water quality issues under Section 208 of the Federal Clean Water Act. This Plan is commonly referred to as the 208 Plan and, as defined in State and Federal law, it is a planning and not a regulatory document. The 2003 208 Plan update supersedes the 1999 update and reflects the dynamic nature and changing conditions in the region.

The 2003 update of the 208 Plan follows the watershed approach. Five watersheds are in the Pikes Peak Region including the Chico Creek watershed. The 208 Plan provides guidance on water quality goals and objectives, and social, economic, and environmental costs and benefits. The 208 Plan is used to assist local, state, and federal decision makers focus on priority water quality issues and provide local input and guidance to Colorado's overall water quality program.

Because most of the stream segments in the Chico Creek watershed are ephemeral, there are currently no monitoring stations located in the watershed. The USGS in cooperation with Cherokee Metropolitan District collected samples from 36 wells in August 1984 for nitrate analysis. Twenty-eight of those wells were re-sampled in 1996.No significant differences were found for the 28 wells sampled in 1984 and 1996. Results indicate that nitrate concentrations increased in the southern two-thirds of the basin.

Poeter, E., Thyne, G., Vanderbeek, G., and Guler, C., 2003, Ground Water in Turkey Creek Basin of the Rocky Mountain Front Range in Colorado: in Engineering Geology in Colorado-Contributions, Trends, and Case Histories. Denver, Colorado: Association of Engineering Geologists, 26 p.

Evaluation of front-range fractured aquifers is difficult because the expense of characterization is not deemed warranted for development decisions. Data integration in Turkey Creek Basin, a well-studied area, reduces uncertainty and eventually will identify the key data required for characterization. Current analysis of the available data reveals the basin can be represented with an equivalent porous media model to facilitate management decisions at the watershed scale. However, impacts on individual wells cannot be predicted accurately. Water levels are declining and water quality is impacted by anthropogenic activity in Turkey Creek Basin, but the available data only provide an estimate of whether the basin can sustain the current population. Using one approach, annual recharge is estimated to be on the order of an inch per year (25.4mm/yr), with 75% of that volume pumped, but only 7% consumed. However, the estimates are uncertain due to the short period of record and limited spatial distribution. Ground-water chemistry has been impacted by anthropogenic effects that include high nitrate and chloride and lower pH, primarily in areas of high population density.

Trojan, M. D., Maloney, J. S., Stocklinger, J. M., Eid, E. P., and Lahtinen, M. J., 2003. Effects of Land Use on Ground Water Quality in the Anoka Sand Plain Aquifer of Minnesota. Ground Water Vol. 41, No. 4, pg. 482 – 492.

We began a study, in 1996, to compare ground water quality under irrigated and nonirrigated agriculture, sewered and nonsewered residential developments, industrial, and nondeveloped land uses. Twenty-three monitoring wells were completed in the upper meter of an unconfined sand aquifer. Between 1997 and 2000, sampling occurred quarterly for major ions, trace inorganic chemicals, volatile organic compounds (VOCs), herbicides, and herbicide degradates. On single occasions, we collected samples for polynuclear aromatic hydrocarbons (PAHs), perchlorate, and coliform bacteria. We observed significant differences in water chemistry beneath different land uses. Concentrations of several trace inorganic chemicals were greatest under sewered urban areas. VOC detection frequencies were 100% in commercial areas, 52% in sewered residential areas, and <10% for other land uses. Median nitrate concentrations were greatest under irrigated agriculture (15,350 µg/L) and nonsewered residential areas (6080 µg/L). Herbicides and degradates of acetanilide and triazine herbicides were detected in 86% of samples from irrigated agricultural areas, 68% of samples from nonirrigated areas, and <10% of samples from other land uses. Degradates accounted for 96% of the reported herbicide mass. We did not observe seasonal differences in water chemistry, but observed trends in water chemistry when land use changes occurred. Our results show land use is the dominant factor affecting shallow ground water quality. Trend monitoring programs should focus on areas where land use is changing, while resource managers and planners must consider potential impacts of land use changes on ground water quality.

2002

Halepaska and Associates, Inc., 2002, El Paso County Water Report: El Paso County Water Authority, 2002, 125 p.

The El Paso County Water Authority (EPCWA) has prepared this Water Report to assist in evaluating how water demands of the EPCWA members can be met to the year 2020. Current annual water demands in El Paso County (County) are estimated to be approximately 89,600 acre-feet (ac-ft). These values include Colorado Springs Utilities (CSU), which is not a member of EPCWA. The estimated current annual water demand, without CSU, is approximately 19,600 ac-ft. The future water demand for year 2020 is estimated to be 163,300 ac-ft with CSU and approximately 30,000 without CSU. Therefore, this Water Report looks at not only continuing to provide the current water demands of approximately 20,000 ac-ft per year (ac-ft/yr), but also expand that water supply to provide up to 30,000 ac-ft/yr by the year 2020. This report does not address water quality.

Martin, P., Bassinger, S., and Steele, T., 2002, A Case Study: Teller County, Colorado, in Fractured-Rock Aquifers 2002, March 13-15, 2002, Denver, Proceedings, National Groundwater Association, pg. 62-65

Teller County, like many of the counties in the mountainous portions of Colorado where fractured rock aquifers comprise the bulk of the overall water supply, is experiencing the effects on local ground water of older, poorly maintained and designed ISDS. ISDS-derived contamination has been detected in some water supply wells in Teller County and the

potential for much more serious impacts on the drinking water supply is being brought to the forefront by the more recent increase in population growth within parts of the County. In addition, the County also has numerous existing and platted subdivisions wherein the existence of many very small lots concentrated in local areas are raising questions over the ability of lot owners to develop adequate water supply and sewage treatment and the means by which this will be done without further greatly exacerbating the problems of ground-water quality protections and adequacy of supply. All of the foregoing is made more critical due to the relatively limited nature of the underlying fractured crystalline rock aquifers and to the mountainous and general colder alpine nature of the county.

In light of these growing problems, the County authorized a multiphase study to assess the potential magnitude and important parameters of the problem in light of expected levels of growth, to examine three selected subdivisions in detail relative to water supply, water quality and ISDS usage as a function of time and buildout levels, to identify alternatives that might assist the County in developing regulatory guidelines to protect the County water supply, and to identify areas where further data collection and study would be of significant value.

For the subdivision studies, a mass-balance model incorporating past levels of growth and predicted future levels of buildout was constructed and utilized to make gross predictions of estimated nitrate concentration buildup in the underlying ground water with time and assuming that use of conventional ISDS technology continued. In each case, the model runs indicated that ambient nitrate contamination above the maximum permissible limit would be expected to occur throughout the subdivisions within relatively short periods of time, but in every case by the year 2020.

Water rights considerations and increased downstream scrutiny of any activities in the headwaters of the South Platte River and the Arkansas River that could impact water supply and water quality will require increased awareness by Teller County water authorities and will have potentially large future impacts on the methodologies considered as appropriate options for treatment of residential sewage.

Colorado Water Quality Control Commission, 2002. Recommendations of the Individual Sewage Disposal System Steering Committee, February 14, 2002, 30 p.

The ISDS Steering Committee was established in early 2001 by Jane Norton, Executive Director of the Colorado Department of Public Health and Environment. The Steering Committee members represent a wide range of expertise and interests related to onsite wastewater systems. The Steering Committee members agreed that an important first step in their efforts would be to arrive at a consensus regarding the current status quo with respect to the potential water quality impacts of onsite wastewater systems. This effort led to the development of a Summary Characterization of Onsite Wastewater System Impacts, which is set forth in Appendix B and includes:

1. *Water quality impacts are occurring from onsite wastewater systems in a number of specific areas in Colorado. However, the presence and nature of these problems often has not been verified or rigorously documented.*
2. *The overall scope and extent of water quality impacts from onsite wastewater systems in most areas of Colorado is unknown.*

3. There are areas of known nitrate contamination and increased nitrate levels in ground water in areas of high density (lots less than one acre) and a significant number of homes. In some surface water basins, phosphorus loadings from onsite wastewater systems are a potentially significant water quality factor.
4. ISDS systems pose a greater risk when they are present in high numbers and high density, they are present in areas served by private drinking water wells that are shallow or poorly constructed, they are improperly sited, particularly in sensitive environments, they were installed prior to 1973, when uniform design and siting standards were first established, and/or when they are not properly designed, installed, operated and/or maintained.
5. Growth trends in Colorado are likely to result in the installation of substantially greater numbers of onsite wastewater systems in the years to come. In some areas of Colorado, it will continue to be necessary and appropriate to serve homes and/or businesses with onsite wastewater systems, rather than centralized wastewater systems.
6. Properly sited, designed, installed, operated and maintained onsite wastewater systems can function without resulting in adverse water quality impacts.

Based on its assessment of options to address the principal risk factors identified in the Summary Characterization, the Steering Committee developed 13 recommendations.

Wakida, F.T., and Lerner, D.N, 2002, Nitrate leaching from construction sites to groundwater in the Nottingham, UK, urban area, Groundwater Protection & Restoration Group, Department of Civil & Structural Engineering, University of Sheffield, Mappin Street, Sheffield S1 3JD: in Water Science and Technology, 2002, Vol. 45 (9) pg. 243-248 http://cat.inist.fr/?aModele=afficheN&cpsidt=14180567)

Nitrate pollution has been identified as a major water quality issue in the UK. The aim of this project is to research the rate of nitrate leaching to groundwater that arises from construction works. The study area is situated in Nottingham UK, which is situated on the Triassic Sandstone aquifer. Soil samples up to a depth of 2.50 m were taken from three sites under construction and other land use. The results have shown a high variability in the concentrations of soil-nitrate. The reasons for this variability include soil type, past land use, soil treatment and type of vegetation prior to construction works. The average nitrogen load was 65 kg N ha(-1) which is higher than the nitrate leaching observed when temporary grassland is ploughed during autumn. The highest nitrate concentrations were observed in an allotment site (133 kg N ha(-1)) due to the high amount of manure applied at this location. The construction practice of top soil stripping can produce a reduction of nitrate leaching because it removes the part of the soil that contains most of the potentially mineralizable nitrogen.

2000

U.S. Geological Survey, 2000, Quality of Ground Water and Surface Water in an Area of Individual Sewage Disposal System Use Near Barker Reservoir, Nederland, Colorado, August - September 1998: U.S. Geological Survey Open-File Report 00-214, 7 p.

Analyses of ground water north of Barker Reservoir do not indicate widespread contamination, although isolated areas have concentrations of septic indicators such as boron, nitrate, and TOC that are larger than at other areas. The sites that show the greatest concentrations of indicator constituents (for example, S5, W3, W7, and W13) are at *residences that are older than the other residences north of Barker Reservoir in this study, and contaminants may have had more time to reach the ground water. Surface-water site D3 had greater concentrations of nitrate, phosphorus, fecal coliform, and TOC than upgradient site S7.*

South of Barker Reservoir, downgradient surface-water sites (D1, D2, S3, and S4) had greater concentrations of some constituents than upgradient surface-water sites (S1 and S2). The contamination could be from runoff in the area or from wildlife and domestic animals but also could indicate ISDS contamination. Ground-water data are limited south of the reservoir, with only one relatively shallow well to sample (well W1). Concentrations of nitrate, boron, fecal coliform, and TOC at this site were suggestive of possible ISDS effects.

1997 and older

Brendle, 1997, U. S. Geological Survey Fact Sheet FS-072-97, Have Nitrate Concentrations Changed in the Upper Black Squirrel Creek Basin Since 1984?

The alluvial aquifer of the upper Black Squirrel Creek Basin, about 25 miles east of Colorado Springs, supplies most of the water for irrigation and domestic use in the basin and, since 1964, supplies water for export to the Colorado Springs area. Most wells in the basin tap the alluvial aquifer and have high yields, ranging from about 10 gallons per minutes (gal/min) for stock wells to more than 1,000 gal/min for high-capacity irrigation wells. Because of increasing demand for ground water in the basin, the U.S. Geological Survey, in cooperation with the Cherokee Metropolitan District (CMD), collected samples from 36 wells in the upper Black Squirrel Creek alluvial aquifer in August 1984 to determine distribution of concentrations of nitrite plus nitrate as nitrogen (referred to as nitrate). Twenty-eight of the 36 wells sampled in August 1984 were resampled in August 1996 to determine whether nitrate concentrations in the alluvial aquifer changed since 1984. Findings show that the proportion of samples with nitrate concentrations in the 5.1 to 10 mg/L range increased 36-54% from 1984 to 1996. The proportion of samples with concentrations from 1.0 to 5.0 mg/L decreased 43-25% from 1984 to 1996. 57% of the wells sampled had small to no differences in nitrate concentrations, 29% indicated moderate increases, and 14% indicated moderate to large decreases. A statistical test showed that average nitrate concentrations did not change significantly. However, wells in the southern two-thirds of the basin did show a significant increase in nitrate concentrations.

Watts, K.R., 1995, Hydrogeology and simulation of flow between the alluvial and bedrock aquifers in the upper Black Squirrel Creek basin, El Paso County, Colorado: U.S. Geological Survey Water-Resources Investigations Report 94-4238, 82 p.

Anticipated increases in pumping from the bedrock aquifers in El Paso County potentially could affect the direction and rate of flow between the alluvial and bedrock aquifers and lower water levels in the overlying alluvial aquifer. The alluvial aquifer underlies about 90 square miles in the upper Black Squirrel Creek Basin of eastern El Paso County. The alluvial aquifer consists of unconsolidated alluvial deposits that unconformably overlie siltstones, sandstones, and conglomerate (bedrock aquifers) and claystone, shale, and coal (bedrock confining units) of the Denver Basin. The bedrock aquifers (Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers) are separated by confining units (upper and lower Denver and the

Laramie confining units) and overlie a relatively thick and impermeable Pierre confining unit. The Pierre confining unit is assumed to be a no-flow boundary at the base of the alluvial/ bedrock aquifer system.

During 1949-90, substantial water-level declines, as large as 50 feet, in the alluvial aquifer resulted from withdrawals from the alluvial aquifer for irrigation and municipal supplies. Average recharge to the alluvial aquifer from infiltration of precipitation and surface water was an estimated 11.97 cubic feet per second and from the underlying bedrock aquifers was an estimated 0.87 cubic foot per second.

Water-level data from eight bedrock observation wells and eight nearby alluvial wells indicate that, locally, the alluvial and bedrock aquifers probably are hydraulically connected and that the alluvial aquifer in the upper Black Squirrel Creek Basin receives recharge from the Denver and Arapahoe aquifers but-locally recharges the Laramie-Fox Hills aquifer.

Physical and chemical characteristics of water from the bedrock aquifers in the study area generally differ from the physical and chemical characteristics of water from the alluvial aquifer, except for the physical and chemical characteristics of water from one bedrock well, which is completed in the Laramie-Fox Hills aquifer. In the southern part of the study area, physical and chemical characteristics of ground water indicate downward flow of water from the alluvial aquifer to the Laramie-Fox Hills aquifer.

A three-dimensional numerical model was used to evaluate flow of water between the alluvial aquifer and underlying bedrock. Simulation of steady-state conditions indicates that flow from the bedrock aquifers to the alluvial aquifer was about 7 percent of recharge to the alluvial aquifer, about 0.87 cubic foot per second. The potential effects of withdrawal from the alluvial and bedrock aquifers at estimated (October 1989 to September 1990) rates and from the bedrock aquifers at two larger hypothetical rates were simulated for a 50-year projection period. The model simulations indicate that water levels in the alluvial aquifer will decline an average of 8.6 feet after 50 years of pumping at estimated October 1989 to September 1990 rates. Increases in withdrawals from the bedrock aquifers in El Paso County were simulated to: (1) capture flow that currently discharges from the bedrock aquifers to springs and streams in upland areas and to the alluvial aquifer, (2) induce flow downward from the alluvial aquifer, and (3) accelerate the rate of water level decline in the alluvial aquifer.

Eckhardt, D. and Strackleberg, P., 1995. Relation of Ground-Water Quality to Land Use on Long Island, New York. Ground Water, Vol. 33, No. 6, pg. 1019 – 1033.

Water-quality data from 90 monitoring wells screened within 50 feet of the water table in the unconfined upper glacial aquifer beneath five areas of differing land use in Nassau and Suffolk Counties, Long Island, were compared to assess the effects of land use on ground-water quality. The areas, which range from 22 to 44 square miles, represent suburban land sewered more than 22 years at the time of the study (long-term sewered), suburban land sewered less than 8 years (recently sewered), suburban land without a regional sewer system, agricultural land, and undeveloped (forested) land. Comparison of water-quality data from the 90 wells indicated that samples from the undeveloped area had the lowest and smallest range in concentrations of several human-derived constituents, such as nitrate, alkalinity, boron, synthetic solvents, and pesticides. Concentrations of

these constituents in samples from the three suburban areas and the agricultural area generally were intermediate to high and had the widest variation.

Maximum-likelihood logistic regression analysis of explanatory variables that characterize the type of land use and population density within a 1/2-mile radius of each of the 90 wells was used to develop predictive equations for contaminant occurrence in ground water within 50 feet of the water table. Two logistic regression equations for the 90 monitoring wells were compared with equations developed independently from ground-water quality data at more than 240 other wells throughout Nassau and Suffolk Counties to evaluate the predictive value of the land-use variables at the larger two-county scale. The results demonstrate that the population density and amount of agricultural, commercial, and high- and medium-density residential land within specified areas around wells can be reliable predictors of contaminant presence. The strength of the correlations supports the premise that land use affects the quality of water in water-table aquifers overlain by highly permeable material because land use commonly determines the types and amounts of chemicals introduced at land surface. When coupled with GIS technology and accurate, detailed land-use and water-quality information, the methods and results of this study can be useful to local planning boards in evaluation of potential effects of development on ground-water quality. The methods can also be useful to hydrologists in the analysis and design of ground-water-monitoring networks.

Buckles, D.R., and Watts, K.R., 1988, Geohydrology, water quality, and preliminary simulations of ground-water flow of the alluvial aquifer in the upper Black Squirrel Creek basin, El Paso County, Colorado: U.S. Geological Survey Water-Resources Investigations Report 88-4017, 49 p.

The upper Black Squirrel Creek basin in eastern El Paso County, Colorado, is underlain by an alluvial aquifer and four bedrock aquifers. Groundwater pumpage from the alluvial aquifer has increased since the mid-1950's, and water level declines have been substantial; the bedrock aquifers virtually are undeveloped. Groundwater pumpage for domestic, stock, agricultural, and municipal uses have exceeded recharge for the past 25 years. The present extent of the effect of pumpage on the alluvial aquifer was evaluated, and a groundwater flow model was used to simulate the future effect of continued pumpage on the aquifer.

Measured water level declines from 1974 through 1984 were as much as 30 ft in an area north of Ellicott, Colorado. On the basis of the simulations, water level declines from October 1984 to April 1999 north of Ellicott might be as much as 20 to 30 ft and as much as 1 to 10 ft in most of the aquifer. Flow from the bedrock aquifers to the alluvial aquifer may account for a substantial volume of the recharge to the alluvial aquifer.

The groundwater flow models provided a means of evaluating the importance of groundwater evapotranspiration at various stages of aquifer development. Simulated groundwater evapotranspiration was about 43% of the outflow from the aquifer during predevelopment stages but was less than 3% of the outflow from the aquifer during late-development stages.

Analyses of 36 groundwater samples collected during 1984 indicated that concentrations of dissolved nitrite plus nitrate as nitrogen generally were large. Samples from 5 of the 36 wells had concentrations of dissolved nitrite plus nitrate as nitrogen that exceeded drinking water standards. Water from the alluvial aquifer generally is of suitable quality for most uses.

Edelmann and Cain, 1985, Sources of Water and Nitrogen to the Widefield Aquifer, Southwestern El Paso County, Colorado, U. S. Geological Survey Water-Resources Investigations Report 85-4162, 81 p.

The Widefield aquifer near Colorado Springs, Colorado, is recharged primarily by Fountain Creek and, to a lesser extent, by infiltration and percolation of water from the land surface and from groundwater inflow. During the past 20 to 30 years, concentrations of nitrate (as nitrogen) in the Widefield aquifer have increased from 0.5 to 3.0 milligrams/L to nearly 10 milligrams/L, and occasionally exceed the drinking-water standard.

During the summer of 1982, the concentrations of nitrite plus nitrate as nitrogen in water in the aquifer ranged from 3.2 to 15 milligrams/L with a mean concentration of 6.9 milligrams/L. In general, the nitrite-plus-nitrate concentrations are greatest near the north end of the aquifer, probably resulting from effluent from Colorado Springs Sewage Treatment Plant being discharged to Fountain Creek. During 1982, 93% of the total estimated 160 tons of nitrogen available to enter the Widefield aquifer was from the Colorado Springs Sewage Treatment Plant. Nitrogen also enters the aquifer as a result of seepage from Canal No. 4, artificial recharge ponds, and irrigation at the Pinello Ranch.

Livingston, R.K., Klein, J.M., and Bingham, D.L., 1976, Water Resources of El Paso, County, Colorado: Colorado Water Conservation Board, Colorado Water Resources Circular No. 32, 85 p.

El Paso County is an area of 2,157 square miles located along the Front Range in Central Colorado. The purpose of this study is to appraise and describe the surface water, the groundwater, and the water quality in the county. This report was prepared under a cooperative agreement with the city of Colorado Springs, El Paso County board of Commissioners, Pikes Peak Area Council of Governments, and the U.S. Air Force Academy.

Alluvial deposits, widespread throughout El Paso County, are important sources of water supply. The principal alluvial aquifers are in Fountain Creek and Jimmy Camp Creek valleys, which contain an estimated 100,000 acre-feet of water in storage, and in the upper Black Squirrel Creek basin, which contains an estimated 350,000 acre-feet of water in storage. The Widefield aquifer, an alluvial aquifer located in Fountain Creek valley, contains about 8,000 acre-feet of water in storage.

The dissolved solids concentration of water from the alluvium of Fountain and Jimmy Camp valleys generally increases in a downstream direction and ranges from 364 to 3,690 milligrams per liter. The dissolved solids concentration of water from the alluvial aquifer in the upper Black Squirrel Creek basin is generally less than 250 milligrams per liter.

Colorado Division of Water Resources Memorandum, February 13, 1974, Consumptive Use of Water by Homes Utilizing Leach Fields for Sewage Disposal: unpublished.

In February 1974, then State Engineer C.J. Kuiper asked staff to investigate the consumptive use of water by homes using leach fields for sewage disposal. In preparing a plan of augmentation, developers relying on leach fields for effluent disposal were submitting the figure of 10% consumptive use within the system. The State Engineer had accepted this value without knowing whether or not the figure is accurate. Division of Water Resources *staff spent considerable time reviewing the published literature but found no direct studies pertaining to consumptive use of residential septic systems.*

Literature with ancillary information useful to their investigation was obtained. In addition, a number of persons and agencies were contacted to solicit additional information and input. Based on their findings, staff concluded that 80% of the water entering a house was used by toilets and in bathing. Applying estimates for in-house consumption and evaporation, they determined that 8.4% of the water would be consumptively used before entering the septic tank. Staff determined that during the growing season approximately 9.6% of the water was consumed within the leach field. On an annual basis, this amounted to only 3.9%. Thus, on an annual basis, the total consumptive use (in-house + leach field) was estimated at 12.3% (8.4% + 3.9%).

Bingham, D.L., and Klein, J.M., 1973, Water-level declines and ground-water quality, upper Black Squirrel Creek basin, Colorado: Colorado Water Conservation Board Water Resources Circular 23, 21 p.

Ground-water-level declines of 10 feet or more in a 15-square-mile area and declines of 20 to 35 feet over a 5-square mile area have been observed in the alluvial aquifer during 1964-71. The saturated thickness of the aquifer exceeds 40 feet in about 40 square miles of the 350-square-mile basin. Present trends indicate a continued lowering of the water table. Water of a good chemical quality, dissolved-solids concentrations less than 250 milligrams per liter, underlies the central part of the basin. The dissolved-solids concentration increases laterally from the central part of the basin.

McGovern, H.E., and Jenkins, E.D., 1966, Ground water in Black Squirrel Creek valley El Paso County, Colorado: U.S. Geological Survey Hydrologic Investigations Atlas HA-236, 1 sheet.

The purpose of this study is to determine ground-water conditions in the alluvium in 1964 and to point out possible effects of further ground-water development. Three wells were sampled for chemical constituents and to determine aquifer properties. This study concluded that ground water can be pumped for short periods of time at rates exceeding underflow without significantly depleting the aquifer and that the chemical quality of the water is very good. The water is described as mixed cation bicarbonate with TDS less than 250 mg/L; sodium and bicarbonate were observed to increase slightly to the south. The results of increased pumping would have both detrimental and beneficial affects to the aquifer. A general decline in water levels would cause an increase in pumping lifts, reduction in well yields, and the elimination of subirrigation in some areas. Benefits would include a reduction in non-beneficial evapotranspiration, creation of additional storage space for salvage of excess surface runoff, a decrease of underflow out of the valley and utilization of the large quantity of water in storage.

Appendix C

Data Tables
El Paso County Groundwater Quality Study

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Appendix C, Table 1
El Paso County Groundwater Quality Study

Well Number Reference Table (for use with Figure 3.1)

Map Number	Site ID
1	SC01206219CC
2	SC01206230BB
3	SC01206230BBC
4	SC01206230BDB
5	SC01206230CDC
6	SC01206314DDC
7	SC01206322BBB
8	SC01206336ACC
9	SC01306207BCB
10	SC01306209BBB
11	SC01306216AAB
12	SC01306219CDB
13	SC01306221BDD
14	SC01306229DAC
15	SC01306230ACC1
16	SC01306230ACC3
17	SC01306231ACC
18	SC01306231BAA
19	SC01306301A
20	SC01306301CCC
21	SC01306301DCB
22	SC01306306DAA
23	SC01306312ACB
24	SC01306312ACB2
25	SC01306312CDB
26	SC01306314ABB
27	SC01306322ADB
28	SC01306323CCA
29	SC01306324ABB2
30	SC01306334ABB
31	SC01306336CA
32	SC01406204AB
33	SC01406205ACD
34	SC01406205BBB
35	SC01406205CAA
36	SC01406207ACD
37	SC01406208CCB
38	SC01406216CCC
39	SC01406220DBC

Map Number	Site ID
40	SC01406228CCB
41	SC01406229DCB
42	SC01406231BAA
43	SC01406232B
44	SC01406232BBA
45	SC01406303DCC
46	SC01406312DCD
47	SC01406313DAA2
48	SC01406323AA
49	SC01406325AD
50	SC01406336AAB
51	SC01406408AA
52	SC01506205BDD
53	SC01506207DA
54	SC01506218ACB
55	SC01506301AAA
56	SC01506310DCC
57	SC01506312ACA
58	SC01506312CBA
59	SC01506312DCC
60	SC01506313BAA
61	SC01506313BBB
62	SC01506323CDB
63	SC01506324CDD
64	SC01506324D
65	SC01506324DAB
66	SC01506325ABA
67	SC01506325BBA
68	SC01506326BAB
69	SC01506335AAA
70	SC01506335AAB
71	SC01506335DCC1
72	SC01506335DCC2

Please see Appendix A for explanation of Site ID numbering system

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Groundwater Quality Data Summary

Parameter	Number of Data Points	Detections	Minimum	Maximum	Average of Detected Values	US EPA Drinking Water MCL	Values Exceeding MCL or SMCL
WELL AND SAMPLING INFORMATION							
Well Permit No.	22	NA	NA	NA	NA	NA	NA
Local Well Name	34	NA	NA	NA	NA	NA	NA
Depth to Water (ft)	9	9	26.0	180.0	76	NA	NA
Sample Collection Depth	9	9	102.0	186.0	139	NA	NA
PHYSICAL PARAMETERS							
Water Temperature (C)	103	103	9.4	20.0	13.1	NA	NA
pH	120	120	6.3	9.2	7.3	6.5 - 8.5[1]	2[2]
Specific Cond. (mhos/cm)	101	101	270	1430	446	NA	NA
GENERAL CHEMISTRY							
Total Dissolved Solids (mg/L)	77	77	165	842	287	500[1]	6
Alkalinity	43	43	48	197	109	NA	NA
Hardness (ppm)	50	50	7	510	111	NA	NA
Turbidity (NTU)	15	13	0	3.56	1.1	NA	NA
Sodium Adsorption Ratio	42	42	0.63	19.00	3.2	NA	NA
Langlier Index	3	1	NA	0.44	0.4	NA	NA
Calcium Carbonate	2	2	62	65	64	NA	NA
Carbonate	23	1	DLNQ	10.0	10.0	NA	NA
Bicarbonate	44	44	58	289	128	NA	NA
Chloride	74	74	3.5	76	13.7	250[1]	0
Nitrate (as N)	148	141	<0.05	72	6.8	10	9
Sulfate	53	53	17	250	57	250[1]	1
Phosphate	63	50	DLNQ	2.0	0.1	NA	NA
Bromide	9	8	<0.1	0.2	0.1	NA	NA
Calcium	53	53	16	170.0	39.0	NA	NA
Magnesium	52	48	<5.2	54	5.6	NA	NA
Sodium	55	55	18	140	46.2	NA	NA
Potassium	51	49	<1	27	2.7	NA	NA
Silicate (as SiO_2)	30	30	16	33	27.3	NA	NA
METALS							
Antimony	3	0	NA	NA	NA	0.006	NA
Iron	43	35	<0.03	2.8	0.178	0.3[1]	3
Cadmium	22	2	DLNQ	0.0037	0.002	0.005	0
Chromium	24	8	DLNQ	0.014	0.25	0.1	0
Lead	21	2	DLNQ	0.00087	0.0007	0.015	0
Mercury	17	2	DLNQ	0.0050	0.003	0.002	0
Seleniuum	18	12	DLNQ	0.0180	0.007	0.05	0
Silver	15	5	DLNQ	0.0012	0.0009	0.1[1]	0
Manganese	38	9	DLNQ	0.024	0.007	0.05[1]	0
Barium	19	13	DLNQ	0.36	0.066	2	0
Arsenic	18	2	DLNQ	0.01	0.006	0.01	1
Beryllium	4	0	NA	NA	NA	0.004	NA
Cobalt	1	0	NA	NA	NA	NA	NA
Copper	7	0	NA	NA	NA	1[1]	NA
Vanadium	1	0	NA	NA	NA	NA	NA
Zinc	7	4	<0.02	0.0152	0.0102	1[1]	0
Thallium	4	0	NA	NA	NA	0.002	NA

Parameter	Number of Data Points	Detections	Minimum	Maximum	Average of Detected Values	US EPA Drinking Water MCL	Values Exceeding MCL or SMCL
Endrin	21	0	NA	NA	NA	0.002	NA
Lindane	20	0	NA	NA	NA	0.0002	NA
Methoxychlor	20	0	NA	NA	NA	0.04	NA
Toxaphane	14	0	NA	NA	NA	0.003	NA
2, 4-D[3]	20	0	NA	NA	NA	0.07	NA
Fenoprop (2, 4-5 TP)	14	0	NA	NA	NA	0.05	NA
RADIOACTIVITY							
Gross Alpha	13	13	0.3	3.6	1.5	15[4]	0
Gross Beta	13	13	1.1	6.0	2.8	50[4]	0
ORGANIC CONSTITUENTS							
Benzene	3	0	NA	NA	NA	0.005	NA
Ethylbenzene	3	0	NA	NA	NA	0.7	NA
Total Xylenes	3	0	NA	NA	NA	10	NA
Toluene	3	0	NA	NA	NA	1	NA
Tetrachloroethene	3	0	NA	NA	NA	0.005	NA
Trichloroethene	3	0	NA	NA	NA	0.005	NA
cis-1,2-Dichloroethene	3	0	NA	NA	NA	0.07	NA
Vinyl Chloride	3	0	NA	NA	NA	0.002	NA
1,1,1-Trichloroethane	3	0	NA	NA	NA	0.2	NA
Carbon Tetrachloride	3	0	NA	NA	NA	NA	NA
Napthalene	2	0	NA	NA	NA	0.005	NA

NOTES:

MCL - US EPA Drinking Water Maximum Contaminant Level
SMCL - US EPA Drinking Water Secondary Maximum Contaminant Level
All non-radioactivity concentration data in mg/L, Radioactivity in pCi/L
NA - Not applicable for parameter
DLNQ - Detection Limit not quantified in source data

1. Constituent has no MCL, Secondary Drinking Water Standard provided
2. Two pH values were outside SMCL range of 6.5 - 8.5
3. 2,4-Dichlorophenoxyacetic acid
4. US EPA 2001

Appendix C, Table 3
El Paso County Groundwater Quality Study

Well Information and Physical Parameters

Site ID	Sample Date	Well Permit No.	Local Name	Temperature (C)	pH	Specific Conductance (mhos/cm)
SC01206219CC	3/1/2006	27554-RFP	Guthrie Alluvial Well #2		6.95	
SC01206230BB	3/1/2006	612-RFP	Guthrie Alluvial Well #1		7.44	
SC01206230BBC	11/7/2006		PP-D-027	11.5	7.70	484
SC01206230BDB	8/9/1984			14.5	6.80	370
SC01206230BDB	8/21/1996					
SC01206230CDC	8/8/1984			18.0	6.60	375
SC01206230CDC	8/21/1996					
SC01206314DDC	8/9/1984			11.0	7.00	1430
SC01206322BBB	8/9/1984			13.0	6.90	400
SC01206322BBB	8/21/1996					
SC01206336ACC	8/8/1984			11.5	6.30	400
SC01206336ACC	8/21/1996					
SC01306207BCB	1/20/1986	29089-F	CMD-06		7.10	
SC01306209BBB	8/10/1984			13.0	7.20	1380
SC01306209BBB	8/22/1996					
SC01306216AAB	8/10/1984			13.5	7.50	630
SC01306219CDB	9/10/1980	24680-F	CMD-05		7.30	
SC01306219CDB	8/7/1984			13.5	7.70	390
SC01306219CDB	8/22/1996					
SC01306221BDD	8/10/1984			13.5	9.20	350
SC01306229DAC	11/30/2006		PP-D-039	9.4	8.10	948
SC01306230ACC1	8/8/1984		CMD-I	13.0	7.30	358
SC01306230ACC1	1/21/1994		CMD-I	11.0	7.10	391
SC01306230ACC1	2/8/1985		CMD-I	12.0	7.10	410
SC01306230ACC1	2/11/1988		CMD-I	11.0	7.30	417
SC01306230ACC1	2/13/1991		CMD-I	12.0	7.30	412
SC01306230ACC1	2/19/1993		CMD-I	11.0	7.20	402
SC01306230ACC1	2/20/1998		CMD-I	11.5	7.30	394
SC01306230ACC1	2/21/1992		CMD-I	12.0	7.20	404
SC01306230ACC1	2/23/1987		CMD-I	12.5		400
SC01306230ACC1	2/24/1989		CMD-I	13.0	7.30	370
SC01306230ACC1	2/26/1997		CMD-I	12.0	7.30	399
SC01306230ACC1	2/27/1990		CMD-I	11.5	7.40	416
SC01306230ACC1	2/29/1996		CMD-I	12.0	7.20	407
SC01306230ACC1	8/22/1996		CMD-I			
SC01306230ACC1	3/17/1995		CMD-I	12.5	7.20	404

Site ID	Sample Date	Well Permit No.	Local Name	Temperature (C)	pH	Specific Conductance (mhos/cm)
SC01306230ACC1	5/9/1991		CMD-I	12.5	7.20	402
SC01306230ACC1	5/13/1985		CMD-I	12.0	7.50	410
SC01306230ACC1	5/13/1988		CMD-I	12.5	7.30	410
SC01306230ACC1	5/15/1990		CMD-I	12.5	7.40	412
SC01306230ACC1	5/15/1992		CMD-I	12.5	7.10	400
SC01306230ACC1	5/16/1989		CMD-I		7.30	379
SC01306230ACC1	5/21/1993		CMD-I	12.0	7.20	399
SC01306230ACC1	5/29/1986		CMD-I	13.0	7.70	390
SC01306230ACC1	6/12/1987		CMD-I	13.0	6.70	400
SC01306230ACC1	8/7/1984		CMD-I	12.5	7.20	425
SC01306230ACC1	8/7/1986		CMD-I	13.0	7.30	358
SC01306230ACC1	8/16/1985		CMD-I	12.5		375
SC01306230ACC1	8/16/1991		CMD-I	12.5	7.20	402
SC01306230ACC1	8/18/1988		CMD-I	12.5	7.20	404
SC01306230ACC1	8/21/1992		CMD-I	13.0	7.20	393
SC01306230ACC1	8/22/1989		CMD-I	11.5	7.20	418
SC01306230ACC1	8/23/1990		CMD-I	13.0	7.60	410
SC01306230ACC1	8/27/1987		CMD-I	12.0	7.20	412
SC01306230ACC1	8/27/1993		CMD-I	12.0	7.20	400
SC01306230ACC1	8/28/1998		CMD-I	15.0	7.20	396
SC01306230ACC1	9/8/1994		CMD-I	13.6	7.20	396
SC01306230ACC1	9/9/1997		CMD-I	12.0	7.20	400
SC01306230ACC1	9/25/1996		CMD-I	13.0	7.10	401
SC01306230ACC1	9/28/1995		CMD-I	12.0		395
SC01306230ACC1	11/10/1993		CMD-I	12.0	7.30	396
SC01306230ACC1	11/13/1990		CMD-I	12.5	7.40	408
SC01306230ACC1	11/13/1992		CMD-I	10.5	7.20	403
SC01306230ACC1	11/20/1986		CMD-I	12.0	7.20	411
SC01306230ACC1	11/20/1987		CMD-I	12.0	7.10	413
SC01306230ACC1	11/21/1989		CMD-I	11.5	7.30	405
SC01306230ACC1	11/22/1991		CMD-I	11.5	7.20	409
SC01306230ACC1	11/23/1988		CMD-I	13.0	7.20	395
SC01306230ACC1	11/29/1985		CMD-I	12.0		280
SC01306230ACC3	9/8/1980	24976-F	CMD-04		7.30	
SC01306231ACC	8/7/1984			13.5	7.20	385
SC01306231ACC	8/22/1996					
SC01306231BAA	9/8/1971			12.5	7.20	324
SC01306301A	1/1/1954		A	11.7	7.40	311
SC01306301CCC	8/16/1984			15.0	6.60	270
SC01306301CCC	8/19/1996					

Well Information and Physical Parameters

Site ID	Sample Date	Well Permit No.	Local Name	Temperature (C)	pH	Specific Conductance (mhos/cm)
SC01306301DCB	1/1/1987		CMD-08		7.10	
SC01306306DAA	8/9/1984			11.0	7.80	520
SC01306306DAA	8/21/1996					
SC01306312ACB	9/27/2006		PP-D-014	13.1	7.70	392
SC01306312ACB2	1/1/1986	29088-F	CMD-07		7.40	
SC01306312CDB	8/9/1984			12.5	7.50	320
SC01306312CDB	8/19/1996					
SC01306314ABB	8/13/1984			11.5	8.10	451
SC01306314ABB	8/21/1996					
SC01306322ADB	8/10/1984			13.0	7.70	555
SC01306322ADB	8/21/1996					
SC01306323CCA	9/27/2006		PP-D-013	13.5	7.50	749
SC01306324ABB2	11/28/2006		CMD-18	20.0	7.00	
SC01306334ABB	8/10/1984			13.5	7.30	410
SC01306334ABB	8/21/1996					
SC01306336CA	5/7/2008	277307	SLB-2A		6.60	
SC01406204AB	5/7/2008	277314	SLB-3		6.90	
SC01406205ACD	8/16/1984			14.5	6.70	385
SC01406205BBB	8/7/1984			13.0	6.70	380
SC01406205BBB	8/22/1996					
SC01406205CAA	8/7/1984			13.5	6.70	410
SC01406205CAA	8/22/1996					
SC01406207ACD	11/30/2006		PP-D-040	9.8	8.40	496
SC01406208CCB	8/10/1984			14.5	7.00	290
SC01406208CCB	8/19/1996					
SC01406216CCC	8/10/1984			13.0	7.50	870
SC01406220DBC	8/12/1986			13.0	7.30	535
SC01406220DBC	9/8/1971			12.5	7.10	488
SC01406220DBC	8/10/1984			17.5	7.30	825
SC01406228CCB	9/8/1971			11.5	7.60	935
SC01406229DCB	12/1/1955			12.1		440
SC01406231BAA	8/7/1984			14.5	6.80	310
SC01406232B	1/1/1955		B	12.2	7.50	335
SC01406232BBA	8/7/1984			15.5	6.60	330
SC01406303DCC	8/9/1984			16.0	8.20	305
SC01406303DCC	8/19/1996					
SC01406312DCD	9/8/1971			18.5	7.20	297
SC01406312DCD	8/10/1984			16.0	7.40	295
SC01406312DCD	8/21/1996					
SC01406313DAA2	8/10/1984			13.5	7.10	290

Well Information and Physical Parameters

Site ID	Sample Date	Well Permit No.	Local Name	Temperature (C)	pH	Specific Conductance (mhos/cm)
SC01406313DAA2	8/19/1996					
SC01406323AA	5/7/2008	277315	SLB-4		6.80	
SC01406325AD	5/8/2008	277316	SLB-5		6.60	
SC01406336AAB	8/7/1984			14.5	7.10	338
SC01406336AAB	8/20/1996					
SC01406408AA	11/5/2009	033357-M	MWG-15	13.3	6.92	545
SC01506205BDD	12/1/2006		PP-D-042	12.9	8.30	594
SC01506207DA	5/8/2008	277318	SLB06		6.70	
SC01506218ACB	8/8/1984			13.5	7.10	525
SC01506218ACB	8/20/1996					
SC01506301AAA	8/7/1984			15.0	7.10	310
SC01506310DCC	8/7/1984			14.5	7.20	280
SC01506310DCC	8/20/1996					
SC01506312ACA	11/1/1987	14145-FP	CMD-09		7.60	
SC01506312CBA	11/1/1987	14146-FP	CMD-10		7.60	
SC01506312DCC	8/7/1984			16.5	6.90	305
SC01506313BAA	1/1/1992	11198-FP	CMD-12		7.55	
SC01506313BAA	9/8/1971			14.0	7.40	286
SC01506313BBB	11/1/1987	6821-FP	CMD-11		7.60	
SC01506323CDB	4/12/2001	52429-F	CMD-14	15.5	6.99	
SC01506323CDB	7/27/1999	52429-F	CMD-14		7.60	
SC01506324CDD	9/8/1971			13.5	7.20	384
SC01506324D	1/1/1955		C	12.8	7.50	343
SC01506324DAB	7/24/1984			14.0	7.90	554
SC01506325ABA	9/8/1971			15.0	7.40	1150
SC01506325BBA	7/24/1984			14.0	8.40	325
SC01506325BBA	8/20/1996					
SC01506326BAB	8/8/1984			14.5	6.90	375
SC01506326BAB	8/20/1996					
SC01506335AAA	5/30/2000	54070-F	CMD-15		7.35	
SC01506335AAB	8/7/2000	54069-F	CMD-16		7.47	
SC01506335DCC1	9/25/2000	63094-F	CMD-17		7.67	
SC01506335DCC1	6/9/2005	63094-F	CMD-17	20.0	7.57	
SC01506335DCC2	9/27/2006		PP-D-015	14.9	7.30	414

								Anions								Cations					SiO2)
Site ID	Sample Date	Total Dissolved Solids (mg/L)	Alkalinity	Hardness (ppm)	Turbidity (NTU)	Sodium Adsorption Ratio	Langlier Index	Calcium Carbonate	Carbonate	Bicarbonate	Chloride	Nitrate (as N)	Sulfate	Phosphate	Flouride	Bromide	Calcium	Magnesium	Sodium	Potassium	Silicate (as SiO_2)
SC01206219CC	3/1/2006	228	71	87	0.47	1.92			DLNQ	71.2	8.7	6.2	41	2.00	DLNQ		29.00	3.50	29.00	2.50	
SC01206230BB	3/1/2006	243	76	84	1.20	1.74			DLNQ	76.1	10.3	6.4	45	0.29	DLNQ		35.00	4.20	29.00	2.50	
SC01206230BBC	11/7/2006	260	82	103					<0.1	99.5	13.4	6.7	47				33.98	4.55	25.56	2.80	
SC01206230BDB	8/9/1984	244										**11.0**									
SC01206230BDB	8/21/1996											8.3									
SC01206230CDC	8/8/1984	237										**11.0**									
SC01206230CDC	8/21/1996											0.7									
SC01206314DDC	8/9/1984	**650**		510		1.64				307.0	76.0	**72.0**	110	0.02	0.50		170.00	21.00	85.00	4.20	31.00
SC01206322BBB	8/9/1984	316										1.7									
SC01206322BBB	8/21/1996											2.8									
SC01206336ACC	8/8/1984	262	79	104		1.66				96.0	10.0	6.3	65	0.07	0.40		35.00	4.10	39.00	2.40	28.00
SC01206336ACC	8/21/1996											6.8									
SC01306207BCB	1/20/1986	210	85	98	0				<0.1	100.0	7.7	2.4	84	<0.1	0.40	0.20	39.00	<1	39.00	1.30	16.00
SC01306209BBB	8/10/1984	**842**										**33.0**									
SC01306209BBB	8/22/1996											**25.0**									
SC01306216AAB	8/10/1984	401										3.6									
SC01306219CDB	9/10/1980			88		1.37			<0.1	83.0	14.0	2.4	45	<0.1	1.00		16.00	12.00	21.00	<1	28.00
SC01306219CDB	8/7/1984	261	101	95		1.97				123.0	8.9	6.5	50	0.04	0.40		32.00	3.60	44.00	2.40	30.00
SC01306219CDB	8/22/1996											**6.3**									
SC01306221BDD	8/10/1984	210										0.2									
SC01306229DAC	11/30/2006	454	165	134					<0.1	201.0	18.9	**11.5**	105				44.68	5.37	76.27	0.91	
SC01306230ACC1	8/7/1984	272	96	113		1.59				117.0	12.0	6.0	62	0.05	0.40		38.00	4.50	39.00	2.30	30.00
SC01306230ACC1	8/8/1984	328	97								12.0	<6.8	60				35.00	<4.4	40.00	2.40	
SC01306230ACC1	2/8/1985										11.0	6.1									
SC01306230ACC1	5/13/1985										11.0	5.9									
SC01306230ACC1	8/16/1985										11.0	6.5									
SC01306230ACC1	11/29/1985										10.0	6.7									
SC01306230ACC1	5/29/1986										12.0	6.9									
SC01306230ACC1	8/7/1986	328	97	8		19.00					12.0	<6.8	60								30.00
SC01306230ACC1	11/20/1986										11.0	6.3									
SC01306230ACC1	2/23/1987										14.0	6.8									
SC01306230ACC1	6/12/1987										13.0	6.9									
SC01306230ACC1	8/27/1987										11.0	6.6									
SC01306230ACC1	11/20/1987										13.0										
SC01306230ACC1	2/11/1988										13.0	9.8									
SC01306230ACC1	5/13/1988										12.0	7.0									
SC01306230ACC1	8/18/1988										11.0	7.2									
SC01306230ACC1	11/23/1988										11.0	7.6									
SC01306230ACC1	2/24/1989										9.9	5.8									
SC01306230ACC1	5/16/1989										11.0	7.2									
SC01306230ACC1	8/22/1989										11.0	6.8									
SC01306230ACC1	11/21/1989										10.0	7.0									

Site ID	Sample Date	Total Dissolved Solids (mg/L)	Alkalinity	Hardness (ppm)	Turbidity (NTU)	Sodium Adsorption Ratio	Langlier Index	Anions								Cations					SiO2)
								Calcium Carbonate	Carbonate	Bicarbonate	Chloride	Nitrate (as N)	Sulfate	Phosphate	Flouride	Bromide	Calcium	Magnesium	Sodium	Potassium	Silicate (as SiO_2)
SC01306230ACC1	2/27/1990										10.0	8.0									
SC01306230ACC1	5/15/1990										9.9	7.6									
SC01306230ACC1	8/23/1990										10.0	7.7									
SC01306230ACC1	11/13/1990											7.0		0.03							
SC01306230ACC1	2/13/1991											7.6		0.04							
SC01306230ACC1	5/9/1991											7.8		0.04							
SC01306230ACC1	8/16/1991											7.3		0.04							
SC01306230ACC1	11/22/1991											6.6		0.04							
SC01306230ACC1	2/21/1992											7.4		0.04							
SC01306230ACC1	5/15/1992											8.0		0.05							
SC01306230ACC1	8/21/1992											8.3		0.04							
SC01306230ACC1	11/13/1992											7.4		0.04							
SC01306230ACC1	2/19/1993											7.3		0.04							
SC01306230ACC1	5/21/1993											7.9		0.05							
SC01306230ACC1	8/27/1993											8.3		0.04							
SC01306230ACC1	11/10/1993											7.7		0.04							
SC01306230ACC1	1/21/1994											8.2		0.04							
SC01306230ACC1	9/8/1994											8.2		0.04							
SC01306230ACC1	3/17/1995											8.2		0.03							
SC01306230ACC1	9/28/1995											8.5		0.04							
SC01306230ACC1	2/29/1996											8.1		0.04							
SC01306230ACC1	8/22/1996											8.6									
SC01306230ACC1	9/25/1996											8.3		0.04							
SC01306230ACC1	2/26/1997											8.7		0.04							
SC01306230ACC1	9/9/1997											7.9		0.02							
SC01306230ACC1	2/20/1998											8.2		0.04							
SC01306230ACC1	8/28/1998											8.2		0.04							
SC01306230ACC3	9/8/1980			112		0.63			<0.1	127.0	8.4	2.5	37	<0.1	0.30		36.00	54.00	18.00	<1	30.00
SC01306231ACC	8/7/1984	251	95	93		1.85				116.0	9.7	6.0	51	0.05	0.40		31.00	3.70	41.00	2.00	29.00
SC01306231ACC	8/22/1996											8.4									
SC01306231BAA	9/8/1971	233		72		2.90				108.0	7.6	6.5	43	0.09	0.30		24.00	2.90	40.00	2.00	31.00
SC01306301A	1/1/1954	225		80		2.40				91.0	11.0	5.0	51				27.00	3.20	35.00	2.20	
SC01306301CCC	8/16/1984	171										6.5									
SC01306301CCC	8/19/1996											7.8									
SC01306301DCB	1/1/1987	265	80	88	0.4				<0.3	96.0	13.0	9.5	80	0.10	0.40	0.10	36.00	<1	42.00	1.20	27.00
SC01306306DAA	8/9/1984	321										<0.1									
SC01306306DAA	8/21/1996											<0.05									
SC01306312ACB	9/27/2006	223	48	72					<0.1	58.2	13.2	8.8	31				23.01	3.46	30.69	0.75	
SC01306312ACB2	1/1/1986	165	105	56	0.7	3.23			<0.1	125.0	3.5	1.0	29	<0.1	0.60	0.10	16.00	3.70	39.00	1.30	17.00
SC01306312CDB	8/9/1984	195										2.8									
SC01306312CDB	8/19/1996											3.1									
SC01306314ABB	8/13/1984	257										1.7									

Site ID	Sample Date	Total Dissolved Solids (mg/L)	Alkalinity	Hardness (ppm)	Turbidity (NTU)	Sodium Adsorption Ratio	Langlier Index	Anions								Cations					SiO2)
								Calcium Carbonate	Carbonate	Bicarbonate	Chloride	Nitrate (as N)	Sulfate	Phosphate	Flouride	Bromide	Calcium	Magnesium	Sodium	Potassium	Silicate (as SiO_2)
SC01306314ABB	8/21/1996											0.3									
SC01306322ADB	8/10/1984	353										2.9									
SC01306322ADB	8/21/1996											2.5									
SC01306323CCA	9/27/2006	438	149	153					<0.1	182.0	27.5	4.4	79				50.14	6.83	62.11	0.85	
SC01306324ABB2	11/28/2006	278	86				<0.75					8.3					38.00		39.00		
SC01306334ABB	8/10/1984	267	107	103		1.97				130.0	6.1	**11.0**	33	0.04	0.40		36.00	3.30	46.00	1.90	27.00
SC01306334ABB	8/21/1996											**11.0**									
SC01306336CA	5/7/2008	268	157	65		5.22					20.5	1.7	23	0.08			22.60	1.96	68.10	1.24	
SC01406204AB	5/7/2008	443	193	138		5.30					51.9	3.0	86	<0.065			47.20	4.83	101.00	1.19	
SC01406205ACD	8/16/1984	233										6.0									
SC01406205BBB	8/7/1984	255	89	99		1.75				109.0	10.0	6.5	53	0.05	0.40		33.00	3.90	40.00	2.10	30.00
SC01406205BBB	8/22/1996											5.9									
SC01406205CAA	8/7/1984	266	82	106		1.73				100.0	14.0	7.0	58	0.05	0.40		36.00	4.00	41.00	2.30	30.00
SC01406205CAA	8/22/1996											7.1									
SC01406207ACD	11/30/2006	243	107	104					<0.1	130.0	7.4	7.1	39				35.13	4.09	24.66	1.70	
SC01406208CCB	8/10/1984	193										4.8									
SC01406208CCB	8/19/1996											7.4									
SC01406216CCC	8/10/1984	**546**	197	212		2.99				240.0	48.0	8.1	140	0.04	0.70		73.00	7.20	100.00	2.80	20.00
SC01406220DBC	9/8/1971	329		130		2.44				145.0	16.0	8.7	73	0.15			45.00	5.50	46.00	2.60	31.00
SC01406220DBC	8/10/1984	**548**										8.4									
SC01406220DBC	8/12/1986	284	125	7		17.00					24.0	<10	72		0.30		47.00	<5.2	50.00	2.60	27.00
SC01406228CCB	9/8/1971	**596**		260		3.83				289.0	48.0	4.3	160	0.40	0.30		87.00	9.80	100.00		26.00
SC01406231BAA	8/7/1984	206	90	74		1.83				110.0	6.8	5.1	27	0.08	0.50		25.00	2.70	36.00	1.90	
SC01406232B	1/1/1955	239		90		2.34				103.0	12.0	5.4	51				30.00	3.60	36.00	2.50	30.00
SC01406232BBA	8/7/1984	220										4.1									
SC01406303DCC	8/9/1984	179										0.7									
SC01406303DCC	8/19/1996											5.0									
SC01406312DCD	9/8/1971	217		84		1.74				110.0	6.5	6.8	32	0.06	0.30		29.00	2.90	26.00	3.00	33.00
SC01406312DCD	8/10/1984	200										4.2									
SC01406312DCD	8/21/1996											4.4									
SC01406313DAA2	8/10/1984	196										4.4									
SC01406313DAA2	8/19/1996											5.3									
SC01406323AA	5/7/2008	262	110	91		2.79					16.8	5.3	35	<0.065			31.80	2.85	43.30	2.17	
SC01406325AD	5/8/2008	234	109	91		2.22					12.5	4.9	28	<0.065			31.70	2.91	34.50	2.34	
SC01406336AAB	8/7/1984	222										4.4									
SC01406336AAB	8/20/1996											5.8									
SC01406408AA	11/5/2009		190	170	3.56	2.36			10.00	190.0	19.0	<0.5	54				59.00	5.40	50.00	5.00	
SC01506205BDD	12/1/2006	312	119	78					<0.1	145.0	13.2	7.9	44				27.24	2.35	54.48	1.23	
SC01506207DA	5/8/2008	320	146	115		3.31					19.5	4.5	56	0.08			39.70	3.81	57.70	1.65	
SC01506218ACB	8/8/1984	326	176	129		2.56				215.0	13.0	4.4	61	0.15	1.00		44.00	4.70	67.00	2.40	22.00
SC01506218ACB	8/20/1996											5.8									
SC01506301AAA	8/7/1984	204										5.1									

								Anions								Cations					SiO2)
Site ID	Sample Date	Total Dissolved Solids (mg/L)	Alkalinity	Hardness (ppm)	Turbidity (NTU)	Sodium Adsorption Ratio	Langlier Index	Calcium Carbonate	Carbonate	Bicarbonate	Chloride	Nitrate (as N)	Sulfate	Phosphate	Flouride	Bromide	Calcium	Magnesium	Sodium	Potassium	Silicate (as SiO_2)
SC01506310DCC	8/7/1984	200	104	86		1.50				127.0	7.0	5.5	17	0.06	0.40		30.00	2.80	32.00	1.90	22.00
SC01506310DCC	8/20/1996											5.6									
SC01506312ACA	11/1/1987	185	96	100	2.00	1.50			<0.1	115.0	9.8	4.2	32	0.04	0.47	0.20	34.00	2.80	24.00	2.40	27.00
SC01506312CBA	11/1/1987	225	100	96	0	1.52			<0.1	120.0	10.0	5.3	45	0.03	0.42	<0.1	46.00	3.40	28.00	27.00	24.00
SC01506312DCC	8/7/1984	199										3.5									
SC01506313BAA	9/8/1971	198		70		2.28				128.0	5.9	3.7	20	0.18	0.40		24.00	2.50	31.00	2.30	32.00
SC01506313BAA	1/1/1992	210	93	83	1.46	2.26			DLNQ	93.0	7.5	4.2	24	DLNQ	0.40	0.02	29.00	2.54	33.40	1.90	17.40
SC01506313BBB	11/1/1987	260	105	115	0.90	2.09			<0.01	130.0	9.1	<0.5	32	0.05	0.40	0.20	39.00	3.60	36.00	2.70	27.00
SC01506323CDB	7/27/1999	257	86		0.16				DLNQ	85.7	12.3	6.0	57	DLNQ	0.45		29.00	3.10	46.00	2.20	
SC01506323CDB	4/12/2001	250	90				<1.29	65.00				6.6			0.54				43.00		
SC01506324CDD	9/8/1971	262		94		2.60				134.0	13.0	4.1	53	0.25	0.40		32.00	3.50	41.00	1.60	33.00
SC01506324D	1/1/1955	241		75		3.26				124.0	11.0	2.9	51				26.00	3.40	47.00	1.70	
SC01506324DAB	7/24/1984	349										4.3									
SC01506325ABA	9/8/1971	**767**		290		5.09				281.0	46.0	**11.0**	**250**	0.09	0.70		95.00	12.00	140.00	3.00	33.00
SC01506325BBA	7/24/1984	223										4.6									
SC01506325BBA	8/20/1996											5.6									
SC01506326BAB	8/8/1984	235										5.5									
SC01506326BAB	8/20/1996											5.8									
SC01506335AAA	5/30/2000	232	83	95	0.37	3.03			DLNQ	83.2	8.4	4.8	44	DLNQ	0.46	0.04	32.00	3.70	48.00	2.60	
SC01506335AAB	8/7/2000	209	95	71	1.20	2.48			DLNQ	95.4	5.8	3.7	28	DLNQ	0.65	0.02	24.00	2.70	34.00	2.10	
SC01506335DCC1	9/25/2000	197	99		0.34				DLNQ	99.3	5.6	3.5	25	DLNQ	0.48		24.00	2.90	39.00	2.20	
SC01506335DCC1	6/9/2005	204	97				0.44	62.00				3.6			0.49				32.00		
SC01506335DCC2	9/27/2006	244	77	97					-0.10	94.3	13.5	3.6	44				31.54	4.37	28.28	1.02	

NOTES:
All concentration data in mg/L
NA - Not applicable for parameter
DLNQ - Detection Limit not quantified in source data
Bold text indicated MCL / SMCL exceedence

Appendix C, Table 5
El Paso County Groundwater Quality Study

Dissolved Metals Data

Site ID	Sample Date	Antimony	Iron	Cadmium	Chromium	Lead	Mercury	Seleniuum	Silver	Manganese	Barium	Aresnic	Beryllium	Cobalt	Copper	Vanadium	Zinc	Thallium
SC01206219CC	3/1/2006		**2.80**	DLNQ	DLNQ	DLNQ	DLNQ	0.0074	DLNQ	0.024	0.088	DLNQ						
SC01206230BB	3/1/2006		**0.48**	DLNQ	DLNQ	DLNQ	DLNQ	0.0074	DLNQ	0.016	0.110	DLNQ						
SC01206230BBC	11/07/06		<0.01	<0.005	<0.01	<0.005				<0.01	0.019				<0.01		0.01	
SC01206314DDC	8/9/1984		0.045							0.003								
SC01206336ACC	8/8/1984		0.006															
SC01306207BCB	1/20/1986		0.060		<0.005	<0.005	<0.005	0.006	0.0009			<0.01						
SC01306219CDB	9/10/1980		**1.0**															
SC01306219CDB	8/7/1984		0.008							0.002								
SC01306229DAC	11/30/06		<0.01	<0.005	<0.01	<0.005				<0.01	0.010				<0.01		<0.01	
SC01306230ACC1	8/7/1984		0.030							0.001								
SC01306230ACC1	8/7/1986		0.004							<1								
SC01306230ACC3	9/8/1980		0.030															
SC01306231ACC	8/7/1984		0.014							<0.001								
SC01306231BAA	9/8/1971		0.005							DLNQ								
SC01306301DCB	1/1/1987		0.060		0.005	<0.005	0.005	0.018	0.0008	<0.05		**0.01**						
SC01306312ACB	09/27/06		<0.01	<0.005	<0.01	<0.005				<0.01	<0.01				<0.01		<0.01	
SC01306312ACB2	1/1/1986		0.260	0.0037	<0.005	<0.005	<0.0005	0.003	0.0005			<0.01						
SC01306323CCA	09/27/06		<0.01	<0.005	<0.01	<0.005				<0.01	0.022				<0.01		0.01	
SC01306324ABB2	11/28/2006	<0.0004		<0.0005	0.0016		<0.0001	0.006			0.120	<0.0014	<0.0003					<0.0003
SC01306334ABB	8/10/1984		0.004							<0.001								
SC01406205BBB	8/7/1984		0.010							<0.001								
SC01406205CAA	8/7/1984		0.010							0.003								
SC01406207ACD	11/30/06		<0.01	<0.005	<0.01	<0.005				<0.01	0.011				<0.01		0.0152	
SC01406216CCC	8/10/1984		0.016							<0.001								
SC01406220DBC	9/8/1971		0.005							DLNQ								
SC01406220DBC	8/12/1986		0.005							<0.001								
SC01406228CCB	9/8/1971		0.005							DLNQ								
SC01406231BAA	8/7/1984		0.014							0.002								
SC01406312DCD	9/8/1971		0.020							DLNQ								
SC01406408AA	11/5/2009			<0.005	<0.01	<0.005		<0.005	<0.025		<0.2	<0.01	<0.005	<0.05	<0.025	<0.05	<0.02	<0.002
SC01506205BDD	12/01/06		<0.01	<0.005	<0.01	<0.005				<0.01	<0.01				<0.01		0.0057	
SC01506218ACB	8/8/1984		0.019							<0.001								
SC01506301AAA	8/7/1984																	
SC01506310DCC	8/7/1984		0.022							0.003								
SC01506312ACA	Nov-87		0.120	<0.01	<0.01	<0.01	<0.0005	<0.01	<0.001	<0.01		<0.01						
SC01506312CBA	Nov-87		<0.03	<0.01	<0.01	<0.01	<0.0005	<0.01	<0.001	0.01		<0.01						
SC01506313BAA	9/8/1971		0.005							DLNQ								
SC01506313BAA	1/1/1992		0.068	DLNQ	DLNQ	DLNQ	0.0009	DLNQ	DLNQ	DLNQ	0.016	DLNQ						
SC01506313BBB	Nov-87		0.080	<0.01	<0.01	<0.01	<0.005	<0.01	0.0010	<0.01		<0.01						
SC01506323CDB	7/27/1999		0.260	0.0002	0.0140	0.0009	DLNQ	0.010	0.0012	DLNQ	DLNQ	0.0014						
SC01506323CDB	4/12/2001	<0.005		<0.0001	0.0020		<0.0001	0.006			0.021	<0.001	<0.001					<0.001
SC01506324CDD	9/8/1971		0.020							DLNQ								
SC01506325ABA	9/8/1971		0.020							DLNQ								
SC01506335AAA	5/30/2000		0.250	DLNQ	0.0033	0.0006	DLNQ	0.0059	DLNQ	DLNQ	0.040	DLNQ						
SC01506335AAB	8/7/2000		0.210	DLNQ	0.0032	DLNQ	DLNQ	0.0071	DLNQ	DLNQ	0.021	DLNQ						
SC01506335DCC1	9/25/2000		0.270	DLNQ	0.0061	DLNQ	DLNQ	0.0051	DLNQ	DLNQ	0.360	DLNQ						
SC01506335DCC1	6/9/2005	<0.002		<0.0005	<0.006		<0.0001	0.0061			0.024	<0.002	<0.001					<0.001
SC01506335DCC2	09/27/06		<0.01	<0.005	<0.01	<0.005				<0.01	<0.01				<0.01		<0.01	

NOTES:
Bold text indicated MCL / SMCL exceedence
All concentration data in mg/L
DLNQ - Detection Limit not quantified in source data

Appendix C, Table 6
El Paso County Groundwater Quality Study

Pesticides / Herbicides and Radionuclide Data

Site ID	Sample Date	Pesticides and Herbicides						Radioactivity	
		Endrin	Lindane	Methoxychlor	Toxaphene	2, 4-D	2, 4-5 TP	Gross Alpha	Gross Beta
SC01206219CC	3/1/2006	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	1.40	2.10
SC01206230BB	3/1/2006	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	2.80	2.20
SC01206230BBC	11/7/2006	<0.00014	<0.000069	<0.000004		<0.000084			
SC01306207BCB	1/20/1986	<0.0001	<0.001	<0.001	<0.002	<0.01	<0.005		
SC01306229DAC	11/30/2006	<0.00014	<0.000069	<0.000004		<0.000084			
SC01306301DCB	1/1/1987	<0.0001	<0.001	<0.001	<0.002	<0.01	<0.005		
SC01306312ACB	9/27/2006	<0.00016	<0.000075	<0.000004		<0.000041			
SC01306312ACB2	1/1/1986	<0.0001	<0.001	<0.001	<0.002	<0.01	<0.005		
SC01306323CCA	9/27/2006	<0.00016	<0.000075	<0.000004		<0.000041			
SC01306324ABB2	11/28/2006	<0.00001	<0.00001	<0.00005	<0.0005	<0.0001	<0.0002	1.00	2.70
SC01306334ABB	8/21/1996	DLNQ							
SC01406207ACD	11/30/2006	<0.00014	<0.000069	<0.000004		<0.000084			
SC01506205BDD	12/1/2006	<0.00014	<0.000069	<0.000004		<0.000084			
SC01506312ACA	11/1/1987	<0.0001	<0.001	<0.001	<0.002	<0.01	<0.005	1.50	6.00
SC01506312CBA	11/1/1987	<0.0001	<0.001	<0.001	<0.002	<0.01	<0.005	2.10	1.10
SC01506313BAA	1/1/1992	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	3.60	3.40
SC01506313BBB	11/1/1987	<0.0001	<0.001	<0.001	<0.002	<0.01	<0.005		
SC01506323CDB	7/27/1999							2.50	2.70
SC01506323CDB	4/12/2001							1.38	3.59
SC01506335AAA	5/30/2000	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	0.40	2.20
SC01506335AAB	8/7/2000	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	DLNQ	0.90	2.90
SC01506335DCC1	9/25/2000							0.30	2.60
SC01506335DCC1	6/9/2005	<0.00001	<0.00002	<0.0001	<0.001	<0.0001	<0.0002	0.50	1.50
SC01506335DCC2	9/27/2006	<0.00016	<0.000075	<0.000004		<0.000041			

NOTES:

All Pesticide and Herbicide concentration data in mg/L; Radioactivity data in pCi/L

DLNQ - Detection limit not quantified in source data

2,4,5-TP - 2 (2,4,5-Trichlorophenoxy) propionic acid

2, 4-D - 2,4-Dichlorophenoxyacetic Acid

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Appendix C, Table 7
El Paso County Groundwater Quality Study

Organic Compound Data

Site ID	Sample Date	Benzene	Ethylbenzene	Total Xylenes	Toluene	Napthalene
SC01306324ABB2	11/28/2006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
SC01406408AA	11/5/2009	<0.0016	<0.0012	<0.0056	<0.002	
SC01506335DCC1	6/9/2005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Site ID	Sample Date	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	Vinyl chloride	1,1,1-Trichloroethane	Carbon Tetrachloride
SC01306324ABB2	11/28/2006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
SC01406408AA	11/5/2009	<0.0012	<0.0016	<0.0016	<0.002	<0.0012	<0.0016
SC01506335DCC1	6/9/2005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

NOTE:
All concentration data in mg/L

EXHIBIT W: LAND USE PUBLIC PARCELS MAPS

LEGEND

METRO DISTRICT BOUNDARY

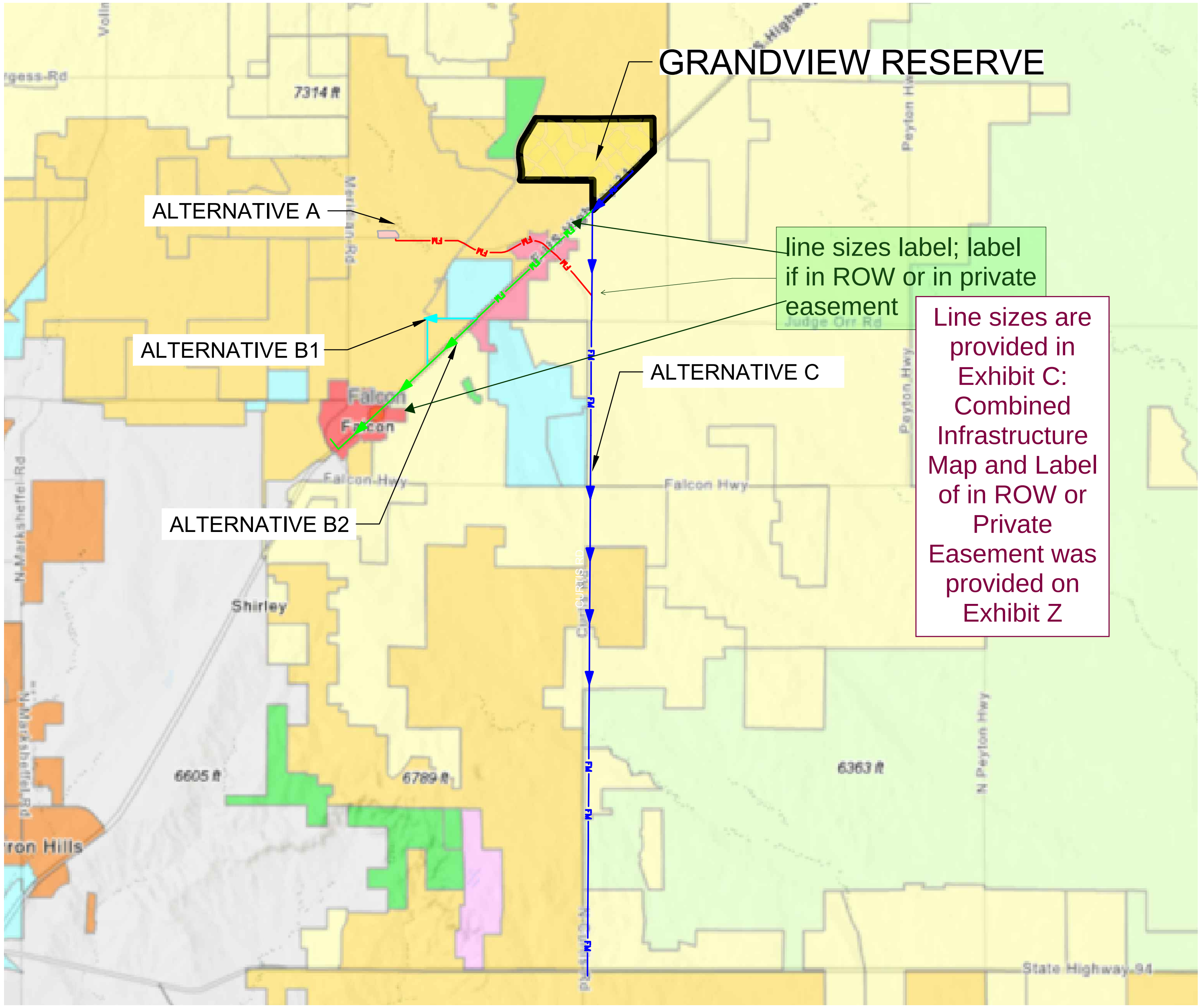
PROPOSED GRAVITY LINES

PROPOSED DUAL FORCE MAINS

FM FM FM

El Paso County Master Plan Land Uses

- Rural
- Large-Lot Residential
- Suburban Residential
- Urban Residential
- Rural Center
- Regional Center
- Employment Center
- Regional Open Space
- Military
- Utility
- Incorporated Area
- Unincorporated Towns



HRGreen.com

HRGreen

GRANDVIEW RESERVE
METROPOLITAN DISTRICT
LAND USES

SHEET
5

SCALE:1" = 10000'
DATE: 9/26/2022

HR GREEN Xrefs: xgt-1-AV01; EPC_Parcels

LEGEND

METRO DISTRICT BOUNDARY

PROPOSED GRAVITY LINE

PROPOSED DUAL FORCEMAINS

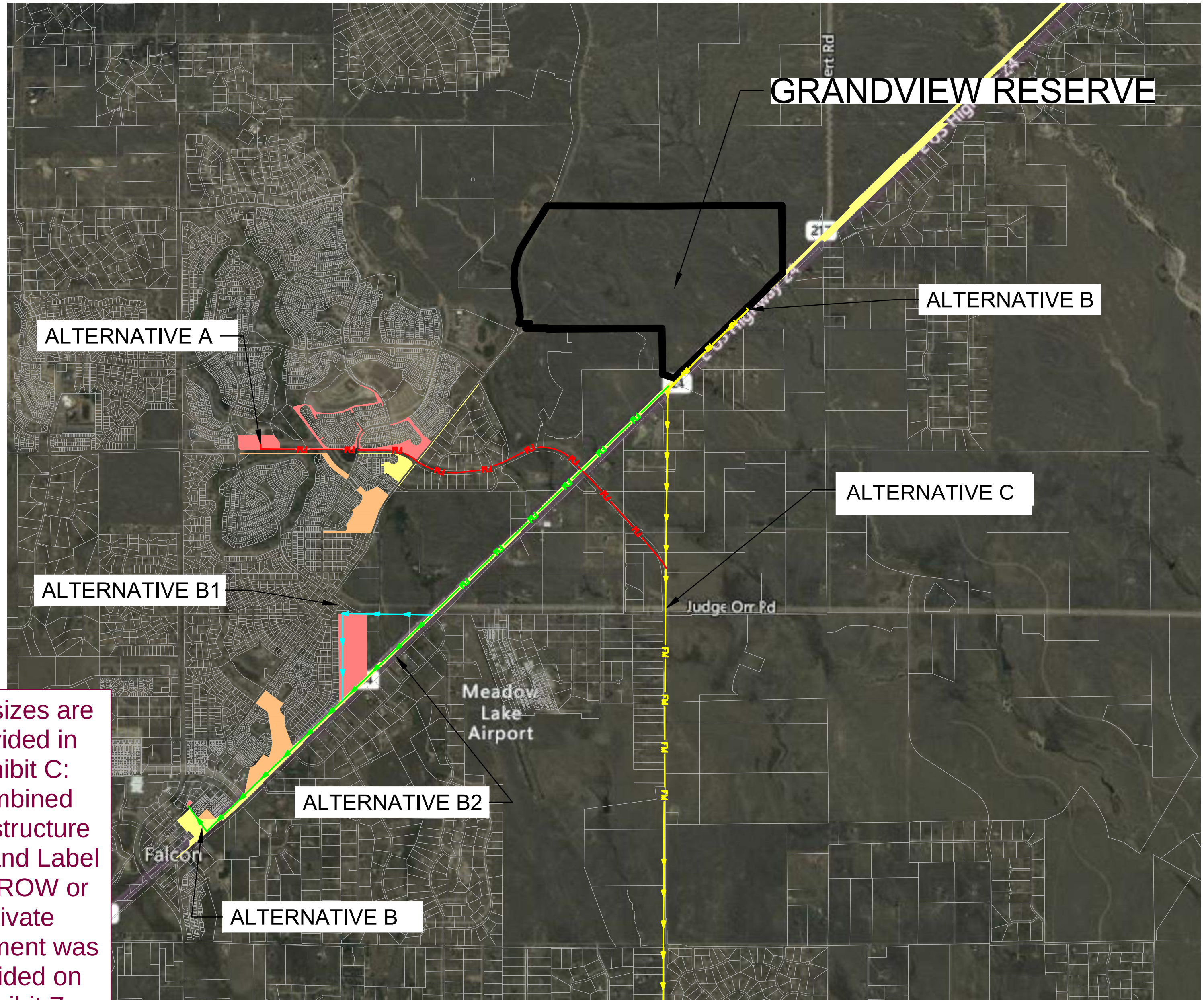
FM FM FM

PUBLICLY OWNED PARCELS:

EL PASO COUNTY

MERIDIAN SERVICE METROPOLITAN DISTRICT

WOODMEN HILLS METROPOLITAN DISTRICT



Line sizes are provided in Exhibit C: Combined Infrastructure Map and Label of in ROW or Private Easement was provided on Exhibit Z

line sizes label; label if in ROW or in private easement

HRGreen

HRGreen.com

GRANDVIEW RESERVE METROPOLITAN DISTRICT

PUBLIC PARCELS

SHEET

2

SCALE: 1" = 5000'

DATE: 2/20/2023

HR GREEN Xrefs: xgt-1-AV01; EPC_Parcels

LEGEND

METRO DISTRICT BOUNDARY

PROPOSED GRAVITY LINE

PROPOSED DUAL FORCEMAINS

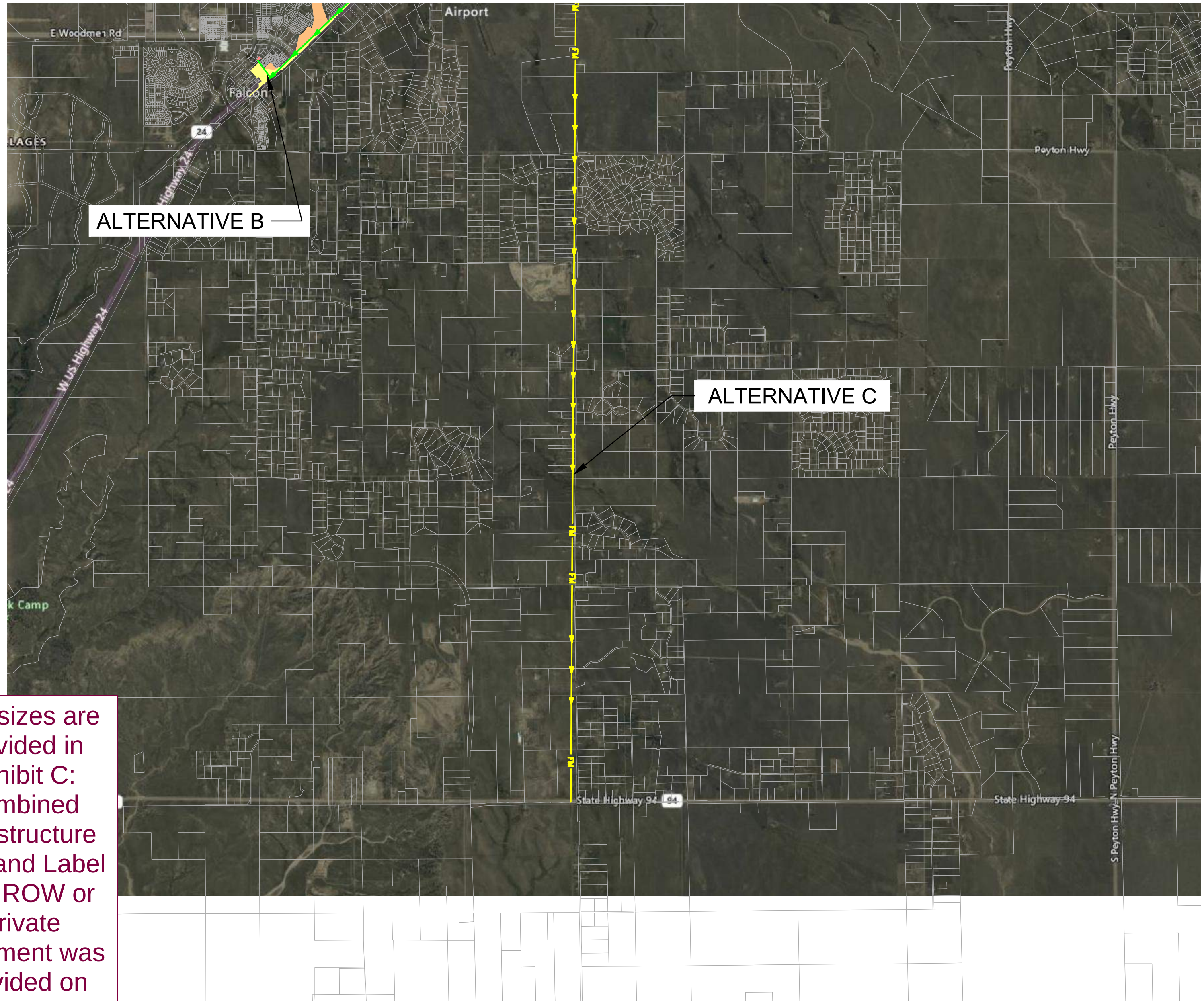
FM FM FM

PUBLICLY OWNED PARCELS:

EL PASO COUNTY

MERIDIAN SERVICE METROPOLITAN DISTRICT

WOODMEN HILLS METROPOLITAN DISTRICT



Line sizes are provided in Exhibit C: Combined Infrastructure Map and Label of in ROW or Private Easement was provided on Exhibit Z

line sizes label; label if in ROW or in private easement

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GRANDVIEW RESERVE METROPOLITAN DISTRICT

PUBLIC PARCELS

SHEET

3

SCALE: 1" = 7500'

DATE: 2/20/2023

HR GREEN Xrefs: xgt-1-AV01; EPC_Parcels

EXHIBIT X: TRAFFIC IMPACT ANALYSIS

LSC TRANSPORTATION CONSULTANTS, INC.
2504 East Pikes Peak Avenue, Suite 304
Colorado Springs, CO 80909
(719) 633-2868
FAX (719) 633-5430
E-mail: lsc@lsctrans.com
Website: http://www.lsctrans.com

April 17, 2020

Mr. Paul Howard &
Mr. Peter Martz
4 Site Investments LLC
1271 Kelly Johnson Boulevard, Suite 100
Colorado Springs, CO 80920

RE: Grandview Reserve
El Paso County, Colorado
Master Traffic Impact Analysis
LSC #184840

Dear Peter:

In response to your request, LSC Transportation Consultants, Inc. has prepared this master traffic impact analysis for the Grandview Reserve Sketch Plan in El Paso County, Colorado. As shown in Figure 1, the 768-acre site is located west of the intersection of US Highway 24 and Elbert Road in El Paso County, Colorado.

REPORT CONTENTS

This report is being prepared as part of a submittal to El Paso County. It identifies the traffic impacts of the Grandview Reserve residential development. The report contains the following:

- The traffic count data and street conditions
- Short-term and 2040 baseline/background traffic volume estimates
- The projected average weekday and peak-hour vehicle-trips to be generated by the site
- The assignment of the site's projected traffic volumes to the key area streets and intersections for the short and long term and the resulting total traffic volumes for the short and long term
- The resulting traffic impacts including level of service analysis at key intersections
- Findings and recommendations

PREVIOUS TRAFFIC REPORTS COMPLETED IN THE AREA

A list of other traffic studies in the area of study completed within the past five years (that LSC is aware of) is attached for reference. This study accounts for the land use, trip generation and the roadway network included in these studies.

LAND USE AND ACCESS

Site Plan

Figure 2 shows the proposed Grandview Reserve sketch plan. The site is planned to be developed with up to 3,261 residential dwelling units, 17 acres of commercial uses, an elementary school, and a church. Two full-movement access points are proposed to Eastonville Road and seven full-movement access points are proposed to an extension of Rex Road through the site. Figure 2 shows the proposed spacing of the access points. The sketch plan also shows a future street connection to planned Phase 3 of the Waterbury development.

The site access points to Rex Road and Eastonville Road will need to meet County standards for intersection and stopping sight distance.

ROADWAY AND TRAFFIC CONDITIONS

Area Roadways

The major roadways in the site's vicinity are shown on Figure 1 and are described below. Copies of the 2016 El Paso County Major Transportation Corridors Plan (MTCP) 2040 Roadway Plan and 2016 MTCP 2060 Corridor Preservation Plan with the site location identified on them have been attached to this report.

- **US Highway 24 (US Hwy 24)** is generally a two-lane State Highway extending east/west across Colorado connecting the Buena Vista, Colorado Springs, and Limon areas. US Hwy 24 is planned to be widened to four lanes through the Falcon area. The US Hwy 24 PEL identifies this widening as a high priority with a timeline of less than 10 years. US Hwy 24 in the vicinity is classified as an EX – Expressway/Major Bypass by the Colorado Department of Transportation (CDOT). US Hwy 24 is shown as a four-lane Principal Arterial on the *MTCP* and the *Preserved Corridor Network Plan*. The posted speed limit on US Hwy 24 adjacent to the site is 65 miles per hour (mph).
- **Eastonville Road** extends northeast from Meridian Road to past Hodgen Road. It is shown as a two-lane Minor Arterial on the El Paso County *Major Transportation Corridors Plan* and the *Preserved Corridor Network Plan*. Eastonville Road has a three-lane cross-section (one through lane in each direction plus a center two-way, left-turn lane) from Woodmen Hills Drive to Snaffle Bit Road (approximately midway between Judge Orr Road and Stapleton Road). Eastonville Road is a two-lane roadway north and south of this section. PPRTA-funded improvements are anticipated in the future at the intersection of Eastonville Road and Stapleton Drive that would likely add northbound and southbound left-turn lanes. The posted speed limit north of Stapleton Drive is 35 mph.
- **Rex Road** extends east from Goodson Road to Pyramid Peak Drive within the Meridian Ranch development. Rex Road will be extended east through Meridian Ranch and the currently

proposed Grandview Reserve sketch plan area to US Hwy 24 as discussed in the Rex Road Corridor section below.

