IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

El Paso County, Colorado

Local office

Colorado Ecological Services Field Office

☎ (303) 236-4773
📠 (303) 236-4005

MAILING ADDRESS
Denver Federal Center
P.O. Box 25486
Denver, CO 80225-0486

PHYSICAL ADDRESS

134 Union Boulevard, Suite 670
Lakewood, CO 80228-1807

http://www.fws.gov/coloradoES
http://www.fws.gov/platteriver

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Preble's Meadow Jumping Mouse Zapus hudsonius preblei There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4090	Threatened

Birds

NAME	STATUS
Least Tern Sterna antillarum This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8505	Endangered
Mexican Spotted Owl Strix occidentalis lucida There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8196	Threatened
Piping Plover Charadrius melodus This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/6039	Threatened
Whooping Crane Grus americana This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/758	Endangered

Fishes

NAME	STATUS
Greenback Cutthroat Trout Oncorhynchus clarkii stomias No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2775	Threatened

Pallid Sturgeon *Scaphirhynchus albus* Endangered

This species only needs to be considered if the following condition applies:

- Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7162

Flowering Plants

NAME STATUS

Ute Ladies'-tresses *Spiranthes diluvialis* Threatened

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2159

Western Prairie Fringed Orchid *Platanthera praeclara* Threatened

This species only needs to be considered if the following condition applies:

- Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/1669

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

THERE ARE NO MIGRATORY BIRDS OF CONSERVATION CONCERN EXPECTED TO OCCUR AT THIS LOCATION.

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the “no data” indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ “Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds” at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER POND
- Palustrine

RIVERINE
- Riverine

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

IPaC resource list

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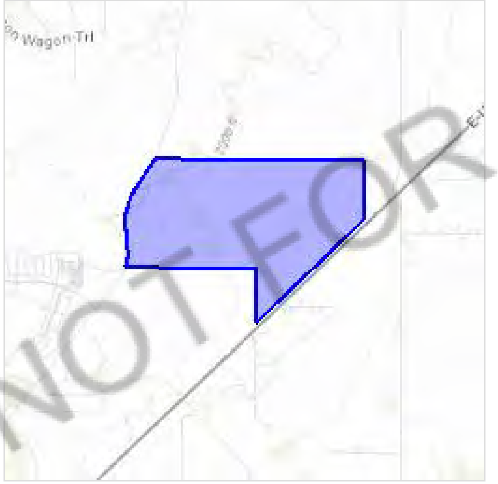
Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

El Paso County, Colorado



Local office

Colorado Ecological Services Field Office

☎ (303) 236-4773
📠 (303) 236-4005

MAILING ADDRESS
Denver Federal Center
P.O. Box 25486
Denver, CO 80225-0486

PHYSICAL ADDRESS

134 Union Boulevard, Suite 670
Lakewood, CO 80228-1807

http://www.fws.gov/coloradoES
http://www.fws.gov/platteriver

Endangered species

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The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

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2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Preble's Meadow Jumping Mouse Zapus hudsonius preblei There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4090	Threatened

Birds

NAME	STATUS
Least Tern Sterna antillarum This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8505	Endangered
Mexican Spotted Owl Strix occidentalis lucida There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8196	Threatened
Piping Plover Charadrius melodus This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/6039	Threatened
Whooping Crane Grus americana This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/758	Endangered

Fishes

NAME	STATUS
Greenback Cutthroat Trout Oncorhynchus clarkii stomias No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2775	Threatened

Pallid Sturgeon Scaphirhynchus albus — Endangered

This species only needs to be considered if the following condition applies:

- Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7162

Flowering Plants

NAME	STATUS
Ute Ladies'-tresses Spiranthes diluvialis No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2159	Threatened
Western Prairie Fringed Orchid Platanthera praeclara This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1669	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
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THERE ARE NO MIGRATORY BIRDS OF CONSERVATION CONCERN EXPECTED TO OCCUR AT THIS LOCATION.

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

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Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

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How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

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What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
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Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the “no data” indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER POND
- Palustrine

RIVERINE
- Riverine

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix E

Mineral Estate Owner Certification

CERTIFICATION:

I Mike Bramlett on behalf of JR Engineering researched the records of the El Paso County Clerk and Recorder and established that there was/[✓ was not] a mineral estate owner(s) on the real property known as Grandview Reserve. An initial public hearing on Grandview Reserve Preliminary Plan which is the subject of the hearing, is schedules for to be determined, ~~2000~~ 2019.

~~Pursuant to §24-65.5-103(4), C.R.S., I certify that a Notice of an initial public hearing was mailed to the mineral estate owner(s) (if established above) and a copy was mailed to the El Paso County Planning Department on ____________, 200___.~~

Dated this 8 day of JAnuary, 20~~0~~19.

Mike Bramlett

STATE OF COLORADO)
) s.s.
COUNTY OF EL PASO)

The foregoing certification was acknowledged before me this 8 day of January, 20~~0~~19, by Mike Bramlett.

Witness my hand and official seal.

My Commission Expires: 09-01-2020

LaDonna Nelson
Notary Public

LADONNA NELSON
Notary Public
State of Colorado
Notary ID # 20164033617
My Commission Expires 09-01-2020

Appendix F

ESA Clearance Letter from the USFWS

Ecological Benefits - Economic Value ecologicalbenefits.co

ecos ecosystem services LLC

Informal Consultation Request

April 10, 2020

Mr. Drue DeBerry
Acting Colorado Field Supervisor
U.S. Fish and Wildlife Service
Colorado Ecological Services Field Office
134 Union Blvd., Suite 670
Lakewood, Colorado 80228

RE: Request for Technical Assistance Regarding the Likelihood of Take of Federally-listed Threatened and Endangered Species resulting from the proposed development of the Grandview Reserve Project in El Paso County, Colorado

Dear Mr. DeBerry:

Ecosystem Services, LLC (ecos) has prepared the enclosed habitat evaluation on behalf of 4 Site Investments to describe the physical/ecological characteristics of the Grandview Reserve site (Site) and evaluate the potential effects of the proposed development project (Project) on the Federally-listed threatened and endangered (T&E) species protected under the Endangered Species Act (ESA).

The El Paso County Environmental Division has completed its review of the Project and has requested that 4 Site Investments provide a “Clearance Letter” obtained from the U.S. Fish and Wildlife Service (USFWS) to the Planning and Community Development Department prior to project commencement “where the project will result in ground disturbing activity in habitat occupied or potentially occupied by threatened or endangered species and/or where development will occur within 300 feet of the centerline of a stream or within 300 feet of the 100 year floodplain, whichever is greater.”

At this time there is no Federal action and no Federal agency is making a formal effects determination under Section 7 (a)(2) of the ESA. Therefore, ecos is requesting technical assistance from USFWS regarding 4 Site Investments’ (i.e., the non-federal party) responsibilities under the ESA, and specifically the likelihood of the Project (described herein) resulting in take of listed species. If the USFWS concurs with the findings presented herein we request that you issue an informal letter of concurrence for use in the El Paso County Project review process.

1.0 SITE LOCATION and PROJECT DESCRIPTION

The Site is located in the Falcon/Peyton area of El Paso County and is bounded along the north by 4 Way Ranch Phase I, along the south by Waterbury, along the southeast by Highway 24, and along the west by Eastonville Road. There are no existing structures, roads, or other infrastructure on the Site. The Site is located approximately 4.14 miles southwest of Peyton, 4.16 miles northeast of Falcon and 4.66 miles south of Eastonville, in El Paso County, Colorado. The Site is generally located within the south ½ of Section 21, south ½ of Section 22, the north ½ of Section 27, and the north ½ of Section 28, Township 12 South, Range 64 West in El Paso County, Colorado. The center of the Site is situated at approximately Latitude 38.98541389 north, -104.55472222 east (refer to Figure 1).

Technical Assistance
Tracking Number: 2019-TA-0460

U.S. FISH AND WILDLIFE SERVICE

● NO CONCERNS

○ CONCUR NOT LIKELY TO ADVERSELY AFFECT

○ NO COMMENT

04/29/2020

Liisa Schmoele DATE
Colorado Assistant Field Supervisor

Remarks: Ute ladies'-tresses orchid and Preble's mouse are not likely to occupy the project site. Project is still consistent with the section 7 conclusions from 2019.

Appendix G

Professional Qualifications

ecos ecosystem services LLC

RESUME

Grant E. Gurnée, P.W.S.

Owner/Managing Partner
Senior Restoration Ecologist
Professional Wetland Scientist
Fisheries and Wildlife Biologist

AREAS OF EXPERTISE:

- Project Management for Complex, Environmental Regulatory and Restoration Projects
- Habitat Assessment, Surveys, Planning, Permitting, Restoration Design, Construction Oversight & Monitoring for:
  - Aquatic, Wetland and Riparian Habitat, and Wildlife Habitat
  - Threatened & Endangered Species, Special Status Species, and Species of Concern
  - Nesting Birds & Raptors
  - Natural Areas, Open Space, Trails and Environmental Education Facilities
  - Conservation and Resource Mitigation Banks
- Natural Resources/Environmental Regulatory Compliance
- Construction Oversight & Best Management Practices
- Grant Funding Support for Conservation and Restoration Projects
- Expert Witness Testimony

EDUCATION:

- MCRP, Environmental Planning and Law Program, Rutgers University, 1994
- Bachelor of Science, Biology, Richard Stockton College of N.J., 1984

EMPLOYMENT HISTORY:

- 2008-Present: Owner, Managing Partner and Senior Restoration Ecologist
  Ecosystem Services, LLC, Erie, Colorado
- 1999-2011: Ecological Restoration Group Manager
  Walsh Environmental Scientists and Engineers, LLC, Boulder, Colorado
- 1994-1999: Vice President and Consulting Division Manager
  Aquatic and Wetland Company, Boulder, Colorado
- 1987-1994: Ecological Assessment Group Manager
  Killam Associates, Millburn, New Jersey
- 1989 – 1994: Owner and Ecologist, Westhill Environmental, Colonia, NJ
- 1986-1987: Project Manager, Connolly Environmental, Denville, New Jersey
- 1985-1986: Biological Technician/Team Lead, EA Engineering Science and Technology, Forked River Field Station, New Jersey

CONTINUING EDUCATION:

- Navigable Waters Protection Rule (NWPR) USEPA Webcast - 2020
- Colorado Stream Restoration Network, Stream Restoration Body of Knowledge Seminar Series – 2014 to 2019
- Stream Functions Pyramid Workshop, Denver, CO - 2014
- Colorado Natural Heritage Program, Wetland Plant Identification - 2014
- Colorado Natural Heritage Program, Ecological Integrity Assessment for Colorado Wetlands - 2013
- FACWet – Functional Assessment of Colorado Wetlands - 2010, 2012 and 2013
- Natural Treatment System Design and Implementation, Southwest Wetlands, Phoenix, AZ - 1995
- Continuing Education in Coastal and Wetland Ecology, Rutgers University, 1985 – 1994

CERTIFICATIONS:

- Professional Wetland Scientist, Certification (#559), Society of Wetland Scientists Certification Program, 1995
- Certified Wetland Delineator, Army Corps of Engineers Wetland Delineator Certification Program, 1993
- Wetland Mitigation Planning and Design Certification, Environmental Concern, Sparks, MD, 1992
- Certified Ornithologist, Marine Biologist, Aquatic Biologist and Ecologist for the preparation and certification of Environmentally Sensitive Areas Protection Plans, N.J. Dept. of Environmental Protection and Energy, 1988
- Wetland Delineation and Regulatory Certification, National Wetland Science Training Institute, 1988

PROTECTED SPECIES SURVEYS AND HABITAT ASSESSMENTS:

- Ute-ladies' tresses orchid and Colorado butterfly plant
- Preble's meadow jumping mouse
- Nesting birds and raptors, including burrowing owls
- Swift fox and bobcat
- Boreal toad
- Pine Barrens and grey tree frogs
- Freshwater, estuarine and marine surveys for native fish
- Western Tiger Salamander
- Terrestrial and sea turtles

EXPERIENCE SUMMARY:

Mr. Gurnée is a founder and managing partner of Ecosystem Services, LLC (ecos), a design-build, ecological planning and design firm that is the culmination of his life's work and passion for restoring and conserving the natural world. Grant is a certified Professional Wetland Scientist with over 36 years of experience in wetland ecology, restoration ecology, wildlife and fisheries biology, environmental planning, and regulatory compliance. Prior to ecos Grant established the Ecological Restoration Group at Walsh Environmental and was the Vice President in charge of the Consulting & Design Division for Aquatic and Wetland Company, the first design-build-grow firm in Colorado. Mr. Gurnée utilizes his diverse field assessment and hands-on experience to bring a unique and pragmatic, big-picture perspective to projects from conceptual planning through implementation. Grant's environmental planning and law education combined with his regulatory compliance experience make him one of the leading experts in the Intermountain West in Clean Water Act and Endangered Species Act issues. He enjoys teaching and furthering the science and art that comprise the field of restoration ecology. As such, Grant has published and presented papers and technical manuals, and lectured nationally and internationally at educational programs that further the understanding of aquatic, wetland, riparian and Threatened and Endangered (T&E) species habitat assessment and restoration. Mr. Gurnée has also been called upon to provide expert reports, expert witness testimony and liaison representation in complex regulatory compliance matters.

RELEVANT PROJECT EXPERIENCE:

The following is a sampling of select projects and clientele that Grant has successfully completed or is currently involved in:

Habitat Assessment and Regulatory Compliance

- **Cinemark Preliminary Habitat Assessment and Jurisdictional Assessment, Colorado Springs, CO** – ecos was hired by Classic Consulting Engineers and Surveyors to perform a Preliminary Habitat Assessment (PHA) and Jurisdictional Assessment of waters of the U.S. (WOUS) under the Clean Water Act (CWA)for Cinemark property within Colorado Springs, Colorado. The PHA included an assessment and mapping of vegetation, noxious weeds, Federal and State Listed Candidate, T&E Species, Wildlife Species of Concern (including Raptors), Waters of the U.S. and Wetland Habitat, Floodplains, and Cultural, Archeological and Paleontological Resources. The PHA Report summarizes ecos' Site assessment findings and includes the mapping of all ecological constraints and cultural resources, a preliminary jurisdictional status determination of all potential wetland habitat and WOUS under the CWA, a summary of ecological opportunities and constraints, and provides regulatory guidance to assist in planning and implementing the future development of the site.

- **Morning Fresh Dairy Farm Clean Water Act Jurisdictional Assessment, Bellvue, CO** – ecos was retained by Otis, Bedingfield & Peters, LLC to assist the Morning Fresh Dairy Farm in determining the jurisdictional status of onsite drainages under the CWA, including the assessment of onsite and offsite, downstream connections to Waters of the United States.
- **4 Way Ranch Assessment & Regulatory Compliance Report, El Paso County, CO** - ecos was retained by 4 Way Ranch to perform a natural resource assessment for their Phase 2 development, and to prepare a Natural Features Wetland, Wildfire, Noxious Weeds & Wildlife Report (Report) pursuant to El Paso County environmental review regulations. The purpose of the project was to identify and document the natural resources, ecological characteristics and existing conditions of the Site; identify potential ecological impacts associated with Site development; and provide current regulatory guidance related to potential development-related impacts to natural resources, including: Mineral and Natural Resource Extraction; Vegetation; Wetland Habitat and WOUS; Noxious Weeds; Wildfire Hazard; Wildlife; Federal and State Listed Candidate, Threatened and Endangered Species; and Raptors and Migratory Birds.
- **Banning Lewis Ranch, Colorado Springs, CO** – ecos was hired by Norwood Homes to perform a PHA for the Banning Lewis Ranch (BLR), an 18,000-acre property within El Paso County, Colorado that will double the size of Colorado Springs once it is developed. The PHA included an assessment and mapping of vegetation, noxious weeds, Federal and State Listed Candidate, T&E Species, Wildlife Species of Concern (including Raptors), Waters of the U.S. and Wetland Habitat, Floodplains, and Cultural, Archeological and Paleontological Resources. The PHA Report summarizes ecos' Site assessment findings and includes the mapping of all ecological constraints and cultural resources, a preliminary jurisdictional status determination of all potential wetland habitat and WOUS under the CWA, a summary of ecological opportunities and constraints, and provides regulatory guidance to assist in planning and implementing the future development of the BLR. Norwood and their planning team, in association with ecos, are currently uploading and interpreting all of the ecos Site assessment mapping into their base GIS layers to inform future site planning and recommend proactive measures to conserve wildlife and wetland habitat, pristine prairie and ephemeral creeks, floodplains, and significant cultural resources.
- **Clean Water Act Jurisdictional Assessment of El Guique Mine in Estaca, New Mexico –** Ecos assisted Espanola Transit Mix, LLC (ETM) in their assessment at the El Guique Mine in Estaca, New Mexico (Site) by determining the potential jurisdictional status of onsite drainages and other waters under the CWA. We reviewed available background information and base mapping to gain a better understanding of the Site and the adjacent offsite area and prepared an overlay of potential WOUS on Google Earth aerial Imagery for mark-up and notation in the field. Ecos then conducted a field assessment to review Site conditions, and potential offsite, downstream connections to WOUS, and particularly the presence of a Significant Nexus to the Rio Grande, a TNW. We drafted a Technical Memorandum summarizing the methodology employed, the results of the field assessment, the rationale under the CWA for all areas deemed to be excluded or non-jurisdictional and illustrated the locations of potential jurisdictional and non-jurisdictional features identified in the field on Google Earth aerial imagery.
- **Bellvue Pipeline Project, BMP Facilitator, Larimer County, CO** – ecos was retained by the City of Greeley as Best Management Practices (BMP) Facilitators to provide pre-construction documentation post-construction oversight of pipeline reclamation processes. Essential responsibilities include meeting with landowners prior to construction to facilitate project understanding and post-construction outcomes; to document landowner needs and wants relative to project goals and land use; to document and monitor pre- and post-construction reclamation and maintenance requirements; and to ensure the contractors maintain compliance with all state and federal laws, county regulations, and Greeley construction and restoration specifications.
- **Encana Oil and Gas (USA), Denver Julesburg Basin, CO** – Encana hired ecos to assess their ecological constraints, recommend means and methods to avoid, minimize and permit unavoidable impacts; and to mitigate, restore and prepare ecological management plans for their drilling and pipeline operations in the Denver Julesburg basin. Grant's role on the team is to perform site assessments, research background data, and prepare assessment reports and mapping data that can be utilized by Encana's project managers to proactively track ecological resources before issues arise. In addition to client consultation, Ecos is responsible for tracking drill site schedules, constraints, restoration and management efforts in a data base and reporting said information to Encana's project manager on a regular basis.
- **Georgetown Lake, Georgetown, CO** –ecos was hired to perform an onsite assessment of ecological resources and prepare a summary report to describe the physical/ecological characteristics of the Project

area and evaluate the potential effects of the construction of a loop trail project on environmental issues and species of concern to support a GOCO grant application. Items evaluated and documented, include site location/ownership, general site characteristics, current land use, proposed impacts, possible effects on Federal– and State-listed T&E animal and plant species, unique or important wildlife, water quality, water bodies, wetlands, and floodplains, stormwater runoff, sedimentation, soil erosion, and invasive species. The assessment report also included mitigation measures, project benefits, and environmental compliance recommendations under applicable regulatory programs.