- **Stapleton Drive** is shown as an Urban four-lane Principal Arterial on the El Paso County *Major Transportation Corridors Plan* and El Paso County *Corridor Preservation Plan (CPP)*. Stapleton Drive extends east from Towner Drive to US Hwy 24. Stapleton continues southeast, then south as Curtis Road. It is planned to be ultimately extended west to connect with the Briargate Parkway extension. Stapleton Drive currently is a half-section of a four-lane Principal Arterial street (one through lane in each direction) between Meridian Road and US Hwy 24. The posted speed limit between Eastonville Road and US Hwy 24 is 45 mph.

Existing Traffic Volumes

Figure 3 shows the existing traffic volumes at key intersections in the vicinity of the site. These volumes are based on manual intersection turning movement counts conducted by LSC in May 2017, November 2018, and December 2018. The count data sheets are attached for reference. Figure 3 also shows the Colorado Department of Transportation Average Annual Daily Traffic volumes (AADT) on US Hwy 24 in the vicinity of the site and an estimate of the average weekday traffic volumes on key street segments, based on the peak-hour counts.

Existing Levels of Service

Level of service (LOS) is a quantitative measure of the level of delay at an intersection. Level of service is indicated on a scale from "A" to "F." LOS A represents control delay of less than 10 seconds for unsignalized and signalized intersections. LOS F represents control delay of more than 50 seconds for unsignalized intersections and more than 80 seconds for signalized intersections. Table 1 shows the level of service delay ranges.

Table 1: Intersection Levels of Service Delay Ranges

	Signalized Intersections	Unsignalized Intersections
Level of Service	Average Control Delay (seconds per vehicle)	Average Control Delay (seconds per vehicle)[1]
A	10.0 sec or less	10.0 sec or less
B	10.1-20.0 sec	10.1-15.0 sec
C	20.1-35.0 sec	15.1-25.0 sec
D	35.1-55.0 sec	25.1-35.0 sec
E	55.1-80.0 sec	35.1-50.0 sec
F	80.1 sec or more	50.1 sec or more
(1) For unsignalized intersections if V/C ratio is greater than 1.0 the level of service is LOS F regardless of the projected average control delay per vehicle.		

Figure 3 presents the results of the existing intersection level of service analysis. The intersections of US Hwy 24/Stapleton, Eastonville/Stapleton, and Londonderry/Eastonville were analyzed based on the unsignalized method of analysis procedures from the *Highway Capacity Manual, 6th Edition* by the Transportation Research Board. The level of service reports are attached.

The southbound left-turn, northbound left-turn, and through movements at the two-way, stop sign-controlled intersection of Stapleton/US Hwy 24 are currently operating at LOS F during the afternoon peak hour.

The eastbound approach at the two-way stop sign-controlled intersection of Stapleton/Eastonville is currently operating at LOS F during the morning peak hour. All other movements are currently operating at a LOS D or better during the peak hours.

The eastbound left-turn movement at the two-way, stop sign-controlled intersection of Eastonville/Londonderry is currently operating at a LOS D during the morning peak hour.

The El Paso County 2060 *Corridor Preservation Plan* (CPP) shows Rex Road extending east from Eastonville Road along the north boundary of the site and terminating at Elbert Road just north of US Hwy 24. However, the Colorado Department of Transportation US Hwy 24 *Planning and Environmental Linkages Study Final Corridor Conditions Report (PEL)* dated December 2016 labels the future roadway intersecting US Hwy 24 at mile post 324.72 (about one mile southwest of Elbert Road) as "Rex Road." As shown in Figure 2 Rex Road is planned to be constructed southeast through the currently proposed Grandview Reserve sketch plan area and will intersect US Hwy 24 at approximately the location shown on the PEL.

SHORT-TERM (YEAR 2023) BACKGROUND TRAFFIC

Background traffic is the traffic estimated to be on the adjacent roadways and at adjacent intersections without the proposed development's trip generation of site-generated traffic volumes. Background traffic includes the through traffic and the traffic generated by nearby developments, but assumes zero traffic generated by the site. Figure 4 shows the projected background traffic volumes for the short term (2023).

These background traffic volumes have been based on the existing traffic volumes (from Figure 4) plus increases in traffic due to regional growth including buildout of existing and currently proposed subdivisions within the Waterbury development located northeast of the intersection of Eastonville/Stapleton, Meridian Ranch Filings 1-3 and Filings 6-8, Estates Filings 2-3, Meridian Ranch Filing 11, Stonebridge Filings 1, 2, and 3, Meridian Ranch Filing 9, the Vistas at Meridian Ranch Filing 1, WindingWalk at Meridian Ranch Filing 1, The Enclave at Stonebridge at Meridian Ranch, the Estates at Rolling Hills Ranch Filing No. 1, and the Rolling Hills Ranch at Meridian Ranch PUD. The short-term background traffic volumes assume Rex Road has been extended from its existing terminus to the Rolling Hills Ranch at Meridian Ranch PUD access but **not** further east to Eastonville Road. The background traffic scenarios also hypothetically assume Rex Road has been constructed from Eastonville Road through the site to US Hwy 24, but the background traffic scenarios include only the non-site traffic.

2040 BACKGROUND TRAFFIC

Figure 5 shows the projected 20-year background traffic volumes for the year 2040. The 2040 background/baseline traffic volumes are based on the *Colorado Department of Transportation US Hwy 24 Planning and Environmental Linkages Study Final Corridor Conditions Report* dated December 2016 and on previous work completed by LSC in the area, including work done for the Meridian Ranch and Waterbury developments. The background traffic scenarios hypothetically assume Rex Road through the site, but the background traffic scenarios include only the non-site traffic. The 2040 background traffic volumes do not include traffic from Grandview Reserve.

TRIP GENERATION

The site-generated vehicle-trips were estimated using the nationally published trip generation rates from *Trip Generation, 10th Edition, 2017* by the Institute of Transportation Engineers (ITE). Table 2 shows the trip generation estimates.

The total number of vehicle-trips generated by the land uses has been reduced to account for the internal vehicle-trips made within the site between land uses, without use of the external streets surrounding the site. Table 2 shows the number of internal trips assumed for each land use. The internal trip reduction for the commercial parcels is an estimate by LSC, based on National Highway Cooperative Highway Research Program (NCHRP) Report 684 Enhancing Internal Trip Capture Estimation for Mixed-Use Developments. The results of the spreadsheet model are attached. An additional 50 percent of the school trips were also assumed to be internal to the site.

The total number of vehicle-trips generated has also been reduced to take into account the "pass-by" phenomena. A pass-by trip is made by a motorist who would already be on the adjacent roadways regardless of the proposed development, but who stops in at the site while passing by. The motorist would then continue on his or her way to a final destination in the original direction. The pass-by percentages shown on Table 2 are from the Trip Generation Handbook - An ITE Proposed Recommended Practice, 3rd Edition, 2017 by ITE.

Phase 1 is planned to include buildout of up to 1,585 residential dwelling units in Parcels I, J K, and L. Following Phase 1, Grandview Reserve is expected to generate about 13,212 vehicle-trips on the average weekday, with about half entering and half exiting the site during a 24-hour period. During the morning peak hour, which generally occurs for one hour between 6:30 and 8:30 a.m., about 283 vehicles would enter and 848 vehicles would exit the site. During the afternoon peak hour, which generally occurs for one hour between 4:15 and 6:15 p.m., about 908 vehicles would enter and 533 vehicles would exit the site.

At buildout, Grandview Reserve is expected to generate about c new external vehicle-trips on the average weekday, with about half entering and half exiting the site during a 24-hour period. During the morning peak hour, about 797 vehicles would enter and 1,933 vehicles would exit the site. During the afternoon peak hour, about 2,176 vehicles would enter and 1,409 vehicles would exit the site.

DIRECTIONAL DISTRIBUTION AND ASSIGNMENT

The directional distribution of the site-generated traffic volumes on the area roadways is an important factor in determining the site's traffic impacts. Figure 7 shows the directional distribution estimates for the site-generated traffic volumes. The estimates have been based on the following factors: the recent traffic count data; the Pikes Peak Area Council of Governments' 2040 traffic projections, the site's location with respect to the nearby employment, commercial and activity centers, and the balance of the Falcon and Colorado Springs metropolitan areas; the site's proposed land use; the site's proposed access points; and the phasing of the existing and future roadway system serving the site.

When the distribution percentages (from Figure 7) were applied to the trip generation estimates (from Table 2), the site-generated traffic volumes on the area roadways were determined. Figure 7 shows the site-generated traffic volumes following Phase 1. Figure 8 shows the site-generated traffic volumes at buildout of Grandview Reserve.

TOTAL TRAFFIC

Figure 9 shows the projected short-term total traffic volumes. The short-term total traffic volumes are the sum of the short-term background traffic volumes (from Figure 4) plus the Phase 1 site-generated traffic volumes (from Figure 7).

Figure 10 shows the projected 2040 total traffic volumes. The 2040 total traffic volumes are the sum of the 2040 background traffic volumes (from Figure 5) plus the buildout site-generated traffic volumes (from Figure 8).

PROJECTED LEVELS OF SERVICE

The key area intersections and site access points have been analyzed to determine the projected future levels of service based on the unsignalized method of analysis procedures from the *Highway Capacity Manual, 6th Edition* by the Transportation Research Board and Synchro signalized intersection procedures. Table 3 shows the level of service analysis results based on the projected short-term traffic volumes and Table 4 shows the level of service analysis results based on the 2040 traffic volumes. The level of service reports are attached.

Rex/Eastonville

In the short-term, it was assumed that a new section of Rex Road would be constructed from Eastonville Road through the Grandview Reserve sketch plan area to US Hwy 24. It was assumed that the section of Rex Road just west of Eastonville Road through the Meridian Ranch development was not yet constructed. The intersection of Rex/Eastonville is projected to operate at LOS B or better for all movements during the peak hours as a stop sign-controlled "T" intersection based on the projected short-term total traffic volumes.

By 2040 it was assumed that Rex Road would be completed between Meridian Road and US Hwy 24. Based on the projected 2040 total traffic volumes the intersection of Rex/Meridian is projected to operate at LOS F for some of the minor approach volumes, if it is stop sign-controlled. If this intersection is constructed as a one-lane modern roundabout or if it is traffic-signal controlled, all movements are projected to operate at LOS D or better during the peak hours.

Rex Road Site Access Points

The site access points to Rex Road were analyzed as two-way, stop-controlled intersections and one-lane modern roundabouts. The intersection of the proposed residential collector and the access point for the commercial parcels were also analyzed as assuming traffic signal control. The first three intersections east of Eastonville Road (intersections 2, 3, and 4) are projected to operate at a satisfactory level of service as two-way, stop sign-controlled intersections. The remaining access points will likely need alternate traffic control to achieve an acceptable level of service.

Rex/US Hwy 24

The intersection of Rex/US Hwy 24 is projected to operate at LOS D as a stop-sign controlled "T" intersection based on the projected short-term total traffic volumes. The analysis assumes left-turn and right-turn deceleration and acceleration lanes on US Hwy 24 at this intersection. By 2040 this intersection was assumed to be traffic signal controlled. All movements are projected to operate at LOS D or better based on the projected 2040 total traffic volumes.

Eastonville Site Access Point

The two site access points to Eastonville Road are planned beyond Phase 1. Based on the projected 2040 total traffic volumes, the westbound approach at the north site access is projected to operate at LOS E during the peak hours. If this access were constructed as a modern one-lane roundabout, all approaches are projected to operate at a satisfactory level of service. The south site access is projected to operate at LOS D or better for all movements during the peak hours as a stop sign-controlled "T" intersection.

Londonderry/Eastonville

The eastbound left-turn movement at the stop sign-controlled intersection of Londonderry/Eastonville is projected to operate at LOS F during the peak hours, based on the projected short-term total traffic volumes. All movements at this intersection are projected to operate at a satisfactory level of service if it is reconstructed as a modern roundabout or traffic-signal controlled. By 2040, it will likely be necessary to provide two northbound and southbound through lanes to achieve an acceptable level of service.

Stapleton/Eastonville

The eastbound approach at the intersection of Stapleton/Eastonville is currently operating at LOS F during the morning peak hour. A PPRTA project is currently planned to improve Eastonville Road in the vicinity of the site, however the timing of this project is unknown. To maintain an acceptable level of service these PPRTA improvements will need to be completed and the intersection will need to be converted to traffic signal control.

By 2040, it was assumed that Stapleton Drive would be constructed to its full cross section. Even with improvements to Stapleton Drive it may not be possible to maintain an acceptable level of service at this intersection without also widening Eastonville Road to provide two northbound and southbound through lanes.

Stapleton/US Hwy 24

The intersection of US Hwy 24/Stapleton is currently stop sign-controlled. The northbound and southbound left-turn movements and the northbound through movements are currently operating at LOS F during the peak hours. This intersection is planned to be signalized in the future. Once signalized, all movements are projected to operate at LOS D or better during the peak hours, based on the projected short-term total traffic volumes. By 2040 some movements at this intersection are projected to operate at LOS E or F during the peak hours. Alternate traffic control options were presented in the US Hwy 24 PEL Study. Alternatives to a “conventional” four-leg signalized intersection may include a jug handle intersection, a continuous flow intersection (or partial/half CFI) or a junior interchange. An alternate intersection design may be needed long-term to maintain an acceptable level of service.

TRAFFIC SIGNAL WARRANT ANALYSIS

The intersections of Stapleton/Eastonville and Stapleton/US Hwy 24 were analyzed to determine when Four-Hour Vehicular Volume Traffic Signal Warrant thresholds would be reached or exceeded, based on the projected peak-hour traffic volumes. This analysis using the peak hours is intended to provide an indication that a warrant may be met or is close to being met. In order for a Four-Hour Traffic Signal Warrant to be satisfied, the volume threshold would need to be met for two additional hours of the day. For example, the four-hour warrant would be satisfied with the volume thresholds met for one hour in the morning, two hours (instead of the one-hour peak) during the afternoon peak period, and an hour during the mid-afternoon. The satisfaction of warrants does not indicate that a signal must be installed. The decision to require a signal to be installed rests with the County.

Stapleton/Eastonville

Table 5 shows the results of the analysis for the intersection of Stapleton/Eastonville. The minor approach volumes were assumed to include either the eastbound left-turn, through, and right-turn movements or the westbound left-turn and through movements (the right-turn movements were excluded, as there is an exclusive right-turn lane). Even if the threshold is met based on both the eastbound and westbound approaches, it would only be considered to be met once for that hour. As shown in the Table 4, the thresholds for a Four-Hour Vehicular Volume Traffic Signal Warrant are projected to be exceeded based on the morning peak hour and the afternoon peak hour, based on the projected short-term background and total traffic.

Stapleton/US Hwy 24

Table 6 shows the signal warrant analysis for the intersection of Stapleton/US Hwy 24, based on the existing traffic volumes. This analysis includes data for four hours — 6:30 to 7:30 a.m., 7:30 to 8:30 a.m., 4:00 to 5:00 p.m., and 5:00 to 6:00 p.m. The analysis assumes the minor approach includes the higher of either the southbound (Stapleton Drive) left-turn and through movements or northbound (Curtis Road) left-turn and through movements. This intersection currently meets the thresholds for a Four-Hour Vehicular Volume Traffic Signal Warrant for three of the four hours. It is very likely that a fourth hour could be found that currently meets the thresholds for a traffic signal warrant. Additional traffic counts would be needed to confirm this.

FUNCTIONAL CLASSIFICATIONS AND LANEAGE

Figure 11 shows the recommended functional classifications for the roadways in the vicinity of the site. The functional classifications and number of through lanes are consistent with the current El Paso County *MTCP*. Figure 12 shows the recommended number of through lanes on the roadways in the vicinity of the site.

MULTI-MODAL AND PEDESTRIAN/BIKE TRANSPORATION

- A park n’ ride facility is planned for a site near Meridan Road and US Highway 24.
- The Rock Island Regional Trail passes adjacent to the site.
- Many of the area county roads have been or will be upgraded to provide paved shoulders for cyclists. Stapleton and Elbert Road are shown as future “bike routes.”
- The MTCP shows a future primary regional trail along Eastonville Road. Another future primary regional trail is shown extending west from Eastonville Road though Meridian Ranch.
- The Highway 24 PEL study also includes multi-modal elements.

CONCLUSIONS AND RECOMMENDATIONS

Trip Generation

- At buildout Grandview Reserve is expected to generate about 30,870 new external vehicle-trips on the average weekday, with about half entering and half exiting the site during a 24-hour period. During the morning peak hour, about 797 vehicles would enter and 1,933 vehicles would exit the site. During the afternoon peak hour, about 2,176 vehicles would enter and 1,409 vehicles would exit the site.

Required Improvements

Auxiliary Turn Lanes

- Based on the short-term total traffic volumes shown in Figure 9 and the criteria contained in the *State of Colorado Highway Access Code,* an eastbound left-turn lane is projected to be warranted on US Hwy 24 approaching Rex Road. Based on a posted speed limit of 65 miles per hour (mph), the prescribed lane length for the deceleration lane is 1,400 feet long (including 600 feet of stacking distance) plus a 300-foot taper. In the future, it will be necessary to provide dual eastbound left-turn lanes.

- Based on the short-term total traffic volumes shown in Figure 9 and the criteria contained in the *State of Colorado Highway Access Code,* a westbound right-turn acceleration lane is projected to be warranted on US Hwy 24 at Rex Road. Based on a posted speed limit of 65 miles per hour (mph), the prescribed lane length for the acceleration lane is 1,380 feet long plus a 300-foot taper.

- Based on the short-term total traffic volumes shown in Figure 9 and the criteria contained in the State of Colorado Highway Access Code, a westbound right-turn deceleration lane is projected to be warranted on US Hwy 24 approaching Rex Road. Based on a posted speed limit of 65 miles per hour (mph), the prescribed lane length for the deceleration lane is 800 feet long plus a 300-foot taper.

- Based on the short-term total traffic volumes and the level of service analysis results, an eastbound left-turn acceleration lane on US Hwy 24 at Rex Road would reduce the delay for the left turn from Rex onto eastbound Highway 24. This lane may be required by CDOT at some point as development progresses. Based on a posted speed limit of 65 miles per hour (mph), the prescribed lane length for the acceleration lane is 1,380 feet long plus a 300-foot taper. A channelized T configuration (with raised center median channelization) may be part of the traffic control phasing over time at this intersection.

- Based on the 2040 total traffic volumes shown in Figure 10 and the criteria contained in the *El Paso County Engineering Criteria Manual* (ECM) the new section of Rex Road between Eastonville and US Hwy 24 should anticipate the need for with right-turn and left-turn deceleration lanes approaching all access points and intersections.

- Based on the 2040 total traffic volumes shown in Figure 10 and the criteria contained in the *El Paso County Engineering Criteria Manual* (ECM) northbound and southbound left-turn lanes will be needed on Eastonville approaching Rex Road and the site access points. These auxiliary lanes would not be needed if these intersections are designed as modern roundabouts.

* * * * *

Please contact me if you have any questions or need further assistance.

Sincerely,

LSC TRANSPORTATION CONSULTANTS, INC.

By: Jeffrey C. Hodsdon, P.E.
Principal

JCH:KDF:jas

Enclosures: Tables 2-6
Appendix Table 1
Figures 1-12
MTCP Maps
NCHRP Report 684 Internal Trip Capture Estimation Tool
Traffic Count Reports
Level of Service Reports

Tables

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Table 2
Trip Generation Estimate
Grandview Reserve

Land Use Code	Land Use Description	Trip Generation Units	Trip Generation Rates [1]: Average Weekday Traffic	Trip Generation Rates [1]: Morning Peak Hour In	Trip Generation Rates [1]: Morning Peak Hour Out	Trip Generation Rates [1]: Afternoon Peak Hour In	Trip Generation Rates [1]: Afternoon Peak Hour Out	Total Trips Generated: Average Weekday Traffic	Total Trips Generated: Morning Peak Hour In	Total Trips Generated: Morning Peak Hour Out	Total Trips Generated: Afternoon Peak Hour In	Total Trips Generated: Afternoon Peak Hour Out	Internal Trips Generated[2]: Average Weekday Traffic	Internal Trips Generated[2]: Morning Peak Hour In	Internal Trips Generated[2]: Morning Peak Hour Out	Internal Trips Generated[2]: Afternoon Peak Hour In	Internal Trips Generated[2]: Afternoon Peak Hour Out	External Trips Generated: Average Weekday Traffic	External Trips Generated: Morning Peak Hour In	External Trips Generated: Morning Peak Hour Out	External Trips Generated: Afternoon Peak Hour In	External Trips Generated: Afternoon Peak Hour Out	Pass-By Trips [3]	New External Trips Generated: Average Weekday Traffic
Short-Term Trip Generation Estimate																								
210	Single-Family Detached Housing	1,585 DU	8.34	0.18	0.53	0.57	0.34	13,212	283	848	908	533	0	0	0	0	0	13,212	283	848	908	533	0%	13,212
Buildout Trip Generation Estimate																								
520	Elementary School	500 Students	1.89	0.36	0.31	0.08	0.09	945	181	154	41	44	473	91	39	10	22	472	90	115	31	22	0%	472
820	Shopping Center	133 KSF[4]	54.88	1.02	0.62	2.42	2.62	7,299	135	83	322	349	599	18	12	3	40	6,700	117	71	319	309	34%	4,422
560	Church	49 KSF	6.49	0.21	0.14	0.20	0.25	318	10	7	10	12	0	0	0	0	0	318	10	7	10	12	0%	318
210	Single-Family Detached Housing	3,261 DU[5]	7.87	0.18	0.53	0.56	0.33	25,658	580	1,740	1,816	1,066	0	0	0	0	0	25,658	580	1,740	1,816	1,066	0%	25,658
		3,261 DU						**34,220**	**906**	**1,984**	**2,189**	**1,471**	**1,072**	**109**	**51**	**13**	**62**	**33,148**	**797**	**1,933**	**2,176**	**1,409**		**30,870**

Notes:
(1) Source: "Trip Generation, 10th Edition, 2017" by the Institute of Transportation Engineers (ITE)
(2) Internal trips to and from the commercial parcels were based on the attached NCHRP 684 Internal Trip Capture Estimation Tool. About one half the school trips were assumed to be internal to the site.
(3) Source: "Trip Generation Handbook - An ITE Proposed Recommended Practice, Third Edition September 2017" by ITE
(4) KSF = one thousand square feet of floor space
(5) DU = dwelling unit

Source: LSC Transportation Consultants, Inc.

Table 3
Short-Term Level of Service Analysis
Grandview Reserve

Intersection	Traffic Control	Movement	Short-Term Background Traffic AM	Short-Term Background Traffic PM	Short-Term Total Traffic AM	Short-Term Total Traffic PM
#1 Rex/Eastonville	TWSC	Westbound Left	A	A	B	B
		Westbound Right	A	A	A	A
		Southbound Left	A	A	A	A
#3 Rex/Parcel H	TWSC	Northbound Left	- - -	- - -	B	B
		Northbound Right	- - -	- - -	A	B
		Westbound Left	- - -	- - -	A	A
#4 Rex/Parcel I	TWSC	Northbound Left	- - -	- - -	B	B
		Northbound Right	- - -	- - -	A	B
		Westbound Left	- - -	- - -	A	A
#5 Rex/Parcels I & J	TWSC	Northbound Left	- - -	- - -	B	C
		Northbound Right	- - -	- - -	A	B
		Westbound Left	- - -	- - -	A	A
#6 Rex/Residential Collector	TWSC	Eastbound Left	- - -	- - -	A	A
		Southbound Left	- - -	- - -	B	B
		Southbound Right	- - -	- - -	A	B
#7 Rex/Parcels J & K	TWSC	Northbound Left	- - -	- - -	B	F
		Northbound Right	- - -	- - -	B	B
		Westbound Left	- - -	- - -	A	A
	Roundabout	Eastbound Through/Right	- - -	- - -	C	A
		Westbound Left/Through	- - -	- - -	A	A
		Northbound Left/Right	- - -	- - -	A	A
		Overall	- - -	- - -	**A**	**A**
#9 Rex/US 24	TWSC	Northbound Left	A	A	A	B
		Eastbound Left (With Acceleration Lane)	B	C	D	B
		Eastbound Right (With Acceleration Lane)	A	A	A	A
#12 Eastonville/Londonderry	TWSC	Northbound Left	A	A	B	A
		Eastbound Left	F	F	F	F
		Eastbound Right	B	A	C	B
	Roundabout	Eastbound	- - -	- - -	B	A
		Northbound	- - -	- - -	A	B
		Southbound	- - -	- - -	B	A
		Overall	- - -	- - -	**A**	**B**
	Signal	Eastbound Left	- - -	- - -	D	D
		Eastbound Right	- - -	- - -	B	B
		Northbound Left	- - -	- - -	A	A
		Northbound Through	- - -	- - -	A	A
		Southbound Through	- - -	- - -	A	A
		Southbound Right	- - -	- - -	A	A
		Overall	- - -	- - -	**A**	**A**
#13 Eastonville/Stapleton	TWSC	Northbound Left	A	A	A	A
		Eastbound	F	F	F	F
		Westbound Left/Through	F	F	F	F
		Westbound Right	B	B	B	C
		Southbound Left	A	A	A	A
	Signal	Eastbound Left/Through/Right	- - -	- - -	C	D
		Westbound Left/Through	- - -	- - -	C	B
		Westbound Right	- - -	- - -	A	A
		Northbound Left	- - -	- - -	B	C
		Northbound Through/Right	- - -	- - -	D	D
		Southbound Left	- - -	- - -	C	D
		Southbound Through/Right	- - -	- - -	C	C
		Overall	- - -	- - -	**C**	**C**
#14 US 24/Stapleton	TWSC	Northbound Left	A	B	B	C
		Eastbound Through	F	F	F	F
		Eastbound Right	F	F	F	F
		Eastbound Left	A	A	A	A
		Westbound Through	F	F	F	F
		Westbound Right	F	F	F	F
		Westbound Left	A	A	A	A
		Southbound Left	A	A	A	B
	Signal	Eastbound Left	- - -	- - -	D	C
		Eastbound Through	- - -	- - -	D	D
		Eastbound Right	- - -	- - -	A	A
		Westbound Left	- - -	- - -	C	C
		Westbound Through	- - -	- - -	C	D
		Westbound Right	- - -	- - -	A	A
		Northbound Left	- - -	- - -	D	D
		Northbound Through	- - -	- - -	B	C
		Northbound Right	- - -	- - -	A	A
		Southbound Left	- - -	- - -	A	A
		Southbound Through	- - -	- - -	D	C
		Southbound Right	- - -	- - -	A	A
		Overall	- - -	- - -	**C**	**C**

Source: LSC Transportation Consultants, Inc. Apr-20

Table 4
Page 1 of 3
2040 Level of Service Analysis
Grandview Reserve

Intersection	Traffic Control	Movement	2040 Background Traffic AM	2040 Background Traffic PM	2040 Total Traffic AM	2040 Total Traffic PM
#1 Rex/Eastonville	TWSC	Northbound Left	A	A	A	A
		Eastbound Left	B	C	C	F
		Eastbound Through	C	C	E	F
		Eastbound Right	B	A	B	B
		Westbound Left	D	D	F	F
		Westbound Through	B	C	C	D
		Westbound Right	A	A	A	A
		Southbound Left	A	A	A	A
	Roundabout	Eastbound Left/Through/Right	- - -	- - -	D	B
		Westbound Left/Through/Right	- - -	- - -	C	B
		Northbound Left/Through	- - -	- - -	A	A
		Northbound Right	- - -	- - -	A	B
		Southbound Left/Through/Right	- - -	- - -	B	B
		Overall	- - -	- - -	**C**	**B**
	Signal	Eastbound Left	- - -	- - -	A	B
		Eastbound Through	- - -	- - -	B	C
		Eastbound Right	- - -	- - -	A	A
		Westbound Left	- - -	- - -	D	C
		Westbound Through	- - -	- - -	B	B
		Westbound Right	- - -	- - -	A	A
		Northbound Left	- - -	- - -	B	B
		Northbound Through	- - -	- - -	B	B
		Northbound Right	- - -	- - -	A	A
		Southbound Left	- - -	- - -	B	B
		Southbound Through	- - -	- - -	B	B
		Southbound Right	- - -	- - -	A	A
		Overall	- - -	- - -	**C**	**B**
#2 Rex/Parcels A & B	TWSC	Northbound Left	- - -	- - -	C	C
		Northbound Right	- - -	- - -	B	C
		Westbound Left	- - -	- - -	A	A
	Roundabout	Eastbound Through/Right	- - -	- - -	A	B
		Westbound Left/Through	- - -	- - -	A	A
		Northbound Left/Right	- - -	- - -	A	A
		Overall	- - -	- - -	**A**	**A**
#3 Rex/Parcel H	TWSC	Northbound Left	- - -	- - -	C	C
		Northbound Right	- - -	- - -	B	C
		Westbound Left	- - -	- - -	A	B
	Roundabout	Eastbound Through/Right	- - -	- - -	A	B
		Westbound Left/Through	- - -	- - -	A	A
		Northbound Left/Right	- - -	- - -	A	A
		Overall	- - -	- - -	**A**	**B**
#4 Rex/Parcel I	TWSC	Northbound Left	- - -	- - -	C	D
		Northbound Right	- - -	- - -	B	C
		Westbound Left	- - -	- - -	A	B
	Roundabout	Eastbound Through/Right	- - -	- - -	A	C
		Westbound Left/Through	- - -	- - -	A	A
		Northbound Left/Right	- - -	- - -	A	A
		Overall	- - -	- - -	**A**	**B**
#5 Rex/Parcels I & J	TWSC	Northbound Left	- - -	- - -	D	E
		Northbound Right	- - -	- - -	C	C
		Westbound Left	- - -	- - -	A	B
	Roundabout	Eastbound Through/Right	- - -	- - -	A	C
		Westbound Left/Through	- - -	- - -	A	B
		Northbound Left/Right	- - -	- - -	B	A
		Overall	- - -	- - -	**A**	**B**

Source: LSC Transportation Consultants, Inc. Apr-20

Table 4
Page 2 of 3
2040 Level of Service Analysis
Grandview Reserve

Intersection	Traffic Control	Movement	2040 Background Traffic AM	2040 Background Traffic PM	2040 Total Traffic AM	2040 Total Traffic PM
#6 Rex/Residential Collector	TWSC	Eastbound Left	- - -	- - -	A	B
		Southbound Left	- - -	- - -	F	F
		Southbound Right	- - -	- - -	B	C
	Roundabout	Eastbound Left/Through	- - -	- - -	D	C
		Westbound Through	- - -	- - -	A	A
		Westbound Right	- - -	- - -	A	A
		Southbound Left/Right	- - -	- - -	C	B
		Overall	- - -	- - -	**C**	**B**
	Signal	Eastbound Left	- - -	- - -	B	B
		Eastbound Through	- - -	- - -	B	A
		Westbound Through	- - -	- - -	D	D
		Westbound Right	- - -	- - -	C	B
		Southbound Left	- - -	- - -	D	D
		Southbound Right	- - -	- - -	A	A
		Overall	- - -	- - -	**C**	**C**
#7 Rex/Parcels J & K	TWSC	Northbound Left	- - -	- - -	E	F
		Northbound Right	- - -	- - -	F	C
		Westbound Left	- - -	- - -	B	B
	Roundabout	Eastbound Through/Right	- - -	- - -	C	B
		Westbound Left/Through	- - -	- - -	A	D
		Northbound Left/Right	- - -	- - -	C	A
		Overall	- - -	- - -	**C**	**C**
#8 Rex/Parcels C1 & C2	TWSC	Northbound Left	- - -	- - -	F	F
		Northbound Through/Right	- - -	- - -	C	C
		Eastbound Left	- - -	- - -	A	B
		Westbound Left	- - -	- - -	B	B
		Southbound Left	- - -	- - -	F	F
		Southbound Through/Right	- - -	- - -	B	C
	Roundabout	Eastbound Left/Through	- - -	- - -	A	A
		Eastbound Through/Right	- - -	- - -	A	A
		Westbound Left/Through	- - -	- - -	A	A
		Westbound Through/Right	- - -	- - -	A	A
		Northbound Left/Through/Right	- - -	- - -	A	A
		Southbound Left/Through/Right	- - -	- - -	A	B
		Overall	- - -	- - -	**A**	**A**
	Signal	Eastbound Left	- - -	- - -	A	B
		Eastbound Through (2)	- - -	- - -	B	B
		Eastbound Right	- - -	- - -	A	A
		Westbound Left	- - -	- - -	D	D
		Westbound Through (2)	- - -	- - -	D	D
		Westbound Right	- - -	- - -	C	B
		Northbound Left	- - -	- - -	C	C
		Northbound Through/Right	- - -	- - -	A	A
		Southbound Left	- - -	- - -	C	C
		Southbound Through/Right	- - -	- - -	A	A
		Overall	- - -	- - -	**C**	**C**
#9 Rex/US 24	Signal	Eastbound Left	D	D	D	D
		Eastbound Right	A	A	A	A
		Northbound Left (2)	E	E	D	D
		Northbound Through (2)	A	A	A	A
		Southbound Through (2)	B	B	C	D
		Southbound Right	A	A	A	A
		Overall	**A**	**B**	**B**	**C**
#10 Eastonville/Parcel C	TWSC	Westbound	- - -	- - -	E	E
		Southbound Left	- - -	- - -	A	B
	Roundabout	Westbound Left/Right	- - -	- - -	A	A
		Northbound Through/Right	- - -	- - -	A	C
		Southbound Left/Through	- - -	- - -	C	A
		Overall	- - -	- - -	**C**	**C**

Source: LSC Transportation Consultants, Inc. Apr-20

Table 4
Page 3 of 3
2040 Level of Service Analysis
Grandview Reserve

Intersection	Traffic Control	Movement	2040 Background Traffic AM	2040 Background Traffic PM	2040 Total Traffic AM	2040 Total Traffic PM
#11 Eastonville/Parcels E & F	TWSC	Westbound	- - -	- - -	D	D
		Southbound Left	- - -	- - -	A	B
	Roundabout	Westbound Left/Right	- - -	- - -	A	B
		Northbound Through/Right	- - -	- - -	A	C
		Southbound Left/Through	- - -	- - -	F	A
		Overall	- - -	- - -	**E**	**C**
#12 Eastonville/Londonderry	TWSC	Northbound Left	A	A	C	B
		Eastbound Left	C	F	F	F
		Eastbound Right	C	B	F	C
	Roundabout	Eastbound Left	- - -	- - -	B	A
		Eastbound Right	- - -	- - -	C	A
		Northbound Left	- - -	- - -	A	A
		Northbound Through	- - -	- - -	A	D
		Southbound Through	- - -	- - -	A	A
		Southbound Through/Right	- - -	- - -	B	A
		Overall	- - -	- - -	**A**	**C**
	Signal	Eastbound Left	- - -	- - -	C	C
		Eastbound Right	- - -	- - -	B	A
		Northbound Left	- - -	- - -	A	B
		Northbound Through (2)	- - -	- - -	A	A
		Southbound Through (2)	- - -	- - -	B	B
		Southbound Right	- - -	- - -	A	A
		Overall	- - -	- - -	**B**	**B**
#13 Eastonville/Stapleton	Signal (One NB/SB TH Lane)	Eastbound Left	D	D	D	F
		Eastbound Through (2)	C	C	D	D
		Eastbound Right	A	A	A	A
		Westbound Left	C	B	D	C
		Westbound Through (2)	C	D	D	F
		Westbound Right	A	A	A	B
		Northbound Left	C	D	D	E
		Northbound Through (1)	C	D	C	F
		Northbound Right	A	A	A	B
		Southbound Left	C	D	D	F
		Southbound Through (1)	D	D	D	D
		Southbound Right	A	A	B	A
		Overall	**C**	**C**	**D**	**E**
	Signal (Two NB/SB TH Lanes)	Eastbound Left	- - -	- - -	D	E
		Eastbound Through (2)	- - -	- - -	C	C
		Eastbound Right	- - -	- - -	A	A
		Westbound Left	- - -	- - -	C	C
		Westbound Through (2)	- - -	- - -	C	D
		Westbound Right	- - -	- - -	A	A
		Northbound Left	- - -	- - -	C	D
		Northbound Through (2)	- - -	- - -	C	D
		Northbound Right	- - -	- - -	A	A
		Southbound Left	- - -	- - -	D	E
		Southbound Through (2)	- - -	- - -	D	D
		Southbound Right	- - -	- - -	C	B
		Overall	- - -	- - -	**C**	**D**
#14 US 24/Stapleton	Signal	Eastbound Left (2)	D	D	D	E
		Eastbound Through (2)	D	C	D	C
		Eastbound Right	A	A	A	A
		Westbound Left (2)	D	D	D	D
		Westbound Through (2)	D	D	D	D
		Westbound Right	A	A	A	A
		Northbound Left (2)	D	D	D	E
		Northbound Through (2)	C	C	C	F
		Northbound Right	A	A	A	B
		Southbound Left (2)	D	D	D	E
		Southbound Through (2)	D	D	F	F
		Southbound Right	A	A	A	A
		Overall	**C**	**D**	**F**	**F**

Source: LSC Transportation Consultants, Inc. Apr-20

Table 5
Grandview Reserve
Traffic Signal Warrant Analysis of Eastonville/Stapleton
Peak-Hour Four-Hour Vehicular Volume Evaluation

Year	AM Peak Hour						PM Peak Hour					
	Peak-Hour Traffic Volumes			Volume Evaluation(1)			Peak-Hour Traffic Volumes			Volume Evaluation(1)		
		Minor		Minor St	EB	WB		Minor		Minor St	EB	WB
	Major(2)	EB(3)	WB(4)	Minimum	Met?	Met?	Major(2)	EB(3)	WB(4)	Minimum	Met?	Met?
Existing	544	123	48	318	No	No	213	70	123	484	No	No
2023 Background	859	389	194	185	**Yes**	**Yes**	679	299	373	258	**Yes**	**Yes**
2023 Total	1159	428	194	108	**Yes**	**Yes**	984	426	373	154	**Yes**	**Yes**

Notes:

(1) Based on 2 lanes on major approach and 1 lane on minor approach.

(2) The major street volumes include all (left/through/right) movements on Eastonville Road.

(3) The EB minor street volumes include all easbound movements (left, through, and right) on Stapleton Drive.

(4) The WB minor street volumes include only the left and through westbound movements on Stapleton Dr. The right-turn movements have been excluded because there is an existing exclusive right-turn lane on this approach.

Source: LSC Transportation Consultants, Inc.

Table 6
Grandview Reserve
Traffic Signal Warrant Analysis of Stapleton/US 24
Peak-Hour Four-Hour Vehicular Volume Evaluation

Time	Traffic Volumes			Volume Evaluation[1]		
	Major[2]	Minor		Minor St Minimum	EB Met?	WB Met?
		SEB[3]	NWB[4]			
6:30 AM - 7:30 AM	838	166	75	96	**Yes**	No
7:30 AM - 8:30 AM	691	77	63	143	No	No
4:00 PM - 5:00 PM	882	109	43	85	**Yes**	No
5:00 PM - 6:00 PM	932	87	57	80	**Yes**	No

Notes:
(1) Based on 2 or more lanes on the major approach and 2 or more lanes on the minor approach (70% Factor).
(2) The major street volumes include all (left/through/right) movements on US 24
(3) The SEB minor street volumes include only the easbound left-turn and through movements on Stapleton Dr. The right-turn movements have been excluded
(4) The NWB minor street volumes include only the left and through westbound movements on Curtis Rd. The right-turn movements have been excluded

Source: LSC Transportation Consultants, Inc.

Appendix Table 1

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Appendix Table 1
Area Trafffic Impact Studies by LSC
Rolling Hills Ranch Filing Nos. 1-3

Study	Date
Meridian Ranch	
Meridian Ranch Sketch Plan TIA	April 11, 2011
Meridian Ranch Filing 11 Updated TIA	November 26, 2013
Stonebridge at Meridian Ranch Filing No. 1 Updated TIA	April 23, 2014
Stonebridge at Meridian Ranch Transportation Memorandum	July 28, 2015
Meridian Ranch Filing 8 Updated TIA	December 23, 2014
Meridian Ranch Filing 9 Updated TIA	May 21, 2015
Meridian Ranch Sketch Plan 2015 Amendment TIA	July 30, 2015
The Vistas at Meridian Ranch TIA	March 24, 2016
Meridian Ranch Estates Filing No. 2 Transportation Memorandum	August 27, 2015
The Vistas at Meridian Ranch Updated Transportation Memorandum	June 20, 2017
Londonderry Drive Pedestrian Operations and Safety Study	February 8, 2017
Stonebridge Filing 3 at Meridian Ranch Updated TIA	March 20, 2017
Meridian Ranch Sketch Plan 2017 Amendment TIA	October 3, 2017
WindingWalk at Meridian Ranch and The Enclave at Stonebridge at Meridian Ranch Updated Traffic Impact Analysis	May 10, 2018
Rolling Hills Ranch at Meridian Ranch PUDSP Traffic Impact Analysis	March 9, 2020
The Estates at Rolling Hills Ranch Filing No. 1 Traffic Impact Analysis	March 13, 2020
Waterbury/4-Way Ranch	
Waterbury PUD Development Plan Updated TIA	January 10, 2013
Waterbury Preliminary Plan No. 1 Updated TIA	June 5, 2013
Waterbury Phase 2 Preliminary Plan	August 3, 2017
Waterbury Phase 1 Filing Nos. 2 and 3	October 16, 2017

Source: LSC Transportation Consultants, Inc.

Figures

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Figure 1

Vicinity Map

Grandview Reserve (LSC #184840)

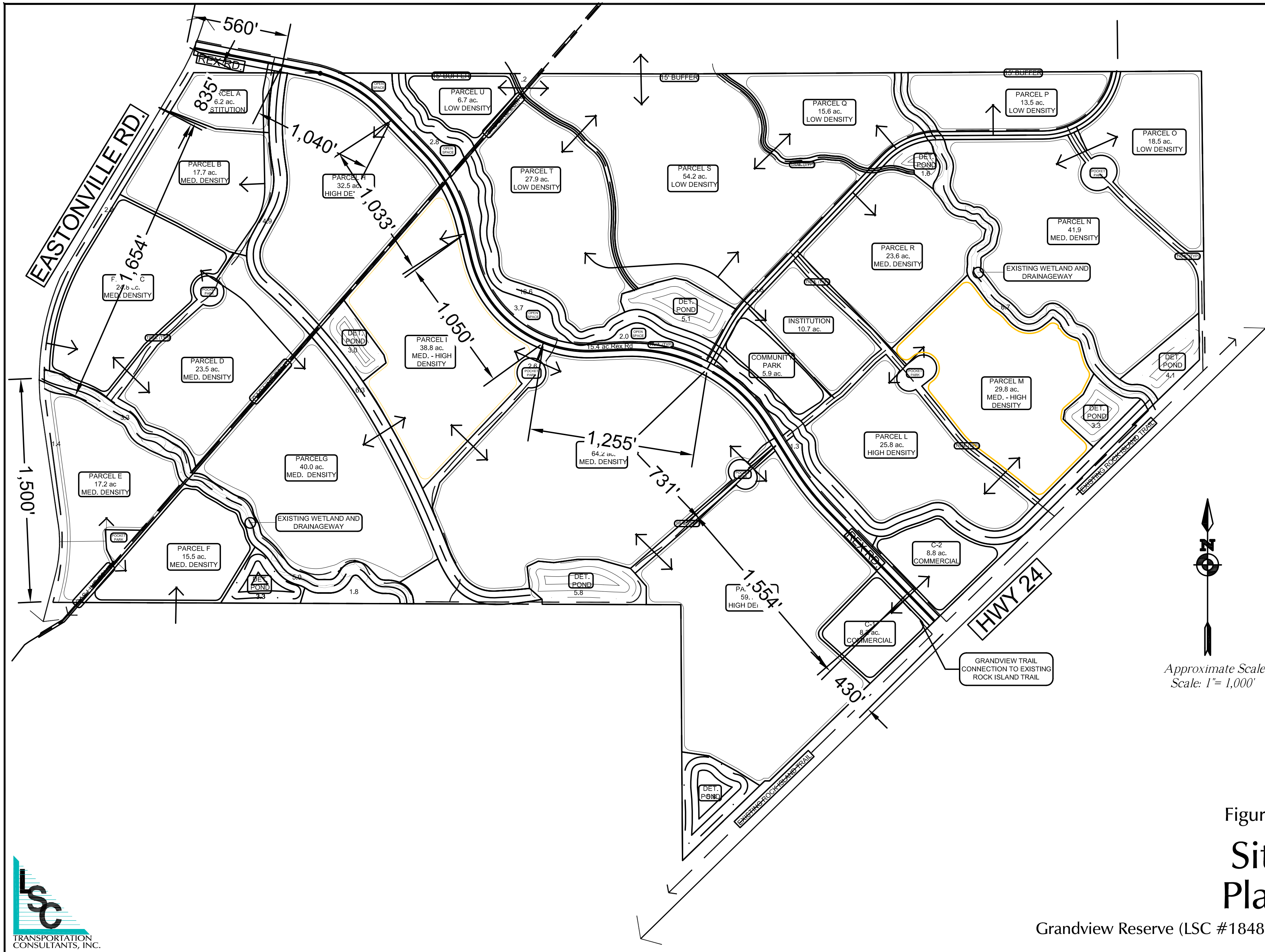
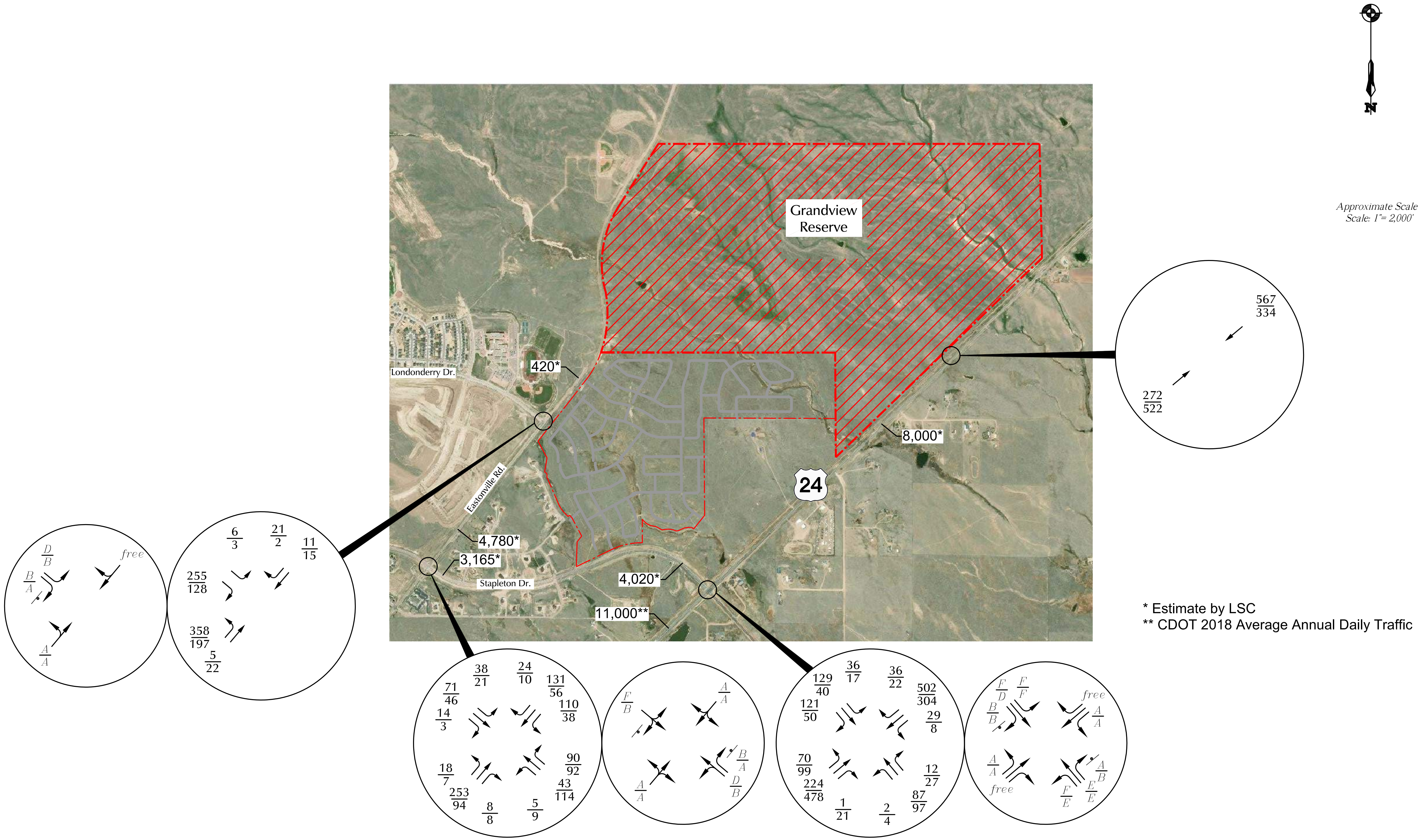


Figure 2

Site Plan

Grandview Reserve (LSC #184840)

TRANSPORTATION CONSULTANTS, INC.



LEGEND:

= Stop Sign

XX/XX = AM Weekday Peak-Hour Traffic (vehicles per hour) / PM Weekday Peak-Hour Traffic (vehicles per hour) Based on counts by LSC Nov. 2018 and Dec. 2018

A/B = AM Individual Movement Peak-Hour Level of Service / PM Individual Movement Peak-Hour Level of Service

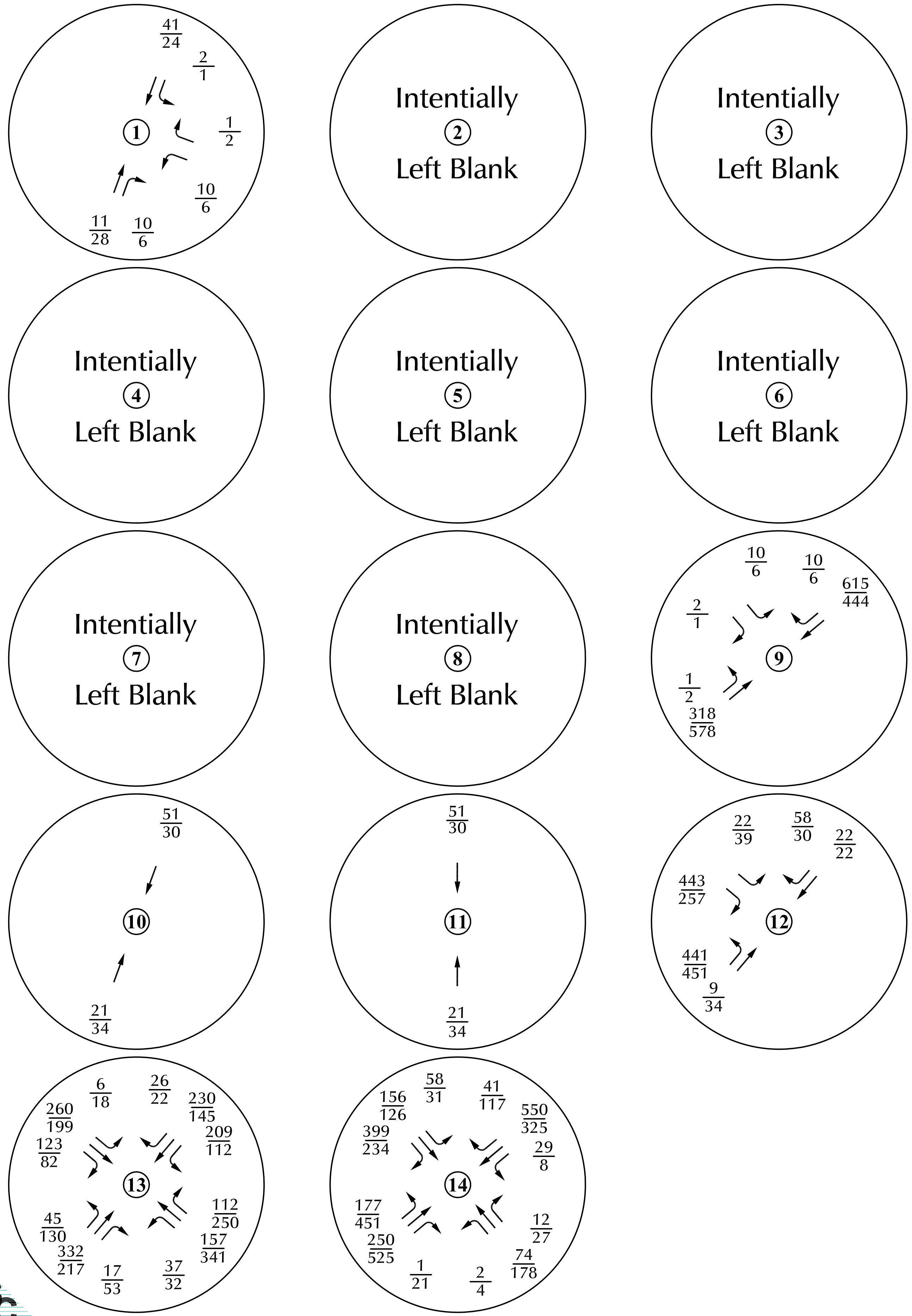
X,XXX= Average Daily Traffic (vehicles per day)

LSC TRANSPORTATION CONSULTANTS, INC.

Figure 3

Existing Traffic, Lane Geometry and Traffic Control and Level of Service

Grandview Reserve (LSC #184840)



LEGEND:

XX/XX = AM Weekday Peak-Hour Traffic (vehicles per hour) / PM Weekday Peak-Hour Traffic (vehicles per hour)

X,XXX= Annual Average Daily Traffic (vehicles per day)

N

Approximate Scale
Scale: 1"= 2,000'

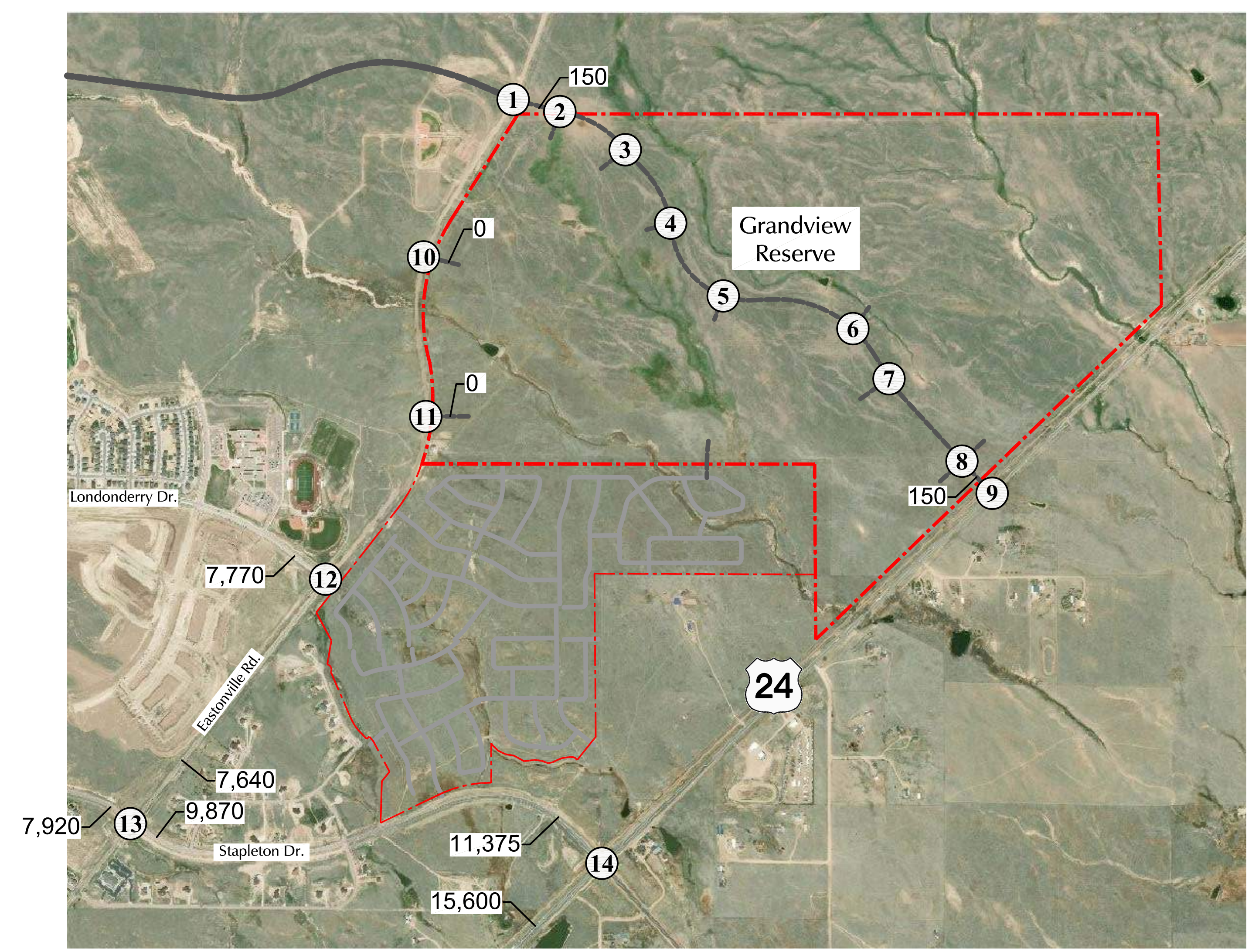
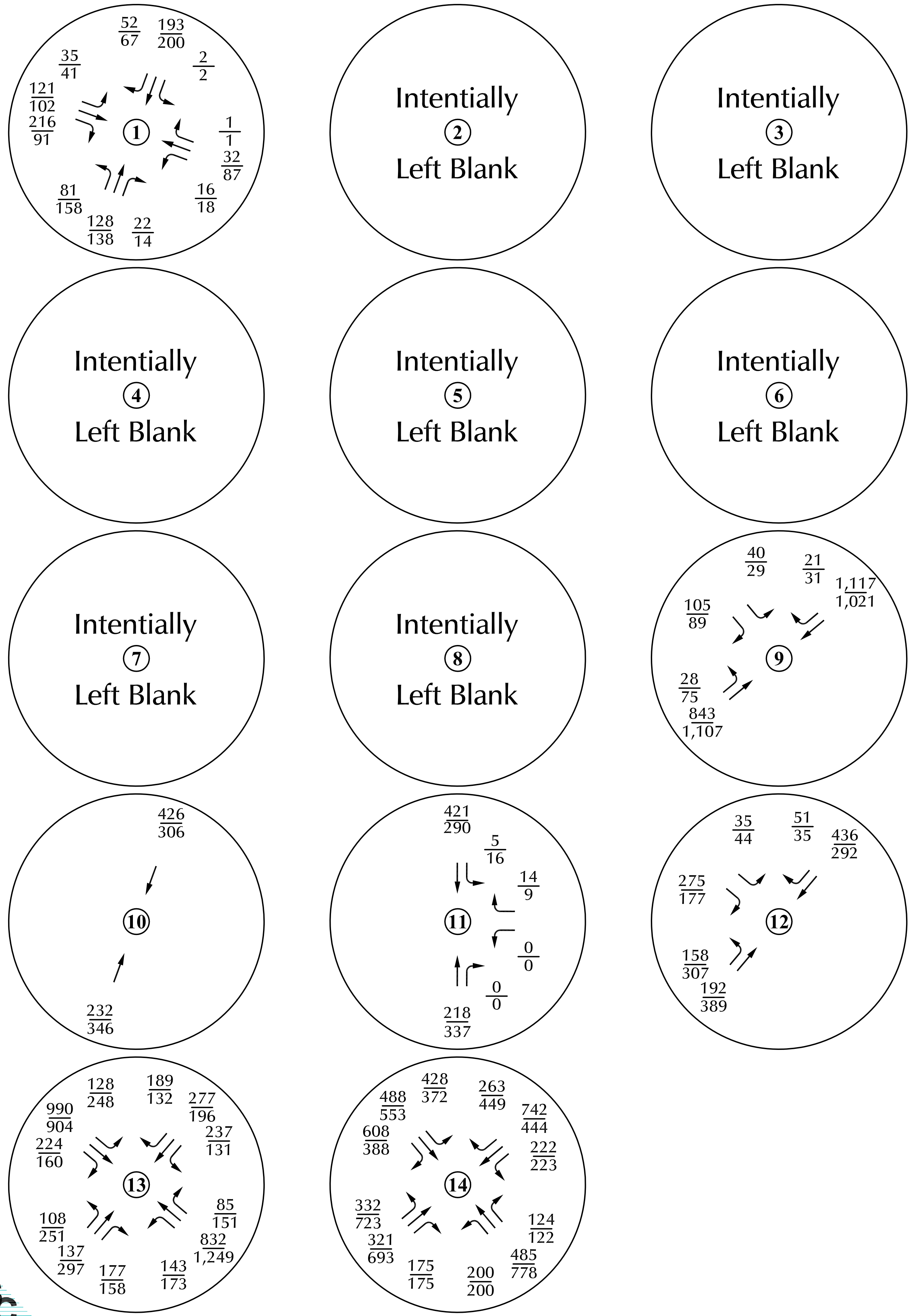


Figure 4

Short-Term Background Traffic

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.



LEGEND:

XX/XX = AM Weekday Peak-Hour Traffic (vehicles per hour) / PM Weekday Peak-Hour Traffic (vehicles per hour)

X,XXX= Annual Average Daily Traffic (vehicles per day)

N

Approximate Scale
Scale: 1"= 2,000'

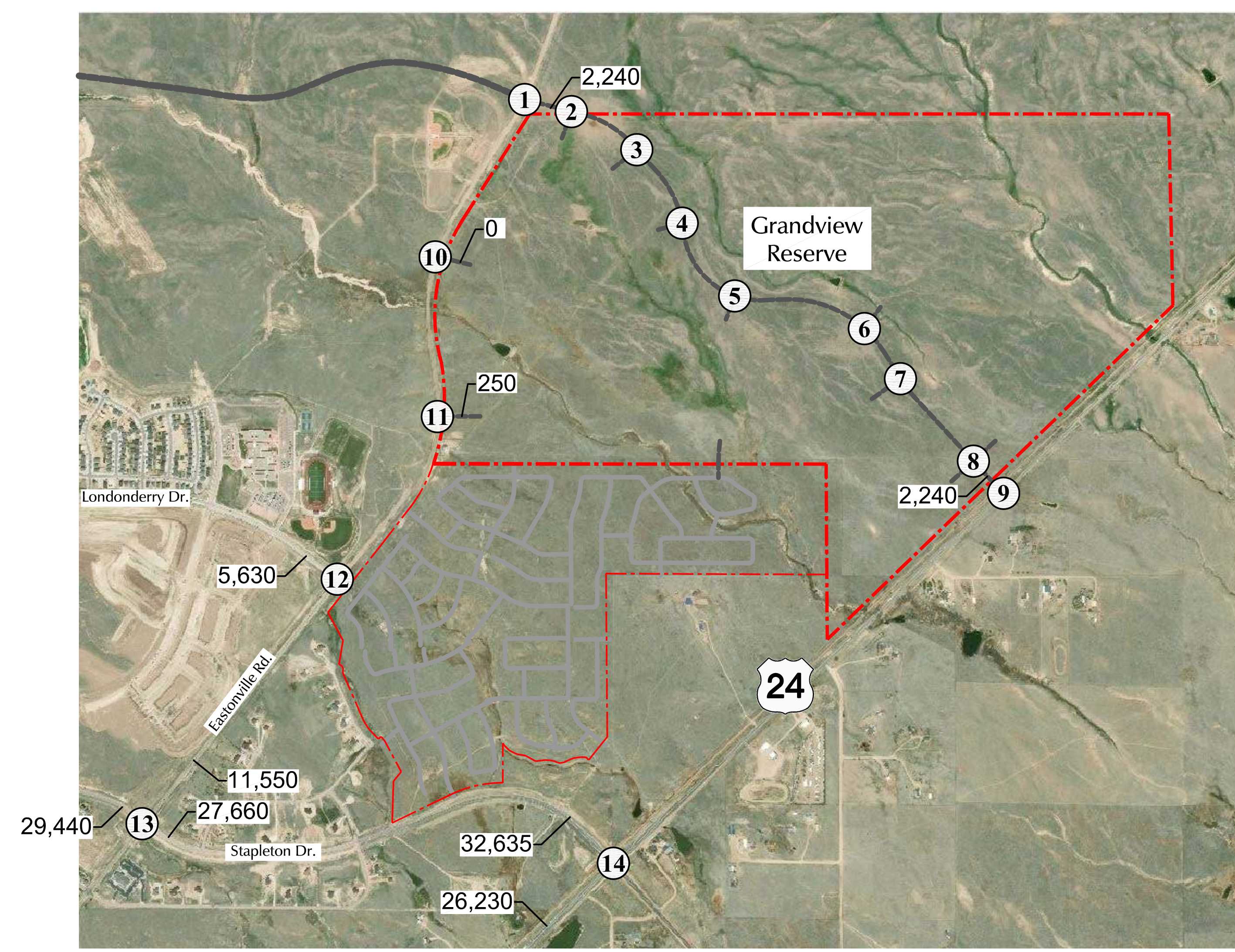
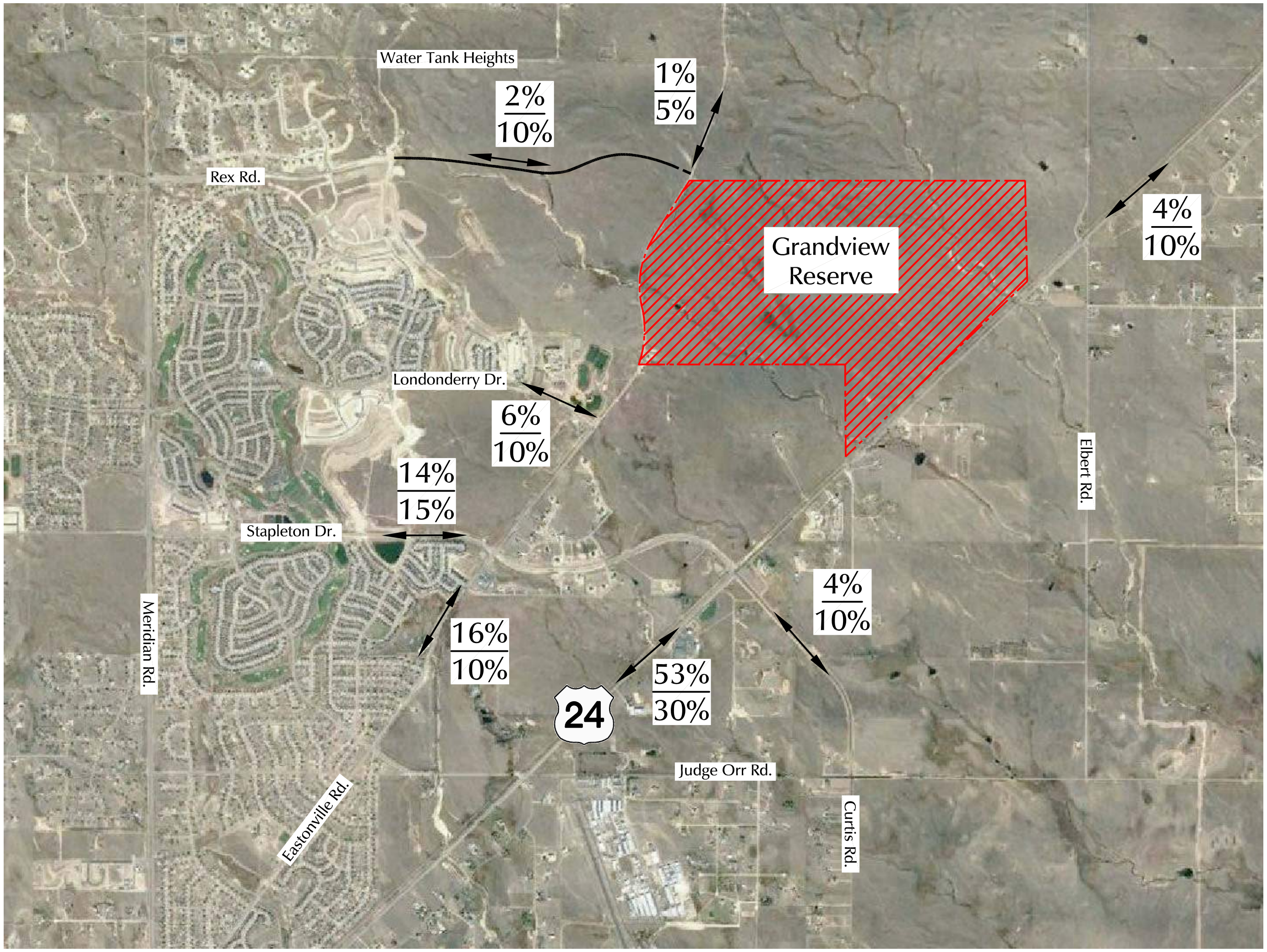


Figure 5

Year 2040 Background Traffic

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.



N

Approximate Scale
Scale: 1"= 4,000'

Figure 6

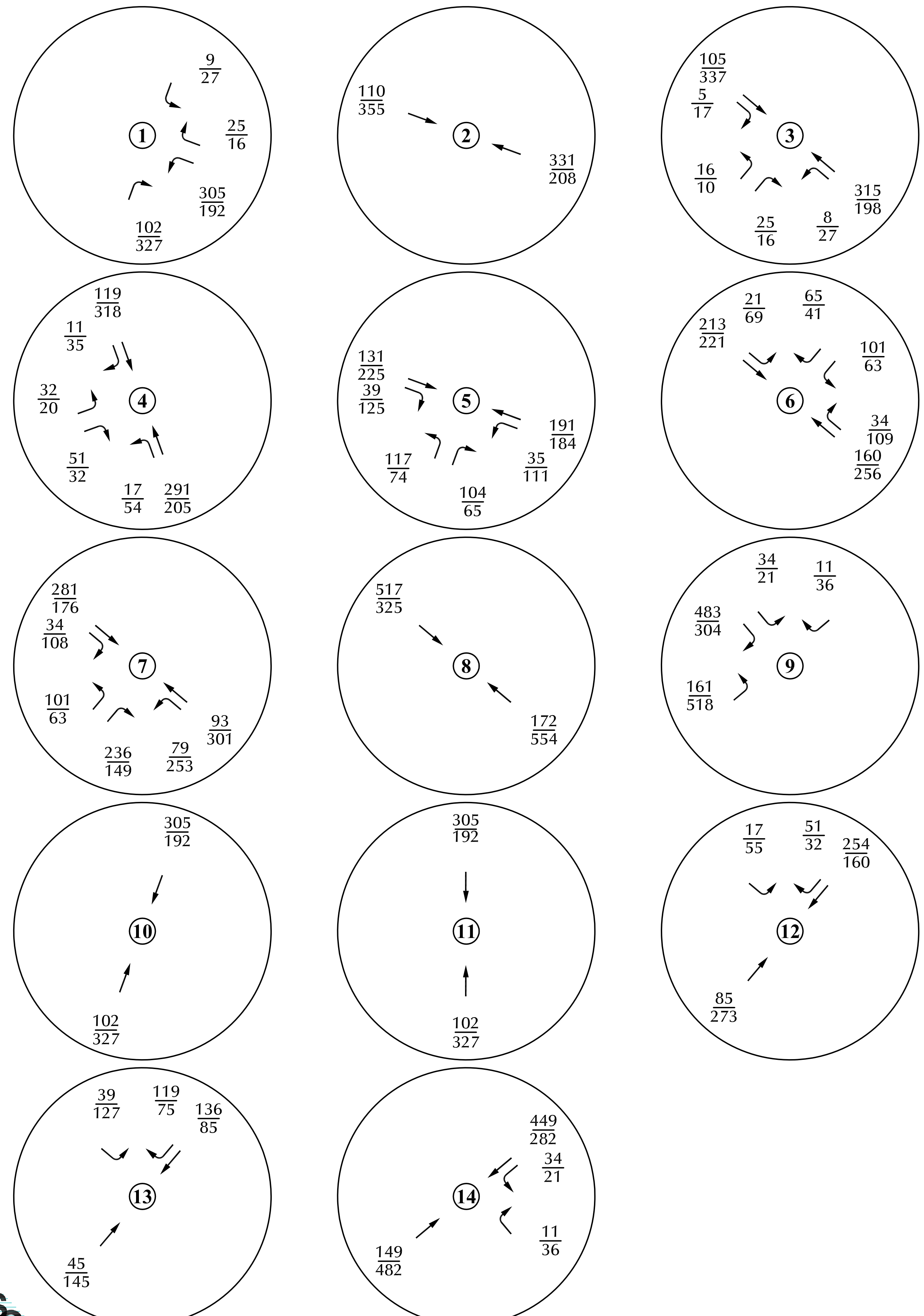
Directional Distribution of Site-Generated Traffic

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.

LEGEND:

↔ XX% / XX% = Residential Percent Directional Distribution / Non-Residential Percent Directional Distribution



LEGEND:

XX/XX = AM Weekday Peak-Hour Traffic (vehicles per hour) / PM Weekday Peak-Hour Traffic (vehicles per hour)

X,XXX= Annual Average Daily Traffic (vehicles per day)

N

Approximate Scale
Scale: 1"= 2,000'

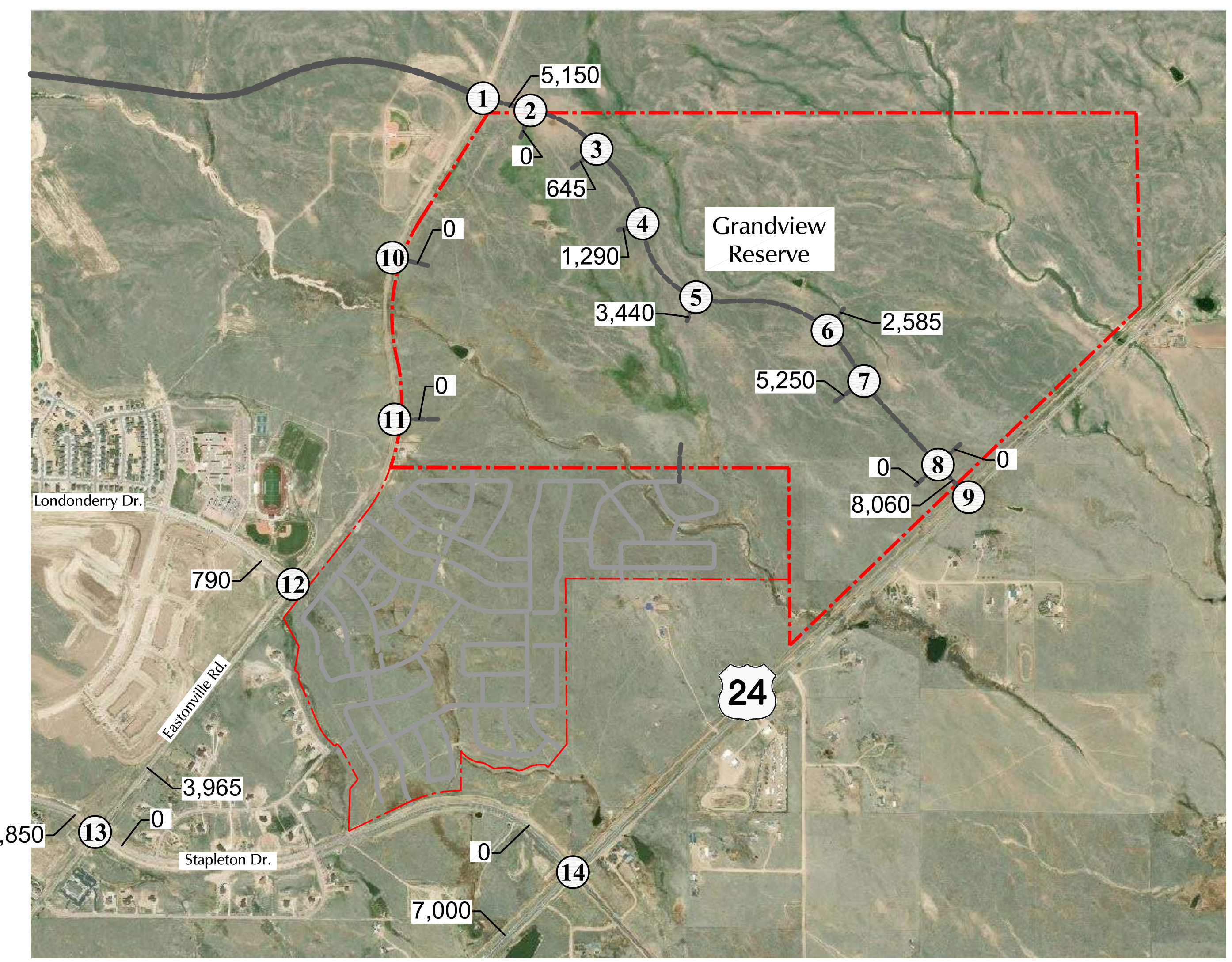


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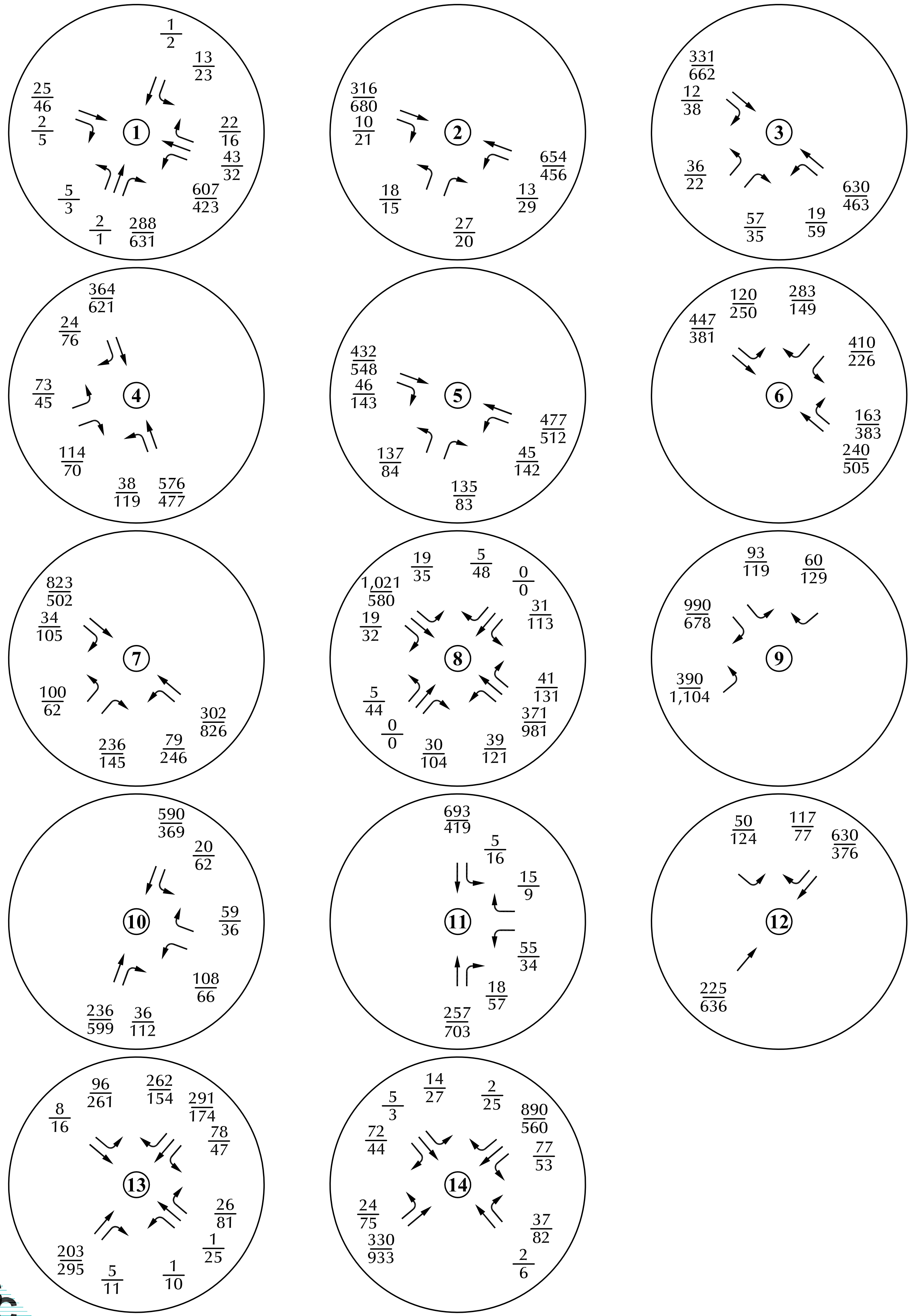
Figure 7

Assignment of Phase 1 Site-Generated Traffic

Grandview Reserve (LSC #184840)

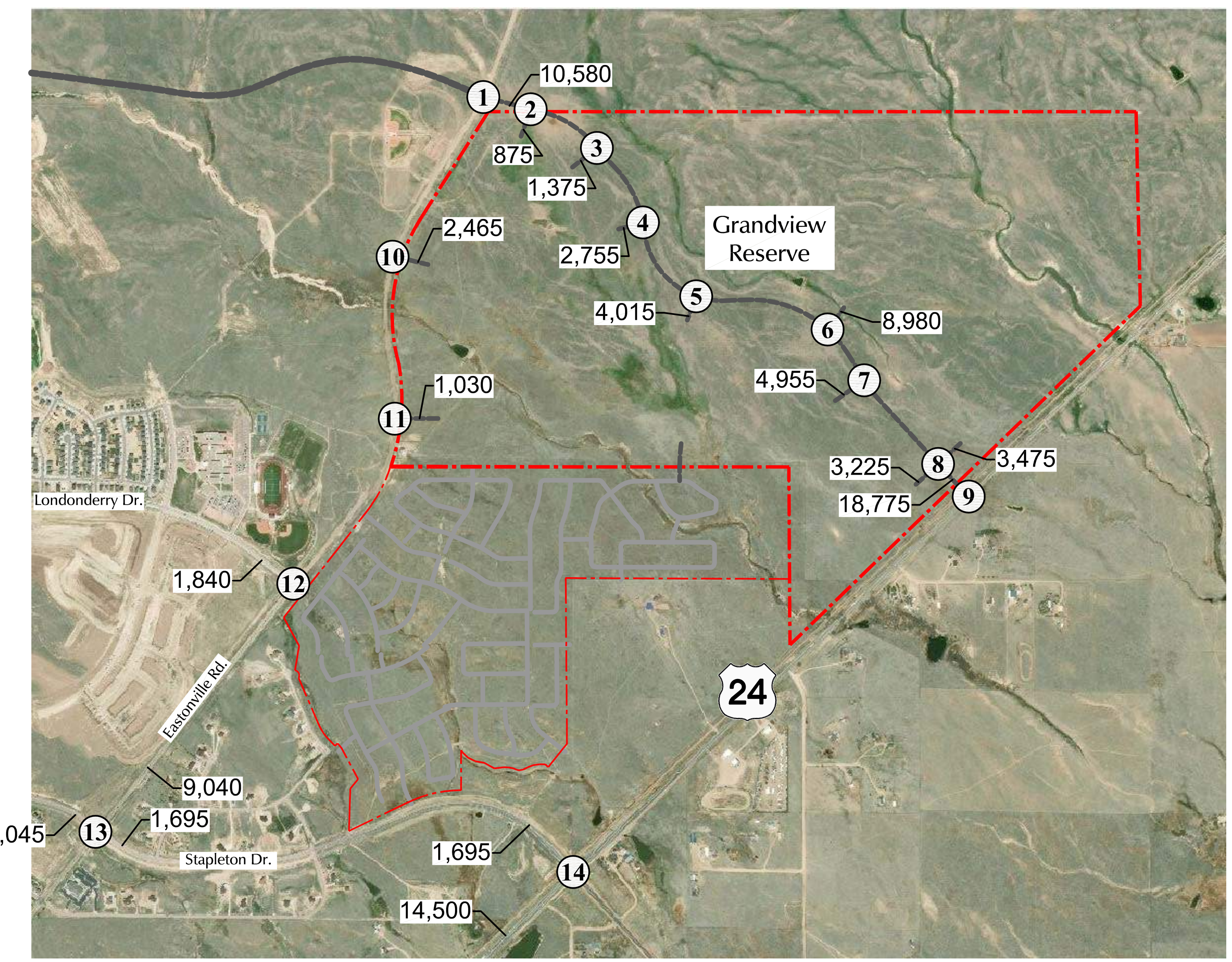


LEGEND:

XX/XX = AM Weekday Peak-Hour Traffic (vehicles per hour) / PM Weekday Peak-Hour Traffic (vehicles per hour)

X,XXX= Annual Average Daily Traffic (vehicles per day)

Approximate Scale
Scale: 1"= 2,000'

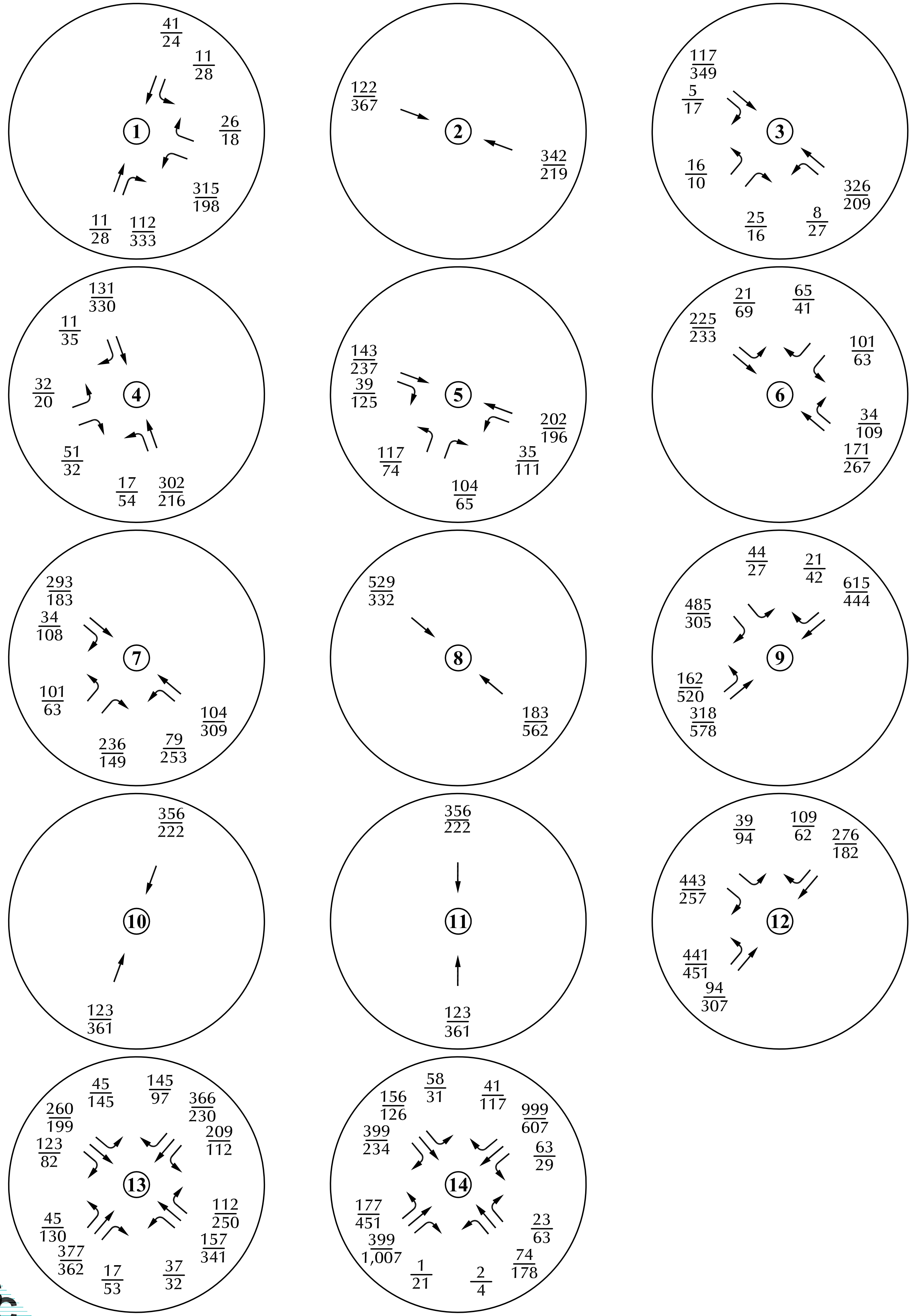


TRANSPORTATION CONSULTANTS, INC.

Figure 8

Assignment of Buildout Site-Generated Traffic

Grandview Reserve (LSC #184840)



LEGEND:

XX/XX = AM Weekday Peak-Hour Traffic (vehicles per hour) / PM Weekday Peak-Hour Traffic (vehicles per hour)

X,XXX= Annual Average Daily Traffic (vehicles per day)

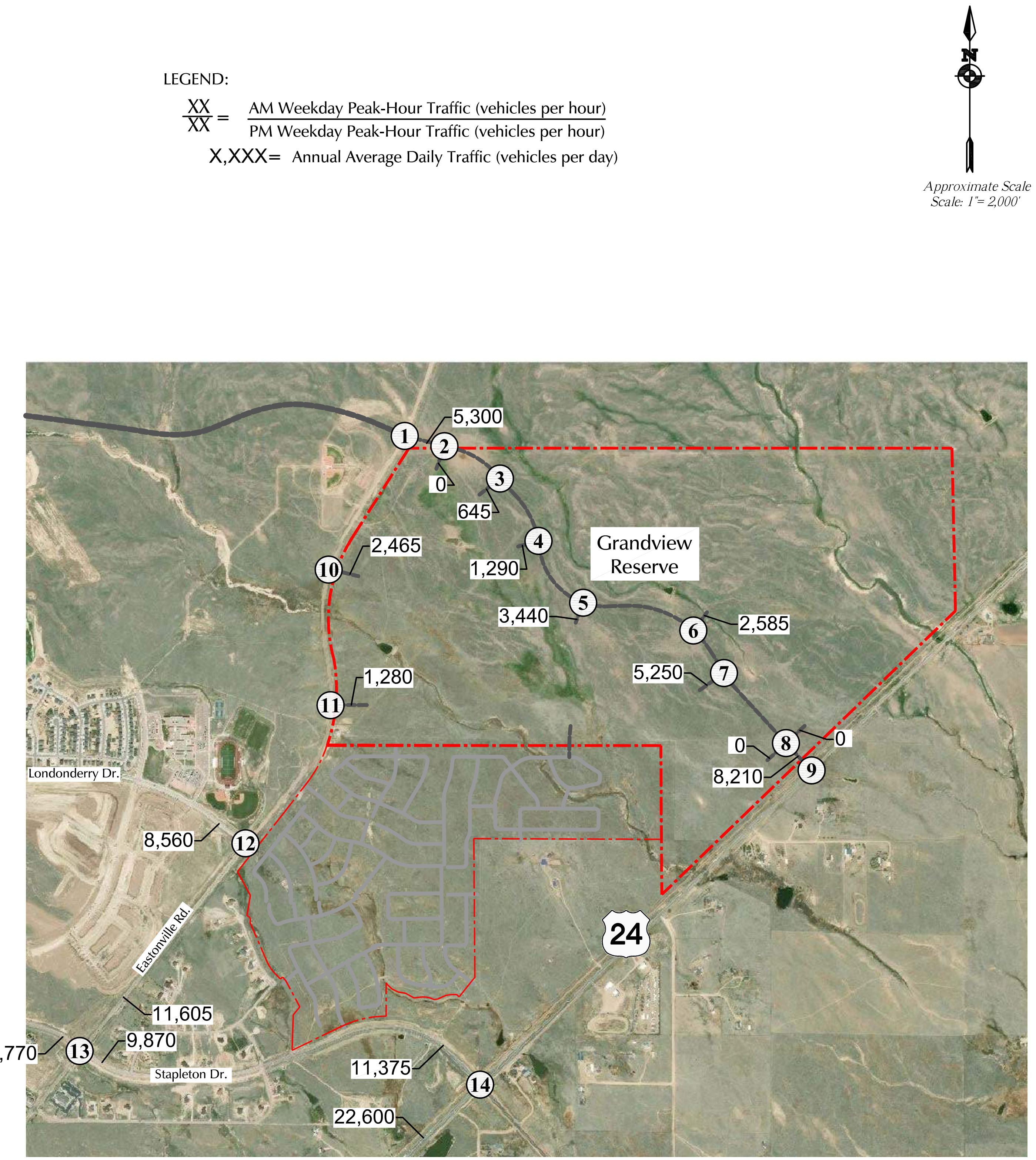
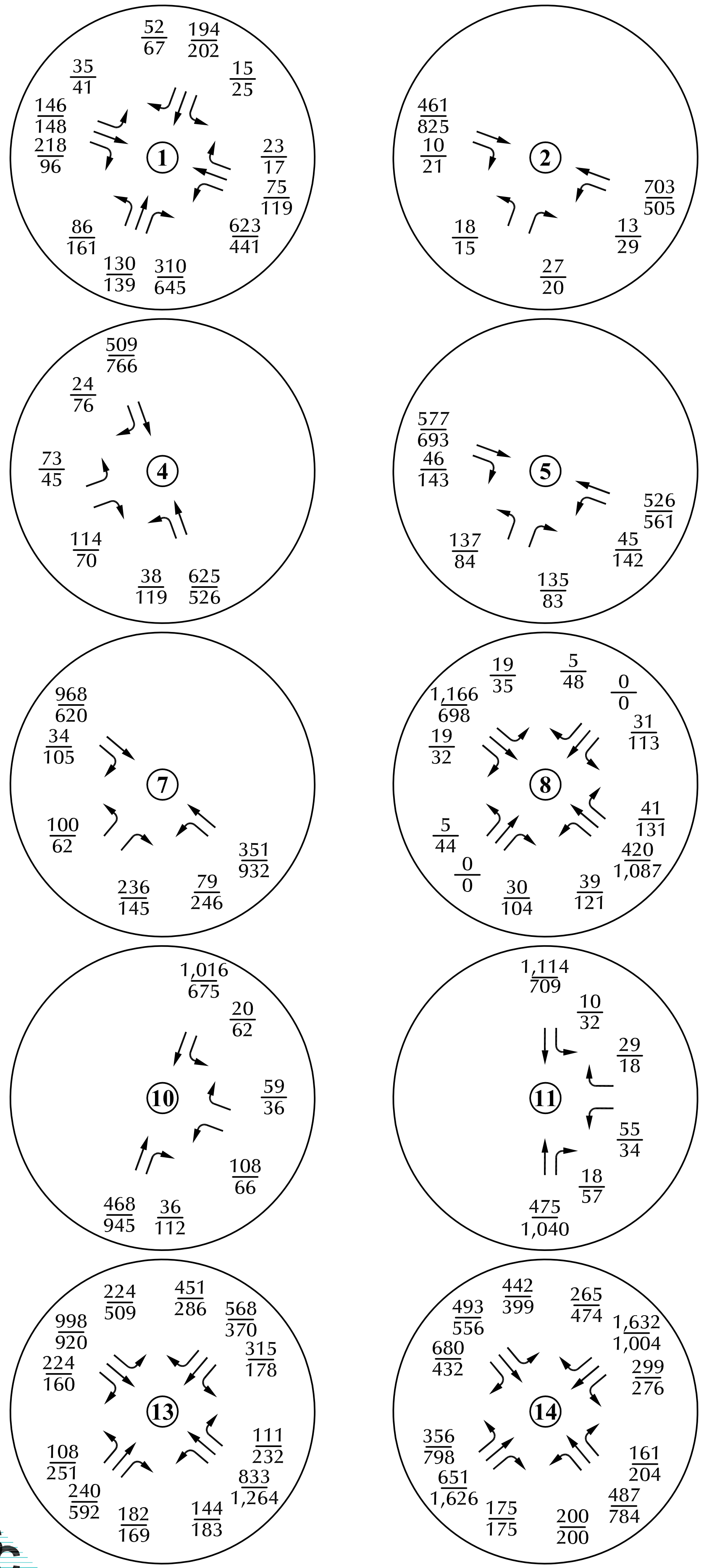


Figure 9

Short-Term Total Traffic

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.



LEGEND:

XX/XX = AM Weekday Peak-Hour Traffic (vehicles per hour) / PM Weekday Peak-Hour Traffic (vehicles per hour)

X,XXX= Annual Average Daily Traffic (vehicles per day)

Approximate Scale
Scale: 1"= 2,000'

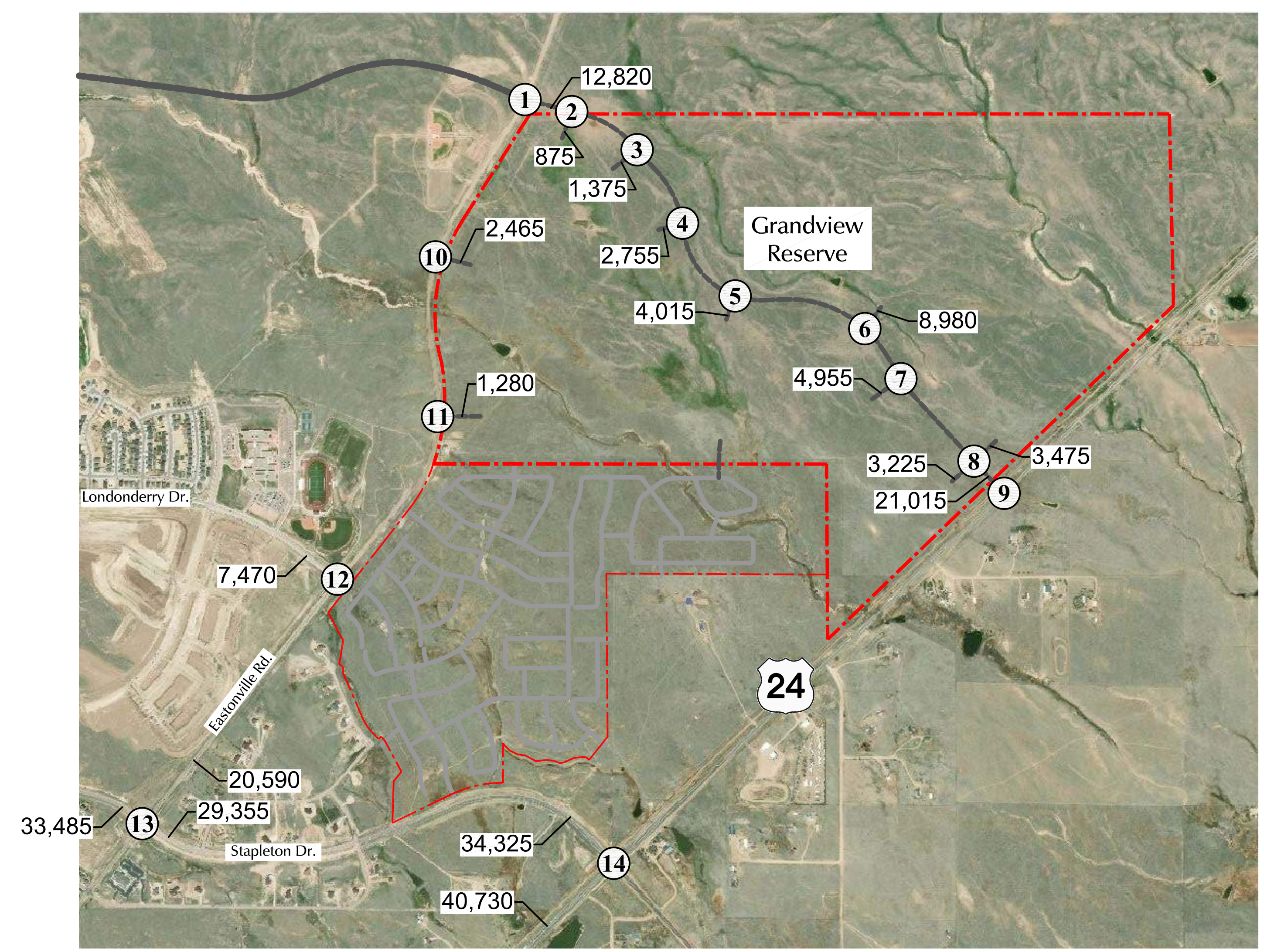


Figure 10

Year 2040 Total Traffic

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.

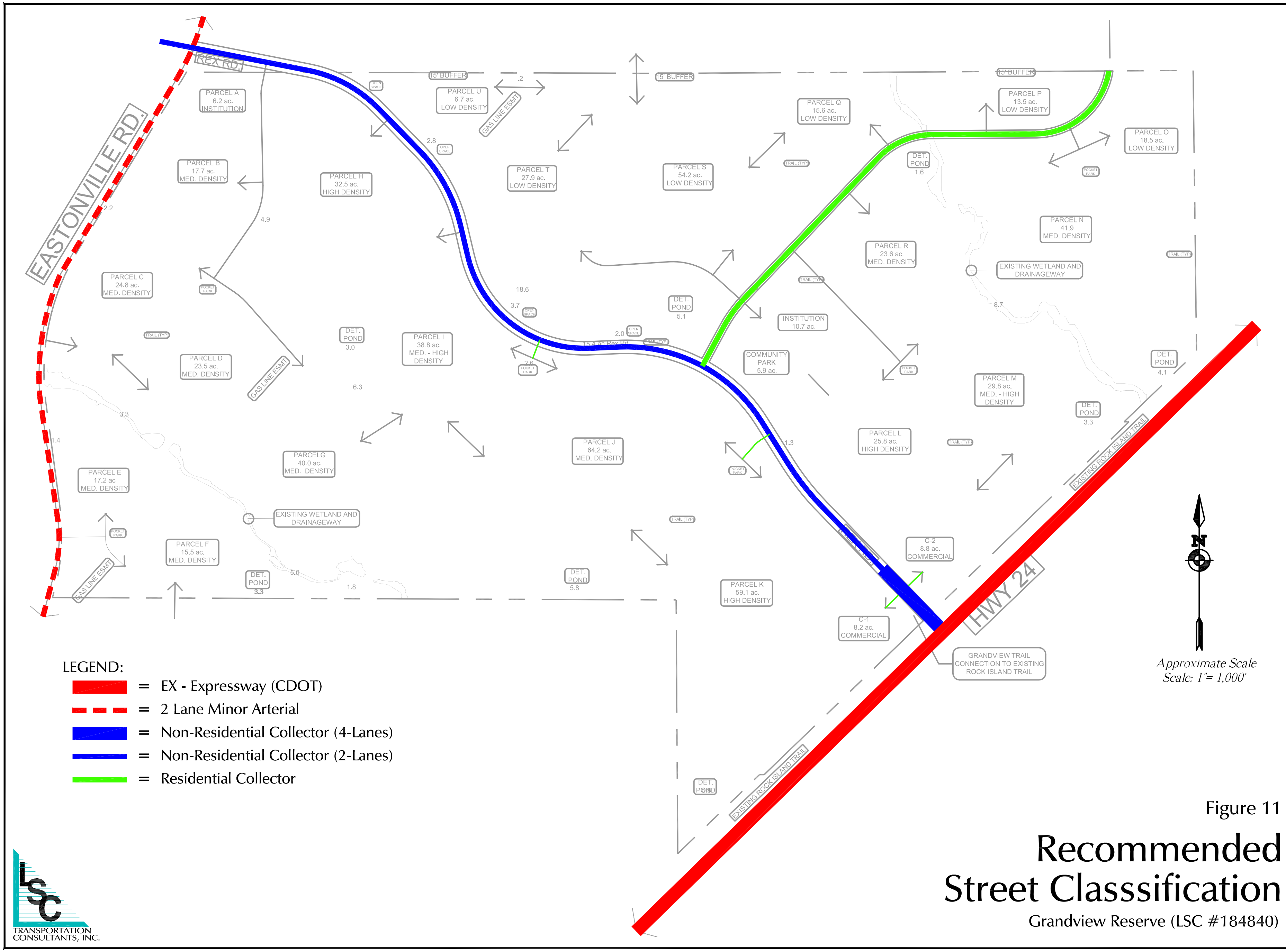


Figure 11

Recommended Street Classsification

Grandview Reserve (LSC #184840)

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MTCP Maps

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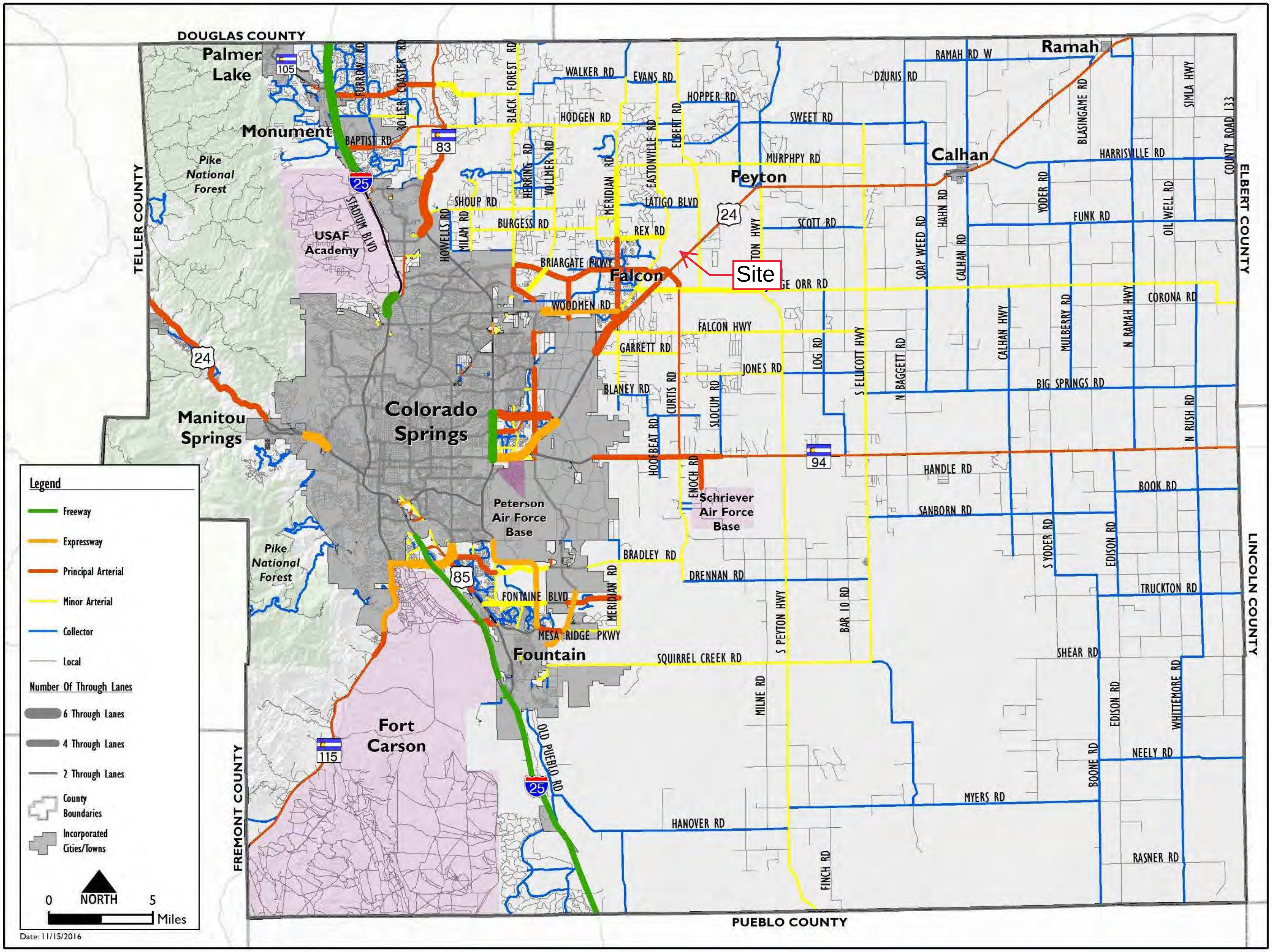
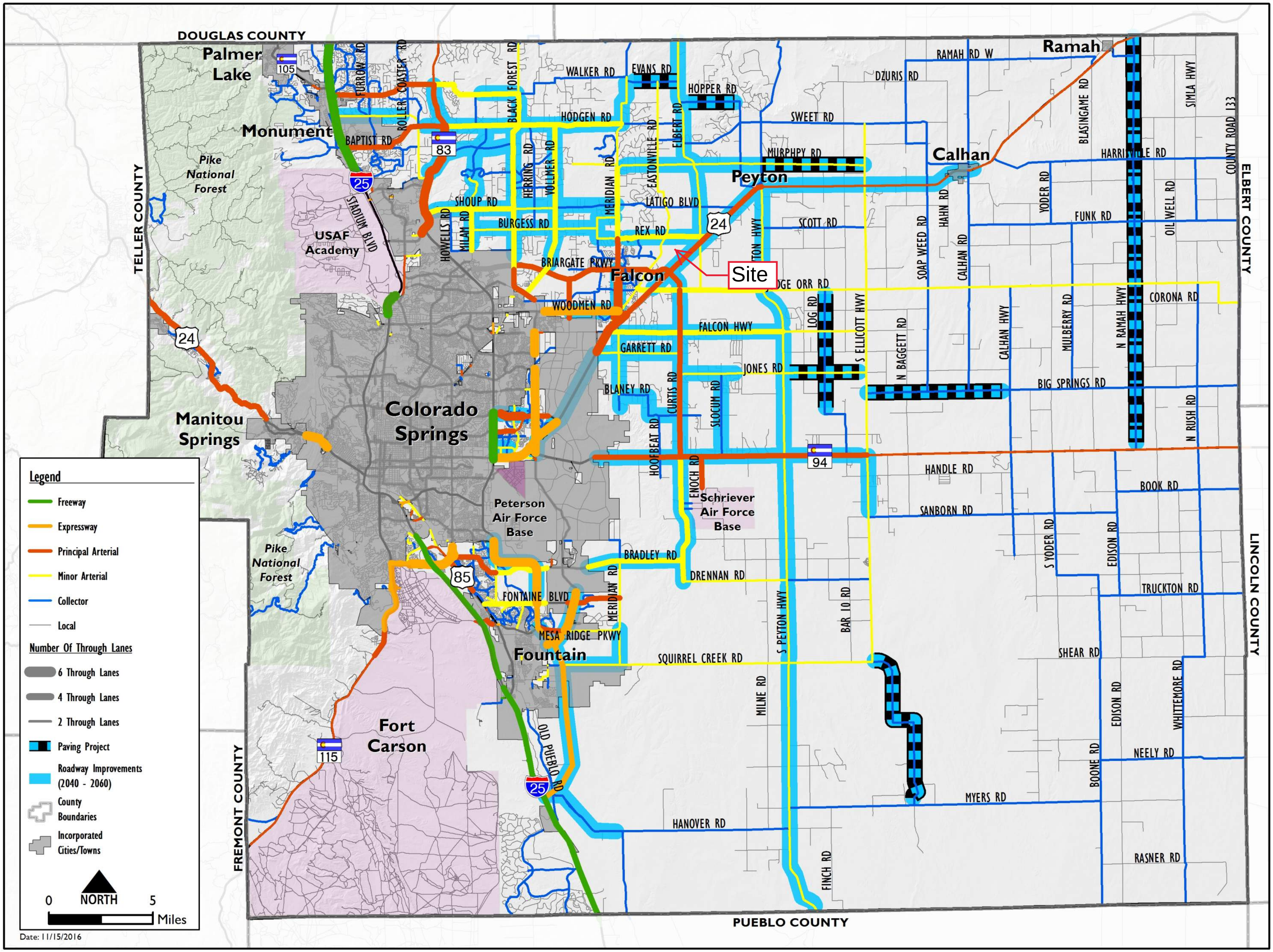


Map 14: 2040 Roadway Plan (Classification and Lanes)

Map 17: 2060 Corridor Preservation



NCHRP Report 684 Internal Trip Capture Estimation Tool

TRANSPORTATION
CONSULTANTS, INC.

NCHRP 684 Internal Trip Capture Estimation Tool			
Project Name:	Grandview Reserve	**Organization:**	LSC Transportation Consultants, Inc.
Project Location:	Rex/US 24	**Performed By:**	KDF
Scenario Description:	Buildout	**Date:**	3/9/2020
Analysis Year:	2040	**Checked By:**	
Analysis Period:	**AM Street Peak Hour**	**Date:**	

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail				218	135	83
Restaurant				0		
Cinema/Entertainment				0		
Residential				2,320	580	1,740
Hotel				0		
All Other Land Uses[2]				352	191	161
				2,890	906	1,984

Table 2-A: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized	Veh. Occ.[4]	% Transit	% Non-Motorized
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		0	0	12	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	17	0	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary

	Total	Entering	Exiting
All Person-Trips	2,890	906	1,984
Internal Capture Percentage	2%	3%	1%
External Vehicle-Trips[5]	2,832	877	1,955
External Transit-Trips[6]	0	0	0
External Non-Motorized Trips[6]	0	0	0

Table 6-A: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	13%	14%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	2%	1%
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

[2]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

[3]Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).

[4]Enter vehicle occupancy assumed in Table 1-A vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made to Tables 5-A, 9-A (O and D). Enter transit, non-motorized percentages that will result with proposed mixed-use project complete.

[5]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A.

[6]Person-Trips

*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

Project Name:	Grandview Reserve
Analysis Period:	**AM Street Peak Hour**

Table 7-A: Conversion of Vehicle-Trip Ends to Person-Trip Ends							
Land Use	Table 7-A (D): Entering Trips				Table 7-A (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*		Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0		1.00	0	0
Retail	1.00	135	135		1.00	83	83
Restaurant	1.00	0	0		1.00	0	0
Cinema/Entertainment	1.00	0	0		1.00	0	0
Residential	1.00	580	580		1.00	1740	1740
Hotel	1.00	0	0		1.00	0	0

Table 8-A (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	24		11	0	12	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	35	17	348	0		0
Hotel	0	0	0	0	0	

Table 8-A (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		43	0	0	0	0
Retail	0		0	0	12	0
Restaurant	0	11		0	29	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	23	0	0		0
Hotel	0	5	0	0	0	

Table 9-A (D): Internal and External Trips Summary (Entering Trips)							
Destination Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0		0	0	0
Retail	17	118	135		118	0	0
Restaurant	0	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	12	568	580		568	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	191	191		191	0	0

Table 9-A (O): Internal and External Trips Summary (Exiting Trips)							
Origin Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0		0	0	0
Retail	12	71	83		71	0	0
Restaurant	0	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	17	1723	1740		1723	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	161	161		161	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A
[2]Person-Trips
[3]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator
*Indicates computation that has been rounded to the nearest whole number.

NCHRP 684 Internal Trip Capture Estimation Tool				
Project Name:	Grandview Reserve		**Organization:**	LSC Transportation Consultants, Inc.
Project Location:	Rex/US 24		**Performed By:**	KDF
Scenario Description:	Buildout		**Date:**	3/9/2020
Analysis Year:	2040		**Checked By:**	
Analysis Period:	**PM Street Peak Hour**		**Date:**	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)				Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units		Total	Entering	Exiting
Office					0		
Retail					671	322	349
Restaurant					0		
Cinema/Entertainment					0		
Residential					2,882	1,816	1,066
Hotel					0		
All Other Land Uses[2]					107	51	56
					3,660	2,189	1,471

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips				Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized		Veh. Occ.[4]	% Transit	% Non-Motorized
Office							
Retail							
Restaurant							
Cinema/Entertainment							
Residential							
Hotel							
All Other Land Uses[2]							

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail					2640	
Restaurant						
Cinema/Entertainment						
Residential		2640				
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		0	0	40	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	3	0	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary

	Total	Entering	Exiting
All Person-Trips	3,660	2,189	1,471
Internal Capture Percentage	2%	2%	3%
External Vehicle-Trips[5]	3,574	2,146	1,428
External Transit-Trips[6]	0	0	0
External Non-Motorized Trips[6]	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	1%	11%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	2%	0%
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.
[2]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.
[3]Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).
[4]Enter vehicle occupancy assumed in Table 1-P vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be
[5]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P.
[6]Person-Trips
*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

Project Name:	Grandview Reserve
Analysis Period:	**PM Street Peak Hour**

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-P (D): Entering Trips				Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*		Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0		1.00	0	0
Retail	1.00	322	322		1.00	349	349
Restaurant	1.00	0	0		1.00	0	0
Cinema/Entertainment	1.00	0	0		1.00	0	0
Residential	1.00	1816	1816		1.00	1066	1066
Hotel	1.00	0	0		1.00	0	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	7		101	14	40	17
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	43	45	224	0		32
Hotel	0	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		26	0	0	73	0
Retail	0		0	0	835	0
Restaurant	0	161		0	291	0
Cinema/Entertainment	0	13	0		73	0
Residential	0	3	0	0		0
Hotel	0	6	0	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0		0	0	0
Retail	3	319	322		319	0	0
Restaurant	0	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	40	1776	1816		1776	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	51	51		51	0	0

Table 9-P (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0		0	0	0
Retail	40	309	349		309	0	0
Restaurant	0	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0	0
Residential	3	1063	1066		1063	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	56	56		56	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P
[2]Person-Trips
[3]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator
*Indicates computation that has been rounded to the nearest whole number.

Traffic Counts

TRANSPORTATION
CONSULTANTS, INC.

LSC Transportation Consultants, Inc.

545 E Pikes Peak Ave, Suite 210
Colorado Springs, CO 80905
719-633-2868

File Name : Eastonville Rd - Londonderry Dr AM 12-18
Site Code : 184750
Start Date : 12/11/2018

Groups Printed- Unshifted

	Eastonville Rd Southbound				Westbound				Eastonville Rd Northbound				Londonderry Dr Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30	0	3	1	0	0	0	0	0	19	2	0	0	1	0	39	0	65
06:45	0	0	5	0	0	0	0	0	55	0	0	0	0	0	67	0	127
Total	0	3	6	0	0	0	0	0	74	2	0	0	1	0	106	0	192
07:00	0	5	7	0	0	0	0	0	142	3	0	0	1	0	72	0	230
07:15	0	4	8	0	0	0	0	0	132	1	0	0	3	0	85	0	233
07:30	0	2	1	0	0	0	0	0	29	1	0	0	2	0	31	0	66
07:45	0	4	1	0	0	0	0	0	26	0	0	0	0	0	26	0	57
Total	0	15	17	0	0	0	0	0	329	5	0	0	6	0	214	0	586
08:00	0	2	3	0	0	0	0	0	19	2	0	0	2	0	36	0	64
08:15	0	2	2	0	0	0	0	0	17	1	0	0	1	0	22	0	45
Grand Total	0	22	28	0	0	0	0	0	439	10	0	0	10	0	378	0	887
Apprch %	0	44	56	0	0	0	0	0	97.8	2.2	0	0	2.6	0	97.4	0	
Total %	0	2.5	3.2	0	0	0	0	0	49.5	1.1	0	0	1.1	0	42.6	0	

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545 E Pikes Peak Ave, Suite 210
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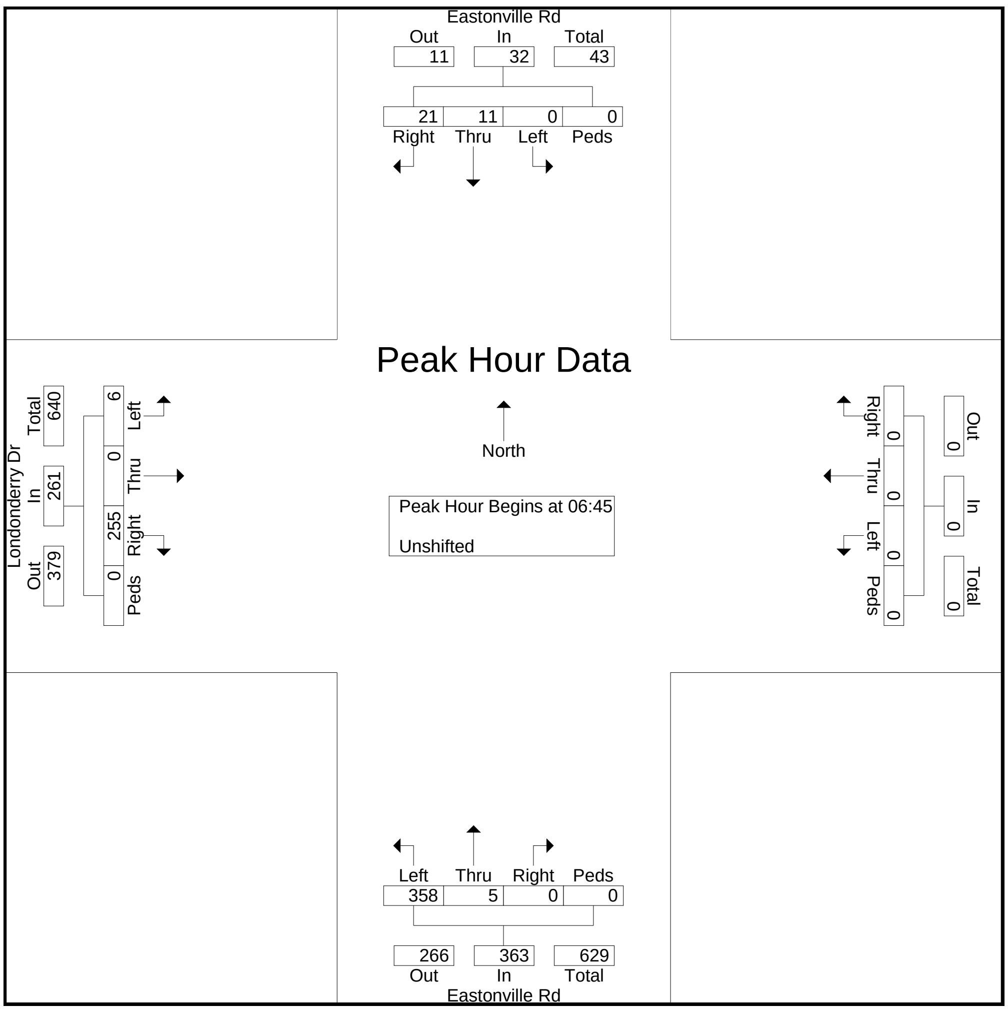
719-633-2868

File Name : Eastonville Rd - Londonderry Dr AM 12-18
Site Code : 184750
Start Date : 12/11/2018
Page No : 2

	Eastonville Rd Southbound					Westbound					Eastonville Rd Northbound					Londonderry Dr Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 to 08:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:45																					
06:45	0	0	5	0	5	0	0	0	0	0	55	0	0	0	55	0	0	67	0	67	127
07:00	0	**5**	7	0	**12**	0	0	0	0	0	**142**	**3**	0	0	**145**	1	0	72	0	73	230
07:15	0	4	**8**	0	12	0	0	0	0	0	132	1	0	0	133	**3**	0	**85**	0	**88**	**233**
07:30	0	2	1	0	3	0	0	0	0	0	29	1	0	0	30	2	0	31	0	33	66
Total Volume	0	11	21	0	32	0	0	0	0	0	358	5	0	0	363	6	0	255	0	261	656
% App. Total	0	34.4	65.6	0		0	0	0	0		98.6	1.4	0	0		2.3	0	97.7	0		
PHF	.000	.550	.656	.000	.667	.000	.000	.000	.000	.000	.630	.417	.000	.000	.626	.500	.000	.750	.000	.741	.704



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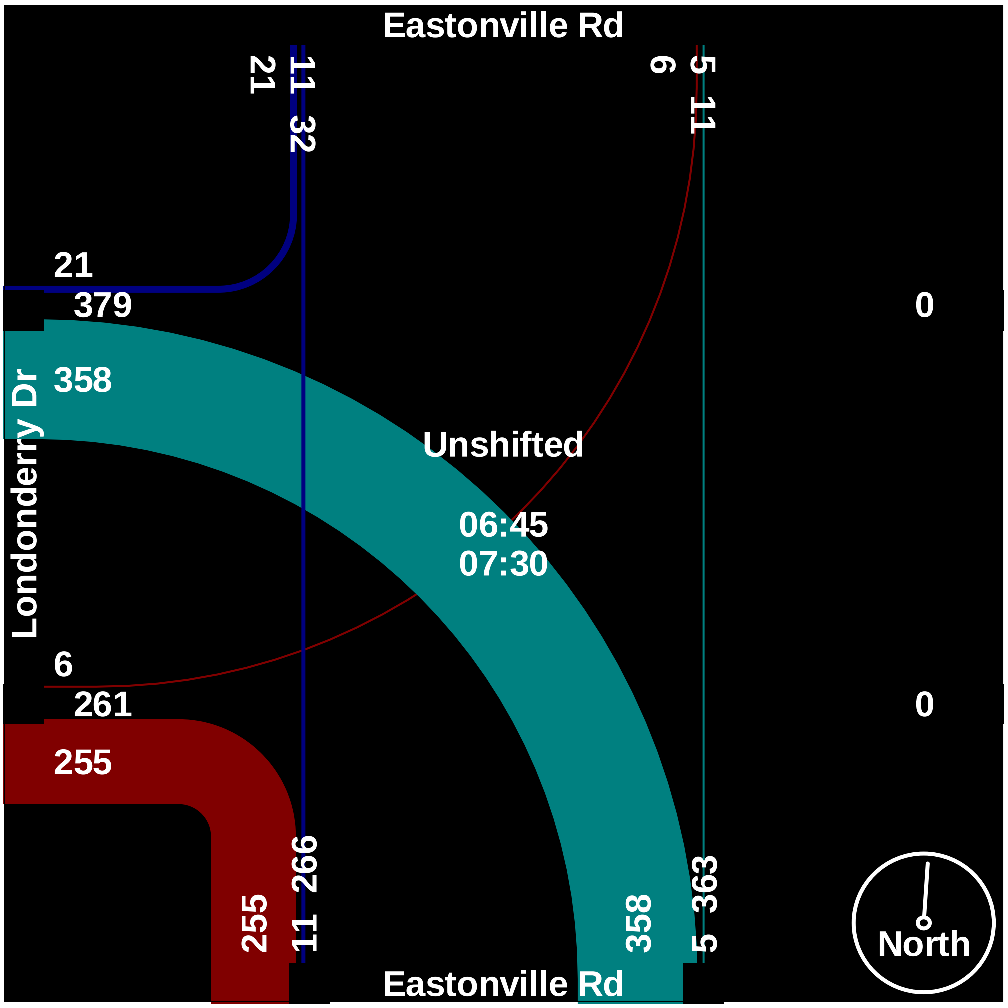
File Name : Eastonville Rd - Londonderry Dr AM 12-18
Site Code : 184750
Start Date : 12/11/2018
Page No : 3



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File Name : Eastonville Rd - Londonderry Dr PM 12-18
Site Code : 184750
Start Date : 12/11/2018
Page No : 1

Groups Printed- Unshifted

	Eastonville Rd Southbound				Westbound				Eastonville Rd Northbound				Londonderry Dr Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
16:00	0	4	1	0	0	0	0	0	52	6	0	0	0	0	53	0	116
16:15	0	3	1	0	0	0	0	0	52	7	0	0	0	0	17	0	80
16:30	0	5	0	0	0	0	0	0	49	8	0	0	1	0	29	0	92
16:45	0	3	0	0	0	0	0	0	44	1	0	0	2	0	29	0	79
Total	0	15	2	0	0	0	0	0	197	22	0	0	3	0	128	0	367
17:00	0	1	1	0	0	0	0	0	37	7	0	0	0	0	21	0	67
17:15	0	1	1	0	0	0	0	0	68	5	0	0	0	0	23	0	98
17:30	0	7	1	0	0	0	0	0	53	2	0	0	1	0	11	0	75
17:45	0	3	1	0	0	0	0	0	46	2	0	0	1	0	13	0	66
Total	0	12	4	0	0	0	0	0	204	16	0	0	2	0	68	0	306
Grand Total	0	27	6	0	0	0	0	0	401	38	0	0	5	0	196	0	673
Apprch %	0	81.8	18.2	0	0	0	0	0	91.3	8.7	0	0	2.5	0	97.5	0	
Total %	0	4	0.9	0	0	0	0	0	59.6	5.6	0	0	0.7	0	29.1	0	

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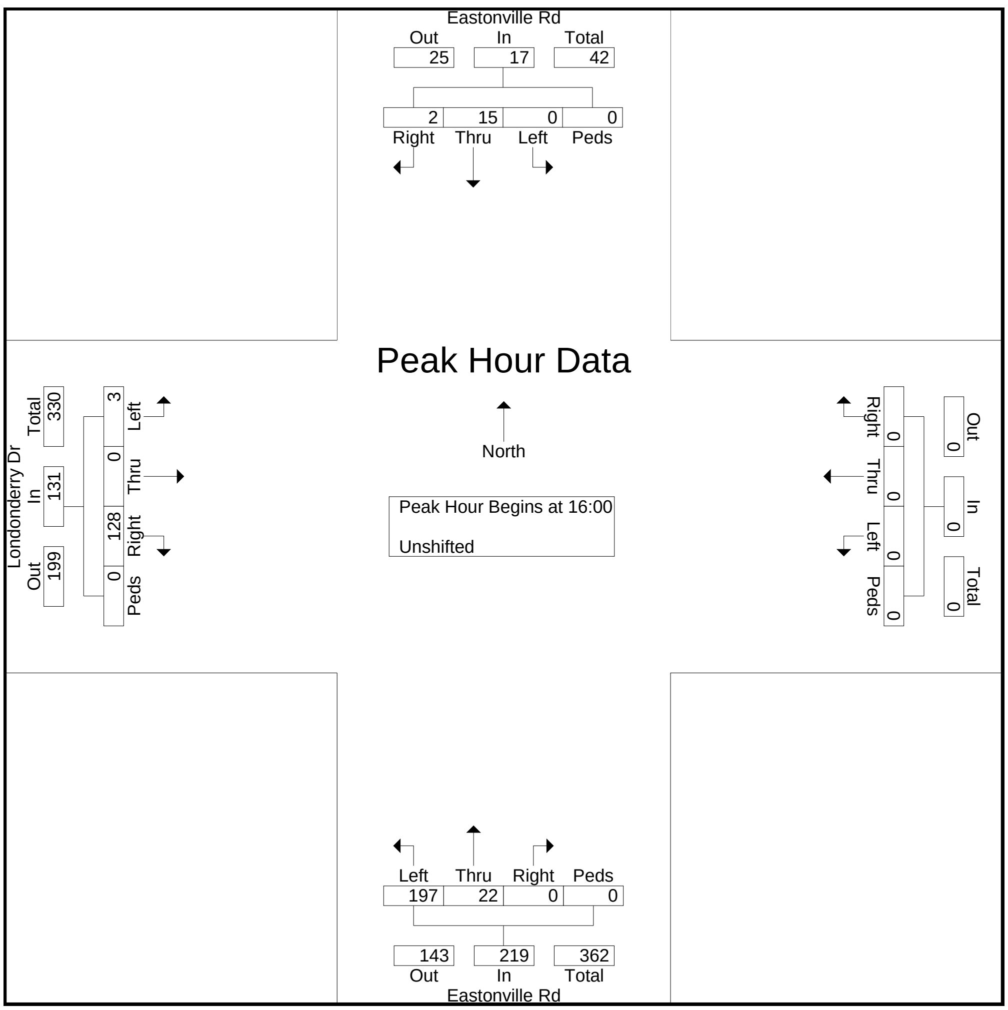
File Name : Eastonville Rd - Londonderry Dr PM 12-18
Site Code : 184750
Start Date : 12/11/2018
Page No : 2

	Eastonville Rd Southbound					Westbound					Eastonville Rd Northbound					Londonderry Dr Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:00																					
16:00	0	4	**1**	0	**5**	0	0	0	0	0	**52**	6	0	0	58	0	0	**53**	0	**53**	**116**
16:15	0	3	1	0	4	0	0	0	0	0	52	7	0	0	**59**	0	0	17	0	17	80
16:30	0	**5**	0	0	5	0	0	0	0	0	49	**8**	0	0	57	1	0	29	0	30	92
16:45	0	3	0	0	3	0	0	0	0	0	44	1	0	0	45	**2**	0	29	0	31	79
Total Volume	0	15	2	0	17	0	0	0	0	0	197	22	0	0	219	3	0	128	0	131	367
% App. Total	0	88.2	11.8	0		0	0	0	0		90	10	0	0		2.3	0	97.7	0		
PHF	.000	.750	.500	.000	.850	.000	.000	.000	.000	.000	.947	.688	.000	.000	.928	.375	.000	.604	.000	.618	.791



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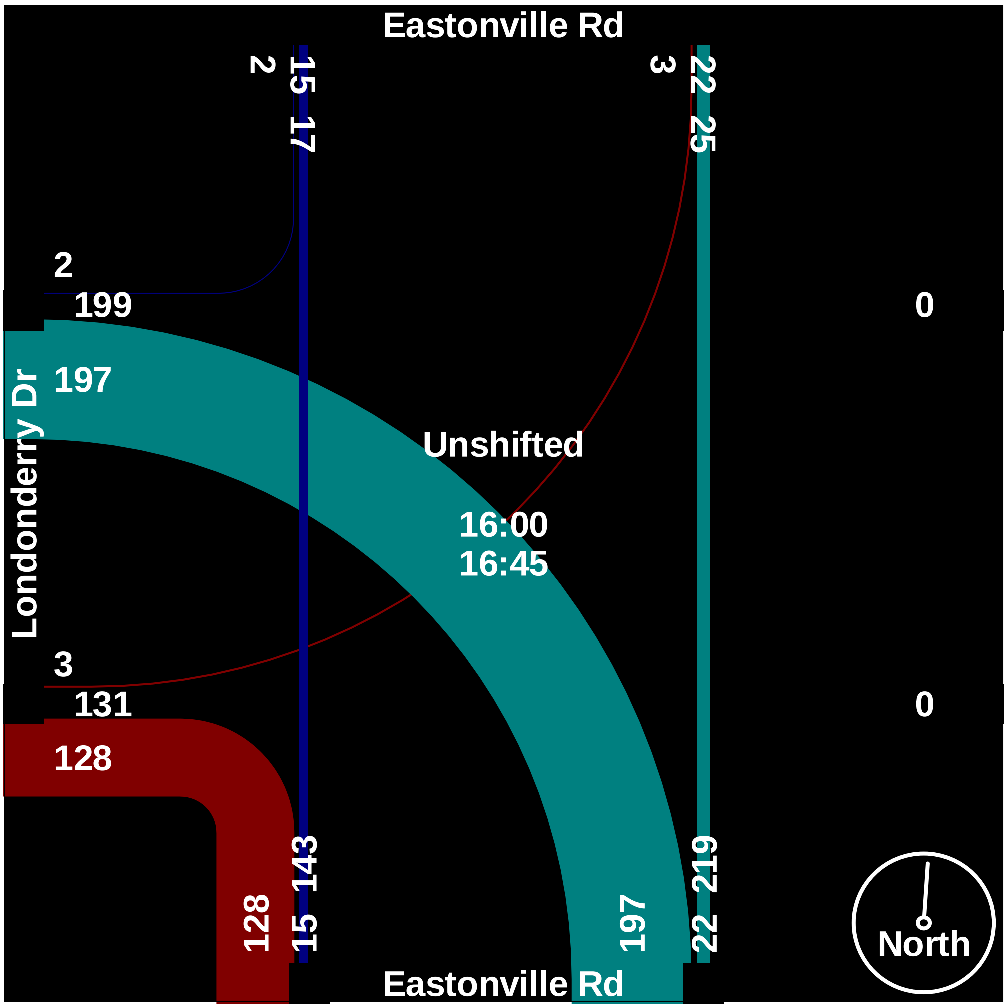
File Name : Eastonville Rd - Londonderry Dr PM 12-18
Site Code : 184750
Start Date : 12/11/2018
Page No : 3



Counts by LSC

LSC Transportation Consultants, Inc.

File Name : Eastonville Rd - Stapleton Dr 5-23-17 AM
Site Code : 00174350
Start Date : 05/23/2017
Page No : 1

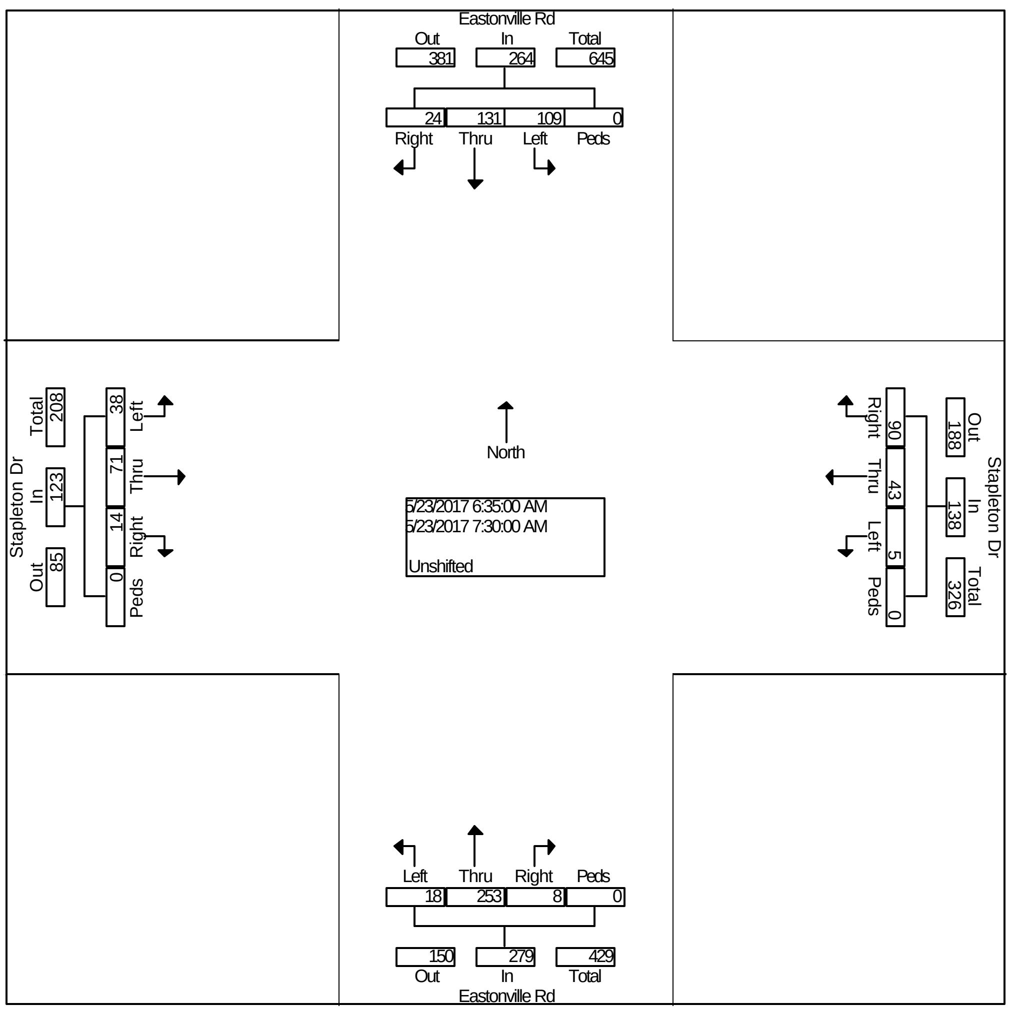
Groups Printed- Unshifted

	Eastonville Rd From North				Stapleton Dr From East				Eastonville Rd From South				Stapleton Dr From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
06:30 AM	1	11	18	0	9	1	0	0	0	30	1	0	1	12	5	0	89
06:45 AM	2	16	25	0	19	5	2	0	0	42	3	0	4	17	8	0	143
07:00 AM	10	46	24	0	35	9	1	0	0	111	6	0	6	19	18	0	285
07:15 AM	10	54	37	0	25	20	1	0	7	75	7	0	2	16	6	0	260
07:30 AM	2	14	19	0	7	25	2	0	2	3	3	0	2	21	5	0	105
07:45 AM	4	7	11	0	11	15	2	0	0	8	2	0	4	29	2	0	95
08:00 AM	0	11	11	0	14	11	1	0	0	9	0	1	0	25	2	0	85
08:15 AM	3	11	22	0	7	10	1	0	1	10	2	0	0	11	2	0	80
Grand Total	32	170	167	0	127	96	10	0	10	288	24	1	19	150	48	0	1142
Apprch %	8.7	46.1	45.3	0.0	54.5	41.2	4.3	0.0	3.1	89.2	7.4	0.3	8.8	69.1	22.1	0.0	
Total %	2.8	14.9	14.6	0.0	11.1	8.4	0.9	0.0	0.9	25.2	2.1	0.1	1.7	13.1	4.2	0.0	

Counts by LSC

File Name : Eastonville Rd - Stapleton Dr 5-23-17 AM
Site Code : 00174350
Start Date : 05/23/2017
Page No : 2

	Eastonville Rd From North					Stapleton Dr From East					Eastonville Rd From South					Stapleton Dr From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 06:30 AM to 08:25 AM - Peak 1 of 1																					
Intersection	06:35 AM																				
Volume	24	131	109	0	264	90	43	5	0	138	8	253	18	0	279	14	71	38	0	123	804
Percent	9.1	49.6	41.3	0.0		65.2	31.2	3.6	0.0		2.9	90.7	6.5	0.0		11.4	57.7	30.9	0.0		
07:10 Volume	3	18	8	0	29	15	4	0	0	19	0	38	1	0	39	2	6	7	0	15	102
Peak Factor																					0.657
High Int.	07:25 AM					07:10 AM					07:05 AM					07:05 AM					
Volume	2	23	14	0	39	15	4	0	0	19	0	39	3	0	42	3	7	5	0	15	
Peak Factor					0.564					0.605					0.554					0.683	



Counts by LSC

LSC Transportation Consultants, Inc.

File Name : Eastonville Rd - Stapleton Dr PM
Site Code : 00174350
Start Date : 05/11/2017
Page No : 1

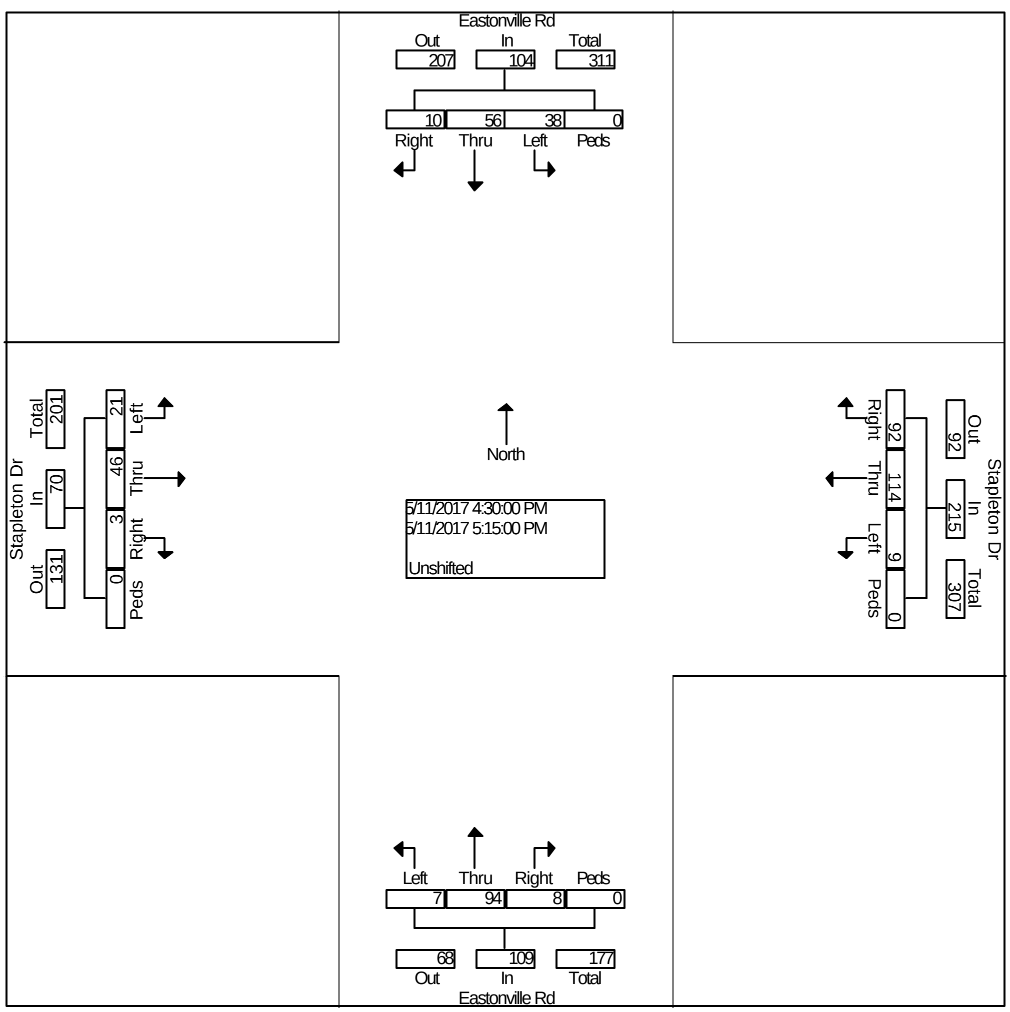
Groups Printed- Unshifted

	Eastonville Rd From North				Stapleton Dr From East				Eastonville Rd From South				Stapleton Dr From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
04:00 PM	2	19	12	0	16	19	1	0	1	23	1	0	1	13	2	0	110
04:15 PM	0	12	5	0	24	25	3	0	1	19	4	0	1	5	6	0	105
04:30 PM	3	16	12	0	16	35	5	0	2	19	3	0	2	9	9	0	131
04:45 PM	4	9	7	0	23	29	2	0	4	34	1	0	1	9	8	0	131
Total	9	56	36	0	79	108	11	0	8	95	9	0	5	36	25	0	477
05:00 PM	2	18	11	0	28	27	2	0	1	20	3	0	0	9	2	0	123
05:15 PM	1	13	8	0	25	23	0	0	1	21	0	0	0	19	2	0	113
05:30 PM	1	19	1	0	12	14	2	0	3	37	3	0	1	13	1	0	107
05:45 PM	1	16	1	0	11	13	1	0	2	31	1	0	1	9	1	0	88
Total	5	66	21	0	76	77	5	0	7	109	7	0	2	50	6	0	431
Grand Total	14	122	57	0	155	185	16	0	15	204	16	0	7	86	31	0	908
Apprch %	7.3	63.2	29.5	0.0	43.5	52.0	4.5	0.0	6.4	86.8	6.8	0.0	5.6	69.4	25.0	0.0	
Total %	1.5	13.4	6.3	0.0	17.1	20.4	1.8	0.0	1.7	22.5	1.8	0.0	0.8	9.5	3.4	0.0	

Counts by LSC

File Name : Eastonville Rd - Stapleton Dr PM
Site Code : 00174350
Start Date : 05/11/2017

	Eastonville Rd From North					Stapleton Dr From East					Eastonville Rd From South					Stapleton Dr From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:30 PM																				
Volume	10	56	38	0	104	92	114	9	0	215	8	94	7	0	109	3	46	21	0	70	498
Percent	9.6	53.8	36.5	0.0		42.8	53.0	4.2	0.0		7.3	86.2	6.4	0.0		4.3	65.7	30.0	0.0		
04:45 Volume	4	9	7	0	20	23	29	2	0	54	4	34	1	0	39	1	9	8	0	18	131
Peak Factor																					0.950
High Int.	04:30 PM					05:00 PM					04:45 PM					05:15 PM					
Volume	3	16	12	0	31	28	27	2	0	57	4	34	1	0	39	0	19	2	0	21	
Peak Factor					0.839					0.943					0.699					0.833	



LSC Transportation Consultants, Inc.
545 E Pikes Peak Ave, Suite 210
Colorado Springs, CO 80905
719-633-2868

File Name : Hwy 24 - Stapleton Rd AM 11-18
Site Code : 184750
Start Date : 11/15/2018

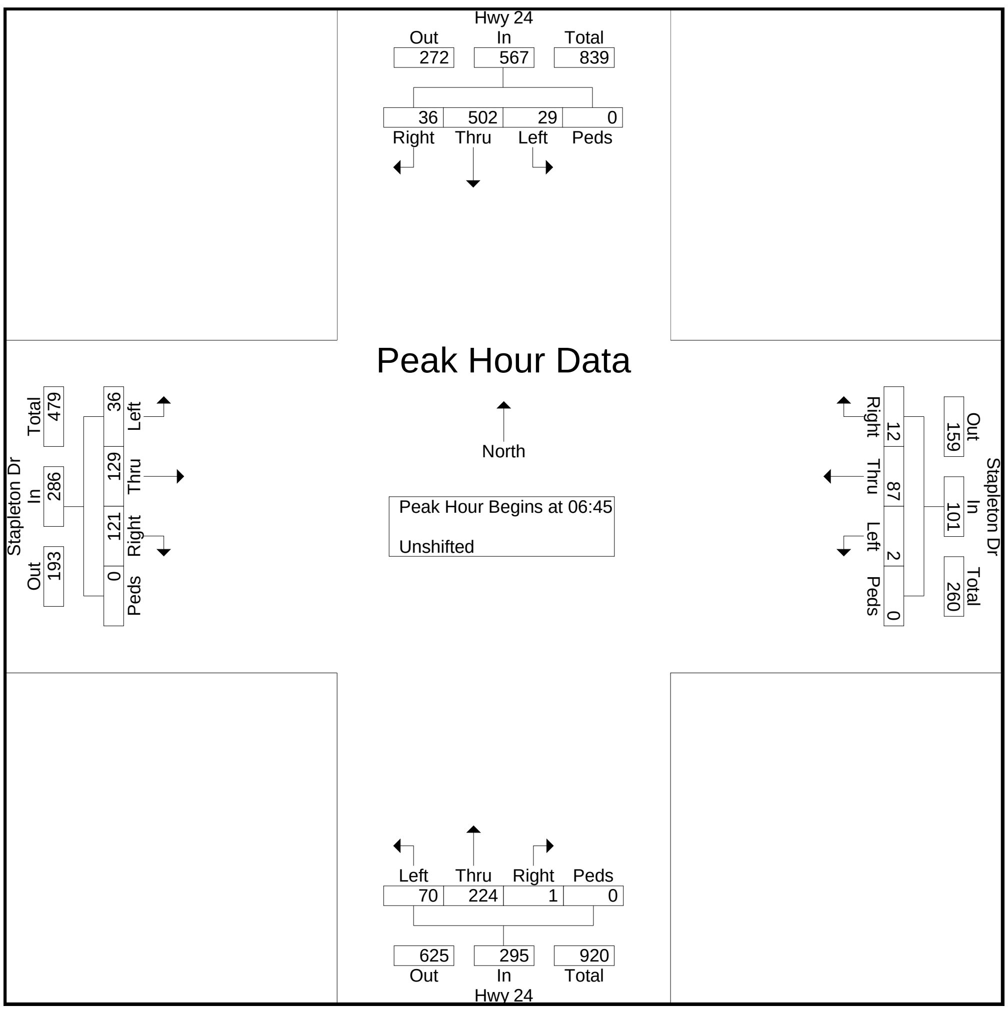
Groups Printed- Unshifted

	Hwy 24 Southbound				Stapleton Dr Westbound				Hwy 24 Northbound				Stapleton Dr Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
06:30	4	120	3	0	0	11	3	0	5	39	0	0	2	30	26	0	243
06:45	7	123	7	0	0	12	4	0	13	55	0	0	11	25	33	0	290
Total	11	243	10	0	0	23	7	0	18	94	0	0	13	55	59	0	533
07:00	9	125	8	0	1	22	4	0	24	70	0	0	12	37	33	0	345
07:15	7	139	11	0	0	29	4	0	18	51	0	0	10	39	27	0	335
07:30	6	115	10	0	1	24	0	0	15	48	1	0	3	28	28	0	279
07:45	6	106	9	0	0	11	4	0	6	43	1	0	5	19	19	0	229
Total	28	485	38	0	2	86	12	0	63	212	2	0	30	123	107	0	1188
08:00	2	74	6	0	4	11	2	0	13	66	0	0	1	10	17	0	206
08:15	3	86	5	0	3	9	0	0	8	60	2	0	2	9	13	0	200
Grand Total	44	888	59	0	9	129	21	0	102	432	4	0	46	197	196	0	2127
Apprch %	4.4	89.6	6	0	5.7	81.1	13.2	0	19	80.3	0.7	0	10.5	44.9	44.6	0	
Total %	2.1	41.7	2.8	0	0.4	6.1	1	0	4.8	20.3	0.2	0	2.2	9.3	9.2	0	

LSC Transportation Consultants, Inc.
545 E Pikes Peak Ave, Suite 210
Colorado Springs, CO 80905
719-633-2868

File Name : Hwy 24 - Stapleton Rd AM 11-18
Site Code : 184750
Start Date : 11/15/2018

	Hwy 24 Southbound					Stapleton Dr Westbound					Hwy 24 Northbound					Stapleton Dr Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:30 to 08:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:45																					
06:45	7	123	7	0	137	0	12	**4**	0	16	13	55	0	0	68	11	25	**33**	0	69	290
07:00	**9**	125	8	0	142	**1**	22	4	0	27	**24**	**70**	0	0	**94**	**12**	37	33	0	**82**	**345**
07:15	7	**139**	**11**	0	**157**	0	**29**	4	0	**33**	18	51	0	0	69	10	**39**	27	0	76	335
07:30	6	115	10	0	131	1	24	0	0	25	15	48	**1**	0	64	3	28	28	0	59	279
Total Volume	29	502	36	0	567	2	87	12	0	101	70	224	1	0	295	36	129	121	0	286	1249
% App. Total	5.1	88.5	6.3	0		2	86.1	11.9	0		23.7	75.9	0.3	0		12.6	45.1	42.3	0		
PHF	.806	.903	.818	.000	.903	.500	.750	.750	.000	.765	.729	.800	.250	.000	.785	.750	.827	.917	.000	.872	.905



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File Name : Hwy 24 - Stapleton Rd AM 11-18
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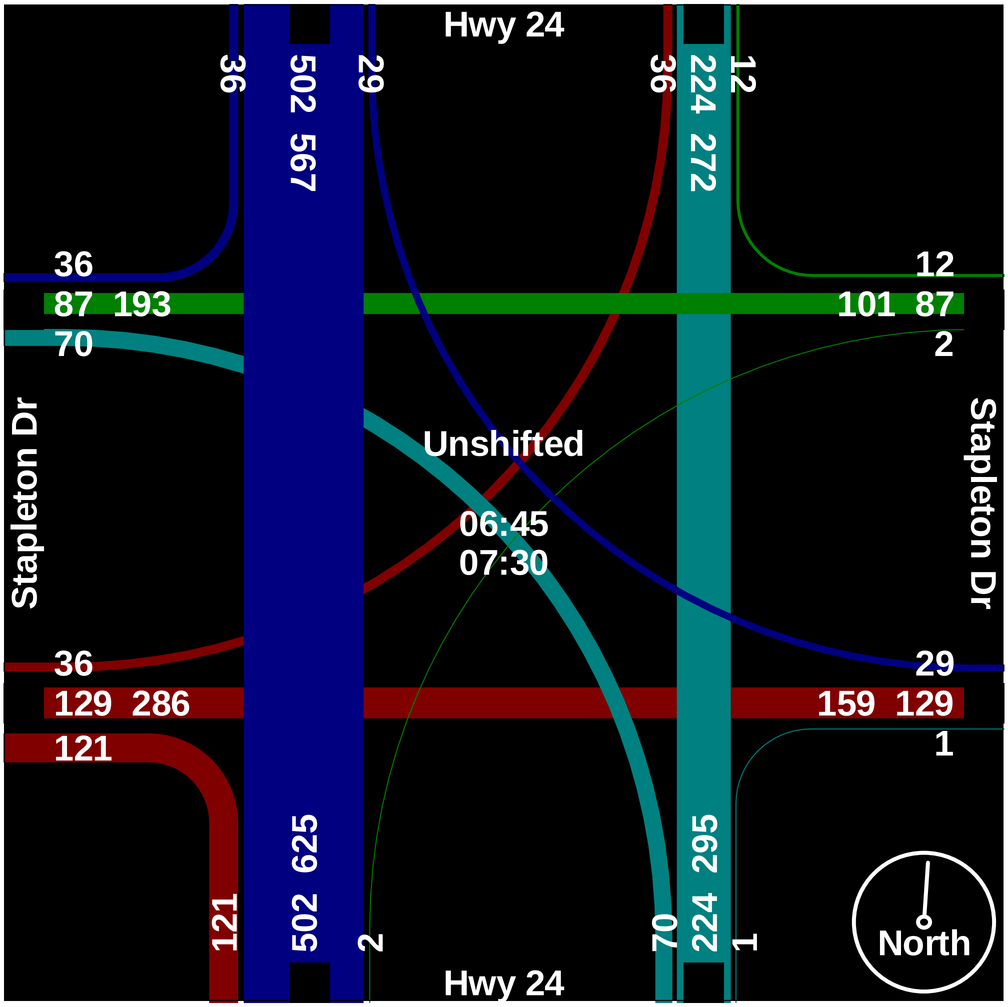

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File Name : Hwy 24 - Stapleton Rd PM 11-18
Site Code : 00184750
Start Date : 11/28/2018
Page No : 1

Groups Printed- Unshifted

	Hwy 24 Southbound				**Stapleton Rd Westbound**				**Hwy 24 Northbound**				**Stapleton Rd Eastbound**				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
16:00	4	73	11	0	1	20	6	0	20	127	5	0	5	6	11	0	289
16:15	1	73	9	0	3	31	5	0	13	100	5	1	7	5	9	0	262
16:30	3	85	3	0	1	23	7	0	28	96	4	0	2	6	13	0	271
16:45	4	73	9	0	1	29	7	0	32	98	6	0	5	7	14	0	285
Total	12	304	32	0	6	103	25	0	93	421	20	1	19	24	47	0	1107
17:00	2	94	2	0	0	22	5	0	18	138	4	0	0	10	16	0	311
17:15	1	74	7	0	2	23	9	0	29	109	7	0	7	15	13	0	296
17:30	1	63	4	0	1	23	6	0	20	133	4	0	5	8	7	0	275
17:45	4	55	4	0	1	15	6	0	18	136	5	0	4	8	6	0	262
Total	8	286	17	0	4	83	26	0	85	516	20	0	16	41	42	0	1144
Grand Total	20	590	49	0	10	186	51	0	178	937	40	1	35	65	89	0	2251
Apprch %	3	89.5	7.4	0	4	75.3	20.6	0	15.4	81.1	3.5	0.1	18.5	34.4	47.1	0	
Total %	0.9	26.2	2.2	0	0.4	8.3	2.3	0	7.9	41.6	1.8	0	1.6	2.9	4	0	

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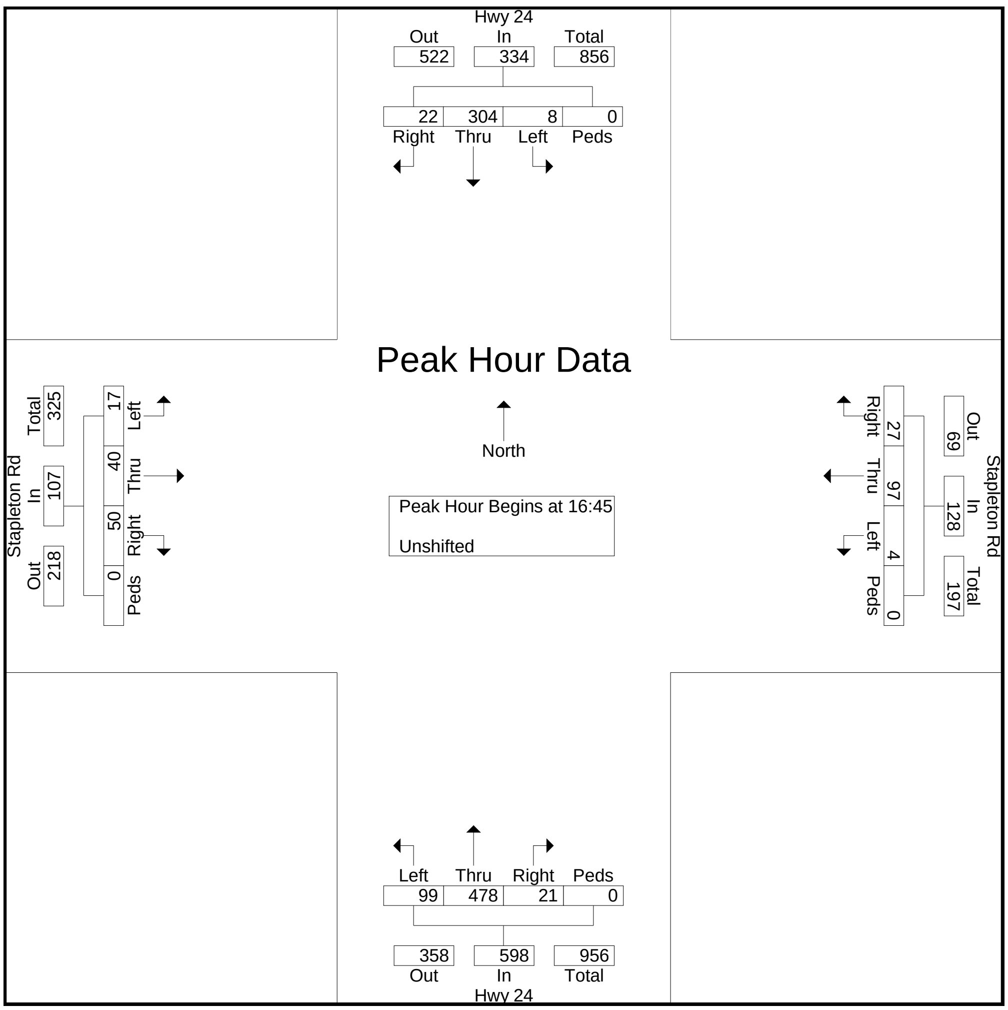
File Name : Hwy 24 - Stapleton Rd PM 11-18
Site Code : 00184750
Start Date : 11/28/2018

	Hwy 24 Southbound					Stapleton Rd Westbound					Hwy 24 Northbound					Stapleton Rd Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:45																					
16:45	**4**	73	**9**	0	86	1	**29**	7	0	**37**	**32**	98	6	0	136	5	7	14	0	26	285
17:00	2	**94**	2	0	**98**	0	22	5	0	27	18	**138**	4	0	**160**	0	10	**16**	0	26	**311**
17:15	1	74	7	0	82	**2**	23	**9**	0	34	29	109	**7**	0	145	**7**	**15**	13	0	**35**	296
17:30	1	63	4	0	68	1	23	6	0	30	20	133	4	0	157	5	8	7	0	20	275
Total Volume	8	304	22	0	334	4	97	27	0	128	99	478	21	0	598	17	40	50	0	107	1167
% App. Total	2.4	91	6.6	0		3.1	75.8	21.1	0		16.6	79.9	3.5	0		15.9	37.4	46.7	0		
PHF	.500	.809	.611	.000	.852	.500	.836	.750	.000	.865	.773	.866	.750	.000	.934	.607	.667	.781	.000	.764	.938



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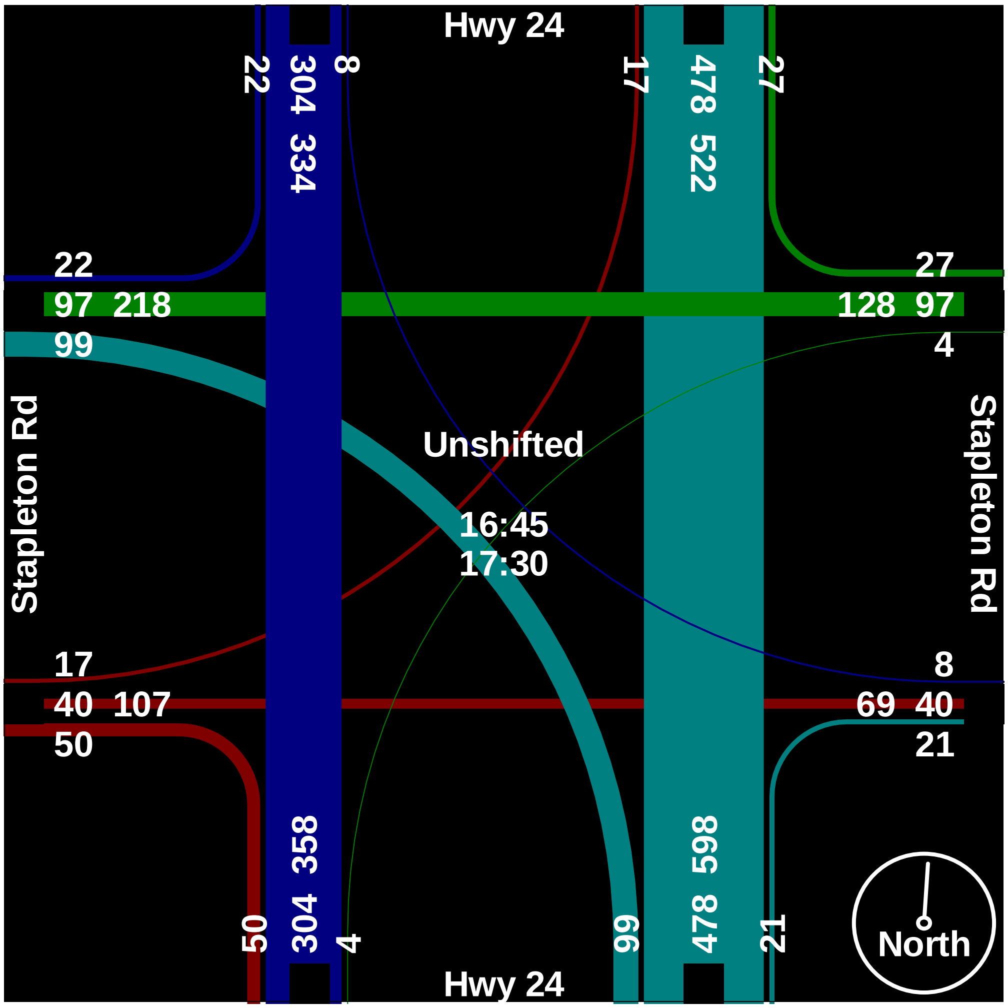


Levels of Service

TRANSPORTATION
CONSULTANTS, INC.