- **Site Assessments for General Vegetation Cover and T&E Species Presence/Absence** – ecos was retained by JADE Consulting, LLC to perform the assessment of two future development sites located in Lafayette and Yuma, Colorado. We performed a desk-top assessment to identify existing site characteristics and screen the potential presence/absence of federally-listed T&E species and followed up with onsite assessments to verify our preliminary findings. Our findings and recommendations were summarized in a Technical Memorandum in which we determined that no further assessment or regulatory compliance actions are required.
- **The Cove Assessment & Regulatory Compliance Report, El Paso County, CO** - ecos was retained by Lake Woodmoor Development, Inc.to perform a natural resource assessment for The Cove development, and to prepare a Natural Features Wetland, Wildfire, Noxious Weeds & Wildlife Report (Report) pursuant to El Paso County environmental review regulations. The purpose of the project was to identify and document the natural resources, ecological characteristics and existing conditions of the Site; identify potential ecological impacts associated with Site development; and provide current regulatory guidance related to potential development-related impacts to natural resources, including: Mineral and Natural Resource Extraction; Vegetation; Wetland Habitat and Waters of the U.S.; Noxious Weeds; Wildfire Hazard; Wildlife; Federal and State Listed Candidate, Threatened and Endangered Species; and Raptors and Migratory Birds.
- **Jurisdictional Determination Request for Banning Lewis Ranch, Villages 1 and 2 Residential Development, El Paso County, CO** - ecos was retained by Oakwood Homes, LLC to review a 2014 Jurisdictional Boundary Delineation and determine if a portion of the wetlands and waters within the site could be deemed non-jurisdictional under the Clean Water Act (CWA) based on their "isolated" status. Following data review, ecos arranged a field assessment with the U.S. Army Corps of Engineers (Corps) to review site conditions, and potential offsite, downstream connections to waters of the U.S. (WOUS), and particularly the presence of a Significant Nexus to Traditional Navigable Waters TNW). Ecos and the Corps agreed that several of the intermittent drainages on the suite are not jurisdictional under the CWA, as they are not: 1) a TNW or wetland adjacent to a TNW; 2) a Relatively Permanent Water (RPW) or a wetland directly abutting an RPW with perennial or seasonal flow; 3) a tributary to a TNW; or 4) a direct tributary to a downstream WOUS as the feature loses it bed and banks. The Corps submitted ecos' findings to the U.S. Environmental Protection Agency (EPA) and they concurred and issued an Approved Jurisdictional Determination stating that the drainages were indeed "isolated" features exempt from the CWA.
- **Bellvue Pipeline Project, CWA and ESA Regulatory Negotiation, Larimer County, CO** – ecos assisted the City of Greeley from 2011 through 2014 in their negotiations with the Corps to facilitate review and verification of the Project under CWA, Nationwide Permit12 (NP12) in 2014. Grant aided the City during Corps meetings, field visits and teleconferences; in coordinating with the Corps and the technical experts on the Corps Common Technical Platform (CTP) team; and in utilizing the CTP Poudre watershed data to assess the probability of Project-specific impacts. Grant also provided regulatory and technical support to the City for the CWA, Pre-Construction Notification (PCN) Supplement for the Project from 2014 through the USACE's 2017 issuance of the "removal of capacity conditions for the Northern and Fort Collins segments" placed on the 2014 NP12. His tasks included performing Impact Avoidance Evaluations, providing historical context and data from the initial work performed for the City on this Project, assisting a Team of multi-disciplinary professionals in the preparation of Impact Assessment Reports, meeting with the City to discuss overall regulatory strategy, assisting with the preparation of the cover letter to transmit the PCN Supplement to the USACE, and assisting with discussions and presentations to the USACE during their review and processing of a Minimal Effects Determination for the Project.
  Mr. Gurnée also assisted Greeley in their negotiations with the FWS to facilitate review and consultation for the Northern Segment of the Project under Section 7 of the ESA. Grant led the field assessment with FWS, identification and prioritization of potential PMJM habitat mitigation sites, development of a conceptual design for the selected PMJM habitat mitigation sites, and preparation of the Biological Assessment

Addendum and Habitat Mitigation Plan. Grant also aided the City during agency review and approval of the FWS Biological Opinion by utilizing his relationships with the FWS, and extensive experience of ESA regulations, policies and precedents.

- **Appraisal Support Documentation Report for the 1st Bank Parcel, Colorado Springs, CO** - ecos was retained by 1st Bank Holding Company to perform a Preble's meadow jumping mouse (PMJM) habitat assessment, mitigation cost analysis and conceptual lot layout for the approximate 9.4-acre 1st Bank Parcel (Site) situated south of the Gleneagle residential development and north of the current Northgate Open Space along Smith Creek in Colorado Springs, Colorado.
- **South Boulder Canon Ditch Maintenance, CWA Exemption Determination, Erie, CO** – ecos assisted the Town of Erie in exempting their proposed ditch maintenance project by performing an assessment of site conditions, submitting the assessment report to the Corps, and verifying that said project is exempt pursuant to Section 404(f) of the CWA.
- **Endangered Species Act (ESA) Compliance Documentation for the Pinon Lake tributary CLOMR Application, Forest Lakes Filing 2B in El Paso County, Colorado** – ecos performed an assessment to document the absence of federally-listed T&E species and their habitat and prepared a report for FEMA that documents that the proposed CLOMR action will not result in a "take" of T&E species.
- **Gleneagle Infill Development Assessment & Regulatory Compliance Report, El Paso County, CO** - ecos was retained by G & S Development, Inc. to perform a natural resource assessment for the proposed Gleneagle Infill Development at the former Gleneagle Golf Course, and to prepare a Natural Features and Wetland Report (Report) pursuant to El Paso County environmental review regulations. The purpose of the project was to identify and document the natural resources, ecological characteristics and existing conditions of the Site; identify potential ecological impacts associated with Site development; and provide current regulatory guidance related to potential development-related impacts to natural resources, including: Mineral and Natural Resource Extraction; Vegetation; Wetland Habitat and Waters of the U.S.; Weeds; Wildfire Hazard; Wildlife; Federal and State Listed Candidate, Threatened and Endangered Species; and Raptors and Migratory Birds. As part of the Project, ecos obtained an Approved Jurisdictional Determination from the Corps.
- **North Fork at Briargate Habitat Evaluation and ESA Compliance, Colorado Springs, CO** - ecos performed a habitat evaluation on behalf of High Valley Land Co., Inc. and La Plata Communities to support informal consultation with the U.S. Fish and Wildlife Service (FWS) under the ESA for potential effects to the Federally-listed, threatened PMJM from the proposed North Fork development, Filings 3 through 7 at Briargate.
- **C Lazy U Preserves Natural Resource Inventory and Conservation Easement Documentation, Grand County, CO** – ecos is assisting the C Lazy U Preserves in assessing and documenting the conservation values of the 980-acre site known as C Lazy U Preserves near Granby, CO such that the site may be protected under Conservation Easements (CE's) held by The Nature Conservancy. The purpose of the CE's is the long-term preservation of the scenic, open space, agricultural, significant natural habitat, native vegetation, rare plant communities, riparian, and wetland values of the Property. ecos staff completed the Easement Documentation Reports Phase 1 of the CE's in 2006, Phase 2 in 2007, and Phase 3 in 2015.
- **Seaman Water Management Project, Riparian-Wetland Technical Support -** Mr. Gurnée supported Greeley in the NEPA EIS process by reviewing riparian and wetland technical reports prepared by the Corps CTP team, and providing comments to assist the City in their formal review and response to the Corps. He also provided technical and regulatory support for CWA and ESA (PMJM habitat) assessment, consultation, and compensatory mitigation planning and design.
- **City of Louisville, City of Westminster, Jefferson County and Town of Monument** – ecos performed numerous wetland habitat, wildlife, MBTA and T&E species habitat ecological assessments, wetland delineations, and Clean Water Act Section 404 and Endangered Species Act Section 7 Permits and mitigation plans for counties, municipalities and quasi- municipalities, including Highway 42 and 96th Street realignment, Jim Baker Reservoir, Standley Lake Protection Project, Triview Metro District Preble's and wetland habitat mitigation planning.
- **ARCO Clark Fork River Basin Anaconda Smelter Superfund Site, Anaconda, MT** – Grant and his Team performed wetland delineation, functional assessments, and impact analysis over a 200 square mile area affected by historic mining practices and current remedial actions required by an EPA consent decree.

- **ARCO Clark Fork River Basin Milltown Reservoir Superfund Site, Missoula, MT** – Mr. Gurnée and his Team performed wetland delineation, functional assessments, and impact analysis of proposed remedial actions that will remove metal laden sediments from the site prior to dam removal.
- **C-Lazy-U and Horn Ranch Environmental Assessments, Granby, CO** – Mr. Gurnée and his Team performed an assessment of ecological opportunities and constraints in the aquatic, riparian, wetland and threatened and endangered species habitat along the Colorado River for the development and enhancement of fishing/resort ranch amenities.
- **Village at Avon, Avon, CO** – Grant and his Team performed a wetland delineation and prepared CWA Section 404 permitting for the town center expansion and low-density ranchette development.

Protected Species Surveys and Habitat Assessments

- **Golden Eagle Monitoring at Meadow Park in Lyons, CO** - ecos was retained by the Town of Lyons (Town) to perform the monthly monitoring of the Golden Eagle (*Aquila chrysaetos*) nest sites at Meadow Park, to prepare monthly Monitoring Summary Memorandum following each event, and to prepare and submit annual reporting to the U.S. Fish and Wildlife Service (USFWS) associated with the *Lyons Federal Fish and Wildlife Permit #MB82833B-0, Eagle Take Associated With But Not The Purpose Of An Activity* (Take Permit).
- **Nesting Birds, Raptors and Burrowing Owls** – Grant has completed over 100 pre-construction nesting surveys and numerous monitoring surveys for raptors and burrowing owls. His projects include pipeline rights-of-way, housing and commercial development projects, stream and river restoration projects, wind and solar farm projects, and oil and gas projects along the Front Range of Colorado, as well as projects in the Pine Barrens of southern New Jersey. His avian experience includes golden eagle nest monitoring; barred owl roost and nest monitoring, and call playback inventory; and multi-species raptor surveys.
- **Native Plants** - Grant has completed numerous pre-construction and monitoring surveys for Ute ladies' tresses orchid and Colorado butterfly plant since 1994. His projects include pipeline rights-of way, mined land reclamation projects, housing and commercial development projects, stream and river restoration projects, wind and solar farm projects, and oil and gas projects along the Front Range of Colorado.
- **Threatened, Endangered and Candidate Species** – Grant trained with the leading expert, Robert Stoecker, PhD, in 1994 and 1995 to gain an understanding of the soon to be listed, Preble's meadow jumping mouse, a threatened species; and since that time, he has completed numerous surveys, habitat assessments, and ESA consultations. He has also performed night-time Swift fox surveys at windfarm sites in southern CO and Boreal toad surveys in northern CO. Prior to relocating to CO Grant performed numerous surveys in N.J., including bobcat surveys to assist in protecting the Pyramid Rock Natural Area; Pine Barrens and gray tree frog surveys, and native Pine Barrens fish surveys with his mentor, Dr. Rudy Arndt; and Eastern box turtle surveys. He also assessed migration routes and alternative mitigation measures for sea turtles that were being impacted by the Garden State Parkway.

Wetland Mitigation and Habitat Restoration

- **Park Creek Mitigation Bank, Fort Collins, CO –** ecos was retained by Burns and McDonnell to assess, map, and prepare preliminary mitigation design of aquatic, wetland, riparian and terrestrial habitat in support of a mitigation banking prospectus. Upon completion and acceptance of the prospectus by the USACE, ecos has been tasked to manage the baseline assessment of the site, including groundwater testing, topographic surveys, and hydrology; prepare a detailed habitat design for inclusion in mitigation banking instrument; as well as coordinate design-build process with a selected nursery and contractor.
- **Front Range Mitigation and Habitat Conservation Bank –** ecos is assisting Restoration Systems, LLC (RS), the Bank Sponsor, with the assessment, planning and design of the Front Range Umbrella Bank for Aquatic Resource Mitigation & Habitat Conservation (Bank). This "umbrella" Bank is intended to provide habitat mitigation for projects along the entire Front Range of Colorado. The **ecos**/RS Team is in the process of securing viable sites in the major watersheds along the Front Range; and recently submitted the Draft Prospectus for the establishment of the Bank to the U.S. Army Corps of Engineers, Albuquerque District, Southern Colorado Regulatory Office and Omaha District, Denver Regulatory Office.
- **Lions Park Poudre River CWA and ESA Mitigation Site** - ecos assisted Greeley in developing and constructing an advance river and wetland mitigation site at Lions Park in LaPorte, Colorado that may be used for future CWA impacts in the Poudre River watershed. We also prepared a conceptual design for Preble's meadow jumping mouse habitat that will be used to support ESA consultation. ecos assessed the

site, prepared the designs, and coordinated review with Greeley, Colorado Department of Parks and Wildlife, Larimer County Parks and Open Lands and Larimer County Engineering Department. The mitigation site provides compensatory mitigation for impacts to wetland and waters of the U.S. under the CWA and will also provide compensation for PMJM habitat under the ESA. This mitigation project entails development of mitigation measures including bioengineered streambank stabilization, fishery habitat enhancement, riparian and wetland habitat restoration and PMJM habitat enhancement.