Intersection	
Int Delay, s/veh	24.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	38	71	14	5	43	90	18	253	8	110	131	24
Future Vol, veh/h	38	71	14	5	43	90	18	253	8	110	131	24
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	66	66	66	71	71	71	60	60	60	79	79	79
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	58	108	21	7	61	127	30	422	13	139	166	30

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1042	954	181	1013	963	429	196	0	0	435	0	0
Stage 1	459	459	-	489	489	-	-	-	-	-	-	-
Stage 2	583	495	-	524	474	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	208	259	862	217	256	626	1377	-	-	1125	-	-
Stage 1	582	566	-	561	549	-	-	-	-	-	-	-
Stage 2	498	546	-	537	558	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	114	217	862	114	214	626	1377	-	-	1125	-	-
Mov Cap-2 Maneuver	114	217	-	114	214	-	-	-	-	-	-	-
Stage 1	565	487	-	545	533	-	-	-	-	-	-	-
Stage 2	342	530	-	351	480	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	125.8	19.3	0.5	3.6
HCM LOS	F	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1377	-	-	182	196	626	1125	-	-
HCM Lane V/C Ratio	0.022	-	-	1.024	0.345	0.202	0.124	-	-
HCM Control Delay (s)	7.7	0	-	125.8	32.7	12.2	8.7	0	-
HCM Lane LOS	A	A	-	F	D	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	8.6	1.4	0.8	0.4	-	-

Intersection	
Int Delay, s/veh	8.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	6	255	358	5	11	21
Future Vol, veh/h	6	255	358	5	11	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	74	74	68	92	92	67
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	345	526	5	12	31

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1085	28	43	0	-	0
Stage 1	28	-	-	-	-	-
Stage 2	1057	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	240	1047	1566	-	-	-
Stage 1	995	-	-	-	-	-
Stage 2	334	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	159	1047	1566	-	-	-
Mov Cap-2 Maneuver	159	-	-	-	-	-
Stage 1	660	-	-	-	-	-
Stage 2	334	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	8.4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1566	-	159	1047	-	-
HCM Lane V/C Ratio	0.336	-	0.051	0.329	-	-
HCM Control Delay (s)	8.5	0	28.9	10.1	-	-
HCM Lane LOS	A	A	D	B	-	-
HCM 95th %tile Q(veh)	1.5	-	0.2	1.4	-	-

Intersection	
Int Delay, s/veh	12.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	36	129	121	2	87	12	70	224	1	29	502	36
Future Vol, veh/h	36	129	121	2	87	12	70	224	1	29	502	36
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	185	-	325	225	-	225	1000	-	0	785	-	785
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	94	94	94	78	78	78	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	41	148	139	2	93	13	90	287	1	29	502	36

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1081	1028	502	1189	1063	287	538	0	0	288	0	0
Stage 1	560	560	-	467	467	-	-	-	-	-	-	-
Stage 2	521	468	-	722	596	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	195	234	569	165	223	752	1030	-	-	1274	-	-
Stage 1	513	511	-	576	562	-	-	-	-	-	-	-
Stage 2	539	561	-	418	492	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	113	209	569	49	199	752	1030	-	-	1274	-	-
Mov Cap-2 Maneuver	113	209	-	49	199	-	-	-	-	-	-	-
Stage 1	468	499	-	526	513	-	-	-	-	-	-	-
Stage 2	396	512	-	217	481	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	37.6	35.4	2.1	0.4
HCM LOS	E	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1030	-	-	113	209	569	49	199	752	1274	-	-
HCM Lane V/C Ratio	0.087	-	-	0.366	0.709	0.244	0.043	0.465	0.017	0.023	-	-
HCM Control Delay (s)	8.8	-	-	54.2	55.7	13.4	81.8	37.9	9.9	7.9	-	-
HCM Lane LOS	A	-	-	F	F	B	F	E	A	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	1.5	4.6	1	0.1	2.2	0.1	0.1	-	-

Intersection	
Int Delay, s/veh	6.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	21	46	3	9	114	92	7	94	8	38	56	10
Future Vol, veh/h	21	46	3	9	114	92	7	94	8	38	56	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	250	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	97	97	97	100	100	100	68	68	68	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	22	47	3	9	114	92	10	138	12	38	56	10

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	404	307	61	326	306	144	66	0	0	150	0	0
Stage 1	137	137	-	164	164	-	-	-	-	-	-	-
Stage 2	267	170	-	162	142	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	557	607	1004	627	608	903	1536	-	-	1431	-	-
Stage 1	866	783	-	838	762	-	-	-	-	-	-	-
Stage 2	738	758	-	840	779	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	414	586	1004	571	587	903	1536	-	-	1431	-	-
Mov Cap-2 Maneuver	414	586	-	571	587	-	-	-	-	-	-	-
Stage 1	860	761	-	832	757	-	-	-	-	-	-	-
Stage 2	559	753	-	763	757	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	12.9	11.3	0.5	2.8
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1536	-	-	529	586	903	1431	-	-
HCM Lane V/C Ratio	0.007	-	-	0.136	0.21	0.102	0.027	-	-
HCM Control Delay (s)	7.4	0	-	12.9	12.8	9.4	7.6	0	-
HCM Lane LOS	A	A	-	B	B	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.5	0.8	0.3	0.1	-	-

Intersection	
Int Delay, s/veh	7.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	3	128	197	22	15	2
Future Vol, veh/h	3	128	197	22	15	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	62	62	94	94	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	206	210	23	18	2

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	462	19	20	0	-	0
Stage 1	19	-	-	-	-	-
Stage 2	443	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	558	1059	1596	-	-	-
Stage 1	1004	-	-	-	-	-
Stage 2	647	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	484	1059	1596	-	-	-
Mov Cap-2 Maneuver	484	-	-	-	-	-
Stage 1	870	-	-	-	-	-
Stage 2	647	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.3	6.8	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1596	-	484	1059	-	-
HCM Lane V/C Ratio	0.131	-	0.01	0.195	-	-
HCM Control Delay (s)	7.6	0	12.5	9.2	-	-
HCM Lane LOS	A	A	B	A	-	-
HCM 95th %tile Q(veh)	0.5	-	0	0.7	-	-

Intersection	
Int Delay, s/veh	6.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Vol, veh/h	17	40	50	4	97	27	99	478	23	8	304	22
Future Vol, veh/h	17	40	50	4	97	27	99	478	23	8	304	22
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	185	-	325	225	-	225	1000	-	0	785	-	785
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	93	93	93	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	17	40	50	4	97	27	106	514	25	9	358	26

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1177	1127	358	1160	1128	514	384	0	0	539	0	0
Stage 1	376	376	-	726	726	-	-	-	-	-	-	-
Stage 2	801	751	-	434	402	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	168	205	686	172	204	560	1174	-	-	1029	-	-
Stage 1	645	616	-	416	430	-	-	-	-	-	-	-
Stage 2	378	418	-	600	600	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	87	185	686	123	184	560	1174	-	-	1029	-	-
Mov Cap-2 Maneuver	87	185	-	123	184	-	-	-	-	-	-	-
Stage 1	587	610	-	379	391	-	-	-	-	-	-	-
Stage 2	246	380	-	515	595	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	25	37.3	1.4	0.2
HCM LOS	D	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1174	-	-	87	185	686	123	184	560	1029	-	-
HCM Lane V/C Ratio	0.091	-	-	0.195	0.216	0.073	0.033	0.527	0.048	0.009	-	-
HCM Control Delay (s)	8.4	-	-	56.2	29.7	10.7	35.3	44.5	11.8	8.5	-	-
HCM Lane LOS	A	-	-	F	D	B	E	E	B	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	0.7	0.8	0.2	0.1	2.7	0.2	0	-	-

Intersection	
Int Delay, s/veh	1.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	1	11	10	2	41
Future Vol, veh/h	10	1	11	10	2	41
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	1	13	12	2	48

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	65	13	0	0	25	0
Stage 1	13	-	-	-	-	-
Stage 2	52	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	941	1067	-	-	1589	-
Stage 1	1010	-	-	-	-	-
Stage 2	970	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	940	1067	-	-	1589	-
Mov Cap-2 Maneuver	940	-	-	-	-	-
Stage 1	1009	-	-	-	-	-
Stage 2	970	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.9	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	940	1067	1589	-
HCM Lane V/C Ratio	-	-	0.013	0.001	0.001	-
HCM Control Delay (s)	-	-	8.9	8.4	7.3	-
HCM Lane LOS	-	-	A	A	A	-
HCM 95th %tile Q(veh)	-	-	0	0	0	-

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	10	2	1	318	615	10
Future Vol, veh/h	10	2	1	318	615	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	None
Storage Length	100	0	800	-	-	800
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	2	1	346	668	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1016	-	679	0	-	0
Stage 1	668	-	-	-	-	-
Stage 2	348	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	264	0	913	-	-	-
Stage 1	510	0	-	-	-	-
Stage 2	715	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	264	-	913	-	-	-
Mov Cap-2 Maneuver	386	-	-	-	-	-
Stage 1	509	-	-	-	-	-
Stage 2	715	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.6	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	913	-	386	-	-	-
HCM Lane V/C Ratio	0.001	-	0.028	-	-	-
HCM Control Delay (s)	8.9	-	14.6	0	-	-
HCM Lane LOS	A	-	B	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-	-

Intersection						
Int Delay, s/veh	9.1					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	22	443	441	9	22	58
Future Vol, veh/h	22	443	441	9	22	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	400	-	-	155
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	521	519	11	26	68

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1075	26	94	0	-	0
Stage 1	26	-	-	-	-	-
Stage 2	1049	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	243	1050	1500	-	-	-
Stage 1	997	-	-	-	-	-
Stage 2	337	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	159	1050	1500	-	-	-
Mov Cap-2 Maneuver	~ -864	-	-	-	-	-
Stage 1	652	-	-	-	-	-
Stage 2	337	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	11.3		8.5		0	
HCM LOS	B					

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1500	-	+	1050	-	-
HCM Lane V/C Ratio	0.346	-	-	0.496	-	-
HCM Control Delay (s)	8.7	-	1	11.8	-	-
HCM Lane LOS	A	-	A	B	-	-
HCM 95th %tile Q(veh)	1.6	-	-	2.8	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	6	260	123	37	157	112	45	332	17	209	230	26
Future Vol, veh/h	6	260	123	37	157	112	45	332	17	209	230	26
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	250	0	-	-	400	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	87	87	87	87	87	87	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	299	141	43	180	129	52	382	20	227	250	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1369	1224	264	1434	1228	392	278	0	0	402	0	0
Stage 1	718	718	-	496	496	-	-	-	-	-	-	-
Stage 2	651	506	-	938	732	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	124	~ 179	775	112	~ 178	657	1285	-	-	1157	-	-
Stage 1	420	433	-	556	545	-	-	-	-	-	-	-
Stage 2	457	540	-	317	427	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 138	775	-	~ 137	657	1285	-	-	1157	-	-
Mov Cap-2 Maneuver	-	~ 138	-	-	~ 137	-	-	-	-	-	-	-
Stage 1	403	348	-	534	523	-	-	-	-	-	-	-
Stage 2	231	518	-	~ 29	343	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			0.9	4
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1285	-	-	-	-	657	1157	-	-
HCM Lane V/C Ratio	0.04	-	-	-	-	0.196	0.196	-	-
HCM Control Delay (s)	7.9	-	-	-	-	11.8	8.9	-	-
HCM Lane LOS	A	-	-	-	-	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	-	-	0.7	0.7	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	54.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	58	156	399	2	74	12	177	250	1	29	550	41
Future Vol, veh/h	58	156	399	2	74	12	177	250	1	29	550	41
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Free	-	-	Free	-	-	None	-	-	None
Storage Length	185	-	325	225	-	225	1000	-	0	785	-	785
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	83	83	83	92	92	92	93	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	63	170	434	2	89	14	192	272	1	31	591	44

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1354	1310	-	1416	1353	-	635	0	0	273	0	0
Stage 1	653	653	-	656	656	-	-	-	-	-	-	-
Stage 2	701	657	-	760	697	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	-	7.12	6.52	-	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	-	3.518	4.018	-	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	127	~ 159	0	115	150	0	948	-	-	1290	-	-
Stage 1	456	464	0	454	462	0	-	-	-	-	-	-
Stage 2	429	462	0	398	443	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 41	~ 124	-	-	117	-	948	-	-	1290	-	-
Mov Cap-2 Maneuver	~ 41	~ 124	-	-	117	-	-	-	-	-	-	-
Stage 1	363	453	-	362	368	-	-	-	-	-	-	-
Stage 2	259	368	-	243	432	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 332		4	0.4
HCM LOS	F	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	948	-	-	41	124	-	-	117	-	1290	-	-
HCM Lane V/C Ratio	0.203	-	-	1.538	1.367	-	-	0.762	-	0.024	-	-
HCM Control Delay (s)	9.8	-	-	$ 488.3	273.9	0	-	98.1	0	7.9	-	-
HCM Lane LOS	A	-	-	F	F	A	-	F	A	A	-	-
HCM 95th %tile Q(veh)	0.8	-	-	6.4	11.3	-	-	4.3	-	0.1	-	-

Notes

~: Volume exceeds capacity　$: Delay exceeds 300s　+: Computation Not Defined　*: All major volume in platoon

Intersection	
Int Delay, s/veh	1.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	6	2	28	6	1	24
Future Vol, veh/h	6	2	28	6	1	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	2	33	7	1	28

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	63	33	0	0	40	0
Stage 1	33	-	-	-	-	-
Stage 2	30	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	943	1041	-	-	1570	-
Stage 1	989	-	-	-	-	-
Stage 2	993	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	942	1041	-	-	1570	-
Mov Cap-2 Maneuver	942	-	-	-	-	-
Stage 1	988	-	-	-	-	-
Stage 2	993	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.8	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	942	1041	1570	-
HCM Lane V/C Ratio	-	-	0.007	0.002	0.001	-
HCM Control Delay (s)	-	-	8.9	8.5	7.3	-
HCM Lane LOS	-	-	A	A	A	-
HCM 95th %tile Q(veh)	-	-	0	0	0	-

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	6	1	2	578	444	6
Future Vol, veh/h	6	1	2	578	444	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	None
Storage Length	100	0	800	-	-	800
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	1	2	628	483	7

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1115	-	490	0	-	0
Stage 1	483	-	-	-	-	-
Stage 2	632	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	230	0	1073	-	-	-
Stage 1	620	0	-	-	-	-
Stage 2	530	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	230	-	1073	-	-	-
Mov Cap-2 Maneuver	364	-	-	-	-	-
Stage 1	619	-	-	-	-	-
Stage 2	530	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	15.1	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1073	-	364	-	-	-
HCM Lane V/C Ratio	0.002	-	0.018	-	-	-
HCM Control Delay (s)	8.4	-	15.1	0	-	-
HCM Lane LOS	A	-	C	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-	-

Intersection						
Int Delay, s/veh	7.7					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Traffic Vol, veh/h	39	257	451	34	22	30
Future Vol, veh/h	39	257	451	34	22	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	400	-	-	155
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	302	531	40	26	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1128	26	61	0	-	0
Stage 1	26	-	-	-	-	-
Stage 2	1102	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	226	1050	1542	-	-	-
Stage 1	997	-	-	-	-	-
Stage 2	318	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	148	1050	1542	-	-	-
Mov Cap-2 Maneuver	~ -1014	-	-	-	-	-
Stage 1	654	-	-	-	-	-
Stage 2	318	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.7	8	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1542	-	+	1050	-	-
HCM Lane V/C Ratio	0.344	-	-	0.288	-	-
HCM Control Delay (s)	8.6	-	1.6	9.8	-	-
HCM Lane LOS	A	-	A	A	-	-
HCM 95th %tile Q(veh)	1.6	-	-	1.2	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	18	199	82	32	341	250	130	217	53	112	145	22
Future Vol, veh/h	18	199	82	32	341	250	130	217	53	112	145	22
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	250	0	-	-	400	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	87	87	87	87	87	87	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	229	94	37	392	287	149	249	61	122	158	24

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1331	1022	170	1154	1004	280	182	0	0	310	0	0
Stage 1	414	414	-	578	578	-	-	-	-	-	-	-
Stage 2	917	608	-	576	426	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	132	236	874	174	~ 242	759	1393	-	-	1250	-	-
Stage 1	616	593	-	501	501	-	-	-	-	-	-	-
Stage 2	326	486	-	503	586	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 190	874	-	~ 195	759	1393	-	-	1250	-	-
Mov Cap-2 Maneuver	-	~ 190	-	-	~ 195	-	-	-	-	-	-	-
Stage 1	550	535	-	447	447	-	-	-	-	-	-	-
Stage 2	22	434	-	232	529	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			2.6	3.3
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1393	-	-	-	-	759	1250	-	-
HCM Lane V/C Ratio	0.107	-	-	-	-	0.379	0.097	-	-
HCM Control Delay (s)	7.9	-	-	-	-	12.6	8.2	-	-
HCM Lane LOS	A	-	-	-	-	B	A	-	-
HCM 95th %tile Q(veh)	0.4	-	-	-	-	1.8	0.3	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	31	126	234	4	178	27	451	525	21	8	325	117
Future Vol, veh/h	31	126	234	4	178	27	451	525	21	8	325	117
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Free	-	-	Free	-	-	None	-	-	None
Storage Length	185	-	325	225	-	225	1000	-	0	785	-	785
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	83	83	83	92	92	92	93	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	34	137	254	5	214	33	490	571	23	9	349	126

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2037	1941	-	2050	2044	-	475	0	0	594	0	0
Stage 1	367	367	-	1551	1551	-	-	-	-	-	-	-
Stage 2	1670	1574	-	499	493	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	-	7.12	6.52	-	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	-	3.518	4.018	-	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	42	~ 65	0	41	~ 56	0	1087	-	-	982	-	-
Stage 1	653	622	0	142	~ 175	0	-	-	-	-	-	-
Stage 2	121	170	0	554	547	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 35	-	-	~ 30	-	1087	-	-	982	-	-
Mov Cap-2 Maneuver	-	~ 35	-	-	~ 30	-	-	-	-	-	-	-
Stage 1	358	616	-	78	~ 96	-	-	-	-	-	-	-
Stage 2	-	~ 93	-	427	542	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			5	0.2
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1087	-	-	-	35	-	-	30	-	982	-	-
HCM Lane V/C Ratio	0.451	-	-	-	3.913	-	-	7.149	-	0.009	-	-
HCM Control Delay (s)	11	-	-	-	$ 1544.8	0	-	$ 3025	0	8.7	-	-
HCM Lane LOS	B	-	-	-	F	A	-	F	A	A	-	-
HCM 95th %tile Q(veh)	2.4	-	-	-	16	-	-	26.1	-	0	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	7.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	315	26	11	112	11	41
Future Vol, veh/h	315	26	11	112	11	41
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	371	31	13	132	13	48

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	87	13	0	0	145	0
Stage 1	13	-	-	-	-	-
Stage 2	74	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	914	1067	-	-	1437	-
Stage 1	1010	-	-	-	-	-
Stage 2	949	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	906	1067	-	-	1437	-
Mov Cap-2 Maneuver	906	-	-	-	-	-
Stage 1	1001	-	-	-	-	-
Stage 2	949	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.5	0	1.6
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	906	1067	1437	-
HCM Lane V/C Ratio	-	-	0.409	0.029	0.009	-
HCM Control Delay (s)	-	-	11.7	8.5	7.5	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	2	0.1	0	-

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	117	5	8	326	16	25
Future Vol, veh/h	117	5	8	326	16	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	205	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	138	6	9	384	19	29

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	144	0	543	141
Stage 1	-	-	-	-	141	-
Stage 2	-	-	-	-	402	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1438	-	501	907
Stage 1	-	-	-	-	886	-
Stage 2	-	-	-	-	676	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1438	-	498	907
Mov Cap-2 Maneuver	-	-	-	-	562	-
Stage 1	-	-	-	-	881	-
Stage 2	-	-	-	-	676	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	10.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	562	907	-	-	1438	-
HCM Lane V/C Ratio	0.033	0.032	-	-	0.007	-
HCM Control Delay (s)	11.6	9.1	-	-	7.5	-
HCM Lane LOS	B	A	-	-	A	-
HCM 95th %tile Q(veh)	0.1	0.1	-	-	0	-

Intersection	
Int Delay, s/veh	1.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	131	11	17	302	32	51
Future Vol, veh/h	131	11	17	302	32	51
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	154	13	20	355	38	60

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	167	0	549	154
Stage 1	-	-	-	-	154	-
Stage 2	-	-	-	-	395	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1411	-	497	892
Stage 1	-	-	-	-	874	-
Stage 2	-	-	-	-	681	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1411	-	490	892
Mov Cap-2 Maneuver	-	-	-	-	554	-
Stage 1	-	-	-	-	862	-
Stage 2	-	-	-	-	681	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	10.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	554	892	-	-	1411	-
HCM Lane V/C Ratio	0.068	0.067	-	-	0.014	-
HCM Control Delay (s)	12	9.3	-	-	7.6	-
HCM Lane LOS	B	A	-	-	A	-
HCM 95th %tile Q(veh)	0.2	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	4.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	143	39	35	202	117	104
Future Vol, veh/h	143	39	35	202	117	104
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	168	46	41	238	138	122

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	214	0	488	168
Stage 1	-	-	-	-	168	-
Stage 2	-	-	-	-	320	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1356	-	539	876
Stage 1	-	-	-	-	862	-
Stage 2	-	-	-	-	736	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1356	-	523	876
Mov Cap-2 Maneuver	-	-	-	-	579	-
Stage 1	-	-	-	-	836	-
Stage 2	-	-	-	-	736	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	11.5
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	579	876	-	-	1356	-
HCM Lane V/C Ratio	0.238	0.14	-	-	0.03	-
HCM Control Delay (s)	13.1	9.8	-	-	7.7	-
HCM Lane LOS	B	A	-	-	A	-
HCM 95th %tile Q(veh)	0.9	0.5	-	-	0.1	-

Intersection	
Int Delay, s/veh	3.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	21	225	171	34	101	65
Future Vol, veh/h	21	225	171	34	101	65
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	405	-	-	155	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	25	265	201	40	119	76

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	241	0	-	0	516	201
Stage 1	-	-	-	-	201	-
Stage 2	-	-	-	-	315	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1326	-	-	-	519	840
Stage 1	-	-	-	-	833	-
Stage 2	-	-	-	-	740	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1326	-	-	-	509	840
Mov Cap-2 Maneuver	-	-	-	-	577	-
Stage 1	-	-	-	-	817	-
Stage 2	-	-	-	-	740	-

Approach	EB		WB		SB
HCM Control Delay, s	0.7		0		11.6
HCM LOS					B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1326	-	-	-	577	840
HCM Lane V/C Ratio	0.019	-	-	-	0.206	0.091
HCM Control Delay (s)	7.8	-	-	-	12.9	9.7
HCM Lane LOS	A	-	-	-	B	A
HCM 95th %tile Q(veh)	0.1	-	-	-	0.8	0.3

Intersection	
Int Delay, s/veh	6.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	293	34	79	104	101	236
Future Vol, veh/h	293	34	79	104	101	236
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	405	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	345	40	93	122	119	278

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	385	0	653	345
Stage 1	-	-	-	-	345	-
Stage 2	-	-	-	-	308	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1173	-	432	698
Stage 1	-	-	-	-	717	-
Stage 2	-	-	-	-	745	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1173	-	398	698
Mov Cap-2 Maneuver	-	-	-	-	481	-
Stage 1	-	-	-	-	660	-
Stage 2	-	-	-	-	745	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.6	13.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	481	698	-	-	1173	-
HCM Lane V/C Ratio	0.247	0.398	-	-	0.079	-
HCM Control Delay (s)	14.9	13.5	-	-	8.3	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	1	1.9	-	-	0.3	-

Intersection	
Intersection Delay, s/veh	6.7
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	385	215	397
Demand Flow Rate, veh/h	393	219	405
Vehicles Circulating, veh/h	95	121	352
Vehicles Exiting, veh/h	245	636	136
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.8	4.6	8.6
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	393	219	405
Cap Entry Lane, veh/h	1252	1220	964
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	385	215	397
Cap Entry, veh/h	1227	1195	945
V/C Ratio	0.314	0.180	0.420
Control Delay, s/veh	5.8	4.6	8.6
LOS	A	A	A
95th %tile Queue, veh	1	1	2

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	44	485	162	318	615	21
Future Vol, veh/h	44	485	162	318	615	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	None
Storage Length	100	0	800	-	-	800
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	48	527	176	346	668	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1366	-	691	0	-	0
Stage 1	668	-	-	-	-	-
Stage 2	698	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	162	0	904	-	-	-
Stage 1	510	0	-	-	-	-
Stage 2	494	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	130	-	904	-	-	-
Mov Cap-2 Maneuver	222	-	-	-	-	-
Stage 1	411	-	-	-	-	-
Stage 2	494	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	25.6	3.4	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	904	-	222	-	-	-
HCM Lane V/C Ratio	0.195	-	0.215	-	-	-
HCM Control Delay (s)	9.9	-	25.6	0	-	-
HCM Lane LOS	A	-	D	A	-	-
HCM 95th %tile Q(veh)	0.7	-	0.8	-	-	-

Intersection	
Int Delay, s/veh	10.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	39	443	441	94	276	109
Future Vol, veh/h	39	443	441	94	276	109
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	400	-	-	155
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	521	519	111	325	128

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1474	325	453	0	-	0
Stage 1	325	-	-	-	-	-
Stage 2	1149	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	139	716	1108	-	-	-
Stage 1	732	-	-	-	-	-
Stage 2	302	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	74	716	1108	-	-	-
Mov Cap-2 Maneuver	~ -3438	-	-	-	-	-
Stage 1	389	-	-	-	-	-
Stage 2	302	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.8	9.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1108	-	+	716	-	-
HCM Lane V/C Ratio	0.468	-	-	0.728	-	-
HCM Control Delay (s)	11.1	-	4	22.3	-	-
HCM Lane LOS	B	-	A	C	-	-
HCM 95th %tile Q(veh)	2.6	-	-	6.4	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	9.2
Intersection LOS	A

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	567	630	453
Demand Flow Rate, veh/h	578	642	463
Vehicles Circulating, veh/h	331	47	529
Vehicles Exiting, veh/h	660	862	160
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.1	7.4	10.8
Approach LOS	B	A	B

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.328
Entry Flow, veh/h	578	642	463
Cap Entry Lane, veh/h	1072	1364	906
Entry HV Adj Factor	0.981	0.981	0.979
Flow Entry, veh/h	567	630	453
Cap Entry, veh/h	1051	1339	887
V/C Ratio	0.539	0.471	0.511
Control Delay, s/veh	10.1	7.4	10.8
LOS	B	A	B
95th %tile Queue, veh	3	3	3

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	39	443	441	94	276	109
Future Volume (vph)	39	443	441	94	276	109
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	70.0	70.0	70.0	70.0
Total Split (%)	22.2%	22.2%	77.8%	77.8%	77.8%	77.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max	Max	Max	Max
Act Effct Green (s)	9.1	9.1	65.1	65.1	65.1	65.1
Actuated g/C Ratio	0.11	0.11	0.77	0.77	0.77	0.77
v/c Ratio	0.24	0.82	0.64	0.08	0.23	0.10
Control Delay	36.8	15.1	9.6	3.0	3.5	0.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.8	15.1	9.6	3.0	3.5	0.9
LOS	D	B	A	A	A	A
Approach Delay	16.9			8.5	2.7	
Approach LOS	B			A	A	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 84.2	
Natural Cycle: 60	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.82	
Intersection Signal Delay: 9.8	Intersection LOS: A
Intersection Capacity Utilization 55.6%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 12: Eastonville Rd & Londonderry Dr

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	260	123	37	157	112	45	377	17	209	366	145
Future Vol, veh/h	45	260	123	37	157	112	45	377	17	209	366	145
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	250	0	-	-	400	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	87	87	87	87	87	87	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	52	299	141	43	180	129	52	433	20	227	398	158

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1633	1488	477	1698	1557	443	556	0	0	453	0	0
Stage 1	931	931	-	547	547	-	-	-	-	-	-	-
Stage 2	702	557	-	1151	1010	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	81	~ 124	588	73	~ 113	615	1015	-	-	1108	-	-
Stage 1	320	346	-	521	517	-	-	-	-	-	-	-
Stage 2	429	512	-	241	317	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 93	588	-	~ 85	615	1015	-	-	1108	-	-
Mov Cap-2 Maneuver	-	~ 93	-	-	~ 85	-	-	-	-	-	-	-
Stage 1	304	~ 275	-	494	491	-	-	-	-	-	-	-
Stage 2	204	486	-	-	252	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			0.9	2.6
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1015	-	-	-	-	615	1108	-	-
HCM Lane V/C Ratio	0.051	-	-	-	-	0.209	0.205	-	-
HCM Control Delay (s)	8.7	-	-	-	-	12.4	9.1	-	-
HCM Lane LOS	A	-	-	-	-	B	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	-	-	0.8	0.8	-	-

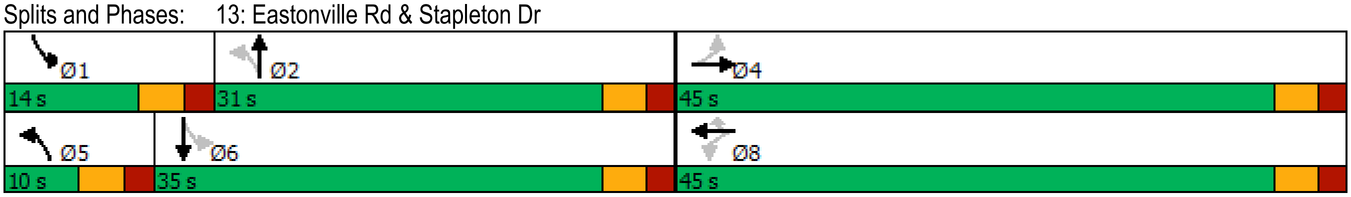
Notes

~: Volume exceeds capacity $: Delay exceeds 300s   +: Computation Not Defined   *: All major volume in platoon

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	45	260	37	157	112	45	377	209	366
Future Volume (vph)	45	260	37	157	112	45	377	209	366
Turn Type	Perm	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases		4		8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total Split (s)	45.0	45.0	45.0	45.0	45.0	10.0	31.0	14.0	35.0
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	11.1%	34.4%	15.6%	38.9%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag						Lead	Lag	Lead	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None
Act Effct Green (s)		25.8		25.8	25.8	27.4	22.2	36.1	31.3
Actuated g/C Ratio		0.35		0.35	0.35	0.38	0.31	0.50	0.43
v/c Ratio		0.80		0.41	0.20	0.17	0.80	0.61	0.71
Control Delay		30.5		20.2	4.0	13.6	36.8	21.3	26.8
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		30.5		20.2	4.0	13.6	36.8	21.3	26.8
LOS		C		C	A	B	D	C	C
Approach Delay		30.5		14.3			34.4		25.2
Approach LOS		C		B			C		C

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 72.7	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.80	
Intersection Signal Delay: 26.8	Intersection LOS: C
Intersection Capacity Utilization 83.1%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 13: Eastonville Rd & Stapleton Dr



Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	58	156	399	2	74	23	177	399	1	63	999	41
Future Vol, veh/h	58	156	399	2	74	23	177	399	1	63	999	41
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Free	-	-	Free	-	-	None	-	-	None
Storage Length	185	-	325	225	-	225	1000	-	0	785	-	785
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	83	83	83	92	92	92	93	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	63	170	434	2	89	28	192	434	1	68	1074	44

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2073	2029	-	2135	2072	-	1118	0	0	435	0	0
Stage 1	1210	1210	-	818	818	-	-	-	-	-	-	-
Stage 2	863	819	-	1317	1254	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	-	7.12	6.52	-	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	-	3.518	4.018	-	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 40	~ 57	0	36	~ 54	0	625	-	-	1125	-	-
Stage 1	223	255	0	370	390	0	-	-	-	-	-	-
Stage 2	349	389	0	194	243	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 37	-	-	~ 35	-	625	-	-	1125	-	-
Mov Cap-2 Maneuver	-	~ 37	-	-	~ 35	-	-	-	-	-	-	-
Stage 1	155	240	-	256	270	-	-	-	-	-	-	-
Stage 2	162	270	-	53	228	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			4.1	0.5
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	625	-	-	-	37	-	-	35	-	1125	-	-
HCM Lane V/C Ratio	0.308	-	-	-	4.583	-	-	2.547	-	0.06	-	-
HCM Control Delay (s)	13.3	-	-	$	1830.7	0	-	$ 945	0	8.4	-	-
HCM Lane LOS	B	-	-	-	F	A	-	F	A	A	-	-
HCM 95th %tile Q(veh)	1.3	-	-	-	19.8	-	-	10.1	-	0.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	58	156	399	2	74	23	177	399	1	63	999	41
Future Volume (vph)	58	156	399	2	74	23	177	399	1	63	999	41
Turn Type	Perm	NA	Free	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8	2		2	6		6
Detector Phase	4	4		8	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0		20.0	20.0	20.0	10.0	20.0	20.0	10.0	20.0	20.0
Total Split (s)	25.0	25.0		25.0	25.0	25.0	12.0	55.0	55.0	10.0	53.0	53.0
Total Split (%)	27.8%	27.8%		27.8%	27.8%	27.8%	13.3%	61.1%	61.1%	11.1%	58.9%	58.9%
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None	None	None	Max	Max	None	Max	Max
Act Effct Green (s)	12.8	12.8	82.9	12.8	12.8	12.8	57.7	51.2	51.2	53.1	47.1	47.1
Actuated g/C Ratio	0.15	0.15	1.00	0.15	0.15	0.15	0.70	0.62	0.62	0.64	0.57	0.57
v/c Ratio	0.32	0.59	0.27	0.01	0.31	0.09	0.81	0.38	0.00	0.11	1.02	0.05
Control Delay	35.1	41.3	0.4	29.0	33.6	0.5	43.4	10.4	0.0	4.7	52.3	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.1	41.3	0.4	29.0	33.6	0.5	43.4	10.4	0.0	4.7	52.3	0.6
LOS	D	D	A	C	C	A	D	B	A	A	D	A
Approach Delay		14.1			25.8			20.5			47.6	
Approach LOS		B			C			C			D	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 82.9	
Natural Cycle: 90	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.02	
Intersection Signal Delay: 31.5	Intersection LOS: C
Intersection Capacity Utilization 85.6%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 14: US 24 & Stapleton Dr

Intersection	
Int Delay, s/veh	4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	198	18	28	333	28	24
Future Vol, veh/h	198	18	28	333	28	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	300	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	233	21	33	392	33	28

Major/Minor	Minor1			Major1	Major2	
Conflicting Flow All	127	33	0	0	425	0
Stage 1	33	-	-	-	-	-
Stage 2	94	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	868	1041	-	-	1134	-
Stage 1	989	-	-	-	-	-
Stage 2	930	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	843	1041	-	-	1134	-
Mov Cap-2 Maneuver	843	-	-	-	-	-
Stage 1	960	-	-	-	-	-
Stage 2	930	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.7	0	4.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	843	1041	1134	-
HCM Lane V/C Ratio	-	-	0.276	0.02	0.029	-
HCM Control Delay (s)	-	-	10.9	8.5	8.3	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	1.1	0.1	0.1	-

Intersection	
Int Delay, s/veh	0.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	349	17	27	209	10	16
Future Vol, veh/h	349	17	27	209	10	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	205	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	411	20	32	246	12	19

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	431	0	731	421
Stage 1	-	-	-	-	421	-
Stage 2	-	-	-	-	310	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1129	-	389	632
Stage 1	-	-	-	-	662	-
Stage 2	-	-	-	-	744	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1129	-	378	632
Mov Cap-2 Maneuver	-	-	-	-	480	-
Stage 1	-	-	-	-	643	-
Stage 2	-	-	-	-	744	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	11.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	480	632	-	-	1129	-
HCM Lane V/C Ratio	0.025	0.03	-	-	0.028	-
HCM Control Delay (s)	12.7	10.9	-	-	8.3	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0.1	0.1	-	-	0.1	-

Intersection	
Int Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	330	35	54	216	20	32
Future Vol, veh/h	330	35	54	216	20	32
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	388	41	64	254	24	38

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	429	0	770	388
Stage 1	-	-	-	-	388	-
Stage 2	-	-	-	-	382	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1130	-	369	660
Stage 1	-	-	-	-	686	-
Stage 2	-	-	-	-	690	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1130	-	348	660
Mov Cap-2 Maneuver	-	-	-	-	449	-
Stage 1	-	-	-	-	647	-
Stage 2	-	-	-	-	690	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.7	11.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	449	660	-	-	1130	-
HCM Lane V/C Ratio	0.052	0.057	-	-	0.056	-
HCM Control Delay (s)	13.5	10.8	-	-	8.4	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	0.2	-	-	0.2	-

Intersection	
Int Delay, s/veh	3.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	237	125	111	196	74	65
Future Vol, veh/h	237	125	111	196	74	65
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	279	147	131	231	87	76

Major/Minor	Major1			Major2	Minor1	
Conflicting Flow All	0	0	426	0	772	279
Stage 1	-	-	-	-	279	-
Stage 2	-	-	-	-	493	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1133	-	368	760
Stage 1	-	-	-	-	768	-
Stage 2	-	-	-	-	614	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1133	-	325	760
Mov Cap-2 Maneuver	-	-	-	-	396	-
Stage 1	-	-	-	-	679	-
Stage 2	-	-	-	-	614	-

Approach	EB			WB	NB	
HCM Control Delay, s	0			3.1	13.7	
HCM LOS					B	

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	396	760	-	-	1133	-
HCM Lane V/C Ratio	0.22	0.101	-	-	0.115	-
HCM Control Delay (s)	16.6	10.3	-	-	8.6	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	0.8	0.3	-	-	0.4	-

Intersection						
Int Delay, s/veh	2.5					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	69	233	267	109	63	41
Future Vol, veh/h	69	233	267	109	63	41
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	405	-	-	155	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	81	274	314	128	74	48

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	442	0	-	0	750	314
Stage 1	-	-	-	-	314	-
Stage 2	-	-	-	-	436	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1118	-	-	-	379	726
Stage 1	-	-	-	-	741	-
Stage 2	-	-	-	-	652	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1118	-	-	-	352	726
Mov Cap-2 Maneuver	-	-	-	-	442	-
Stage 1	-	-	-	-	688	-
Stage 2	-	-	-	-	652	-

Approach	EB	WB	SB
HCM Control Delay, s	1.9	0	13
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1118	-	-	-	442	726
HCM Lane V/C Ratio	0.073	-	-	-	0.168	0.066
HCM Control Delay (s)	8.5	-	-	-	14.8	10.3
HCM Lane LOS	A	-	-	-	B	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6	0.2

Intersection	
Int Delay, s/veh	29

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	183	108	253	309	63	149
Future Vol, veh/h	183	108	253	309	63	149
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	405	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	215	127	298	364	74	175

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	342	0	1175	215
Stage 1	-	-	-	-	215	-
Stage 2	-	-	-	-	960	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1217	-	212	825
Stage 1	-	-	-	-	821	-
Stage 2	-	-	-	-	372	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1217	-	160	825
Mov Cap-2 Maneuver	-	-	-	-	~ 50	-
Stage 1	-	-	-	-	620	-
Stage 2	-	-	-	-	372	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4	135.2
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	50	825	-	-	1217	-
HCM Lane V/C Ratio	1.482	0.212	-	-	0.245	-
HCM Control Delay (s)	$ 430.1	10.5	-	-	8.9	-
HCM Lane LOS	F	B	-	-	A	-
HCM 95th %tile Q(veh)	7	0.8	-	-	1	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Intersection Delay, s/veh	7.6
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	342	662	249
Demand Flow Rate, veh/h	349	675	253
Vehicles Circulating, veh/h	304	75	219
Vehicles Exiting, veh/h	446	397	434
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.3	8.7	5.4
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	349	675	253
Cap Entry Lane, veh/h	1012	1278	1104
Entry HV Adj Factor	0.979	0.980	0.984
Flow Entry, veh/h	342	662	249
Cap Entry, veh/h	991	1253	1086
V/C Ratio	0.345	0.528	0.229
Control Delay, s/veh	7.3	8.7	5.4
LOS	A	A	A
95th %tile Queue, veh	2	3	1

Intersection	
Int Delay, s/veh	4.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	27	305	520	578	444	42
Future Vol, veh/h	27	305	520	578	444	42
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	Free	-	None	-	None
Storage Length	100	0	800	-	-	800
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	29	332	565	628	483	46

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2241	-	529	0	-	0
Stage 1	483	-	-	-	-	-
Stage 2	1758	-	-	-	-	-
Critical Hdwy	6.42	-	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	-	2.218	-	-	-
Pot Cap-1 Maneuver	46	0	1038	-	-	-
Stage 1	620	0	-	-	-	-
Stage 2	152	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 21	-	1038	-	-	-
Mov Cap-2 Maneuver	624	-	-	-	-	-
Stage 1	283	-	-	-	-	-
Stage 2	152	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.1	5.9	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1038	-	624	-	-	-
HCM Lane V/C Ratio	0.545	-	0.047	-	-	-
HCM Control Delay (s)	12.5	-	11.1	0	-	-
HCM Lane LOS	B	-	B	A	-	-
HCM 95th %tile Q(veh)	3.4	-	0.1	-	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	5.8					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	94	257	451	307	182	62
Future Vol, veh/h	94	257	451	307	182	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	400	-	-	155
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	111	302	531	361	214	73

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1637	214	287	0	-	0
Stage 1	214	-	-	-	-	-
Stage 2	1423	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	111	826	1275	-	-	-
Stage 1	822	-	-	-	-	-
Stage 2	222	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 65	826	1275	-	-	-
Mov Cap-2 Maneuver	~ -3386	-	-	-	-	-
Stage 1	480	-	-	-	-	-
Stage 2	222	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.8	5.8	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1275	-	+	826	-	-
HCM Lane V/C Ratio	0.416	-	-	0.366	-	-
HCM Control Delay (s)	9.8	-	4	11.9	-	-
HCM Lane LOS	A	-	A	B	-	-
HCM 95th %tile Q(veh)	2.1	-	-	1.7	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	10.3
Intersection LOS	B

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	413	892	287
Demand Flow Rate, veh/h	421	910	292
Vehicles Circulating, veh/h	218	113	542
Vehicles Exiting, veh/h	616	526	481
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.6	12.9	7.7
Approach LOS	A	B	A

Lane	Left	Left	Left
Designated Moves	LR	LT	TR
Assumed Moves	LR	LT	TR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.328
Entry Flow, veh/h	421	910	292
Cap Entry Lane, veh/h	1180	1290	896
Entry HV Adj Factor	0.981	0.980	0.982
Flow Entry, veh/h	413	892	287
Cap Entry, veh/h	1157	1264	880
V/C Ratio	0.357	0.705	0.326
Control Delay, s/veh	6.6	12.9	7.7
LOS	A	B	A
95th %tile Queue, veh	2	6	1

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	94	257	451	307	182	62
Future Volume (vph)	94	257	451	307	182	62
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	70.0	70.0	70.0	70.0
Total Split (%)	22.2%	22.2%	77.8%	77.8%	77.8%	77.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max	Max	Max	Max
Act Effct Green (s)	10.6	10.6	65.1	65.1	65.1	65.1
Actuated g/C Ratio	0.12	0.12	0.76	0.76	0.76	0.76
v/c Ratio	0.51	0.66	0.60	0.26	0.15	0.06
Control Delay	43.2	11.8	8.7	3.9	3.4	1.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.2	11.8	8.7	3.9	3.4	1.0
LOS	D	B	A	A	A	A
Approach Delay	20.2			6.8	2.8	
Approach LOS	C			A	A	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 85.7	
Natural Cycle: 60	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.66	
Intersection Signal Delay: 9.5	Intersection LOS: A
Intersection Capacity Utilization 52.3%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 12: Eastonville Rd & Londonderry Dr

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	145	199	82	32	341	250	130	362	53	112	230	97
Future Vol, veh/h	145	199	82	32	341	250	130	362	53	112	230	97
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	250	0	-	-	400	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	87	87	87	87	87	87	87	87	87	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	167	229	94	37	392	287	149	416	61	122	250	105

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1631	1322	303	1453	1344	447	355	0	0	477	0	0
Stage 1	547	547	-	745	745	-	-	-	-	-	-	-
Stage 2	1084	775	-	708	599	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 81	~ 156	737	108	~ 152	612	1204	-	-	1085	-	-
Stage 1	521	517	-	406	421	-	-	-	-	-	-	-
Stage 2	263	408	-	426	490	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 121	737	-	~ 118	612	1204	-	-	1085	-	-
Mov Cap-2 Maneuver	-	~ 121	-	-	~ 118	-	-	-	-	-	-	-
Stage 1	456	459	-	356	~ 369	-	-	-	-	-	-	-
Stage 2	-	357	-	165	435	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			2	2.2
HCM LOS	-	-		

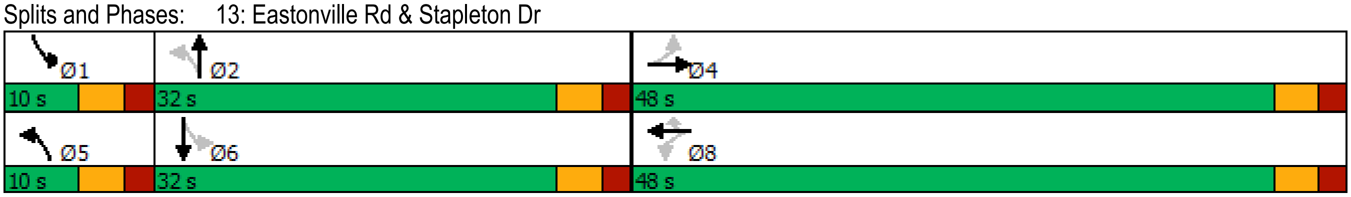
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1204	-	-	-	-	612	1085	-	-
HCM Lane V/C Ratio	0.124	-	-	-	-	0.47	0.112	-	-
HCM Control Delay (s)	8.4	-	-	-	-	16	8.7	-	-
HCM Lane LOS	A	-	-	-	-	C	A	-	-
HCM 95th %tile Q(veh)	0.4	-	-	-	-	2.5	0.4	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	145	199	32	341	250	130	362	112	230
Future Volume (vph)	145	199	32	341	250	130	362	112	230
Turn Type	Perm	NA	Perm	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases		4		8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	4	4	8	8	8	5	2	1	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total Split (s)	48.0	48.0	48.0	48.0	48.0	10.0	32.0	10.0	32.0
Total Split (%)	53.3%	53.3%	53.3%	53.3%	53.3%	11.1%	35.6%	11.1%	35.6%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag						Lead	Lag	Lead	Lag
Lead-Lag Optimize?						Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None
Act Effct Green (s)		42.9		42.9	42.9	30.2	25.2	30.2	25.2
Actuated g/C Ratio		0.49		0.49	0.49	0.34	0.29	0.34	0.29
v/c Ratio		0.95		0.51	0.31	0.55	0.90	0.66	0.67
Control Delay		53.0		18.5	2.7	27.0	52.3	37.3	33.0
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		53.0		18.5	2.7	27.0	52.3	37.3	33.0
LOS		D		B	A	C	D	D	C
Approach Delay		53.0		12.2			46.3		34.1
Approach LOS		D		B			D		C

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 88.2	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.95	
Intersection Signal Delay: 34.6	Intersection LOS: C
Intersection Capacity Utilization 88.3%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 13: Eastonville Rd & Stapleton Dr



Intersection	
Int Delay, s/veh	2.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Vol, veh/h	31	126	234	4	178	63	451	1007	21	29	607	117
Future Vol, veh/h	31	126	234	4	178	63	451	1007	21	29	607	117
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Free	-	-	Free	-	-	None	-	-	None
Storage Length	185	-	325	225	-	225	1000	-	0	785	-	785
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	83	83	83	92	92	92	93	93	93
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	34	137	254	5	214	76	490	1095	23	31	653	126

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2909	2813	-	2922	2916	-	779	0	0	1118	0	0
Stage 1	715	715	-	2075	2075	-	-	-	-	-	-	-
Stage 2	2194	2098	-	847	841	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	-	7.12	6.52	-	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	-	3.518	4.018	-	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	~ 10	~ 18	0	10	~ 15	0	838	-	-	625	-	-
Stage 1	422	434	0	70	~ 96	0	-	-	-	-	-	-
Stage 2	60	~ 93	0	357	380	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 7	-	-	~ 6	-	838	-	-	625	-	-
Mov Cap-2 Maneuver	-	~ 7	-	-	~ 6	-	-	-	-	-	-	-
Stage 1	175	412	-	29	~ 40	-	-	-	-	-	-	-
Stage 2	-	~ 39	-	227	361	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			4.6	0.4
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	838	-	-	-	7	-	-	6	-	625	-	-
HCM Lane V/C Ratio	0.585	-	-	-	19.565	-	-	35.743	-	0.05	-	-
HCM Control Delay (s)	15.2	-	-	-	$ 9384.4	0	-	$ 16834	0	11.1	-	-
HCM Lane LOS	C	-	-	-	F	A	-	F	A	B	-	-
HCM 95th %tile Q(veh)	3.9	-	-	-	19	-	-	28.8	-	0.2	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	31	126	234	4	178	63	451	1007	21	29	607	117
Future Volume (vph)	31	126	234	4	178	63	451	1007	21	29	607	117
Turn Type	Perm	NA	Free	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8	2		2	6		6
Detector Phase	4	4		8	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0		20.0	20.0	20.0	10.0	20.0	20.0	10.0	20.0	20.0
Total Split (s)	25.0	25.0		25.0	25.0	25.0	18.0	55.0	55.0	10.0	47.0	47.0
Total Split (%)	27.8%	27.8%		27.8%	27.8%	27.8%	20.0%	61.1%	61.1%	11.1%	52.2%	52.2%
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag							Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None	None	None	Max	Max	None	Max	Max
Act Effct Green (s)	14.7	14.7	84.8	14.7	14.7	14.7	60.1	55.3	55.3	47.1	41.1	41.1
Actuated g/C Ratio	0.17	0.17	1.00	0.17	0.17	0.17	0.71	0.65	0.65	0.56	0.48	0.48
v/c Ratio	0.25	0.43	0.16	0.03	0.66	0.19	0.99	0.90	0.02	0.17	0.72	0.15
Control Delay	34.7	35.2	0.2	28.2	43.1	1.0	54.3	27.9	0.0	7.9	24.0	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.7	35.2	0.2	28.2	43.1	1.0	54.3	27.9	0.0	7.9	24.0	2.4
LOS	C	D	A	C	D	A	D	C	A	A	C	A
Approach Delay		14.3			32.0			35.5			20.0	
Approach LOS		B			C			D			C	

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 84.8	
Natural Cycle: 90	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.99	
Intersection Signal Delay: 28.3	Intersection LOS: C
Intersection Capacity Utilization 88.2%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 14: US 24 & Stapleton Dr

Intersection	
Int Delay, s/veh	7.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	35	121	216	16	32	1	81	128	22	2	193	52
Future Vol, veh/h	35	121	216	16	32	1	81	128	22	2	193	52
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	205	-	155	300	-	155	315	-	155	205	-	155
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	127	227	17	34	1	85	135	23	2	203	55

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	541	535	203	717	567	135	258	0	0	158	0	0
Stage 1	207	207	-	305	305	-	-	-	-	-	-	-
Stage 2	334	328	-	412	262	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	452	452	838	345	433	914	1307	-	-	1422	-	-
Stage 1	795	731	-	705	662	-	-	-	-	-	-	-
Stage 2	680	647	-	617	691	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	401	422	838	184	404	914	1307	-	-	1422	-	-
Mov Cap-2 Maneuver	401	422	-	184	404	-	-	-	-	-	-	-
Stage 1	743	730	-	659	619	-	-	-	-	-	-	-
Stage 2	600	605	-	371	690	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.3	18.4	2.8	0.1
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1307	-	-	401	422	838	184	404	914	1422	-	-
HCM Lane V/C Ratio	0.065	-	-	0.092	0.302	0.271	0.092	0.083	0.001	0.001	-	-
HCM Control Delay (s)	7.9	-	-	14.9	17.2	10.9	26.5	14.7	8.9	7.5	-	-
HCM Lane LOS	A	-	-	B	C	B	D	B	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.3	1.3	1.1	0.3	0.3	0	0	-	-

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	40	105	28	843	1117	21
Future Volume (vph)	40	105	28	843	1117	21
Turn Type	Prot	Free	Prot	NA	NA	Perm
Protected Phases	6		7	4	8	
Permitted Phases		Free				8
Detector Phase	6		7	4	8	8
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	20.0		10.0	20.0	20.0	20.0
Total Split (s)	25.0		48.0	95.0	47.0	47.0
Total Split (%)	20.8%		40.0%	79.2%	39.2%	39.2%
Yellow Time (s)	3.0		3.0	3.0	3.0	3.0
All-Red Time (s)	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.0	5.0	5.0	5.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	Max		None	C-Max	C-Max	C-Max
Act Effct Green (s)	20.0	120.0	6.5	90.0	82.8	82.8
Actuated g/C Ratio	0.17	1.00	0.05	0.75	0.69	0.69
v/c Ratio	0.14	0.07	0.16	0.32	0.48	0.02
Control Delay	44.2	0.1	55.6	5.3	10.2	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.2	0.1	55.6	5.3	10.2	3.7
LOS	D	A	E	A	B	A
Approach Delay	12.2			7.0	10.0	
Approach LOS	B			A	B	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 15 (13%), Referenced to phase 4:NBT and 8:SBT, Start of Green	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.48	
Intersection Signal Delay: 9.0	Intersection LOS: A
Intersection Capacity Utilization 43.4%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 9: US 24 & Rex Rd

Intersection						
Int Delay, s/veh	5.8					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	35	275	158	192	463	51
Future Vol, veh/h	35	275	158	192	463	51
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	0	-	-	155
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	37	289	166	202	487	54

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1021	487	541	0	-	0
Stage 1	487	-	-	-	-	-
Stage 2	534	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	262	581	1028	-	-	-
Stage 1	618	-	-	-	-	-
Stage 2	588	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	220	581	1028	-	-	-
Mov Cap-2 Maneuver	311	-	-	-	-	-
Stage 1	519	-	-	-	-	-
Stage 2	588	-	-	-	-	-

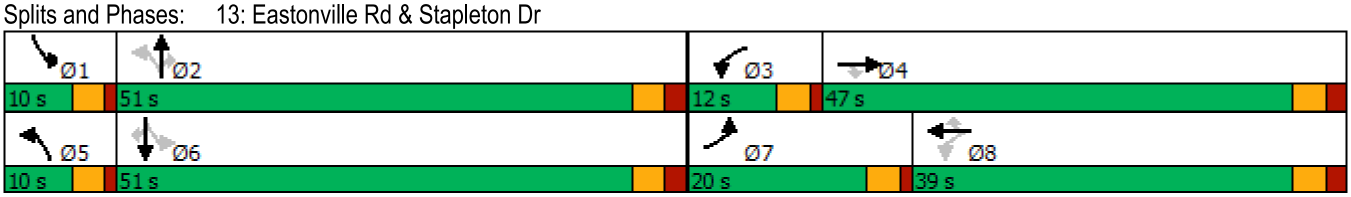
Approach	EB	NB	SB
HCM Control Delay, s	17.3	4.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1028	-	311	581	-	-
HCM Lane V/C Ratio	0.162	-	0.118	0.498	-	-
HCM Control Delay (s)	9.2	-	18.1	17.2	-	-
HCM Lane LOS	A	-	C	C	-	-
HCM 95th %tile Q(veh)	0.6	-	0.4	2.8	-	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	128	990	224	143	832	85	108	137	177	237	277	189
Future Volume (vph)	128	990	224	143	832	85	108	137	177	237	277	189
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Total Split (s)	20.0	47.0	47.0	12.0	39.0	39.0	10.0	51.0	51.0	10.0	51.0	51.0
Total Split (%)	16.7%	39.2%	39.2%	10.0%	32.5%	32.5%	8.3%	42.5%	42.5%	8.3%	42.5%	42.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	9.0	33.2	33.2	41.6	32.4	32.4	27.2	20.0	20.0	27.2	20.0	20.0
Actuated g/C Ratio	0.10	0.39	0.39	0.48	0.38	0.38	0.32	0.23	0.23	0.32	0.23	0.23
v/c Ratio	0.38	0.76	0.32	0.58	0.66	0.13	0.39	0.33	0.36	0.59	0.67	0.38
Control Delay	41.8	27.5	5.7	22.8	25.7	2.0	24.5	30.6	6.7	29.7	39.2	6.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.8	27.5	5.7	22.8	25.7	2.0	24.5	30.6	6.7	29.7	39.2	6.6
LOS	D	C	A	C	C	A	C	C	A	C	D	A
Approach Delay		25.2			23.4			19.0			27.2	
Approach LOS		C			C			B			C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 86	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.76	
Intersection Signal Delay: 24.3	Intersection LOS: C
Intersection Capacity Utilization 70.9%	ICU Level of Service C
Analysis Period (min) 15	

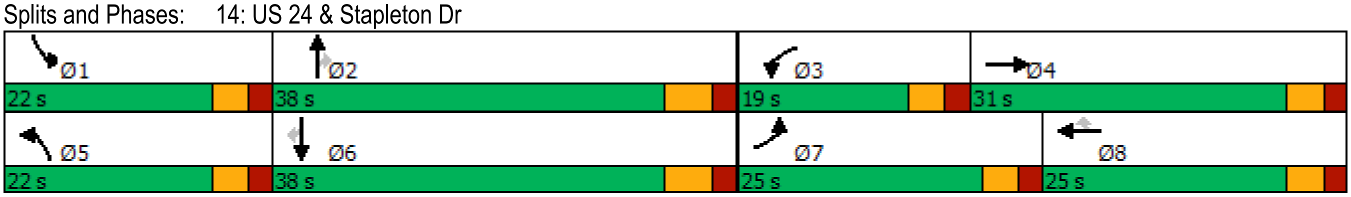
Splits and Phases: 13: Eastonville Rd & Stapleton Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	428	488	608	200	485	124	332	321	175	222	742	263
Future Volume (vph)	428	488	608	200	485	124	332	321	175	222	742	263
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2			6
Detector Phase	7	4		3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	10.0		10.0	10.0	10.0	10.0	11.0	11.0	10.0	11.0	11.0
Total Split (s)	25.0	31.0		19.0	25.0	25.0	22.0	38.0	38.0	22.0	38.0	38.0
Total Split (%)	22.7%	28.2%		17.3%	22.7%	22.7%	20.0%	34.5%	34.5%	20.0%	34.5%	34.5%
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None	None	None	Max	Max	None	Max	Max
Act Effct Green (s)	17.8	24.9	104.7	11.5	18.7	18.7	15.0	34.7	34.7	12.5	32.2	32.2
Actuated g/C Ratio	0.17	0.24	1.00	0.11	0.18	0.18	0.14	0.33	0.33	0.12	0.31	0.31
v/c Ratio	0.77	0.61	0.40	0.56	0.81	0.31	0.71	0.29	0.28	0.57	0.70	0.41
Control Delay	51.8	39.5	0.8	50.9	53.0	3.9	51.9	27.9	5.5	50.0	37.0	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.8	39.5	0.8	50.9	53.0	3.9	51.9	27.9	5.5	50.0	37.0	5.6
LOS	D	D	A	D	D	A	D	C	A	D	D	A
Approach Delay		27.5			44.9			32.8			32.5	
Approach LOS		C			D			C			C	

Intersection Summary	
Cycle Length: 110	
Actuated Cycle Length: 104.7	
Natural Cycle: 65	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.81	
Intersection Signal Delay: 33.1	Intersection LOS: C
Intersection Capacity Utilization 73.1%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 14: US 24 & Stapleton Dr



Intersection	
Int Delay, s/veh	8.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	41	102	91	18	87	1	158	138	14	2	200	67
Future Vol, veh/h	41	102	91	18	87	1	158	138	14	2	200	67
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	205	-	155	300	-	155	315	-	155	205	-	155
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	43	107	96	19	92	1	166	145	15	2	211	71

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	746	707	211	829	763	145	282	0	0	160	0	0
Stage 1	215	215	-	477	477	-	-	-	-	-	-	-
Stage 2	531	492	-	352	286	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	330	360	829	290	334	902	1280	-	-	1419	-	-
Stage 1	787	725	-	569	556	-	-	-	-	-	-	-
Stage 2	532	548	-	665	675	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	225	313	829	171	290	902	1280	-	-	1419	-	-
Mov Cap-2 Maneuver	225	313	-	171	290	-	-	-	-	-	-	-
Stage 1	685	724	-	495	484	-	-	-	-	-	-	-
Stage 2	375	477	-	500	674	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18	23.8	4.2	0.1
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1280	-	-	225	313	829	171	290	902	1419	-	-
HCM Lane V/C Ratio	0.13	-	-	0.192	0.343	0.116	0.111	0.316	0.001	0.001	-	-
HCM Control Delay (s)	8.2	-	-	24.8	22.4	9.9	28.7	23	9	7.5	-	-
HCM Lane LOS	A	-	-	C	C	A	D	C	A	A	-	-
HCM 95th %tile Q(veh)	0.4	-	-	0.7	1.5	0.4	0.4	1.3	0	0	-	-

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	29	89	75	1107	1021	31
Future Volume (vph)	29	89	75	1107	1021	31
Turn Type	Prot	Free	Prot	NA	NA	Perm
Protected Phases	6		7	4	8	
Permitted Phases		Free				8
Detector Phase	6		7	4	8	8
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	20.0		10.0	20.0	20.0	20.0
Total Split (s)	25.0		15.0	95.0	80.0	80.0
Total Split (%)	20.8%		12.5%	79.2%	66.7%	66.7%
Yellow Time (s)	3.0		3.0	3.0	3.0	3.0
All-Red Time (s)	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.0	5.0	5.0	5.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	Max		None	C-Max	C-Max	C-Max
Act Effct Green (s)	20.0	120.0	8.1	90.0	79.1	79.1
Actuated g/C Ratio	0.17	1.00	0.07	0.75	0.66	0.66
v/c Ratio	0.11	0.06	0.34	0.43	0.46	0.03
Control Delay	43.6	0.1	57.1	6.1	11.4	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.6	0.1	57.1	6.1	11.4	2.9
LOS	D	A	E	A	B	A
Approach Delay	10.9			9.4	11.1	
Approach LOS	B			A	B	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 15 (13%), Referenced to phase 4:NBT and 8:SBT, Start of Green	
Natural Cycle: 55	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.46	
Intersection Signal Delay: 10.3	Intersection LOS: B
Intersection Capacity Utilization 44.6%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 9: US 24 & Rex Rd

Intersection						
Int Delay, s/veh	2.2					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	
Traffic Vol, veh/h	44	177	307	389	292	35
Future Vol, veh/h	44	177	307	389	292	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	0	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	186	323	409	307	37

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1381	326	344	0	-	0
Stage 1	326	-	-	-	-	-
Stage 2	1055	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	159	715	1215	-	-	-
Stage 1	731	-	-	-	-	-
Stage 2	335	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	117	715	1215	-	-	-
Mov Cap-2 Maneuver	~ -21	-	-	-	-	-
Stage 1	537	-	-	-	-	-
Stage 2	335	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s		4	0
HCM LOS	-		

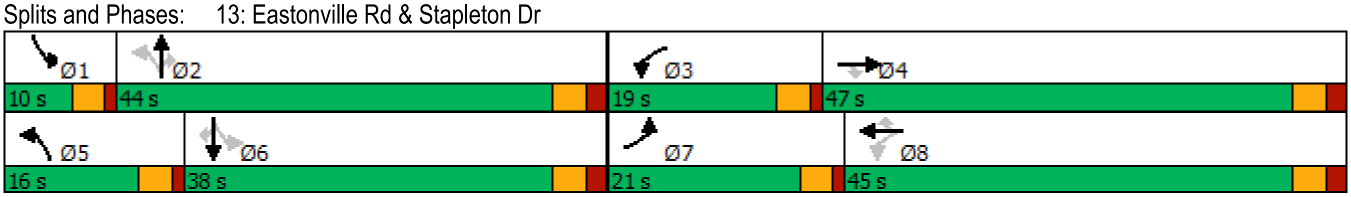
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1215	-	+	715	-	-
HCM Lane V/C Ratio	0.266	-	-	0.261	-	-
HCM Control Delay (s)	9	-	-	11.8	-	-
HCM Lane LOS	A	-	-	B	-	-
HCM 95th %tile Q(veh)	1.1	-	-	1	-	-

Notes
~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	248	904	160	173	1249	151	251	297	158	131	196	132
Future Volume (vph)	248	904	160	173	1249	151	251	297	158	131	196	132
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Total Split (s)	21.0	47.0	47.0	19.0	45.0	45.0	16.0	44.0	44.0	10.0	38.0	38.0
Total Split (%)	17.5%	39.2%	39.2%	15.8%	37.5%	37.5%	13.3%	36.7%	36.7%	8.3%	31.7%	31.7%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	12.8	42.6	42.6	51.8	40.3	40.3	34.3	23.2	23.2	24.3	17.3	17.3
Actuated g/C Ratio	0.13	0.42	0.42	0.52	0.40	0.40	0.34	0.23	0.23	0.24	0.17	0.17
v/c Ratio	0.60	0.62	0.22	0.54	0.90	0.22	0.75	0.73	0.34	0.57	0.64	0.36
Control Delay	48.2	26.2	4.9	17.5	39.4	7.5	41.0	46.3	6.8	36.1	48.5	8.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.2	26.2	4.9	17.5	39.4	7.5	41.0	46.3	6.8	36.1	48.5	8.8
LOS	D	C	A	B	D	A	D	D	A	D	D	A
Approach Delay		27.8			33.8			35.6			33.5	
Approach LOS		C			C			D			C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 100.5	
Natural Cycle: 70	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.90	
Intersection Signal Delay: 32.1	Intersection LOS: C
Intersection Capacity Utilization 80.8%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 13: Eastonville Rd & Stapleton Dr

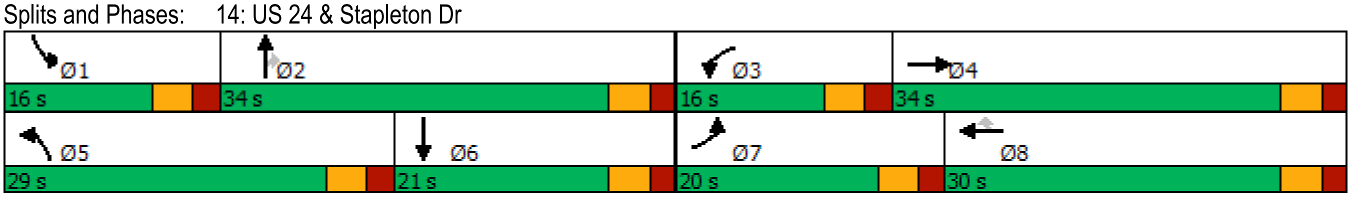


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	372	553	388	200	778	122	723	693	175	223	444	449
Future Volume (vph)	372	553	388	200	778	122	723	693	175	223	444	449
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2			Free
Detector Phase	7	4		3	8	8	5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	10.0	10.0		10.0	10.0	10.0	10.0	11.0	11.0	10.0	11.0	
Total Split (s)	20.0	34.0		16.0	30.0	30.0	29.0	34.0	34.0	16.0	21.0	
Total Split (%)	20.0%	34.0%		16.0%	30.0%	30.0%	29.0%	34.0%	34.0%	16.0%	21.0%	
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None		None	None	None	None	Max	Max	None	Max	
Act Effct Green (s)	14.4	28.8	98.6	10.2	24.7	24.7	23.3	29.1	29.1	10.4	16.2	98.6
Actuated g/C Ratio	0.15	0.29	1.00	0.10	0.25	0.25	0.24	0.30	0.30	0.11	0.16	1.00
v/c Ratio	0.78	0.56	0.26	0.59	0.93	0.24	0.91	0.68	0.31	0.65	0.78	0.30
Control Delay	52.9	32.3	0.4	49.8	53.9	2.4	53.4	34.8	5.7	51.4	50.4	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.9	32.3	0.4	49.8	53.9	2.4	53.4	34.8	5.7	51.4	50.4	0.5
LOS	D	C	A	D	D	A	D	C	A	D	D	A
Approach Delay		28.7			47.4			40.0			30.3	
Approach LOS		C			D			D			C	

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 98.6
Natural Cycle: 75
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 36.6 Intersection LOS: D
Intersection Capacity Utilization 81.7% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 14: US 24 & Stapleton Dr



Intersection	
Int Delay, s/veh	721

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	35	146	218	623	75	23	86	130	310	15	194	52
Future Vol, veh/h	35	146	218	623	75	23	86	130	310	15	194	52
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	205	-	155	300	-	155	315	-	155	205	-	155
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	154	229	656	79	24	91	137	326	16	204	55

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	770	881	204	774	610	137	259	0	0	463	0	0
Stage 1	236	236	-	319	319	-	-	-	-	-	-	-
Stage 2	534	645	-	455	291	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	318	285	837	~ 316	409	911	1306	-	-	1098	-	-
Stage 1	767	710	-	693	653	-	-	-	-	-	-	-
Stage 2	530	467	-	~ 585	672	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	244	261	837	~ 115	375	911	1306	-	-	1098	-	-
Mov Cap-2 Maneuver	244	261	-	~ 115	375	-	-	-	-	-	-	-
Stage 1	713	699	-	~ 644	607	-	-	-	-	-	-	-
Stage 2	418	434	-	~ 326	662	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	21.4	$ 1894.1	1.3	0.5
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1306	-	-	244	261	837	115	375	911	1098	-	-
HCM Lane V/C Ratio	0.069	-	-	0.151	0.589	0.274	5.703	0.211	0.027	0.014	-	-
HCM Control Delay (s)	8	-	-	22.4	36.8	10.9	$ 2189.7	17.1	9.1	8.3	-	-
HCM Lane LOS	A	-	-	C	E	B	F	C	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.5	3.4	1.1	71.1	0.8	0.1	0	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	15.8
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	420	759	554	275
Demand Flow Rate, veh/h	429	774	566	280
Vehicles Circulating, veh/h	893	271	211	843
Vehicles Exiting, veh/h	230	506	1111	202
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	29.5	16.4	5.4	14.3
Approach LOS	D	C	A	B

Lane	Left	Left	Left	Right	Left
Designated Moves	LTR	LTR	LT	R	LTR
Assumed Moves	LTR	LTR	LT	R	LTR
RT Channelized					
Lane Util	1.000	1.000	0.412	0.588	1.000
Follow-Up Headway, s	2.609	2.609	2.535	2.535	2.609
Critical Headway, s	4.976	4.976	4.544	4.544	4.976
Entry Flow, veh/h	429	774	233	333	280
Cap Entry Lane, veh/h	555	1047	1172	1172	584
Entry HV Adj Factor	0.979	0.981	0.980	0.979	0.982
Flow Entry, veh/h	420	759	228	326	275
Cap Entry, veh/h	543	1027	1148	1147	573
V/C Ratio	0.773	0.740	0.199	0.284	0.479
Control Delay, s/veh	29.5	16.4	4.9	5.8	14.3
LOS	D	C	A	A	B
95th %tile Queue, veh	7	7	1	1	3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	146	218	623	75	23	86	130	310	15	194	52
Future Volume (vph)	35	146	218	623	75	23	86	130	310	15	194	52
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	20.0	20.0	10.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	15.0	30.0	30.0	15.0	30.0	30.0	75.0	75.0	75.0	75.0	75.0	75.0
Total Split (%)	12.5%	25.0%	25.0%	12.5%	25.0%	25.0%	62.5%	62.5%	62.5%	62.5%	62.5%	62.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	15.4	9.2	9.2	23.8	20.2	20.2	10.8	10.8	10.8	10.8	10.8	10.8
Actuated g/C Ratio	0.34	0.20	0.20	0.53	0.45	0.45	0.24	0.24	0.24	0.24	0.24	0.24
v/c Ratio	0.07	0.41	0.45	1.00	0.10	0.03	0.33	0.31	0.52	0.05	0.46	0.13
Control Delay	6.7	19.8	6.3	49.6	11.4	1.2	18.1	16.5	5.7	14.1	18.8	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.7	19.8	6.3	49.6	11.4	1.2	18.1	16.5	5.7	14.1	18.8	5.1
LOS	A	B	A	D	B	A	B	B	A	B	B	A
Approach Delay		11.3			44.1			10.4			15.8	
Approach LOS		B			D			B			B	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 45.3	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.00	
Intersection Signal Delay: 24.1	Intersection LOS: C
Intersection Capacity Utilization 73.8%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 1: Eastonville Rd & Rex Rd

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	461	10	13	703	18	27
Future Vol, veh/h	461	10	13	703	18	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	205	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	485	11	14	740	19	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	496	0	1259	491
Stage 1	-	-	-	-	491	-
Stage 2	-	-	-	-	768	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1068	-	188	578
Stage 1	-	-	-	-	615	-
Stage 2	-	-	-	-	458	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1068	-	186	578
Mov Cap-2 Maneuver	-	-	-	-	316	-
Stage 1	-	-	-	-	607	-
Stage 2	-	-	-	-	458	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	13.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	316	578	-	-	1068	-
HCM Lane V/C Ratio	0.06	0.049	-	-	0.013	-
HCM Control Delay (s)	17.1	11.6	-	-	8.4	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	0.2	-	-	0	-

Intersection	
Intersection Delay, s/veh	7.8
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	496	754	47
Demand Flow Rate, veh/h	506	769	48
Vehicles Circulating, veh/h	14	19	495
Vehicles Exiting, veh/h	774	524	25
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.1	9.1	5.0
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	506	769	48
Cap Entry Lane, veh/h	1360	1353	833
Entry HV Adj Factor	0.981	0.981	0.979
Flow Entry, veh/h	496	754	47
Cap Entry, veh/h	1334	1327	816
V/C Ratio	0.372	0.568	0.058
Control Delay, s/veh	6.1	9.1	5.0
LOS	A	A	A
95th %tile Queue, veh	2	4	0

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	476	12	19	679	36	57
Future Vol, veh/h	476	12	19	679	36	57
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	205	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	517	13	21	738	39	62

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	530	0	1304	524
Stage 1	-	-	-	-	524	-
Stage 2	-	-	-	-	780	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1037	-	177	553
Stage 1	-	-	-	-	594	-
Stage 2	-	-	-	-	452	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1037	-	173	553
Mov Cap-2 Maneuver	-	-	-	-	302	-
Stage 1	-	-	-	-	582	-
Stage 2	-	-	-	-	452	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	14.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	302	553	-	-	1037	-
HCM Lane V/C Ratio	0.13	0.112	-	-	0.02	-
HCM Control Delay (s)	18.7	12.3	-	-	8.5	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	0.4	-	-	0.1	-

Intersection	
Intersection Delay, s/veh	8.1
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	530	759	101
Demand Flow Rate, veh/h	540	774	103
Vehicles Circulating, veh/h	21	40	527
Vehicles Exiting, veh/h	793	590	34
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.5	9.5	5.9
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	540	774	103
Cap Entry Lane, veh/h	1351	1325	806
Entry HV Adj Factor	0.981	0.981	0.981
Flow Entry, veh/h	530	759	101
Cap Entry, veh/h	1325	1299	790
V/C Ratio	0.400	0.584	0.128
Control Delay, s/veh	6.5	9.5	5.9
LOS	A	A	A
95th %tile Queue, veh	2	4	0

Intersection	
Int Delay, s/veh	2.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	509	24	38	625	73	114
Future Vol, veh/h	509	24	38	625	73	114
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	536	25	40	658	77	120

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	561	0	1274	536
Stage 1	-	-	-	-	536	-
Stage 2	-	-	-	-	738	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1010	-	184	545
Stage 1	-	-	-	-	587	-
Stage 2	-	-	-	-	473	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1010	-	177	545
Mov Cap-2 Maneuver	-	-	-	-	302	-
Stage 1	-	-	-	-	564	-
Stage 2	-	-	-	-	473	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	16.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	302	545	-	-	1010	-
HCM Lane V/C Ratio	0.254	0.22	-	-	0.04	-
HCM Control Delay (s)	20.9	13.5	-	-	8.7	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	1	0.8	-	-	0.1	-

Intersection	
Intersection Delay, s/veh	8.2
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	561	698	197
Demand Flow Rate, veh/h	573	712	201
Vehicles Circulating, veh/h	41	79	547
Vehicles Exiting, veh/h	750	669	66
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.0	9.3	7.5
Approach LOS	A	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	573	712	201
Cap Entry Lane, veh/h	1323	1273	790
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	561	698	197
Cap Entry, veh/h	1296	1248	774
V/C Ratio	0.433	0.559	0.254
Control Delay, s/veh	7.0	9.3	7.5
LOS	A	A	A
95th %tile Queue, veh	2	4	1

Intersection						
Int Delay, s/veh	4.2					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	577	46	45	526	137	135
Future Vol, veh/h	577	46	45	526	137	135
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	607	48	47	554	144	142

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	655	0	1255	607
Stage 1	-	-	-	-	607	-
Stage 2	-	-	-	-	648	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	932	-	189	496
Stage 1	-	-	-	-	544	-
Stage 2	-	-	-	-	521	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	932	-	180	496
Mov Cap-2 Maneuver	-	-	-	-	308	-
Stage 1	-	-	-	-	517	-
Stage 2	-	-	-	-	521	-

Approach	EB		WB		NB	
HCM Control Delay, s	0		0.7		20.9	
HCM LOS					C	

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	308	496	-	-	932	-
HCM Lane V/C Ratio	0.468	0.287	-	-	0.051	-
HCM Control Delay (s)	26.6	15.1	-	-	9.1	-
HCM Lane LOS	D	C	-	-	A	-
HCM 95th %tile Q(veh)	2.4	1.2	-	-	0.2	-

Intersection	
Intersection Delay, s/veh	8.9
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	655	601	286
Demand Flow Rate, veh/h	668	613	292
Vehicles Circulating, veh/h	48	147	619
Vehicles Exiting, veh/h	712	764	97
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.2	8.9	10.3
Approach LOS	A	A	B

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	668	613	292
Cap Entry Lane, veh/h	1314	1188	734
Entry HV Adj Factor	0.980	0.980	0.979
Flow Entry, veh/h	655	601	286
Cap Entry, veh/h	1288	1164	719
V/C Ratio	0.508	0.516	0.398
Control Delay, s/veh	8.2	8.9	10.3
LOS	A	A	B
95th %tile Queue, veh	3	3	2

Intersection	
Int Delay, s/veh	91

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	120	592	289	163	410	283
Future Vol, veh/h	120	592	289	163	410	283
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	405	-	-	155	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	126	623	304	172	432	298

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	476	0	-	0	1179	304
Stage 1	-	-	-	-	304	-
Stage 2	-	-	-	-	875	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1086	-	-	-	~ 211	736
Stage 1	-	-	-	-	748	-
Stage 2	-	-	-	-	~ 408	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1086	-	-	-	~ 187	736
Mov Cap-2 Maneuver	-	-	-	-	~ 243	-
Stage 1	-	-	-	-	661	-
Stage 2	-	-	-	-	~ 408	-

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	242.2
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1086	-	-	-	243	736
HCM Lane V/C Ratio	0.116	-	-	-	1.776	0.405
HCM Control Delay (s)	8.8	-	-	-	$ 400.2	13.2
HCM Lane LOS	A	-	-	-	F	B
HCM 95th %tile Q(veh)	0.4	-	-	-	29.1	2

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	18.6
Intersection LOS	C

Approach	EB	WB	SB
Entry Lanes	1	2	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	749	476	730
Demand Flow Rate, veh/h	764	485	745
Vehicles Circulating, veh/h	441	129	310
Vehicles Exiting, veh/h	614	1076	304
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	29.0	4.7	17.0
Approach LOS	D	A	C

Lane	Left	Left	Right	Left
Designated Moves	LT	LT	R	LR
Assumed Moves	LT	LT	R	LR
RT Channelized				
Lane Util	1.000	0.639	0.361	1.000
Follow-Up Headway, s	2.609	2.535	2.535	2.609
Critical Headway, s	4.976	4.544	4.544	4.976
Entry Flow, veh/h	764	310	175	745
Cap Entry Lane, veh/h	880	1263	1263	1006
Entry HV Adj Factor	0.980	0.980	0.983	0.980
Flow Entry, veh/h	749	304	172	730
Cap Entry, veh/h	862	1238	1241	986
V/C Ratio	0.868	0.245	0.139	0.741
Control Delay, s/veh	29.0	5.1	4.1	17.0
LOS	D	A	A	C
95th %tile Queue, veh	11	1	0	7

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	120	592	289	163	410	283
Future Volume (vph)	120	592	289	163	410	283
Turn Type	pm+pt	NA	NA	Perm	Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Detector Phase	5	2	6	6	4	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	15.0	78.0	63.0	63.0	42.0	42.0
Total Split (%)	12.5%	65.0%	52.5%	52.5%	35.0%	35.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Recall Mode	None	C-Max	None	None	Max	Max
Act Effct Green (s)	73.0	73.0	59.2	59.2	37.0	37.0
Actuated g/C Ratio	0.61	0.61	0.49	0.49	0.31	0.31
v/c Ratio	0.21	0.55	0.33	0.20	0.79	0.43
Control Delay	10.9	16.1	47.7	26.7	50.1	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.9	16.1	47.7	26.7	50.1	5.5
LOS	B	B	D	C	D	A
Approach Delay		15.3	40.1		31.9	
Approach LOS		B	D		C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green	
Natural Cycle: 55	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.79	
Intersection Signal Delay: 27.5	Intersection LOS: C
Intersection Capacity Utilization 62.2%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 6: Rex Rd & Residential Collector

Intersection	
Int Delay, s/veh	10.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	968	34	79	351	100	236
Future Vol, veh/h	968	34	79	351	100	236
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	405	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1019	36	83	369	105	248

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1055	0	1554	1019
Stage 1	-	-	-	-	1019	-
Stage 2	-	-	-	-	535	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	660	-	125	288
Stage 1	-	-	-	-	348	-
Stage 2	-	-	-	-	587	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	660	-	109	288
Mov Cap-2 Maneuver	-	-	-	-	219	-
Stage 1	-	-	-	-	304	-
Stage 2	-	-	-	-	587	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.1	54.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	219	288	-	-	660	-
HCM Lane V/C Ratio	0.481	0.863	-	-	0.126	-
HCM Control Delay (s)	35.8	62.8	-	-	11.2	-
HCM Lane LOS	E	F	-	-	B	-
HCM 95th %tile Q(veh)	2.4	7.5	-	-	0.4	-

Intersection	
Intersection Delay, s/veh	15.1
Intersection LOS	C

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	1055	452	353
Demand Flow Rate, veh/h	1076	461	360
Vehicles Circulating, veh/h	85	107	1039
Vehicles Exiting, veh/h	483	1292	122
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	17.7	6.2	18.7
Approach LOS	C	A	C

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.328
Entry Flow, veh/h	1076	461	360
Cap Entry Lane, veh/h	1321	1297	587
Entry HV Adj Factor	0.980	0.980	0.981
Flow Entry, veh/h	1055	452	353
Cap Entry, veh/h	1295	1270	576
V/C Ratio	0.814	0.356	0.613
Control Delay, s/veh	17.7	6.2	18.7
LOS	C	A	C
95th %tile Queue, veh	10	2	4

Intersection	
Int Delay, s/veh	4.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	19	1166	19	39	420	41	5	0	30	31	0	5
Future Vol, veh/h	19	1166	19	39	420	41	5	0	30	31	0	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	205	-	155	200	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	20	1227	20	41	442	43	5	0	32	33	0	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	485	0	0	1247	0	0	1815	1834	1227	1817	1811	442
Stage 1	-	-	-	-	-	-	1267	1267	-	524	524	-
Stage 2	-	-	-	-	-	-	548	567	-	1293	1287	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1078	-	-	558	-	-	60	76	217	60	79	615
Stage 1	-	-	-	-	-	-	207	240	-	537	530	-
Stage 2	-	-	-	-	-	-	521	507	-	200	235	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1078	-	-	558	-	-	55	69	217	48	72	615
Mov Cap-2 Maneuver	-	-	-	-	-	-	55	69	-	48	72	-
Stage 1	-	-	-	-	-	-	203	235	-	527	491	-
Stage 2	-	-	-	-	-	-	479	470	-	168	231	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	0.9	32	152.8
HCM LOS			D	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	55	217	1078	-	-	558	-	-	48	615
HCM Lane V/C Ratio	0.096	0.146	0.019	-	-	0.074	-	-	0.68	0.009
HCM Control Delay (s)	77.3	24.4	8.4	-	-	12	-	-	175.7	10.9
HCM Lane LOS	F	C	A	-	-	B	-	-	F	B
HCM 95th %tile Q(veh)	0.3	0.5	0.1	-	-	0.2	-	-	2.7	0

Intersection	
Intersection Delay, s/veh	7.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	2	2	1	1
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	1309	545	38	39
Demand Flow Rate, veh/h	1334	556	39	40
Vehicles Circulating, veh/h	78	26	1348	514
Vehicles Exiting, veh/h	476	1361	64	68
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	8.4	4.4	9.4	4.4
Approach LOS	A	A	A	A

Lane	Left	Right	Left	Right	Left	Left
Designated Moves	LT	TR	LT	TR	LTR	LTR
Assumed Moves	LT	TR	LT	TR	LTR	LTR
RT Channelized						
Lane Util	0.470	0.530	0.469	0.531	1.000	1.000
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.535	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.328	4.328
Entry Flow, veh/h	627	707	261	295	39	40
Cap Entry Lane, veh/h	1256	1329	1318	1389	451	917
Entry HV Adj Factor	0.981	0.981	0.981	0.979	0.974	0.975
Flow Entry, veh/h	615	694	256	289	38	39
Cap Entry, veh/h	1232	1304	1293	1360	440	894
V/C Ratio	0.499	0.532	0.198	0.212	0.086	0.044
Control Delay, s/veh	8.3	8.5	4.5	4.4	9.4	4.4
LOS	A	A	A	A	A	A
95th %tile Queue, veh	3	3	1	1	0	0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	19	1166	19	39	420	41	5	0	31	0
Future Volume (vph)	19	1166	19	39	420	41	5	0	31	0
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases		2			6			8		4
Permitted Phases	2		2	6		6	8		4	
Detector Phase	2	2	2	6	6	6	8	8	4	4
Switch Phase										
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	95.0	95.0	95.0	95.0	95.0	95.0	25.0	25.0	25.0	25.0
Total Split (%)	79.2%	79.2%	79.2%	79.2%	79.2%	79.2%	20.8%	20.8%	20.8%	20.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	61.5	61.5	61.5	61.5	61.5	61.5	48.5	48.5	48.5	48.5
Actuated g/C Ratio	0.51	0.51	0.51	0.51	0.51	0.51	0.40	0.40	0.40	0.40
v/c Ratio	0.04	0.68	0.02	0.34	0.24	0.05	0.01	0.04	0.06	0.01
Control Delay	8.2	17.5	1.6	53.6	40.2	25.3	27.8	0.1	27.2	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.2	17.5	1.6	53.6	40.2	25.3	27.8	0.1	27.2	0.0
LOS	A	B	A	D	D	C	C	A	C	A
Approach Delay		17.1			40.0			3.9		23.6
Approach LOS		B			D			A		C

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 4:SBTL and 8:NBTL, Start of Green	
Natural Cycle: 50	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.68	
Intersection Signal Delay: 23.4	Intersection LOS: C
Intersection Capacity Utilization 49.1%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 8: C-1/C-2 & Rex Rd

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	133	1095	418	833	1096	81
Future Volume (vph)	133	1095	418	833	1096	81
Turn Type	Prot	Free	Prot	NA	NA	Perm
Protected Phases	6		7	4	8	
Permitted Phases		Free				8
Detector Phase	6		7	4	8	8
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	20.0		10.0	20.0	20.0	20.0
Total Split (s)	25.0		48.0	95.0	47.0	47.0
Total Split (%)	20.8%		40.0%	79.2%	39.2%	39.2%
Yellow Time (s)	3.0		3.0	3.0	3.0	3.0
All-Red Time (s)	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.0	5.0	5.0	5.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	Max		None	C-Max	C-Max	C-Max
Act Effct Green (s)	20.0	120.0	20.9	90.0	64.1	64.1
Actuated g/C Ratio	0.17	1.00	0.17	0.75	0.53	0.53
v/c Ratio	0.47	0.73	0.74	0.32	0.61	0.10
Control Delay	51.3	3.0	54.3	5.3	21.7	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.3	3.0	54.3	5.3	21.7	5.1
LOS	D	A	D	A	C	A
Approach Delay	8.2			22.0	20.6	
Approach LOS	A			C	C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 15 (13%), Referenced to phase 4:NBT and 8:SBT, Start of Green	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.74	
Intersection Signal Delay: 16.9	Intersection LOS: B
Intersection Capacity Utilization 62.1%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 9: US 24 & Rex Rd

Intersection						
Int Delay, s/veh	3.6					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	108	59	468	36	20	1016
Future Vol, veh/h	108	59	468	36	20	1016
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	114	62	493	38	21	1069

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1604	493	0	0	531	0
Stage 1	493	-	-	-	-	-
Stage 2	1111	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	116	576	-	-	1036	-
Stage 1	614	-	-	-	-	-
Stage 2	315	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	114	576	-	-	1036	-
Mov Cap-2 Maneuver	224	-	-	-	-	-
Stage 1	602	-	-	-	-	-
Stage 2	315	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	35.8	0	0.2
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	286	1036	-
HCM Lane V/C Ratio	-	-	0.615	0.02	-
HCM Control Delay (s)	-	-	35.8	8.5	-
HCM Lane LOS	-	-	E	A	-
HCM 95th %tile Q(veh)	-	-	3.8	0.1	-

Intersection	
Intersection Delay, s/veh	15.6
Intersection LOS	C

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	176	531	1090
Demand Flow Rate, veh/h	179	542	1111
Vehicles Circulating, veh/h	503	21	116
Vehicles Exiting, veh/h	60	1206	566
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.9	6.2	21.7
Approach LOS	A	A	C

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.328
Entry Flow, veh/h	179	542	1111
Cap Entry Lane, veh/h	926	1395	1287
Entry HV Adj Factor	0.983	0.980	0.981
Flow Entry, veh/h	176	531	1090
Cap Entry, veh/h	910	1367	1262
V/C Ratio	0.193	0.389	0.863
Control Delay, s/veh	5.9	6.2	21.7
LOS	A	A	C
95th %tile Queue, veh	1	2	12

Intersection	
Int Delay, s/veh	1.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	55	29	475	18	10	1114
Future Vol, veh/h	55	29	475	18	10	1114
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	65	34	559	21	12	1311

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1894	559	0	0	580	0
Stage 1	559	-	-	-	-	-
Stage 2	1335	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	77	529	-	-	994	-
Stage 1	572	-	-	-	-	-
Stage 2	245	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	76	529	-	-	994	-
Mov Cap-2 Maneuver	178	-	-	-	-	-
Stage 1	565	-	-	-	-	-
Stage 2	245	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	31.8	0	0.1
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	231	994	-
HCM Lane V/C Ratio	-	-	0.428	0.012	-
HCM Control Delay (s)	-	-	31.8	8.7	-
HCM Lane LOS	-	-	D	A	-
HCM 95th %tile Q(veh)	-	-	2	0	-

Intersection	
Intersection Delay, s/veh	39.4
Intersection LOS	E

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	99	580	1323
Demand Flow Rate, veh/h	101	591	1349
Vehicles Circulating, veh/h	570	12	66
Vehicles Exiting, veh/h	33	1403	605
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.1	6.9	56.1
Approach LOS	A	A	F

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	101	591	1349
Cap Entry Lane, veh/h	772	1363	1290
Entry HV Adj Factor	0.980	0.981	0.981
Flow Entry, veh/h	99	580	1323
Cap Entry, veh/h	756	1337	1265
V/C Ratio	0.131	0.434	1.046
Control Delay, s/veh	6.1	6.9	56.1
LOS	A	A	F
95th %tile Queue, veh	0	2	26

Intersection	
Int Delay, s/veh	24.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	85	275	158	417	1093	168
Future Vol, veh/h	85	275	158	417	1093	168
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	0	-	-	155
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	89	289	166	439	1151	177

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1922	1151	1328	0	-	0
Stage 1	1151	-	-	-	-	-
Stage 2	771	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 74	~ 241	520	-	-	-
Stage 1	301	-	-	-	-	-
Stage 2	456	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 50	~ 241	520	-	-	-
Mov Cap-2 Maneuver	132	-	-	-	-	-
Stage 1	205	-	-	-	-	-
Stage 2	456	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	144.7	4.2	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	520	-	132	241	-	-
HCM Lane V/C Ratio	0.32	-	0.678	1.201	-	-
HCM Control Delay (s)	15.1	-	76.3	165.8	-	-
HCM Lane LOS	C	-	F	F	-	-
HCM 95th %tile Q(veh)	1.4	-	3.7	13.9	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Intersection Delay, s/veh	9.8
Intersection LOS	A

Approach	EB	NB	SB
Entry Lanes	2	2	2
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	378	605	1328
Demand Flow Rate, veh/h	386	617	1355
Vehicles Circulating, veh/h	1174	91	169
Vehicles Exiting, veh/h	350	1469	539
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	16.7	5.4	9.9
Approach LOS	C	A	A

Lane	Left	Right	Left	Right	Left	Right
Designated Moves	L	TR	L	TR	LT	TR
Assumed Moves	L	TR	L	TR	LT	TR
RT Channelized						
Lane Util	0.236	0.764	0.274	0.726	0.470	0.530
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.667	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.645	4.328
Entry Flow, veh/h	91	295	169	448	637	718
Cap Entry Lane, veh/h	458	523	1241	1314	1155	1230
Entry HV Adj Factor	0.978	0.980	0.982	0.980	0.980	0.980
Flow Entry, veh/h	89	289	166	439	624	704
Cap Entry, veh/h	448	513	1219	1289	1132	1206
V/C Ratio	0.199	0.564	0.136	0.341	0.551	0.584
Control Delay, s/veh	11.0	18.5	4.1	5.9	9.8	10.0
LOS	B	C	A	A	A	B
95th %tile Queue, veh	1	3	0	2	3	4

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	85	275	158	417	1093	168
Future Volume (vph)	85	275	158	417	1093	168
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0	10.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	13.0	100.0	87.0	87.0
Total Split (%)	16.7%	16.7%	10.8%	83.3%	72.5%	72.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	10.0	10.0	43.3	43.3	30.0	30.0
Actuated g/C Ratio	0.16	0.16	0.68	0.68	0.47	0.47
v/c Ratio	0.32	0.69	0.46	0.18	0.69	0.21
Control Delay	29.3	18.7	9.7	4.1	15.6	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.3	18.7	9.7	4.1	15.6	2.4
LOS	C	B	A	A	B	A
Approach Delay	21.2			5.6	13.8	
Approach LOS	C			A	B	

Intersection Summary

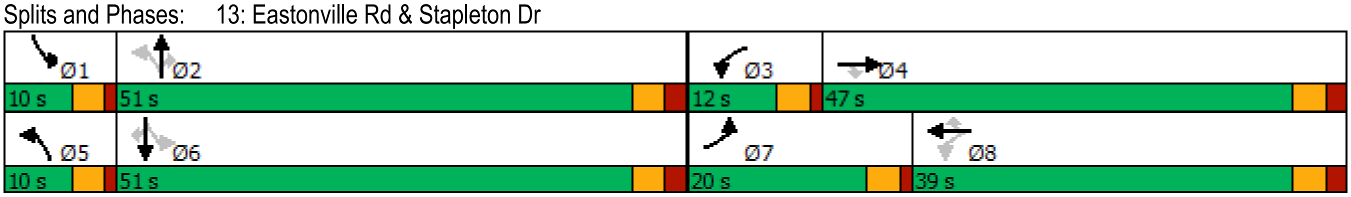
Cycle Length: 120
Actuated Cycle Length: 63.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 12.9 — Intersection LOS: B
Intersection Capacity Utilization 56.2% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 12: Eastonville Rd & Londonderry Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	224	998	224	144	833	111	108	240	182	315	568	451
Future Volume (vph)	224	998	224	144	833	111	108	240	182	315	568	451
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Total Split (s)	20.0	47.0	47.0	12.0	39.0	39.0	10.0	51.0	51.0	10.0	51.0	51.0
Total Split (%)	16.7%	39.2%	39.2%	10.0%	32.5%	32.5%	8.3%	42.5%	42.5%	8.3%	42.5%	42.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	12.9	38.4	38.4	42.8	33.6	33.6	48.2	41.1	41.1	48.2	41.1	41.1
Actuated g/C Ratio	0.12	0.34	0.34	0.38	0.30	0.30	0.43	0.37	0.37	0.43	0.37	0.37
v/c Ratio	0.60	0.87	0.35	0.78	0.82	0.21	0.64	0.37	0.27	0.74	0.88	0.62
Control Delay	54.9	43.5	7.8	50.1	45.1	5.7	36.2	28.0	4.5	35.4	48.5	14.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.9	43.5	7.8	50.1	45.1	5.7	36.2	28.0	4.5	35.4	48.5	14.6
LOS	D	D	A	D	D	A	D	C	A	D	D	B
Approach Delay		39.7			41.7			21.6			34.0	
Approach LOS		D			D			C			C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 111.9	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.88	
Intersection Signal Delay: 36.3	Intersection LOS: D
Intersection Capacity Utilization 86.4%	ICU Level of Service E
Analysis Period (min) 15	

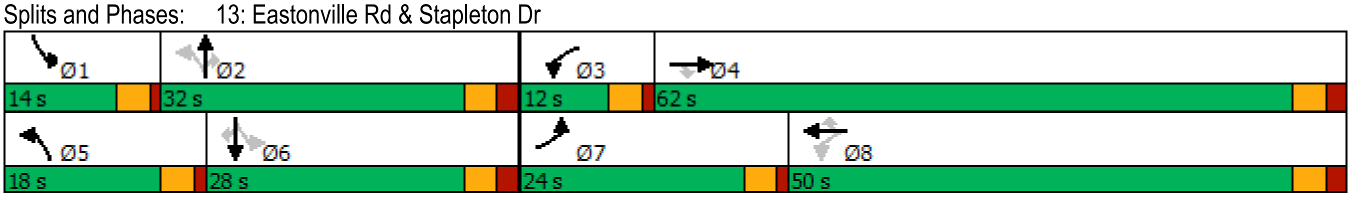
Splits and Phases: 13: Eastonville Rd & Stapleton Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	224	998	224	144	833	111	108	240	182	315	568	451
Future Volume (vph)	224	998	224	144	833	111	108	240	182	315	568	451
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Total Split (s)	24.0	62.0	62.0	12.0	50.0	50.0	18.0	32.0	32.0	14.0	28.0	28.0
Total Split (%)	20.0%	51.7%	51.7%	10.0%	41.7%	41.7%	15.0%	26.7%	26.7%	11.7%	23.3%	23.3%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	12.1	37.4	37.4	42.1	33.2	33.2	33.4	22.1	22.1	33.2	22.0	22.0
Actuated g/C Ratio	0.13	0.39	0.39	0.44	0.35	0.35	0.35	0.23	0.23	0.35	0.23	0.23
v/c Ratio	0.55	0.76	0.31	0.65	0.72	0.19	0.40	0.31	0.38	0.75	0.74	0.76
Control Delay	46.1	29.5	3.6	29.3	31.6	4.4	25.5	33.0	8.4	38.7	42.4	20.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.1	29.5	3.6	29.3	31.6	4.4	25.5	33.0	8.4	38.7	42.4	20.2
LOS	D	C	A	C	C	A	C	C	A	D	D	C
Approach Delay		28.1			28.5			23.0			34.0	
Approach LOS		C			C			C			C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 96	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.76	
Intersection Signal Delay: 29.4	Intersection LOS: C
Intersection Capacity Utilization 74.7%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 13: Eastonville Rd & Stapleton Dr

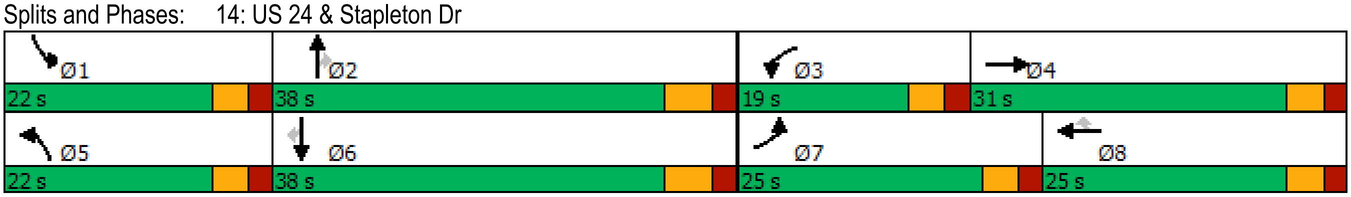


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	442	493	680	200	487	161	356	651	175	299	1632	265
Future Volume (vph)	442	493	680	200	487	161	356	651	175	299	1632	265
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2			6
Detector Phase	7	4		3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	10.0		10.0	10.0	10.0	10.0	11.0	11.0	10.0	11.0	11.0
Total Split (s)	25.0	31.0		19.0	25.0	25.0	22.0	38.0	38.0	22.0	38.0	38.0
Total Split (%)	22.7%	28.2%		17.3%	22.7%	22.7%	20.0%	34.5%	34.5%	20.0%	34.5%	34.5%
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None		None	None	None	None	Max	Max	None	Max	Max
Act Effct Green (s)	18.1	25.3	105.6	11.6	18.8	18.8	15.5	33.1	33.1	14.5	32.1	32.1
Actuated g/C Ratio	0.17	0.24	1.00	0.11	0.18	0.18	0.15	0.31	0.31	0.14	0.30	0.30
v/c Ratio	0.79	0.61	0.45	0.56	0.82	0.39	0.75	0.62	0.30	0.67	1.55	0.41
Control Delay	52.9	39.7	0.9	51.3	53.7	8.0	53.6	34.8	5.7	51.2	279.4	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.9	39.7	0.9	51.3	53.7	8.0	53.6	34.8	5.7	51.2	279.4	5.6
LOS	D	D	A	D	D	A	D	C	A	D	F	A
Approach Delay		27.0			44.5			36.2			213.8	
Approach LOS		C			D			D			F	

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 105.6
Natural Cycle: 130
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.55
Intersection Signal Delay: 100.6 — Intersection LOS: F
Intersection Capacity Utilization 98.8% — ICU Level of Service F
Analysis Period (min) 15

Splits and Phases: 14: US 24 & Stapleton Dr



Intersection	
Int Delay, s/veh	22.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	41	148	96	441	119	17	161	139	645	25	202	67
Future Vol, veh/h	41	148	96	441	119	17	161	139	645	25	202	67
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	205	-	155	300	-	155	315	-	155	205	-	155
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	43	156	101	464	125	18	169	146	679	26	213	71

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1160	1428	213	913	820	146	284	0	0	825	0	0
Stage 1	265	265	-	484	484	-	-	-	-	-	-	-
Stage 2	895	1163	-	429	336	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	172	~ 135	827	~ 254	310	901	1278	-	-	805	-	-
Stage 1	740	689	-	564	552	-	-	-	-	-	-	-
Stage 2	335	269	-	604	642	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	93	~ 113	827	-	260	901	1278	-	-	805	-	-
Mov Cap-2 Maneuver	93	~ 113	-	-	260	-	-	-	-	-	-	-
Stage 1	642	667	-	490	479	-	-	-	-	-	-	-
Stage 2	210	233	-	~ 393	621	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	162.7		1.4	0.8
HCM LOS	F	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1278	-	-	93	113	827	-	260	901	805	-	-
HCM Lane V/C Ratio	0.133	-	-	0.464	1.379	0.122	-	0.482	0.02	0.033	-	-
HCM Control Delay (s)	8.2	-	-	73.5	286.4	10	-	31.1	9.1	9.6	-	-
HCM Lane LOS	A	-	-	F	F	B	-	D	A	A	-	-
HCM 95th %tile Q(veh)	0.5	-	-	2	10.8	0.4	-	2.4	0.1	0.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	11.7
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	300	607	994	310
Demand Flow Rate, veh/h	306	619	1014	316
Vehicles Circulating, veh/h	717	365	230	772
Vehicles Exiting, veh/h	371	879	793	211
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	12.5	14.0	9.3	14.1
Approach LOS	B	B	A	B

Lane	Left	Left	Left	Right	Left
Designated Moves	LTR	LTR	LT	R	LTR
Assumed Moves	LTR	LTR	LT	R	LTR
RT Channelized					
Lane Util	1.000	1.000	0.317	0.683	1.000
Follow-Up Headway, s	2.609	2.609	2.535	2.535	2.609
Critical Headway, s	4.976	4.976	4.544	4.544	4.976
Entry Flow, veh/h	306	619	321	693	316
Cap Entry Lane, veh/h	664	951	1152	1152	628
Entry HV Adj Factor	0.980	0.981	0.982	0.980	0.980
Flow Entry, veh/h	300	607	315	679	310
Cap Entry, veh/h	651	933	1131	1129	615
V/C Ratio	0.461	0.651	0.279	0.602	0.503
Control Delay, s/veh	12.5	14.0	5.8	10.9	14.1
LOS	B	B	A	B	B
95th %tile Queue, veh	2	5	1	4	3

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	41	148	96	441	119	17	161	139	645	25	202	67
Future Volume (vph)	41	148	96	441	119	17	161	139	645	25	202	67
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	20.0	20.0	10.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	15.0	30.0	30.0	15.0	30.0	30.0	75.0	75.0	75.0	75.0	75.0	75.0
Total Split (%)	12.5%	25.0%	25.0%	12.5%	25.0%	25.0%	62.5%	62.5%	62.5%	62.5%	62.5%	62.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	16.4	9.9	9.9	24.6	21.2	21.2	16.8	16.8	16.8	16.8	16.8	16.8
Actuated g/C Ratio	0.31	0.19	0.19	0.47	0.40	0.40	0.32	0.32	0.32	0.32	0.32	0.32
v/c Ratio	0.09	0.44	0.27	0.79	0.17	0.03	0.46	0.24	0.74	0.07	0.36	0.13
Control Delay	10.5	25.1	7.6	25.8	16.3	0.1	18.4	13.9	7.9	12.3	15.2	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.5	25.1	7.6	25.8	16.3	0.1	18.4	13.9	7.9	12.3	15.2	4.2
LOS	B	C	A	C	B	A	B	B	A	B	B	A
Approach Delay		17.1			23.1			10.6			12.4	
Approach LOS		B			C			B			B	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 52.5	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.79	
Intersection Signal Delay: 15.2	Intersection LOS: B
Intersection Capacity Utilization 68.4%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 1: Eastonville Rd & Rex Rd

Intersection						
Int Delay, s/veh	0.6					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	825	21	29	505	15	20
Future Vol, veh/h	825	21	29	505	15	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	205	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	868	22	31	532	16	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	890	0	1473	879
Stage 1	-	-	-	-	879	-
Stage 2	-	-	-	-	594	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	761	-	140	347
Stage 1	-	-	-	-	406	-
Stage 2	-	-	-	-	552	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	761	-	134	347
Mov Cap-2 Maneuver	-	-	-	-	263	-
Stage 1	-	-	-	-	389	-
Stage 2	-	-	-	-	552	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	17.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	263	347	-	-	761	-
HCM Lane V/C Ratio	0.06	0.061	-	-	0.04	-
HCM Control Delay (s)	19.6	16	-	-	9.9	-
HCM Lane LOS	C	C	-	-	A	-
HCM 95th %tile Q(veh)	0.2	0.2	-	-	0.1	-

Intersection	
Intersection Delay, s/veh	9.8
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	890	563	37
Demand Flow Rate, veh/h	907	575	37
Vehicles Circulating, veh/h	32	16	885
Vehicles Exiting, veh/h	559	906	54
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	11.7	6.8	7.2
Approach LOS	B	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	907	575	37
Cap Entry Lane, veh/h	1336	1358	560
Entry HV Adj Factor	0.981	0.980	1.000
Flow Entry, veh/h	890	563	37
Cap Entry, veh/h	1310	1330	560
V/C Ratio	0.679	0.424	0.066
Control Delay, s/veh	11.7	6.8	7.2
LOS	B	A	A
95th %tile Queue, veh	6	2	0

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	807	38	59	512	22	35
Future Vol, veh/h	807	38	59	512	22	35
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	205	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	849	40	62	539	23	37

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	889	0	1532	869
Stage 1	-	-	-	-	869	-
Stage 2	-	-	-	-	663	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	762	-	128	351
Stage 1	-	-	-	-	410	-
Stage 2	-	-	-	-	512	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	762	-	118	351
Mov Cap-2 Maneuver	-	-	-	-	241	-
Stage 1	-	-	-	-	377	-
Stage 2	-	-	-	-	512	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	18.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	241	351	-	-	762	-
HCM Lane V/C Ratio	0.096	0.105	-	-	0.082	-
HCM Control Delay (s)	21.5	16.5	-	-	10.1	-
HCM Lane LOS	C	C	-	-	B	-
HCM 95th %tile Q(veh)	0.3	0.3	-	-	0.3	-

Intersection	
Intersection Delay, s/veh	10.4
Intersection LOS	B

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	889	601	60
Demand Flow Rate, veh/h	907	613	61
Vehicles Circulating, veh/h	63	23	866
Vehicles Exiting, veh/h	573	904	104
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	12.7	7.2	7.7
Approach LOS	B	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	907	613	61
Cap Entry Lane, veh/h	1294	1348	571
Entry HV Adj Factor	0.980	0.981	0.984
Flow Entry, veh/h	889	601	60
Cap Entry, veh/h	1268	1322	561
V/C Ratio	0.701	0.455	0.107
Control Delay, s/veh	12.7	7.2	7.7
LOS	B	A	A
95th %tile Queue, veh	6	2	0

Intersection	
Int Delay, s/veh	2.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	766	76	119	526	45	70
Future Vol, veh/h	766	76	119	526	45	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	806	80	125	554	47	74

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	886	0	1610	806
Stage 1	-	-	-	-	806	-
Stage 2	-	-	-	-	804	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	764	-	115	382
Stage 1	-	-	-	-	439	-
Stage 2	-	-	-	-	440	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	764	-	96	382
Mov Cap-2 Maneuver	-	-	-	-	198	-
Stage 1	-	-	-	-	367	-
Stage 2	-	-	-	-	440	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2	21.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	198	382	-	-	764	-
HCM Lane V/C Ratio	0.239	0.193	-	-	0.164	-
HCM Control Delay (s)	28.8	16.7	-	-	10.6	-
HCM Lane LOS	D	C	-	-	B	-
HCM 95th %tile Q(veh)	0.9	0.7	-	-	0.6	-

Intersection	
Intersection Delay, s/veh	12.0
Intersection LOS	B

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	886	679	121
Demand Flow Rate, veh/h	904	693	123
Vehicles Circulating, veh/h	127	48	822
Vehicles Exiting, veh/h	613	897	209
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	15.0	8.5	8.7
Approach LOS	C	A	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	904	693	123
Cap Entry Lane, veh/h	1212	1314	597
Entry HV Adj Factor	0.980	0.980	0.984
Flow Entry, veh/h	886	679	121
Cap Entry, veh/h	1188	1287	587
V/C Ratio	0.746	0.527	0.206
Control Delay, s/veh	15.0	8.5	8.7
LOS	C	A	A
95th %tile Queue, veh	7	3	1

Intersection	
Int Delay, s/veh	3.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	693	143	142	561	84	83
Future Vol, veh/h	693	143	142	561	84	83
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	305	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	729	151	149	591	88	87

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	880	0	1618	729
Stage 1	-	-	-	-	729	-
Stage 2	-	-	-	-	889	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	768	-	114	423
Stage 1	-	-	-	-	477	-
Stage 2	-	-	-	-	402	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	768	-	92	423
Mov Cap-2 Maneuver	-	-	-	-	179	-
Stage 1	-	-	-	-	384	-
Stage 2	-	-	-	-	402	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.2	29.6
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	179	423	-	-	768	-
HCM Lane V/C Ratio	0.494	0.207	-	-	0.195	-
HCM Control Delay (s)	43.3	15.7	-	-	10.8	-
HCM Lane LOS	E	C	-	-	B	-
HCM 95th %tile Q(veh)	2.4	0.8	-	-	0.7	-

Intersection	
Intersection Delay, s/veh	12.9
Intersection LOS	B

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	880	740	175
Demand Flow Rate, veh/h	898	755	179
Vehicles Circulating, veh/h	152	90	744
Vehicles Exiting, veh/h	693	833	306
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	16.0	10.2	9.3
Approach LOS	C	B	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	898	755	179
Cap Entry Lane, veh/h	1182	1259	646
Entry HV Adj Factor	0.980	0.980	0.978
Flow Entry, veh/h	880	740	175
Cap Entry, veh/h	1159	1234	632
V/C Ratio	0.760	0.600	0.277
Control Delay, s/veh	16.0	10.2	9.3
LOS	C	B	A
95th %tile Queue, veh	8	4	1

Intersection	
Int Delay, s/veh	173.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	250	526	554	383	226	149
Future Vol, veh/h	250	526	554	383	226	149
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	405	-	-	155	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	263	554	583	403	238	157

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	986	0	-	0	1663	583
Stage 1	-	-	-	-	583	-
Stage 2	-	-	-	-	1080	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	701	-	-	-	~ 107	512
Stage 1	-	-	-	-	558	-
Stage 2	-	-	-	-	326	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	701	-	-	-	~ 67	512
Mov Cap-2 Maneuver	-	-	-	-	~ 57	-
Stage 1	-	-	-	-	349	-
Stage 2	-	-	-	-	326	-

Approach	EB	WB	SB
HCM Control Delay, s	4.2	0	$ 955.2
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	701	-	-	-	57	512
HCM Lane V/C Ratio	0.375	-	-	-	4.174	0.306
HCM Control Delay (s)	13.2	-	-	-	$ 1575	15.1
HCM Lane LOS	B	-	-	-	F	C
HCM 95th %tile Q(veh)	1.7	-	-	-	26	1.3

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	12.8
Intersection LOS	B

Approach	EB	WB	SB
Entry Lanes	1	2	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	817	986	395
Demand Flow Rate, veh/h	833	1006	403
Vehicles Circulating, veh/h	243	268	595
Vehicles Exiting, veh/h	755	808	679
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	17.8	8.6	13.1
Approach LOS	C	A	B

Lane	Left	Left	Right	Left
Designated Moves	LT	LT	R	LR
Assumed Moves	LT	LT	R	LR
RT Channelized				
Lane Util	1.000	0.591	0.409	1.000
Follow-Up Headway, s	2.609	2.535	2.535	2.609
Critical Headway, s	4.976	4.544	4.544	4.976
Entry Flow, veh/h	833	595	411	403
Cap Entry Lane, veh/h	1077	1113	1113	752
Entry HV Adj Factor	0.981	0.980	0.981	0.980
Flow Entry, veh/h	817	583	403	395
Cap Entry, veh/h	1056	1091	1091	737
V/C Ratio	0.773	0.535	0.369	0.536
Control Delay, s/veh	17.8	9.7	7.1	13.1
LOS	C	A	A	B
95th %tile Queue, veh	8	3	2	3

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	250	526	554	383	226	149
Future Volume (vph)	250	526	554	383	226	149
Turn Type	pm+pt	NA	NA	Perm	Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Detector Phase	5	2	6	6	4	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	15.0	90.0	75.0	75.0	30.0	30.0
Total Split (%)	12.5%	75.0%	62.5%	62.5%	25.0%	25.0%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Recall Mode	None	C-Max	None	None	Max	Max
Act Effct Green (s)	85.0	85.0	70.3	70.3	25.0	25.0
Actuated g/C Ratio	0.71	0.71	0.59	0.59	0.21	0.21
v/c Ratio	0.53	0.42	0.53	0.37	0.65	0.35
Control Delay	10.1	8.4	37.7	18.9	52.7	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.1	8.4	37.7	18.9	52.7	8.3
LOS	B	A	D	B	D	A
Approach Delay		9.0	30.0		35.1	
Approach LOS		A	C		D	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.65	
Intersection Signal Delay: 23.1	Intersection LOS: C
Intersection Capacity Utilization 68.0%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 6: Rex Rd & Residential Collector

Intersection						
Int Delay, s/veh	1.3					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	620	105	246	932	62	145
Future Vol, veh/h	620	105	246	932	62	145
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	155	405	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	653	111	259	981	65	153

Major/Minor	Major1			Major2	Minor1	
Conflicting Flow All	0	0	764	0	2152	653
Stage 1	-	-	-	-	653	-
Stage 2	-	-	-	-	1499	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	849	-	~ 53	467
Stage 1	-	-	-	-	518	-
Stage 2	-	-	-	-	204	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	849	-	~ 37	467
Mov Cap-2 Maneuver	-	-	-	-	~ -84	-
Stage 1	-	-	-	-	360	-
Stage 2	-	-	-	-	204	-

Approach	EB			WB	NB	
HCM Control Delay, s	0			2.3		
HCM LOS					-	

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	+	467	-	-	849	-
HCM Lane V/C Ratio	-	0.327	-	-	0.305	-
HCM Control Delay (s)	-	16.4	-	-	11.1	-
HCM Lane LOS	-	C	-	-	B	-
HCM 95th %tile Q(veh)	-	1.4	-	-	1.3	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Intersection Delay, s/veh	22.6
Intersection LOS	C

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	764	1240	218
Demand Flow Rate, veh/h	779	1265	222
Vehicles Circulating, veh/h	264	66	666
Vehicles Exiting, veh/h	1067	822	377
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	13.4	30.9	7.6
Approach LOS	B	D	A

Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.328
Entry Flow, veh/h	779	1265	222
Cap Entry Lane, veh/h	1135	1343	806
Entry HV Adj Factor	0.981	0.981	0.982
Flow Entry, veh/h	764	1240	218
Cap Entry, veh/h	1113	1316	792
V/C Ratio	0.687	0.942	0.275
Control Delay, s/veh	13.4	30.9	7.6
LOS	B	D	A
95th %tile Queue, veh	6	17	1

Intersection	
Int Delay, s/veh	170.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	35	698	32	121	1087	131	44	0	104	113	0	48
Future Vol, veh/h	35	698	32	121	1087	131	44	0	104	113	0	48
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	205	-	155	200	-	0	0	-	-	0	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	735	34	127	1144	138	46	0	109	119	0	51

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1282	0	0	769	0	0	2302	2345	735	2279	2241	1144
Stage 1	-	-	-	-	-	-	809	809	-	1398	1398	-
Stage 2	-	-	-	-	-	-	1493	1536	-	881	843	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	541	-	-	845	-	-	~ 27	36	420	~ 28	42	243
Stage 1	-	-	-	-	-	-	374	394	-	174	207	-
Stage 2	-	-	-	-	-	-	154	178	-	341	380	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	541	-	-	845	-	-	~ 18	29	420	~ 17	33	243
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 18	29	-	~ 17	33	-
Stage 1	-	-	-	-	-	-	349	367	-	162	176	-
Stage 2	-	-	-	-	-	-	104	151	-	235	354	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.6	0.9	$ 355.4	$ 2213.2
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	18	420	541	-	-	845	-	-	17	243
HCM Lane V/C Ratio	2.573	0.261	0.068	-	-	0.151	-	-	6.997	0.208
HCM Control Delay (s)	$ 1156.3	16.6	12.1	-	-	10	-	-	$ 3143.2	23.7
HCM Lane LOS	F	C	B	-	-	B	-	-	F	C
HCM 95th %tile Q(veh)	6.3	1	0.2	-	-	0.5	-	-	15.6	0.8

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Intersection Delay, s/veh	8.9
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	2	2	1	1
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	806	1409	155	170
Demand Flow Rate, veh/h	823	1438	158	173
Vehicles Circulating, veh/h	251	85	909	1344
Vehicles Exiting, veh/h	1266	982	165	179
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	7.1	9.2	8.6	14.9
Approach LOS	A	A	A	B

Lane	Left	Right	Left	Right	Left	Left
Designated Moves	LT	TR	LT	TR	LTR	LTR
Assumed Moves	LT	TR	LT	TR	LTR	LTR
RT Channelized						
Lane Util	0.470	0.530	0.470	0.530	1.000	1.000
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.535	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.328	4.328
Entry Flow, veh/h	387	436	676	762	158	173
Cap Entry Lane, veh/h	1072	1147	1248	1321	656	453
Entry HV Adj Factor	0.979	0.980	0.980	0.980	0.981	0.983
Flow Entry, veh/h	379	427	662	747	155	170
Cap Entry, veh/h	1049	1124	1223	1295	643	445
V/C Ratio	0.361	0.380	0.542	0.577	0.241	0.382
Control Delay, s/veh	7.2	7.1	9.1	9.4	8.6	14.9
LOS	A	A	A	A	A	B
95th %tile Queue, veh	2	2	3	4	1	2

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	35	698	32	121	1087	131	44	0	113	0
Future Volume (vph)	35	698	32	121	1087	131	44	0	113	0
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	NA
Protected Phases		2			6			8		4
Permitted Phases	2		2	6		6	8		4	
Detector Phase	2	2	2	6	6	6	8	8	4	4
Switch Phase										
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	95.0	95.0	95.0	95.0	95.0	95.0	25.0	25.0	25.0	25.0
Total Split (%)	79.2%	79.2%	79.2%	79.2%	79.2%	79.2%	20.8%	20.8%	20.8%	20.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag										
Lead-Lag Optimize?										
Recall Mode	None	None	None	None	None	None	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	58.4	58.4	58.4	58.4	58.4	58.4	51.6	51.6	51.6	51.6
Actuated g/C Ratio	0.49	0.49	0.49	0.49	0.49	0.49	0.43	0.43	0.43	0.43
v/c Ratio	0.30	0.43	0.04	0.47	0.66	0.16	0.08	0.13	0.22	0.07
Control Delay	17.4	15.2	1.6	42.0	44.3	17.3	25.4	0.3	26.3	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Total Delay	17.4	15.2	1.6	42.0	44.6	17.3	25.4	0.3	26.3	0.2
LOS	B	B	A	D	D	B	C	A	C	A
Approach Delay		14.7			41.7			7.8		18.5
Approach LOS		B			D			A		B

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 4:SBTL and 8:NBTL, Start of Green	
Natural Cycle: 45	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.66	
Intersection Signal Delay: 29.5	Intersection LOS: C
Intersection Capacity Utilization 59.6%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 8: C-1/C-2 & Rex Rd

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	148	767	1179	1044	980	160
Future Volume (vph)	148	767	1179	1044	980	160
Turn Type	Prot	Free	Prot	NA	NA	Perm
Protected Phases	6		7	4	8	
Permitted Phases		Free				8
Detector Phase	6		7	4	8	8
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	20.0		10.0	20.0	20.0	20.0
Total Split (s)	25.0		54.0	95.0	41.0	41.0
Total Split (%)	20.8%		45.0%	79.2%	34.2%	34.2%
Yellow Time (s)	3.0		3.0	3.0	3.0	3.0
All-Red Time (s)	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.0	5.0	5.0	5.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	Max		None	C-Max	C-Max	C-Max
Act Effct Green (s)	20.0	120.0	47.3	90.0	37.7	37.7
Actuated g/C Ratio	0.17	1.00	0.39	0.75	0.31	0.31
v/c Ratio	0.53	0.51	0.92	0.40	0.93	0.28
Control Delay	53.0	1.2	46.1	5.9	55.0	8.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.0	1.2	46.1	5.9	55.0	8.4
LOS	D	A	D	A	D	A
Approach Delay	9.6			27.5	48.4	
Approach LOS	A			C	D	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 15 (13%), Referenced to phase 4:NBT and 8:SBT, Start of Green	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.93	
Intersection Signal Delay: 29.3	Intersection LOS: C
Intersection Capacity Utilization 81.4%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 9: US 24 & Rex Rd

Intersection	
Int Delay, s/veh	2.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	66	36	945	112	62	675
Future Vol, veh/h	66	36	945	112	62	675
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	69	38	995	118	65	711

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1836	995	0	0	1113	0
Stage 1	995	-	-	-	-	-
Stage 2	841	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	83	297	-	-	627	-
Stage 1	358	-	-	-	-	-
Stage 2	423	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	74	297	-	-	627	-
Mov Cap-2 Maneuver	188	-	-	-	-	-
Stage 1	321	-	-	-	-	-
Stage 2	423	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	37.1	0	1
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	216	627	-
HCM Lane V/C Ratio	-	-	0.497	0.104	-
HCM Control Delay (s)	-	-	37.1	11.4	-
HCM Lane LOS	-	-	E	B	-
HCM 95th %tile Q(veh)	-	-	2.5	0.3	-

Intersection	
Intersection Delay, s/veh	15.1
Intersection LOS	C

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	107	1113	776
Demand Flow Rate, veh/h	109	1135	791
Vehicles Circulating, veh/h	1015	66	70
Vehicles Exiting, veh/h	186	795	1054
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.4	19.6	9.6
Approach LOS	A	C	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.535	2.535	2.535
Critical Headway, s	4.328	4.328	4.328
Entry Flow, veh/h	109	1135	791
Cap Entry Lane, veh/h	599	1343	1338
Entry HV Adj Factor	0.982	0.981	0.981
Flow Entry, veh/h	107	1113	776
Cap Entry, veh/h	588	1317	1312
V/C Ratio	0.182	0.845	0.591
Control Delay, s/veh	8.4	19.6	9.6
LOS	A	C	A
95th %tile Queue, veh	1	11	4

Intersection						
Int Delay, s/veh	1					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	34	18	1040	57	32	709
Future Vol, veh/h	34	18	1040	57	32	709
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	155	205	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	36	19	1095	60	34	746

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1909	1095	0	0	1155	0
Stage 1	1095	-	-	-	-	-
Stage 2	814	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	75	260	-	-	605	-
Stage 1	321	-	-	-	-	-
Stage 2	436	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	71	260	-	-	605	-
Mov Cap-2 Maneuver	189	-	-	-	-	-
Stage 1	303	-	-	-	-	-
Stage 2	436	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	28.2	0	0.5
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	209	605	-
HCM Lane V/C Ratio	-	-	0.262	0.056	-
HCM Control Delay (s)	-	-	28.2	11.3	-
HCM Lane LOS	-	-	D	B	-
HCM 95th %tile Q(veh)	-	-	1	0.2	-

Intersection	
Intersection Delay, s/veh	17.7
Intersection LOS	C

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	55	1155	780
Demand Flow Rate, veh/h	56	1178	796
Vehicles Circulating, veh/h	1117	35	37
Vehicles Exiting, veh/h	96	798	1136
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.1	23.3	9.8
Approach LOS	B	C	A

Lane	Left	Left	Left
Designated Moves	LR	TR	LT
Assumed Moves	LR	TR	LT
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	56	1178	796
Cap Entry Lane, veh/h	442	1331	1329
Entry HV Adj Factor	0.982	0.981	0.980
Flow Entry, veh/h	55	1155	780
Cap Entry, veh/h	434	1306	1302
V/C Ratio	0.127	0.885	0.599
Control Delay, s/veh	10.1	23.3	9.8
LOS	B	C	A
95th %tile Queue, veh	0	13	4

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	168	177	307	1025	668	112
Future Vol, veh/h	168	177	307	1025	668	112
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	0	-	-	155
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	177	186	323	1079	703	118

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2428	703	821	0	-	0
Stage 1	703	-	-	-	-	-
Stage 2	1725	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 35	438	808	-	-	-
Stage 1	491	-	-	-	-	-
Stage 2	~ 158	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 21	438	808	-	-	-
Mov Cap-2 Maneuver	~ -510	-	-	-	-	-
Stage 1	295	-	-	-	-	-
Stage 2	~ 158	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s		2.9	0
HCM LOS	-		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	808	-	+	438	-	-
HCM Lane V/C Ratio	0.4	-	-	0.425	-	-
HCM Control Delay (s)	12.4	-	-	19.2	-	-
HCM Lane LOS	B	-	-	C	-	-
HCM 95th %tile Q(veh)	1.9	-	-	2.1	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Intersection Delay, s/veh	15.7					
Intersection LOS	C					

Approach		EB		NB		SB
Entry Lanes		2		2		2
Conflicting Circle Lanes		2		2		2
Adj Approach Flow, veh/h		363		1402		821
Demand Flow Rate, veh/h		371		1430		837
Vehicles Circulating, veh/h		717		181		329
Vehicles Exiting, veh/h		449		907		1282
Ped Vol Crossing Leg, #/h		0		0		0
Ped Cap Adj		1.000		1.000		1.000
Approach Delay, s/veh		8.0		22.2		7.9
Approach LOS		A		C		A

Lane	Left	Right	Left	Right	Left	Right
Designated Moves	L	TR	L	TR	LT	TR
Assumed Moves	L	TR	L	TR	LT	TR
RT Channelized						
Lane Util	0.488	0.512	0.230	0.770	0.470	0.530
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.667	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.645	4.328
Entry Flow, veh/h	181	190	329	1101	393	444
Cap Entry Lane, veh/h	698	772	1143	1218	997	1074
Entry HV Adj Factor	0.978	0.979	0.982	0.980	0.982	0.980
Flow Entry, veh/h	177	186	323	1079	386	435
Cap Entry, veh/h	683	756	1122	1194	979	1052
V/C Ratio	0.259	0.246	0.288	0.904	0.394	0.414
Control Delay, s/veh	8.4	7.5	5.9	27.1	8.0	7.9
LOS	A	A	A	D	A	A
95th %tile Queue, veh	1	1	1	14	2	2

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	168	177	307	1025	668	112
Future Volume (vph)	168	177	307	1025	668	112
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	20.0	20.0	10.0	20.0	20.0	20.0
Total Split (s)	30.0	30.0	15.0	90.0	75.0	75.0
Total Split (%)	25.0%	25.0%	12.5%	75.0%	62.5%	62.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	None	None	None	None	None	None
Act Effct Green (s)	11.0	11.0	33.9	33.9	18.6	18.6
Actuated g/C Ratio	0.20	0.20	0.62	0.62	0.34	0.34
v/c Ratio	0.50	0.40	0.63	0.50	0.59	0.19
Control Delay	26.1	6.9	12.5	7.0	17.3	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.1	6.9	12.5	7.0	17.3	4.0
LOS	C	A	B	A	B	A
Approach Delay	16.2			8.3	15.4	
Approach LOS	B			A	B	

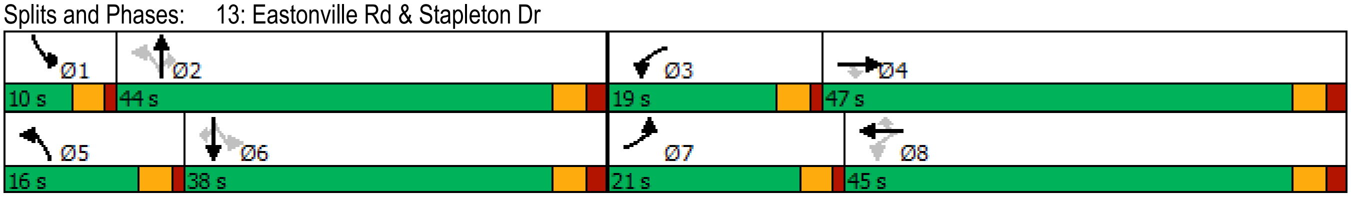
Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 55	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.63	
Intersection Signal Delay: 11.6	Intersection LOS: B
Intersection Capacity Utilization 57.3%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 12: Eastonville Rd & Londonderry Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	509	920	160	183	1264	232	251	592	169	178	370	286
Future Volume (vph)	509	920	160	183	1264	232	251	592	169	178	370	286
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Total Split (s)	21.0	47.0	47.0	19.0	45.0	45.0	16.0	44.0	44.0	10.0	38.0	38.0
Total Split (%)	17.5%	39.2%	39.2%	15.8%	37.5%	37.5%	13.3%	36.7%	36.7%	8.3%	31.7%	31.7%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	17.0	44.6	44.6	53.4	40.0	40.0	50.0	39.0	39.0	40.0	33.0	33.0
Actuated g/C Ratio	0.14	0.37	0.37	0.44	0.33	0.33	0.42	0.32	0.32	0.33	0.28	0.28
v/c Ratio	1.10	0.71	0.24	0.68	1.09	0.38	0.89	1.03	0.30	1.23	0.76	0.47
Control Delay	119.3	36.4	6.0	30.3	94.0	12.4	58.5	84.6	11.1	175.5	50.8	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	119.3	36.4	6.0	30.3	94.0	12.4	58.5	84.6	11.1	175.5	50.8	7.9
LOS	F	D	A	C	F	B	E	F	B	F	D	A
Approach Delay		60.4			75.4			65.9			62.6	
Approach LOS		E			E			E			E	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Natural Cycle: 130	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.23	
Intersection Signal Delay: 66.7	Intersection LOS: E
Intersection Capacity Utilization 105.5%	ICU Level of Service G
Analysis Period (min) 15	

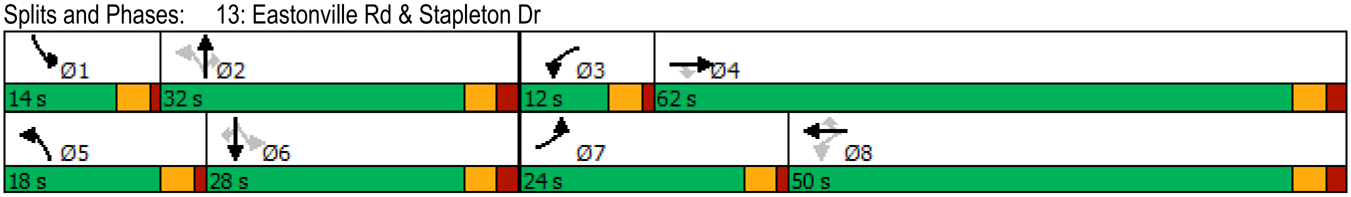
Splits and Phases: 13: Eastonville Rd & Stapleton Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	509	920	160	183	1264	232	251	592	169	178	370	286
Future Volume (vph)	509	920	160	183	1264	232	251	592	169	178	370	286
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Total Split (s)	24.0	62.0	62.0	12.0	50.0	50.0	18.0	32.0	32.0	14.0	28.0	28.0
Total Split (%)	20.0%	51.7%	51.7%	10.0%	41.7%	41.7%	15.0%	26.7%	26.7%	11.7%	23.3%	23.3%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None	None	None
Act Effct Green (s)	19.9	56.9	56.9	53.9	45.0	45.0	40.1	25.2	25.2	32.4	21.3	21.3
Actuated g/C Ratio	0.17	0.48	0.48	0.46	0.38	0.38	0.34	0.21	0.21	0.27	0.18	0.18
v/c Ratio	0.93	0.55	0.20	0.62	0.96	0.34	0.81	0.82	0.37	0.87	0.61	0.59
Control Delay	72.1	23.4	3.2	23.8	52.6	9.8	50.9	54.5	7.9	67.0	49.0	12.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	72.1	23.4	3.2	23.8	52.6	9.8	50.9	54.5	7.9	67.0	49.0	12.0
LOS	E	C	A	C	D	A	D	D	A	E	D	B
Approach Delay		37.2			43.3			45.8			40.1	
Approach LOS		D			D			D			D	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 118.1	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.96	
Intersection Signal Delay: 41.4	Intersection LOS: D
Intersection Capacity Utilization 90.7%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 13: Eastonville Rd & Stapleton Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	399	556	432	200	784	204	798	1626	175	276	1004	474
Future Volume (vph)	399	556	432	200	784	204	798	1626	175	276	1004	474
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2			Free
Detector Phase	7	4		3	8	8	5	2	2	1	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	10.0	10.0		10.0	10.0	10.0	10.0	11.0	11.0	10.0	11.0	
Total Split (s)	20.0	34.0		16.0	30.0	30.0	29.0	34.0	34.0	16.0	21.0	
Total Split (%)	20.0%	34.0%		16.0%	30.0%	30.0%	29.0%	34.0%	34.0%	16.0%	21.0%	
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None		None	None	None	None	Max	Max	None	Max	
Act Effct Green (s)	14.6	29.4	99.6	10.2	25.0	25.0	24.0	29.2	29.2	10.8	16.0	99.6
Actuated g/C Ratio	0.15	0.30	1.00	0.10	0.25	0.25	0.24	0.29	0.29	0.11	0.16	1.00
v/c Ratio	0.83	0.56	0.29	0.60	0.93	0.39	0.99	1.60	0.33	0.78	1.80	0.32
Control Delay	56.9	32.3	0.5	50.2	54.7	6.5	66.6	303.4	11.0	58.9	395.9	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.9	32.3	0.5	50.2	54.7	6.5	66.6	303.4	11.0	58.9	395.9	0.5
LOS	E	C	A	D	D	A	E	F	B	E	F	A
Approach Delay		29.5			45.6			210.6			233.1	
Approach LOS		C			D			F			F	

Intersection Summary	
Cycle Length: 100	
Actuated Cycle Length: 99.6	
Natural Cycle: 140	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.80	
Intersection Signal Delay: 150.7	Intersection LOS: F
Intersection Capacity Utilization 102.5%	ICU Level of Service G
Analysis Period (min) 15	

Splits and Phases: 14: US 24 & Stapleton Dr

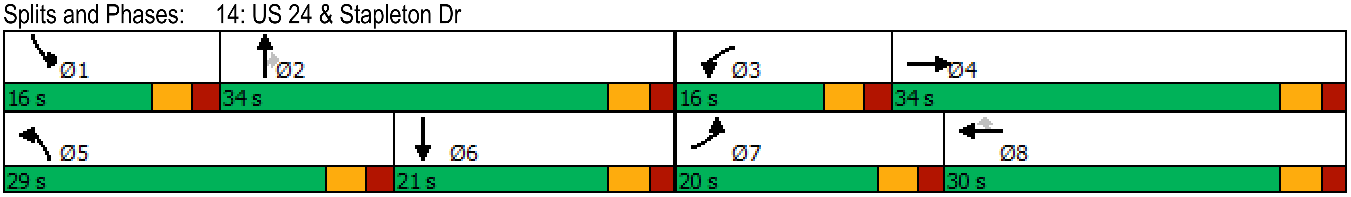
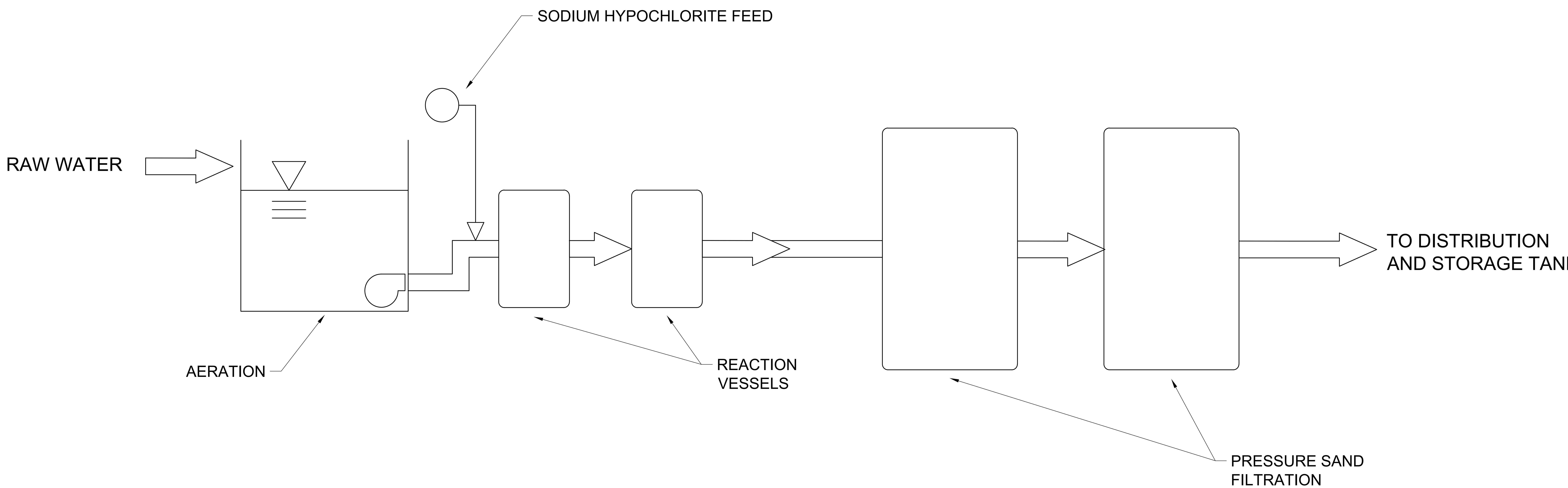


EXHIBIT Y: WATER TREATMENT PLANT PROCESS FLOW DIAGRAM



WATER TREATMENT PLANT PROCESS FLOW DIAGRAM

PRELIMINARY
NOT FOR CONSTRUCTION

NOT TO SCALE

HRGreen

Job No.:	201662	WATER TREATMENT FLOW
Prepared By:	SJF	
Date:	12/20/21	

FIG.XX

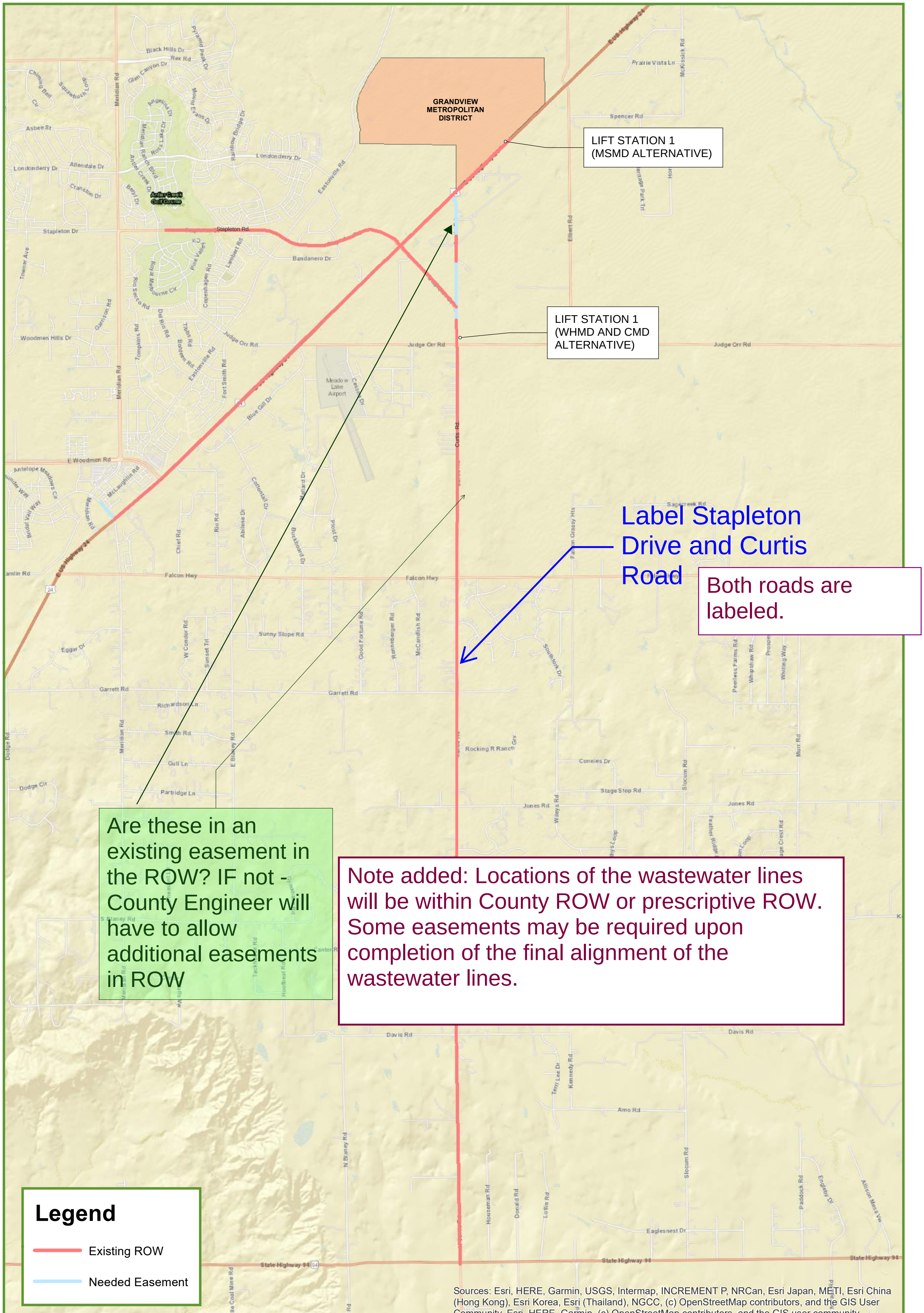
FERNANDEZ, SARAH, 12/21/2021 1:14 PM

HRGreen DRAWING PATH:J:\2020\201662.05\CAD\Dwgs\WATER TREATMENT FLOW.dwg

EXHIBIT Z: ROW – EASEMENT WAASTEWATER ALIGNMENT

wastewater

Corrected



HRGreen

Grandview Metropolitan District
ROW and Easements Exhibit

El Paso County
Colorado

N W E S

0 2,000 4,000
Feet
1 inch = 4,000 feet

EXHIBIT AA: CMD IGA AND WHMD DRAFT AGREEMENT

IGA Between Cherokee Metropolitan District and Grandview Reserve Metropolitan District No. 1

CHEROKEE METROPOLITAN DISTRICT AND GRANDVIEW RESERVE METROPOLITAN DISTRICT NO. 1 INTERGOVERNMENTAL AGREEMENT

This Intergovernmental Agreement ("Agreement") is made and entered into effective this 21st day of December 2021 ("Effective Date") by and between Cherokee Metropolitan District, a Colorado Title 32 Special District ("Cherokee") and Grandview Reserve Metropolitan District No. 1,____________________, a Colorado Title 32 Special District ("Grandview"). Cherokee and Grandview are referred to herein collectively as "Parties" and individually as a "Party".

RECITALS

A. The Parties are both quasi-municipal corporations and political subdivisions of the State of Colorado formed pursuant to Title 32, Colorado Revised Statutes.

B. The Parties supply or will supply a variety of municipal services to their residents and landowners within their respective boundaries and service areas, including water and wastewater services.

C. Cherokee owns and operates a wastewater collection and treatment system, including a wastewater pipeline ("Cherokee Wastewater Line") that conveys wastewater from its service area to a wastewater treatment plant ("Cherokee WWTP"), located at 19174 Drennan Road, Colorado Springs, CO 80928, with a capacity to treat 4.8 million gallons per day of wastewater. The Cherokee WWTP is rated for a total discharge of 4.8 million gallons per day ("MGD"), of which Cherokee has a right to 2.6 MGD of wastewater treatment capacity. The Cherokee WWTP and the related Cherokee-owned wastewater facilities are referred to herein as the "Cherokee Wastewater System".

D. Cherokee does not currently utilize its full 2.6 MGD of wastewater treatment capacity at the Cherokee WWTP. Cherokee has 0.5 MGD of wastewater treatment capacity at the Cherokee WWTP available for use by Grandview.

E. Cherokee operates a recharge facility ("Cherokee Recharge Facility") located at the northeast corner of Bar 10 Road and Henderson Lane in Ellicott, Colorado, at which treated effluent from the Cherokee WWTP is discharged into a series of rapid infiltration basins ("RIBs") for recharge of the alluvial aquifer.

F. Cherokee is currently prosecuting a replacement plan before the Ground Water Commission, which replacement plan seeks approval of new groundwater withdrawals based on the recharge of the alluvial aquifer at the Cherokee Recharge Facility.

G. Grandview desires to contract for wastewater treatment capacity in the Cherokee WWTP and the associated wastewater delivery infrastructure, as more specifically described herein, in the amount of one-half (0.5) million gallons per day (MGD).

H. Subject to the terms set forth below, Grandview will construct certain improvements in connection with the wastewater treatment capacity to be provided by Cherokee under this Agreement. Grandview must obtain the funds necessary to complete such improvements pursuant to a separate promissory note or other agreement between Grandview and a third party (the "Grandview Financing").

I. Cherokee is willing to provide wastewater treatment capacity in the Cherokee WWTP and the associated wastewater delivery infrastructure to Grandview subject to the terms and conditions set forth herein.

NOW, THEREFORE, for and in consideration of the foregoing recitals, which are incorporated herein, and the mutual benefits and obligations set forth herein, the Parties agree as follows:

1. **TERM OF AGREEMENT**. This Agreement shall become effective on and as of the date first written above and shall remain in effect until terminated in accordance with its terms.

2. **OWNERSHIP AND CONTROL OF CHEROKEE WWTP**. Cherokee will maintain a 100% ownership interest in and sole control of all Cherokee facilities, including without limitation the Cherokee Wastewater Line, the Cherokee WWTP, the Cherokee Recharge Facility, and the Cherokee Wastewater System. A map of Cherokee's current facilities and system is attached as **Exhibit A**. Service provided under this Agreement shall be subject to Cherokee's then-current rules, regulations, and standards, and then-current costs and fees, all as may be amended from time to time.

3. **CONNECTION AND TRANSMISSION**. Grandview shall design and construct a wastewater lift station, wastewater peak flow equalization system, wastewater emergency storage system, wastewater force main and all necessary

appurtenances (the "Grandview Delivery System") to connect Grandview's sanitary sewer system to the Cherokee Wastewater System at one of the potential locations shown on the attached Exhibit A as agreed upon by the Parties prior to the time of connection. The location at which Grandview's wastewater is delivered into the Cherokee Wastewater System is the "Connection Point". In the event the Parties do not agree, Cherokee will determine the Connection Point, in its sole discretion. Grandview, at its sole cost and expense, shall obtain Cherokee and all other necessary state and local government and agency approvals to make such connection. Grandview is the sole owner and operator of the Grandview Delivery System and shall be responsible for all aspects of the Grandview Delivery System, including without limitation design, construction, operation, maintenance, and replacement.

3.1 Grandview Connection to MSMD Facilities. The Parties acknowledge that Grandview may elect to connect the Grandview Delivery System to the wastewater facilities of Meridian Service Metropolitan District ("MSMD") at the MSMD Lift Station Possible Connection Point shown on Exhibit A ("Grandview-MSMD Connection"), and that such connection may allow Grandview to comply with several of the requirements of this Agreement, including without limitation peak flow equalization, wastewater emergency storage, and pretreatment. Prior to construction of the Grandview-MSMD Connection or any related facilities, Grandview shall, at its sole cost and expense provide Cherokee with design drawings of the proposed connection and any related facilities, as well as an engineering report explaining how the proposed connection will comply with the terms of this Agreement. If Grandview elects to pursue the Grandview-MSMD Connection, then Grandview shall design and construct the connection such that Grandview's wastewater is metered prior to the Grandview-MSMD Connection. Grandview, at its sole cost and expense, shall obtain Cherokee and all other necessary federal, state, local government, and agency approvals of the Grandview-MSMD Connection and any related facilities, including without limitation any upgrades or upsizing of the existing MSMD facilities. Cherokee's approval of the Grandview-MSMD Connection shall not be unreasonably withheld or delayed. Grandview's wastewater shall be subject to all terms and conditions in this Agreement regardless of whether it elects to construct the Grandview-MSMD Connection.

4. DELIVERY/TREATMENT/DISCHARGE/EQUALIZATION /EMERGENCY STORAGE.

4.1 Delivery. Grandview will deliver its wastewater to the Connection Point and the Grandview wastewater will then be conveyed via the Cherokee Wastewater Line to the Cherokee WWTP, as shown on the attached Exhibit A.

4.2 Pretreatment: Grandview shall, at its sole cost and expense, design and construct pretreatment facilities, including without limitation screening, grit removal, flow equalization and emergency storage, as further described below. All such pretreatment facilities shall be constructed at a location such that Grandview's wastewater is or can be subjected to such pretreatment prior to the delivery of said wastewater to the Connection Point. Grandview, at its sole cost and expense, shall obtain Cherokee and all other necessary federal, state, local government, and agency approvals of such pretreatment facilities. Grandview shall solely own and control such pretreatment facilities and shall be solely responsible for all aspects of the operation and maintenance of its pretreatment facilities, including without limitation screening, grit removal, flow equalization and emergency storage, as further described below.

4.2.1 Screening. Grandview shall, at its sole cost and expense, design, permit, and construct a facility that screens its wastewater through a 6 millimeter mechanical screen with redundancy.

4.2.2 Grit Removal. Grandview shall, at its sole cost and expense, design, permit, and construct a facility for grit removal that includes without limitation a concentrator, pump, washer/classifier, dewatering, and disposal for particles with a specific gravity greater than 2.65. This removal shall be 95% efficient for particles 75 microns and larger at average daily flow and 95% efficient for particles 106 microns and larger at peak hour flow.

4.2.3 Flow Equalization. Grandview shall equalize wastewater flow rates in order to reduce the wastewater flow peaking impacts at the Connection Point. Grandview shall install a wastewater flow equalization system so that Grandview wastewater flows into the Connection Point at any time do not exceed a range of 0.5 to 1.5 times Grandview's design average daily wastewater flow. Grandview shall size accordingly and install such wastewater peak flow equalization system and companion pumping facilities, as necessary, at its sole cost and expense. Grandview shall obtain Cherokee and all other necessary federal, state, local government, and agency approvals to make such installation of its wastewater peak flow equalization system and companion pumping facilities.

4.2.4 Emergency Storage. Grandview shall, at its sole cost and expense, design, permit, and construct a wastewater emergency storage system to meet all Cherokee, federal, state, local government, and agency specifications, rules and regulations. Grandview shall install such wastewater pumping facility and emergency storage system at its sole cost and expense, prior to any Grandview wastewater being delivered into the Cherokee Wastewater Line. Grandview shall, at its sole cost and expense, obtain Cherokee and all other necessary federal, state, local government, and agency approvals to make the installation of its wastewater emergency storage system.

4.2.5 Pretreatment Program. Grandview shall adopt, implement, and enforce a Pretreatment Program if required to do so by federal and/or state regulation. Grandview shall be solely responsible for compliance with all pretreatment requirements under federal and/or state regulation, including enforcement activities against users within Grandview's service area who violate requirements of the Pretreatment Program. In addition to Grandview's responsibility for such pretreatment compliance, Grandview hereby authorizes Cherokee to conduct enforcement activities as described in Cherokee Ordinance 83-0100, as amended from time to time, against users within Grandview's service area, with authority to disconnect users who violate requirements of the Pretreatment Program. Grandview shall submit an annual report documenting Pretreatment Program activities on an annual basis on forms provided by Cherokee to Cherokee by email to Cherokee's Pretreatment Coordinator and Cherokee's General Manager, and provided to Cherokee at the address given herein.

4.3 Treatment: Grandview wastewater will receive wastewater treatment at the Cherokee WWTP. Cherokee shall be responsible for compliance with the discharge permit for the Cherokee WWTP. Grandview is not a third-party beneficiary to Cherokee's discharge permit. Except in the event of Cherokee's failure to deliver the wastewater treatment contemplated herein or breach of this Agreement, violation of applicable law or negligence or willful misconduct, Cherokee shall have no liability to Grandview regarding any treated wastewater or the discharge thereof.

4.4 Discharge: Unless otherwise agreed pursuant to Section 8.3.7 herein, Grandview treated wastewater will be discharged from the Cherokee WWTP to the RIBs, as shown on Exhibit A, and allowed to infiltrate into the ground water table of the Upper Black Squirrel Creek Designated Groundwater Basin (the "UBS Basin").

4.5 Wastewater Delivery and Treatment Capacity. Subject to Grandview's compliance with all the terms and conditions of this Agreement, and so long as Grandview is not in default of this Agreement and this Agreement is not otherwise terminated, Cherokee will reserve wastewater delivery capacity from the Connection Point to the Cherokee WWTP and wastewater treatment capacity at the Cherokee WWTP for up to one-half million gallons per day (0.5 MGD) or 19.2% of the 2.6 MGD wastewater treatment capacity that Cherokee is currently entitled to use at the Cherokee WWTP ("Grandview Dedicated Capacity"). Such amount constitutes the maximum rate of dedicated wastewater treatment capacity that Cherokee is obligated to provide hereunder during any time period. Cherokee represents and warrants to

Grandview that, subject to the terms of this Agreement including without limitation the Parties acknowledgement of the Compliance Order on Consent described in Section 7.8 herein, to the best of Cherokee's knowledge and subject to satisfaction of Grandview's obligations herein, Cherokee is willing and able to provide the wastewater treatment capacity contemplated herein and that Cherokee's obligation to accept or treat Grandview's wastewater is not materially impacted by any currently existing injunction, order, or judgment of any court, state or federal agency action. Should Grandview elect to construct the Grandview-MSMD Connection, any such connection shall be pursuant to a separate agreement with MSMD and/or an amendment to this Agreement, and the dedication of the Grandview Dedicated Capacity described herein does not grant Grandview the right to connect to or use any MSMD structures or facilities.

4.5.1 Interruption. Cherokee shall not be liable to Grandview for failure to accept or treat Grandview's wastewater when such failure is the result of any injunction, order, or judgment of any court, state or federal agency action, or when such failure is the result of a strike, casualty, upset condition, mechanical or power failure, weather or flood condition, or other cause beyond Cherokee's reasonable control which arise after the Effective Date. Cherokee shall have the right to interrupt service and require Grandview to temporarily store and contain wastewater flows to the extent of Grandview's storage capabilities in the event of a malfunction of any wastewater delivery or treatment systems, including without limitation the Cherokee Wastewater Line, the Cherokee WWTP, and the RIBs. In the event of maintenance to any wastewater delivery or treatment systems which will prevent Cherokee from delivering Grandview's wastewater to the Cherokee WWTP, a 48-hour notice will be given to Grandview after which Grandview will temporarily store and contain wastewater to the extent of Grandview's storage capabilities. Nothing in this Section or Agreement shall be construed to limit, alter, or effect Cherokee's 100% ownership and operational control of any Cherokee facilities, including without limitation the Cherokee Wastewater Line, the Cherokee WWTP, the Cherokee Recharge Facility, and the Cherokee Wastewater System.

4.6 Chemical Treatment. Grandview understands and hereby acknowledges that it may be necessary to add chemical treatment to its wastewater prior to any Grandview wastewater being delivered into the Cherokee Wastewater Line in order to comply with this Agreement. Grandview shall obtain Cherokee and all other necessary federal, state, local government, and agency approvals of such chemical treatment prior to installation or modification of any chemical addition systems and/or pretreatment systems.

4.7 Meter Installation and SCADA System. Grandview shall purchase and install discharge meter systems approved by Cherokee that will provide totalized flows together with a corresponding continuous flow chart to measure all of Grandview's wastewater flows. If Grandview does not elect to construct the Grandview-MSMD Connection, then Grandview shall install the wastewater discharge meter system at the Connection Point. If Grandview does elect to construct the Grandview-MSMD Connection, then Grandview shall design and construct the connection such that Grandview's wastewater is metered prior to the Grandview-MSMD Connection. Grandview shall read the discharge meter(s), provide monthly reports of such metering and wastewater flows to Cherokee, and provide Cherokee access to digital readouts of the wastewater flow meters. Grandview shall be responsible, at its sole cost and expense, to install a Cherokee-approved supervisory control and data acquisition ("SCADA") system to allow Cherokee to view and read Grandview wastewater flow data at all times. Grandview shall, at its sole cost and expense purchase, install, maintain and replace the meter and SCADA system. Grandview shall obtain Cherokee and all other necessary federal, state, local government, and agency approvals for the installation of such meter and SCADA system.

5. **Payment.**

5.1 Capital Payments. Grandview shall pay Cherokee for the Grandview Dedicated Capacity in five (5) installments, each of which shall constitute twenty percent (20%) of the capital costs associated with the Grandview Dedicated Capacity as determined by Cherokee pursuant to sections 5.4 and 5.5 of this Agreement ("Capital Payments"). The amount of each Capital Payment is currently calculated as one million four hundred forty-four thousand four hundred forty-eight dollars and eighty cents ($1,444,448.80).

5.2 First Capital Payment. Grandview shall appropriate sufficient funds and provide the first Capital Payment to Cherokee upon the earlier of: (i) the date on which Grandview receives funds from the Grandview Financing; (ii) within 90 days of approval of Grandview's Site Plan by El Paso County, or (iii) December 31, 2023. A copy of all documents pertaining to the Grandview Financing shall be provided to Cherokee prior to the execution thereof. Upon Grandview's payment of the first Capital Payment, Cherokee shall issue a binding "Will Serve" letter to Grandview.

5.3 Subsequent Capital Payments. The four (4) Capital Payments due after the first Capital Payment shall be made on or before December 31 of each calendar year after the year in which the first Capital Payment is made, until such time as Grandview has paid Cherokee a total of seven million two hundred twenty-two thousand two hundred and forty-four dollars ($7,222,244.00) in total Capital Payments. The amount of such Capital Payments, including the total amount of all Capital Payments due to Cherokee, may be adjusted by Cherokee as provided herein.

5.4 Adjustment of Capital Payments Based on Metered Grandview Influent. The amount of the Capital Payments is based on the assumption that Grandview will experience an annual growth rate of less than 20% and will achieve buildout of the property in its service area in five (5) years or more. However, if Grandview experiences a higher growth rate than that assumed herein, Cherokee retains the sole discretion to adjust the Capital Payments in direct proportion to the metered amount of Grandview's wastewater (either at the Connection Point or prior to the Grandview-MSMD Connection, as provided in Section 4.7 herein) relative to its total allocated capacity of 0.5 MGD in the Cherokee WWTP. The intent of this Section is to provide for an increase in the Capital Payments only, and there shall be no reduction of any Capital Payments in the event of a slower-than-assumed growth rate.

5.5 Adjustment of Capital Payments Based on Costs. The Parties acknowledge that there will be additional capital costs, including capital costs in excess of and beyond the amount of the Capital Payments, that are necessarily incurred for the Cherokee Wastewater System and the provision of wastewater service hereunder. Those additional capital costs may be the in the form of additions, modifications, repairs or other necessary costs. Cherokee shall have the sole discretion to approve and expend such additional capital costs, to adjust the Capital Payments due hereunder, and/or to require additional Capital Payments, based on an increase or decrease in costs associated with the Cherokee Wastewater System that are reasonably related to the services provided to Grandview pursuant to this Agreement.

5.6 Operations, Maintenance, and Replacement Costs. Grandview shall pay Cherokee a monthly service fee ("Grandview Service Fee") based on its pro-rata share of all operation, maintenance, replacement, and associated costs for the Cherokee WWTP, the Cherokee Recharge Facility, including without limitation all costs and expenses associated with or incurred as a result of any order by federal, state, county, local government, or other regulatory agency to bring the Cherokee WWTP and/or the Cherokee Recharge Facility into compliance with applicable Rules and Regulations, as they exist today or as the same may be hereafter amended or enacted ("O&M Costs"). The Grandview Service Fee shall be allocated by Cherokee to Grandview in direct proportion to Grandview's metered influent flows transmitted to the Cherokee WWTP and the total amount of metered influent. The fees allocated to Grandview pursuant to this Agreement will also include any surcharges charged under Section 7.5 herein, where appropriate, and any Replacement Water Fees charged under Section 8.3.6, if applicable. The Grandview Service Fee shall be established by Cherokee and notice given to Grandview of the amount of the fee no later than October 1 of each year.

5.6.1 Billing and Payments. The Grandview Service Fee will be invoiced once a month and is due and payable within 30 days of receipt of invoice. Grandview shall budget and appropriate sufficient funds for payment of the Grandview Service Fee. Cherokee will provide Grandview with the monthly metered influent sewage flow data and the calculation of the Grandview Service Fee. If Grandview is over six (6) months in arrears for payment of the Grandview Service Fee, Cherokee may, but is not required to, invoice all Grandview customers directly for all current and future Grandview Service Fees, including any and all additional processing and collection fees and/or costs incurred by Cherokee for such direct billing. Grandview shall include in its service contracts with its customers a provision which provides for Cherokee's right to invoice Grandview customers directly, as set forth in the previous sentence.

5.7 Annual Audit. Cherokee shall perform an annual audit of all metered influent sewage flow data and shall invoice Grandview annually for any related annual adjustment of O&M Costs ("Annual Adjustment"). Upon request by Grandview, Cherokee will also provide reasonable documentation supporting the Annual Adjustment. Further, no more than once each calendar year, and at its own expense, Grandview may audit the operations, maintenance and capital improvement records of Cherokee for the purpose of verifying the Grandview Service Fee and Capital Payments and the allocation to Grandview. Grandview must provide at least 30-days advanced notice of its request to review Cherokee's records for such purpose. Cherokee shall cooperate in good faith to facilitate such audit, and the parties shall work in good faith to resolve any discrepancies or issues resulting therefrom. Nothing herein shall be interpreted to require Cherokee to disclose privileged, confidential, or sensitive information.

5.8 Interest/Service Charges. Any fee or charge due hereunder and not timely paid shall accrue interest at 8% annually.

6. PLANT EXPANSION.

6.1 Expansion. The Parties acknowledge and agree that statutes and regulations imposed and propounded by the applicable regulatory authorities as in existence or hereafter amended may require that Cherokee commence the planning for expansion of the Cherokee WWTP when the Cherokee WWTP reaches 80% of capacity and that construction must be underway when the facility reaches 95% of capacity. Cherokee, in its sole discretion, shall determine the need for any such expansion based, in part, on the need for future capacity of Cherokee, Meridian Service Metropolitan District ("MSMD"), Grandview, and any other entity receiving or projected to receive wastewater treatment at the Cherokee WWTP. Should Cherokee determine the need for any such expansion of the Cherokee WWTP, it shall provide notice of such determination to Grandview, and afford Grandview the opportunity to determine if Grandview will participate in the expansion. Nothing in this Agreement obligates Cherokee to expand the Cherokee WWTP, so long as Cherokee can provide the services required under this Agreement without such expansion. Ownership and control of any expansion shall be solely vested in Cherokee unless otherwise agreed.

6.2 Expansion Costs. Cherokee shall define the payment responsibilities for such expansion prior to initiation of same. If Grandview desires additional capacity (*i.e.* beyond 0.5 MGD) in an expanded Cherokee WWTP, it shall pay its adjusted pro-rata share of any capital costs associated with such expansion. If Grandview does not project the need for additional capacity beyond the initial 0.5 MGD allocation of capacity made herein, Grandview shall not be required to fund any expansion of the Cherokee WWTP. However, if modifications are undertaken during any expansion of the Cherokee WWTP that are the result of regulatory requirements and/or needed infrastructure replacement or capital improvements to the Cherokee WWTP, Grandview shall pay its pro-rata share of any capital costs associated with such modifications, regardless of whether Grandview elects to use any additional capacity over its 0.5 MGD allocation made herein. In connection with any future expansion and/or modification of the Cherokee WWTP, the estimated costs of the same shall be fully funded by Grandview prior to commencement of construction of the expansion.

6.3 Expansion Timeline. In the event Cherokee elects to proceed with an expansion and/or modification to the Cherokee WWTP, Cherokee shall provide notice to Grandview of its intent to proceed no later than 24 months prior to the proposed start-of-construction date. Cherokee will pursue the expansion and/or modification with reasonable diligence; however, nothing herein guarantees that the expansion will be completed on any specific timeline.

6.4 Growth Projections. Grandview shall give Cherokee reasonable notice of growth projections and capacity needs on an annual basis so that Cherokee can adequately plan and obtain the necessary governmental approvals. Grandview shall give Cherokee rolling five-year growth projections of capacity needs no later than March 15 of each year.

6.5 Additional Capacity. Grandview may request additional capacity (over 0.5 MGD) at any time, including prior to an expansion of the Cherokee WWTP, and Cherokee agrees to cooperate with Grandview to determine whether such excess capacity is available. Cherokee is under no obligation to provide any additional capacity to Grandview. The Parties shall amend this Agreement or enter into a new written agreement to set forth the terms on which Cherokee will provide excess capacity available to Grandview.

7. **Regulatory Compliance.**

7.1 Cherokee and Grandview Rules and Regulations. Grandview shall adopt discharge rules and regulations prohibiting certain classes of pollutants and controlling certain classes of discharges as stringent as, or more restrictive than those rules and regulations of Cherokee as they may be amended from time to time. Cherokee shall notify Grandview of a proposed amendment to Cherokee's rules, regulations, and standards regarding wastewater treatment no less than sixty (60) days prior to enactment. Grandview's discharge rules and regulations shall maintain these regulations to be in compliance with Cherokee's rules and regulations. If a dispute arises regarding Grandview's adoption of rules and regulations pursuant to this Agreement, Cherokee and Grandview shall work in good faith to resolve any such dispute. Grandview shall submit a copy of Grandview's rules and regulations annually to Cherokee by January 15 and shall submit a copy of any amendments to such rules and regulations within thirty (30) days following adoption. Such rules and regulations and amendments thereto shall be submitted by registered mail to Cherokee at the address contained herein.

7.2 Regulatory Controls. Grandview understands that the Cherokee WWTP, the Cherokee Wastewater System, the Cherokee Recharge Facility, the Cherokee water production and distribution system, and all related facilities are publicly owned treatment works and water systems, and Cherokee is required by law to control wastewaters introduced by all users into the system, and to comply with laws related to the provision of water service. Grandview also understands that Cherokee is subject to present and continuing federal, state, county, local government, and agency statutory and regulatory controls which may, subsequent to the date of this Agreement, be changed, amended, or added to, which controls, changes, amendments or additions are presently unforeseen by the parties hereto and which may result in additional costs for capital improvements, operations, maintenance, repair, inspection, and administration of its system. Such regulatory controls expressly include without limitation any permits or other administratively-implemented controls for the Cherokee Wastewater System, the Cherokee WWTP, the Cherokee Recharge System, the

Cherokee water production and distribution system, and any other facilities related to or described herein, notwithstanding any change to the underlying laws, rules, or regulations. Grandview acknowledges that Cherokee may incur added costs that may increase Grandview's capital and/or O&M Costs as a result of statutory, regulatory, or administrative requirements. Grandview agrees that it will comply with, and cause to be complied with by their users, all federal and state laws and regulations applicable to Cherokee, including without limitation the Clean Water Act of 1977. Cherokee, as the Party with 100% ownership and control of all facilities hereunder, shall retain sole discretion as to compliance with any regulatory controls, and sole discretion to adjust Grandview's Capital Payments and/or the Grandview Service Fee due hereunder to account for any increase in such costs related to regulatory controls and/or requirements.

7.3 Enforcement._Grandview shall meet and require its customers to meet the Cherokee wastewater standards, now current and as amended or updated in the future and including without limitation the standards in this Agreement. Grandview shall be responsible for all costs or penalties associated with its and its customers' failure to meet wastewater standards, and/or causing a violation of the discharge permit for the Cherokee WWTP, for the State of Colorado site approval(s), and/or permit(s) for the Grandview Delivery System.

7.4 Conventional Pollutants. Cherokee's obligation to provide wastewater treatment hereunder is limited to the acceptance for treatment of conventional pollutants. No Significant Industrial User (SIU), as defined in Cherokee's Ordinance 83-0100, as it may be amended from time to time, shall be permitted to connect to Grandview's wastewater system, and no industrial wastes or any other non-conventional pollutants shall be permitted to enter the system without the prior written consent of Cherokee. "Industrial user" and "Industrial wastes" shall be as defined in Cherokee Ordinance 83-0100 as it may be amended from time to time. "Conventional pollutants" shall include biochemical oxygen demand (BOD5), total suspended solids (TSS), fecal coliform, pH, oil and grease, and any additional pollutants that are designated as conventional pollutants under the Clean Water Act, including any amendments thereto, and rules and regulations promulgated by the Environmental Protection Agency and/or the Colorado Department of Public Health and Environment. Grandview shall, at its sole cost and expense, provide Cherokee twice per year (due on January 15, and July 15), an updated inventory of all non-residential users connected to Grandview's wastewater system. Such inventory shall include the user's name, address, business, activity performed and/or materials manufactured by said user, and average daily water usage for previous quarter. The inventory list shall be sent to Cherokee by email to Cherokee's Pretreatment Coordinator and Cherokee's General Manager and provided to Cherokee at the address given herein. Cherokee will provide Grandview with notice of any changes to the email addresses for purposes of the notice described in this Section.

7.5 Strength of Wastewater Standards. Grandview's wastewater shall not exceed the following standards:

7.5.1 Five-day Biochemical Oxygen Demand (BOD5) - 400 milligrams per liter (mg/l)

7.5.2 Total Suspended Solids (TSS) - 400 mg/l

7.5.3 Total Dissolved Solids (TDS) - 600 mg/l

7.5.4 Hydrogen Sulfide - Beginning at the time when Grandview's wastewater influent (as sampled prior to the Grandview-MSMD Connection and/or the Connection Point) reaches an instantaneous rate of one hundred thousand (100,000) gallons per day, Grandview must maintain an average hydrogen sulfide concentration below 1 mg/L as averaged from weekly grab samples in any month ("Hydrogen Sulfide Limit"). If hydrogen sulfide levels rise above the Hydrogen Sulfide Limit in any month, CMD will issue a written warning to Grandview. If hydrogen sulfide levels rise above the Hydrogen Sulfide Limit for two consecutive months, CMD will provide notice to Grandview, and Grandview will immediately undertake chemical treatment to comply with the Hydrogen Sulfide Limit. If Grandview does not comply with the Hydrogen Sulfide Limit as provided herein, Cherokee may assess Grandview a unit surcharge consistent with Section 7.7 herein.

7.5.5 Non-Conventional Pollutants – Except as pre-authorized by Cherokee, any amount of industrial waste or any other non-conventional wastes associated with industrial wastewater discharges that are inconsistent with Section 7.5 herein.

7.5.6 Additions or Modifications – Cherokee may add to or modify the standards described in this Section 7.5 and subsections as necessary, in its sole discretion, to satisfy all regulatory requirements imposed on the Cherokee WWTP and any other component of the Cherokee Wastewater System. In the event Cherokee determines that it is necessary to add to or modify a standard, Cherokee shall provide to Grandview no less than three (3) months written notice of the change.

7.6 Monitoring. Grandview shall test its wastewater a minimum of once a week prior to it entering the Cherokee sewer system at the Grandview-MSMD Connection and/or the Connection Point or any other point per the Cherokee wastewater standards and provide the test results to Cherokee. Such weekly testing shall include without limitation those specific wastewater constituents described in this Agreement. At all points of connection to the Cherokee Wastewater System, Grandview shall install a manhole with a sample port with a composite sampler such that the water quality of Grandview's wastewater can be monitored by Cherokee to ensure that all required standards are being satisfied.

7.7 Surcharges. If Grandview's wastewater exceeds the standards set forth in Section 7.5 above and subject to compliance with Section 7.5.4 (if applicable), the Grandview Service Fee shall be increased to include an extra-strength surcharge(s). In such case, Cherokee shall calculate, in its sole discretion, the extra-strength surcharge(s) to reflect operational costs reasonably related to the exceedance of the values described above. Cherokee may adjust these surcharges from time to time to account for any changes in regulatory requirements.

7.8 Compliance Order on Consent; TDS Reduction Project. Grandview specifically acknowledges that the Colorado Department of Public Health and Environment, Water Quality Control Division (the "Division"), issued the Cherokee WWTP a Compliance Advisory - Notice Of Significant Noncompliance, CDPS Number COX-048348, dated March 25, 2011. The State of Colorado issued a Compliance Order on Consent, Number: MC-140514-1, on June 23, 2014, ("Compliance Order on Consent") to resolve all violations cited by the Division and to establish compliance requirements and criteria for the continued operation of the Cherokee WWTP. This Agreement is subject to all terms and conditions of the Compliance Order on Consent. Grandview also acknowledges that in order to achieve compliance with the Compliance Order on Consent, Cherokee has undertaken the TDS Reduction Project, which includes the conversion of the Cherokee WWTP to membrane bioreactor wastewater treatment and the addition of reverse osmosis treatment, as well as related upgrades. Grandview acknowledges and agrees that its responsibility to pay capital costs associated with the Cherokee WWTP includes the TDS Reduction Project and the related upgrades.

8. RETURN FLOWS AND REPLACEMENT WATER.

8.1 No Representations or Warranties. Cherokee makes no representations or warranties regarding the availability of return flow water from the treated wastewater or the availability of treated wastewater that is released from the Cherokee WWTP. This Agreement is based on the condition that no return flow water from the Cherokee WWTP may or will be available for re-use through the Replacement Plan (defined below), or any amended Replacement Plan, or new replacement plan and that no treated wastewater from the Cherokee WWTP may or will be available to be diverted, to be taken dominion and control of, or to be used for any other purpose.

8.2 Potential for Availability of Return Water. Treated wastewater from the Cherokee WWTP is currently released to the RIBs located at the Cherokee Recharge Facility. Without making any representations or warranties, Cherokee anticipates that a portion of the released treated wastewater will be able to be re-used as ground water through a yet to be approved, pending Replacement Plan, or an amended Replacement Plan, or a new replacement plan.

8.3 Replacement Plan.

8.3.1 Background. In 2008, pursuant to the June 26, 2003 Chico Basin Wastewater Treatment Facility and Black Squirrel Basin Recharge Facility Intergovernmental Agreement between Cherokee and MSMD, as amended ("Cherokee-Meridian IGA"), Cherokee and MSMD jointly applied for a replacement plan with the Colorado Ground Water Commission (the "Commission") to obtain the ability to withdraw additional ground water from the Upper Black Squirrel Creek Designated Ground Water Basin based on the recharge of return flows from the Cherokee WWTP at the Cherokee Recharge Facility (the "Return Flows"), under Case No. 08GW71 (the "Replacement Plan"). The Replacement Plan was the subject of litigation between the Upper Black Squirrel Creek Ground Water Management District ("UBS"), Cherokee and MSMD under both Case No. 08GW71 and Water Court Case No. 98CW80 ("Water Case"). All filings in each case are publicly available. Cherokee and MSMD are currently in the process of updating and amending the Replacement Plan.

8.3.2 Replacement Water. "Replacement Water" is that amount of additional water that the Parties and MSMD are allowed to divert from the Upper Black Squirrel Creek Designated Ground Water Basin as a result of the Replacement Plan. Specifically, this Replacement Water shall include water derived from any new diversion points as well as water derived from existing Cherokee diversion points which result in an increase of productivity over and above the historic amounts produced or authorized for diversion, whichever is greater, from said existing Cherokee diversion points.

8.3.3 Incorporation of Grandview's Water Rights. If Grandview provides written notice to Cherokee of its election to participate in the Replacement Plan and pays its allocable costs as set forth in this Section 8, then, subject to all rules and regulations, Cherokee and Grandview shall cooperate as necessary to incorporate Grandview's water rights and the return flows therefrom ("Grandview Return Flows") into the Replacement Plan, and Grandview may be able to receive a portion of the Replacement Water derived from its treated wastewater ("Grandview Replacement Water"). Notwithstanding the foregoing, Cherokee shall continue to have the sole authority to prosecute the Replacement Plan, including without limitation the right to claim Grandview Return Flows as a source of Replacement Water. If the Replacement Plan utilizing, in part, Grandview's water rights and the Grandview Return Flows is approved ("Approved Plan") and subject to the terms of this Agreement, Grandview shall be entitled to claim an ownership interest in the Grandview Return Flows and/or Grandview Replacement Water (if any); however, the precise amount, rate, and conditions of use of this water is unknown as of the date of this Agreement. The Parties agree to enter into an agreement(s) to establish Grandview's ownership interest of the Grandview Replacement Water and any terms and conditions associated with the operation and use of that water under the Approved Plan after final approval of that plan by the Colorado Ground Water Commission. Cherokee shall have the right to use all of the Grandview Replacement Water until such time as the Parties have reached such agreement establishing Grandview's ownership interest of the Grandview Replacement Water and any terms and conditions associated with the operation and use of that water under the Approved Plan, and Grandview has constructed the facilities necessary to receive delivery of the Grandview Replacement Water.