- **Bellvue Transmission Line Project, Preliminary Compensatory Mitigation Plan (PCMP) -** Mr. Gurnée was the Project Manager for the preparation of the Preliminary Compensatory Mitigation Plan (PCMP) for the Bellvue Transmission Line Project. Built upon preferred strategies in the 2008 Corps Compensatory Mitigation Rules, the PCMP leverages a broad strategy to ensure mitigation success and employs a watershed approach to select and prioritize compensatory mitigation (CM) measures that will best mitigate adverse environmental effects. It is intended to support a Corps determination of minimal adverse effect and allow verification of the Northern Segment of the Project under Nationwide Permit 12. Grant led the Team during the watershed assessment of the Poudre River, identification and prioritization of potential CM and preservation sites, development of a Pilot Watershed Plan, and conceptual design of priority CM sites. The PCMP has been submitted to the Corps for review and approval.
- **Flatirons Parcel Riparian and Wetland Habitat Restoration Project** – Grant assisted Greeley in developing a multiple use project at the Flatirons Parcel, a gravel quarry site in Greeley, Colorado. The site is being decommissioned over the next decade and offers great potential to create a system of ponds connected via a naturalized stream that discharges into the Poudre. The concept design incorporates recreation opportunities that are tied into the Poudre River Trail, a passive park, and the development of wetland, riparian and wildlife habitat.
- **Ruby Pipeline Wetland, Riparian and Waterbody Mitigation and Restoration Plan, WY, UT, NV AND OR -** Mr. Gurnée was the lead restoration ecologist and wetland scientist for the 675-mile, Ruby Pipeline; a natural gas pipeline traversing four states. He was the lead for the preparation of Wetland Mitigation, Riparian and Waterbody Restoration Plans under the CWA, BLM regulations and state equivalent programs. The plans included regulatory guidelines, requirements, and processes; and ecoregion specific restoration plans. The plans detailed specifications for the basis of design, construction, and revegetation; outlined performance criteria, maintenance and monitoring methods for the restoration of approximately 460 acres of temporary wetland impacts.
- **River Point, Sheridan, CO -** Mr. Gurnée was the project manager and lead restoration ecologist for the team that assessed, permitted and designed the natural and aesthetic features of this Brownfields project. The project included a naturalized water quality swale and riverfront improvements which complement the aesthetics and ecology of the South Platte River corridor. The swale was designed to mimic the form and function of a tributary stream, providing passive water treatment with native wetland and riparian vegetation, as well as flood attenuation with instream structures and grade control. The project utilized natural, “bio-engineering” and “bio-technical” techniques to repair and maintain channel and stream bank stability, and native vegetation to enhance and restore habitat. This project also addressed the interface of proposed restaurants, a regional greenway trail, and the river through planning and design of nature trails, interpretive nodes and overlooks/access features that will function to both stabilize banks and help connect people with the river.
- **Caribou Peat Bog Restoration, Nederland, CO –** Grant performed the impact assessment, prepared native plant community design, planting cost estimate, and on-the-ground oversight of restoration volunteers to restore a high-altitude peat bog disturbed by an illegal off-road-vehicle “mudfest”.
- **Opportunity Ponds Operational Unit, Anaconda, MT -** Mr. Gurnée was the project manager and lead restoration ecologist providing technical support to Atlantic Richfield/British Petroleum at a Superfund site in the Upper Clark Fork River basin in Montana between 1995 and 2008. Services included wetland delineation and functional assessment of over 3,000 acres of wetland, stream and pond habitat; design of stream and wetland habitat mitigation projects; and permitting/compliance services. The largest project within the Superfund site was the Opportunity Ponds, a 908-acre wetland, stream and wildlife habitat creation project. The project will result in the largest freshwater mitigation project in the U.S; and is intended to mitigate for historic wetland/waters impacts from Anaconda Mining Company operations and current impacts resulting from remedial actions associated with the Superfund cleanup process.
- **The Club at Flying Horse Golf Course, Colorado Springs, CO –** On behalf of Classic Communities, Grant and his Team assessed wetland habitat, recommended impact avoidance and minimization

measures, and prepared the Section 404, CWA permit for a 1500-acre mixed use development and Weiskopf golf course. The project aesthetic and mitigation measures included the design of native prairie roughs, meandering stream channels and native wetland meadows within the golf course. Extra wetland mitigation was created to serve as a private mitigation bank for the client.

- **Maloit Park, Minturn, CO -** Grant was the project manager and restoration ecologist for the Maloit Park Restoration Project, which was necessitated by the accidental release of mine slurry that contaminated the soils and vegetation of critical wetland habitat at the confluence of Cross Creek and the Eagle River. The project included the assessment of the site, the collection of native wetland seed (that was adapted to site conditions); the selection of appropriate replacement soil; the design of the restoration grading and planting plans; and oversight during the soil replacement, grading and planting phases. Mr. Gurnée also provided follow-up monitoring and reporting to ensure the successful establishment of the wetland habitat.
- **Department of Energy, Private Mitigation Bank, Westminster, CO -** Mr. Gurnée provided the project assessment, design, permitting, mitigation banking instrument negotiation with the Corps and EPA, and construction supervision of a 12-acre wetland mitigation bank for the Department of Energy in Westminster, CO. The project provides compensatory mitigation for impacts associated with the Rocky Flats clean-up and remediation project. It should be noted that this was the first private mitigation bank negotiated in Colorado, and as such it assisted in setting the precedent for future negotiations.
- **Saudi Arabia Coastal Wetland Restoration -** Mr. Gurnée assisted in the restoration planning for 67 square kilometers (41 square miles) of high salt marsh (sabhka) impacted by Gulf War oil spills.

Aquatic, Wetland, and Riparian Habitat Design

- **Saint Vrain Creek Reach 3 Phase 2 Flood Recovery and Restoration, Boulder County, CO** - ecos is part of the Design Team assisting Boulder County Parks & Open Space (BCPOS) with the restoration, repair and enhancement of the Phase 2 reach of the Saint Vrain Creek in rural Boulder County, which was damaged by the 2013 floods. Our role on the project includes: 1) desktop and field assessment to inventory and document the characteristics of the stream reach and riparian corridor (e.g. stream/in-stream features, vegetation, wildlife habitat); identifying and locating significant habitat features within the areas of proposed construction; identifying potential sources of native plant materials for restoration; and identifying areas of opportunity within the breach repair work areas for native vegetation, wetland, PMJM, and fishery habitat restoration; and delineate wetland habitat and waters of the U.S. in all areas of proposed/potential construction-related impact; 2) vegetation community and wildlife habitat restoration design and fish passage design parameters; 3) permitting and compliance under the CWA and ESA; 4) construction oversight for restoration construction; and 5) monitoring and reporting project success/establishment to BCPOS, stakeholders, the Corps, FWS and the State of Colorado Department of Local Affairs (DOLA) under the (the Grant funding agency under the Community Development Block Grant Disaster Recovery (CDBGDR) Resilience Planning Program grant.
- **Big Thompson River Flood Recovery and Restoration, Loveland, CO -** ecos is currently part of a multi-disciplinary team assisting the Big Thompson Watershed Coalition (BTWC) with assessment, design, and construction of the Big Thompson between Rossum and Wilson Drives which are majority-owned by the City of Loveland and Loveland Ready-mix. As with all the flood recovery projects ecos has worked on, we produced 30%, 60% and 100% design plans, construction cost estimates, and specifications guiding soil development/enrichment; upland, riparian, and wetland seeding and planting; and numerous bioengineering techniques aimed at restoring the river and making it more resilient to future flood events. This project is aimed at completion in the summer of 2019.
- **Saint Vrain Creek Reach 3 Flood Recovery and Restoration, Boulder County, CO** - ecos was part of the Design Team assisting BCPOS with the restoration, repair and enhancement of the reach of the Saint Vrain Creek from Highway 36 downstream to Hygiene Road in rural Boulder County, which was damaged by the 2013 floods. Our role on the project included: 1) desktop and field assessment to inventory and document the characteristics of the stream reach and riparian corridor (e.g. stream/in-stream features, vegetation, wildlife habitat); identifying and locating significant habitat features within the areas of proposed construction; identify potential sources of native plant materials for restoration; and identify areas of opportunity within the breach repair work areas for native vegetation, wetland, PMJM, leopard frog and fishery habitat restoration; and delineate wetland habitat and waters of the U.S. in all areas of proposed/potential construction-related impact; 2) vegetation community and wildlife habitat restoration design and fish passage design parameters; 3) permitting and compliance under the CWA, ESA and

NHPA; 4) construction oversight for restoration construction; and 5) monitoring and reporting project success/establishment to BCPOS, stakeholders, the Corps, FWS and the State of Colorado DOLA under the CDBGDR Resilience Planning Program grant.

- **Bohn Park Flood Recovery Design, Town of Lyons, CO** – ecos is part of the Design Team assisting the Town with the restoration, repair and enhancement of Bohn Park in Lyons, which was damaged by the 2013 floods. Ecos roles is to assess and design the natural restoration of the vegetation communities and habitat along St. Vrain Creek and riparian corridor; and to support the project design by acquiring permits/approvals and maintaining regulatory compliance under the CWA, ESA and National Historic Preservation Act (NHPA). The final design will address goals and priorities associated with the Parks Flood Recovery Planning Process, FEMA Project Worksheets and Project Scopes, the Lyons Recovery Action Plan (LRAP), associated Program Development Guides (PDG's), existing Town master plans, comprehensive plans and other relevant documentation and studies.
- **James Creek Post-Flood Restoration, Lefthand Watershed Oversight Group (LWOG), Jamestown, CO** – ecos was part of the LWOG and Boulder County Department of Transportation Team responsible for preparing the 30-60% design package for James Creek Reach 16 as identified in the Left Hand Creek Watershed Master Plan. ecos performed pre- and post-flood plant community assessment; developed revegetation goals and objectives, the basis of design, monitoring protocols, and revegetation plans in accordance with Colorado Department of Local Affairs (DOLA), Community Development Block Grant – Disaster Recovery (CDBG-DR) 30% Guidelines. Specific resources and issues of concern addressed by ecos, included federal and state listed candidate, threatened and endangered species, wildlife species of concern (including raptors), fisheries and fish passage, native plant communities, and management of noxious weeds, all in concert with geomorphic, hydrology and hydraulic analysis and design prepared by other team members.
- **Saint Vrain Creek Restoration and Floodplain Resiliency Plan, Lyons, CO** – ecos is part of the design-build team intent on restoring the St. Vrain Creek corridor in the Town of Lyons that was damaged during the September 2013 flood event. The goal of the project is to create a more resilient floodplain and natural channel condition that will alleviate future threats to the community, reestablish floodplain connectivity, stabilize banks, and restore aquatic, wetland and riparian habitat that was wiped out during the flood. Grant is responsible for CWA, ESA, Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act permitting; as well as developing the plant communities and revegetation strategies needed to restore aquatic and riparian structure and functions within the corridor that support fish, wildlife, recreation, and help the town regain the ecological benefits and economic value they receive from outdoor enthusiasts.
- **Bellvue Raw Water Ponds Riverbank Restoration, Bellvue, CO –** The 2013 flood on the Poudre River altered the course of the river and severely eroded a bank nearly causing a breach of the City of Greeley's raw water ponds – their main municipal water supply. The goal of the project was to stabilize the bank to protect the ponds and to create riparian habitat for the Preble's meadow jumping mouse, a federally listed threatened and endangered species. Jon was responsible for preparing bioengineering design plans and specifications that include soil/cobble encapsulated lifts, stream barbs to deflect flows away from the bank, and harder, biotechnical design of soil/riprap and stream bed scour protection measures to prevent erosion and further undermining and sloughing of the bank. Design plans included specification of native plant materials and various techniques to restore cottonwood forest and willow habitat to further stabilize the bank.
- **Poudre River Pipeline Crossing at Kodak, Windsor, CO –** ecos role on the project was to assess restoration potential, techniques, and prepare design plans and performance specifications to reclaim a pipeline corridor across the lower Poudre River where the City of Greely had to replace 3 major water supply lines. ecos also provided oversight during the construction of site and riverbank stabilization and restoration measures following installation of the pipelines.
- **Lions Park Poudre River Restoration Plan, Laporte, CO –** ecos role on the project was to assess habitat conditions; gather, compile and analyze field survey data; and to prepare the mapping and mitigation design plans for the Lions Park PMJM habitat and the Poudre River Bank Stabilization Plans. We designed and executed the technical drawings for the structural components of the habitat, ensuring that the proposed riparian plant community, habitat structures (brush piles), and bioengineered streambank stabilization measures will create the conditions that alleviate the current habitat fragmentation; support the life requisites of the PMJM; and enhance the overall health of the Poudre River fishery.

- **C Lazy U Ranch, Willow Creek Fishery Enhancement Plan, Granby, CO -** Mr. Gurnée was the lead fisheries biologist and wetland ecologist for the assessment and design of this project. The project entailed 2 miles of instream and riparian cover habitat aimed at enhancing water quality through increased bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach given existing land-use constraints, and ongoing ranching activities. Bank-side improvements included wetland mitigation design to support ranch impacts, detailed seeding and planting plans indicating site-specific plant and seed locations, life zones, and species palettes according to hydrologic, soil, and aspect conditions. Grant was the regulatory lead, consulting with the Corps under Section 404 of the CWA.
- **Edwards Eagle River Restoration Project, Edwards, CO –** Grant was the senior wetland ecologist and fisheries biologist for the Edwards Eagle River Restoration Project (Project); which is roughly 1.5 miles long covering an area of 168 acres of floodplain along the Eagle River in the heart of the Edwards community. The project utilized indigenous materials and methods to naturally integrate habitat structure in the landscape context. He provided grant funding support; stream, riparian, wetland and fisheries habitat assessment, planning and design; and construction oversight services to the Eagle River Watershed Council for the Project. He assisted the ERWC in facilitating the public process associated with developing stakeholder support and gaining funding through the Eagle Mine Natural Resources Damage Fund. The Project was awarded over $2,000,000 in grant funding; $1,400,000 of which was from the Eagle Mine NRDF. The total project cost is projected at $4,300,000.
- **Gypsum Creek Fisheries Enhancement, Gypsum, CO -** Mr. Gurnée was the lead fisheries biologist and restoration ecologist for the instream and riparian habitat assessment, design, permitting and implementation of habitat improvements along Gypsum Creek. Project treatments included both instream and bankside treatments. Instream treatments served to improve deep-water habitat, create flow separation or concentration zones, increase low flow sinuosity, provide instream cover, improve adult fish habitat, create nursery areas, and enhance spawning opportunities. Bankside treatments for aquatic habitat improvements included creation or enhancement of overhead cover; provision of protective cover; and enhancing shading, cooling, and nutrient cycling functions. Bank protection treatments served to correct localized bank instabilities and reduce bank erosion and the potential for sediment deposition downstream. The Colorado Division of Wildlife (CDOW) commented that, “The Gypsum Creek project was implemented in such a low impact manner that you cannot tell that construction had occurred in the area.”
- **Cache La Poudre River Removal Action, Fort Collins, CO -** On behalf of the City of Fort Collins, Mr. Gurnée led negotiations between the EPA, stakeholders and the City regarding riverine, riparian and wetland regulatory and restoration design standards during the removal and remediation of a contaminated reach of the Poudre River. He also provided design review and revision, as well as construction oversight to ensure successful implementation of the instream and streambank restoration along the 0.50 mile, highly visible reach of the river near downtown Fort Collins.
- **TZ Ranch, Elk Hollow Creek Fishery Habitat Enhancement Plan, Saratoga, WY -** ecos performed the assessment and design of the Elk Hollow Creek Project, which included instream and riparian habitat improvements aimed at increasing bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach. Instream improvements included drop structures, plunge pools, deep pools, riffles and spawning habitat. Bank improvements included seeding and planting plans for native wetland and riparian species. Grant was the regulatory lead, consulting with the Corps under Section 404 of the CWA and the Wyoming Department of Fish and Game. ecos also provided construction oversight and native plant installation services to ensure the successful implementation of the Project.
- **Brush Creek Fishery Enhancement Plans, Saratoga, WY –** Grant assisted in the preparation of access and staging plans, design plans and details, and performed on-site construction oversight of instream and riparian habitat enhancements and bioengineered bank stabilization for a 3-mile reach of Brush Creek. The purpose of the project is to enhance fish, bird and wildlife habitat and use these resources to facilitate education and improve the recreational experience of Ranch guests.
- **Brush Creek Ranch Pond Creation Plans, Saratoga, WY –** ecos provided design-build services including site optimization selection; excavation, grading, drainage and revegetation plans; and construction oversight for a 0.30-acre fishing pond. The pond design included an innovative undercut bank design incorporating a framework of trees supporting transplanted, native sod; which provided excellent fish habitat.
- **Boulder Creek Fishery Enhancement and Pond Creation Project, Boulder, CO -** Grant was the lead fisheries biologist and restoration ecologist for this project along a private reach of South Boulder Creek

adjacent to City of Boulder, Eldorado Canyon Open Space. His tasks included instream and riparian habitat assessment, design of instream and pond fishery habitat and riparian enhancement measures and permitting and consultation. Grant was also the regulatory lead, consulting with the FWS regarding PMJM habitat and with the Corps under Section 404 of the CWA.

- **Stream and Floodplain Restoration at A.T. Massey Coal Mining Facility, KY -** Grant was the Project Manager, fisheries biologist and restoration ecologist for the technical team tasked with assessment and restoration of 26 miles of stream corridor following the accidental release of 250 million gallons of coal slurry into two separate drainages in eastern Kentucky. He was the first ecologist to respond after the spill to ensure that fisheries, stream and riparian habitat restoration objectives were incorporated into the selected cleanup measures. As such, Grant devised a "triage" categorization and remediation system for all affected reaches that minimized impacts to sensitive aquatic and riparian habitat based on the site-specific level of cleanup and remediation required. In addition to instream and bank restoration and stabilization, comprehensive riparian corridor restoration was a major component of the project. Grant was the regulatory and permitting lead and coordinated permits and approval with EPA, Corps and State agencies.
- **Roaring Fork Golf and Fishing Club, Basalt, CO -** Mr. Gurnée was the lead fisheries biologist and restoration ecologist for the assessment, design, permitting and construction supervision of a native trout stream (1 mile) with associated wetland complexes (3 acres). The trout stream was created as an amenity and functional fly-fishing challenge for this fishing component of the Roaring Fork Club; and the associated wetland and riparian habitat were created to naturalize the stream and provide compensatory mitigation for impacts associated with the development of the club facilities. Grant was the regulatory and permitting lead and coordinated permits and approval with Corps and CDOW.
- **Spring Creek Wetland Mitigation, Colorado Springs, CO** – Grant and his team generated wetland and creek creation plans that integrated required mitigation into a high density, "new urban" development. The design emphasized re-utilization of urban storm water to sustain wetlands, use of indigenous plants, construction materials, and natural geomorphic relationships.
- **Tobacco Island Project, Kansas City, MO -** Grant was the lead fisheries biologist and restoration ecologist on a multi-disciplinary Team for the Corps, Tobacco Island Project - a portion of the Missouri River Bank Stabilization and Navigation, Fish and Wildlife Mitigation Project. Project tasks included assessment and conceptual design of measures aimed at reconnecting floodplain and riparian habitat to a reach of the Missouri River near Kansas City. He prepared preliminary designs of channel and backwater wetlands; provided regulatory analysis under Section 404 of the CWA; and assisted in the preparation of an Environmental Impact Statement.
- **San Miguel River Corridor Restoration Plan -** Mr. Gurnée was the lead restoration ecologist, planner and designer for phase 1 of the San Miguel River Corridor Restoration Plan, which included a 1-mile reach through Town. He and his team assisted the Town of Telluride in applying for and winning approximately $500,000 in Natural Resource Damage Assessment Fund money from the State of Colorado. The money, along with other funding, was utilized for final design and construction of the project which included instream habitat, streambank restoration, riparian and wetland restoration, trails and parks. Grant was responsible for leading all public meetings, regulatory negotiation and permitting; assisted the Town with grant funding; and provided construction oversight services.
- **High Altitude Stream Restoration at Copper Mountain Resort, CO -** Grant was the lead ecologist for the restoration of an alpine stream and enhancement of associated wetland and riparian habitat situated within tundra habitat atop Union Peak at Copper Mountain Resort. Grant performed the assessment, design, permitting, and construction oversight for one of the highest altitude stream restoration and wetland mitigation projects in Colorado (approximately 11,500 feet above sea level). Innovative bioengineering and construction techniques were designed and adapted to this sensitive environment to minimize construction-related impacts and maximize environmental benefits.

Threatened & Endangered Species Consultation & Habitat Restoration

- **Jackson Creek Land Company PMJM and Wetland Mitigation, Colorado Springs, CO –** ecos has been performing PMJM habitat biological assessments, conservation, mitigation planning and design throughout its range since 1994. Among numerous other private land developers in the Colorado Springs areas, ecos is currently assisting the Jackson Creek Land Company and Triview Metropolitan District with the implementation of physical habitat preservation and mitigation measures, including shortgrass prairie, upland hibernaculum, and riparian habitat restoration. We are also assisting the client with construction oversight and maintaining regulatory compliance during the implementation of the phased mitigation plans.

- **The Farm (formerly Allison Valley Ranch), Colorado Springs, CO –** Mr. Gurnée performed the habitat assessment and mapping; and prepared ESA, Section 7 and CWA, Section 404 consultation documents as required by the FWS and Corps, including mitigation construction documents, specifications, on-site layout of plant communities and construction supervision aimed at restoring wetland and riparian habitat occupied by Preble's meadow jumping mouse. Ecos is currently assisting the owner with construction oversight for habitat restoration and native planting.
- **Advance Mitigation for PMJM Habitat** – ecos is assisting a private client in identifying, assessing, prioritizing and designing advance mitigation sites for PMJM habitat in the North Fork and main stem of the Cache la Poudre River.
- **TriView Metropolitan District ESA and CWA Permit Resolution, Monument, CO -** Mr. Gurnée represented the TriView Metropolitan District (TriView) and Phoenix Bell as the lead consultant to resolve outstanding compliance issues related to a joint ESA, Section 7 Consultation and CWA, Section 404 Permit. Grant lead negotiations amongst the various landowners, TriView and the Town to resolve compliance issues related to PMJM and wetland habitat, such that development may proceed in this core area of the town. Upon resolution and agreement of the stakeholders, he led the negotiations with the FWS and Corps to formally amend the Biological Opinion and 404 Permit. Once the approvals were amended, Grant lead the planning and design of PMJM and wetland habitat to meet mitigation requirements under the ESA and CWA.
- **Bernardi Residential Property, Eldorado Canyon, Boulder, CO –** ecos consulted with the Corps and FWS to document and fulfill regulatory requirements for a residential home construction project in PMJM, wetland and riparian habitat. Mr. Gurnée coordinated with the FWS and Corps and obtained approvals under ESA, Section 7 and CWA, Section 404. He prepared all consultation documents, including the Biological Assessment, mitigation plan, and construction documents and specifications. Grant is leading the on-site layout of plant communities and construction supervision, aimed at restoring wetland and riparian habitat occupied by the PMJM.
- **Northgate Boulevard Realignment, Colorado Springs, CO –** Mr. Gurnée performed the habitat assessment and mapping; and coordinated and prepared ESA, Section 7 and CWA, Section 404 consultation documents as required by the FWS and Corps, including mitigation construction documents, specifications, on-site layout of plant communities and construction supervision aimed at restoring wetland and riparian habitat occupied by Preble's meadow jumping mouse.
- **Jefferson County Highways and Transportation Department Gunbarrel Bridge Replacement, Oxyoke, CO -** ecos staff consulted with the Corps, FWS, CDOT, and the FHWA to document regulatory requirements for a bridge replacement project in PMJM, wetland and riparian habitat. He and his Team produced a CDOT Wetland Finding Report, Biological Assessment, acquired a Section 404 Permit and Biological Opinion (Section 7 of the ESA), and then implemented habitat mitigation improvements at the site.
- **Northgate Project, Colorado Springs, CO -** As project manager, Mr. Gurnée led the team in the assessment, permitting and regulatory negotiation (Section 404 of the CWA and Section 7 of the ESA) for the project which included the planning, design and construction supervision of a precedent setting, "joint" mitigation plan for 60 acres of wetland, riparian and PMJM habitat.

Ecological Master Planning

- **Sundance Trail Guest Ranch, Larimer County,** CO – ecos is currently assisting a local guest ranch in the assessment of natural resources and site features, and the development of site plans to balance natural habitat and aesthetic values with the expansion of guest facilities and services.
- **Sand Creek Channel Improvements Stability Analysis at Indigo Ranch, Colorado Springs, CO** - ecos was retained to perform an analysis of channel stability under proposed development conditions for a 1.17-mile reach of Sand Creek. Ecos utilized existing vegetation composition data, density and height within the Project reach as a basis; and compared the 10-year and 100-year storm event modelling data (specifically flow velocity, flow depth and shear stress) to reference literature to provide a professional opinion regarding the future stability of the channel under developed conditions. The analysis of channel stability for the proposed Project assumes a bioengineering and biotechnical approach that preserves and enhances the existing vegetation, as well as substrate cohesion and stability, within the channel and its

streambanks. The Stability Analysis will likely serve as a benchmark study for the City of Colorado Springs to use to preserve other naturally stable channels.

- **Uncompahgre River Corridor Master Plan, Montrose, CO –** Grant and his Team assessed the character, condition and quality of aquatic, wetland and riparian habitat along a 10-mile rural and urban corridor of the Uncompahgre River through the City of Montrose. Habitats were then rated, ranked, prioritized and master planned for their preservation potential and integration in to the parks, recreation and trail system. The master plans form the foundation for the City to focus environmental stewardship, tourism and generate riverfront economic development with a focus on the river – the major asset of the Community.
- **Brush Creek Stewardship and Enhancement Plan, Saratoga, WY –** Mr. Gurnée managed the assessment of a 12,000-acre, private ranch near Saratoga, Wyoming and the preparation of the Ranch Stewardship Plan (Plan). The Plan includes land and resource stewardship goals, objectives, and implementation action items; including ranch-wide master planning of the trail and recreational systems, design of the Brush Creek riparian corridor trail, and restoration/fisheries habitat enhancement of Brush Creek. Trail and recreation planning and design focused on universal access, habitat sensitivity, environmental education, and wildlife observation opportunities and unique landscape experiences.

Environmental Assessment and Impact Studies

- **NEPA EA for Eagle County Airport Runway Expansion, Eagle County, CO -** Grant was project manager and senior ecologist for an Environmental Assessment (EA) under the National Environmental Policy Act (NEPA) for a proposed 1000-foot runway expansion and ILS installation at the Eagle County Airport, west of Vail, Colorado. Critical issues addressed included noise, ecological, and public opinion considerations. Grant conducted the work under FAA guidance requirements for EAs.
- **NEPA EA for the Avon Interstate 70 Interchange -** Mr. Gurnée was project manager and senior ecologist for this NEPA EA. He performed environmental assessment and data compilation work for construction of a new CDOT interchange and associated development on Interstate 70. This included evaluating T&E Species; a wetlands inventory; a cultural/archeological resources survey; noise and air pollution modeling and studies; and reviewing soils, meteorology, geologic hazards, and other impacts.
- **Raritan River Wetland Inundation Impact Study, N.J. -** Grant's work on the preparation and processing of the first Individual Permit under the New Jersey Freshwater Wetlands Protection Act of 1987 included a precedent setting wetland inundation study. This study shaped the N.J. Department of Environmental Protection's policy regarding the need to assess hydrologic impacts during wetland permit reviews.

Construction Oversight and Plant Installation

- **St. Vrain Creek Reach 3 Flood Recovery and Restoration, Lyons, CO –** Ecos performed construction lay-out and observation during the implementation of the restoration and enhancement of 0.60-acre of riparian Preble's Meadow Jumping Mouse Habitat (PMJM) along the St. Vrain River.
- **2013 Flood and 2014 Runoff Events, Damage Restoration, Cache la Poudre River, CO** - ecos performed the construction oversight of 3 flood and runoff damage restoration projects along the Cache la Poudre River for the City of Greeley, including the Bellvue Treatment Plant Raw Water Ponds Restoration, the Kodak Pipeline Crossing Restoration and the Watson Lake Pipeline Crossing Restoration.
- **Lions Park CWA and ESA Mitigation Site** - ecos performed the construction oversight for an advance river and wetland mitigation site at Lions Park in LaPorte, Colorado.
- **TZ Ranch, Elk Hollow Creek Fishery Habitat Enhancement Plan, Saratoga, WY -** ecos performed the construction oversight for the Elk Hollow Creek Project.
- **Brush Creek Ranch Fishery Enhancement Plans, Saratoga, WY –** Mr. Gurnée assisted in the construction oversight for a 3-mile reach of Brush Creek to improve fisheries and outdoor recreation experiences for guests of the Ranch.
- **C Lazy U Ranch, Willow Creek Fishery Enhancement Plan, Granby, CO -** Grant assisted in the construction oversight for this fishery habitat, channel stabilization and streambank restoration project.
- **Standley Lake Protection Project, Westminster, CO –** Mr. Gurnée performed construction oversight of a 12-acre created emergent wetland that he and his Team designed to fulfill CWA mitigation requirements and bring closure to the City's drinking water protection project.

- **Caribou Peat Bog Restoration, Nederland, CO –** Grant prepared native plant community design, planting cost estimate, and on-the-ground oversight of volunteers to restore a high-altitude peat bog disturbed by an illegal four-wheel drive "mudfest".
- **Department of Energy Wetland Mitigation Bank, Westminster, CO –** Mr. Gurnée provided construction supervision of the grading and planting of a 12-acre wetland mitigation bank that he and his Team designed for the Department of Energy.
- **ARCO Lower Area One and Butte Reduction Works, Butte, MT –** Grant performed construction observation and supervision of temporary labor crews to plant a passive treatment wetland designed to absorb heavy metals from groundwater.

Natural Treatment System Design

- **Natural Treatment Wetlands, Butte, MT -** Mr. Gurnée and his Team performed the assessment and design of the ARCO Lower Area One and Butte Reduction Works passive treatment wetlands. These natural treatment systems were situated within two units of a reclaimed superfund site to treat heavy metals in surface and groundwater.
- **Natural Treatment Wetlands, Avondale, AZ –** Grant and his Team performed the assessment and design of a constructed wetland system to treat surface water and inject/recharge the municipal well system for the City of Avondale, AZ. This system successfully alleviated a well moratorium necessitated by a contaminated groundwater aquifer.

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Gurnée, Grant E. 1995. Optimizing Water Reclamation, Remediation and Reuse with Constructed Wetlands. Environmental Concern Wetland Journal, Summer 1995 Issue. Environmental Concern, Inc. St. Michaels, Maryland.

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Hoag, Chris, Hollis Allen, Craig Fischenich and Grant Gurnée. Assistant instructor for a Bioengineering Workshop sponsored by the U.S. Army Corps of Engineers Waterways Experiment Station and the U.S. Department of Agriculture – Aberdeen Plant Materials Center. September 1998. Carson City, Nevada.

Hoag, Chris and Grant Gurnée. 1998 Glancy Riparian Demonstration Project. Assistant instructor for a hands-on bioengineering workshop on the Carson River. September 1998 near Dayton, Nevada.

Gurnée, Grant E. 1998. Stream and Wetland Restoration Successes and Failures: The Good, the Bad, and the Ugly. Presented at the Colorado Riparian Association (CRA) Restoring the Greenline Conference. October 16, 1998. Salida, Colorado.

Gurnée, Grant E. 1998. Save Our Streams, Wetland Conservation and Sustainability Workshop. Lead Instructor of wetland assessment and restoration course presented with the Izaak Walton League. April 21 & 22, 1998. Boulder, Colorado.

Windell, Jay, and Grant Gurnée. 1998. Creation of a Stream, Riparian and Wetland Ecosystem: Tributary to the Roaring Fork River, Basalt, Colorado. Presented at the American Society of Civil Engineers, Wetlands Engineering & River Restoration Conference. March 23 – 27, 1998. Denver, Colorado.

Gurnée, Grant E. 1998. A Case Study: Department of Energy's Wetland Mitigation Bank at Standley Lake. Presented at the Continuing Legal Education (CLE) International, Colorado Wetlands Conference. January 27 – 29, 1998. Denver, Colorado.

Gurnée, Grant E. 1997. Wetland Mitigation: Design and Implementation via the Design/Build/Grow Process. Presented at the International Erosion Control Association, Erosion & Sediment Control Workshop. November 19, 1997. Northglenn, Colorado.

Gurnée, Grant E. and Gary Bentrup. 1996. Wetland and Riparian Protection Strategies. Presented at the Sierra Club, Regional Growth Strategies Conference, "New Perspectives and Strategies to Preserve Mountain Communities." February 16 – 17, 1996. Glenwood Springs, Colorado.

Gurnée, Grant E. 1994. How to Recognize and Deal with Wetland Regulation Issues. Presented at the Continuing Legal Education (CLE) International, 3rd Annual Western Agricultural and Rural Law Roundup. June 23-25, 1994. Fort Collins, Colorado.

AWARDS:

- Colorado Landscape Contractors Award, Sand Creek Enhancement Project – 2000

PROFESSIONAL ASSOCIATIONS:

- Association of State Wetland Managers (ASWM)
- Society of Wetland Scientists (SWS)
- Environmental Concern (EC)

RESUME

Jon Dauzvardis, M.L.A, P.W.S.

Owner/Managing Partner
Senior Restoration Ecologist
Landscape Architect
Wetland Ecologist

AREAS OF EXPERTISE:

- Vegetation Inventories and Mapping
- Habitat Assessment, Functional Assessment and Wetland Delineation
- Aquatic, Wetland, and Riparian Restoration Ecology, Planning and Design
- Landscape Ecology, Planning and Landscape Architecture
- Conservation and Resource Mitigation Bank Support Services
- Grant Funding Support for Conservation and Restoration Projects
- Open Space and Trail Planning, Design and Habitat Management
- Construction Oversight & Best Management Practices
- AutoCAD, Mapping, Presentation Graphics

EDUCATION:

- Master of Landscape Architecture, Texas A&M University, College Station, Texas, 1995
- Bachelor of Science, Environmental Design, University of Missouri, Columbia, 1991
- Architecture Study, Harvard University Graduate School of Design, Cambridge, Massachusetts, 1989

EMPLOYMENT HISTORY:

- 2008-Present, Owner/Manager and Senior Restoration Ecologist, Ecosystem Services, LLC, Erie Colorado
- 2000 – 2011, Senior Restoration Ecologist, Walsh Environmental Scientists and Engineers, LLC, Boulder, Colorado
- 1997 – 2000, Restoration Ecologist, Construction Supervisor, Aquatic and Wetland Company, Boulder, Colorado
- 1996-1997, Landscape Architect, Design Studios West, Denver, Colorado
- 1995-1996, Landscape Architect, Wenk Associates, Denver, Colorado
- 1994-1995, Graduate Researcher, ALCOA – Texas A&M University, College Station, Texas
- 1994, Johnson County Parks and Recreation Department, Shawnee Mission, Kansas
- 1992-1994, Grounds Maintenance Superintendent, Brazos County, Texas

CONTINUING EDUCATION:

- Stream Functions Pyramid Workshop, Denver, CO - 2014
- Colorado Natural Heritage Program, Wetland Plant Identification - 2014
- Colorado Natural Heritage Program, Ecological Integrity Assessment for Colorado Wetlands - 2013
- FACWet – Functional Assessment of Colorado Wetlands - 2010, 2012 and 2013
- ESRI, ARC View Geographic Information System (GIS) Training, 1996
- Bicycle Planning and Facilities Training, 1994
- AutoCAD Drafting and Design, Self-taught, 1991

CERTIFICATIONS:

- Professional Wetland Scientist Certification (# 1699), Society of Wetland Scientists Certification Program, 2004

EXPERIENCE SUMMARY:

Mr. Dauzvardis is a founder and managing partner of Ecosystem Services, LLC (**ecos**), an ecological planning and design business dedicated to the restoration, enhancement and creation of aquatic, wetland and riparian habitat. Jon is a certified Professional Wetland Scientist with over 25 years of experience working in the fields of landscape architecture and ecological restoration in Colorado, Wyoming, Texas, Kansas and the Intermountain West. Jon's academic and professional work history in housing design and construction, community planning, architecture, landscape architecture, ecological planning and restoration is unique and makes him a valuable and multi-faceted asset to his company, clients and their projects. His diverse knowledge and skills in landscape planning, habitat design, bioengineering, and hands-on experience demonstrate that he can easily negotiate between art and science, man-made and natural systems, generalities and detail, and from concept to construction. Jon takes a practical and realistic approach to problem solving, concentrating on broad scale ecological master planning simultaneously with fine scale design of aquatic, wetland, riparian and terrestrial habitats. As a restoration ecologist, Jon specializes in restoring and enriching habitat structure, stability and health and how to manage landscapes and natural systems so that they function, change, and respond positively over time. Jon's strengths are rooted in his understanding of natural and landscape processes; finding design solutions that integrate the needs of people, wildlife, and visual quality; sustaining ecosystem goods and services; and integration of nature-based recreation and environmental education programs and facilities.