8.3.4 200 Acre-Foot Commitment; Allocation of Grandview Replacement Water. Pursuant to the Cherokee-Meridian IGA and as further hereby agreed upon by the Parties, Cherokee is entitled to receive the first 200 acre-feet of the Return Flows on an annual basis (the "200 Acre-Foot Commitment"). After the 200 Acre-Foot Commitment is fulfilled, Grandview agrees to share the remaining portion of the Grandview Replacement Water from its treated wastewater with Cherokee at a proportion of 80% of the Grandview Return Flows for Grandview and 20% of the Grandview Return Flows for Cherokee.

8.3.5 Payment of Costs. If Grandview elects to join the Replacement Plan, Grandview shall pay Cherokee its pro-rata share of the cost to prepare, litigate, and process the Replacement Plan and the cost of any facilities and/or infrastructure required to be constructed to implement and operate the Approved Plan, based on Grandview's percentage share of Cherokee's capacity in the Cherokee WWTP, which percentage is nineteen and twenty-three hundredths (19.23%) (0.5 MGD/2.6 MGD = 19.23%). Grandview shall not be entitled to any Replacement Water until such time as such payment has been made to Cherokee.

8.3.6 Replacement Water Service Fee. If Grandview elects to join the Replacement Plan and if the Replacement Plan is approved, in addition to the payment described in Section 8.3.5 above, then the Grandview Service Fee shall be adjusted to include a monthly Replacement Water Service Fee equal to Grandview's pro-rata costs based on the proportion of the total amount of Replacement Water delivered to Grandview, of Cherokee's actual costs and expenses to produce, treat, store, and deliver the Grandview Replacement Water to the Cherokee water tank at Tamlin Road and Marksheffel Road (the "Cherokee Water Tank") including, but not limited to, costs of operation, maintenance, repairs and replacement to provide such delivery, treatment and storage of Grandview Replacement Water, and any related costs and expenses. Grandview, at its sole cost and expense, will be responsible for conveyance of the Grandview Replacement Water from the Cherokee Water Tank to wherever it desires to deliver the Grandview Replacement Water, including any and all costs to connect to the Cherokee Water Tank, pump system, water lines and all necessary approvals and permits from federal, state and local governments and all applicable agencies, including Cherokee. The Parties may mutually agree upon a delivery location other than the Cherokee Water Tank for delivery of the Grandview Replacement Water, and in such instance the alternative location shall supplant all references to the Cherokee Water Tank in this Section 8. The Replacement Water Service Fee shall be established and adjusted annually on January 31 by Cherokee, in its sole discretion. Billings for conveying the Grandview Replacement Water will be submitted monthly based upon the metered volume of water conveyed. Billings for this activity carry the same payment provisions as that of the monthly O&M Costs described herein.

8.3.7 Control of Wastewater and Replacement Water. Subject to all terms and conditions herein, as well as any other required Cherokee and federal, state, local government, and other agency approvals, Grandview may elect to divert and take dominion and control of and all responsibility for the Grandview Return Flows at the Cherokee WWTP prior to it entering the Cherokee Recharge Facility, or other wastewater discharge point, and the UBS Basin. All costs and expenses of such treated wastewater diversion shall be borne by Grandview, and Grandview shall obtain all other necessary federal, state, local government, and agency approvals and permits to make such diversion. Until such time as Grandview is allowed to and elects to take its treated wastewater, Grandview hereby grants Cherokee the right to control and use the Grandview wastewater and Grandview Return Flows ("License"), which License is terminable at any time, upon written notice to Cherokee. Until such time as Grandview elects to take the Grandview Return Flows under this Section 8.3.7, the Parties agree to cooperate in the processing of the Replacement Plan, and any amended or new Replacement Plan.

8.3.8 Replacement Water Availability and Use. The Parties acknowledge that there are various known and unknown factors that may affect the amount of Replacement Water that becomes available pursuant to the Approved Plan, including without limitation wastewater treatment losses at the Cherokee WWTP, evaporative losses, delivery losses, the physical ability to divert Replacement Water, and the like. It is also anticipated that, in any approved replacement plan, a portion of the available treated wastewater may be required to be left in the UBS Basin groundwater aquifer and not be allowed to be recovered as Return Flows. The amount of any Replacement Water available will be subject to the future restrictions at the Cherokee WWTP, the Cherokee-Meridian IGA as well as any terms and conditions of the Approved Plan. Grandview acknowledges that these various factors can and will result in less Grandview Replacement Water than influent from Grandview's wastewater. At no time shall Cherokee be required to reduce its water withdrawals below those to which it has been historically entitled to under its water rights. Except as provided above, nothing in this Agreement obligates Cherokee to provide any Return Flows and/or Replacement Water to Grandview.

9. **Additional Provisions.**

9.1 Existing and Future IGAs. Grandview acknowledges that Cherokee has entered into the Cherokee-Meridian IGA, as amended and which may be further amended from time to time without notice or approval by Grandview. Grandview further acknowledges that MSMD has and likely will in the future enter into agreements with other third-parties for use of capacity at the Cherokee WWTP. Grandview is not a third-party beneficiary to any aforesaid agreements.

9.2 Service to Grandview Service Area. Grandview has issued a will-serve letter for the benefit of certain property identified as the Waterbury parcel and may serve that property in addition to all of the area identified as its service area in its approved Service Plan. Grandview may not provide wastewater service to properties other than the Waterbury property and those within its service area without the prior written consent of Cherokee, which consent shall not be unreasonably withheld so long as Grandview remains in compliance with this Agreement. Nothing herein shall be construed to limit or affect Cherokee's discretion to amend this Agreement.

9.3 Service Area Changes. Any significant changes in service area and/or political boundary limits, additions, expansions or deletions of Grandview's wastewater collection system service area, defined as the property currently or to be included within the Grandview Reserve Metropolitan District Nos. 1-4, shall be reported to Cherokee. Grandview must maintain current maps of its wastewater collection system and provide a copy of the documents by registered mail to Cherokee on an annual basis to the address contained herein.

9.4 Grandview System. Cherokee does not own, control, or operate Grandview's water and sanitary sewer system above the Connection Point. However, Grandview shall provide access to any and all such facilities reasonably related to the quality and quantity of wastewater influent. Cherokee shall provide at least 24 hours notice of its intent to access such facilities; however, Cherokee need not provide notice in the event of an emergency, as determined in Cherokee's sole discretion. Further, Grandview shall notify Cherokee within 24 hours of any failure of Grandview's sanitary sewer system that could affect the quality of wastewater influent at the Grandview-MSMD Connection and/or the Connection Point. Cherokee shall have access to Grandview's operations, maintenance, or billing records, as necessary to ensure compliance with the terms of this Agreement. Except as part of Grandview's obligations to pay Cherokee hereunder, which obligations rely upon Grandview's revenue sources, Cherokee shall have no right or claim to any service charges, fees or revenues imposed and collected by Grandview.

10. TERMINATION, DEFAULT, AND REMEDIES.

10.1 Termination After Capital Payments. Except as otherwise expressly set forth herein, after Grandview has made a Capital Payment to Cherokee as required herein, the Parties agree that no default or breach of this Agreement shall justify or permit termination of the continuing obligations of this Agreement as applicable to the proportionate amount of Capital Payments made by Grandview at that time and the proportionate wastewater service capacity therefor; provided, however, that this Section 10.1 does not prohibit termination or suspension of service to a customer as permitted by the Cherokee Rules and Regulations, as they may be revised or amended from time to time. Notwithstanding the foregoing, this Agreement may be terminated for default as provided herein, as applicable to the proportionate wastewater treatment capacity for which Capital Payments have not been timely made as required herein.

10.2 Default. The occurrence of any of the following events not cured within thirty (30) days of receipt of written notice from the non-defaulting Party by the defaulting Party constitutes a default under this Agreement:

10.2.1 failure to pay any fee, charge or other sum when due; or

10.2.2 failure to perform any other term, condition, covenant, representation or warranty; or

10.2.3 The appointment of a receiver, general assignment for the benefit of creditors, or any declaration of filing under any insolvency or bankruptcy act.

10.3 Remedies.

10.3.1 Upon default, the non-defaulting Party may elect to terminate this Agreement by written notice of termination to the defaulting Party, subject to the provisions of Section 10.1, and seek appropriate relief, including without limitation specific performance and/or damages, as may be available under the laws of the State of Colorado. Cherokee may also refuse to allow the addition of any new wastewater taps or connections beyond those being served on the date of default.

10.3.2 In addition to any other remedy provided herein or at law, Grandview shall be solely responsible for, and liable to Cherokee for all costs associated with any damages, fines or additional clean up due to or resulting from the wastewater quality, flows or overflows from Grandview that do not satisfy the terms of this Agreement.

11. MISCELLANEOUS PROVISIONS.

11.1 Warranties and Representations. In addition to the other warranties, covenants and representations, the Parties make the following warranties, representations, and covenants to each other:

11.1.1 Each Party has full right, power, and authority to enter into, perform and observe this Agreement.

11.1.2 Neither the execution of this Agreement, the consummation of the transactions contemplated hereunder, nor the compliance with the terms and conditions of this Agreement by either Party will conflict with or result in a breach of any terms, conditions, or provisions of, or constitute a default under any agreement, instrument, indenture, order or decree to which either Party is a party or by which either Party is bound.

11.1.3 This Agreement is a valid and binding obligation of each of the Parties and is enforceable in accordance with its terms.

11.1.4 The Parties shall keep and perform all of the covenants and agreements contained herein and, except in the event of an uncured default, shall not take any action which could have the effect of rendering this Agreement unenforceable in any manner.

11.1.5 The facilities, systems and Replacement Plan shall not be utilized in any manner which would jeopardize the tax exempt status of any bonds or debt issued by either of the Parties.

11.1.6 Each of the Parties is a duly constituted and validly existing political subdivision of the State of Colorado.

11.1.7 Each Party has, or reasonably believes, it can obtain adequate financial resources to fulfill the obligations of this Agreement.

11.2 Liability of Parties. No provision, covenant or agreement contained in this Agreement, nor any obligations herein imposed upon each Party, nor the breach thereof, shall constitute or create an indebtedness of the other Party within the meaning of any Colorado constitutional provision or statutory limitation. Neither Party shall have any obligation whatsoever to repay any debt or liability of the other Party.

11.3 Indemnification. Subject to the provisions of the Colorado Governmental Immunity Act, and without waiving the same, to the extent permitted by law, each Party agrees to indemnify, protect and hold harmless the other Party from any claims or damages to persons or property resulting from the actions or inactions of the indemnifying Party. Said indemnification shall include, but not be limited to, court costs, damages, and attorneys fees.

11.4 Modification. This Agreement may be modified, amended, changed or terminated, except as otherwise provided herein, in whole or in part, only by an agreement in writing duly authorized and executed by both Parties. No consent of any third party shall be required for the negotiation and execution of any such agreement.

11.5 Waiver. No failure by either Party to insist upon the strict performance of any agreement, term, covenant, or condition hereof or to exercise any right or remedy consequent upon default, and no acceptance of full or partial performance during the continuance of any such default, shall constitute a waiver of any such default of such agreement, term, covenant, or condition. No agreement, term, covenant or condition hereof to be performed or complied with by either Party, and no default thereof, shall be waived, altered, or modified except by a written instrument executed by the non-defaulting Party. The waiver of any breach or default of any of the provisions of this Agreement by either Party shall not constitute a continuing waiver or a waiver of any subsequent breach by the other Party of the same or another provision of this Agreement.

11.6 Integration. This Agreement contains the entire agreement between the Parties and no statement, promise or inducement made by either Party or the agent of either Party that is not contained in this Agreement shall be valid or binding. Each Party agrees that it has not relied upon any prior negotiations, representations, warranties, or understandings, whether oral or written.

11.7 Effect of Invalidity. If any provision of this Agreement is deemed invalid or unenforceable by a court of competent jurisdiction as to either Party, or as to both Parties, such invalidity or unenforceability shall not cause the entire Agreement to be terminated, so long as the primary purposes of this Agreement remain viable.

11.8 Access to Records. Each party shall have the right to inspect the books and records of the other party relating to this Agreement at reasonable times upon reasonable notice.

11.9 Governing Law. This Agreement shall be governed and construed in accordance with the laws of the State of Colorado.

11.10 Venue. The Parties agree and stipulate the proper venue for any court action that might occur in connection with or as a result of this Agreement is the District Court in and for the County of El Paso, Colorado.

11.11 Headings for Convenience Only. The headings, captions and titles contained herein are intended for convenience and reference only and are not intended to define, limit or describe the scope or intent of any of the provisions of this Agreement.

11.12 Notices. Any notices or other communications required or permitted by this Agreement or by law to be served on, given to or delivered to either Party, by the other Party, shall be in writing and shall be deemed received on the date personally delivered to the Party to whom it is addressed, on the date received via email with confirmation of receipt, or, upon receipt in the United States mail, by certified mail, return receipt requested, addressed to the following:

To Cherokee:	General Manager Cherokee Metropolitan District 6250 Palmer Park Blvd. Colorado Springs, CO 80915
With copy to:	Pete Johnson Vranesh & Raisch, LLP 5303 Spine Road, Suite 202 Boulder, CO 80301

To Grandview:
Russ Dykstra

Spencer Fane, LLP

1700 Lincoln St. Suite 2000

Denver, CO 80203

Either Party may change its address for the purpose of this Section by giving written notice of such change to the other Party in the manner provided in this Section.

11.13 Government Authority. The Parties shall comply with any and all valid state, federal or local laws or regulations covering the subject of this Agreement, and any and all valid orders, regulations or licenses issued pursuant to any federal, state or local law or regulation governing the subject of this Agreement. Grandview shall comply with all terms and conditions of the Cherokee-Meridian IGA and the terms and conditions of the Cherokee Rules and Regulations applicable to sanitary sewer service.

11.14 Force Majeure. Either Party shall be excused from performing its obligations under this Agreement during the time and to the extent that it is prevented from performing by a cause beyond its control, including, but not limited to: any incidence of fire, flood, or strike; acts of God; acts of the Government; war or civil disorder; violence or the threat thereof; severe weather; commandeering of material, products, plants, or facilities by the federal, state, or local government; national fuel shortage; when satisfactory evidence of such cause is presented to the other Party, and provided further that such nonperformance is beyond the reasonable control of, and is not due to the fault or negligence of the Party not performing.

11.15 Perpetuity. Insofar at this Agreement affects water and water rights it is the intention of the parties that it be perpetual in nature according to the Colorado Supreme Court's decision in Cherokee v. City of Colorado Springs. Therefore, the parties forever waive any and all arguments in defense to the effect that this Agreement violates the Rule Against Perpetuities.

11.16 Authority to Execute Agreement. The individuals signing this Agreement expressly affirm and represent that they have the authority to enter this Agreement and to bind the Party they represent.

11.17 Fair Dealing. In all cases where the consent or approval of one Party is required before the other may act, or where the agreement or cooperation of either or both Parties is separately or mutually required as a legal or practical matter, then in that event the Parties agree that each will act in a fair and reasonable manner with a view to carrying out the intents and goals of this Agreement as the same are set forth herein, subject to the terms hereof. Grandview will not be bound by or subject to any rules or regulations of the Cherokee that are not also applicable and enforced in the same manner against similarly situated properties and users of Services within Cherokee boundaries, except as otherwise specifically set forth herein or in Cherokee's Rules and Regulations. All references in this Agreement to Cherokee's standards, policies, rules or regulations, or similar references, shall mean the same as adopted and applied by Cherokee within its boundaries, but as the same may be amended from time to time.

11.18 Recording. This Agreement or a summary thereof, with the consent of all parties, may be recorded in the real property records of El Paso County with an attachment thereto setting forth the legal descriptions and containing a Map of Facilities.

11.19 Enterprise. Each Party may establish and operate pursuant to an enterprise as provided by Article X, Section 20 of the Colorado Constitution. Any rights or responsibilities under this Agreement may be assigned to said enterprise provided that such assignment shall not relieve the Parties of their responsibilities hereunder.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the day and year first above written.

[remainder of page left blank intentionally, signature page follows]

CHEROKEE METROPOLITAN DISTRICT

By: [signature]
Name: Steve Hasbrouck
Title: President
December 21, 2021

ATTEST:

By: [signature]
Name: Dennis Daniels
Title: Secretary
December 21, 2021

GRANDVIEW RANCH METROPOLITAN DISTRICT NO. 1

By: [signature]
Name: Paul J. Howard
Title: President

ATTEST:

By: [signature]
Name: Samuel Howard
Title: Treasurer

Exhibit A – Map of Facilities

Agreement for Wastewater Treatment Plant Expansion and Extraterritorial Wastewater Service

AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

THIS AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE (this "Agreement") is made and entered into effective as of ______________________, 2022 (the "Effective Date"), by and between WOODMEN HILLS METROPOLITAN DISTRICT, a quasi-municipal corporation and political subdivision of the state of Colorado, acting by and through its Wastewater Enterprise ("Woodmen"), and MELODY HOMES, INC., a Delaware corporation, D/B/A DR HORTON, its successors and assigns ("Horton"). Woodmen and Horton are sometimes referred to in this Agreement individually as a "Party" and jointly as the "Parties".

RECITALS

A. Woodmen is a quasi-municipal corporation and political subdivision of the state of Colorado formed pursuant to Title 32 of the Colorado Revised Statutes. Among other things, Woodmen provides sewer service within its service area, as well as the service areas of Paint Brush Hills Metropolitan District, Falcon Highlands Metropolitan District, and portions of the 4-Way Ranch Metropolitan District and Meridian Service Metropolitan District, all located in El Paso County, Colorado and generally depicted on the attached **Exhibit A**. To provide this service, Woodmen owns and operates a 1.3-million gallons per day ("MGD") wastewater treatment plant commonly known as the Woodmen Hills Regional Water Reclamation Facility (the "Plant").

B. Woodmen anticipates the need to upgrade the Plant to enhance wastewater treatment processes to comply with anticipated future regulations that will impose stricter effluent limitations (the "Technological Upgrades").

C. Horton is a private developer of residential communities and is under contract to purchase 768.233 acres of real property in El Paso County, Colorado that it seeks to develop into a mixed-use residential community containing approximately 3,500 Single-Family Residential Equivalents, as depicted on **Exhibit B** (the "Horton Property"). The Grandview Reserve Metropolitan District No. 1 has been organized and established to provide water and other services to the Horton Property. Horton desires to have Woodmen provide sewer service to the Horton Property.

D. The Plant currently has sufficient capacity to serve Woodmen's existing service areas and approximately 900 additional Single-Family Residential Equivalents, but has no additional capacity for further extraterritorial service, including the Horton Property, without expansion which would require increasing the Plant's hydraulic loading by approximately 0.602 MGD (the "Capacity Expansion"). If the Plant is to be expanded, efficiencies will be gained by sizing the Capacity Expansion to include the Horton Property and other El Paso County properties in the vicinity of Woodmen including those commonly referred to as KO1515 (68 acres), Silver Star (32 acres), Parcel A (116 acres), and other parcels (collectively, 168 acres), as depicted on Exhibit B. To provide sewer service to all of these properties, Woodmen will need to expand the Plant to reach a minimum design capacity of 2.5 MGD, and to include the Technological Upgrades described in **Exhibit C**. The Capacity Expansion and Technological Upgrades are referred to herein as the "Expansion." Permitting, design, and construction of the Expansion is anticipated to take at least five years.

E. The Parties have determined that having Woodmen expand its wastewater service to include the Horton Property and other nearby properties likely to develop, and having the Parties jointly fund the Expansion under the terms and conditions of this Agreement, will benefit the Parties and future residents of Woodmen and the Horton Property.

F. Woodmen is willing to extend sewer service to the Horton Property upon the completion of funding of the Expansion and reserve for Horton a minimum number of Taps for wastewater service by the Plant and the Expansion, under the terms and conditions of this Agreement, which include Horton's construction and dedication to Woodmen of necessary sewer infrastructure as described in this Agreement.

NOW, THEREFORE, in consideration of the covenants and mutual agreements contained in this Agreement, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties agree as follows:

AGREEMENT

1. **Incorporation of Recitals**. The Parties hereby acknowledge and agree to the Recitals set forth above, which are incorporated herein by this reference.

2. **Definitions**. The definitions in this paragraph apply to this Agreement, and any amendment thereto, except where otherwise specified.

2.1 **Conditional Acceptance** means acceptance by Woodmen of Wastewater Facilities, or applicable portion thereof, constructed by Horton, granted when the following conditions have been met by Horton to the satisfaction of Woodmen: (A) the Wastewater Facilities, has been constructed by Horton (or its agents or contractors), and pressure tested, vacuum tested, jet cleaned, and televised, all of which may be performed by Woodmen at Horton's expense; (B) all surface improvements and restoration, including landscaping and erosion control measures, are complete, but if during the non-irrigation season (November 1 through March 31), no landscaping is required until the next growing season; (C) all necessary approvals of design on construction, contracts, and agreements have been fully executed and delivered to Woodmen, and to the extent lines are in future rights-of-ways which are not yet recorded, Horton has granted an easement to Woodmen for operation and maintenance, in accordance with Woodmen's Bylaws, Rules, and Regulations dated January 27, 2022, as they may be amended (the "Woodmen Regulations"); (D) the project statement and certification of costs, and bill of sale, are submitted in tabular form listing pipe sizes, footage for different sizes, and appurtenances with quantity, and are presented to Woodmen; and (E) record drawings have been presented to Woodmen, in printed hard copy and AutoCAD and PDF files on CD.

2.2 **CPI** means the Consumer Price Index for All Urban Consumers, All Items, for the Denver-Aurora-Lakewood area, as published by the U.S. Department of Labor, Bureau of Labor Statistics, or successor index should publication of the Index cease. Adjustments based on the CPI shall be equal to the percentage increase or decrease in the CPI issued for the calendar year in which such adjustment is to be made (or if the CPI for such year is not yet publicly available, the CPI for the most recent calendar year for which the CPI is publicly available) as compared to the CPI issued for the year in which the Effective Date occurred.

2.3 **Design Capacity** means the capability to receive a specific domestic wastewater flow, expressed as the maximum daily hydraulic capacity in million gallons per day ("MGD") for a domestic wastewater treatment works, as the firm pump capacity for a Lift Station, and as the peak instantaneous hydraulic flow capable of being conveyed for an Interceptor.

2.4 **Final Acceptance** means acceptance by Woodmen of the Wastewater Facilities, or applicable portion thereof, constructed by Horton (or its agents or contractors), granted at the later of: (a) the end of the Warranty Period, or (b) the completion of any correction and repair of any deficiencies identified during the Warranty Period in a manner satisfactory to Woodmen. Woodmen is responsible for repair, maintenance and operation of the Wastewater Facilities after Final Acceptance.

2.5 **Force Main** means pipelines that convey Wastewater under pressure from the discharge side of a Lift Station.

2.6 **Improvement** means any permanent or temporary building, structure, facility, improvement or betterment upon, or for any use or occupancy of any property to which park and recreation or water and wastewater service is or may be furnished, including without limitation use for any domestic, commercial, industrial, construction, irrigation or fire protection purpose, whether public or private.

2.7 **Interceptor Sewer** or **Interceptor** means a sewer line that conveys sewage by gravity, if it performs one or more of the following functions as its primary purpose: (a) it intercepts domestic wastewater from a final point in a collection system and conveys such waste directly to a treatment plant; (b) it is intended to replace an existing treatment plant or Lift Station and transports the collected domestic wastewater to an adjoining collection system or interceptor sewer for treatment; (c) it transports the domestic wastes from one or more municipal collection systems to a regional treatment plant; (d) it is intended to intercept an existing major discharge of raw or inadequately treated wastewater for transport directly to another Interceptor Sewer, Lift Station, or treatment plant.

2.8 **License** means a written permit or license issued by Woodmen in accordance with the Woodmen Regulations.

2.9 **Licensed Premises** means the land and Improvements to which wastewater service is furnished under an approved License for service. The owner of the Licensed Premises is the person who holds legal title to the subject property.

2.10 **Lift Station** means a wastewater pumping station that pumps wastewater to a different point when the continuance of the gravity sewer at reasonable slopes would involve excessive depths of bury or that pumps wastewater from areas too low to drain into available sewers.

2.11 **Local Sanitary Sewer Collection Systems** means all sanitary sewer collection pipelines sized ten inches or less and necessary to serve the Horton Property.

2.12 **Major Interceptor** means any Interceptor sized twelve inches or greater.

2.13 **Main** means those pipes and appurtenant facilities used for collecting wastewater.

2.14 **Regional Sanitary Sewer Systems** means all sanitary sewer collection pipelines sized greater than 10 inches, Major Interceptors, Lift Station and Force Mains necessary to serve the Horton Property and other extraterritorial service areas pursuant to Paragraph 9.3.

2.15 **Sewage** or **Wastewater** means a combination of liquid wastes which may include chemicals, household wastes, human excreta, animal or vegetable matter in suspension or solution, or other solids in suspension or solution which are discharged from a dwelling, building or other structure, with pretreatments, if necessary, that are suitable for treatment at publicly owned treatment works providing standard waste treatment.

2.16 **Single-Family Residential Equivalent ("SFE")** means each single-family connection or connections equivalent to one single-family residence. Currently, one SFE is equal to: one "detached" single-family unit, which means a building or structure used or designed to be used as only one residential unit; each separate residential unit within an "attached" building, such as a duplex or paired lot; and each separate residential unit within a "multifamily" building, such as a townhome or apartment building.

2.17 **Tap** means the physical connection to a wastewater Main that enables wastewater service to be provided to the Licensed Premises.

2.18 **Tap Fee** means a fee required for connection to and service by Woodmen's wastewater system, which shall be paid in the amounts and at the times specified in this Agreement.

2.19 **Underdrain** means a dewatering and/or drainage system designed to intercept, collect, and/or transport groundwater.

2.20 **Warranty Period** means the twenty-four (24) month period of time following Conditional Acceptance, during which Horton must timely correct or repair deficiencies in the Wastewater Facilities Horton constructed pursuant to this Agreement.

2.21 **Wastewater Service Line** means that part of wastewater line for any Licensed Premises connecting at the Tap to the Main.

2.22 **Wastewater Facilities** means, collectively, the Local Sanitary Sewer Collection Systems and the Regional Sanitary Sewer Systems, together with all appurtenant and necessary manholes, services, Taps, pump stations, associated materials, property, and equipment collecting wastewater from individual customers, but excluding the Plant and the Expansion.

3. **Extraterritorial Sewer Service.**

3.1 Woodmen shall be the exclusive wastewater service provider to the Horton Property in perpetuity.

3.2 Woodmen shall issue Taps for such extraterritorial service at the Horton Property in accordance with Paragraph 4.

3.3 Nothing in this Agreement shall prevent Woodmen in its sole discretion from providing future extraterritorial service to areas other than the Horton Property.

4. **Tap Reservation.**

4.1 Upon execution of this Agreement, Woodmen shall reserve, out of the existing capacity of the Plant, sufficient capacity to serve 900 Taps equivalent to 900 SFEs within the Horton Property (the "Horton Reserved Taps"). Woodmen shall make available and Horton shall purchase on a nonrefundable basis the Horton Reserved Taps at Woodmen's current 2022 Tap Fee of $8,750 per Tap according to the following takedown schedule:

4.1.1 100 Taps within thirty (30) days of execution of this Agreement.

4.1.2 200 Taps prior to Woodmen's Conditional Acceptance of a Lift Station and Force Main constructed pursuant to Paragraph 9.3.

4.1.3 300 Taps within one year of the Conditional Acceptance of the Lift Station and Force Main constructed pursuant to Paragraph 9.3.

4.1.4 300 Taps prior to the Final Acceptance of the Lift Station and Force Main constructed pursuant to Paragraph 9.3.

4.2 This Agreement limits the Horton Reserved Taps to 900 SFE during the development of the Expansion, but to the extent Woodmen determines the Plant has additional hydraulic capacity to serve more than the 900 Horton Reserved Taps, Woodmen may in its sole discretion issue additional Taps for the Horton Property during the development of the Expansion at Woodmen's 2022 Tap Fee of $8,750 per Tap, adjusted based on the CPI.

4.3 Following completion of the Expansion, Woodmen shall issue on an as-needed basis 2,600 additional Taps to serve up to 3,500 SFEs on the Horton Property (which includes the 900 Horton Reserved Taps), upon Horton's payment of 70% of Woodmen's 2022 Tap Fee of $8,750 per Tap, adjusted based on the CPI. For example, in the first calendar year following completion of the Expansion, Horton shall pay to Woodmen $5,250 for each Tap. In the following calendar year, Horton shall pay Woodmen a Tap Fee equal to 70% of $8,750 adjusted based on the CPI.[1] Said discount shall be available for Horton's purchase of the 2,600 Taps following completion of the Expansion for a period of twenty years from the date on which Woodmen submits a Certification of Final Completion of the Expansion to the Water Quality Control Division (the "WQCD"). To the extent Woodmen determines that the Plant and the Expansion has additional hydraulic and organic capacity to serve more than the 3,500 SFEs, Woodmen may in its sole discretion issue additional Taps for the Horton Property at Woodmen's then-prevailing Tap Fee. Woodmen's obligation to issue additional sewer Taps as provided in this Paragraph 4.3

[1] ($8,750 * Index Adjustment) * 0.70.

shall expire twenty (20) years from the date on which Horton purchases the last of the 900 Horton Reserved Taps.

4.4 Except for the Tap Fees applicable to the Horton Reserved Taps payable pursuant to the schedule set forth in Paragraph 4.1 above, all Tap Fees necessary for wastewater service to a residence within the Horton Property shall be payable at the time of issuance of a building permit for such residence.

4.5 The Horton Reserved Taps are nonrefundable and shall be assignable or transferrable, without Woodmen's prior consent, only to Horton's successor-in-interest in all or a portion of the Horton Property pursuant to Paragraph 22.1. Except as provided herein, the Horton Reserved Taps shall not be assignable or transferrable to any party without Woodmen's prior written consent.

4.6 All extraterritorial sewer service to the Horton Property requires Horton's strict compliance with the Woodmen Regulations and the Woodmen Water and Wastewater System Standards and Specifications dated March 24, 2011 and last revised December 2021, as they may be amended (the "Woodmen Standards and Specifications"). In particular, notwithstanding any Tap reservation or issuance, no person shall connect to or disconnect from, or repair or otherwise work on any Wastewater Facility or Wastewater Service Line without first obtaining a License from Woodmen pursuant to the Woodmen Regulations, except for Horton during the Warranty Period. Notwithstanding the foregoing, Horton shall have no liability with respect to the acts or omissions of third parties outside of Horton's reasonable control.

5. **Estimated Costs of the Expansion**.

5.1 Current Estimate of Costs. The current estimate of the total cost of the Expansion (the "CEC") is approximately $38 million, as itemized in **Exhibit D**. The CEC is expected to increase over time.

5.2 Allocation of Costs. The total cost of the Expansion (the "Total Cost") shall be allocated to the Parties based on the relative benefits of the Expansion that will accrue to each Party, as determined by Woodmen. As of the Effective Date, the Parties agree that the Total Cost shall be allocated as follows: Horton shall bear 32.59% of the Total Cost ("Horton's Allocable Share"); and Woodmen shall bear 67.41% of the Total Cost ("Woodmen's Allocable Share"), as reflected on **Exhibit E** (the "Total Cost Allocation"), subject to revision as discussed below. Horton's Allocable Share and Woodmen's Allocable Share shall be adjusted as the CEC and Total Cost Allocation are adjusted throughout the permitting, design, and construction of the Expansion, as described in Paragraphs 6–7 below. Woodmen may, in its sole discretion, design and construct the Expansion at a lower hydraulic capacity (but in no event less capacity than would be necessary to serve 3,500 taps reserved herein), in which case it will reallocate Horton's Allocable Share and Woodmen's Allocable Share accordingly.

6. **Allocation of Costs and Phases of the Expansion**.

6.1 During all phases set forth below, Woodmen shall have the final decision on the type and number of facilities comprising the Expansion and the estimated costs thereof.

Woodmen's determination of any adjustments to the Total Cost Allocation that are reflected in the Total Cost Allocation and subsequent updates shall be final.

6.2 Prior to incurring costs for each successive Phase of the Expansion (defined below), Woodmen shall provide Horton a revised Updated CEC, reflecting the then-estimated Total Cost of the Expansion and an updated Total Cost Allocation and bases therefor, as further described below in Paragraph 7, and Horton shall deliver to Woodmen Letters of Credit (defined below), as further described below in Paragraphs 6.4 and 7.3.

6.3 Horton shall have no right to reject, object to, revise or challenge any Updated CEC or the Expansion designs, plans or specifications, or terminate this Agreement based on any Updated CEC, Total Cost or Total Cost Allocation, so long as the adjustment to each Party's Allocable Share is equal to or less than 5% of each Party's Allocable Share as of the Effective Date.

6.4 Phases of Permitting, Design and Construction of the Expansion. Woodmen shall have the sole right and obligation to permit, design, manage construction of and own the Expansion, under the terms and conditions of this Agreement, and Horton shall have no legal or equitable interest in the Plant or Expansion. The Expansion shall be pursued and completed with commercially reasonable efforts by Woodmen in "Phases," as described below.

6.4.1 Phase 1: Within thirty (30) days of the Effective Date, Horton shall deliver to Woodmen the Phase 1 Letter of Credit (defined below). Upon receipt of the Phase 1 Letter of Credit, Woodmen shall initiate and pursue with commercially reasonable efforts to completion the Phase 1 activities for the Expansion. The Phase 1 activities include the following activities and may entail additional ancillary activities:

(i) Preparation and submittal of an application for preliminary effluent limitations ("PELs") or other water quality planning targets ("WQPTs") for the Expansion to the WQCD pursuant to 5 C.C.R. § 1002-22, as amended;

(ii) Modification of the concept plan for the Expansion, as necessary;

(iii) Preparation and submittal of a site location approval application for the Expansion ("Site Application") to the WQCD pursuant to 5 C.C.R. § 1002-22, as amended; and

(iv) Preparation and submittal of 1041 permit application for the Expansion to El Paso County or obtaining confirmation of exemption therefrom.

6.4.2 Phase 2: Upon receipt of approved PELs or other WQPTs, an approved Site Application, and a County-approved 1041 permit or relevant exemption for the Expansion, Woodmen shall prepare and deliver to Horton a revised CEC reflecting the then-estimated Total Cost of the Expansion (the "First Updated CEC") that identifies the components of the Expansion and the associated costs of each as of the date of the First Updated CEC, a revised Total Cost Allocation (the "First Total Cost Allocation"), each Party's Allocable Share, and the bases therefor. Within thirty (30) days of its receipt of the First Updated CEC and First Total Cost Allocation, Horton shall deliver to Woodmen the Phase 2 Letter of Credit (defined below). Upon receipt of the Phase 2 Letter of Credit, Woodmen shall initiate and pursue with commercially reasonable efforts to completion the Phase 2 activities for the Expansion. The Phase 2 activities include the following activities and may entail additional ancillary activities:

(i) Preparation and submittal of a design application of the Expansion to the WQCD pursuant to 5 C.C.R. § 1002-22, as amended; and

(ii) Preparation of final design of the Expansion based on the approved PELs or WQPTs, the approved Site Application, and the design application.

6.4.3 Phase 3: Upon design approval by the WQCD, Woodmen shall prepare and deliver to Horton the Phase 2 final design, a revised CEC reflecting the then-estimated Total Cost of the Expansion (the "Second Updated CEC"), and a revised Total Cost Allocation (the "Second Total Cost Allocation") and the bases therefor. Within thirty (30) days of its receipt of the Second Updated CEC and Second Total Cost Allocation, Horton shall deliver to Woodmen the Phase 3 Letter of Credit (defined below). Upon receipt of the Phase 3 Letter of Credit, Woodmen shall initiate and pursue with commercially reasonable efforts to completion the Phase 3 activities for the Expansion. The Phase 3 activities include the following activities and may entail additional ancillary activities:

(i) The Issuance of Requests for Bids to Construct the Expansion and Receipt and Review of Bids. Woodmen and Horton may review the bids but Woodmen shall have the sole discretion to accept or reject any bid. Upon receipt of bids for the construction of the Expansion, Woodmen may prepare and deliver to Horton a revised CEC (the "Third Updated CEC") and a revised Total Cost Allocation (the "Third Total Cost Allocation") to reflect any differences between the Second Updated CEC and the received bids. The Third Updated CEC will include a 10% upward adjustment to allow for bid increases and change orders during the construction of the Expansion. Within thirty (30) days of its receipt of the Third Updated CEC and Third Total Cost Allocation, Horton shall, if necessary, deliver to Woodmen an amended Phase 3 Letter of Credit reflecting any increase or decrease in Horton's share of the cost to construct the Expansion, as reflected by the Third Updated CEC and Third Total Cost Allocation. To the extent Horton's amended Phase 3 Letter of Credit does not qualify as money that Woodmen has appropriated "equal to or in excess of the contract amount" under C.R.S. § 24-91-103.6, as amended, at the time Woodmen accepts a bid for construction of the Expansion under Phase 3, which decision shall be made solely by Woodmen, Horton shall, within fifteen (15) days, deliver funds to Woodmen in the amount necessary to cover the difference provided such delivery of funds is accompanied by a reduction in the applicable Letter of Credit.

(ii) Managing Expansion Construction. Woodmen shall use commercially reasonable efforts, without negligence or misconduct, to direct, manage and complete the construction of the Expansion in accordance with applicable law. Woodmen shall be solely responsible for obtaining any necessary permits or approvals with the applicable local, state or federal authorities, contracting for the construction of the Expansion with any contractors or subcontractors and, subject to Horton's responsibility to deliver Horton's Allocable Share to Woodmen, timely paying all fees, labor and material costs and other amounts payable in connection with the Expansion. Woodmen shall provide copies of such permits and approvals, including but not limited to any compliance schedule related thereto (the "Compliance Schedule"), to Horton within fifteen (15) days of receipt thereof. Except for the payment of Horton's Allocable Share and the securitization thereof as set forth in Paragraph 7, Horton shall have no responsibility to fund, construct, or review plans or specifications with respect to any portion of the Expansion, and Horton assumes no liability with respect to the designs, plans or specifications prepared or work performed by Woodmen. Horton shall not be responsible for financial penalties associated with Woodmen failing to comply with the Compliance Schedule or other terms and conditions of Woodmen's discharge permit except to the extent caused or contributed to by Horton's default under this Agreement.

(iii) Change Orders; Bid Increases. Woodmen shall have the sole right to approve change orders or bid increases as necessary or desirable, in Woodmen's sole discretion, to complete the Expansion. If, as a result of any change order or bid increase, the cost of construction of the Expansion increases above the approved bid, Woodmen may require Horton, within thirty (30) days of receipt of notice from Woodmen, to deliver an amended Phase 3 Letter of Credit reflecting the increase in such cost.

6.4.4 Progress Meetings. Every three (3) months beginning with the initiation of Phase 1 activities, the Parties shall meet in person or remotely at times and locations to be determined by the Parties to discuss the status of the Expansion and any problems, delays or increased costs anticipated by Woodmen in executing the Expansion.

7. **Joint Funding of the Expansion; Horton Financial Security**. The Parties agree to jointly fund all Phases of the Expansion, based on each Party's Allocable Share of the Total Cost, as reflected in the then-current Updated CEC and Total Cost Allocation.

7.1 Woodmen Financial Capability: Woodmen shall fund Woodmen's Allocable Share of the Expansion and its failure to do so shall be a default of its obligations under this Agreement. Prior to Phase 1 of the Expansion, Woodmen shall demonstrate to Horton that Woodmen has the capacity to fund Woodmen's Allocable Share through the issuance of revenue bonds and shall, at each Phase, issue such bonds in an amount equal to Woodmen's Allocable Share under the relevant Phase, as reflected in the then-current Updated CEC and Total Cost Allocation.

7.2 Horton Monthly Payments. Horton shall fund Horton's Allocable Share of the Expansion and its failure to do so shall be a default under this Agreement.

7.2.1 Woodmen shall invoice Horton on a monthly basis for Horton's Allocable Share incurred during the previous month for the Phase 1, Phase 2 and Phase 3 activities, as applicable, with an itemization of the activities for which the costs were incurred, which itemizations shall include the total cost of all work performed and Horton's Allocable Share of such costs. Horton shall pay all invoiced amounts in full within thirty (30) days of its receipt of each invoice. If Horton disputes any charges on a particular invoice, it shall nonetheless pay the invoice in full, but shall reserve the right to contest the disputed charges. If Horton disputes any invoiced charges, the Parties shall confer and attempt to resolve the dispute. If the Parties are unable to resolve the dispute, either Party refer the matter to arbitration as provided in Paragraph 15 below.

7.2.2 Horton's failure to timely pay in full any portion of an invoice shall constitute a default under this Agreement ("Failure to Pay"). Any payment due from Horton not received by Woodmen within thirty (30) days of Horton's receipt of an invoice shall thereafter incur a late fee equal to two percent (2%) of the invoiced amount per month. Except for the aforementioned late fee, such payment shall not bear interest or incur any other fees or penalties. If any payment and late fee are not paid with sixty (60) days of Horton's receipt of an invoice, Woodmen may seek payment under the applicable Letter of Credit and pursue all available remedies under Paragraph 15 below, including but not limited to seeking damages to reimburse Woodmen for its expenditures on the Expansion made in reliance on Horton's promises hereunder.

7.3 Horton Letters of Credit.

7.3.1 As provided in the preceding Paragraph 7.2, Horton shall provide Woodmen with a Letter of Credit at each Phase of the Expansion. Each Letter of Credit shall: (i) name Woodmen as the beneficiary; (ii) be issued by a financial institution reasonably acceptable to Woodmen; (iii) have an initial expiration date of not less than seven hundred thirty (730) days after the date of its issuance and provide for automatic annual extensions such that it remains effective through its corresponding Phase; (iv) provide that the issuer will deliver a sixty (60)-day advance written notice to beneficiary in the event issuer elects not to extend or elects to otherwise terminate the Letter of Credit; (v) permit partial and full draws; (vi) permit draws to be initiated by facsimile in the event the issuing institution does not have a Denver Metropolitan Area branch at which presentation for draws can be made; (vii) be in substantially the form attached hereto as **Exhibit F**; and (viii) not contain any conditions upon a draw request other than a certification by the beneficiary substantially in the forms shown on Exhibit F. At least twenty (20) days prior to the date of delivery of each Letter of Credit, Horton shall deliver the proposed form of Letter of Credit to Woodmen for review and approval. If Woodmen provides written comments to Horton on the form of Letter of Credit which are not addressed to the satisfaction of Woodmen prior to the date of delivery, then Horton shall instead deliver Good Funds into an escrow account in the full amount of the required Letter of Credit, under an agreement that entitles Woodmen to withdraw said funds to pay for the activities contemplated under this Agreement. Horton may be permitted to replace the same with a Letter of Credit, provided the form of Letter of Credit is approved by Woodmen prior to such replacement.

7.3.2 The face amount of each Letter of Credit shall be as follows:

(i) Phase 1 Letter of Credit: Ten percent (10%) of Horton's Allocable Share of the then-current Updated CEC and Total Cost Allocation.

(ii) Phase 2 Letter of Credit: Twenty percent (20%) of Horton's Allocable Share of the then-current Updated CEC and Total Cost Allocation.

(iii) Phase 3 Letter of Credit: The remaining balance of Horton's Allocable Share of the then-current Updated CEC and Total Cost Allocation.

7.4 Final Accounting. Within six (6) months of the completion of all construction of the Expansion, Woodmen shall provide to Horton a final accounting of the Total

Cost and Total Cost Allocation and the Parties shall, within sixty (60) days, reconcile any respective overpayments or underpayments reflected in the final accounting.

7.5 Horton Failure to Fund Its Allocable Share.

7.5.1 Phases 1-2. Except as provided by Paragraph 22.4 below, if at any time during Phases 1 or 2 of development of the Expansion Horton fails to deliver a Letter of Credit as required hereunder or gives Woodmen written notice that it intends to cease funding of the Expansion, this Agreement shall terminate, and neither party shall have any remaining liability or obligation to the other except that Horton shall be liable to Woodmen for all actual costs, expenditures and financial liabilities that Woodmen has incurred or made towards the permitting, design and construction of the Expansion ("Woodmen's Reliance Costs") up to the date of termination, it being acknowledged by the Parties that those permits, designs and construction may, absent the Expansion, be worthless to Woodmen and Woodmen may have to re-permit, re-design and re-construct the Plant to reflect Plant capacities much smaller than the Expansion, which decision shall solely be in Woodmen's discretion. In the event Horton fails to pay Woodmen's Reliance Costs within thirty (30) days of being invoiced, Woodmen may seek such payment of Woodmen's Reliance Costs under the effective Horton Letter of Credit and pursue all available remedies under Paragraph 15 below, including but not limited to seeking damages for the balance owed by Horton. Under no circumstances, including in the event Horton or its successor terminates the Agreement under this Paragraph 7.5.1, shall Horton be entitled to any reimbursement of its costs or payments made prior to its termination, including but not limited to Tap Fees for the Horton Reserved Taps or subsequently issued Taps; except, however, Horton may assign or transfer any purchased Taps as provided for in Paragraph 4.5.

7.5.2 Phase 3. Once Woodmen initiates the Phase 3 activities, neither Horton nor its assignees shall have any right to terminate this Agreement or to refuse to participate in the funding of the Expansion.

8. **Capacity Allocation**. Woodmen shall reserve sufficient treatment capacity in the Plant and, when constructed, the Expansion, to serve 900 Taps within the Horton Property for a period based on the later of: (a) seven (7) years from the date on which the WQCD issues site location approval for the Lift Station to be constructed pursuant to Paragraph 9.3, or (b) five (5) years from the date on which Horton terminates the Agreement under Paragraph 7.5.1. Woodmen shall reserve sufficient treatment capacity in the Expansion to serve an additional 2,600 Taps (for a total maximum of 3,500 Taps) within the Horton Property for a period of twenty (20) years from the date on which Horton purchases the last of the 900 Horton Reserved Taps. After expiration of any period in which Woodmen must reserve treatment capacity for the Horton Property, Woodmen may provide to a third party the balance of the capacity in the Plaint or the Expansion represented by the remaining Taps. Subject to this reservation, Woodmen may in its sole discretion enter into agreements, or expand its service area, to provide sewer treatment at the Plant and Expansion to properties in addition to the Horton Property.

9. **Sanitary Sewer Facilities**. As a condition to Woodmen's obligation to extend sewer service to the Horton Property, Horton shall design and install, subject to review and approval by Woodmen, the Wastewater Facilities.

9.1 Wastewater Service Lines. Horton shall design and construct all Wastewater Service Lines within the Horton Property pursuant to the Woodmen Regulations and the Woodmen Standards and Specifications. Subject to warranty and acceptance procedures under the Woodmen Standards and Specifications, Woodmen shall own and operate all sanitary sewer facilities constructed pursuant to this Agreement.

9.2 Local Sanitary Sewer Collection Systems. All Local Sanitary Sewer Collection Systems shall be constructed by Horton in accordance with the Woodmen Standards and Specifications, including but not limited to Woodmen's review, inspection, approval, and acceptance processes. Local Sanitary Sewer Collection Systems shall not be eligible for reimbursement under Paragraph 9.5 unless the Parties otherwise agree in writing.

9.3 Regional Sanitary Sewer Systems.

9.3.1 The Parties anticipate that a regional Lift Station and Force Main, the estimated locations of which are depicted on **Exhibit G**, will be necessary to serve the Horton Property pursuant to this Agreement, and that the Force Main will be a double barrel pipeline with each pipeline sized at no less than eight (8) inches in diameter.

9.3.2 All Regional Sanitary Sewer Systems must be adequately sized to serve the Horton Property and any other extraterritorial service areas approved by Woodmen in the future according to Paragraph 9.5. Such Regional Sanitary Sewer Systems shall be located, constructed, and warranted by Horton as required by this Agreement and in conformance with the Woodmen Standards and Specifications. At Woodmen's own expense, Woodmen may direct installation of additional conduits to trenches associated with construction of Regional Sanitary Sewer Systems.

9.3.3 Horton shall use commercially reasonable efforts to acquire all necessary lands, easements, rights of way, or other interests in real property necessary to construct the Regional Sanitary Sewer Systems and, if unable to do so, agrees to compensate Woodmen to the extent Woodmen seeks to acquire such necessary lands, easements, rights of way, or other interests in real property. To the extent Horton acquires the lands, easements, rights of way, or other interests in real property necessary to construct Regional Sanitary Sewer Systems, Horton shall convey such real property interests to Woodmen in accordance with the Woodmen Regulations.

9.3.4 Horton shall obtain all necessary governmental approvals necessary for any proposed Regional Sanitary Sewer Systems, including but not limited to site location approval, design and plan approvals, basis-of-design approval, and any other required local, state, and or federal approvals. No permit request, submittals, and/or applications may be made without Woodmen's approval and signature. All permits shall name Woodmen as the ultimate owner and operator of the facility.

9.3.5 Any Lift Station and Force Main constructed by Horton under this Agreement shall be conveyed to Woodmen, subject to Woodmen's warranty and acceptance procedures under the Woodmen Standards and Specifications. Upon Conditional Acceptance, Woodmen shall allow connection of Taps to the Woodmen wastewater collection and treatment system for wastewater service, though Horton retains the responsibility for correcting and repairing any deficiencies identified during the Warranty Period before Final Acceptance in a manner satisfactory to Woodmen. This Agreement shall constitute a License from Woodmen to Horton over any portion of the Licensed Premises necessary for Horton to correct or repair any deficiencies in the Wastewater Facilities during the Warranty Period.

9.4 Costs of Review and Inspection. Prior to submitting any applications for governmental approvals of any Wastewater Facilities, Horton shall submit draft applications, plans, and specifications to Woodmen for review and comment. Woodmen shall submit any comments to Horton's applications, plans or specifications within thirty (30) days of receipt thereof. Woodmen may invoice Horton, and Horton shall, within thirty (30) days, pay such invoices for the reasonable costs of Woodmen's review of such applications, plans, and specifications, as well as inspection of, all Wastewater Facilities within the Horton Property in accordance with the Woodmen Regulations. Woodmen's invoices may include reasonable charges for the internal costs to Woodmen of time spent by Woodmen's staff on such review and inspection, in addition to the reasonable costs charged by any outside consultants, together with any amounts charged for out-of-pocket costs and administrative fees.

9.5 Reimbursement for Oversizing. Woodmen may require any Regional Sanitary Sewer Systems to be sized larger than would be required to serve only the Horton Property, in which case Woodmen shall require, as a condition to allowing any third party to connect to the oversized facility, that the third party pay to Woodmen a pro rata share of the costs incurred by Horton to design, permit, entitle and construct the facility (the "Horton Facility Costs"), which Woodmen shall remit to Horton, less a two percent (2%) administrative fee that Woodmen shall retain, within thirty (30) days of receipt thereof. Upon completion of the Regional Sanitary Sewer Systems, Horton shall provide Woodmen with documentation, in reasonable detail, establishing the Horton Facility Costs applicable to each Regional Sanitary Sewer System. Each third-party's pro-rata share of the Horton Facility Costs shall be calculated based on the relative capacity of the Regional Sanitary Sewer System facility to be utilized by the third party. The obligation to repay its pro-rata share of the Horton Facility Costs shall be recited in a written agreement between the applicable third party and Woodmen, and Woodmen shall be solely responsible for the collection and remittance to Horton of such pro-rata share. In the event a third party is permitted to connect to the Regional Sanitary Sewer Systems without paying its pro-rata share of the Horton Facility Costs, Woodmen shall be in default of this Paragraph. This right of reimbursement shall expire ten (10) years from the date on which the oversized sewer facility is accepted by Woodmen.

9.6 Underdrains. Underdrains are not part of the Wastewater Facilities, and Woodmen shall have no responsibility for, nor shall it take ownership of, any underdrains or any associated augmentation or replacement requirements. For underdrains that are proposed to be located in the same trench as any Wastewater Service Line or other sanitary sewer system component for the purpose of dewatering the trenches in which such lines or components are located, Horton shall first submit and obtain Woodmen's approval of the designs of such underdrains depicted on the same plans as the proposed Wastewater Service Line or other sanitary sewer system component, and Horton shall allow Woodmen the opportunity to inspect and approve such underdrains after installation and before they are covered with soil to ensure their installation is consistent with approved designs and are otherwise in conformance with the Woodmen Regulations.

9.7 Flow Measurement: Horton shall design and install metering facilities internal to the Lift Station that monitor and transmit wastewater flows electronically in real-time to Woodmen via Supervisory Control and Data Acquisition ("SCADA") or comparable system. Woodmen also may require Horton to design and install metering within manholes in certain interceptors and Local Sanitary Sewer Collection Systems if necessary to confirm design capacities are not exceeded or to monitor wastewater flows. All meters shall be conveyed to Woodmen as provided in the Woodmen Regulations and the Woodmen Standards and Specifications.

10. **Applicable Wastewater Rates, Fees and Charges.**

10.1 Wastewater Service Fees. Except as otherwise provided in this Agreement, customers within the Horton Property receiving wastewater service from Woodmen ("Customers") shall pay the same wastewater service rates, fees, charges, surcharges, and assessments or other financial liabilities however termed required for Woodmen's wastewater services as Woodmen's in-district residents, as they are modified from time to time, in accordance with the Woodmen Regulations. Billing, collection and administration of service fees shall be performed by Woodmen, in accordance with the Woodmen Regulations. Neither Horton nor Grandview Reserve Metropolitan District No. 1 shall have any responsibility to collect service fees, or any liability with respect to Customers' failure to pay such service fees, or failure to comply with the Woodmen Regulations. Woodmen acknowledges that additional mills may be levied by Grandview Reserve Metropolitan District No. 1.

10.2 Pursuant to Paragraph 4 above, Horton shall pay Tap Fees for each Tap served by the Plant or the Expansion.

11. **Water Rights, Return Flows, and Water Quality; Conditions of Service**.

11.1 Water Service Within Horton Property. As of the Effective Date, it is anticipated that Grandview Reserve Metropolitan District No. 1 will be the water provider to the Horton Property. Nothing in this Agreement requires Woodmen to provide water service of any kind to the Horton Property; however, if requested by Horton, Woodmen may in its sole discretion and pursuant to a future agreement provide water service to some or all of the Horton Property. Horton shall, as a condition of receiving sewer service from Woodmen, cause Grandview Reserve Metropolitan District No. 1 and any other water provider to agree to the following provisions.

11.1.1 Return Flows. Grandview Reserve Metropolitan District No. 1, or other water providers to the Horton Property, shall retain ownership of any reusable effluent associated with the first uses of the water rights supplying the Horton Property, based on Woodmen's tracking and accounting for wastewater treated and released from the Plant and Expansion, subject to the following conditions:

(i) Woodmen has no responsibility to measure or account for the first 50.4 acre-feet per year of any water provider's reusable return flows discharged from the Plant or Expansion (based on inflow at 50,000 GPD annual average flow and 10% system losses); rather, ownership of those return flows is ceded to Woodmen, and Woodmen may in its sole discretion account for and take credit for those return flows in its own replacement plan(s). Horton will retain adequate return flow credits for any required 2% and/or 4% depletion returns.

(ii) After the minimum threshold of 50.4 acre feet per year of return flows is met by any water provider, such water provider may claim up to 75% of any remaining reusable return flows to which the provider is entitled under its water rights determinations that are discharged from the Plant or Expansion, calculated and allocated on a monthly basis. Woodmen may claim the right to reuse the remaining 25% of said reusable return flows. As an example, if a water provider's measured influent at the Plant or Expansion is 75,000 gallons per day (on an average annual basis) of fully reusable water, which results in 67,500 gallons per day of reusable return flows (assuming a 10% system loss), then that provider would be entitled to claim 75% of 67,500 minus 45,000, or 22,500 x .75 which equals 16,875 gallons per day of reusable effluent. Woodmen would own and claim reuse credit for the balance, which equals 5,625 gallons per day of reusable effluent. To the extent Horton's return flows exceed the threshold above, Woodmen shall track and report such return flows on a monthly basis.

(iii) Any water provider seeking to claim the right to reuse a portion of the effluent attributable to their influent into the Plant or Expansion must install adequate metering for their influent pursuant to Paragraph 9.7. Any reusable return flows associated with flows into the Woodmen sewer system that are not metered shall be deemed relinquished and may be claimed by Woodmen.

(iv) Credit for reusable effluent shall be calculated on a water year basis (November 1 through October 31).

11.1.2 Future Reclaim or Reuse Facilities. If Woodmen seeks to construct in the future facilities to physically capture and reuse effluent from the Plant and Expansion, water providers serving the Horton Property whose wastewater is discharged into Woodmen's sewer system will be offered to participate in such facilities. Horton agrees to and shall not oppose any Woodmen water replacement plans, aquifer storage projects, and/or other future cases involving the reusable effluent attributable to water supplied to the Horton Property that Woodmen owns pursuant to Paragraphs 11.1.1(i)-(iii). Woodmen agrees to and shall not oppose any Horton replacement plans and/or other future cases involving Horton's water rights except to the extent that Horton risks causing material injury to Woodmen's water rights, infrastructure, or ability to serve Woodmen customers. Each Party shall confer and attempt to resolve issues in good faith before opposing any water rights proceeding in which the other Party is an applicant or project participant, whether solely or in conjunction with other parties.

11.1.3 Exempt Wells Subject to Woodmen's Approval. Any proposed water service within the Horton Property utilizing an exempt well is subject to review and approval by Woodmen.

11.1.4 Water Quality. The Parties acknowledge that the quality of wastewater delivered into the Plant and the Expansion from the Horton Property may affect Woodmen's ability to comply with governmental approvals associated with the Plant and the Expansion, including discharge permits, and may affect Woodmen's and other water providers' ability to claim return flow credit for reusable effluent. The Parties therefore agree to the following with respect to the total dissolved solids ("TDS") concentration in the wastewater delivered from the Horton Property into Woodmen's sewer system:

(i) Once the regional Lift Station constructed pursuant to Paragraph 9.3 above ("Horton Lift Station") is in operation and receiving wastewater from at least 250 SFEs ("Threshold Level"), Woodmen will sample, at Woodmen's sole cost and expense, the TDS concentration in the wastewater at the Horton Lift Station once each month. Once Woodmen has taken a full year's worth of TDS samples at the Horton Lift Station, during the sampling period extending from November through October (the "Sampling Period") beginning after the Threshold Level is met, Woodmen shall calculate prior to the end of the calendar year the annual average of the TDS concentration in the wastewater at the Horton Lift Station for that Sampling Period, which will be considered representative of the TDS concentrations in the wastewater discharged from the Horton Property ("Horton TDS Concentration").

(1) Woodmen also will sample once each month during the initial Sampling Period the TDS concentration in the wastewater at its existing Falcon Lift Station and calculate prior to the end of the calendar year an annual average of the TDS concentration, which will be considered representative of the TDS concentrations in wastewater discharged from the areas delivering wastewater into the Falcon Lift Station ("Woodmen TDS Concentration"). In the event Woodmen ceases use of the Falcon Lift Station in the future, or if it constructs an additional lift station to serve additional properties outside of the Horton Property, Woodmen will change and/or add to its sampling location(s) any new lift station(s), recalculate the Woodmen TDS Concentration, and notify Horton accordingly. If Woodmen samples at multiple locations, it will develop a flow-weighted mean TDS concentration as the Woodmen TDS Concentration. The Woodmen TDS Concentration, once established after the initial Sampling Period, shall not be subject to change except to the extent Woodmen ceases use of the Falcon Lift Station or constructs an additional lift station to serve additional properties outside of the Horton Property.

(2) Woodmen will maintain all sampling data for at least five (5) years and annually notify Horton in writing of the prior Sampling Period's data and the calculated Horton TDS Concentration and Woodmen TDS Concentration. Woodmen will provide any sampling data to Horton at Horton's request.

(3) Beginning in the January following the first Sampling Period in which Woodmen has calculated the Horton TDS Concentration and the Woodmen TDS Concentration, and for each successive calendar year, Woodmen may assess all Customers discharging to the Horton Lift Station a monthly surcharge for the succeeding calendar year following the Sampling Period to offset the costs associated with excess treatment, risk of noncompliance, risk of jeopardizing use of wastewater effluent for water rights purposes, and related administrative and legal costs ("TDS Surcharge"), on the following terms:

a. For every 30 mg/l in excess of 30 mg/l that the Horton TDS Concentration exceeds the Woodmen TDS Concentration, the TDS Surcharge will be $1.20/month per SFE, assessed to each customer within the Horton Property, for the first year in which said TDS concentrations are calculated and compared. The amount of the surcharge will be increased, but not decreased, thereafter annually based on the CPI. Any applicable TDS

Surcharge will be assessed monthly throughout the year after the determination and will be adjusted based on subsequent annual recalculations of the Horton TDS Concentration. For example, if the Horton TDS Concentration exceeds the Woodmen TDS Concentration by 61 mg/l during the initial Sampling Period extending from November, 2026 through October, 2027, each Customer discharging to the Horton Lift Station in calendar year 2028 will be assessed a TDS Surcharge of $2.40/month per SFE. Woodmen will continue its monthly TDS sampling during the November, 2027–October, 2028 Sampling Period and will recalculate the Horton TDS Concentration for that Sampling Period and compare it to the Woodmen TDS Concentration to determine the TDS Surcharge, if any, to be assessed during calendar year 2029.

b. Woodmen may not impose any TDS Surcharge until the Expansion is complete, in operation, and its discharge permit contains a TDS limit. In the event the Horton TDS Concentration is less than the Woodmen TDS Concentration, Woodmen is not obligated to impose a TDS Surcharge on any of its customers outside of the Horton Property.

c. As a condition of allowing any other properties to connect to the Horton Lift Station, Woodmen shall require the sampling of TDS from the wastewater stream discharged from such other properties so that their TDS concentrations can be distinguished from the Horton TDS Concentration, or Woodmen shall waive the TDS Surcharge for the Horton Property until the sampling for such other properties can be accomplished. Woodmen shall not impose a TDS Surcharge on Customers on account of TDS concentrations from customers outside the Horton Property that discharge into the Horton Lift Station.

(ii) Customers are prohibited from utilizing ion exchange, water softener systems, or any other in-home water treatment system that discharges concentrated brine wastes into Woodmen's sanitary sewer system; provided, however, that Horton shall not be liable to Woodmen for any damage or costs arising from any Customers' failure to comply with this Paragraph except to the extent caused by Horton.

(iii) Customers are subject to the Woodmen Regulations, as may be amended, including but not limited to Woodmen's Pretreatment Regulations for all non-residential customers, sewer use resolutions, and any restrictions or prohibitions otherwise approved by Woodmen.

12. **Restrictive Covenants**. The terms of Paragraphs 10.1 and 11.1.3–11.1.4 shall burden, attach to and, run with the Horton Property and shall be binding upon Horton, its successors and assigns, and any other persons or entities which may acquire an ownership or leasehold interest in all or any portion of them and shall inure to the benefit of Woodmen. At Horton's closing of the Horton Property, Horton shall promptly execute and deliver to Woodmen the Restrictive Covenant Agreement attached hereto as **Exhibit H**, with respect to each of the properties, which Woodmen shall then promptly execute and record in the real property records of El Paso County, Colorado. In the event Horton's purchase of the Horton Property is subject to a deed(s) of trust, Horton shall provide the lender's subordination of its deed(s) of trust to be recorded with the Restrictive Covenant Agreement against each.

13. **Representations and Warranties**.

13.1 Representations and Warranties by Woodmen. Woodmen represents and warrants as follows:

13.1.1 Woodmen is a quasi-municipal corporation and political subdivision of the State of Colorado formed pursuant to Title 32 of the Colorado Revised Statutes and has the power to enter into and has taken all actions to date required to authorize this Agreement and to carry out its obligations.

13.1.2 To the knowledge of Woodmen, Woodmen knows of no litigation, proceeding, initiative, referendum, investigation or threat of any of the same contesting the powers of Woodmen or its officials with respect to this Agreement that has not been disclosed in writing to Horton.

13.1.3 To the knowledge of Woodmen, the execution and delivery of this Agreement and the documents required and the consummation of the transactions contemplated by this Agreement will not (i) conflict with or contravene any law, order, rule or regulation applicable to Woodmen or to its governing documents; (ii) result in the breach of any of the terms or provisions or constitute a default under any agreement or other instrument to which Woodmen is a Party or by which it may be bound or affected; or (iii) permit any Party to terminate any such agreement or instruments or to accelerate the maturity of any indebtedness or other obligation of Woodmen.

13.1.4 This Agreement constitutes a valid and binding obligation of Woodmen, enforceable according to its terms, except to the extent limited by bankruptcy, insolvency and other laws of general application affecting creditors' rights and by equitable principles, whether considered at law or in equity.

13.1.5 Reference to Woodmen's "knowledge" and similar phrases means the current, actual (as opposed to constructive or imputed) knowledge of the Board of Directors of Woodmen, Wally Eaves, and Carter Bullion, without any duty or investigation or inquiry. The fact that reference is made herein to Woodmen's Board of Directors of Woodmen, Wally Eaves, and Carter Bullion shall not render them personally liable in any manner whatsoever under this Agreement, including, without limitation, liability for any breach of the representations or warranties in this Paragraph 13.

13.2 Representations and Warranties by Horton. Horton represents and warrants as follows:

13.2.1 Horton is a Delaware corporation in good standing and authorized to do business in the State of Colorado and has the power and the authority to enter into and perform in a timely manner its obligations under this Agreement.

13.2.2 The execution and delivery of this Agreement has been duly and validly authorized by all necessary action on its part to make this Agreement valid and binding upon Horton.

13.2.3 To the knowledge of Horton, the execution and delivery of this Agreement will not (i) conflict with or contravene any law, order, rule or regulation applicable to

Horton or to Horton's governing documents; (ii) result in the breach of any of the terms or provisions or constitute a default under any agreement or other instrument to which Horton is a Party or by which it may be bound or affected; or (iii) permit any Party to terminate any such agreement or instruments or to accelerate the maturity of any indebtedness or other obligation of Horton.

13.2.4 To the knowledge of Horton, there is no litigation, proceeding, initiative, referendum, or investigation or threat or any of the same contesting the powers of Horton or any of its principals or officials with respect to this Agreement that has not been disclosed in writing to Woodmen.

13.2.5 This Agreement constitutes a valid and binding obligation of Horton, enforceable according to its terms, except to the extent limited by bankruptcy, insolvency and other laws of general application affecting creditors' rights and by equitable principles, whether considered at law or in equity.

13.2.6 Reference to Horton's "knowledge" and similar phrases means the current, actual (as opposed to constructive or imputed) knowledge of Bill Carlisle without any duty of investigation or inquiry. The fact that reference is made herein to Mr. Carlisle shall not render him personally liable in any manner whatsoever under this Agreement, including, without limitation, liability for any breach of the representations or warranties in this Paragraph 13.

14. Notices. Any notice or demand under this Agreement shall be in writing and shall be hand delivered, sent by a nationally recognized overnight delivery service, sent by registered or certified mail, postage prepaid, return receipt requested, or sent electronically, to the following address:

TO WOODMEN:

Woodmen Hills Metropolitan District
8046 Eastonville Road
Falcon, CO 80831
Attn: Wally Eaves, Water and Wastewater Enterprise Director
Email: wallyeaves@whmd.org

with copy to:

Brownstein Hyatt Farber Schreck, LLP
410 17th Street, Suite 2200
Denver, CO 80202-4432
Attn: Wayne Forman and Michael Smith
Email: wforman@bhfs.com; msmith@bhfs.com

TO HORTON:

Melody Homes, Inc.
9555 S. Kingston Court
Englewood, CO 80112-5943
Attn: Bill Carlisle
Email: wmcarlisle@drhorton.com

with copy to:

Davis & Ceriani, P.C.
1600 Stout Street, Suite 1710
Denver, CO 80202
Attn: Nicholas Dooher and John Baker
Email: ndooher@davisandceriani.com; jbaker@davisandceriani.com

and:

Melody Homes, Inc.
9555 S. Kingston Court
Englewood, CO 80112-5943
Attn: Robert Coltin, Regional Counsel
Email: rcoltin@drhorton.com

Either Party may change its address by written notice to the other provided for above. Notices shall be effective (i) the next day following the date sent by an established express delivery service which maintains delivery records requiring a signed receipt, (ii) upon receipt by the addressee of a hand delivery, (iii) three days following the date of mailing via certified or registered mail, postage prepaid, return receipt requested, or (iv) the date upon which the notice has been sent electronically.

15. **Default and Remedies**. Except as otherwise provided in this Agreement, including Horton's Failure to Pay under Paragraph 7.2.2 and deliver Letters of Credit under Paragraph 7.3, in the event of a breach or default of this Agreement by any Party, the non-defaulting party shall deliver written notice of such default (including reasonable detail of the nature of such default), and the defaulting party shall be afforded fifteen (15) days after written notice of such default to cure the same; provided, however, that if the default or breach is non-monetary and cannot reasonably be cured within such period, the non-defaulting party shall have fifteen (15) days to commence the cure thereof and diligently pursue the same thereafter. In the event of any uncured default (or the defaulting parties failure to commence the cure thereof subject to the preceding sentence), the non-defaulting Party shall be entitled to recover its respective damages (excluding any consequential, special or punitive damages) incurred as a result of such default and shall have full power and authority to (i) enforce compliance with this Agreement, subject to the negotiation provisions below, in any manner provided for by law or in equity, including, but not limited to, (a) filing an action for such damages, (b) filing an action for injunctive relief, whether to enjoin any

violation or to specifically enforce the provisions of this Agreement, or (ii) terminate this Agreement by written notice to the defaulting Party.

15.1 Negotiation Before Litigation. The Parties shall attempt in good faith to resolve any dispute arising out of or relating to this Agreement promptly by negotiation. Any Party may give the other party written notice of any dispute not resolved in the normal course of business. Within twenty-one (21) days after delivery of the notice, the receiving Party shall submit to the other a written response. The notice and response shall include with reasonable particularity a statement of each Party's position and a summary of arguments supporting that position. Within thirty-five (35) days after delivery of the notice, the Parties shall meet at a mutually-acceptable time and place. Unless otherwise agreed in writing by the negotiating Parties, the above-described negotiation shall end at the close of the first meeting described above ("First Meeting"). Such closure shall not preclude continuing or later negotiations, if desired. All offers, promises, conduct and statements, whether oral or written, made in the course of the negotiation by any of the Parties, their agents, employees, experts, and attorneys are confidential, privileged, and inadmissible for any purpose, including impeachment, in any legal proceeding involving the Parties, provided that evidence that is otherwise admissible or discoverable shall not be rendered inadmissible or non-discoverable as a result of its use in the negotiation. At no time prior to the First Meeting shall either side initiate litigation related to this Agreement except to pursue a provisional remedy that is authorized by law or by agreement of the Parties and except if a Party refuses to engage in negotiation. All applicable statutes of limitation and defenses based upon the passage of time shall be tolled while the procedures in this Paragraph are pending and for twenty-one (21) calendar days thereafter. The Parties will take such action, if any, required to effectuate such tolling.

16. **Attorneys' Fees and Costs**. If any legal action or other proceeding is brought for the enforcement of this Agreement, or because of an alleged dispute, breach, default, or misrepresentation in connection with any of the provisions of this Agreement, the successful or prevailing Party shall be entitled to recover reasonable attorneys' fees, consultants' fees, and other costs incurred in that action or proceeding, in addition to any other relief to which it may be entitled; provided, however, the Parties agree to and hereby waive and release any claims for special, consequential, or punitive damages.

17. **Venue, Governing Law, and Waiver of Jury Trial**. Venue for any and all legal actions regarding this Agreement shall lie in the District Court in and for the County of El Paso, State of Colorado, or if federal court, then in the Federal District Court in and for Colorado in Denver, Colorado. This Agreement and the rights and obligations of the Parties shall be governed by the laws of the State of Colorado. EACH PARTY HEREBY IRREVOCABLY AND UNCONDITIONALLY: (A) CONSENTS AND SUBMITS TO THE EXCLUSIVE JURISDICTION OF THE AFOREMENTIONED COURTS; (B) WAIVES ANY OBJECTION TO THAT CHOICE OF FORUM BASED ON VENUE OR TO THE EFFECT THAT THE FORUM IS NOT CONVENIENT; AND (C) WAIVES ANY RIGHT TO TRIAL BY JURY.

18. **Insurance**.

18.1 Both Parties agree to acquire and maintain throughout the life of this Agreement, statutory workers' compensation insurance coverage, comprehensive general liability insurance coverage and automobile liability insurance coverage, in the minimum amounts set forth below.

18.1.1 Workers compensation insurance: in accordance with applicable law, including employers' liability.

18.1.2 Comprehensive general liability insurance: in the amount of $1,000,000.00 combined single limit bodily injury and property damage, each occurrence; and $2,000,000.00 general aggregate. Coverage shall include all major divisions of coverage and be on a comprehensive basis including premises operations; personal injury liability without employment exclusion; blanket contractual; broad form property damages, including completed operations; medical payments; products and completed operations; independent contractors coverage; and contractors limited pollution coverage.

18.1.3 Automobile liability insurance: in the amount of $1,000,000.00 combined single limit bodily injury and property damage, each accident covering any auto.

18.2 Additional Insured. Woodmen shall be named an additional insured under Horton's insurance policies.

18.3 Subcontractors Insured. If the Parties contracts any portion(s) of the work described herein, such contractor shall be required to furnish certificates evidencing statutory workers' compensation insurance and comprehensive general liability insurance coverage in the same minimum amounts. If the coverage required under this paragraph expires during the term of this Agreement, the Parties and/or the contractor shall provide replacement certificate(s) evidencing the continuation of the required policies.

19. **Relationship of Parties**. Nothing contained herein shall be construed or interpreted as (a) creating a joint venture, partnership or other similar relationship between the Parties or any of them; (b) entitling any person or entity not a Party to this Agreement to any benefits of this Agreement; (c) appointing one of the Parties as the agent of the other Party or authorizing one of the Parties to enter into contracts in the name of the other Party except as permitted by this Agreement; or (d) creating, establishing or imposing a fiduciary duty owed by a Party to the other Party hereunder or in any way creating a fiduciary relationship between the Parties.

20. **No Third-Party Beneficiaries**. No customer or other person or entity other than the Parties shall be deemed to be a third-party beneficiary under this Agreement, and nothing in this Agreement, express or implied, is intended to, and shall not be deemed to, confer upon any customer or other person or entity, other than the Parties and their respective successors and assigns, any rights, remedies, obligations or liabilities under or by reason of this Agreement. It is the express intention of the Parties that any person or entity other than the Parties that may receive services or benefits under this Agreement shall be deemed to be an incidental beneficiary only.

21. **Headings and Titles**. Paragraph headings and titles contained in this Agreement are intended for convenience and reference only and are not intended to define, limit, or describe the scope or intent of any provision of this Agreement.

22. **<u>Assignment and Associated Limitations.</u>**

22.1 Except as provided herein, Horton shall not assign, sell or transfer its rights and obligations under this Agreement without Woodmen's prior written consent, which may be withheld or conditioned in Woodmen's sole discretion.

22.2 Without Woodmen's prior written consent, Horton may assign the entirety of its rights and obligations under this Agreement to a single parent, subsidiary, or affiliate of Horton, or its single parent or any entity which controls, is controlled by, or is under common control with Horton.

22.3 Except as provided in Paragraph 22.2, any assignment, sale, or transfer of Horton's rights and obligations under this Agreement may only be made to an entity to which Horton assigns its rights to purchase all of the Horton Property, provided that the assignee agrees in writing to assume Horton's obligations hereunder with respect to the entire Horton Property, and provided that, consistent with Paragraph 22.1, Woodmen provides prior written consent, which may be withheld or conditioned in Woodmen's sole discretion.

22.4 In the event Horton assigns its interest in this Agreement with respect to the Horton Property:

22.4.1 Neither Horton nor its assigns may exercise the right to terminate this Agreement, in whole or in party, as provided in preceding Paragraph 7.5.1. On the contrary, the failure of Horton or its assigns to timely fund any Phase or deliver a required Letter of Credit shall constitute a default of this Agreement under Paragraphs 7.2.2 and 15; and.

22.4.2 In the event Horton or its assigns defaults under this Agreement, Woodmen, in addition to the remedies available under Paragraph 15, shall be entitled to maintain this Agreement in full force and effect, with Woodmen assuming the defaulting party's portion of Horton's Allocable Share without waiving its right to hold the defaulting party liable for damages hereunder. In the alternative, Woodmen may deem this Agreement terminated as to all parties, which decision shall be communicated to Horton's assignee(s) within thirty (30) days. In either case, the defaulting party shall be liable to Woodmen for all damages related to such default, including but not limited to payment to Woodmen of Woodmen's Reliance Costs up to the date of the default.

22.5 From and after assignment and assumption as provided above, Horton shall be relieved from all obligations assumed thereunder.

23. **<u>Miscellaneous Provisions</u>**.

23.1 This Agreement shall be binding on the Parties and their respective successors and assigns.

23.2 The above and foregoing constitutes the entire agreement between the Parties pertaining to the subject matter of this Agreement and no additional or different oral representation, promise or agreement shall be binding upon any of the Parties hereto with respect to the subject matter of this Agreement.

23.3 No Party shall be excused from complying with any provision of this Agreement by the failure of the other Party to insist upon or to seek compliance. No assent, expressed or implied, to any failure by a Party to comply with a provision of this Agreement shall be deemed or taken to be a waiver of any other failure to comply by said Party. No extension of time for the performance of any obligation or act will be deemed an extension of time for the performance of any other obligation or act.

23.4 Nothing in this Agreement shall be construed as a waiver of the notice requirements, defenses, immunities and limitations the Parties may have under the Colorado Governmental Immunity Act, C.R.S. § 24-10-101, *et seq.*, or to any other defenses, immunities, or limitations of liability available to the Parties against third parties by law.

23.5 Except as otherwise expressly provided in this Agreement, this Agreement may be amended, modified, or changed, in whole or in part, only by written agreement executed by both Parties in the same manner as this Agreement.

23.6 Time is of the essence of this Agreement.

23.7 Neither Party shall be liable for delay or failure to perform hereunder, despite best efforts to perform, if such delay or failure is the result of *force majeure*, and any time limit expressed in this Agreement shall be extended for the period of any delay resulting from any *force majeure*. Timely notices of the occurrence and the end of such delay shall be provided by the Party asserting *force majeure* to the other Party. "*Force majeure*" shall mean causes beyond the reasonable control of a Party such as, but not limited to, adverse weather conditions, acts of God or the public enemy, pandemic, strikes, work stoppages, unavailability of or delay in receiving labor or materials, faults by contractors, subcontractors, utility companies or third parties, fire or other casualty, or action of government authorities other than the Parties.

23.8 The Parties acknowledge that they both participated in the drafting of this Agreement and this Agreement shall not be construed against either one of them based on the interpretative rule that contracts should be construed against the drafter.

23.9 This Agreement may be executed in any number of counterparts, each of which when executed and delivered shall be an original, but all such counterparts shall constitute one and the same instrument.

IN WITNESS WHEREOF, the Parties have set their hands and seals, effective the day and year first above written.

(Remainder of Page Intentionally Blank)

WOODMEN HILLS METROPOLITAN DISTRICT, ACTING BY AND THROUGH ITS WASTEWATER ENTERPRISE

By: ______________________________

Name: ______________________________

Its: President

ATTEST:

____

MELODY HOMES, INC., A DELAWARE CORPORATION, D/B/A DR HORTON

By: ______________________________

Name: ______________________________

Its: ______________________________

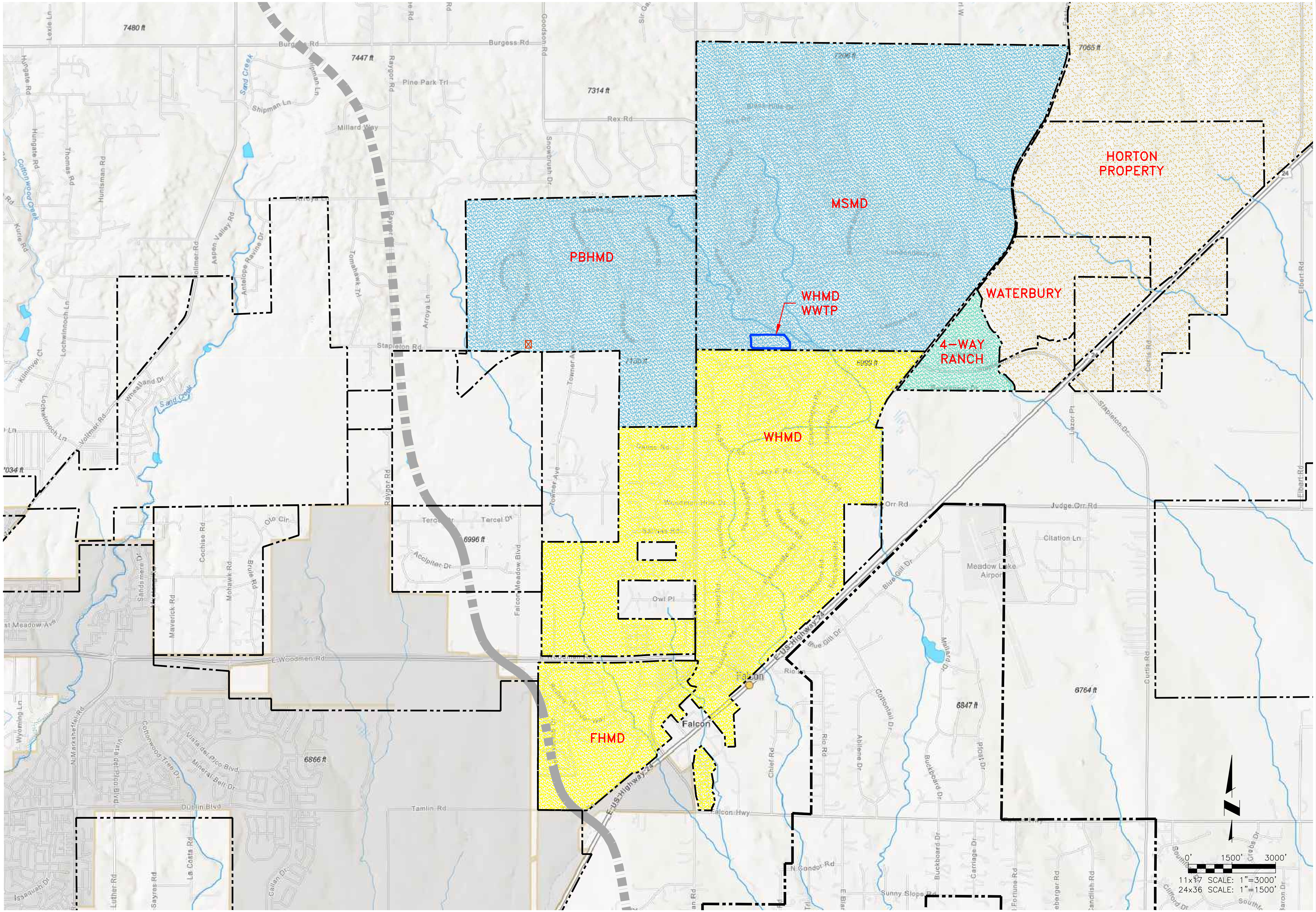
ATTEST:

____

<u>EXHIBIT A</u>
<u>TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE</u>

Woodmen Metropolitan District's Wastewater Service Area

(See Attached)



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JDS-HYDRO CONSULTANTS, INC.
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

DISCLAIMER: THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS. ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO JDS-HYDRO CONSULTANTS, INC. JDS-HYDRO ASSUMES NO LIABILITY FOR UNAUTHORIZED CHANGES AND/OR REVISIONS MADE TO PLANS.

EXHIBIT A

EXISTING SERVICE AREA

EXHIBIT

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

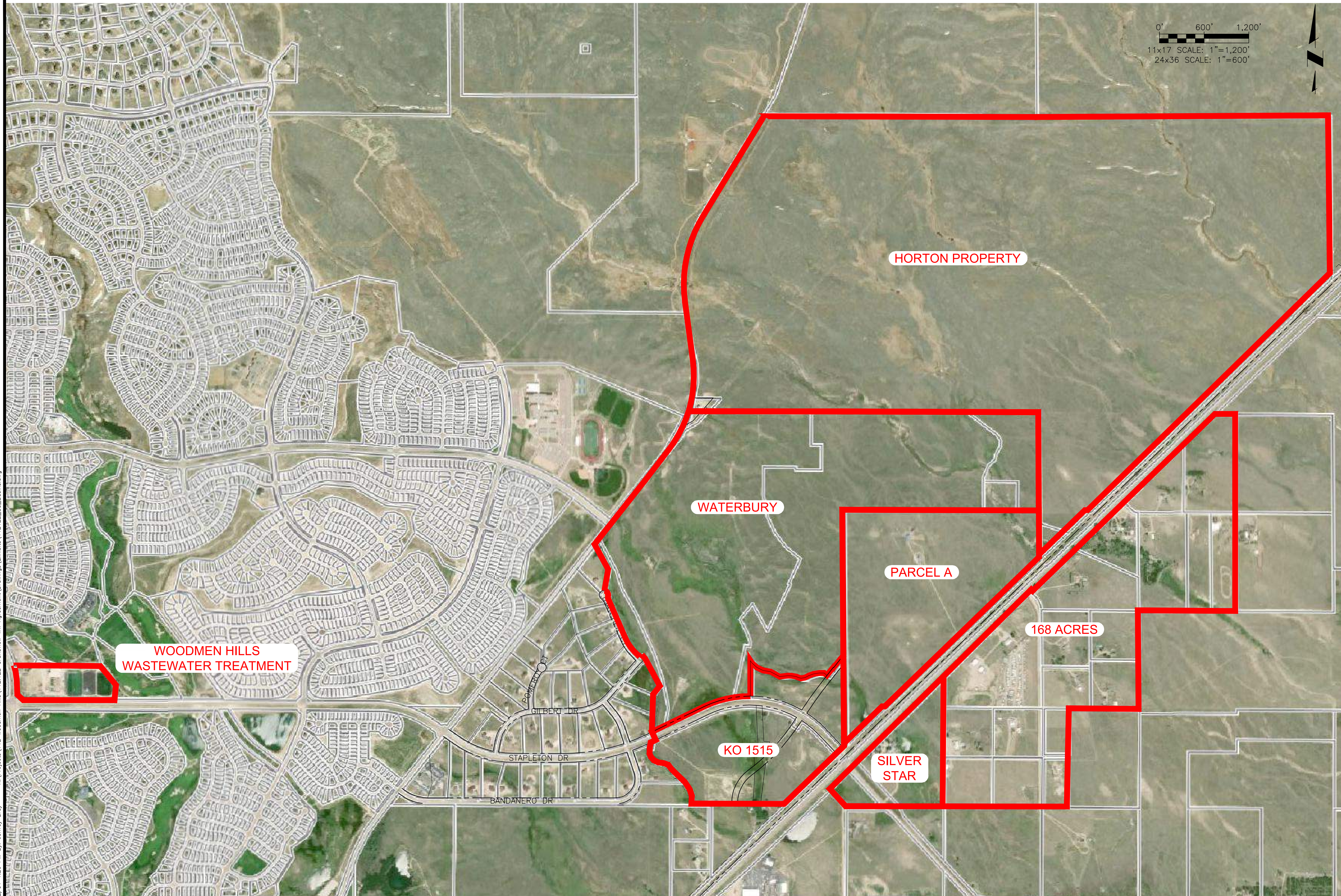
Project No.: 112.122
Date: 12/01/22
Design: RMM
Drawn: RMM
Check: JPM

SHEET A OF

EXHIBIT B
TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

DR Horton Property

(See Attached)



JDS-HYDRO CONSULTANTS, INC.
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

EXHIBIT B

PARCEL OUTLINE

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

REVISIONS

Project No.: 112.122
Date: 12/01/22
Design: JLB
Drawn: JLB
Check: JPM

SHEET B OF

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EXHIBIT C
TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

Woodmen Metropolitan District's Wastewater Treatment Plant Expansion - Technological Upgrades

(See Attached)

This needs to be a highlighted exhibit to expand the existing infrastructure under this 1041; identify exhibit and page number clearly in application.