RELEVANT PROJECT EXPERIENCE:

Mr. Dauzvardis has been an essential team lead and player in hundreds of habitat assessments; permitting efforts; master plans; and aquatic, wetland, and riparian habitat design and mitigation projects. The following is a sampling of select projects and clientele that Jon has successfully completed or is currently involved with:

Habitat Assessment and Regulatory Compliance

Mr. Dauzvardis routinely performs ecological site and resource impacts assessments, jurisdictional wetland determinations and functional assessments to assist clients in site planning, design, and permitting processes. Assessment methods established by the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and Colorado Department of Transportation among others are used to assess habitat elements and screen sites for threatened and endangered plants and animals, wetlands, migratory birds and other wildlife. Jon stresses habitat impact avoidance and minimization to preserve a site's ecological benefits and to minimize regulatory constraints, timing and permitting costs. Jon has performed a multitude of site assessments, delineations and prepared permits, including but not limited to the following notable projects as well as others listed throughout this resume:

- **Banning Lewis Ranch, Colorado Springs, CO –** ecos was hired by Norwood Homes to perform and ecological assessment of wetlands, Sand Creek, Jimmy Camp Creek and its tributaries; and provide regulatory guidance for the Banning Lewis Ranch (BLR), an 18,000-acre site that will double the size of Colorado Springs. Part of Jon's work on the project included mapping and buffer recommendations on how to best conserve pristine prairie and sandy creeks that are highly susceptible to degradation caused by urbanization.
- **Bellvue Pipeline Project, Larimer County, CO** – ecos was retained by the City of Greeley as Best Management Practices (BMP) Facilitators to provide pre-construction documentation post-construction oversight of pipeline reclamation processes. Essential responsibilities include meeting with landowners prior to construction to facilitate project understanding and post-construction outcomes; to document landowner needs and wants relative to project goals and land use; and to document and monitor pre- and post-construction reclamation and maintenance requirements.
- **Georgetown Lake, Georgetown, CO –**ecos was hired to prepare an office level assessment report of ecological resources to describe the physical/ecological characteristics of the Project area and evaluate the potential effects of the construction of a loop trail project on environmental issues and species of concern to support a GOCO grant application. Items evaluated and documented, include site location/ownership, general site characteristics, current land use, proposed impacts, possible effects on Federal– and State-listed T&E animal and plant species, unique or important wildlife, water quality, water bodies, wetlands, and floodplains, stormwater runoff, sedimentation, soil erosion, and invasive species. The assessment report also included mitigation measures, project benefits, and environmental compliance recommendations under applicable regulatory programs.

- **Appraisal Support Documentation Report for the 1st Bank Parcel, Colorado Springs, CO** - ecos was retained by 1st Bank Holding Company to perform a Preble's meadow jumping mouse (PMJM) habitat assessment, mitigation cost analysis, and conceptual lot layout for the approximate 9.4-acre Parcel located adjacent to the Northgate Open Space along Smith Creek. Jon was responsible for preparing the lot layout, existing habitat aerial photo interpretation/delineation, proposed conceptual mitigation, and quantification of impacts and associated mitigation to ascertain appraisal value of the site if it were to be developed.
- **Encana Oil and Gas (USA), Denver Julesburg Basin, CO** – Encana hired ecos to assess their ecological constraints, recommend means and methods to avoid, minimize and permit impacts; and to mitigate, restore and prepare ecological management plans for their drilling and pipeline operations in the Denver Julesburg basin. Jon's role on the team is to perform site assessments, research background data, and prepare assessment reports and mapping data that can be utilized by Encana's project managers and geographic information systems (GIS) department to proactively track ecological resources before issues arise. In addition to client consultation, Jon is responsible for tracking drill site schedules, constraints, restoration and management efforts in a data base and reporting said information to Encana's project manager on a regular basis.
- **Tollgate Creek Riparian and Wetland Habitat Assessment, Aurora, CO** – Jon performed high level aerial photo interpretation and delineation of riparian and wetland habitat along Toll Gate Creek and East Toll Gate Creek from confluence with Sand Creek upstream to East Hampden Avenue. The delineation was performed in Google Earth and imported into AutoCAD by digitizing riparian and wetland habitat zones. Once complete, the data was turned over to the project engineer to incorporate into a Drainage Master Plan for the Urban Drainage and Flood Control District (UDFCD).
- **Eagle River Meadows Ecological Inventory and Strategic Wetland Action Plan, Edwards, CO** – Mr. Dauzvardis delineated, assessed, and provided an analysis of potential adverse effects to wetlands within a complex site adjacent to the Eagle River. Jon also developed a strategic process and decision making tool to determine avoidance, minimization, low impact development (LID), and mitigation measures in support of a County Sketch Plan application for a Multi-use Health Care Community.
- **Mesa County Colorado Riverfront Trail, Grand Junction, CO** – Jon performed wetland delineation, jurisdictional determination, Section 404 Permitting; and prepared wetland mitigation plans to construct approximately two miles of regional trail along the north side of the Colorado River between the James M. Robb and the Colorado River State Park at Corn Lake.
- **ARCO Upper Clark Fork River Basin Superfund Site Functional Wetland Assessment, MT** – Between 2000 and 2008, Jon managed the assessment team and performed extensive wetland delineation, GPS surveying, functional assessments, and impact mapping and analysis covering a 200 square mile Superfund Site affected by historic mining practices. Assessments we done in preparation for soil remediation of heavy metals, capping of tailings ponds, sediment and dam removal, and implementation of compensatory wetland mitigation plans required under a consent decree. Assessment areas included the Anaconda Smelter, Old Works, Opportunity Ponds, and Milltown Reservoir.
- **Jefferson County Highways & Transportation Department Gunbarrel Bridge Replacement, Oxyoke, CO** – Jon consulted with the USACE, USFWS, CDOT, and the FHWA to document regulatory requirements. Produced a CDOT Wetland Finding Report, Biological Assessment, Preble's meadow jumping mouse and wetland mitigation plans, and helped acquire a Section 404 Permit and Biological Opinion.
- **Pole Canyon Wind Farm, Babcock and Brown, Huerfano County,** CO – Assessed and prepared critical issues analysis and County 1041 Permit application for a 125-megawatt wind farm and associated transmission lines located on a 5,800-acre site. The project included detailed site assessments to document the presence or absence of potential development constraints and site-specific ecological conditions as well as preparation of permit maps, plot plans, and environmental analyses, alternatives analysis, and mitigation measures.
- **Dalton Property Wetland Assessment, Longmont, CO** – Provided site assessment, regulatory analyses, and developed a restoration plan for critical riparian and wetland habitat along Left Hand Creek in Boulder County, CO.
- **Colowyo Coal Mine Wetland Delineation, Meeker,** CO – Delineated 1.5 miles of jurisdictional waters and wetlands in preparation for wetland mitigation design along West New Goodspring Creek.
- **Lafarge Northbank Resources Gravel Pit Wetland Assessment, Rifle, CO** – Delineated and acquired a jurisdictional determination from the USACE for complex tailwater and riparian wetlands along the

Colorado River. Prepared gravel pit reclamation plans aimed at providing suitable shallow-water lake edge wetlands to serve as compensatory wetland mitigation.

- **Jefferson County Highways & Transportation Department Highway 73 Expansion, Conifer,** CO – Performed presence/absence study, habitat assessment and documentation of wetlands, Migratory Birds, State Species of Concern, and federally listed T&E Species including Bald eagle, Preble's meadow jumping mouse, the Pawnee montane skipper butterfly and Colorado butterfly plant along a one-mile corridor of highway.
- **Flying Horse Ranch and the Club at Flying Horse Golf Course, Colorado Springs, CO** – Conducted an assessment of wetland habitat, impact avoidance and minimization and Section 404 of the Clean Water Act permitting for a 1500-acre mixed use development and Weiskopf golf course design being implemented by Neiber Golf.
- **C-Lazy-U and Horn Ranch Environmental Assessments, Granby, CO** – Performed site assessment of ecological opportunities and constraints of aquatic, riparian, wetland and threatened and endangered species habitat along the Colorado River for the development and enhancement of fishing/resort ranch amenities.
- **Village at Avon, Avon, CO** – Delineated wetlands and prepared a Section 404 Permit for the town center expansion and low-density ranchette development.
- **Residential Developers and Realtors** – Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for residential developers and realtors, including: 4 Site Investments, Nor'wood, Proterra Properties, Denver Transit Oriented Development Fund, La Plata Communities, Windsor Ridge Homes, Clearwater Communities, Schuck Corporation, Equinox Land Group, DR Horton, Melody Homes, Standard Pacific Homes, Gateway American Properties, Zephyr Real Estate Company, Lowell Development Partners, and Palmer-McAlister, Classic Communities, Stoll Properties, Karen Bernardi, Colorado Commercial Builders, Terra Visions, Smith Creek Holdings, Picolan, Realty Development Services, Northgate Properties.
- **Commercial and Industrial Developers** - Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for commercial and industrial developers, including: Atira Group, Leadership Circle, Ridgeway Valley Enterprises, Morley Companies, HF Holdings, Regency Centers, Miller-Weingarten, Gulf Coast Commercial Development, Traer Creek, Mountain Property Associates, Morley Golf, Executive Consulting, Inc.
- **Architectural and Engineering Companies** – Jon has performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for A&E firms, including: William Guman and Associates, JVA, Beyers Group, Engineering Analytics, Classic Consulting Engineers, J3 Engineering, DHM Design, Del-Mont Consultants, JW Nakai and Associates, Nolte and Associates, JR Engineering, Hyrdosphere, Executive Consulting Engineers, Muller Engineering, Farnsworth Group.
- **Counties, Municipalities, Metro Districts and Quasi-Public Institutions** – Mr. Dauzvardis has performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for counties, municipalities, and quasi-public institutions, including: City of Louisville Highway 42 and 96th Street realignment, City of Westminster Jim Baker Reservoir and Standley Lake Protection Projects, Jefferson County Highway 73 and 67 Improvement Projects, Todd Creek Village Metro District, Town of Monument/Triview Metro District, Boulder Community Hospital, and City of Fort Collins Regulatory Fact Sheets Preparation Project, Todd Creek Village Metro District on-call consultant, Three-lakes Water and Sanitation District, City of Greeley,
- **Educational Institutions** – Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for educational institutions, including: Colorado Mountain College - Steamboat Springs, The Classical Academy – Colorado Springs, and Coal Ridge High School – Rifle.
- **Wind Energy Developers** – Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and critical issues analyses for wind development projects, including: Cedar Creek Windfarm – Weld County, CO, Wheatland Windfarm – Platte County, WY, Silver Mountain Windfarm – Huerfano County, CO, Pole Canyon Windfarm, Huerfano Count, CO.

- **Mining Companies** – Performed wetland and T&E species habitat ecological assessments, wetland delineations, and critical issues analyses for mining companies, including: Brannan Sand and Gravel Company, Lafarge and Kennecott Coal.

Ecological Master Planning

- **Jackson Creek Land Company PMJM and Wetland Mitigation, Colorado Springs, CO** – ecos has been performing Preble's meadow jumping mouse (PMJM) habitat biological assessments, conservation, mitigation planning and design throughout its range since 1994. Among numerous other private land developers in the Colorado Springs areas, ecos is currently assisting the Jackson Creek Land Company and Triview Metropolitan District with the implementation of physical habitat conservation and mitigation measures, including shortgrass prairie, upland hibernaculum, and riparian habitat restoration. Jon is responsible for mapping, design assessment and restoration plan preparation.
- **Park Creek Mitigation Bank, Fort Collins, CO –** ecos was retained by Burns and McDonnell to assess, map, and prepare preliminary mitigation design of aquatic, wetland, riparian and terrestrial habitat in support of a mitigation banking prospectus. Upon completion and acceptance of the prospectus by the USACE, ecos has been tasked to manage the baseline assessment of the site, including groundwater testing, topographic surveys, and hydrology; prepare a detailed habitat design for inclusion in mitigation banking instrument; as well as coordinate design-build process with a selected nursery and contractor. Jon has been responsible for the mapping and preparation of design documents and will co-manage construction and long-term monitoring to help our client meet their performance criteria and sell bank credits.
- **Front Range Umbrella Mitigation Bank, CO –** ecos was retained by Restoration Systems, a nationally renowned wetland mitigation banking firm, to help identify and prepare conceptual design plans for mitigation banking sites to establish the Front Range Umbrella Mitigation Bank (Bank). The purpose of the Bank is to provide compensatory mitigation credits for unavoidable, permitted impacts to aquatic, wetland, riparian, upland, wildlife, and threatened and endangered (T&E) species habitat regulated under the Clean Water and Endangered Species Acts; and to restore, enhance and preserve valuable natural resource functions at degraded mitigation sites within multiple watersheds along Colorado's Front Range. Currently, the Bank is developing banks sites that serve the Cache la Poudre, St. Vrain, Upper South Platte, Fountain and Upper Arkansas watersheds. Jon's primary role on the team is to perform functional habitat assessments; prepare mapping and graphics of baseline and future conditions; grading and plant community design based on hydrologic, hydraulic, and geomorphic modelling and engineering; and communicate with landowners and stakeholders regarding the process, technicalities, and outcomes.
- **Sand Creek Channel Improvements Stability Analysis at Indigo Ranch, Colorado Springs, CO** - ecos was retained to perform an analysis of channel stability under proposed development conditions for a 1.17 mile reach of Sand Creek. Ecos utilized existing vegetation composition data, density and height within the Project reach as a basis; and compared the 10-year and 100-year storm event modelling data (specifically flow velocity, flow depth and shear stress) to reference literature to provide a professional opinion regarding the future stability of the channel under developed conditions. The analysis of channel stability for the proposed Project assumes a bioengineering and biotechnical approach that preserves and enhances the existing vegetation, as well as substrate cohesion and stability, within the channel and its streambanks. The Stability Analysis will likely serve as a benchmark study for the City of Colorado Springs to use to preserve other naturally stable channels.
- **Brush Creek Ranch Stewardship Plan, Saratoga, WY** – Brush Creek Ranch Stewardship Plan, Fishery Enhancement and Bank Stabilization, Saratoga, WY – Mr. Dauzvardis managed the organization, generation and graphic design of the Ranch Stewardship Plan. Jon assessed and prepared stewardship goals, objectives, and implementation action items, including ranch-wide master planning of the trail and recreational systems and design of the Brush Creek riparian corridor trail. Trail and recreation planning and design focused on universal access, habitat sensitivity, environmental education, wildlife observation opportunities and unique landscape experiences. Simultaneously with the master plan, Jon developed revegetation plans to support geomorphic stream alterations and bank stabilization to enhance the creek fishery. Jon was responsible for the design and supervised construction of a cold-water pond to be used by novice anglers to learn the art and experience the pleasure of catching trout.
- **Town of Erie, Comprehensive Plan, Parks Recreation Open Space and Trails Master Plan, and Natural Areas Inventory, Erie, CO -** As a former 8-year Member, Chair, and Vice Chair of the Town Erie

Open Space and Trails Advisory Board (OSTAB) and an Erie resident and small business owner, Jon has an intimate knowledge of Erie's political and physical landscape and public processes. During his tenure on OSTAB, Jon actively participated in the writing and development of the Town's guiding documents. Jon authored the Open Space Chapter of the Comprehensive Plan which eventually was codified in the Town's Unified Development Code (UDC). Jon was the key commenter on the content, analysis and synthesis of the of the Open Space and Trail Chapters and Mapping that was adopted with the Town's first Parks Recreation Open Space and Trails Master Plan (PROST). Jon guided the process used in the development of the Erie Natural Areas Inventory (ENAI) to identify and design a habitat condition, quality and restoration rating and ranking system of significant natural areas throughout the Town's 49-square mile planning area.

- **Uncompahgre River Corridor Master Plan, Montrose, CO** – Jon was responsible for the development of an ecological master plan focusing on the Uncompahgre River as a natural asset for eco-tourism and the generation of riverfront economic development. Mr. Dauzvardis was responsible for assessing the character, condition and quality of aquatic, wetland and riparian habitat; and developing a rating, ranking, land acquisition prioritization system, and associated mapping aimed at the preservation and integration of open space and habitat within the City's parks, recreation and trail system.
- **Ruby Pipeline Wetland, Riparian and Waterbody Mitigation and Restoration Plan, WY, UT, NV and OR** – Jon was responsible for assisting with the generation of a Comprehensive Wetland Mitigation Plan outlining Clean Water Act regulatory guidelines, requirements, and processes. Jon developed an eco-region specific restoration plan for a 675-mile natural gas pipeline specifying the basis of design, construction, revegetation, maintenance, performance criteria, and monitoring means and methods for restoring approximately 460 acres of temporarily impacted riparian and wetland habitat.
- **Dry Creek Regional Urbanization Area, Weld County, CO** – Mr. Dauzvardis performed an ecological inventory and prepared the assessment report for a 6,000-acre Regional Urbanization Area (RUA); and a1000-acre multi-use site development in un-incorporated Weld County. Subsequent phases included establishing ecological policy, goals, and objectives for the study area that will assist the County in the refining their first ever Comprehensive Plan.
- **City of Broomfield I-25 Subarea Environmental Guidelines, Broomfield, CO** – Jon drafted development sensitivity design and ecological sustainability standards.
- **McStain Development Corporation, Mountain Village III Master Plan, Loveland, CO** – Conducted concept planning for recreational and environmental interpretation facilities focusing on lake and wetland habitat features of the community.
- **Estes Park Comprehensive Land Use Plan, Estes Park, Larimer County, CO** – Teamed with town planning staff in producing a county-wide land use plan using GIS as a public involvement/participation tool.
- **San Miguel River Park Corridor Master Plan, Telluride, CO** – Prepared park, trail, wetland and riparian corridor master plan and design for the San Miguel River Park Corridor. Jon prepared illustrative plan graphics that assisted the Town in applying for and winning approximately $500,000 in Natural Resource Damage Assessment Fund money from the State of Colorado, which was used for final design and implementation.
- **South Platte River Wildlife and Recreation Corridor Plan, Denver, CO** – Designed the Zuni Riverfront Park and planned the wildlife and recreation corridor between I-25 and 8th Street near Mile High Stadium. Prepared, steered and presented graphics that the City and County of Denver Mayor's Commission (Wellington Webb) and the Urban Drainage and Flood Control District used to help sell the project to the public and federal funding sources in Washington D.C.
- **Historic Arkansas River Walk, Pueblo, CO** – Coordinated and steered the design and presentation of riparian, aquatic, and palustrine wetlands in the HARP Natural Area. Designed environmental Education Park to include outdoor classroom, access, and multi-thematic interpretive nodes.
- **Pueblo Natural Resources and Environmental Education Council Plan, Pueblo, CO** – Designed the identity and jointly produced strategic natural resource based environmental education plan for Pueblo County (PNREEC). The plan helped build consensus among multiple private and governmental agencies and stakeholders on funding, conservation, restoration, and enhancement priorities throughout the County.
- **Aluminum Company of America (ALCOA) Huisache Cove Master and Design Plan Master of Landscape Architecture Thesis, Port Lavaca, TX** – Served as environmental consultant in researching and generating wildlife habitat restoration plan and multi-functional landfill cap redesign incorporating

coastal prairie, lacustrine, palustrine, estuarine wetlands, passive recreation, bird watching and ecological interpretation facilities on an industrial superfund clean-up site.

Aquatic, Wetland, and Riparian Habitat and Mitigation Design:

- **Big Thompson River Flood Recovery and Restoration, Loveland, CO -** ecos is currently part of a multi-disciplinary team assisting the Big Thompson Watershed Coalition (BTWC) with assessment, design, and construction of the Big Thompson between Rossum and Wilson Drives which are majority-owned by the City of Loveland and Loveland Ready-mix. As with all the flood recovery projects ecos has worked on, Jon produced 30%, 60% and 100% design plans, construction cost estimates, and specifications guiding soil development/enrichment; upland, riparian, and wetland seeding and planting; and numerous bioengineering techniques aimed at restoring the river and making it more resilient to future flood events. This project is aimed at completion in the summer of 2019.
- **Saint Vrain Creek Reach 3 Flood Recovery and Restoration, Boulder County, CO** - ecos is part of the multi-disciplinary team assisting Boulder County Parks & Open Space (BCPOS) with resilient design for the restoration of Reach 3 of the Saint Vrain Creek (from Highway 36 downstream to Hygiene Road) that was damaged by the 2013 floods. Jon's role in the project includes: 1) desktop and field assessment to inventory and document the characteristics of the stream reach and riparian corridor (e.g. in-stream features, vegetation, wildlife habitat); identify and locate significant habitat features within the areas of proposed construction; identify potential sources of native plant materials for restoration; and identify areas of opportunity within the reach that require native vegetation, wetland, PMJM, leopard frog and fishery habitat restoration; and delineate wetland habitat and waters of the U.S. in all areas of proposed/potential construction-related impact; 2) vegetation community and wildlife habitat restoration design; 3) permitting and compliance under the CWA, ESA and NHPA; and 4) construction oversight of restoration construction activities. This project was completed in the summer of 2018.
- **Bohn Park Flood Recovery and Restoration, Town of Lyons, CO** – ecos is part of the Design Team assisting the Town with the restoration, enhancement and stabilization of Bohn Park which was damaged by the 2013 floods. Ecos role is to assess, design, and prepare design-bid-build specifications for the natural restoration of the vegetation communities and habitat along South St. Vrain Creek that have been incorporated in to the landscape architecture of Bohn Park, the Towns largest and most used recreational asset. This project was completed in the spring of 2018.
- **Fourmile Creek Flood Recovery and Restoration, Boulder County, CO** – ecos was part of the Fourmile Watershed Coalition design-build team tasked with restoring flood-damaged properties that were prioritized in the watershed master plan. Jon generated seeding and planting plans, performance notes, cost estimates, and co-managed construction oversight in collaboration with the executive director of the Watershed Coalition. This project was completed in the summer of 2017.
- **James Creek Post-flood Restoration, Lefthand Watershed Oversight Group (LWOG), Jamestown, CO –** ecos was part of the LWOG Team responsible for preparing the 30-60% design package for James Creek Reach 16 as identified in the Lefthand Creek Watershed Master Plan. ecos performed pre- and post-flood plant community assessment; developed revegetation goals and objectives, the basis of design, monitoring protocols, and revegetation plans according to Colorado Department of Local Affairs, Community Development Block Grant – Disaster Recovery 30% Guidelines. Specific resources and issues of concern addressed by ecos, included federal and state listed candidate, threatened and endangered species, wildlife species of concern (including raptors), fisheries and fish passage, native plant communities, and management of noxious weeds.
- **Saint Vrain Creek Flood Recovery and Restoration, Town of Lyons, CO –** ecos is part of a design-build team tasked with restoring the St. Vrain Creek corridor in the Town of Lyons that was damaged during the September 2013 flood event. The goal of the project is to work with the Town and affected land-owners to create a more resilient floodplain and natural channel condition that will help alleviate future threats to the community, reestablish floodplain connectivity, stabilize banks, and restore aquatic, wetland and riparian habitat that was wiped out during the flood. Mr. Dauzvardis is responsible for developing the plant communities and revegetation strategies needed to restore aquatic and riparian structure and functions within the corridor that support fish, wildlife, recreation, and help the Town regain the ecological benefits and economic value they receive from outdoor enthusiasts. This project was completed in the summer of 2016.

- **Plum Creek Mitigation Bank, Sedalia, CO –** ecos was retained by Restoration Systems to prepare conceptual design plans for the Plum Creek Mitigation Bank Site that is currently under consideration by the Chatfield Reservoir Mitigation Company (CRMC). The purpose of the Site is to provide compensatory mitigation credits for unavoidable, permitted impacts to wetland, PMJM and bird (target resources) habitat regulated under the CWA and ESA; and to restore, enhance and preserve natural resource functions. Jon has guided agency and CRMC staff on tours of the Site; performed plant community mapping, baseline EFU assessment for PMJM, and FACWet assessment of wetlands. Jon was responsible for mapping, interpretation, and quantification of historic and existing habitat on the site. Jon prepared Conceptual Design Plans for resource mitigation including channel geomorphology, PMJM and wetland habitat setting the stage for post-mitigation calculations of EFU's.
- **Bellvue Raw Water Ponds Riverbank Restoration, Bellvue, CO –** The 2013 flood on the Poudre River altered the course of the river and severely eroded a bank nearly causing a breach of the City of Greeley's raw water ponds – their main municipal water supply. The goal of the project was to stabilize the bank to protect the ponds and to create riparian habitat for the Preble's meadow jumping mouse, a federally listed threatened and endangered species. Jon was responsible for preparing bioengineering design plans and specifications that include soil/cobble encapsulated lifts, stream barbs to deflect flows away from the bank, and harder, biotechnical design of soil/riprap and stream bed scour protection measures to prevent erosion and further undermining and sloughing of the bank. Design plans included specification of native plant materials and various techniques to restore cottonwood forest and willow habitat to further stabilize the bank.
- **Poudre River Pipeline Crossing at Kodak, Windsor, CO –** Jon's role on the ecos team was to assess restoration potential, techniques, and prepare design plans and performance specifications to reclaim a pipeline corridor across the lower Poudre River where the City of Greely had to replace 3 major water supply lines. Flooding on the Poudre River in 2013 and 2014 temporarily suspended construction of the pipeline. Jon will oversee site stabilization and restoration measures once all 3 pipelines have been installed.
- **Lions Park Poudre River Restoration Plan, Laporte, CO –** Jon's role on the ecos team was to assess habitat conditions; gather, compile and analyze field survey data; and to prepare the mapping and mitigation design plans for the Lions Park PMJM habitat and the Poudre River Bank Stabilization Plans. Jon simultaneously designed and executed the technical drawings for the structural components of the habitat, ensuring that the proposed riparian plant community, habitat structures (brush piles), and bioengineered streambank stabilization measures will create the conditions that alleviate the current habitat fragmentation; support the life requisites of the PMJM; and enhance the overall health of the Poudre River fishery.
- **St. Vrain River Riparian Corridor Enhancement, Lyons, CO –** Jon designed, managed and led the construction of the Preble's Meadow Jumping Mouse Habitat (PMJM) enhancement project along the St. Vrain River. Jon worked in coordination with the project sponsor and Director of the Town of Lyons, Parks, Recreation and Cultural Events Department to implement required mitigation within a passive greenway park along the St. Vrain. Jon's role included riparian/PMJM mitigation site identification and habitat assessment; and design; and implementation of riverbank stabilization and riparian habitat enhancement measures.
- **Brush Creek Fishery Enhancement Plan, Saratoga, WY** – Prepared access, staging and design plans, details and performed on-site construction oversight of instream and riparian habitat enhancements and bioengineered bank stabilization along a 3-mile reach of Brush Creek. The purpose of the project is to enhance fish, bird and wildlife habitat and use these resources to facilitate education and improve the recreational experience of Ranch guests. Access routes were planned so that they can be easily converted to trails to avoid repetitive impacts to high quality habitat and productive pastures.
- **St. Vrain River Riparian Corridor Enhancement, Lyons, CO** – Jon is the lead Landscape Architect for the restoration and enhancement of Preble's Meadow Jumping Mouse Habitat (PMJM) along the St. Vrain River. Jon and ecos are working in coordination with the Town of Lyons, Parks, Recreation and Cultural Events team to implement this restoration project within a passive park area along the St. Vrain. Jon's tasks include riparian/PMJM habitat assessment; PMJM site location and habitat design; and implementation of riverbank stabilization and riparian habitat enhancement measures.
- **TZ Ranch, Elk Hollow Creek Fishery Habitat Enhancement Plan, Saratoga, WY -** ecos performed the assessment and design of the Elk Hollow Creek Project, which included instream and riparian habitat

improvements aimed at increasing bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach. Instream improvements included drop structures, plunge pools, deep pools, riffles and spawning habitat. Bank improvements included seeding and planting plans for native wetland and riparian species. Jon was the lead on the generation of design-build plans and provided construction oversight of instream structure and native plant installation.

- **Brush Creek Ranch Pond Creation Plan, Saratoga, WY** – Prepared below grade pond excavation, grading, drainage and revegetation plan for a 0.30-acre fishing pond, followed by on-site field layout and surveying, wetland sod transplanting, submerged aquatic habitat and construction support of heavy equipment operators. The pond was designed to be a self-sustaining, cold water fishery that supports all components of the aquatic food-chain and incorporates all necessary life requisites for trout; and provide fishing opportunities during high water in Brush Creek.
- **Edwards Eagle River Restoration Project, Edwards, CO** – Assessment, planning, native plant community design and construction oversight of aquatic, wetland, riparian habitat along 1.5 mile reach and 168-acres of floodplain along the Eagle River utilizing indigenous materials and methods that naturally integrate habitat structure in the landscape context. Planning and design included trails, boat launch, boardwalks, overlooks, and interpretive sign systems and thematic content.
- **Boone Property, Boulder Creek Fishery Enhancement Project, Boulder, CO** – Performed site assessment and identified instream and overhead cover habitat to enhance fish habitat along a short reach of Boulder Creek adjacent to City of Boulder, Eldorado Canyon Open Space.
- **C-Lazy-U Ranch Willow Creek Fishery Enhancement Plan, Granby, CO** – Assessed and prepared design plans for 2 miles of instream and overhead cover habitat aimed at enhancing water quality through increased bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach influenced ongoing ranching activities. Bank-side improvements include detailed seeding and planting plans indicating site-specific plant and seed locations, life zones, and species palettes according to hydrologic, soil, and aspect conditions.
- **Colowyo Coal Mine Wetland Creation Plan, Meeker, CO** – Performed wetland mitigation site feasibility assessment and design of 2.2-acres of created wetland benches along a 1.5-mile reach of the West New Goodspring Creek.
- **Uncompahgre River Wetland Creation and Streambank Stabilization, Montrose, CO** – Mr. Dauzvardis developed a Clean Water Act Individual Section 404, alternatives analysis and mitigation plans that successfully defrayed public descent and offset unavoidable impacts related to the River Landing Retail Development Project. Once approved by the USACE, the project turned a degraded, gravel-mined portion of the floodplain into functional and aesthetic riparian habitat that is now enjoyed by the public via a segment of trail that Mr. Dauzvardis designed. Two acres of riparian and “backwater” wetland habitat were strategically created along the Uncompahgre River to ensure reliable hydrologic connectivity and support of the designed wetland plant community. Nearly 350 lineal feet of severely degraded stream bank was stabilized using a naturalized bio-engineering approach that incorporated soil, native seed, erosion control blanket, shrubs, trees, and strategically located river boulders and logs to restore the riparian habitat, create fish habitat and redirect scouring flows away from the once barren bank.
- **River Point at Sheridan Brownfield Redevelopment, Sheridan, CO** – Designed and oversaw the construction of a “bio-engineered” and “bio-technical” vegetative landfill cap system and water quality swale that drains to the South Platte River. Jon was responsible for integrating the swale in to the River Point at Sheridan commercial redevelopment and the City of Englewood Golf Course renewal – renamed to the Broken Tee Golf Course.
- **Broken Tee Golf Course Flood Protection, City of Englewood, CO –** Oversaw the construction of a biotechnical subsurface stabilization and flood protection system (under-armor) designed to ensure that the woodland golf course tees, fairways and greens in the South Platte River floodplain are not compromised by flood scour. Designed and implemented bioengineered bank stabilization and under-armor on Bear Creek that was essential for protecting tees and greens. Jon was responsible for disproving the jurisdictional status of artificially supported wetlands via a groundwater monitoring system.
- **Lafarge Northbank Resources Gravel Pit Wetland Design, Rifle, CO** – Jon asses DMG requirements and prepared gravel pit reclamation plans aimed at providing suitable shallow-water wetlands and islands within the pit closure area to serve as compensatory mitigation for wetland impacts associated with mine operations adjacent to the Colorado River.