This exhibit has been referenced in the text.

ACTUAL IMPROVEMENT
THE EXPANSION AND
WOODMEN HILLS WAS
PLANT MAY VARY SOMEWHAT FROM THOSE CONTEMPLATED HEREIN DUE TO FINAL REGULATORY REQUIREMENTS, BUT AS CONCEIVED WITHIN THIS AGREEMENT THOSE IMPROVEMENTS ARE EXPECTED TO BE GENERALLY OUTLINED AS FOLLOWS.

NEW EXPANDED HEADWORKS INCLUDES;

- COARSE SCREENING
- FINE SCREENING
- GRIT REMOVAL
- LIFT PUMPING

CHANGES TO MAIN BASINS OR BIO-PLANT INCLUDES;

- CONVERSION TO MEMBRANE BIO-REACTOR MODE IN MAIN BASIN AREA
- ADDITIONAL CHEMICAL FEED SYSTEMS APPLIED GENERALLY TO THE MAIN BASIN AREA
- ADDITIONAL SLUDGE STORAGE AND HANDLING
- DEWATERING

CHANGES WITHIN THE EXISTING SUPERSTRUCTURE ENCLOSURE INCLUDES;

- MODIFICATION TO CLARIFIERS AND EQ
- REVERSE OSMOSIS AND CIP SYSTEMS
- DEWATERING
- NEW UV DISINFECTION

OFFSITE IMPROVEMENTS INCLUDES;

- BRINE LINE
- BRINE DISPOSAL

JDS-HYDRO a Division of RESPEC
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

EXHIBIT C

CAPACITY AND TECHNOLOGICAL UPGRADES

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

EXHIBIT

Project No.: 112.122
Date: 12/08/22
Design: JPG
Drawn: AMY
Check: JPG

1

SHEET 1 OF 1

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EXHIBIT D
TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

Woodmen Metropolitan District's Wastewater Treatment Plant Expansion – Current Estimate of Total Cost

(See Attached)

Exhibit D-1
Summary of Cost Estimate

Cost Estimate Summary

Project: ***Woodmen Hills Plant Expansion***
Owner: ***Woodmen Hills Metro***
Engineer: ***JDS-Hydro RESPEC***
Component: ***Current Estimated Cost Summary***
Contractor:

Category	Cost
Headworks	$4,652,870
Bio-Plant Upgrades	$11,797,525
Reverse Osmosis System	$9,878,325
Disinfection	$1,845,145
Site and General Improvements	$790,500
Subtotal	**$28,964,365**
Contingency 15%	$4,344,654.75
Subtotal	$33,309,019.75
Soft Costs 14%	$4,663,262.77
Current Estimated Costs	**$37,972,282.52**

D-2 Headworks Estimate
D-3 Bio Plant Estimate
D-4 R-O System Estimate
D-5 Disinfection Estimate
D-6 Site and General Estimate

Exhibit D-2
Summary of Cost Estimate

Cost Estimate-- **Preliminary Class 4**

Project: ***Woodmen Hills Plant Expansion***
Owner: ***Woodmen Hills Metro***
Engineer: ***JDS-Hydro RESPEC***
Component: ***Headworks Systems***
Contractor:

Item #	Item Description	Quantity	Unit	Unit Cost	Amount
Coarse Screening (2)					
1	Move New Existing Screen/Compactor--6 mil	1	LS	$43,000.00	$43,000
2	Add Second New Screen --6 mil	1	LS	$373,500.00	$373,500
3	Add new Washer Compactor	1	LS	$170,570.00	$170,570
4	Channels (Concrete)	100	CY	$ 1,200.00	$120,000
5	Electrical/SCADA	1	LS	$51,000.00	$51,000
6	Unused	0	LS	$0.00	$0
7	Unused	0	LS	$0.00	$0
8	Unused	0	SF	$0.00	$0
Coarse Screening Sub total					**$758,070**
Fine Screening Single					
1	Fine Drum Screen	1	EA	$891,500.00	$891,500
2	Channels	1	LS	$393,500.00	$393,500
3	Washing/Receiving	1	EA	$272,300.00	$272,300
4	Electrical SCADA	1	LS	$83,000.00	$83,000
5	Unused	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Fine Screening Subtotal					**$1,640,300**
Grit Removal					
1	Pista Grit--Single Channel	1	EA	$296,000.00	$296,000
2	Main Grit Structure (Concrete)	410	LS	$1,200.00	$492,000
3	Classifier/Receiving	1	EA	$273,000.00	$273,000
4	Electrical SCADA	1	LS	$67,000.00	$67,000
5	Unused	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Grit Removal Subtotal					**$1,128,000**
Lift Station					
1	Pumping Units W VFDs	3	EA	$67,000.00	$201,000
2	Suction Header	1	LS	$19,000.00	$19,000
3	Discharge Header	1	LS	$46,200.00	$46,200
4	Wet Well (Concrete)	125	EA	$1,200.00	$150,000
5	Electrical SCADA	1	LS	$92,000.00	$92,000
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Lift Station Subtotal					**$508,200**
Superstructure Site					
1	Site Improvments--grading-finish	1	LS	$25,000.00	$25,000
2	Structure (40 X 25)	1,000	LS	$250.00	$250,000
3	Additional Concrete	45	LS	$1,200.00	$54,000
4	HVAC	1	EA	$187,300.00	$187,300
5	Electrical SCADA	1	LS	$102,000.00	$102,000
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Superstructure Subtotal					**$618,300**
Headworks Total					**$4,652,870**

JDS-Hydro Consultants a Division of Respec

Exhibit D-3
Summory of Cost Estimate

Cost Estimate-- **Preliminary Class 4**

Project:	***Woodmen Hills Plant Expansion***
Owner:	***Woodmen Hills Metro***
Engineer:	***JDS-Hydro RESPEC***
Component:	***Bio-Plant Upgrade Systems***
Contractor:	

Item #	Item Description	Quantity	Unit	Unit Cost	Amount
MBR Equipment Upgrades					
1	Membranes (Each Side)	2	LS	$913,000.00	$1,826,000
2	Suction Pumping System	1	LS	$402,100.00	$402,100
3	Piping Reconfiguration	1	LS	$382,000.00	$382,000
4	Demo RAS Pumping	1	LS	$150,000.00	$150,000
5	Air Systems	1	LS	$378,570.00	$378,570
6	Electrical and Controls	1	LS	$ 462,000.00	$462,000
7	Miscellaneous	1	LS	$200,000.00	$200,000
8	Unused	0	SF	$0.00	$0
MBR Upgrade Equipment Sub total					**$3,800,670**
Aeration Basin Modifications					
1	Demo --Cleanup Basins	3	EA	$100,000.00	$300,000
2	Concrete Walls--Basin	160	CY	$1,200.00	$192,000
3	Modify Aeration System Water Side	1	LS	$1,112,300.00	$1,112,300
4	Modify Air Piping Valving	1	LS	$493,000.00	$493,000
5	Electrical and Controls	1	LS	$342,050.00	$342,050
6	Unused	1	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Aeration Basin Modifications Subtotal					**$2,439,350**
Chem Feed Systems					
1	Alum Storage Feed	1	LS	$383,500.00	$383,500
2	Carbon Source Storage and Feed	1	LS	$574,600.00	$574,600
3	Misc Chemical Lines	1	LS	$172,500.00	$172,500
4	Electrical and Controls	1	LS	$147,555.00	$147,555
5	Unused	1	LS	$0.00	$0
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Chem Feed Systems Subtotal					**$1,278,155**
Dewatering Add One Unit					
1	Second Screw Press	1	EA	$1,134,000.00	$1,134,000
2	Fitrate Capture Return	1	LS	$303,700.00	$303,700
3	Transfer Belts to existing	1	LS	$478,450.00	$478,450
4	Add second Feed Pump/Piping	1	EA	$253,000.00	$253,000
5	Equipment Relocation	1	LS	$237,000.00	$237,000
6	Electrical and Controls	1	LS	$93,200.00	$93,200
7	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Dewatering Subtotal					**$2,499,350**
Additional Sludge Holding					
1	Excavation	1	LS	$223,000.00	$223,000
2	Concrete	810	CY	$1,200.00	$972,000
3	Aeration/Mixing	1	LS	$277,000.00	$277,000
4	Misc Metals	1	LS	$36,000.00	$36,000
5	Electrical SCADA	1	LS	$172,000.00	$172,000
6	Miscellaneous	1	EA	$100,000.00	$100,000
7	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Additional Sludge Holding Subtotal					**$1,780,000**

Bio Plant Total **$11,797,525**

JDS-Hydro Consultants a Division of Respec

Exhibit D-4
Summary of Cost Estimate

Cost Estimate-- **Preliminary Class 4**

Project:	***Woodmen Hills Plant Expansion***
Owner:	***Woodmen Hills Metro***
Engineer:	***JDS-Hydro RESPEC***
Component:	***R-O System***
Contractor:	

Item #	Item Description	Quantity	Unit	Unit Cost	Amount
EQ Basin Mods And Clarifier					
1	Demo Clarifier 2/fill with revetment	1	LS	$273,000.00	$273,000
2	Demo Clarifier 1 Equipment	1	LS	$73,500.00	$73,500
3	New Concrete Dividers	150	CY	$1,200.00	$180,000
4	Piping Changes	1	LS	$ 150,000.00	$150,000
5	Electrical/SCADA	0	LS	$0.00	$0
6	Unused	0	LS	$0.00	$0
7	Unused	0	LS	$0.00	$0
8	Unused	0	SF	$0.00	$0
EQ Basin Mods And Clarifier Sub total					**$676,500**
R-O Feed Pumping					
1	Duplex/Standby Feed Station with VFDs	3	EA	$147,550.00	$442,650
2	Skid Mount System	1	LS	$185,000.00	$185,000
3	Piping	1	LS	$72,000.00	$72,000
4	Electrical SCADA	0	LS	$0.00	$0
5	Unused	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
R-O Feed Pumping Subtotal					**$699,650**
Cartridge Filters					
1	Cartridge Units	2	EA	$113,000.00	$226,000
2	Piping	1	LS	$85,000.00	$85,000
3	Unused	0	EA	$0.00	$0
4	Unused	0	LS	$0.00	$0
5	Unused	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Cartridge Filters Subtotal					**$311,000**
R-O Membranes					
1	500 GPM Full R-O Membrane Skids	2	EA	$1,150,000.00	$2,300,000
2	Piping	1	LS	$42,000.00	$42,000
3	Unused	0	LS	$0.00	$0
4	Unused	0	EA	$0.00	$0
5	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
R-O Membranes Subtotal					**$2,342,000**
Chemical Feed —CIP Systems					
1	Three Chemical/Storage Feed Systems	3	LS	$75,700.00	$227,100
2	Piping	1	LS	$35,000.00	$35,000
3	Unused	0	LS	$0.00	$0
4	Unused	0	EA	$0.00	$0
5	Unused	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
Chemical Feed Systems Subtotal					**$262,100**
Brine Disposal					
1	Phase One Ponds Grading	1	LS	$891,000.00	$891,000
2	Liners	1	LS	$2,484,000.00	$2,484,000
2	Piping	1	LS	$1,380,000.00	$1,380,000
3	Distribution	1	LS	$125,000.00	$125,000
4	Fencing	1	LS	$126,000.00	$126,000
5	Unused	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
Brine Disposal Subtotal					**$5,006,000**
Electrical and SCADA					
1	EQ Basin and Clarifier	0	LS	$0.00	$0
2	RO Feed System	1	LS	$81,700.00	$81,700
2	Cartridge Filters	0	LS	$0.00	$0
3	RO Membranes	1	LS	$273,000.00	$273,000
4	Chemical Feed --CIP	1	LS	$226,375.00	$226,375
5	Brine Disposal	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
Electrical and SCADA Subtotal					**$581,075**
			Total R-O		**$9,878,325**

Exhibit D-5
Summary of Cost Estimate

Cost Estimate-- **Preliminary Class 4**

Project: ***Woodmen Hills Plant Expansion***
Owner: ***Woodmen Hills Metro***
Engineer: ***JDS-Hydro RESPEC***
Component: ***General Site Improvements***
Contractor:

Item #	Item Description	Quantity	Unit	Unit Cost	Amount
Site Work					
1	Demo Existing Disinfection Building and Equipment	1	LS	$250,000.00	$250,000
2	Grading	1	LS	$150,000.00	$150,000
5	Unused	0	LS	$0.00	$0
6	Unused	0	SF	$0.00	$0
Site Work Sub total					**$400,000**
Ultraviolet System					
1	UV Equipment	4	EA	$167,500.00	$670,000
2	Flow Measurement	1	LS	$15,500.00	$15,500
3	Misc Metals/Covers	1	LS	$38,000.00	$38,000
4	Instrumention	1	LS	$53,200.00	$53,200
5	Sampling	1	EA	$17,900.00	$17,900
6	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
UV System Subtotal					**$794,600**
Electrical and Controls					
1	Electrical	1	LS	$113,000.00	$113,000
2	Controls/SCADA	1	LS	$37,500.00	$37,500
3	Unused	0	EA	$0.00	$0
4	Unused	0	EA	$0.00	$0
5	Unused	0	EA	$0.00	$0
Electrical and Controls Subtotal					**$150,500**
Structure					
1	Concrete Channels	150	CY	$1,200.00	$180,000
2	Wash Racks	1	LS	$42,000.00	$42,000
3	Plumbing and Return	1	LS	$29,745.00	$29,745
4	Unused	0	EA	$0.00	$0
5	Unused	0	EA	$0.00	$0
7	Unused	0	EA	$0.00	$0
Structure Subtotal					**$251,745**
Non-potable Systems					
1	Fill Pump	1	LS	$17,500.00	$17,500
2	2000 Gallon Storage	1	LS	$35,000.00	$35,000
3	Direct Feed Pumping System	1	LS	$78,000.00	$78,000
4	Piping	1	LS	$117,800.00	$117,800
5	Unused	0	EA	$0.00	$0
6	Unused	0	EA	$0.00	$0
Non-Pot Systems Subtotal					**$248,300**

$1,845,145

JDS-Hydro Consultants a Division of Respec

Exhibit D-6
Summary of Cost Estimate

Cost Estimate--

Preliminary Class 4

Project: *Woodmen Hills Plant Expansion*
Owner: *Woodmen Hills Metro*
Engineer: *JDS-Hydro RESPEC*
Componei *Site and General Systems*
Contractor:

Item #	Item Description	Quantity	Unit	Unit Cost	Amount
General and Site Improvements					
1	Grading, Access, and Landscaping Improvements	1	LS	$450,000.00	$450,000
2	Laboratory Upgrades	1	LS	$110,000.00	$110,000
3	Central PLC and Telementry Upgrades	1	LS	$147,500.00	$147,500
3	Other Equipment-Instrumentation	1	LS	$83,000.00	$83,000
4	Unused	0	SF	$0.00	$0
Site and General Sub total					**$790,500**
	15% Contingency				$118,575
	Subtotal				$909,075
	14% Soft Costs				$127,271
	Total				**$1,036,346**

JDS-Hydro Consultants a Division of Respec

EXHIBIT E
TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

Woodmen Metropolitan District's Wastewater Treatment Plant Expansion – Total Cost Allocations

(See Attached)

Exhibit E-1
Summary of Cost Allocation

Comprehensive Summary Sheet
Allocation of Costs via Major Line Item Categories
WHMD and Grandview Allocation

Major Cost Category	WHMD	GMD	Total
Headworks	$4,332,065	$1,767,847	$6,099,913
Bio-Membrane Plant Conversion	$9,211,656	$6,254,900	$15,466,555
R-O System	$9,832,008	$3,118,477	$12,950,484
Disinfection	$1,520,977	$898,008	$2,418,985
	$24,896,706	**$12,039,231**	**$36,935,937**
	67.41%	32.59%	
Site/General Improvements	$698,550	$337,796	$1,036,346
Total	**$25,595,255**	**$12,377,027**	**$37,972,283**
	67.41%	**32.59%**	**100.00%**

Sheet E-2 Allocation Ratio Analysis
Sheet E-3 Headworks Allocation
E-4 Bio Plant Upgrades Allocation
E-5 R-O System Allocation
E-6 Disinfection System Allocation

Allocation of Site and General Improvements is allocatted on the overall cost allocation of all other improvements

Exhibit E-2
Summary of Cost Allocation

Allocation of Costs per Flow
WHMD and Grandview Allocation

Capacity		MGD
Woodmen Hills Metropolitan District (Existing Capacity)		1300000
Paint Brush Hills		
Falcon Highlands		
Meridian Service Metropolitan District		
4-Way Existing		
Total Plant Expansion Capacity		2500000
Horton Expansion SFE	3500	
Horton Expansion Flow	602000	602000
Net Woodmen Expansion Flow		598000
Net Woodmen Expansion SFE	3477	
Total Plant Capacity		**2500000**
Woodmen Ratio of Capacity Expansion		49.83%
Grandview Ratio of Capacity Expansion		50.17%
Woodmen Ratio of Regulatory Upgrades		75.92%
Grandview Ration of Regulatory Upgrades		24.08%

Exhibit E-3
Summary of Cost Allocotion

Comprehensive Summory Sheet
Allocation of Costs via Major Line Item Categories
WHMD ond Grondview Allocation

Heodworks Allocation

Item	Associated Cost 2.5 MGD	WHMD Ratio	WHMD Value	GMD Ratio	GMD Value	Allocation Basis
Coarse Screening	$ 758,070	0.49833	$ 377,772	0.50167	$ 380,298	**Capacity**
Fine Screening	$ 1,640,300	0.7592	$ 1,245,316	0.2408	$ 394,984	**Regulatory**
Grit Removal	$ 1,128,000	0.7592	$ 856,378	0.2408	$ 271,622	**Regulatory**
Lift Station	$ 508,200	0.7592	$ 385,825	0.2408	$ 122,375	**Regulatory**
Subtotal	$ 4,034,570		$ 2,865,290		$ 1,169,280	**Sub Total**
			71.02%		**28.98%**	
Superstructure/Site work	$ 618,300	**71.02%**	$439,107	**28.98%**	$179,193	
Subtotal	**$ 4,652,870**		**$3,304,398**		**$1,348,472**	
Contingency (15%)	$697,931		$495,660		$202,271	**Joint**
Subtotal	**$5,350,801**		**$3,800,057**		**$1,550,743**	
Soft Costs (14%)	$749,112		$532,008		$217,104	
Total	**$6,099,913**		**$4,332,065**		**$1,767,847**	**Total**

Regulatory		
GMD	24.08%	
WHMD	75.92%	
Capacity		
GMD	50.17%	
WHMD	49.83%	
Combined GMD	0.742466667	37.12%
Combined WHMD	1.257533333	62.88%
	2.000	

Exhibit E-4
Summary of Cost Allocation

Comprehensive Summary Sheet
Allocation of Costs via Major Line Item Categories
WHMD and Grandview Allocation

Bio-Plant Allocation

Item	2.5 MGD	WHMD Ratio	WHMD Value	GMD Ratio	GMD Value	Allocation Basis
MBR Equipment	$ 3,800,670	0.62877	$ 2,389,735	0.37123	$ 1,410,935	**Combined**
Aeration Basin Modifications	$ 2,439,350	0.62877	$ 1,533,782	0.37123	$ 905,568	**Combined**
Additional Sludge Basins	$ 1,780,000	0.49833	$ 887,033	0.50167	$ 892,967	**Capacity**
Chemical Feed Systems (Alum/Carbon)	$ 1,278,155	0.75920	$ 970,375	0.24080	$ 307,780	**Regulatory**
Dewatering	$ 2,499,350	0.49833	$ 1,245,509	0.50167	$ 1,253,841	**Capacity**
Subtotal	**$ 11,797,525**	**0.596**	**$ 7,026,435**	**0.404**	**$ 4,771,090**	
Contingency (15%)	$ 1,769,629		$ 1,053,965		$ 715,664	**Joint**
Subtotal	$ 13,567,154		$ 8,080,400		$ 5,486,754	
Soft Costs (14%)	$ 1,899,402		$ 1,131,256		$ 768,146	
Total	**$ 15,466,555**		**$ 9,211,656**		**$ 6,254,900**	**Total**

Regulatory		
GMD	24.08%	
WHMD	75.92%	
Capacity		
GMD	50.17%	
WHMD	49.83%	
Combined GMD	0.742466667	37.12%
Combined WHMD	1.257533333	62.88%
	2.000	

Summary of Cost Allocation

Comprehensive Summary Sheet
Allocation of Costs via Major Line Item Categories
WHMD and Grandview Allocation
Reverse Osmosis Summary

R-O Systems are entirely Regulatory Improvements

			WHMD			GMD		
Item		**2.5 MGD**	**Ratio**		**Value**	**Ratio**		**Value**
EQ Basin Mods and clarifier Demo/Backfill	$	676,500	0.7592	$	513,599	0.2408	$	162,901
RO Feed Pumps	$	699,650	0.7592	$	531,174	0.2408	$	168,476
Cartridge Filters	$	311,000	0.7592	$	236,111	0.2408	$	74,889
RO Membrane Skids	$	2,342,000	0.7592	$	1,778,046	0.2408	$	563,954
Chemical Feed Systems	$	262,100	0.7592	$	198,986	0.2408	$	63,114
Brine Disposal	$	5,006,000	0.7592	$	3,800,555	0.2408	$	1,205,445
Electrical and Controls	$	581,075	0.7592	$	441,152	0.2408	$	139,923
Subtotal	$	9,878,325		$	7,499,624		$	2,378,701
Contigency 15%	$	1,481,749		$	1,124,944		$	356,805
Subtotal	$	11,360,074		$	8,624,568		$	2,735,506
Soft Costs 14%	$	1,590,410		$	1,207,440		$	382,971
Total	**$**	**12,950,484.08**			**$9,832,008**		**$**	**3,118,477**

Regulatory		
GMD	24.08%	
WHMD	75.92%	
Capacity		
GMD	50.17%	
WHMD	49.83%	
Combined GMD	0.742466667	37.12%
Combined WHMD	1.257533333	62.88%
	2.000	

Exhibit E-6
Summary of Cost Allocotion

Comprehensive Summary Sheet
Allocotion of Costs via Major Line Item Cetegories
WHMD ond Grandview Allocotion

Disinfection System Improvements are entriely Combination Allocation

Disinfection System Allocotion

Item	Associated Cost 2.5 MGD		WHMD			GMD		
			Ratio		Value	Ratio		Value
Site Work		$400,000	0.6288	$	251,506.67	0.371	$	148,493.33
Equipment		$794,600	0.6288	$	499,617.99	0.371	$	294,982.01
Electrical and Controls		$150,500	0.6288	$	94,629.38	0.371	$	55,870.62
Structure		$251,745	0.6288	$	158,288.86	0.371	$	93,456.14
Non-pot system		$248,300	0.6288	$	156,122.76	0.371	$	92,177.24
Subtotal	$	1,845,145.00		$	1,160,165.67		$	684,979.33
Construction Contigency (15%)	$	276,772		$	174,025		$	102,747
Subtotal	$	2,121,917		$	1,334,191		$	787,726
Soft Costs (14%)	$	297,068		$	186,787		$	110,282
Total	**$**	**2,418,985.10**		**$**	**1,520,977.19**		**$**	**898,007.90**

Regulatory

GMD	24.08%	
WHMD	75.92%	

Capacity

GMD	50.17%	
WHMD	49.83%	
Combined GMD	0.742466667	37.12%
Combined WHMD	1.257533333	62.88%
	2.000	

EXHIBIT F
TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

DR Horton Form Letter of Credit

(See Attached)

IRREVOCABLE STANDBY LETTER OF CREDIT

Issue Date: [___________________________]

Letter of Credit No. [_____________________________]

Beneficiary:
Woodmen Hills Metropolitan District
8046 Eastonville Road
Peyton, CO 80831

Original Letter of Credit Delivered To:

Woodmen Hills Metropolitan District
8046 Eastonville Road
Peyton, CO 80831
Attention: Carter Bullion

Expiration Date: [_________________________________]

Ladies and Gentlemen:

We hereby issue this Irrevocable Standby Letter of Credit No. [_______________________________] (this "Letter of Credit") in your favor for the account of [__________________________________], a [________________________________] ("Applicant") up to an aggregate amount of US $[________________________] ([_____________________________________] and [___]/100 United States Dollars).

The purpose of this Letter of Credit is to secure the obligations of Applicant under that certain AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE, dated [____________________], by and between Applicant and Beneficiary.

You are hereby authorized to draw at sight by any (but not more than one) of the following methods: (1) upon presentation of the original Letter of Credit at our address set forth below; or (2) upon presentation of the original Letter of Credit by courier, Federal Express, UPS (or other similar nationally recognized overnight courier), or priority or first class United States mail to us at the address set forth below:

[_______________________]
[_______________________]
[_______________________]
[_______________________]
Attention: [____________________]

The undrawn portion of this Letter of Credit shall be available until 5:00 p.m. [_________________] Time on the Expiration Date (as extended, if applicable), upon presentation of:

1. Your drawing certificate, marked, "Drawn under Irrevocable Standby Letter of Credit No. [________________________]" and delivered to us as directed by this Letter of Credit;

2. A statement on your stationery addressed to [_________________________________] signed by your

purportedly authorized representative stating: "The undersigned is an authorized representative of Woodmen Hills Metropolitan District, and certifies that the following fact is true:"

a. "WOODMEN HILLS METROPOLITAN DISTRICT ("BENEFICIARY") HAS SUBMITTED A DELINQUENT PAYMENT NOTICE TO [______________________________] ("APPLICANT") IN ACCORDANCE WITH THE PROVISIONS OF THAT CERTAIN AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE, DATED [______________________________], BY AND BETWEEN APPLICANT AND BENEFICIARY (THE "AGREEMENT") STATING THAT (I) APPLICANT HAS FAILED TO DELIVER A PROGRESS PAYMENT FOR HORTON'S ALLOCABLE SHARE (AS DEFINED IN THE AGREEMENT) DUE AND PAYABLE IN ACCORDANCE WITH THE PROVISIONS OF THE AGREEMENT, ON THE DATE UPON WHICH THE SAME WAS DUE AND PAYABLE UNDER THE AGREEMENT, (II) THE CURE PERIOD SPECIFIED IN THE AGREEMENT FOR SAID PROGRESS PAYMENT OF THE SAME HAS EXPIRED, AND (III) SUCH PAYMENT REMAINS UNPAID. THEREFORE, BENEFICIARY IS ENTITLED TO DRAW UNDER THE LETTER OF CREDIT AND DISBURSE THE PROCEEDS AS PROVIDED IN THE AGREEMENT."

OR

b. "WOODMEN HILLS METROPOLITAN DISTRICT ("BENEFICIARY") HAS RECEIVED A TERMINATION NOTICE FROM [______________________________] ("APPLICANT") AND THE OBLIGATION OF APPLICANT TO PAY BENEFICIARY'S RELIANCE COSTS UNDER THAT CERTAIN AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE, DATED [______________________________], BY AND BETWEEN APPLICANT AND BENEFICIARY (THE "AGREEMENT") SECURED BY THE LETTER OF CREDIT REMAINS OUTSTANDING.

OR

c. "WOODMEN HILLS METROPOLITAN DISTRICT ("BENEFICIARY") HAS RECEIVED A NOTICE OF NON-EXTENSION FROM ISSUER AND (I) IT IS LESS THAN THIRTY (30) DAYS PRIOR TO THE SCHEDULED EXPIRATION DATE OF THE LETTER OF CREDIT, AS THE EXPIRATION DATE OF THE LETTER OF CREDIT MAY HAVE BEEN EXTENDED PURSUANT TO ITS TERMS, (II) THE OBLIGATIONS OF APPLICANT UNDER THAT CERTAIN AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE, DATED [______________________________], BY AND BETWEEN APPLICANT AND BENEFICIARY (THE "AGREEMENT") SECURED BY THE LETTER OF CREDIT REMAIN OUTSTANDING, AND (III) APPLICANT HAS FAILED TO DELIVER TO BENEFICIARY EITHER (X) A REPLACEMENT LETTER OF CREDIT IN THE AMOUNT REQUIRED UNDER THE AGREEMENT, OR (Y) REPLACEMENT FUNDS (AS DEFINED IN AND REQUIRED BY THE AGREEMENT), WHICH FAILURE CONSTITUTES A DEFAULT UNDER THE AGREEMENT. THEREFORE,

BENEFICIARY IS ENTITLED TO DRAW UNDER THE LETTER OF CREDIT AND DISBURSE THE PROCEEDS AS PROVIDED IN THE AGREEMENT."; and

3. The original of this Letter of Credit and each amendment to this Letter of Credit (except in the event of facsimile presentation).

If a conforming presentation is delivered to us on a business day on or before 10:00 a.m. [_____________] Time, we will satisfy the drawing request within three (3) businesses days of presentation. If the conforming presentation is received after 10 a.m. [_______________] Time, or on a day that is not a business day, we will satisfy the drawing request within three (3) business days of the next business day.

This Letter of Credit shall be deemed automatically extended, without amendment, for an additional period of one (1) year from the Expiration Date (or the extended Expiration Date then in effect, if applicable), unless not less than sixty (60) days prior to the Expiration Date (or the extended Expiration Date then in effect, if applicable), we notify you in writing, by registered mail, courier service, overnight delivery, or hand delivery, at the Beneficiary address above, that we elect not to extend this Letter of Credit.

Multiple, partial drawings are permitted and we warrant that we will honor each draft under this Letter of Credit, up to the undrawn portion of the face amount, upon your complying presentation to us on or prior to the Expiration Date (as extended, if applicable).

Except as otherwise expressly stated herein, this Letter of Credit is subject to the Uniform Customs and Practice for Documentary Credits, 2007 Revision, the International Chamber of Commerce Publication No. 600 (UCP600), and (except to the extent of any inconsistency with UCP600) shall be governed by Article 5 of the Uniform Commercial Code as in effect in the State of Colorado.

[ISSUER]

By: ________________________________

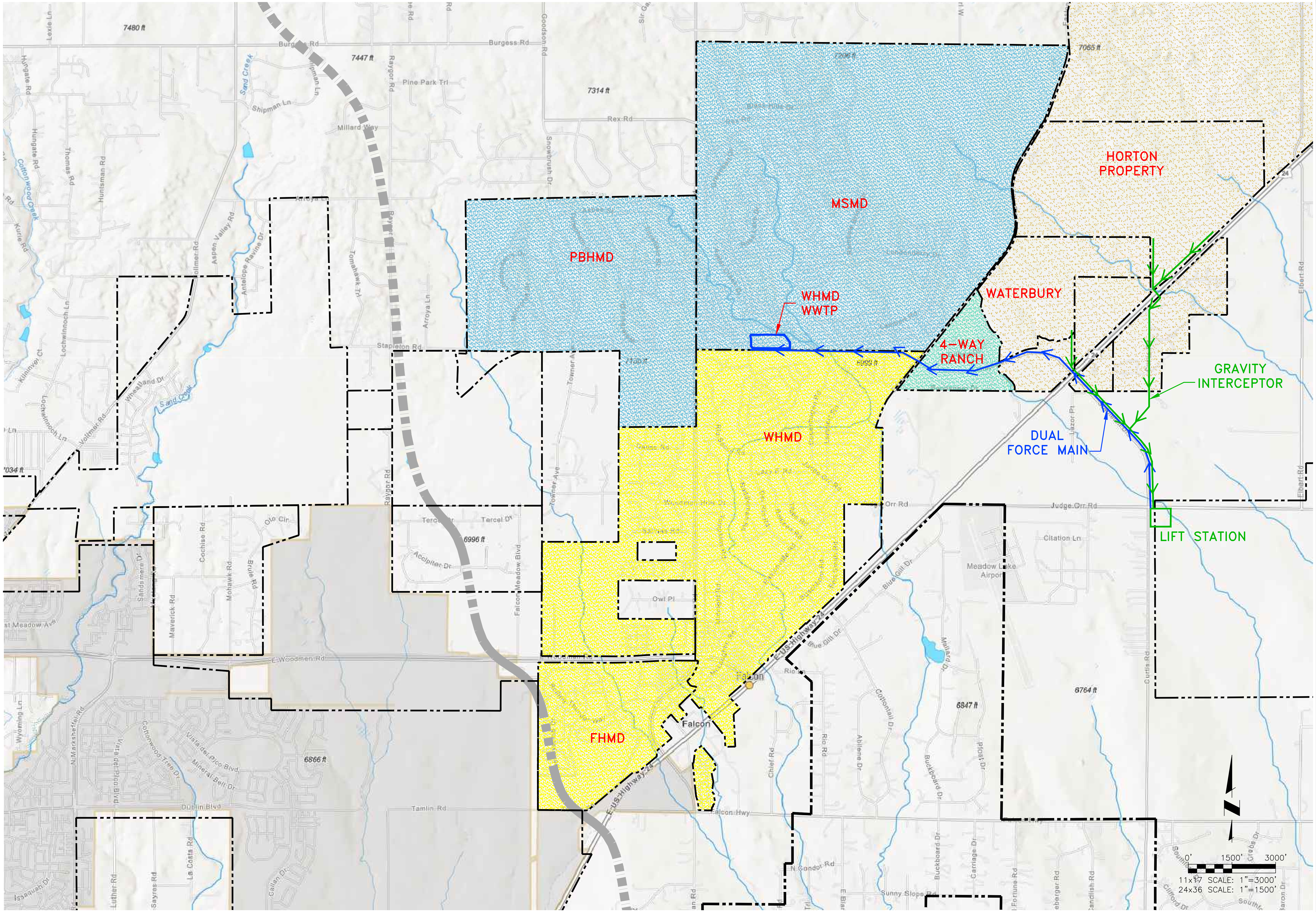
Its: ________________________________

24496730

EXHIBIT G
TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

Estimated Locations of Regional Lift Station and Force Main

(See Attached)



JDS-HYDRO CONSULTANTS, INC.
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

DISCLAIMER: THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS. ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO JDS-HYDRO CONSULTANTS, INC. JDS-HYDRO ASSUMES NO LIABILITY FOR UNAUTHORIZED CHANGES AND/OR REVISIONS MADE TO PLANS.

EXHIBIT G

MAJOR SEWER IMPROVEMENTS

EXHIBIT

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

Project No.: 112.122
Date: 12/01/22
Design: JLB
Drawn: JLB
Check: JPM

SHEET G OF

N:\Projects\112 Woodmen Hills\112.122 Grandview WW Agreement\Drawings\Exhibits\112122_Service_Area.dwg
2022/12/01 1:54 PM By: Jeffrey Bray

EXHIBIT H
TO AGREEMENT FOR WASTEWATER TREATMENT PLANT EXPANSION AND EXTRATERRITORIAL WASTEWATER SERVICE

Restrictive Covenant Agreement

(See Attached)

24963150

RESTRICTIVE COVENANT AGREEMENT

THIS RESTRICTIVE COVENANT AGREEMENT ("Agreement"), dated for reference purposes this _______ day of __________________, 202__, is made and entered into by and between WOODMEN HILLS METROPOLITAN DISTRICT, a quasi-municipal corporation and political subdivision of the state of Colorado, acting by and through its Wastewater Enterprise ("Woodmen"), and MELODY HOMES, INC., a Delaware corporation, D/B/A DR HORTON, its successors and assigns ("Horton"). Woodmen and Horton are sometimes referred to in this Agreement individually as a "Party" and jointly as the "Parties".

RECITALS

A. Woodmen is a quasi-municipal corporation and political subdivision of the state of Colorado formed pursuant to Title 32 of the Colorado Revised Statutes. Among other things, Woodmen provides sewer service within its service area, as well as the service areas of Paint Brush Hills Metropolitan District, Falcon Highlands Metropolitan District, and portions of the 4-Way Ranch Metropolitan District and Meridian Service Metropolitan District, all located in El Paso County, Colorado. To provide this service, Woodmen owns and operates a 1.3-million gallons per day ("MGD") wastewater treatment plant commonly known as the Woodmen Hills Regional Water Reclamation Facility (the "Plant").

B. Horton is a private developer of residential communities and is the fee title holder of that certain real property located in El Paso County, Colorado, legally described on **Exhibit 1** attached hereto (the "Horton Property").

C. The Parties determined that having Woodmen expand its wastewater service to include the Horton Property and other nearby properties likely to develop, and having the Parties jointly fund an expansion of Woodmen's wastewater treatment plant (the "Expansion") will benefit the Parties and future residents of Woodmen and the Horton Property and the Parties have therefore entered into an Agreement for Wastewater Treatment Plant Expansion and Extraterritorial Wastewater Service, effective ___________________, 2022 ("Extraterritorial Wastewater Service Agreement").

D. In connection with the Extraterritorial Wastewater Service Agreement, Horton has agreed to the imposition of certain covenants, conditions and restrictions associated with the Horton Property, as described in this Agreement.

AGREEMENT

NOW, THEREFORE, in consideration of the covenants contained herein and for other valuable consideration, the receipt and adequacy of which is hereby acknowledged, the Parties hereby agrees as follows:

1. **Recitals and Exhibits**. The Recitals above and all Exhibits referenced herein are incorporated into and made a part of this Agreement.

2. **Effective Date**. The "Effective Date" of this Agreement shall be the date the fully signed Agreement is recorded in the El Paso County Clerk & Recorder's Office.

3. **Definitions**

3.1 **CPI** means the Consumer Price Index for All Urban Consumers, All Items, for the Denver-Aurora-Lakewood area, as published by the U.S. Department of Labor, Bureau of Labor Statistics, or successor index should publication of the Index cease. Adjustments based on the CPI shall be equal to the percentage increase or decrease in the CPI issued for the calendar year in which such adjustment is to be made (or if the CPI for such year is not yet publicly available, the CPI for the most recent calendar year for which the CPI is publicly available) as compared to the CPI issued for the year in which the Effective Date occurred.

3.2 **Single-Family Residential Equivalent ("SFE")** means each single-family connection or connections equivalent to one single-family residence. Currently, one SFE is equal to: one "detached" single-family unit, which means a building or structure used or designed to be used as only one residential unit; each separate residential unit within an "attached" building, such as a duplex or paired lot; and each separate residential unit within a "multifamily" building, such as a townhome or apartment building.

3.3 **Woodmen Regulations** means Woodmen's Bylaws, Rules, and Regulations dated January 27, 2022, as they may be amended.

4. **Restrictive Covenants**.

4.1 Wastewater Service Fees. Except as otherwise provided herein, customers within the Horton Property receiving wastewater service from Woodmen ("Customers") shall pay the same wastewater service rates, fees, charges, surcharges, and assessments or other financial liabilities however termed required for Woodmen's wastewater services as Woodmen's in-district residents, as they are modified from time to time, in accordance with the Woodmen Regulations. Billing, collection and administration of service fees shall be performed by Woodmen, in accordance with the Woodmen Regulations.

4.2 Exempt Wells Subject to Woodmen's Approval. Any proposed water service within the Horton Property utilizing an exempt well is subject to review and approval by Woodmen.

4.3 Water Quality. The Parties acknowledge that the quality of wastewater delivered into the Plant and the Expansion from the Horton Property may affect Woodmen's ability to comply with governmental approvals associated with the Plant and Expansion, including discharge permits, and may affect Woodmen's and other water providers' ability to claim return flow credit for reusable effluent. The Parties therefore agree to the following with respect to the total dissolved solids ("TDS") concentration in the wastewater delivered from the Horton Property into Woodmen's sewer system:

(i) As set forth in Paragraph 9.3 of the Extraterritorial Wastewater Service Agreement, the Parties anticipate that a regional Lift Station and Force Main will be necessary to serve the Horton Property pursuant to said agreement, and that the Force Main will be a double barrel pipeline with each pipeline sized at no less than eight (8) inches in diameter. Once said regional Lift Station ("Horton Lift Station") is in operation and receiving wastewater from at least 250 SFEs ("Threshold Level"), Woodmen will sample, at Woodmen's sole cost and expense, the TDS concentration in the wastewater at the Horton Lift Station once each month. Once Woodmen has taken a full year's worth of TDS samples at the Horton Lift Station, during the sampling period extending from November through October (the "Sampling Period") beginning after the Threshold Level is met, Woodmen shall calculate prior to the end of the calendar year the annual average of the TDS concentration in the wastewater at the Horton Lift Station for that Sampling Period, which will be considered representative of the TDS concentrations in the wastewater discharged from the Horton Property ("Horton TDS Concentration").

(ii) Woodmen also will sample once each month during the initial Sampling Period the TDS concentration in the wastewater at its existing Falcon Lift Station and calculate prior to the end of the calendar year an annual average of the TDS concentration, which will be considered representative of the TDS concentrations in wastewater discharged from the areas delivering wastewater into the Falcon Lift Station ("Woodmen TDS Concentration"). In the event Woodmen ceases use of the Falcon Lift Station in the future, or if it constructs an additional lift station to serve additional properties outside of the Horton Property, Woodmen will change and/or add to its sampling location(s) any new lift station(s), recalculate the Woodmen TDS Concentration, and notify Horton accordingly. If Woodmen samples at multiple locations, it will develop a flow-weighted mean TDS concentration as the Woodmen TDS Concentration. The Woodmen TDS Concentration, once established after the initial Sampling Period, shall not be subject to change except to the extent Woodmen ceases use of the Falcon Lift Station or constructs an additional lift station to serve additional properties outside of the Horton Property.

(iii) Woodmen will maintain all sampling data for at least five (5) years and annually notify Horton in writing of the prior Sampling Period's data and the calculated Horton TDS Concentration and Woodmen TDS Concentration. Woodmen will provide any sampling data to Horton at Horton's request.

(iv) Beginning in the January following the first Sampling Period in which Woodmen has calculated the Horton TDS Concentration and the Woodmen TDS Concentration, and for each successive calendar year, Woodmen may assess all Customers discharging to the Horton Lift Station a monthly surcharge for the succeeding calendar year following the Sampling Period to offset the costs associated with excess treatment, risk of noncompliance, risk of jeopardizing use of wastewater effluent for water rights purposes, and related administrative and legal costs ("TDS Surcharge"), on the following terms.

(1) For every 30 mg/l in excess of 30 mg/l that the Horton TDS Concentration exceeds the Woodmen TDS Concentration, the TDS Surcharge will be $1.20/month per SFE, assessed to each customer within the Horton Property, for the first year in which said TDS concentrations are calculated and compared. The amount of the surcharge will be increased, but not decreased, thereafter annually based on the CPI. Any applicable TDS Surcharge will be assessed monthly throughout the year after the determination and will be adjusted based on subsequent annual recalculations of the Horton TDS Concentration. For example, if the Horton TDS Concentration exceeds the Woodmen TDS Concentration by 61 mg/l during the initial

Sampling Period extending from November, 2026 through October, 2027, each Customer discharging to the Horton Lift Station in calendar year 2028 will be assessed a TDS Surcharge of $2.40/month per SFE, Woodmen will continue its monthly TDS sampling during the November, 2027–October, 2028 Sampling Period and will recalculate the Horton TDS Concentration for that Sampling Period and compare it to the Woodmen TDS Concentration to determine the TDS Surcharge, if any, to be assessed during calendar year 2029.

(2) Woodmen may not impose any TDS Surcharge until the Expansion is complete, in operation, and its discharge permit contains a TDS limit. In the event the Horton TDS Concentration is less than the Woodmen TDS Concentration, Woodmen is not obligated to impose a TDS Surcharge on any of its customers outside of the Horton Property.

(3) As a condition of allowing any other properties to connect to the Horton Lift Station, Woodmen shall require the sampling of TDS from the wastewater stream discharged from such other properties so that their TDS concentrations can be distinguished from the Horton TDS Concentration, or Woodmen shall waive the TDS Surcharge for the Horton Property until the sampling for such other properties can be accomplished. Woodmen shall not impose a TDS Surcharge on Customers on account of TDS concentrations from customers outside the Horton Property that discharge into the Horton Lift Station.

(v) Customers are prohibited from utilizing ion exchange, water softener systems, or any other in-home water treatment system that discharges concentrated brine wastes into Woodmen's sanitary sewer system; provided, however, that Horton shall not be liable to Woodmen for any damage or costs arising from any Customers' failure to comply with this Paragraph except to the extent caused by Horton.

(vi) Customers are subject to the Woodmen Regulations, as may be amended, including but not limited to Woodmen's Pretreatment Regulations for all non-residential customers, sewer use resolutions, and any restrictions or prohibitions otherwise approved by Woodmen.

5. **Covenants Run With Land**. This Agreement and the covenants, conditions and restrictions contained in the foregoing Paragraph 4 (the "Covenants") shall burden and run with the Horton Property for the benefit of Woodmen.

6. **Remedies**. Woodmen shall have the right to enforce the terms and conditions of the Covenants, including but not limited to by seeking and obtaining temporary and/or permanent injunctive relief against Horton or any Customer who has violated or threatens to violate any of the Covenants. All of the remedies permitted or available to Woodmen shall be cumulative and not alternative to any other remedies available at law or in equity, and an invocation of any such right or remedy shall not constitute a waiver or election of remedies with respect to any other permitted or available right or remedy.

7. **Notices**. Any notice or communication required or permitted herein shall be given in writing, sent by (i) personal delivery; (ii) expedited delivery service with proof of delivery; (iii) United States mail, postage prepaid, registered or certified mail; or (iv) electronic mail, addressed to the respective addresses set forth below, or to such other address or to the attention of such other

persons as hereafter shall be designated in writing by the applicable Party sent in accordance herewith. Any such notice or communication shall be deemed to have been given either at the time of personal delivery or, in the case of delivery service or mail, as of the date of first attempted delivery at the address and in the manner provided herein, or in the case of electronical mail, upon receipt, and addressed as follows:

To Horton:

Melody Homes, Inc.
9555 S. Kingston Court
Englewood, CO 80112-5943
Attn: Bill Carlisle
Email: wmcarlisle@drhorton.com

with copy to:

Davis & Ceriani, P.C.
1600 Stout Street, Suite 1710
Denver, CO 80202
Attn: Nicholas Dooher and John Baker
Email: ndooher@davisandceriani.com; jbaker@davisandceriani.com

and

Melody Homes, Inc.
9555 S. Kingston Court
Englewood, CO 80112-5943
Attn: Robert Coltin, Regional Counsel
Email: rcoltin@drhorton.com

To Woodmen:

Woodmen Hills Metropolitan District
8046 Eastonville Road
Falcon, CO 80831
Attn: Wally Eaves
Water and Wastewater Enterprises
Email: wallyeaves@whmd.org

with copy to:

Brownstein Hyatt Farber Schreck, LLP
410 17th Street, Suite 2200
Denver, CO 80202-4432
Attn: Wayne Forman and Michael Smith
Email: wforman@bhfs.com; msmith@bhfs.com

8. **Electronic Mail**. The Parties agree that: (i) any notice or communication transmitted by electronic mail shall be treated in all manner and respects as an original written document; (ii) any such notice or communication shall be considered to have the same binding and legal effect as an original document; and (iii) at the request of either Party, any such notice or communication shall be re-delivered or re-executed, as appropriate, by the Party in its original form. The Parties further agree that they shall not raise the transmission of a notice or communication by electronic mail as a defense in any proceeding or action in which the validity of such notice or communication is at issue and hereby forever waive such defense. For purposes of this Agreement, the term "electronic mail" means email.

9. **Term**. The Covenants shall continue in effect in perpetuity, unless and until they are unilaterally terminated by Woodmen in its sole discretion.

10. **Severability**. If any clause, sentence or other portion of this Agreement shall become illegal, null or void for any reason, or shall be held by any court of competent jurisdiction to be so, the remaining portion hereof shall remain in full force and effect and the court shall construe this Agreement as much as possible to give rise to the intent to the language hereof.

11. **Amendment to Agreement**. No representations, promises, terms, conditions or obligations regarding the subject matter of this Agreement, other than those expressly set forth herein, shall be of any force and effect. No modification, change or alteration of this Agreement shall be of any force or effect, unless it is in writing, and signed by the Parties.

12. **Counterparts**. This Agreement may be executed in counterparts, and upon full execution thereof, such copies taken together shall be deemed to be a full and complete agreement between the Parties.

13. **Venue, Governing Law, and Waiver of Jury Trial.** Venue for any and all legal actions regarding this Agreement shall lie in the District Court in and for the County of El Paso, State of Colorado, or if federal court, then in the Federal District Court in and for Colorado in Denver, Colorado. This Agreement and the rights and obligations of the Parties shall be governed by the laws of the State of Colorado. EACH PARTY HEREBY IRREVOCABLY AND UNCONDITIONALLY: (A) CONSENTS AND SUBMITS TO THE EXCLUSIVE JURISDICTION OF THE AFOREMENTIONED COURTS; (B) WAIVES ANY OBJECTION TO THAT CHOICE OF FORUM BASED ON VENUE OR TO THE EFFECT THAT THE FORUM IS NOT CONVENIENT; AND (C) WAIVES ANY RIGHT TO TRIAL BY JURY.

(*Remainder of Page Intentionally Blank*)

IN WITNESS WHEREOF, the Parties have set their hands and seals, effective the day and year first above written.

WOODMEN HILLS METROPOLITAN DISTRICT, ACTING BY AND THROUGH ITS WASTEWATER ENTERPRISE

By: ______________________________

Name: ______________________________

Its: ______President______________

ATTEST:

____

STATE OF COLORADO)
) ss.
COUNTY OF EL PASO)

The foregoing instrument was acknowledged before me this ______ day of

______________, 202__, by ____.

WITNESS my hand and official seal.

My Commission expires: ____________________________

____
Notary Public

MELODY HOMES, INC., A DELAWARE CORPORATION, D/B/A DR HORTON

By: ______________________________

Name: ______________________________

Its: ______________________________

ATTEST:

____

STATE OF COLORADO)
) ss.
COUNTY OF EL PASO)

The foregoing instrument was acknowledged before me this ______ day of

______________, 202__, by ____.

WITNESS my hand and official seal.

My Commission expires: ___________________________

____
Notary Public

EXHIBIT 1
TO RESTRICTIVE COVENANT AGREEMENT

Legal Description of DR Horton Property

(See Attached)

24663945

Exhibit A

PROPOSED PLAT OF GRANDVIEW RESERVE FILING NO. 1

A TRACT OF LAND BEING A PORTION OF SECTION 21, AND A PORTION OF THE NORTH HALF OF SECTION 28, TOWNSHIP 12 SOUTH, RANGE 64 WEST OF THE 6TH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO, BEING DESCRIBED AS FOLLOWS:

BASIS OF BEARINGS: THE EAST LINE OF SECTION 21, TOWNSHIP 12 SOUTH, RANGE 64 WEST OF THE 6TH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO, BEING MONUMENTED AT THE SOUTHERLY END BY A 3-1/4" ALUMINUM SURVEYORS CAP STAMPED ACCORDINGLY, PLS 30087, AND BEING MONUMENTED AT THE NORTHERLY END BY A 3-1/4"ALUMINUM SURVEYORS CAP STAMPED ACCORDINGLY, PLS30087, BEING ASSUMED TO BEAR N00°52'26"W, A DISTANCE OF 5290.17 FEET.

COMMENCING AT THE SOUTHEAST CORNER OF SECTION 21, TOWNSHIP 12 SOUTH, RANGE 64 WEST OF THE 6TH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO;

THENCE N00°52'26"W ON THE EAST LINE OF SAID SECTION 21, A DISTANCE OF 2,645.09 FEET TO A POINT ON THE NORTH LINE OF THE SOUTH HALF OF SAID SECTION 21;

THENCE N89°50'58"W, ON SAID NORTHERLY LINE, A DISTANCE OF 2,934.88 FEET TO THE POINT OF BEGINNING;

THENCE S11°05'24"W, A DISTANCE OF 24.40 FEET;
THENCE S78°54'36"E, A DISTANCE OF 185.19 FEET;
THENCE S26°50'16"W, A DISTANCE OF 203.39 FEET TO A POINT OF CURVE,

THENCE ON THE ARC OF A CURVE TO THE LEFT, HAVING A DELTA OF 32°15'55", A RADIUS OF 250.00 FEET, A DISTANCE OF 140.78 FEET TO A POINT OF TANGENT;

THENCE S05°25'39"E, A DISTANCE OF 185.30 FEET TO A POINT OF CURVE,

THENCE ON THE ARC OF A CURVE TO THE RIGHT, HAVING A DELTA OF 11°17'04", A RADIUS OF 1,140.00 FEET, A DISTANCE OF 224.52 FEET TO A POINT OF TANGENT;

THENCE S05°51'25"W, A DISTANCE OF 481.83 FEET TO A POINT OF CURVE;

THENCE ON THE ARC OF A CURVE TO THE LEFT, HAVING DELTA OF 55°09'30", A RADIUS OF 550.00 FEET, A DISTANCE OF 529.48 FEET TO A POINT OF TANGENT;

THENCE S49°18'05"E, A DISTANCE OF 342.14 FEET TO A POINT OF CURVE;

THENCE ON THE ARC OF A CURVE TO THE RIGHT, HAVING A DELTA OF 29°29'59", A RADIUS OF 1,050.00 FEET, A DISTANCE OF 540.61 FEET TO A POINT OF TANGENT;

THENCE S19°48'06"E, A DISTANCE OF 438.38 FEET TO A POINT OF CURVE;

THENCE ON THE ARC OF A CURVE TO THE LEFT, HAVING A DELTA OF 08°00'18", A RADIUS OF 1,950.00 FEET, A DISTANCE OF 272.44 FEET TO A POINT OF TANGENT;

THENCE S27°48'24"E, A DISTANCE OF 779.86 FEET TO A POINT OF CURVE;

THENCE ON THE ARC OF A CURVE TO THE LEFT, HAVING A DELTA OF 61°56'07", A RADIUS OF 190.00 FEET, A DISTANCE OF 205.39 FEET TO A POINT OF TANGENT;

THENCE S89°44'32"E, A DISTANCE OF 289.03 FEET;

THENCE S00°12'52"W, A DISTANCE OF 111.41 FEET TO A POINT ON THE SOUTH LINE OF THE NORTH HALF OF THE NORTH HALF OF SAID SECTION 28;

THENCE N89°47'08"W, ON SAID SOUTH LINE, A DISTANCE OF A DISTANCE OF 2,630.21 FEET;
THENCE N00°12'52"E, A DISTANCE OF 25.00 FEET;

THENCE N89°47'08"W, A DISTANCE OF 679.35 FEET;

THENCE N44°47'01"W, A DISTANCE OF 42.37 FEET;
THENCE N41°52'38"E, A DISTANCE OF 21.11 FEET;
THENCE N41°03'22"E, A DISTANCE OF 139.03 FEET; THENCE S89°58'12"W, A DISTANCE OF 288.62 FEET TO A POINT ON CURVE, SAID POINT BEING ON THE EASTERLY RIGHT-OF-WAY LINE OF EXISTING EASTONVILLE ROAD (60.00 FOOT WIDE);

THENCE ON SAID EASTERLY RIGHT-OF-WAY AS DEFINED BY CERTIFIED BOUNDARY SURVEY, AS RECORDED UNDER DEPOSIT NO. 201900096, THE FOLLOWING SEVEN (7) COURSES:

1. ON THE ARC OF A CURVE TO THE LEFT, WHOSE CENTER BEARS N79°27'48"W, HAVING A DELTA OF 18°12'30", A RADIUS OF 1,630.00 FEET; A DISTANCE OF 518.00 FEET TO A POINT OF TANGENT;

2. N07°40'18"W, A DISTANCE OF 777.34 FEET TO A POINT OF CURVE;

3. ON THE ARC OF A CURVE TO THE RIGHT, HAVING A DELTA OF 39°01'10", A RADIUS OF 1,770.00 FEET, A DISTANCE OF 1,205.40 FEET TO A POINT OF TANGENT;

4. N31°20'52"E, A DISTANCE OF 1,517.37 FEET TO A POINT OF CURVE;
5. ON THE ARC OF A CURVE TO THE LEFT, HAVING A DELTA OF 2°07'03", A RADIUS OF 1,330.00 FEET, A DISTANCE OF 49.15 FEET TO A POINT ON THE NORTH LINE OF THE SOUTH HALF OF SAID SECTION 21;
6. THENCE CONTINUING ON THE ARC OF A CURVE TO THE LEFT, HAVING A DELTA OF 09°53'50", A RADIUS OF 1,330.00 FEET, A DISTANCE OF 229.74 FEET TO A POINT OF TANGENT;
7. N19°19'59"E, A DISTANCE OF 81.04 FEET;

THENCE S74°09'13"E, A DISTANCE OF 47.53 FEET;
THENCE S27°01'36"E, A DISTANCE OF 35.92 FEET;
THENCE S71°02'24"E, A DISTANCE OF 160.69 FEET TO A POINT OF CURVE;

THENCE ON THE ARC OF A CURVE TO THE LEFT, HAVING A DELTA OF 07°52'12", A RADIUS OF 1,150.00 FEET, A DISTANCE OF 157.96 FEET TO A POINT OF TANGENT;

THENCE S78°54'36"E, A DISTANCE OF 237.75 FEET; THENCE S11°05'24"W, A DISTANCE OF 105.60 FEET TO THE POINT OF BEGINNING.

INFORMATIONAL NOTE ONLY:
CALCULATED AREA OF 8,253,692 SQ. FEET
OR 189.479 ACRES MORE OR
LESS.

PREPARED BY :
JONATHAN W. TESSIN, PROFESSIONAL LAND SURVEYOR
COLORADO PLS NO. 33196 FOR AND ON
BEHALF OF EDWARD-JAMES SURVEYING, INC.
926 Elkton Drive 4732 Colorado Springs, CO 80907

EXHIBIT BB: WATER/WASTEWATER REPORT

WATER RESOURCES & WASTEWATER REPORT

For

Grandview Reserve Sketch Plan

April 2020
Revised: August 2020

JDS-HYDRO CONSULTANTS, INC.

5540 TECH CENTER DR, SUITE 100, COLORADO SPRINGS, CO 80919 (719) 227-0072 FAX (719) 471-3401

WATER RESOURCES & WASTEWATER REPORT

APRIL 2020
REVISED: AUGUST 2020

Prepared for:

Land Development Companies
1271 Kelly Johnson Blvd. Ste 100
Colorado Springs, CO 80920

Prepared by:

JDS-Hydro Consultants, Inc
5540 Tech Center Dr, Suite 100
Colorado Springs, CO 80919

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this report is to address the specific water and wastewater needs of the proposed Grandview Reserve subdivision in Falcon, CO.

Development at Grandview Reserve by Land Development Companies consists of 768.23 acres and roughly 3,261 Single Family Equivalent (SFE) wastewater users (made up of single family residents, commercial, a church, and a school), located between Eastonville Rd and Highway 24, within Sections 21, 22, 27, and 28, all in Township 12 South, Range 64 West of the 6th Principal Meridian. Residential properties within the development will be provided water services through the proposed district formed as a part of the land use process.

A draft of the Sketch Plan including adjacent roadways is included in ***Appendix A***.

At this point, five (5) phases are anticipated, but not yet ordered or sequenced.

2.0 PROJECTED WATER DEMANDS

It is expected that each SFE in Grandview Reserve will require an average of 0.353 annual acre-feet of water. This anticipated water demand is consistent with historic needs for nearby developments.

Table 1 below summarizes the water demand estimations for Grandview Reserve.

Table 1: Water Supply and Demand Summary

Description	SFE's	Demand/SFE ***(AF/Year)***	Total Demand ***(AF/Year)***
Single Family Residences	3,260	0.353	1,150.78
School	10		3.53
Church	5		1.7
Commercial	59.5		21.00
Grant Totals	***3,334.5***		***1,177.08***

Notes:

- *Commercial demand is anticipated at 3.5 SFE's per acre (3.5*17=59.5 AF)*
- *Church and school SFE's are anticipated to be similar to other churches and schools in the Falcon area.*

Demand for housing, commercial, and institutional development is dynamic, and buildout will commence as market demands dictate.

The Water Supply Information Summary is located in ***Appendix B***.

3.0 WATER SYSTEM FACILITIES & PHYSICAL SUPPLY

3.1 Source of Supply:

Future local wells, mostly in the Arapahoe and Laramie-Fox Hills formations, will provide water for the Grandview Reserve subdivision. Off-site wells will likely be needed (from neighboring lands owned by 4-Site Investments, LLC) for full build-out.

- The total annual water demand for 3,332.4 SFE's is calculated to be 1,177.08 AF.
- 4 Site Investments, the property owner, owns 1,400 AF of Arapahoe non-tributary water.
- The adjoining 4 Way Ranch owns 2,023 AF of Laramie-Fox Hills non-tributary water, and 1,011 AF of Arapahoe non-tributary water.
- Any additional water, should it be needed, will be derived from the 4 Way Ranch water.
- Water from the Arapahoe and Laramie-Fox Hills formations is Non-Tributary, Non-Renewable water.
- A breakdown of demand vs. supply is below:

4 Site Water	1,400 AF
4 Way Ranch Water	3,034 AF
Total Supply	*4,434 AF*
Grandview Demand:	*1,177.08 AF*
300-Year Quantity:	*3,531.24 AF (Less than the available supply)*

Copies of the water rights listed above are located in ***Appendix E***.

In order to produce 1,177.08 AF of water (which equates to 1.05 million gallons per day, MGD), approximately 14 well sites will be needed. A well site will consist of an Arapahoe well and a Laramix-Fox Hills well with a total production rate of about 110 gallons per minute.

If the wells are pumped 12 hours per day, that equates to 79,200 gallons produced by each well site each day. Fourteen (14) well sites can produce 1.11 MGD (when only pumping half the time) in order to satisfy the demand of 1.05 MGD.

Grandview is to build the infrastructure on their land as well as on future off-site wells in 4-Way Ranch withholdings. A future IGA will be implemented between the parties.

3.2 Water Treatment:

Water treatment will be in the form of a single or multiple treatment facilities utilizing pressure-sand filtration. Ideally, a single centralized facility is easier for operation and maintenance. However, construction of a single facility capable of meeting buildout demands is not always economical in early stages. Therefore, two or more facilities may be constructed as building progresses.

Pressure-sand treatment systems are utilized by many other metropolitan districts in the Falcon area. They are typically used to treat secondary contaminant levels in source water (iron and manganese), primarily for aesthetics (taste and odor).

3.3 Water Storage

Water storage will have to be sized for the largest commercial building in the development and meet International Fire Code standards. That volume of water, referred to as "fire-flow volume," will be added to the Maximum Daily Demand to establish the required water storage volume.

3.4 Distribution & Transmission Lines:

Distribution lines will likely be PVC, adequately-sized to convey fire-flows throughout the subdivision. They will be constructed by Grandview. No other districts are planned to provide water or infrastructure for Grandview's water system. Only water from 4-Way Ranch withholdings will be used to supplement Grandview's supply, and, as mentioned above, Grandview will be responsible for building are required infrastructure.

3.5 Water Quality

Water quality must meet Colorado Department of Public Health & Environment (CDPHE) regulations for primary drinking water standards.

4.0 WASTEWATER REPORT

4.1 Projected Wastewater Loads:

Wastewater projections are based on similar districts' historical use in this area. It is expected that each SFE in Grandview Reserve will generate an average of 172 gallons/day of wastewater. Table 2 below summarizes the projected wastewater loads for Grandview Reserve.

Table 2: Projected Wastewater Loads Summary

Description	SFE's	Unite Base Flow ***(GPD)***	Average Daily Flow ***(GPD)***
Single Family Residences	3,260		560,720
School	10	172	1,720
Church	5		860
Commercial	59.5		10,234
Grant Totals	***3,334.5***		***573,534***

4.2 Treatment Facilities:

The regional wastewater treatment provider in the area of Grandview Reserve is the Woodmen Hills Metropolitan District (WHMD). WHMD has constructed a new regional wastewater treatment facility which was placed online in the spring of 2019. The new plant is an advanced wastewater treatment plant with a rated hydraulic capacity of 1.3 MGD. WHMD is currently in compliance with its discharge permit and the treatment facility has adequate capacity for the additional flows.

Current loading at the facility is roughly 68%, but adequate capacity does not currently exist to handle the additional expected flows from Grandview.

As the regional wastewater treatment provider in the area, the District may possibly have excess capacity to serve future development contingent upon a potential service agreement, a future Inter-governmental Agreement (IGA) between the two agencies, and possible inclusion into the District.

Please refer to ***Appendix C*** for a map showing possible location of connection to WHMD's system, as well as the location of WHMD's treatment facility.

4.3 Collection and Pumping Facilities:

This project will be required to install gravity sewer facilities in accordance with certain standards and approvals. Said gravity sewer facilities could connect to existing collection systems owned and operated by WHMD.

Wastewater pumping facilities will be necessary to serve the Grandview Reserve Subdivision. A potential wastewater service letter from WHMD is included in ***Appendix D***.

EXHIBIT CC: WATER/WASTEWATER COMMITMENT LETTERS

WOODMEN HILLS
METROPOLITAN DISTRICT

January 13, 2023

Riley Hillen, PE

DR Horton

9555 S Kingston Ct

Englewood, Colorado 80112

Re: Will-serve for wastewater service for Grandview Reserve Development

Dear Mr. Hillen,

The above-named development encompasses 768.23 acres of land outside WHMD boundaries in El Paso County that will be a mixed-use residential community of approximately 3,500 single family residential equivalents.

The above said development has approached WHMD for wastewater services. This letter is a notice of "will-serve" for the Grandview Reserve. At present, WHMD can only take on a partial capacity of the wastewater treatment needed by Grandview Reserve (900 SFE's). Through the negotiation of an IGA between WHMD and Grandview Reserve (DR Horton), full ability to treat the total 3,500 SFE's can be obtained.

A full Commitment Letter will be granted upon signing and approval of an IGA between WHMD and DR Horton.

If you have any questions, please do not hesitate to call.

Sincerely,

Wally Eaves, Wastewater Enterprise Director, Woodmen Hills Metropolitan District

Cc: John P. McGinn, District Engineer

JD Shivvers, Water Enterprise Director

Grandview Reserve Metropolitan District

4 Site Investments LLC
1271 Kelly Johnson Blvd, Suite 100
Colorado Springs, CO 80920

July 20, 2021

Dear 4 Site Investments, LLC:

Grandview Reserve Metropolitan District #1 ("Project") has asked the Grandview Reserve Metropolitan District ("District") for the availability of water to service the Project located between Highway 24 and Eastonville Road. The Project is proposed to include approximately 581 single-family equivalent ("SFE's") dwelling units (571 single-family houses, 10 Church/Recreation Center), and will be within the service area of the District. The District is in the process of obtaining Title 32 status through El Paso County. With the creation of this district, the water master plan will be developed to include multiple large capacity wells and associated collection system that will be treated, stored and distributed in order to provide service to all properties within the District.

Upon completion of the first phase, the expandable large well collection system capacity will be sufficient to serve approximately 581 SFE's based on presumptive use of 0.353 ac/ft per SFE annual demand, considering process waters, drought/irrigation and pumping contingencies. The developer has determined that this volume is sufficient for the Project.

This commitment to serve the Project is based upon the approval of the Grandview Reserve Metropolitan District Title 32 status. Final required water quantities may be adjusted depending on the approved final plat SFE requirements of the Project.

Sincerely,

Paul J Howard

Manager

Enclosure

CC:

CHEROKEE METROPOLITAN DISTRICT

6250 Palmer Park Blvd., Colorado Springs, CO 80915-2842
Telephone: (719) 597-5080 Fax: (719) 597-5145

July 20, 2021
4 Site Investments, LLC
1271 Kelly Johnson Blvd. #100
Colorado Springs, CO 80919

Sent via email: paulinfinity1@msn.com

Re: Wastewater Treatment Service Commitment to Grandview Reserve Metropolitan District

Dear Grandview Reserve Metropolitan District,

As requested, this document will serve as a formal Letter of Commitment from the Cherokee Metropolitan District to provide wastewater treatment services for the Grandview Reserve development located north and northeast of the intersection of U.S. Highway 24 and Stapleton Road, subject to the mutual execution of a Wastewater Service Intergovernmental Agreement (IGA). Cherokee Metropolitan District owns and operates a wastewater conveyance and treatment system south of the development and has entered good faith negotiations with the development to complete the IGA, which will define the terms of all related wastewater services.

Cherokee Metropolitan District has allocated 500,000 gallons per day of wastewater treatment capacity to this development under the terms of the draft IGA. This capacity is sufficient to serve between 2900-2950 SFEs based on presumptive use values from El Paso County. The developer has determined that this volume is sufficient for the proposed subdivision.

This wastewater commitment is hereby made exclusively for this specific development project up to the daily average volume specified above, contingent upon execution of the IGA. To confirm this commitment, the developer must provide the District with a copy of the final plat approval from El Paso County Development Services within 12 months of the date of this letter. Otherwise, the District may use this allocation for other developments requesting wastewater treatment. If the volume of wastewater treatment in the agreement is changed by a subsequent amendment, this letter will no longer be valid and an updated one reflecting this change will be provided.

If I may be of further assistance, please contact me at your convenience.

Sincerely,

Amy Lathen
General Manager

Cc: Peter Johnson; Water Counsel w/ encl: sent via email
Steve Hasbrouck; Board President w/ encl: sent via email
Jeff Munger; Water Resource Engineer: sent via email
Kevin Brown; Jr. Engineer: sent via email

EXHIBIT DD: CDPHE CORRESPONDENCE

HRGreen
5619 DTC Parkway | Suite 1150 | Greenwood Village, CO 80111
Main 720.602.4999 + **Fax** 844.273.1057
HRGREEN.COM

February 15, 2023

Ms. Kari Parsons
Planning & Community Development Department - Land Use Review Division
City of Colorado Springs
2880 International Circle
Colorado Springs, CO 80910

Re: CDPHE Correspondence

Dear Ms. Parsons,

Coordination with the Colorado Department of Public Health and Environment (CDPHE) has taken place to discuss the Water Treatment Facility as well as the Wastewater Lift Stations and Forcemains that will service the Grandview Reserve Metropolitan District (GRMD). Mark Volle and I met with Doug Camrud (CDPHE Engineering Section Unit Manager) and Ian Sutton (CDPHE Senior Review Engineer) on January 6, 2022 to discuss the project. Follow up emails regarding CDPHE requirements are enclosed.

GRMD intendes to submit the following to CDPHE:

i. Site Location Application for lift station(s) – Anticipated submittal date: June 2023
ii. Construction documents and Basis of Design Report (BDR) for lift station(s) and force main(s) – Anticipated submittal date: February 2024
iii. BDR and Construction Documents for the water system including water treatment facility, source water (wells) and storage tank – Anticipated submittal date: November 2023

Copies of all CDPHE approvals will be provided to EPC as they are obtained.

Sincerely,

HR GREEN, INC

Gregory Panza, PE, PMP
Senior Project Manager

Volle, Mark

From: Sutton - CDPHE, Ian <ian.sutton@state.co.us>
Sent: Friday, February 11, 2022 2:53 PM
To: Volle, Mark
Subject: Re: Reg 22 question

This email came from outside the HR Green organization. Please use caution when clicking on hyperlinks and opening attachments

Hello Mark,

You are correct that we do not require the geotechnical report as part of the site application process for new lift stations. We do however require a geotechnical report to evaluate any natural hazards that would endanger the lift station during the design review. The exact text can be found in the **State of Colorado Design Criteria for Domestic Wastewater Treatment Works Section 1.3.2(c).** I have seen it where the geotech report is still submitted with the site application because it has been prepared and we just carry that over to the design review. But if you are in the process of creating the site application and do not want to wait for the geotech report to be finalized, then you can just submit it with the PDR.

Hopefully that helps and is what you are looking for. Let me know if you have any other questions.

Thanks and I hope you have a great weekend as well,

Ian Sutton, P.E.
Senior Review Engineer
Engineering Section
Pronouns: He/Him

COLORADO
Water Quality Control Division
Department of Public Health & Environment

P 303.692.6430
M 720.260.4629
4300 Cherry Creek Drive South, Denver, CO 80246
ian.sutton@state.co.us | www.colorado.gov/cdphe/wqcd

On Fri, Feb 11, 2022 at 9:07 AM Volle, Mark <mvolle@hrgreen.com> wrote:

> Ian,
>
> Im getting started on the site applications that we've discussed recently. The last time I submitted a site app for a lift station was under Reg 22.7 I think and at the time a geotechnical report was required. In reviewing the updated Reg 22, I have not found a requirement for geotechnical reports for lift stations. Could you please confirm that geotechnical

reports are not required for lift station site apps? Or if they are, please let me know the section of Reg 22 that requires them. I really appreciate your time in answering my questions.

Thanks and have a great weekend!

Mark Volle, PE

Lead Engineer - Water

HR Green® | Building Communities. Improving Lives.

HRGreen.

1975 Research Parkway | Suite 230 | Colorado Springs, CO 80920
Main 719.300.4140 | **Direct** 719.394.2436
HRGREEN.COM

Volle, Mark

From: Sutton - CDPHE, Ian <ian.sutton@state.co.us>
Sent: Friday, January 28, 2022 10:42 AM
To: Volle, Mark
Subject: Re: Legal control

Hello Mark,

Sorry for the delay. We can move forward with the site application with the contract documentation showing the description of the property and what will be owned by the system. The site approval letter will have a condition of approval stating that the final design cannot be approved until the system can show full ownership and control of the property. So the system will need to close on the property and have the documentation to show control prior to design review.

Hopefully that all makes sense. Let me know if you have any questions.

Thanks,

Ian Sutton, P.E.
Senior Review Engineer
Engineering Section
Pronouns: He/Him

COLORADO
Water Quality Control Division
Department of Public Health & Environment

P 303.692.6430
M 720.260.4629
4300 Cherry Creek Drive South, Denver, CO 80246
ian.sutton@state.co.us | www.colorado.gov/cdphe/wqcd

On Wed, Jan 26, 2022 at 4:16 PM Volle, Mark <mvolle@hrgreen.com> wrote:

> Ian,
>
> I reviewed Reg 22 and found the following:
>
> Section 22.9(1)(b)(iv) states that we need to provide "legal arrangements showing control of the site…or showing the ability of the entity to acquire the site or right-of-way and use it for the project life." If the project owner for a lift station project has a parcel under contract but has not closed on it, is that sufficient evidence that they have the ability to acquire it? In this case, the owner has the parcel under contract and can close on it anytime in 2022. They would

prefer to wait to close until the Site App is approved because if it isn't approved for some reason, then they would have a property that isn't useful for them.

Im asking now because the local 208 reviewer (PPACG) has stated that they will defer to CDPHE on what satisfies that section of Reg 22 so having clarification from you now will help guide the local 208 review process. We haven't submitted yet but are working on the application. If you have any questions, please let me know.

Thanks,

Mark Volle, PE

Lead Engineer - Water

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HRGreen.

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Main 719.300.4140 | **Direct** 719.394.2436
HRGREEN.COM

EXHIBIT EE: APPLICANT RESUMES

Gregory Panza, PE, PMP | Senior Project Manager

With more than 20 years of experience, Greg manages and master plans land development and municipal projects. He offers experience in both the engineering and construction realms. As a Professional Engineer, Greg has provided management of major civil infrastructure for healthcare, residential, recreational, training, and commercial projects. His project management, construction management, and general contracting experience, nearly 15 years in total, has included project sequencing for multi-year construction, including 5-years managing construction for the National Park Service's Intermountain Region. Greg has managed construction schedules, budgets, and on-site contractors for multi-million dollar projects. Greg brings a broad knowledge of the civil field, including drainage, construction inspection, surveying, and stormwater management analysis. His project experience ranges from hydrologic & hydraulic analysis, utility and drainage studies consistent with FEMA, Corps and local requirements, utility coordination, heavy civil utility construction, mass grading, and roadway design projects with construction costs of up to $20 million.

EXPERIENCE

25 Years

EDUCATION

BS, Civil Engineering, Ohio University- 1996

REGISTRATION / LICENSE

Professional Engineer, CO, 37081, 2002

SPECIALIZED TRAINING & CERTIFICATIONS

FAC Academy Program/Project Manager (FAC-P/PM)
Contracting Officer Representative (COR)

SELECTED PROJECT EXPERIENCE

171006.01
Home Place Ranch-Engineering - Goodwin Knight
Project Manager
Home Place Ranch retained HR Green to provide Preliminary Engineering, Planning, and Landscape Design services required to seek Preliminary P.D. Site Plan approval form the Town of Monument for the Phase One area. Home Place Ranch is approximately 427 acres within the town of Monument, CO in northern El Paso County. It is bordered by Higby Road on the northern property boundary, Promontory Pointe and Jackson Creek communities on the south and southwest.

Greg was responsible for managing the infrastructure design and working with the client on phasing of development

OTHER FIRM EXPERIENCE

Todd Creek Village North | Adams County, CO
Senior Project Manager for this 930-acre mixed-use master plan in north Denver metro area within the Todd Creek Metro District. Project includes a multi-phased development and infrastructure master plan. Initial phases of the project required on-site treatment of sanitary effluent and recirculation of effluent into an irrigation distribution system for a 180-lot and two commercial outlot development.

Adams Crossing | Brighton, CO

At the forefront of innovation, this 780-acre project will be Colorado's first true "Agriburbia Development", combining agricultural, residential, and urban development. The project is designed to take advantage of the disconnected impervious areas to improve water quality and decrease the need for flood attenuation along Second Creek.

The project requires drainage swales, sediment basins, detention and channel facilities and connections into existing regional trail system. HEC-RAS studies were conducted to verify flood boundaries based on the currently farmed land to determine consistency with FEMA FIRM panels. The detention pond areas are designed to straddle the 100-year flood limits to expand the floodplain boundary, decreasing the overall high water level.

Mountain Sky | Ft. Lupton, CO
Senior Project Manager for this 80-acre, 6 phase single-family subdivision within Ft. Lupton. This project is located at the
bottom of an 800-acre drainage basin and required upstream bypass flow routing through the development. High ground water conditions led to the design of cut-off walls and subdrainage underdrain system to make basement products an option. Bedrock located near the surface was mapped and grading was designed to eliminate the need for rock excavation during mass-grading operations. Offsite infrastructure included improvements to CDOT Highway 52 and installation of offsite irrigation and water distribution from one mile away.

Big Horn Regional Northern Supply Pipeline | Worland, WY
Construction Manager for this $8M regional water line spanning across four rural towns. One pump house, two pressure vaults, a one-million-gallon concrete storage tank, 17 miles of distribution piping, three river crossings, coordination with four towns, two counties, BLM, USDA, two regional water boards and multiple land owners. Coordinating schedules of 14 subcontractors and 19 suppliers. Responsible for value engineering analysis, subcontractor solicitations, construction means and methods, project submittals, scheduling, permitting, public affairs, project budget and personnel staffing. National Park Service project.

Sable Blvd & Alameda Pkwy Waterline Relocation for Sable Basin & City Center Project (MESA IV PROJECT) | Aurora, CO
Utility infrastructure for a 362,500 SF open space and TOD. Lowering of a 36” potable waterline, considering the various forces acting on the pipe and bends to design restraints, thrust blocks, and add a blow off and air vac. Rerouting of an 8” waterline, adding various bends to the line. Also: 2300 LF of 84-108” RCP for stormwater, pipe hydraulics, H&H, pressure pipe flow, UDSewer calculations, outfall analysis, watershed analysis, and construction plans and specs. Internal Project Management.

Pelican Lake Ranch | Weld County, CO
This project consisted of a 2,700-acre residential estate home project surrounding Milton Lake Reservoir. A CUHP and SWMM analysis was conducted, modeling critical overflow routes, eventually making its way to Milton Lake Reservoir. Improvised erosion control BMP’s to control sandy soil conditions were implemented throughout this catchment.

This project was intertwined with gas and oil field tanks, derricks and piping. Coordination with five oil and gas companies for the rerouting and/or preservation of existing lines and derricks was required to create a safe community, assuring pipelines were not exposed due to sediment transport during large rain events.

Griswold Water Treatment and South Satellite Improvements | Aurora, CO
This project was experiencing major sediment transport and environmental concerns. Both of the sites were impacted by lack of vegetation, a prairie dog colony, steep slopes, poor stormwater conveyance and a lack of irrigation. Increased runoff was transporting mineral and organic sediment as well as asphalt millings and vehicle runoff across the site to the Cherry Creek drainageway.

A sub-watershed study was completed for the area tributary to the Griswold Water Treatment Plant and the South Satellite Maintenance Facility. Solutions included redirecting, regrading and installing approximately 6,000 SY of erosion control matting to facilitate spawning of vegetation. Hyporheic baffles were installed to settle out phosphorus and sulfides and plantings installed along the drainage channels to uptake undesired soluble minerals. Five-acres of restoration resolved erosion transport issues.

Sewer Improvements for Lima Alley and Paris Alley at Montview Boulevard | Aurora, CO
Project Manager for this project consists of resolving clogging and capacity issues of the sanitary sewer system within the alleys of Lima Street and Paris Street to increase overall capacity along East Montview. Project required analyzing upstream tributary basins and designing a 3-mile sanitary sewer bypass system through the existing infrastructure of old-town Aurora.

Oxford Station Transit Oriented Development | Englewood, CO
Project Manager for this project demonstrates Greg's experience on TOD projects for private developers. The 3.5-acre in-fill site at Oxford Light Rail Station is constrained on three sides and consists of 40,600 SF industrial warehouse facilities and 9500 SF commercial facilities, as well as the addition of two proposed buildings (24,100 SF and 26,400 SF). Infrastructure design includes utility design and location, easement services, drainage, traffic impact study, erosion control, storm water master plan, water and sewer utilities, grading, and hydrology & hydraulics (H&H). There is a large sewer line crossing on the north side of the site, and the existing storm sewer floods often. Requires analysis of impact to the Platte River.

Blake Street Artisan, Denver, CO
Located in the LoDo section of Denver, this infill project required creative flood attenuation and water quality treatment to be viable. The project is situated on an existing contaminated manufacturing warehouse. Infiltration of stormwater was prohibited due to the spreading of soil contamination. A series of ground level water quality gardens and separators were installed to facilitate initial treatment. Stormwater was directed to sand filters, gravity drained to underground detention storage and released to non-contaminated areas via level spreaders, eventually sheet flowing to the Platte River.

Cherry Creek Vista Filing 17-B, Greenwood Village, Colorado
This project consisted of a 30-acre infill residential development along Cottonwood Creek within the Cherry Creek reservoir drainage basin. Project included 108 single family homes, utilities, roadway system, water quality and detention pond system. Coordination with the Army Corp of Engineers was required to re-establish wetlands and create new wetlands.

HRGreen

Christian McFarland, PE | Lead Engineer

Chris is a dedicated and creative Professional Engineer with design expertise in drainage, floodplain management, grading, erosion control, utility design and roadway design. Wide range of experience that includes simple intersections and pad site design to master planning multiple section land development projects, and complex roadway expansions. He has proven ability to design and deliver projects on time and on budget.

EXPERIENCE

14 Years

EDUCATION

BS, Civil Engineering, Colorado State University- 2006

REGISTRATION / LICENSE

Professional Engineer, CO, 44947, 2011

SPECIALIZED TRAINING & CERTIFICATIONS

Drainage Related:
UDFCD Stream Academy
HEC-RAS 2D Modeling
EPASWMM Advanced Modeling Techniques
Green Infrastructure and Low Impact Development Design
Best Management Practices for Construction in Waterways
Certified Floodplain Manager (License lapsed, need to renew fall 2019)

Federal Government Related:
UFC-Minimum Antiterrorism and Force Protection Standards for DOD Buildings SpecsIntact

PROFESSIONAL AFFILIATIONS

Society of American Military Engineers
Colorado Association of State Floodplain Managers

SELECTED PROJECT EXPERIENCE

180382.02
CDN Red Rocks LP - CDN Rooney Gulch - CDN Red Rocks LP
Project Engineer
This 800-unit master planned multifamily community is located along the main corridor along the hogback. leading into the mountains. One of the primary features of this community is an approximate one-mile stretch of gulch within the Rooney Gulch Watershed. HR Green was contracted to provide a sustainable solution for stabilizing the gulch, anticipating the development to occur within the entire corridor. HR Green worked with Urban Drainage and Flood Control District on establishing a bio-engineered approach to managing the increased run-off as a result of development.

Chris was responsible for design and calculations for the grade control and bank stabilization structures proposed within the gulch. Chris also assisted in analyzing the SWMM model for the hydrologic analysis of the site to size numerous detention and water quality facilities for the overall development.