- **Leach Creek Stream Enhancement, Grand Junction, CO** – Designed stream corridor enhancements for a ½-mile section of Leach Creek that was channelized and used as an irrigation canal. Enhancements were designed to restore natural channel form and function, improve the aquatic environment, and provide mitigation for jurisdictional impacts permitted under the Nationwide Permit program. This project is being used as a model and replicated along other reaches of Leach Creek
- **Castro Property Wetlands and Wildlife Ponds, Beulah, CO** – Performed the site assessment, feasibility analysis, water resource and minor dam design, native plant design, landscape architecture, and supported the water rights application needed to create shallow water wetland habitat for amphibians, waterfowl, migrating bird and ungulates, and deep water habitat for trout at a sub-alpine elevation of 9000 feet. Project included development of a spring, creation of a creek and a mechanical water circulation and aeration system to support the aquatic, wetland, and riparian ecosystem. Organized, supervised and participated in a volunteer planting effort.
- **Jefferson County Gunbarrel Bridge Replacement, Oxyoke, CO** – Developed construction plans and specifications and oversaw construction of wetland and Preble's mouse habitat mitigation to enhance weedy and degraded wetland and Preble's mouse habitat along Gunbarrel Creek, a tributary to the upper South Platte River near Deckers, CO.
- **Coal Creek Bank Stabilization, Erie, CO** – Assessed, permitted, designed and performed construction oversight of bio-engineered/bio-technical bank stabilization and wetland creation associated with the Vista Parkway bridge crossing over Coal Creek in Erie, CO. The project involved pulling back vertical banks and restoring native wetland, riparian, and short grass prairie habitat.
- **Spring Creek Wetland Mitigation, Colorado Springs, CO** – Generated wetland and creek creation plans that integrated required mitigation into a high density, "new urban" development. The design emphasized re-utilization of urban storm water to sustain wetlands, use of indigenous plants, construction materials, and natural geomorphic relationships.
- **Sulphur Gulch, Parker, CO** – Developed a naturalized sculpted concrete drop structure design, planting and bio-engineering plans for a highly visible, urbanizing reach of a sandy creek through the center of the Town of Parker.
- **Skylark Creek Restoration Plan, Kremmling, CO** – Designed and performed construction oversight of aquatic, wetland and riparian plant community, and trail system along a historic side channel of the Upper Colorado River on a private fishing ranch.
- **ARCO Opportunity Ponds Wetland Mitigation Design, Anaconda, MT –** Jon generated the design of a 908-acre complex of wetlands and terrestrial habitat required to meet the Consent Decree and the functional assessment criteria established during the wetland assessment process mentioned previously. The design is currently being implemented. Once complete, the grading, drainage, hydrology, and revegetation strategy used to create wetlands from massive soil borrow pits will potentially be the largest inland, freshwater wetland mitigation project in the United States.
- **Northgate Boulevard Realignment, Colorado Springs, CO** – Coordinated and prepared ESA Section 7 and CWA Section 404 consultation documents as required by the USFWS and USACE, including mitigation construction documents, specifications, on-site layout of plant communities and construction supervision aimed at restoring wetland and riparian habitat occupied by Preble's meadow jumping mouse.
- **Northgate PMJM and Wetland Mitigation Plan, Colorado Springs, CO** – Mr. Dauzvardis was an instrumental member of multidisciplinary team responsible for delineating wetlands, preparing ESA Section 7 and CWA Section 404 assessment, impact analysis and consultation documents as required by the USFWS and USACE. As the lead designer, Jon was responsible for the design of over 80 acres of wetland, riparian, and grassland habitat utilized as primary and secondary habitat for Preble's Meadow Jumping Mouse, a Federally-listed threatened species. Jon prepared mitigation construction documents, specifications, onsite layout of plant communities and supervised construction for this precedent setting mitigation plan designed to offset impacts to critical habitat over a 1200-acre site.
- **Martin County Coal Corporation, Inez, KY** – Mr. Dauzvardis bioengineered and performed on-the-ground triage of two stream corridors, consisting of 26 miles, impacted by a coal slurry spill that originated from a mountaintop mine reservoir used to hold liquefied coal dust. Jon identified and documented critically imperiled stream banks and human settlements, and then designed, coordinated, led and supervised local crews during the implementation of specified floodplain, bioengineered bank stabilization, and reforestation efforts.

- **Uncompahgre River Restoration and Park Corridor, Ouray, CO** – Jon designed and performed construction oversight of the restoration and reclamation of one mile of upland, riparian and wetland habitat left barren by historic placer mining. The major challenge presented by this project was a lack of soil, organic matter and nutrients to sustain vegetation. This constraint was addressed by amending the soil with humate and planting and seeding riparian vegetation to initiate natural succession and bioaccumulation of matter, assisted by an irrigation system that injected organic fertilizer and microbes (mycorrhizea) in to the substrate.
- **Burlington Mine Remediation, Jamestown, CO** – Preparation and management of specification package, best management practices (BMPs), and revegetation design for mine waste capping and closure.
- **Powder River Coal Company – Porcupine Creek Restoration, Douglas, WY** – Designed and supervised the construction of this post mine wetland/creek restoration project. Following the pit closure, reclamation specialists reestablished the original location and geomorphic relationships of the creek using historic aerial photography using a trapezoidal channel cross-section design. Jon adapted the design creating grading and wetland planting plans that mimic the landform, natural lateral and longitudinal channel tilt, and plant communities that are indigenous to ephemeral creeks in the shortgrass prairie landscapes of eastern Wyoming.
- **Sand Creek Corridor Habitat Enhancement at Bluff Lake, Denver, CO** – Prepared plant community, bioengineering and bank stabilization design. Prepared visualization graphics to present and receive design approval.
- **Intrawest Resort Development, West Ten Mile Creek, Copper Mountain Village, CO** – Prepared vegetation community and concept design of village base streamside recreational amenities.

Construction and Plant Installation:

- **St. Vrain River Riparian Corridor Enhancement, Lyons, CO –** Jon managed construction and implementation of the restoration and enhancement of 0.60-acre of riparian Preble’s Meadow Jumping Mouse Habitat (PMJM) along the St. Vrain River.
- **Standley Lake Protection Project, Westminster, CO** – Designed and supervised construction of a 0.50-acre created emergent wetland to fulfill final mitigation requirements of the USACE and bring closure to the City’s drinking water protection project.
- **Caribou Peat Bog Restoration, Nederland, CO** –Prepared native plant community design, planting cost estimate, and on-the-ground oversight of volunteers to restore a high-altitude peat bog disturbed by an illegal four-wheel drive “mudfest”.
- **Department of Energy (DOE) Wetland Mitigation Bank, Westminster, CO** – Construction supervision of grading and planting plans of a 12-acre wetland mitigation bank design for the Department of Energy.
- **ARCO Lower Area One and Butte Reduction Works, Butte, MT** – Performed construction observation and supervision of temporary labor crews to plant a passive treatment wetland designed to absorb heavy metals from groundwater.
- **Colorado Department of Transportation Mitigation Bank, Limon, CO** – Performed in-field planting design and supervised local labor to complete a 10-acre wetland mitigation bank designed by CDOT to offset future wetland impacts in the transportation region.
- **Irvine Ranch Water District – San Joaquin Wetland Treatment System, Irvine, CA** – Planting superintendent of a wetland designed to be a used as tertiary wastewater treatment facility and waterfowl refuge.

PRESENTATIONS & INSTRUCTION:

Dauzvardis, Jonathan B. 2008. Preserving the Ecological Services of Willow Cuttings. Research presented at the Colorado Riparian Association (CRA) Sustaining Colorado Watersheds Conference. October 2, 2008. Vail, Colorado.

Dauzvardis, Jonathan B. 2006. Water Pollution and Wetland Plant Tolerance to Various Ph Levels. Classroom instruction with Elementary Students. Flagstaff Academy Charter School. February 2, 2006. Longmont, Colorado.

Dauzvardis, Jonathan B. 2006. Soil Erosion and Habitat Destruction. Classroom instruction with Elementary Students. Flagstaff Academy Charter School. January 26, 2006. Longmont, Colorado.

Dauzvardis, Jonathan B. 2004. Wetland and Wildlife Habitat Restoration, Opportunity Ponds, Anaconda, Montana. Poster Presentation at Ecological Restoration Conference. October, 2003. Orlando, Florida.

Dauzvardis, Jonathan B. 2003. Application of Landscape Ecology Principles to Mine Remediation and Wetland Creation: An Ecological Restoration Seminar using a Case Study of the Opportunity Ponds Wetlands Plan, Anaconda, Montana. Presented at the University of Colorado, Denver. November, 2003. Denver, Colorado.

Dauzvardis, Jonathan B. 2000. Endangered Species Act Issues: Incorporating the ESA into Mitigation Projects. Presented at the Continuing Legal Education (CLE, International) Colorado Wetlands Conference. September 18, 2000. Denver, Colorado.

AWARDS:

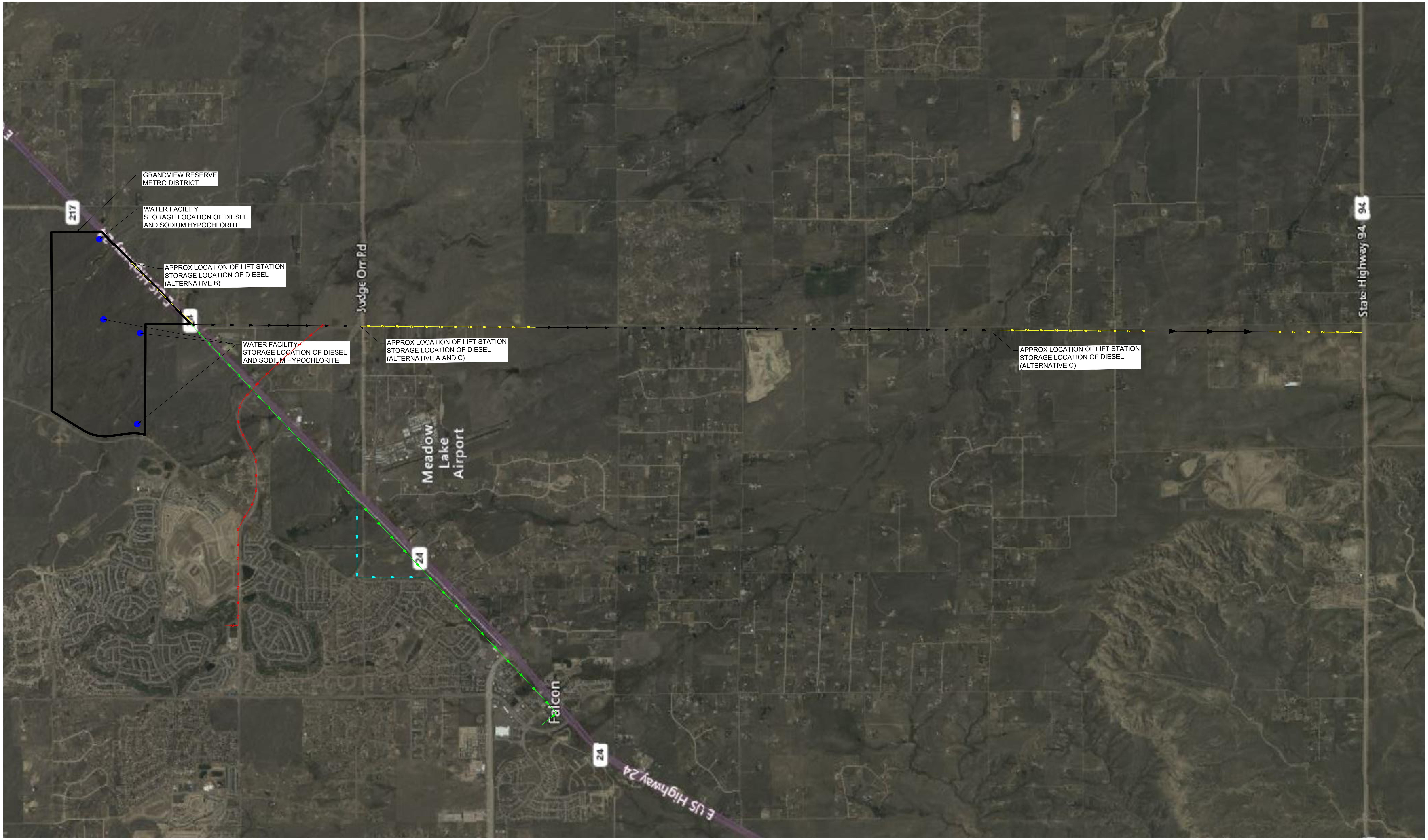
- Colorado Landscape Contractors Award, Sand Creek Enhancement Project – 2000
- Colorado Landscape Contractors Award, Skylark Creek Restoration Project – 1998
- Colorado American Society of Landscape Architects, Research, and Communications – 1997
- Texas American Society of Landscape Architects Honor Award – 1995
- Texas A&M Landscape Architecture Faculty Award – 1995

PROFESSIONAL ASSOCIATIONS:

- Town of Erie, Colorado Open Space and Trails Advisory Board (OSTAB) - As a former member and chair of the Town of Erie Open Space and Trails Advisory Board (OSTAB), Mr. Dauzvardis routinely collaborated with Town Administrator, Community Planning, Public Works, and Parks and Recreation Directors and Staff, and advised the Board of Trustees on all matters related to the goals, objectives, prioritization, acquisition, conservation, and the management of open space and trails throughout a 49-square mile planning area. Jon's 8-year experience on the OSTAB translates to an intimate knowledge of public processes.
- Society of Wetland Scientists (SWS)

EXHIBIT P: HAZARDOUS MATERIAL LOCATION EXHIBIT

BUDGE, CASSIDY, 2/20/2023 9:32 AM



NORTH

0 1000 2000

HRGreen

Job No.:	201662
Prepared By:	SJF
Date:	12/21/2021

HAZARDOUS MATERIALS

FIG.A

HRGreen DRAWING PATH:J:\2020\201662.01\CAD\Dwgs_Exhibits\Hazardous Materials Location Exhibit.dwg

EXHIBIT Q: NOISE STUDY

TRANSPORTATION
CONSULTANTS, INC.

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

July 9, 2020

Mr. Peter Martz
4 Site Investments, LLC
P.O. Box 50223
Colorado Springs, CO 80949

RE: Grandview Reserve
Noise Impact Study
El Paso County, Colorado
LSC #184841

Dear Mr. Martz:

In response to your request, LSC Transportation Consultants, Inc. has completed a detailed analysis of the noise impacts of US Highway (US) 24 on the residential areas within the proposed Grandview Reserve development. The site is located west of US 24 in the vicinity of the future intersection of Rex Road in El Paso County, Colorado. LSC has completed an evaluation of the noise exposure for submittal to El Paso County and the Colorado Department of Transportation in accordance with the Federal Highway Administration (FHWA) requirements.

LSC used the software program Traffic Noise Model Version 2.5, developed by FHWA, to predict the noise levels at nine key locations on the east side of the development adjacent to US 24. An elevation of five feet was assumed for the height of each receiver. The receiver locations are shown in Figure 1.

The input data for the noise predictions included traffic volumes, roadway geometry, topographic elevations, and the locations of the receivers. The analysis was completed using the projected 2040 afternoon peak-hour traffic volumes taken from the *Grandview Reserve Master Traffic Impact Analysis* by LSC dated April 17, 2020. The roadway geometry assumes the future condition of US 24 with two through lanes in each direction as identified in the *Colorado Department of Transportation US 24 Planning and Environmental Linkages Study Final Corridor Conditions Report* dated December 2016. The noise analysis inputs and outputs are attached.

The results of the noise prediction were compared to the noise abatement criteria contained in Exhibit 1 of the *Colorado Department of Transportation Noise Analysis and Abatement Guidelines* dated January 15, 2015. The proposed residential areas would be considered Category “B” land uses. The threshold for exterior noise level for Category B is 66 decibels Leq(h). The results of the noise prediction show that in the year 2040, receivers 1, 2, and 3 located on the east boundary of Parcel K would have predicted noise levels which would exceed this threshold. If a six-and-a-half-foot high noise barrier were constructed at the location shown on Figure 1, these noise receiver locations are predicted to be below the threshold. This noise barrier could be a wall, a berm, or a combination of the two. If a wall is constructed, it should be made of a rigid material with a density of at least 4 pounds per square foot and should have no gaps.

Receivers 4 through 9 located on the east boundary of Parcels L, M, and N have predicted noise levels that would **not** exceed 66 decibels Leq(h) and therefore noise mitigation would not be required adjacent to these parcels.

* * * * * *

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

Respectfully submitted,

LSC TRANSPORTATION CONSULTANTS, INC.

By: Kirstin D. Ferrin, P.E.
Senior Transportation Engineer

COLORADO REGISTERED
KIRSTIN DAY FERRIN
38417
7-9-20
PROFESSIONAL ENGINEER

KDF:jas

Enclosures: Figure 1
Noise Analysis Inputs/Outputs

Figure 1

TRANSPORTATION
CONSULTANTS, INC.