OTHER FIRM EXPERIENCE

I-25 & Erie Parkway Master Plan – Erie, CO
Project Manager
Chris was responsible for early planning and engineering for future master development led by the Town of Erie. The I-25 and Erie Parkway Master Plan encompasses the 1,280 acres of land located at the northwest corner of I-25 and Erie Parkway. The Town's intent is to create a regionally-scaled retail and employment center at Erie's eastern gateway servicing the Northern Colorado marketplace that is recognized as a true destination where businesses and people flourish. The vision for the development future of the Plan area is one that maximizes the site's revenue generating potential while employing sound land use and high quality design principles.

Land Development Project – Commerce City, CO
Project Manager
Chris was the lead designer for a ~350 single family home development in Commerce City. Worked with adjacent developers, Commerce City and UDFCD to design a major outfall channel and detention standards for a large drainage area for multiple developments.

Meridian Village Development – Denver, CO
Project Engineer
Chris provided site utility engineering, over lot grading for Meridian Village development. Located south of Lincoln Avenue & east of I-25 the will feature rolling home sites, spectacular views of the Front Range Mountains, and Downtown Denver.

Christian Brothers Automotive – Various Locations
Project Manager
Chris provided project management and lead design for various Christian Brothers Automotive shops within the state of Colorado. Chris led all planning processes and partners on the projects for plat approval, site development design and preparation of construction documents.

Cannon Air Force Base SOPS Training Facility
Project Manager
Responsible for design and management of a large base expansion at Cannon Air Force base including site layout, grading, utility design, specification preparation and construction Administration.

Municipal Project and Light Rail Addition – Aurora, CO
Project Manager
Responsible for master drainage analysis for a 2.5 square mile drainage basin, new Light Rail Station connection to the Aurora Municipal Center and design of a large pre-cast structure beneath a 6 lane arterial road.

Hospital Expansion – Cortez, CO
Project Manager
Responsible for design and project management including parking lot site layout and grading, drainage design, utility construction, erosion control design, specification preparation and construction administration services.

Tinker Air Force Base – Oklahoma City, OK
Project Manager
Responsible for design included grading, drainage, utilities, site layout, specification preparation and construction administration services to accommodate KC-46A airplane.

HRGreen

Toll Gate Creek Bank Stabilization - Aurora, CO
Lead Designer
Responsible for design, alternative analysis, and modeling for a river bank stabilization project within the City of Aurora.

Aurora High Line Canal Improvements - Aurora, CO
Project Manager
Responsible for design, alternative analysis, project management, and plan preparation for approximately 4 miles of regional parks trail. Work included coordination and design for an at-grade rail road crossing, at-grade crossing of a major collector including traffic signalization, and a grade separated crossing of I-70, a major interstate Highway.

First Creek Interceptor - Aurora, CO
Project Manager
Responsible for design, alternative analysis, project management, and plan preparation for a new 36" gravity sewer line for the City of Aurora. Work included alternative analysis of various routing options and construction methods, plan preparation, and coordination with the local health department and other various stakeholders for approval.

Ground Water Recharge System – Fort Morgan, CO
Project Engineer
Responsible for design, alternative analysis, and plan preparation for a groundwater recharge system for various land owners and farmers near Fort Morgan Colorado. Design included ~3.5 miles of non-potable water line, river intake and pumping system in order to carry water to various groundwater recharge ponds for future irrigation purposes.

Trevor Igel, EIT | Staff Engineer II

Trevor has a variety of hands on experience ranging from the physical analysis of hydraulic phenomena, to stream, wetland and general ecosystem restoration. His experience also includes computational hydraulic and hydrologic analysis, drainage design, grading, erosion control, surveying and construction inspection. Trevor is proficient in AutoCAD, Civil 3D, GIS, 1 and 2 Dimensional HEC-RAS analysis and SWMM modeling.

EXPERIENCE

2 Years

EDUCATION

BS, Environmental Engineering, Colorado State University - Fort Collins- 2019

REGISTRATION / LICENSE

Engineer In Training, CO, N/A, 2019

PROFESSIONAL AFFILIATIONS

ACEC Scholarship Review Committee

SELECTED PROJECT EXPERIENCE

160473
Nevada WWTF and Trunk Sanitary Sewer Improvements - City of Nevada, IA
Staff Engineer

Facility planning, antidegradation alternative analysis, SRF loan for new 8.5 mgd plant to meet the needs of new effluent limits, nutrient removal requirements, future growth and industrial expansion. Conveyance package includes pump station, force main, and trunk sewer from old plant to new plant approximately 3.5 miles south. Design elements include:

- Administration & Maintenance Building
- Headworks Building (Screening and Grit Removal)
- 3-Stage Oxidation Ditches for nutrient removal
- Secondary Treatment Building (with laboratory)
- Secondary Clarifiers
- Ultraviolet (UV) Disinfection Building
- Aerobic Digesters with integral thickening system
- Solids Processing Building
- Biosolids Storage Tank
- New outfall

The project also involved process modeling, easements, survey, and geotechnical soil borings.

Trevor was the Staff Engineer on this project.

171006.01
Home Place Ranch-Engineering - Goodwin Knight
Staff Engineer

Home Place Ranch retained HR Green to provide Preliminary Engineering, Planning, and Landscape Design services required to seek Preliminary P.D. Site Plan approval form the Town of Monument for the

Phase One area. Home Place Ranch is approximately 427 acres within the town of Monument, CO in northern El Paso County. It is bordered by Higby Road on the northern property boundary, Promontory Pointe and Jackson Creek communities on the south and southwest.

Trevor was responsible for site grading, preparation of the preliminary utility plans, drainage analysis, and preliminary construction drawings.

180382.02
CDN Red Rocks LP - CDN Rooney Gulch - CDN Red Rocks LP
Staff Engineer
This 800-unit master planned multifamily community is located along the main corridor along the hogback. leading into the mountains. One of the primary features of this community is an approximate one-mile stretch of gulch within the Rooney Gulch Watershed. HR Green was contracted to provide a sustainable solution for stabilizing the gulch, anticipating the development to occur within the entire corridor. HR Green worked with Urban Drainage and Flood Control District on establishing a bio-engineered approach to managing the increased run-off as a result of development.

Trevor was responsible for the hydraulic analysis of the project site as well as the analysis of the changes development poses on the sites hydrology. Trevor also assisted in the development of the preliminary planset for proposed gulch stabilization, water detention and quality facilities as well as site grading.

181211.17
Aerotropolis Area Coordinating Metropolitan District - The Aurora Highlands - Miscellaneous - Aerotropolis Area Coordinating Metropolitan District
Staff Engineer
HR Green is providing Engineering Services for the Aurora Highlands Master Planned Community located in Aurora, Colorado. The Aurora Highlands consists of approximately 3,150 total acres within the City of Aurora. This project includes the development of a Framework Development Plan Manual including Master Drainage Study, Master Utility Study and, Public Improvement Plan. Kristine was responsible for all H&H analysis and development of the master drainage plan report requiring approval from the City of Aurora and UDFCD.

Trevor assisted in the analysis of site hydrology as well as the development of a site drainage plan, sanitary sewer design, and the master drainage and master utility studies.

Sarah Fernandez I Design Technician I

Sarah is an analytical and detail-oriented individual with acute knowledge of drafting technologies. She will support the design and construction services task lead to ensure that tasks are completed efficiently and accurately. Her diverse background in communication and design is an asset in producing clear, detailed plans. Sarah has experience in digital drafting and 3-D modeling in AutoCAD and Civil 3D.

EXPERIENCE

1 Years

EDUCATION

MA, Literature, University of Colorado- 2016
BA, Humanities, University of Colorado- 2013
AAS, Drafting Technologies, College of Southern Idaho- 2020

SELECTED PROJECT EXPERIENCE

180582
Fountain Mesa Road and Caballero Ave. Design On-Call - El Paso County, CO
Design Technician
HR Green was retained by the County of El Paso, CO to provide Civil Engineering Planning and Design services for the Fountain Mesa Road/Caballero Avenue Intersection project. HR Green's services included project coordination, project management, traffic study, conceptual and preliminary design.

Sarah assisted in developing and editing plan sets for the project by importing and analyzing survey data and design elements. She ensured clarity and accuracy of plans sets for final submittal. She also attended a webinar on roundabout design concepts in consideration of this project.

181211.37
Aerotropolis Area Coordinating Metro District - The Aurora Highlands - Prairies Water Relocation - Aerotropolis Area Coordinating Metropolitan District
Design Technician
Sarah played an integral role in developing the sheet set for this project and organizing various data references and design elements to ensure plans were clear and straightforward. She applied her research skills to ensure the large-scale project made considerations for the upstream and downstream impacts of the pipeline.

191850
All Pro Capital - Woodmen Heights Commercial Center - All Pro Capital
Design Technician
As Design Technician, Sarah collaborated with professionals in various engineering disciplines to ensure that Landscaping, Water, and Land Development needs were addressed succinctly in the Woodmen Heights Commercial Center plans. She exercised critical attention to detail in revising plan sets for Water, Sanitary, Utility, Grading and Erosion, and Roadway Design.

19P0781
UDFCD, CO - Rooney Gulch FBP Section - Mile High Flood District, CO
Design Technician
Sarah was responsible for transferring design elements from Autodesk Civil 3D into GIS. She communicated with the client to ensure the files were accessible and the file type suited their needs.

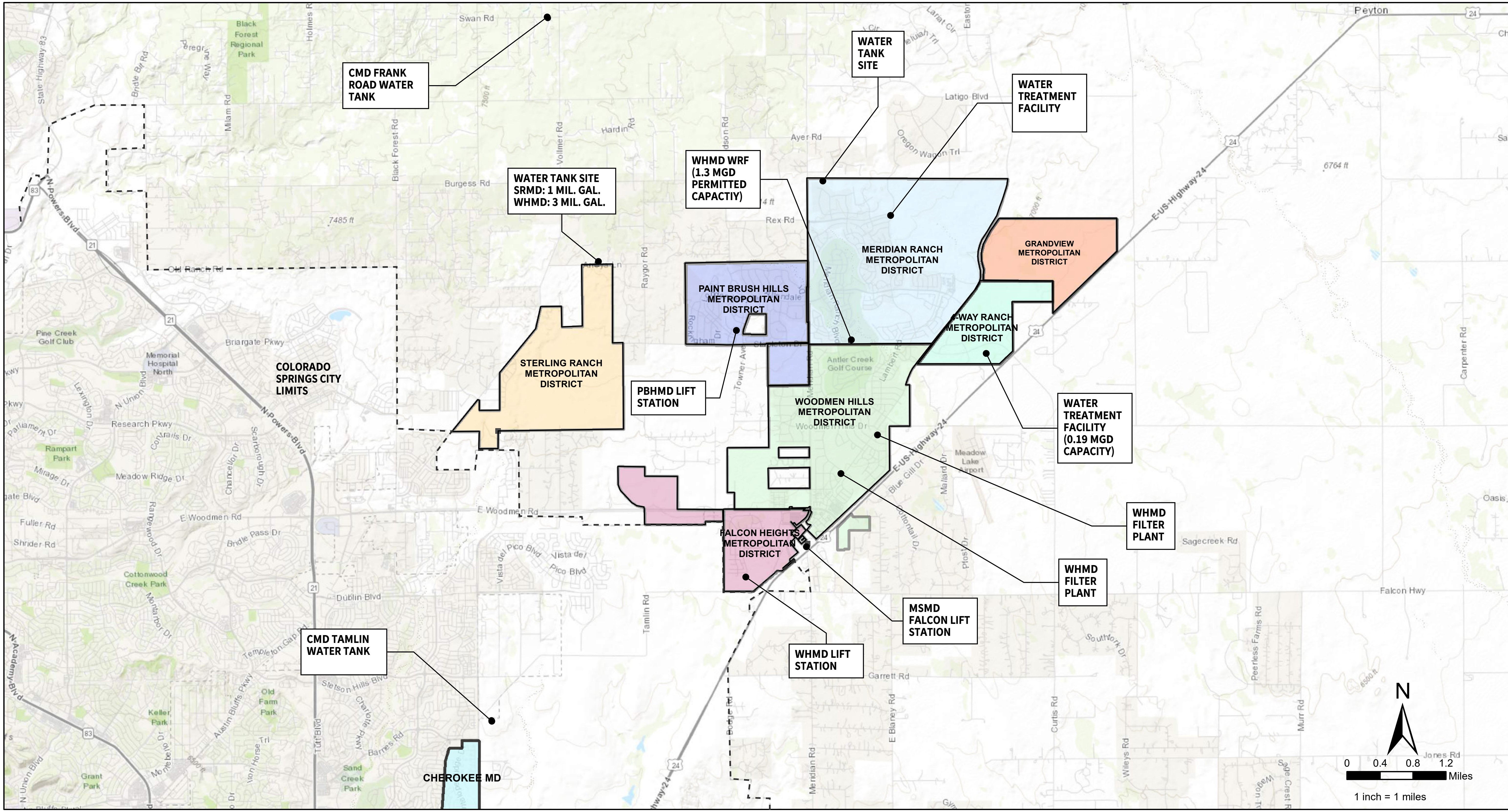
200106.01
Inland Group, CO - Copper Apartments at Greeley - Copper Platte Apartments, LLC
Design Technician
Sarah worked to set up sheet layouts and preliminary design elements to expedite the plan development process. Through this project, she gained valuable insight into elements of Land Development to add to her knowledge of Water Operations.

200192
Westminster, CO - On-call Engineering Services - City of Westminster, CO
Design Technician
Sarah used project data to develop maps and exhibits demonstrating the most effective grouping of projects for maintenance of various city drainage and storm sewer networks.

200192.01
Westminster, CO - Legacy Ridge Golf Course Drainage - City of Westminster, CO
Design Technician
Sarah was responsible for the layout, design, and revision of the plan sheets involved in the portion of this project. She gained insight into sustainable water retention design through Total Hydrology Planning and Green Drainage Systems trainings and applied her knowledge in her reviewing of the project plan sheets.

200548
Lafayette, CO - Copper Stone Apartments Floodplain - Inland Group
Design Technician
Sarah assisted in compiling the necessary information and digital exhibits to submit a completed a LOMC floodplain revision application. She worked to gain a greater knowledge of FEMA standards and familiarize herself with the process of floodplain management by attending the ASFPM webinars.

EXHIBIT FF: SURROUNDING INFRASTRUCTURE



Grandview Metropolitan District

Surrounding Metropolitan Districts Infrastructure Map

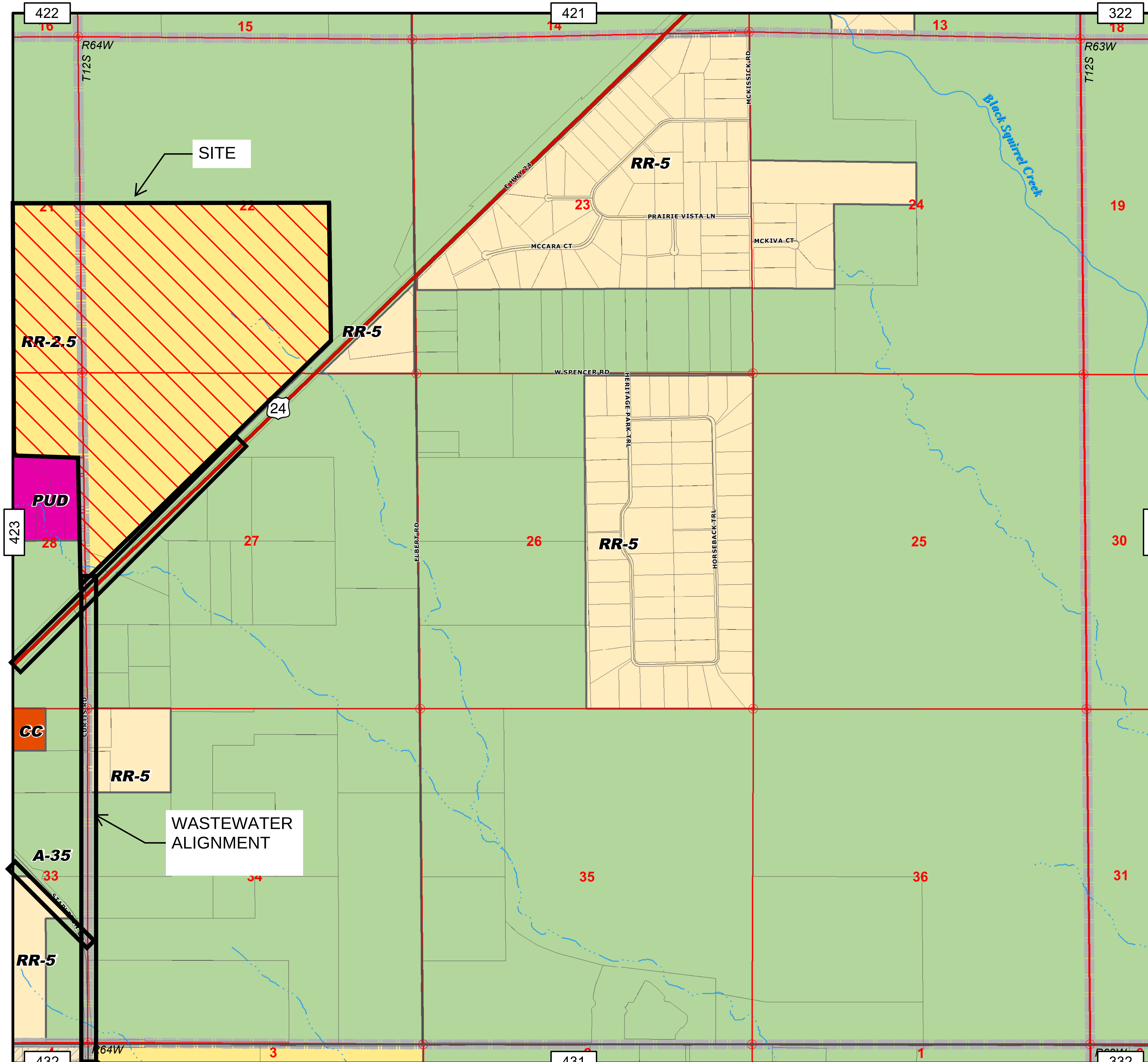
El Paso County Colorado

Data Source:
Coordinate System: NAD 1983 StatePlane Colorado Central FIPS 0502 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Foot US

HRGreen

HRG PLOT: 3:27:58 PM 2/20/2023 BY: cbudge FILE: J:\2020\201662.07\GIS\workingfile.mxd

EXHIBIT GG: EXISTING ZONING MAP



Zone Map 424

- El Paso County -
Development Services Department

Zoning Designations

- RS-20000: Residential Suburban (20,000 sq. ft.)
- RS-6000: Residential Suburban (6,000 sq. ft.)
- RS-5000: Residential Suburban (5,000 sq. ft.)
- RM-12: Residential Multi-Dwelling (12 DU/acre)
- RM-30: Residential Multi-Dwelling (30 DU/acre)
- RR-0.5: Residential Rural (0.5 acres)
- RR-2.5: Residential Rural (2.5 acres)
- RR-5: Residential Rural (5 acres)
- R-T: Residential - Topographic
- MHP: Mobile Home Park
- MHP-R: Mobile Home Park, Rural
- MHS: Mobile Home Subdivision
- RVP: Recreational Vehicle Park
- F-5: Forest & Recreation (5 acres)
- PUD: Planned Unit Development
- CC: Commercial Community
- CR: Commercial Regional
- CS: Commercial Service
- I-2: Limited Industrial
- I-3: Heavy Industrial
- A-5: Agricultural (5 acres)
- A-35: Agricultural (35 acres)
- C-1: ** Commercial
- C-2: ** Commercial
- M: ** Industrial
- R-4: ** Planned Development

** Indicates an obsolete designation

Supporting Data

- Highways
- Major Roadways
- Creeks - Perennial
- Creeks - Intermittent
- Section Corner Nodes
- Sections
- Parcels
- Military
- Pike National Forest
- Incorporated Cities
- Zone Map Boundary
- Zoning Overlay
- Special Uses

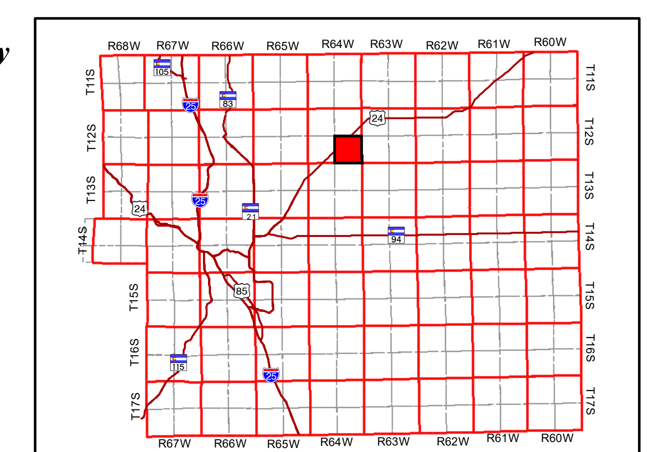
N W E S

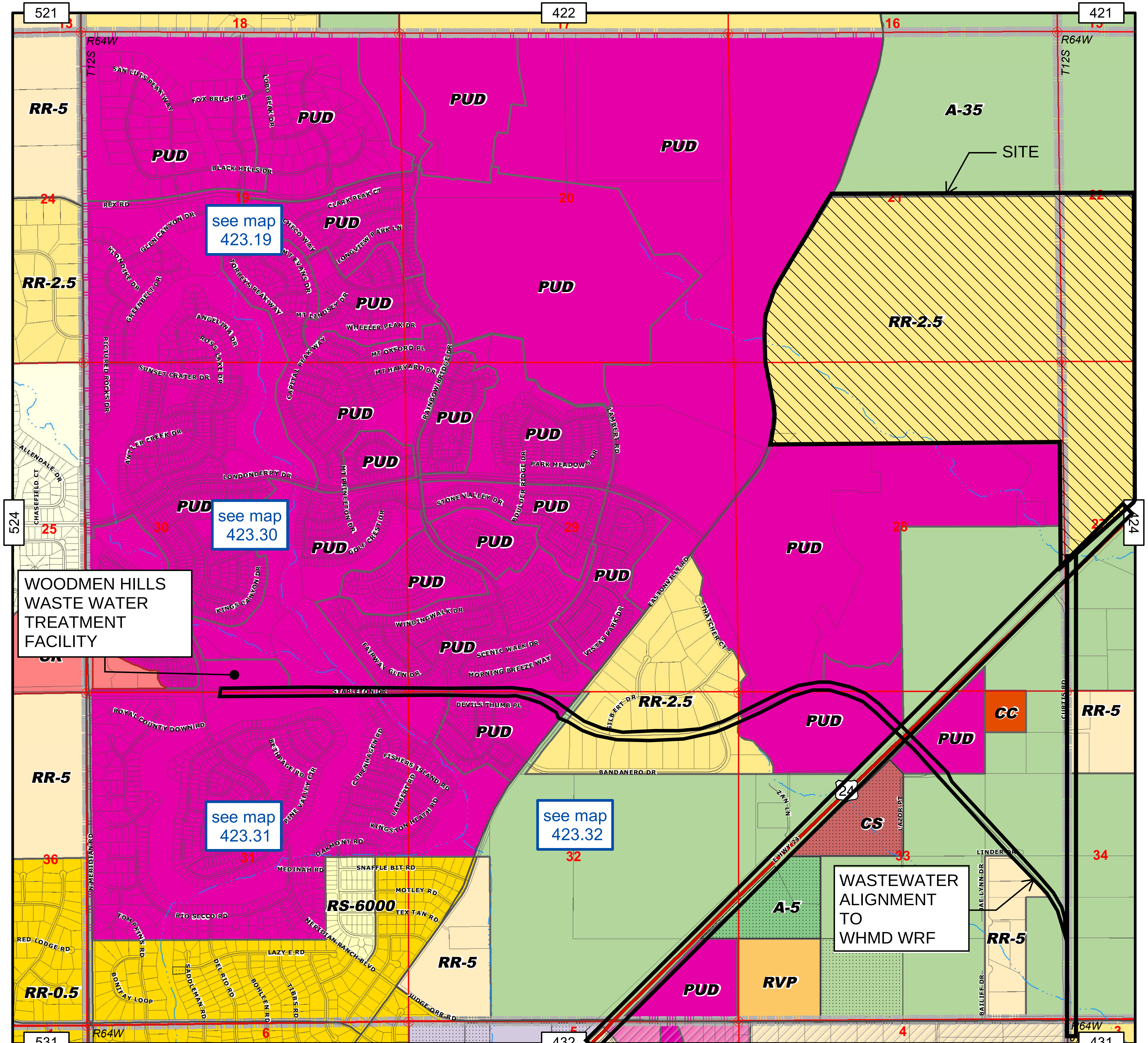
1,600 800 0 1,600 Feet

July 11, 2019

1 inch = 1,600 feet

Vicinity Map





Zone Map 423

- El Paso County -
Development Services Department

Zoning Designations

- RS-20000: Residential Suburban (20,000 sq. ft.)
- RS-6000: Residential Suburban (6,000 sq. ft.)
- RS-5000: Residential Suburban (5,000 sq. ft.)
- RM-12: Residential Multi-Dwelling (12 DU/acre)
- RM-30: Residential Multi-Dwelling (30 DU/acre)
- RR-0.5: Residential Rural (0.5 acres)
- RR-2.5: Residential Rural (2.5 acres)
- RR-5: Residential Rural (5 acres)
- R-T: Residential - Topographic
- MHP: Mobile Home Park
- MHP-R: Mobile Home Park, Rural
- MHS: Mobile Home Subdivision
- RVP: Recreational Vehicle Park
- F-5: Forest & Recreation (5 acres)
- PUD: Planned Unit Development
- CC: Commercial Community
- CR: Commercial Regional
- CS: Commercial Service
- I-2: Limited Industrial
- I-3: Heavy Industrial
- A-5: Agricultural (5 acres)
- A-35: Agricultural (35 acres)
- C-1: ** Commercial
- C-2: ** Commercial
- M: ** Industrial
- R-4: ** Planned Development

** Indicates an obsolete designation

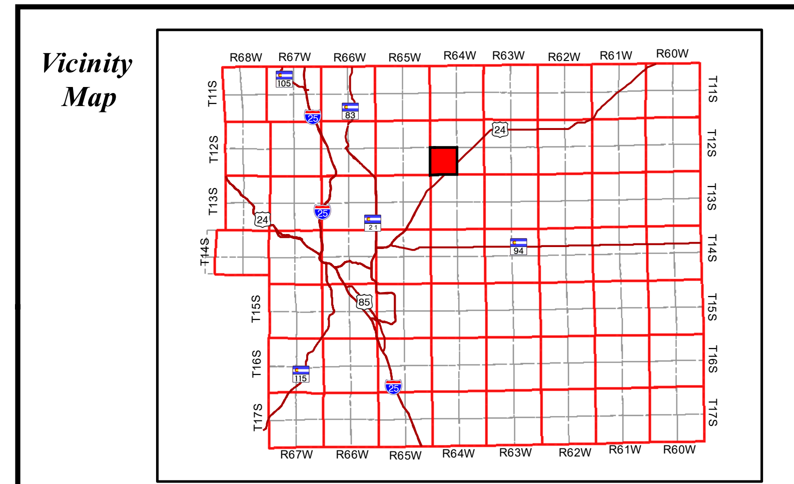
Supporting Data

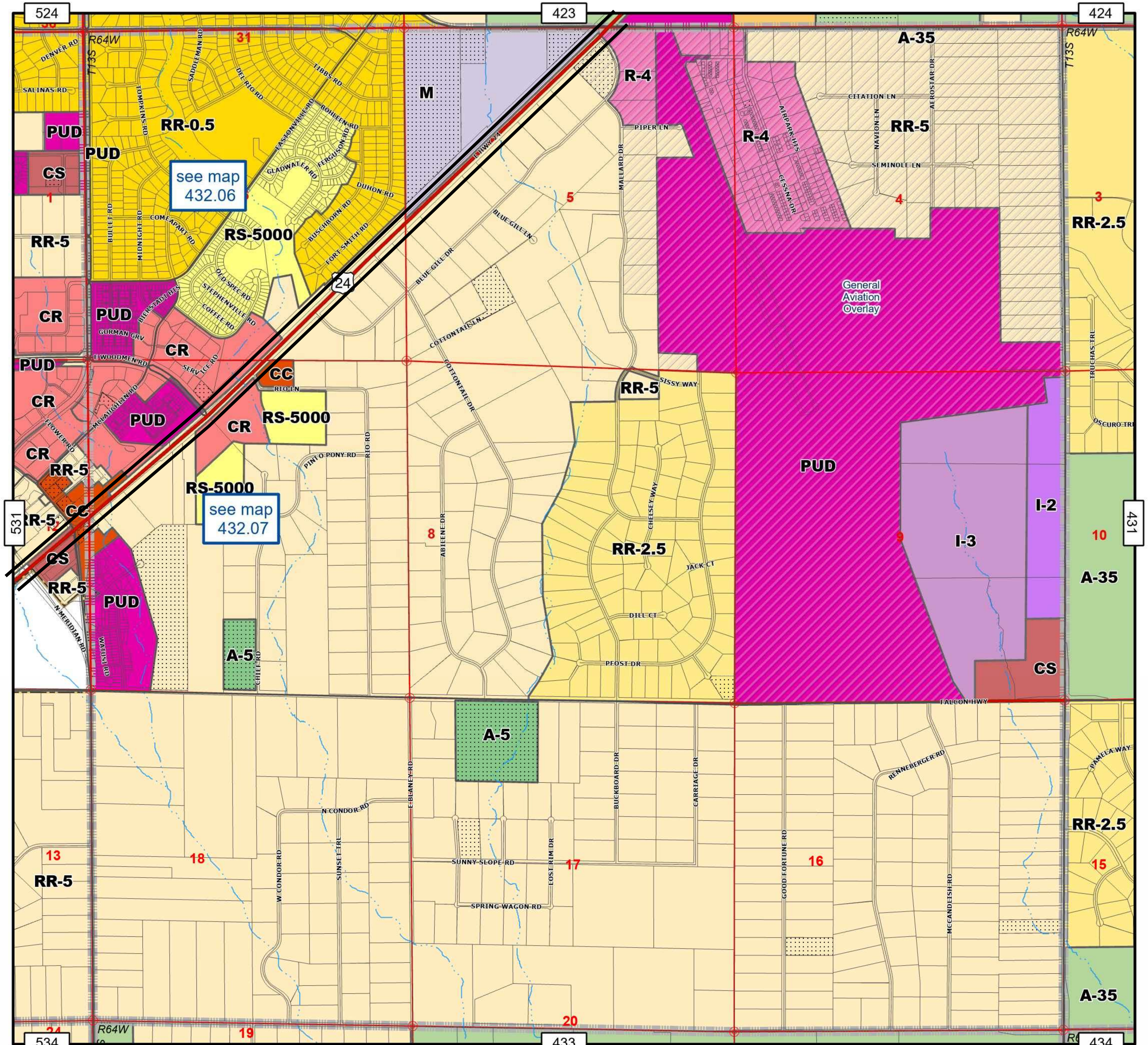
- Highways
- Major Roadways
- Creeks - Perennial
- Creeks - Intermittent
- Section Corner Nodes
- Sections
- Parcels
- Military
- Pike National Forest
- Incorporated Cities
- Zone Map Boundary
- Zoning Overlay
- Special Uses

1,600 800 0 1,600 Feet

1 inch = 1,600 feet

January 11, 2021





Zone Map 432

- El Paso County -

Development Services Department

Zoning Designations

- RS-20000: Residential Suburban (20,000 sq. ft.)
- RS-6000: Residential Suburban (6,000 sq. ft.)
- RS-5000: Residential Suburban (5,000 sq. ft.)
- RM-12: Residential Multi-Dwelling (12 DU/acre)
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- A-5: Agricultural (5 acres)
- A-35: Agricultural (35 acres)
- C-1: ** Commercial
- C-2: ** Commercial
- M: ** Industrial
- R-4: ** Planned Development

** Indicates an obsolete designation

Supporting Data

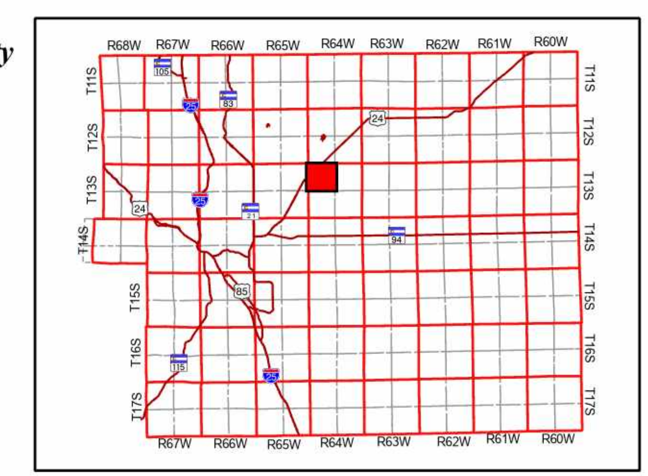
- Highways
- Major Roadways
- Creeks - Perennial
- Creeks - Intermittent
- Section Corner Nodes
- Sections
- Parcels
- Military
- Pike National Forest
- Incorporated Cities
- Zone Map Boundary
- Zoning Overlay
- Special Uses

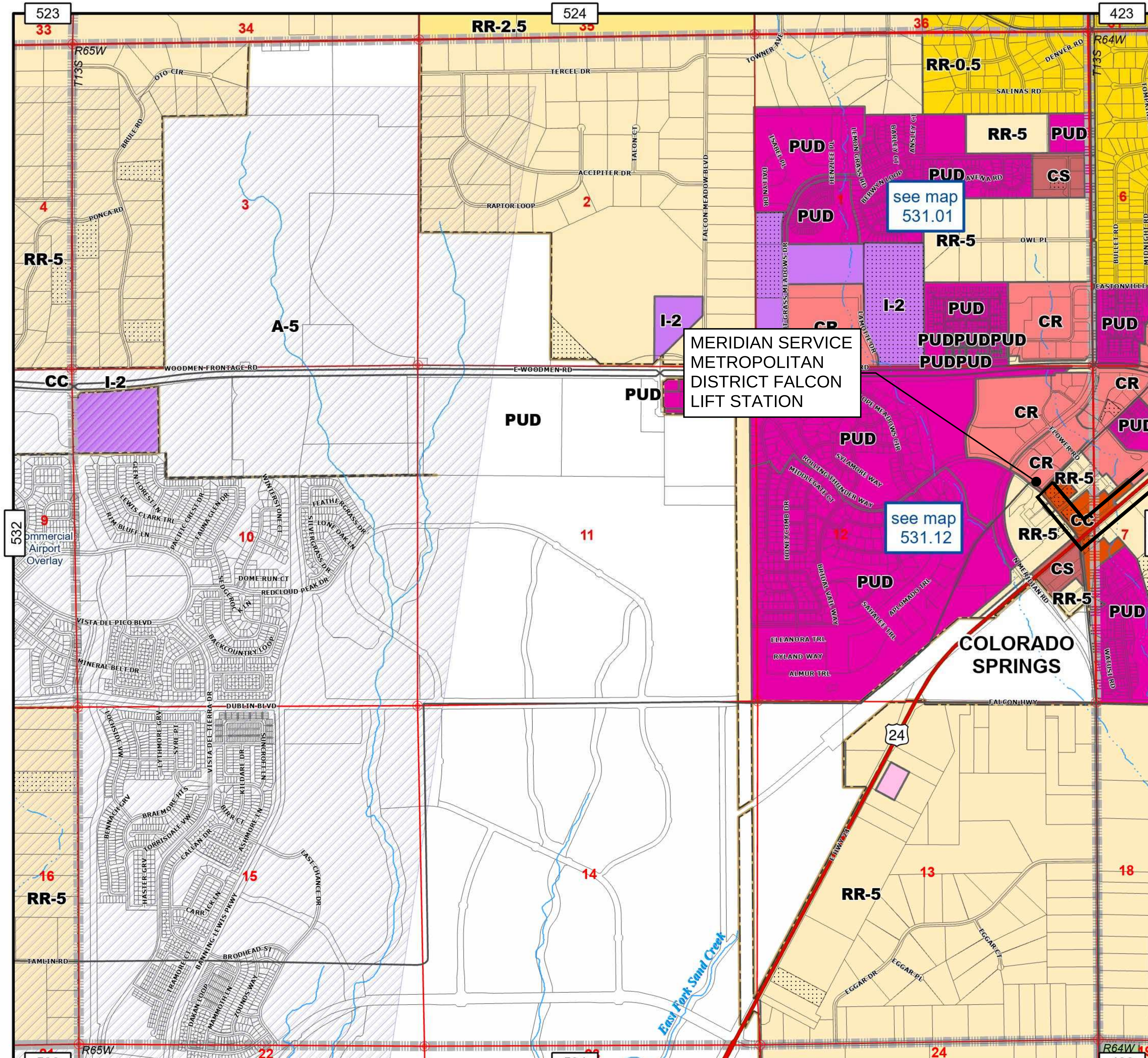
N E S W

1,000 500 0 1,000 Feet

January 13, 2023

1:19,200





Zone Map 531

- El Paso County -
Development Services Department

Zoning Designations

- RS-20000: Residential Suburban (20,000 sq. ft.)
- RS-6000: Residential Suburban (6,000 sq. ft.)
- RS-5000: Residential Suburban (5,000 sq. ft.)
- RM-12: Residential Multi-Dwelling (12 DU/acre)
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- A-5: Agricultural (5 acres)
- A-35: Agricultural (35 acres)
- C-1: ** Commercial
- C-2: ** Commercial
- M: ** Industrial
- R-4: ** Planned Development

** Indicates an obsolete designation

Supporting Data

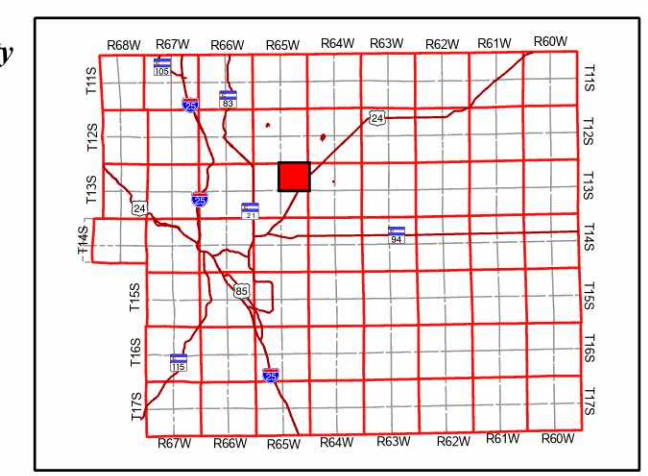
- Highways
- Major Roadways
- Creeks - Perennial
- Creeks - Intermittent
- Section Corner Nodes
- Sections
- Parcels
- Military
- Pike National Forest
- Incorporated Cities
- Zone Map Boundary
- Zoning Overlay
- Special Uses

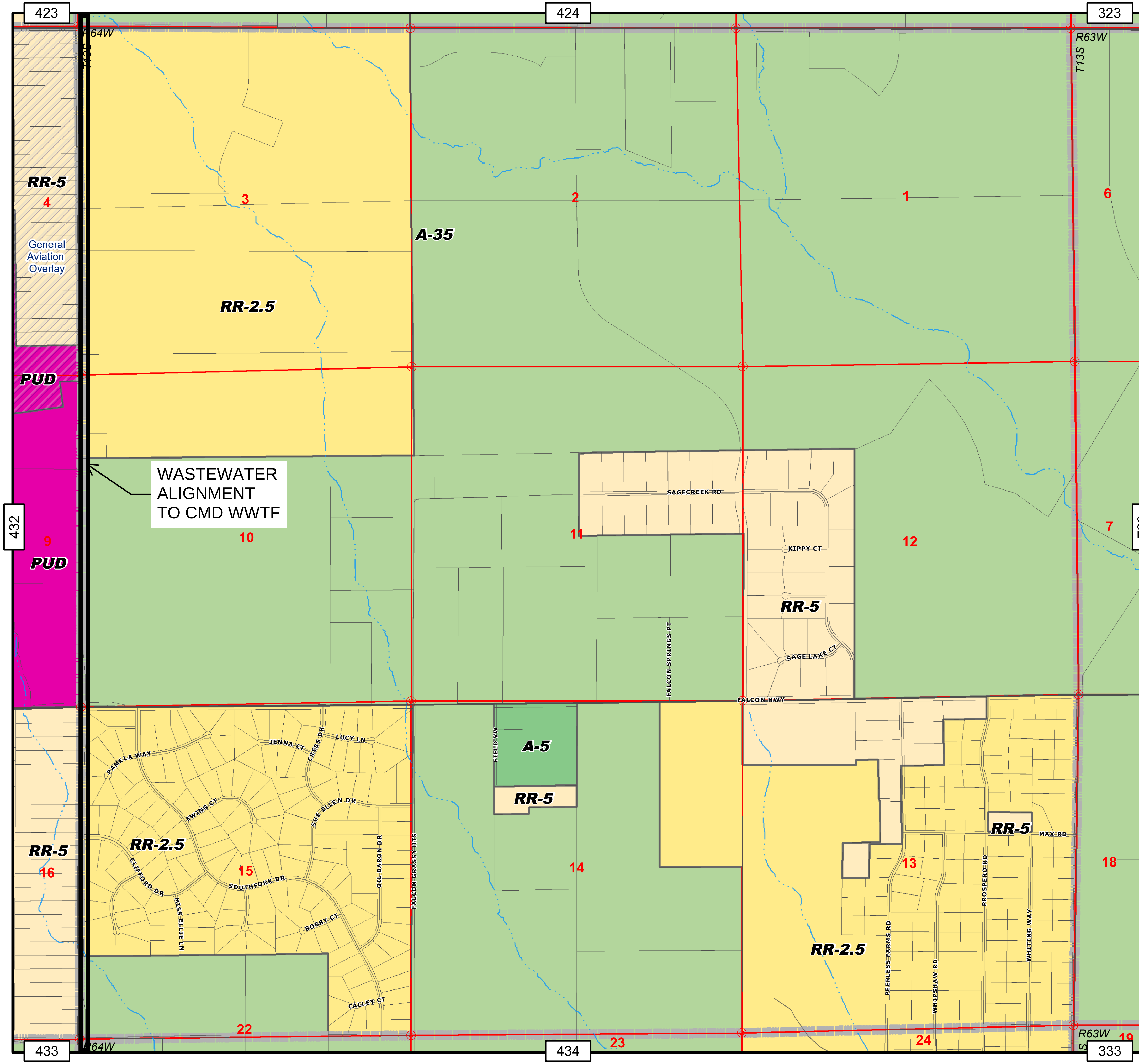
1,000 500 0 1,000 Feet

January 13, 2023

1:19,200

Vicinity Map





Zone Map 431

- El Paso County -
Development Services Department

Zoning Designations

- RS-20000: Residential Suburban (20,000 sq. ft.)
- RS-6000: Residential Suburban (6,000 sq. ft.)
- RS-5000: Residential Suburban (5,000 sq. ft.)
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- CC: Commercial Community
- CR: Commercial Regional
- CS: Commercial Service
- I-2: Limited Industrial
- I-3: Heavy Industrial
- A-5: Agricultural (5 acres)
- A-35: Agricultural (35 acres)
- C-1: ** Commercial
- C-2: ** Commercial
- M: ** Industrial
- R-4: ** Planned Development

** Indicates an obsolete designation

Supporting Data

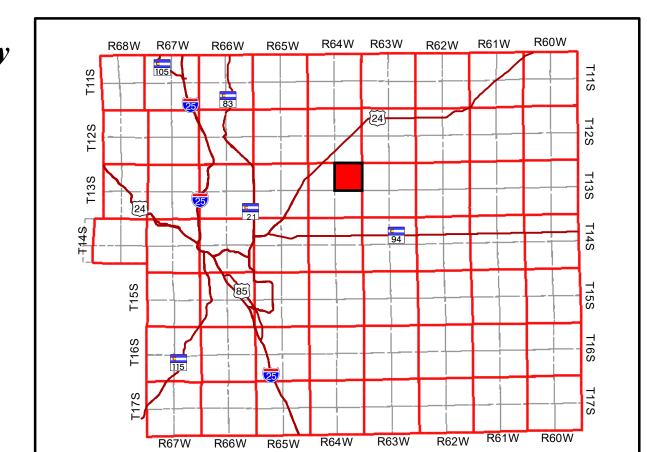
- Highways
- Major Roadways
- Creeks - Perennial
- Creeks - Intermittent
- Section Corner Nodes
- Sections
- Parcels
- Military
- Pike National Forest
- Incorporated Cities
- Zone Map Boundary
- Zoning Overlay
- Special Uses

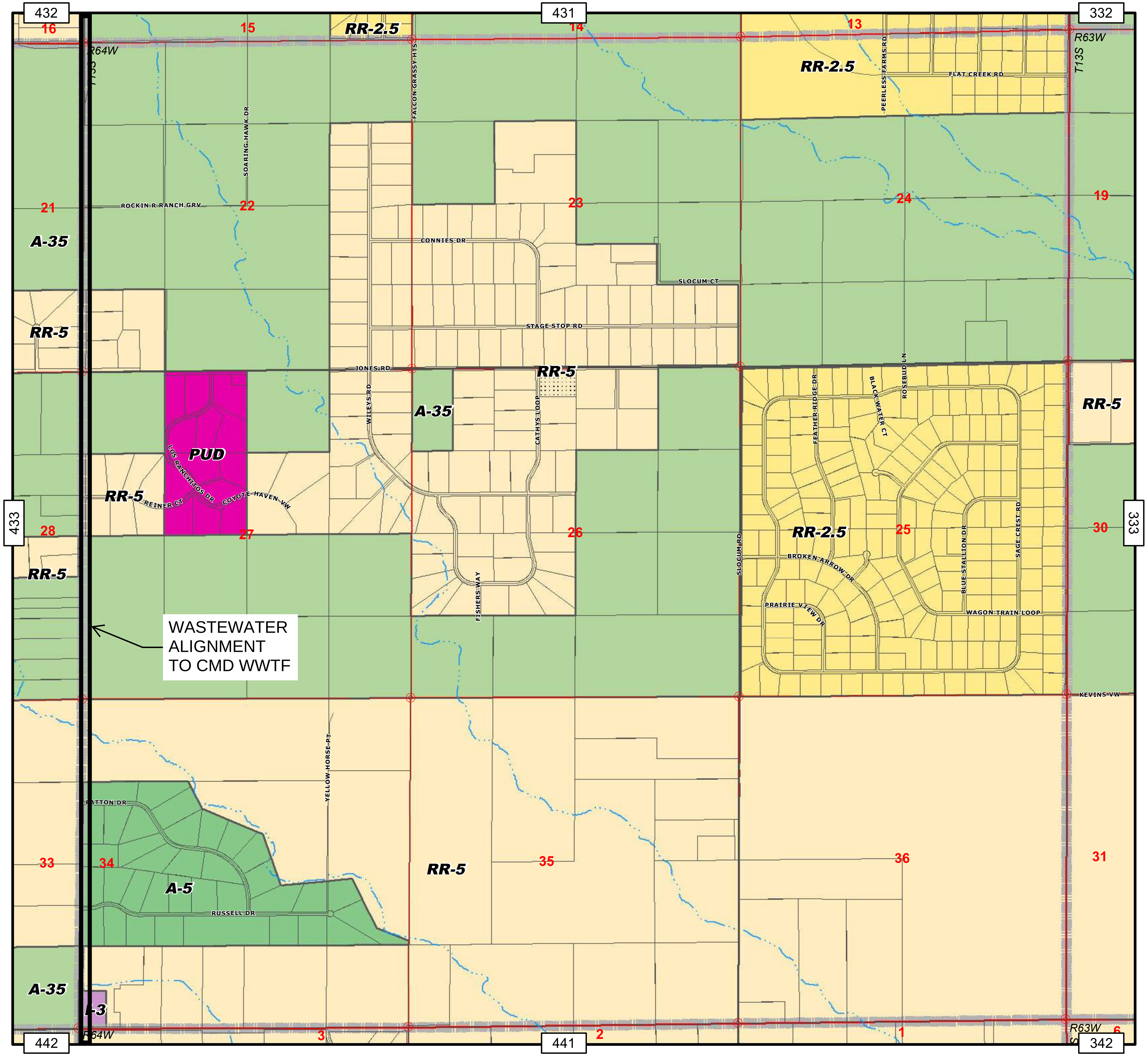
1,600 800 0 1,600 Feet

1 inch = 1,600 feet

July 11, 2019

Vicinity Map





Zone Map 434

- El Paso County -
Development Services Department

Zoning Designations

- RS-20000: Residential Suburban (20,000 sq. ft.)
- RS-6000: Residential Suburban (6,000 sq. ft.)
- RS-5000: Residential Suburban (5,000 sq. ft.)
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- I-3: Heavy Industrial
- A-5: Agricultural (5 acres)
- A-35: Agricultural (35 acres)
- C-1: ** Commercial
- C-2: ** Commercial
- M: ** Industrial
- R-4: ** Planned Development

** Indicates an obsolete designation

Supporting Data

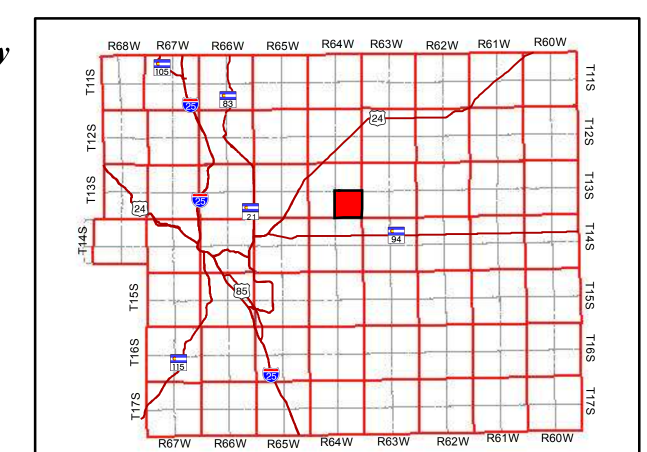
- Highways
- Major Roadways
- Creeks - Perennial
- Creeks - Intermittent
- Section Corner Nodes
- Sections
- Parcels
- Military
- Pike National Forest
- Incorporated Cities
- Zone Map Boundary
- Zoning Overlay
- Special Uses

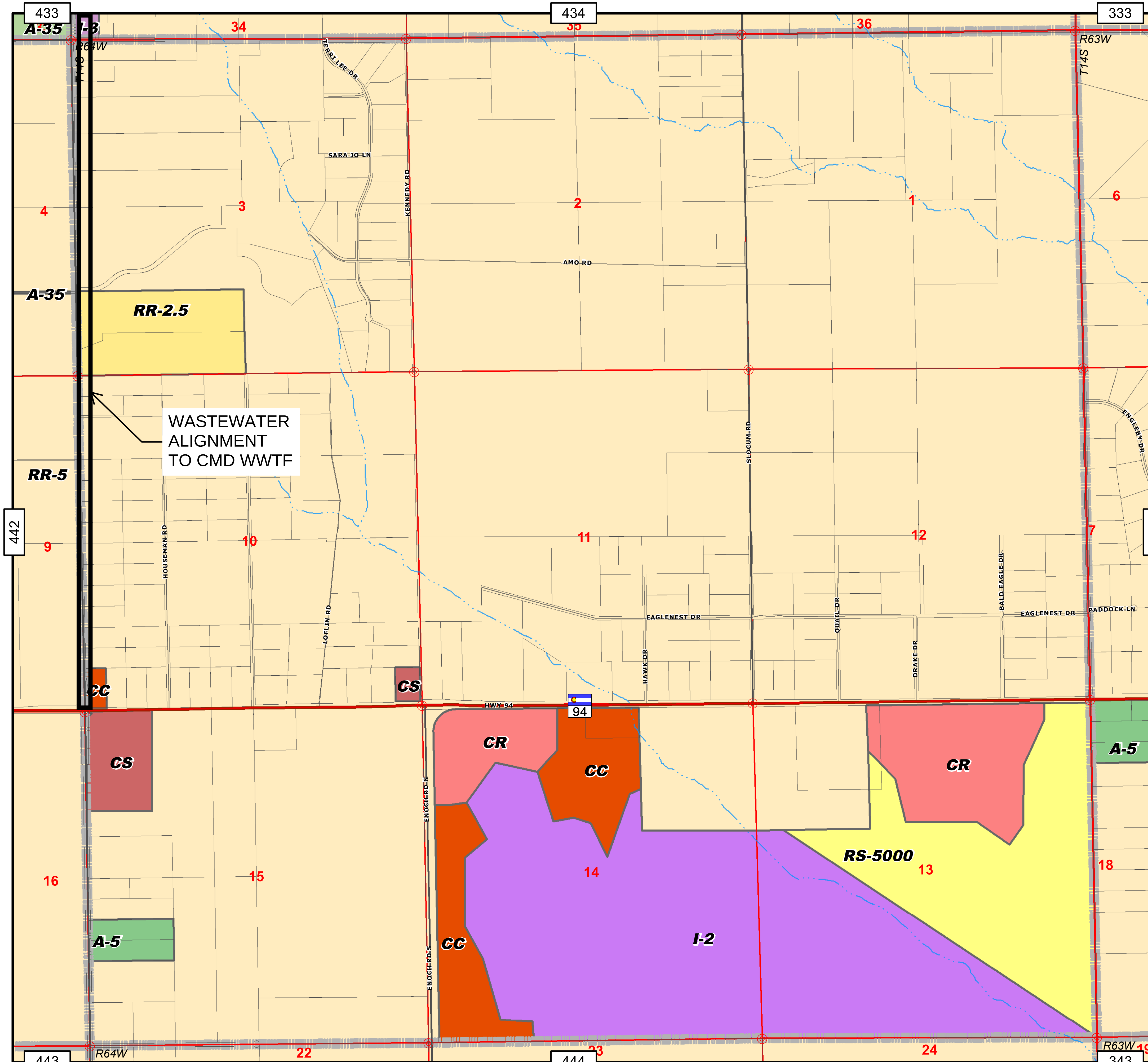
May 25, 2016

1,600 800 0 1,600 Feet

1 inch = 1,600 feet

Vicinity Map





Zone Map 441

- El Paso County -
Development Services Department

Zoning Designations

- RS-20000: Residential Suburban (20,000 sq. ft.)
- RS-6000: Residential Suburban (6,000 sq. ft.)
- RS-5000: Residential Suburban (5,000 sq. ft.)
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- C-1: ** Commercial
- C-2: ** Commercial
- M: ** Industrial
- R-4: ** Planned Development

** Indicates an obsolete designation

Supporting Data

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- Creeks - Intermittent
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- Incorporated Cities
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- Zoning Overlay
- Special Uses

N W E S

1,600 800 0 1,600 Feet

1 inch = 1,600 feet

April 14, 2021

Vicinity Map

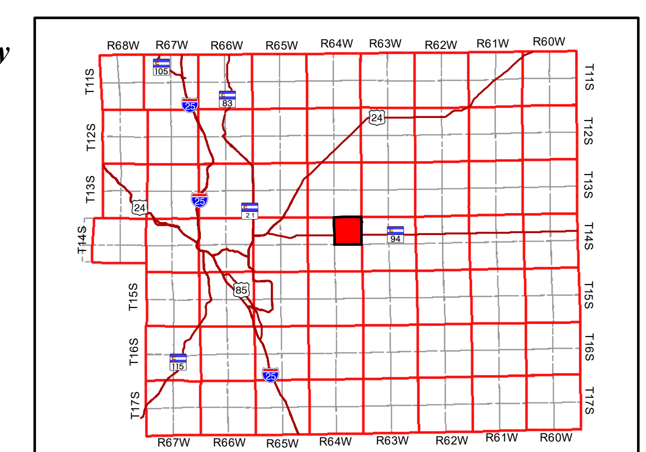
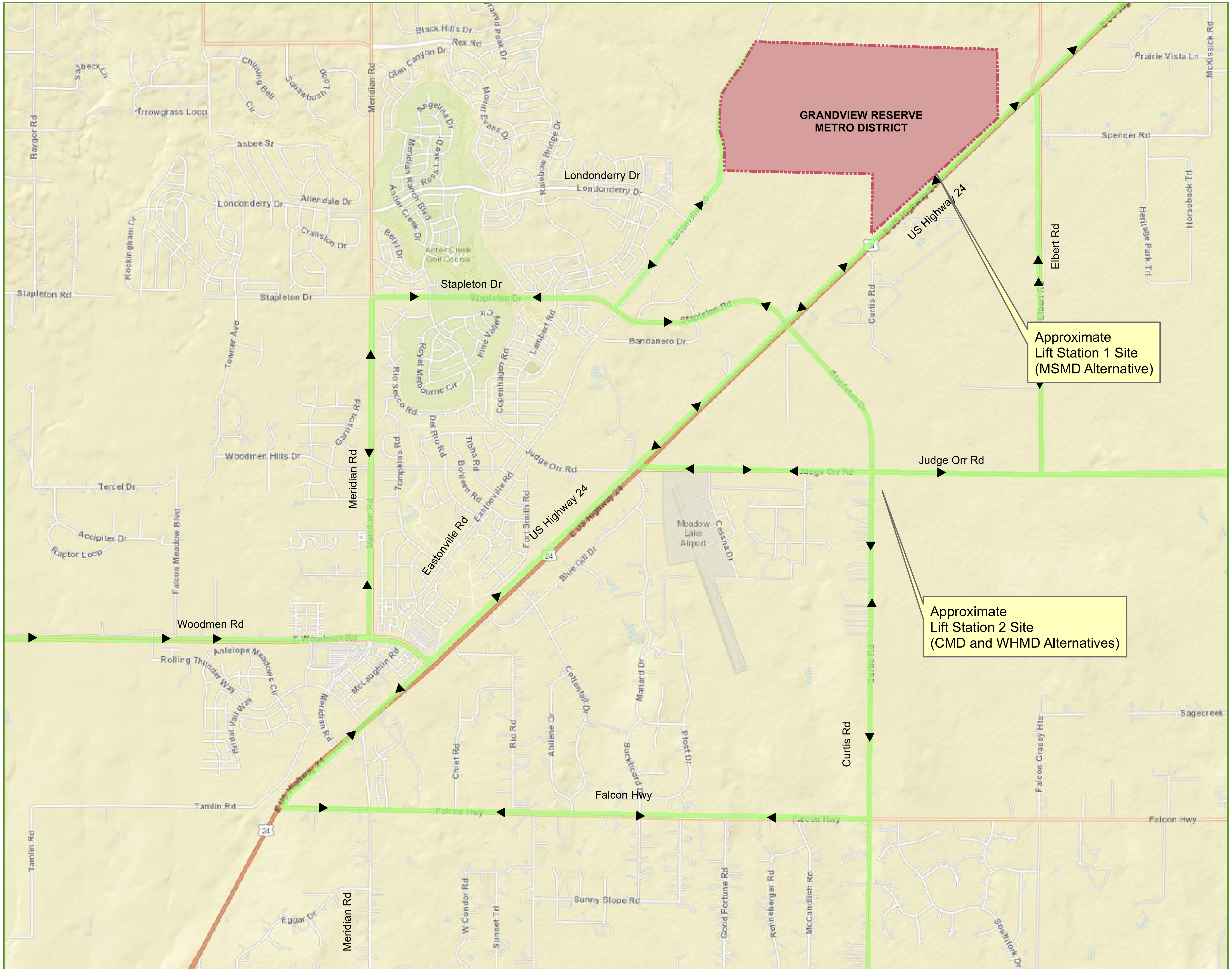


EXHIBIT HH: HAUL ROUTE EXHIBIT



Legend

Proposed Grandview Project Area

Preliminary Haul Route

Haul anticipated in both directions

Notes:

The proposed preliminary haul routes are for legal loads only. Any oversized or overweight loads will require a specific permit.

As projects are contracted out, different haul routes may be proposed by the applicant to EPC.

These preliminary haul routes are for construction of infrastructure covered by the 1041 permit only.

0 2,250 4,500 6,750 Feet

1 inch = 3,946 feet

N

Haul Route Exhibit

Grandview Reserve Metropolitan District 1041

HRGreen

1975 Research Parkway Suite 230
Colorado Springs, CO 80920
Phone: 719.300.4140

		DATE: 12/5/2023
		DRAWN BY: SJF
HRG JOB NO: 201662	**APPROVED BY:** MTV	**DESIGNED BY:** SJF

HRGJ:\2020\201662\GIS\Haul Route Exhibit 2.mxd Plotted: 12/5/2023 at 3:56:52 PM by cbudge

Legend

Proposed Grandview Project Area

Preliminary Haul Route
Haul anticipated in both directions

Notes:

The proposed preliminary haul routes are for legal loads only. Any oversized or overweight loads will require a specific permit.

As projects are contracted out, different haul routes may be proposed by the applicant to EPC.

These preliminary haul routes are for construction of infrastructure covered by the 1041 permit only.

0 2,800 5,600 8,400 Feet
1 inch = 5,000 feet
N

Haul Route Exhibit

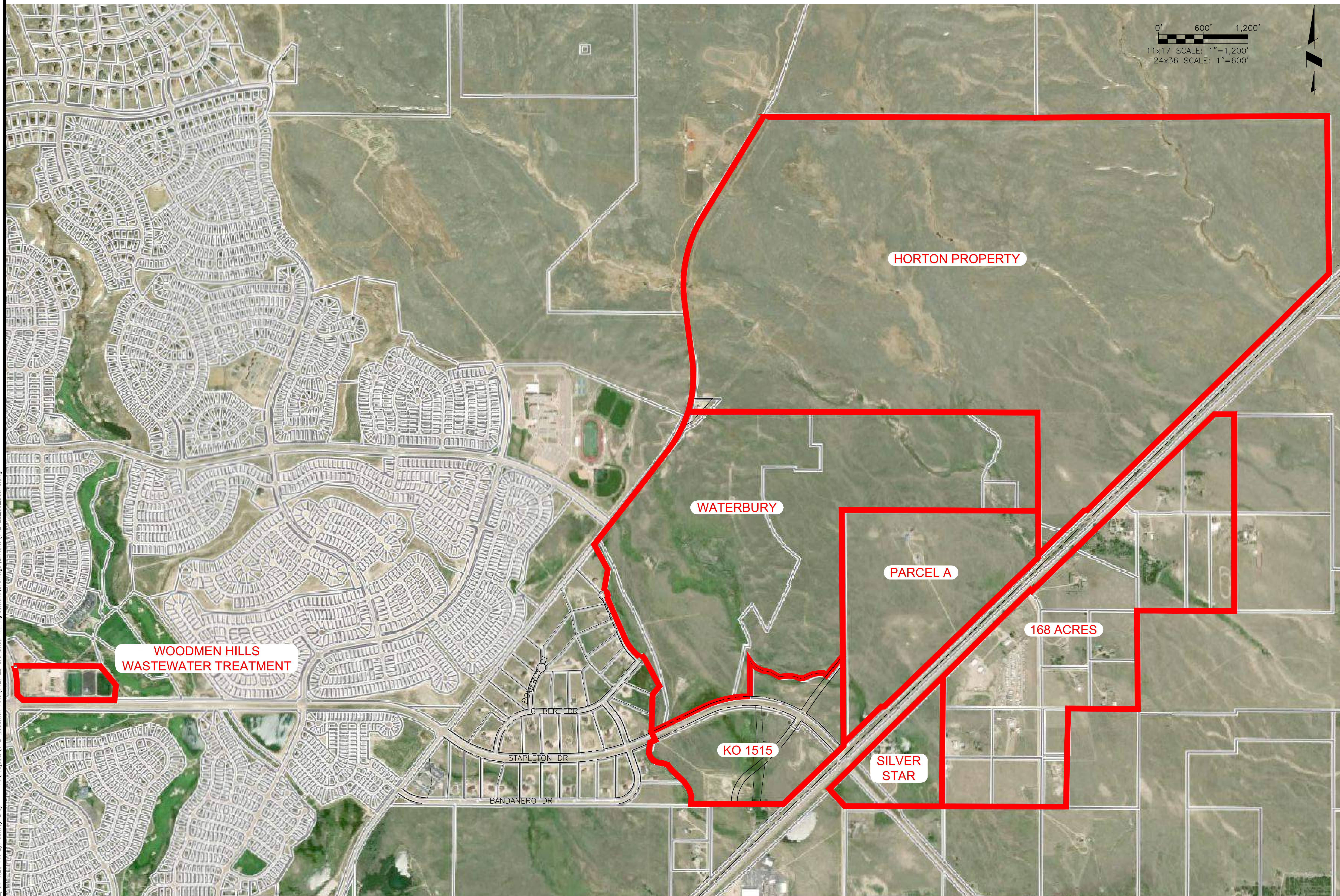
Grandview Reserve Metropolitan District 1041

HRGreen
1975 Research Parkway Suite 230
Colorado Springs, CO 80920
Phone: 719.300.4140

HRG JOB NO: 201662	**APPROVED BY:** MTV	**DATE:** 12/5/2023
		DRAWN BY: SJF
		DESIGNED BY: SJF

HRGJ:\2020\201662\GIS\Haul Route Exhibit.mxd Plotted: 12/5/2023 at 4:09:40 PM by cbudge

EXHIBIT II: SERVICE AREA FOR WOODMEN ALTERNATIVE



JDS-HYDRO CONSULTANTS, INC.
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

DISCLAIMER: THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS. ANY ERRORS OR OMISSIONS SHALL BE REPORTED TO JDS-HYDRO CONSULTANTS, INC. JDS-HYDRO ASSUMES NO LIABILITY FOR UNAUTHORIZED CHANGES AND/OR REVISIONS MADE TO PLANS.

EXHIBIT B

PARCEL OUTLINE

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

Project No.: 112.122
Date: 12/01/22
Design: JLB
Drawn: JLB
Check: JPM

B
SHEET OF

N:\Projects\112 Woodmen Hills\112.122 Grandview WW Agreement\Drawings\Exhibits\112122_SS_Basins.dwg
2022/12/01 1:26 PM By: Jeffrey Bray

EXHIBIT JJ: WELL PERMITS

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER **88211-F**

RECEIPT NUMBER **10027733**

ORIGINAL PERMIT APPLICANT(S)

GRANDVIEW RESERVE METROPOLITAN DISTRICT NO. 1
(PAUL HOWARD)

APPROVED WELL LOCATION

Water Division: 2 Water District: 10
Designated Basin: UPPER BLACK SQUIRREL CREEK
Management District: UPPER BLACK SQUIRREL
County: EL PASO
Parcel Name: N/A
Physical Address: N/A

NE 1/4 NW 1/4 Section 28 Township 12.0 S Range 64.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 537609.0 Northing: 4314956.6

PERMIT TO CONSTRUCT A NEW WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-90-107(7) and the Findings and Orders of the Colorado Ground Water Commission dated July 22, 2004 for Determination of Water Right No. 511-BD, December 3, 2008 Determination of Water Right No. 511-BD Amendment No. 1, and September 26, 2022 for Determination of Water Right No. 511-BD Amendment No. 2.
4) The pumping rate of this well shall not exceed 100 GPM.
5) Production from this well is restricted to the Arapahoe aquifer, which corresponds to the interval between 1,210 feet and 1,675 feet below the ground surface.
6) The allowed average annual amount of groundwater that may be withdrawn by this well under this permit may not exceed 1,400 acre-feet, subject to the conditions of Determination of Water Right no. 511-BD and Amendment No. 2 including but not limited to the allowed maximum annual amount of withdrawal.
7) The total amount of groundwater that may be withdrawn by this well under this permit may not exceed a volume of 140,000 acre-feet, subject to the conditions of Determination of Water Right no. 511-BD and Amendment No. 2.
8) The use of groundwater from this well is limited to domestic, livestock watering, lawn irrigation, commercial, industrial, replacement, augmentation and municipal use by Four-Way Ranch Metropolitan District and the Woodman Hills Metropolitan District; and all municipal purposes by the Grandview Reserve Metropolitan District No. 1 including: domestic, agricultural, stock watering, irrigation, commercial, industrial, manufacturing, fire protection, power generation, wetlands, piscatorial, and wildlife, either directly or after storage. The place of use shall be limited to the 8,095-acre land area and the service area of the Woodman Hills Metropolitan District within the Upper Black Squirrel Creek Designated Groundwater Basin claimed in the above described Order of the Commission dated December 3, 2008 for Amendment No. 1.
9) No more than 98% of the groundwater withdrawn annually shall be consumed. The Commission may require well owners to demonstrate periodically that no more than 98% of the water withdrawn is being consumed.
10) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
11) The entire length of the hole shall be geophysically logged as required by Rule 9 of the Statewide Nontributary Ground Water Rules prior to installing casing.
12) A totalizing flow meter or Commission approved measuring device must be installed on this well and maintained in good working order. Permanent records of all diversions must be maintained by the well owner (collected at least annually) and submitted to the Upper Black Squirrel Creek Ground Water Management District and the Ground Water Commission upon request.
13) This well shall be constructed within 200 feet of the location specified on this permit. This well shall not be located within 600 feet of another large-capacity well completed in the Arapahoe aquifer.

14) ADVANCE NOTICE REQUIRED - Pursuant to Construction Rule 6.2.2.1 (2 CCR 402-2), licensed or private drillers and pump installers must provide advance notification (by 11:59 pm the day before) to the State Engineer prior to each of the following for this well: the start of well construction, the initial installation of the first permanent pump, and the initial installation of a cistern connected to the water well supply system. Any change in the date of construction/installation must be re-noticed prior to the activity (by 11:59 pm the day before). Information regarding the notification process and a link to the electronic notification form can be found on the Division of Water Resources website at dwr.colorado.gov

NOTE: This well is withdrawing water from a non-renewable aquifer. While the withdrawals from this aquifer are administered based on a 100 year aquifer life, water level declines may prevent this well from diverting the permitted amounts for that 100 years.

NOTE: This well is located within the Upper Black Squirrel Creek Ground Water Management District where local District Rules apply which may further limit the withdrawal and use of designated ground water as authorized under this permit.

NOTE: This well will be completed in a Type 1 aquifer overlain by multiple confining layers and must be constructed with solid steel casing and grouted in accordance with Well Construction Rule 10.4.5.2 (2 CCR 402-2).

NOTE: This permit will expire on the expiration date unless the well is constructed by that date. A Well Construction and Yield Estimate Report (GWS-31) must be submitted to the Division of Water Resources to verify the well has been constructed. A one-time extension of the expiration date may be available. Contact the DWR for additional information or refer to the extension request form (GWS-64). Upon installation of the pump, a Pump Installation and Production Equipment Test Report (GWS-32) must be submitted to the Division of Water Resources. In addition, a Notice of Commencement of Beneficial Use (GWS-19) must be filed with the Division of Water Resources by the well owner within 30-days after first commencement of use. Forms are available at: dwr.colorado.gov

Wenli Dickinson

Issued By WENLI DICKINSON

Date Issued: 6/22/2023

Expiration Date: N/A

COLORADO
Division of Water Resources
Department of Natural Resources

WELL PERMIT NUMBER **88240-F**

RECEIPT NUMBER **10027734**

ORIGINAL PERMIT APPLICANT(S)

GRANDVIEW RESERVE METROPOLITAN DISTRICT NO. 1
(PAUL HOWARD)

APPROVED WELL LOCATION

Water Division: 2	Water District: 10
Designated Basin:	UPPER BLACK SQUIRREL CREEK
Management District:	UPPER BLACK SQUIRREL
County:	EL PASO
Parcel Name:	N/A
Physical Address:	N/A

NE 1/4 NW 1/4 Section 28 Township 12.0 S Range 64.0 W Sixth P.M.

UTM COORDINATES (Meters, Zone:13, NAD83)

Easting: 537607.1 Northing: 4314958.4

PERMIT TO CONSTRUCT A NEW WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-90-107(7) and the Findings and Orders of the Colorado Ground Water Commission dated July 22, 2004 for Determination of Water Right No. 510-BD, December 3, 2008 for Determination of Water Right No. 510-BD Amendment No. 1, and September 26, 2022 for Determination of Water Right No. 510-BD Amendment No. 2.
4) The pumping rate of this well shall not exceed 150 GPM.
5) The allowed average annual amount of groundwater that may be withdrawn by this well under this permit may not exceed 1,312.5 acre-feet, subject to the conditions of the above referenced Findings and Orders, including but not limited to the allowed maximum annual amount of withdrawal.
6) The total amount of groundwater that may be withdrawn by this well under this permit may not exceed a volume of 131,250 acre-feet, subject to the conditions of the above referenced Findings and Orders.
7) The use of groundwater from this well is limited to domestic, livestock watering, lawn irrigation, commercial, industrial, replacement, augmentation and municipal use by Four-Way Ranch Metropolitan District and the Woodman Hills Metropolitan District; and all municipal purposes by the Grandview Reserve Metropolitan District No. 1 including: domestic, agricultural, stock watering, irrigation, commercial, industrial, manufacturing, fire protection, power generation, wetlands, piscatorial, and wildlife, either directly or after storage. The place of use shall be limited to the 8,095-acre land area and the service area of the Woodman Hills Metropolitan District within the Upper Black Squirrel Creek Designated Groundwater Basin claimed in the above described Order of the Commission dated December 3, 2008 for Amendment No. 1.
8) Production from this well is limited to the Laramie-Fox Hills aquifer which is located approximately 2,025 feet below ground surface and extends to a depth of approximately 2,290 feet. In accordance with Rule 10.4.8 of the Water Well Construction Rules, plain steel casing must be installed and grouted from the top of the permitted production zone up to at least ten feet above the base of the surface casing, or to the depth required by Rule 10.5.2.1, if no surface casing is installed. (NOTE: If coals and/or carbonaceous shales are encountered in the borehole, plain casing and grout should be installed through these intervals to exclude poor quality water from entering the well.)
9) The owner shall mark the well in a conspicuous location with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
10) A totalizing flow meter or Commission approved measuring device must be installed on this well and maintained in good working order. Permanent records of all diversions must be maintained by the well owner (collected at least annually) and submitted to the Upper Black Squirrel Creek Ground Water Management District and the Ground Water Commission upon request.
11) The entire length of the hole shall be geophysically logged as required by Rule 9 of the Statewide Nontributary Ground Water Rules prior to installing casing.

12) This well shall be constructed within 200 feet of the location specified on this permit. This well shall not be located within 600 feet of another large-capacity well completed in the Laramie-Fox Hills aquifer.

13) No more than 98% of the groundwater withdrawn annually shall be consumed. The Commission may require well owners to demonstrate periodically that no more than 98% of the water withdrawn is being consumed.

14) ADVANCE NOTICE REQUIRED - Pursuant to Construction Rule 6.2.2.1 (2 CCR 402-2), licensed or private drillers and pump installers must provide advance notification (by 11:59 pm the day before) to the State Engineer prior to each of the following for this well: the start of well construction, the initial installation of the first permanent pump, and the initial installation of a cistern connected to the water well supply system. Any change in the date of construction/installation must be re-noticed prior to the activity (by 11:59 pm the day before). Information regarding the notification process and a link to the electronic notification form can be found on the Division of Water Resources website at dwr.colorado.gov

NOTE: This well is withdrawing water from a non-renewable aquifer. While the withdrawals from this aquifer are administered based on a 100 year aquifer life, water level declines may prevent this well from diverting the permitted amounts for that 100 years.

NOTE: This well is located within the Upper Black Squirrel Creek Ground Water Management District where local District Rules apply which may further limit the withdrawal and use of designated ground water as authorized under this permit.

NOTE: This permit will expire on the expiration date unless the well is constructed by that date. A Well Construction and Yield Estimate Report (GWS-31) must be submitted to the Division of Water Resources to verify the well has been constructed. A one-time extension of the expiration date may be available. Contact the DWR for additional information or refer to the extension request form (GWS-64). Upon installation of the pump, a Pump Installation and Production Equipment Test Report (GWS-32) must be submitted to the Division of Water Resources. In addition, a Notice of Commencement of Beneficial Use (GWS-19) must be filed with the Division of Water Resources by the well owner within 30-days after first commencement of use. Forms are available at: dwr.colorado.gov

Wenli Dickinson

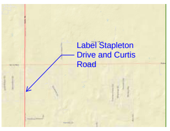
Issued By WENLI DICKINSON

Date Issued: 6/27/2023

Expiration Date: 6/27/2024

V4_Full Document Compiled with Appendices redline.pdf Markup Summary

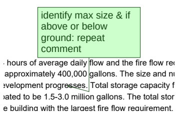
CDurham (1)



Subject: Callout
Page Label: 861
Author: CDurham
Date: 1/8/2024 4:15:21 PM
Status:
Color: ■
Layer:
Space:

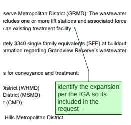
Label Stapleton Drive and Curtis Road

dsdparsons (37)



Subject: Planner
Page Label: 8
Author: dsdparsons
Date: 1/17/2024 11:36:42 AM
Status:
Color: ■
Layer:
Space:

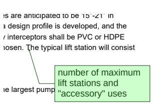
identify max size & if above or below ground: repeat comment



Subject: Planner
Page Label: 8
Author: dsdparsons
Date: 1/17/2024 11:37:29 AM
Status:
Color: ■
Layer:
Space:

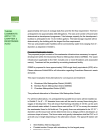
identify the expansion per the IGA so its included in the request-

---



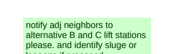
Subject: Planner
Page Label: 8
Author: dsdparsons
Date: 1/17/2024 11:38:14 AM
Status:
Color: ■
Layer:
Space:

number of maximum lift stations and "accessory" uses



Subject: Planner
Page Label: 8
Author: dsdparsons
Date: 1/17/2024 11:43:07 AM
Status:
Color: ■
Layer:
Space:

THESE COMMENTS APPLY TO CHAPTER 4 RESPONSES ALSO



Subject: Planner
Page Label: 8
Author: dsdparsons
Date: 1/17/2024 11:48:30 AM
Status:
Color: ■
Layer:
Space:

notify adj neighbors to alternative B and C lift stations please. and identify sluge or lagoons if propsoed.

Subject: Planner
Page Label: 9
Author: dsdparsons
Date: 1/17/2024 11:40:10 AM
Status:
Color: ■
Layer:
Space:

to verify no sludge or open lagoons are proposed here correct- as they are not requested?

Subject: Arrow
Page Label: 9
Author: dsdparsons
Date: 1/17/2024 11:39:21 AM
Status:
Color: ■
Layer:
Space:

Subject: Planner
Page Label: 10
Author: dsdparsons
Date: 1/17/2024 11:41:05 AM
Status:
Color: ■
Layer:
Space:

including ancillary facilities , and

Subject: Planner
Page Label: 54
Author: dsdparsons
Date: 1/17/2024 11:44:40 AM
Status:
Color: ■
Layer:
Space:

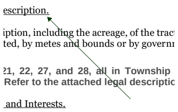
expansion to WMHD per IGA include in request

Subject: Planner
Page Label: 54
Author: dsdparsons
Date: 1/17/2024 11:45:09 AM
Status:
Color: ■
Layer:
Space:

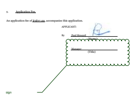
no open lagoons or sludge in alternative B and C correct?

Subject: Planner
Page Label: 56
Author: dsdparsons
Date: 1/17/2024 12:24:56 PM
Status:
Color: ■
Layer:
Space:

In addition, please add the parcel Nos for all 3 lift station alternatives; keep the legal provided

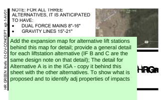


Subject: Arrow
Page Label: 56
Author: dsdparsons
Date: 1/17/2024 12:25:18 PM
Status:
Color:
Layer:
Space:



Subject: Planner
Page Label: 57
Author: dsdparsons
Date: 1/17/2024 11:45:44 AM
Status:
Color:
Layer:
Space:

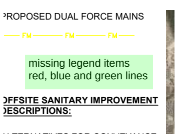
sign



Subject: Planner
Page Label: [1] SANITARY OFFSITE
Author: dsdparsons
Date: 1/17/2024 12:29:18 PM
Status:
Color:
Layer:
Space:

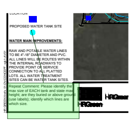
Add the expansion map for alternative lift stations behind this map for detail; provide a general detail for each liftstation alternative (IF B and C are the same design note on that detail); The detail for Alternative A is in the IGA - copy it behind this sheet with the other alternatives. To show what is proposed and to identify adj properties of impacts

---



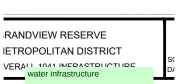
Subject: Planner
Page Label: [1] SANITARY OFFSITE
Author: dsdparsons
Date: 1/17/2024 12:30:01 PM
Status:
Color:
Layer:
Space:

missing legend items red, blue and green lines



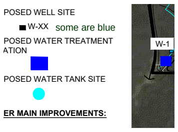
Subject: Planner
Page Label: [1] SANITARY
Author: dsdparsons
Date: 1/17/2024 12:31:05 PM
Status:
Color:
Layer:
Space:

Repeat Comment: Please identify the max size of EACH tank and state max height; are they buried or above ground (use labels); identify which lines are which size.



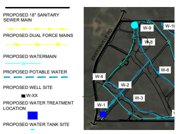
Subject: Planner
Page Label: [1] SANITARY
Author: dsdparsons
Date: 1/17/2024 12:51:28 PM
Status:
Color:
Layer:
Space:

water infrastructure

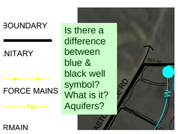


Subject: Planner
Page Label: [1] SANITARY
Author: dsdparsons
Date: 1/17/2024 12:57:57 PM
Status:
Color:
Layer:
Space:

some are blue

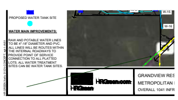


Subject: Planner
Page Label: [1] SANITARY
Author: dsdparsons
Date: 1/17/2024 12:55:41 PM
Status:
Color:
Layer:
Space:

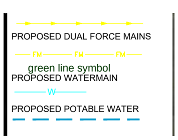


Subject: Planner
Page Label: [1] SANITARY
Author: dsdparsons
Date: 1/17/2024 12:56:57 PM
Status:
Color:
Layer:
Space:

Is there a difference between blue & black well symbol? What is it? Aquifers?

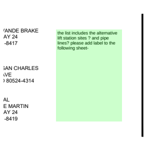


Subject: Arrow
Page Label: [1] SANITARY
Author: dsdparsons
Date: 1/17/2024 12:57:30 PM
Status:
Color:
Layer:
Space:



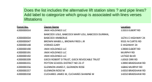
Subject: Planner
Page Label: [1] SANITARY
Author: dsdparsons
Date: 1/17/2024 12:58:19 PM
Status:
Color:
Layer:
Space:

green line symbol



Subject: Planner
Page Label: [1] SP1.3
Author: dsdparsons
Date: 1/17/2024 12:32:29 PM
Status:
Color:
Layer:
Space:

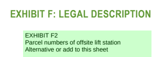
the list includes the alternative lift station sites ? and pipe lines? please add label to the following sheet-



Subject: Planner
Page Label: 61
Author: dsdparsons
Date: 1/17/2024 12:33:45 PM
Status:
Color:
Layer:
Space:

Does the list includes the alternative lift station sites ? and pipe lines? Add label to categorize which group is associated with lines verses liftstations

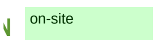
---



Subject: Planner
Page Label: 68
Author: dsdparsons
Date: 1/17/2024 12:35:01 PM
Status:
Color:
Layer:
Space:

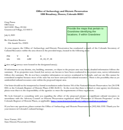
EXHIBIT F2
Parcel numbers of offsite lift station Alternative or add to this sheet

---



Subject: Planner
Page Label: 68
Author: dsdparsons
Date: 1/17/2024 12:35:10 PM
Status:
Color:
Layer:
Space:

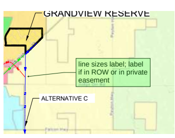
on-site



Subject: Planner
Page Label: 464
Author: dsdparsons
Date: 1/17/2024 10:58:00 AM
Status:
Color:
Layer:
Space:

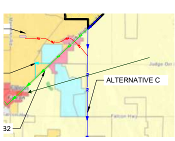
Provide the maps that pertain to Grandview identifying the locations. if within Grandview

---

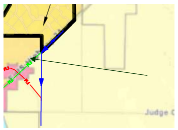


Subject: Planner
Page Label: [1] LAND USES
Author: dsdparsons
Date: 1/17/2024 11:25:01 AM
Status:
Color:
Layer:
Space:

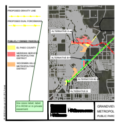
line sizes label; label if in ROW or in private easement



Subject: Arrow
Page Label: [1] LAND USES
Author: dsdparsons
Date: 1/17/2024 11:25:12 AM
Status:
Color:
Layer:
Space:

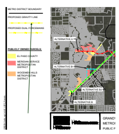


Subject: Arrow
Page Label: [1] LAND USES
Author: dsdparsons
Date: 1/17/2024 11:25:16 AM
Status:
Color:
Layer:
Space:



Subject: Planner
Page Label: [1] SANITARY OFFSITE
Author: dsdparsons
Date: 1/17/2024 11:26:23 AM
Status:
Color:
Layer:
Space:

line sizes label; label if in ROW or in private easement



Subject: Arrow
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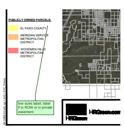
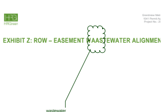
Author: dsdparsons
Date: 1/17/2024 11:26:11 AM
Status:
Color:
Layer:
Space:



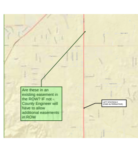
Subject: Planner
Page Label: [1] SANITARY OFFSITE (2)
Author: dsdparsons
Date: 1/17/2024 11:26:33 AM
Status:
Color:
Layer:
Space:

line sizes label; label if in ROW or in private easement



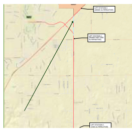
Subject: Planner
Page Label: 860
Author: dsdparsons
Date: 1/17/2024 11:28:18 AM
Status:
Color:
Layer:
Space:

wastewater



Subject: Planner
Page Label: 861
Author: dsdparsons
Date: 1/17/2024 11:29:41 AM
Status:
Color:
Layer:
Space:

Are these in an existing easement in the ROW? IF not - County Engineer will have to allow additional easements in ROW



Subject: Arrow
Page Label: 861
Author: dsdparsons
Date: 1/17/2024 11:29:54 AM
Status:
Color:
Layer:
Space:

Subject: Planner
Page Label: 894
Author: dsdparsons
Date: 1/17/2024 11:33:48 AM
Status:
Color:
Layer:
Space:

This needs to be a highlighted exhibit to expand the existing infrastructure under this 1041; identify exhibit and page number clearly in application.