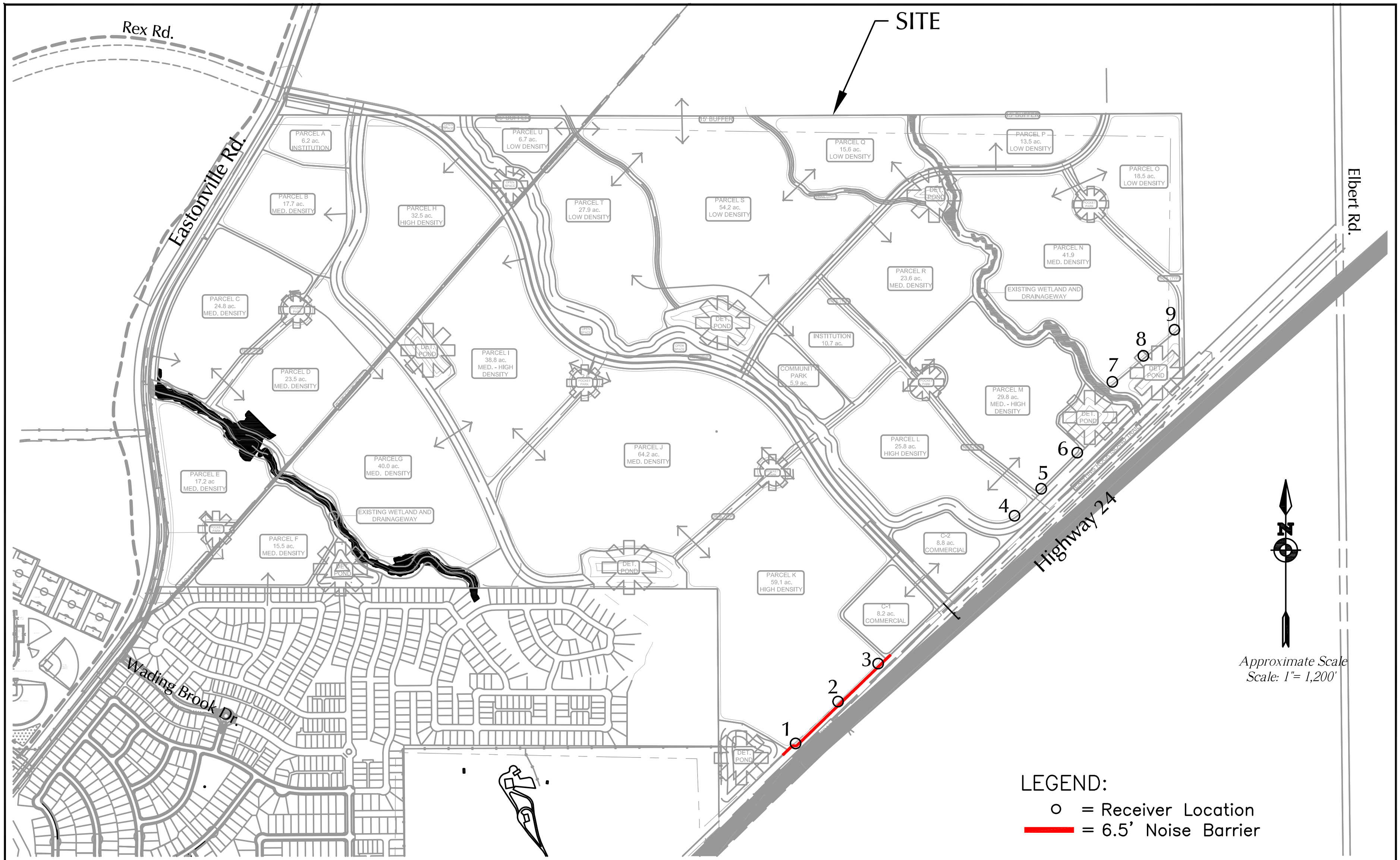


Figure 1

Noise Analysis Data

Grandview Reserve Noise Analysis (LSC #184841)

LSC TRANSPORTATION CONSULTANTS, INC.

Noise Analysis Inputs/Outputs

TRANSPORTATION
CONSULTANTS, INC.

LSC Transportation Consultants, Inc		**12 May 2020**	
KDF		**TNM 2.5**	
		Calculated with TNM 2.5	
RESULTS: SOUND LEVELS			
PROJECT/CONTRACT:	**Grandview Reserve**		
RUN:	**2040 PM Peak Hour**		
BARRIER DESIGN:	**INPUT HEIGHTS**		**Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.**
ATMOSPHERICS:	**68 deg F, 50% RH**		

Receiver												
Name	**No.**	**#DUs**	**Existing**	**No Barrier**					**With Barrier**			
			LAeq1h	**LAeq1h**		**Increase over existing**		**Type**	**Calculated**	**Noise Reduction**		
				Calculated	**Crit'n**	**Calculated**	**Crit'n**	**Impact**	**LAeq1h**	**Calculated**	**Goal**	**Calculated**
							Sub'l Inc					**minus**
												Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
Receiver1	1	1	0.0	68.2	66	68.2	10	Snd Lvl	66.0	2.2	8	-5.8
Receiver2	2	1	0.0	68.9	66	68.9	10	Snd Lvl	64.6	4.3	8	-3.7
Receiver3	3	1	0.0	69.2	66	69.2	10	Snd Lvl	65.5	3.7	8	-4.3
Receiver4	4	1	0.0	62.0	66	62.0	10	----	62.0	0.0	8	-8.0
Receiver5	5	1	0.0	61.8	66	61.8	10	----	61.8	0.0	8	-8.0
Receiver6	6	1	0.0	61.5	66	61.5	10	----	61.5	0.0	8	-8.0
Receiver7	7	1	0.0	56.9	66	56.9	10	----	56.9	0.0	8	-8.0
Receiver8	8	1	0.0	57.1	66	57.1	10	----	57.1	0.0	8	-8.0
Receiver9	9	1	0.0	57.3	66	57.3	10	----	57.3	0.0	8	-8.0

Dwelling Units	**# DUs**	**Noise Reduction**		
		Min	**Avg**	**Max**
		dB	**dB**	**dB**
All Selected	9	0.0	1.1	4.3
All Impacted	3	2.2	3.4	4.3
All that meet NR Goal	0	0.0	0.0	0.0

LSC Transportation Consultants, Inc **12 May 2020**
KDF **TNM 2.5**

INPUT: TRAFFIC FOR LAeq1h Volumes
PROJECT/CONTRACT: **Grandview Reserve**
RUN: **2040 PM Peak Hour**

Roadway	**Points**											
Name	**Name**	**No.**	**Segment**									
			Autos		**MTrucks**		**HTrucks**		**Buses**		**Motorcycles**	
			V	**S**	**V**	**S**	**V**	**S**	**V**	**S**	**V**	**S**
			veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph	veh/hr	mph
US 24 EB Southwest of Rex Rd	point1	1	2119	65	42	65	62	65	0	0	0	0
	point3	3	2119	65	42	65	62	65	0	0	0	0
	point4	4	2119	65	42	65	62	65	0	0	0	0
	point5	5	2119	65	42	65	62	65	0	0	0	0
	point6	6	2119	65	42	65	62	65	0	0	0	0
	point7	7	2119	65	42	65	62	65	0	0	0	0
	point8	8	2119	65	42	65	62	65	0	0	0	0
	point9	9	2119	65	42	65	62	65	0	0	0	0
	point10	10	2119	65	42	65	62	65	0	0	0	0
	point11	11	2119	65	42	65	62	65	0	0	0	0
	point12	12	2119	65	42	65	62	65	0	0	0	0
	point13	13	2119	65	42	65	62	65	0	0	0	0
	point14	14	2119	65	42	65	62	65	0	0	0	0
	point15	15	2119	65	42	65	62	65	0	0	0	0
	point16	16	2119	65	42	65	62	65	0	0	0	0
	point17	17	2119	65	42	65	62	65	0	0	0	0
	point2	2										
US 24 EB Northeast of Rex Rd	point18	18	1136	65	23	65	33	65	0	0	0	0
	point20	20	1136	65	23	65	33	65	0	0	0	0
	point21	21	1136	65	23	65	33	65	0	0	0	0
	point22	22	1136	65	23	65	33	65	0	0	0	0
	point23	23	1136	65	23	65	33	65	0	0	0	0
	point24	24	1136	65	23	65	33	65	0	0	0	0

	point25	25	1136	65	23	65	33	65	0	0	0	0
	point26	26	1136	65	23	65	33	65	0	0	0	0
	point27	27	1136	65	23	65	33	65	0	0	0	0
	point28	28	1136	65	23	65	33	65	0	0	0	0
	point29	29	1136	65	23	65	33	65	0	0	0	0
	point30	30	1136	65	23	65	33	65	0	0	0	0
	point19	19										
US 24 WB Northeast of Rex Rd	point31	31	1086	65	22	65	32	65	0	0	0	0
	point33	33	1086	65	22	65	32	65	0	0	0	0
	point34	34	1086	65	22	65	32	65	0	0	0	0
	point35	35	1086	65	22	65	32	65	0	0	0	0
	point36	36	1086	65	22	65	32	65	0	0	0	0
	point37	37	1086	65	22	65	32	65	0	0	0	0
	point38	38	1086	65	22	65	32	65	0	0	0	0
	point39	39	1086	65	22	65	32	65	0	0	0	0
	point40	40	1086	65	22	65	32	65	0	0	0	0
	point41	41	1086	65	22	65	32	65	0	0	0	0
	point42	42	1086	65	22	65	32	65	0	0	0	0
	point43	43	1086	65	22	65	32	65	0	0	0	0
	point32	32										
US 24 WB Southwest of Rex Rd	point44	44	1665	65	33	65	49	65	0	0	0	0
	point47	47	1665	65	33	65	49	65	0	0	0	0
	point48	48	1665	65	33	65	49	65	0	0	0	0
	point49	49	1665	65	33	65	49	65	0	0	0	0
	point50	50	1665	65	33	65	49	65	0	0	0	0
	point51	51	1665	65	33	65	49	65	0	0	0	0
	point52	52	1665	65	33	65	49	65	0	0	0	0
	point53	53	1665	65	33	65	49	65	0	0	0	0
	point54	54	1665	65	33	65	49	65	0	0	0	0
	point55	55	1665	65	33	65	49	65	0	0	0	0
	point56	56	1665	65	33	65	49	65	0	0	0	0
	point57	57	1665	65	33	65	49	65	0	0	0	0
	point58	58	1665	65	33	0	49	65	0	0	0	0
	point59	59	1665	65	33	65	49	65	0	0	0	0
	point60	60	1665	65	33	65	49	65	0	0	0	0
	point61	61	1665	65	33	65	49	65	0	0	0	0

LSC Transportation Consultants, Inc **12 May 2020**
KDF **TNM 2.5**

INPUT: ROADWAYS
PROJECT/CONTRACT: **Grandview Reserve**
RUN: **2040 PM Peak Hour**

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway		Points									
Name	Width	Name	No.	Coordinates (pavement)			Flow Control			Segment	
				X	Y	Z	Control Device	Speed Constraint	Percent Vehicles Affected	Pvmt Type	On Struct?
	ft			ft	ft	ft		mph	%		
US 24 EB Southwest of Rex Rd	24.0	point1	1	3,269,332.5	1,416,773.2	6,876.00				Average	
		point3	3	3,269,607.2	1,417,039.1	6,876.00				Average	
		point4	4	3,269,944.2	1,417,365.2	6,875.00				Average	
		point5	5	3,269,994.5	1,417,414.1	6,875.00				Average	
		point6	6	3,270,271.0	1,417,681.6	6,876.00				Average	
		point7	7	3,270,446.2	1,417,851.2	6,877.00				Average	
		point8	8	3,270,553.0	1,417,954.8	6,877.00				Average	
		point9	9	3,270,682.5	1,418,080.2	6,876.00				Average	
		point10	10	3,270,766.2	1,418,161.1	6,875.00				Average	
		point11	11	3,270,845.5	1,418,237.9	6,874.00				Average	
		point12	12	3,270,854.0	1,418,246.2	6,874.00				Average	
		point13	13	3,270,921.2	1,418,311.2	6,873.00				Average	
		point14	14	3,271,058.2	1,418,443.8	6,872.00				Average	
		point15	15	3,271,156.5	1,418,539.0	6,871.00				Average	
		point16	16	3,271,254.5	1,418,633.8	6,870.00				Average	
		point17	17	3,271,353.2	1,418,729.2	6,869.00				Average	
		point2	2	3,271,538.2	1,418,907.9	6,869.00					
US 24 EB Northeast of Rex Rd	24.0	point18	18	3,271,546.5	1,418,916.5	6,869.00	Signal	0.00	50	Average	
		point20	20	3,271,782.0	1,419,144.2	6,869.00				Average	
		point21	21	3,271,914.0	1,419,272.1	6,870.00				Average	
		point22	22	3,271,953.0	1,419,310.0	6,870.00				Average	
		point23	23	3,272,050.5	1,419,404.2	6,869.00				Average	
		point24	24	3,272,112.0	1,419,463.9	6,868.00				Average	
		point25	25	3,272,159.5	1,419,509.9	6,867.00				Average	
		point26	26	3,272,226.8	1,419,574.8	6,866.00				Average	

		point27	27	3,272,296.8	1,419,642.6	6,865.00				Average	
		point28	28	3,272,393.0	1,419,735.8	6,864.00				Average	
		point29	29	3,272,914.8	1,420,241.0	6,864.00				Average	
		point30	30	3,273,166.5	1,420,484.6	6,865.00				Average	
		point19	19	3,274,763.8	1,422,030.8	6,871.00					
US 24 WB Northeast of Rex Rd	24.0	point31	31	3,274,722.0	1,422,073.9	6,871.00				Average	
		point33	33	3,273,171.8	1,420,573.2	6,865.00				Average	
		point34	34	3,272,886.5	1,420,297.0	6,864.00				Average	
		point35	35	3,272,349.8	1,419,777.6	6,864.00				Average	
		point36	36	3,272,255.5	1,419,686.1	6,865.00				Average	
		point37	37	3,272,183.0	1,419,616.0	6,866.00				Average	
		point38	38	3,272,118.5	1,419,553.6	6,867.00				Average	
		point39	39	3,272,069.5	1,419,506.2	6,868.00				Average	
		point40	40	3,272,007.8	1,419,446.4	6,869.00				Average	
		point41	41	3,271,915.2	1,419,356.8	6,870.00				Average	
		point42	42	3,271,872.0	1,419,315.0	6,870.00				Average	
		point43	43	3,271,739.5	1,419,186.6	6,869.00				Average	
		point32	32	3,271,505.2	1,418,960.0	6,869.00					
US 24 WB Southwest of Rex Rd	24.0	point44	44	3,271,496.8	1,418,951.8	6,869.00	Signal	0.00	50	Average	
		point47	47	3,271,313.2	1,418,774.1	6,869.00				Average	
		point48	48	3,271,214.2	1,418,678.2	6,870.00				Average	
		point49	49	3,271,118.0	1,418,585.1	6,871.00				Average	
		point50	50	3,271,017.5	1,418,487.8	6,872.00				Average	
		point51	51	3,270,883.8	1,418,358.2	6,873.00				Average	
		point52	52	3,270,814.5	1,418,291.4	6,874.00				Average	
		point53	53	3,270,806.5	1,418,283.4	6,874.00				Average	
		point54	54	3,270,727.2	1,418,207.1	6,875.00				Average	
		point55	55	3,270,642.0	1,418,124.1	6,876.00				Average	
		point56	56	3,270,513.0	1,417,999.5	6,877.00				Average	
		point57	57	3,270,406.0	1,417,895.9	6,877.00				Average	
		point58	58	3,270,226.5	1,417,722.1	6,876.00				Average	
		point59	59	3,269,950.8	1,417,455.1	6,875.00				Average	
		point60	60	3,269,900.2	1,417,406.2	6,875.00				Average	
		point61	61	3,269,492.8	1,417,011.8	6,876.00				Average	
		point45	45	3,269,333.0	1,416,857.1	6,876.00					

LSC Transportation Consultants, Inc **12 May 2020**
KDF **TNM 2.5**

INPUT: RECEIVERS
PROJECT/CONTRACT: **Grandview Reserve**
RUN: **2040 PM Peak Hour**

Receiver											
Name	**No.**	**#DUs**	**Coordinates (ground)**			**Height**	**Input Sound Levels and Criteria**				**Active**
			X	**Y**	**Z**	**above**	**Existing**	**Impact Criteria**		**NR**	**in**
						Ground	**LAeq1h**	**LAeq1h**	**Sub'l**	**Goal**	**Calc.**
			ft	ft	ft	ft	dBA	dBA	dB	dB	
Receiver1	1	1	3,270,152.0	1,417,886.6	6,878.00	4.92	0.00	66	10.0	8.0	Y
Receiver2	2	1	3,270,529.2	1,418,216.6	6,876.00	4.92	0.00	66	10.0	8.0	Y
Receiver3	3	1	3,270,865.0	1,418,535.0	6,872.00	4.92	0.00	66	10.0	8.0	Y
Receiver4	4	1	3,272,008.2	1,419,773.9	6,867.00	4.92	0.00	66	10.0	8.0	Y
Receiver5	5	1	3,272,232.8	1,420,000.0	6,867.00	4.92	0.00	66	10.0	8.0	Y
Receiver6	6	1	3,272,534.5	1,420,302.9	6,865.50	4.92	0.00	66	10.0	8.0	Y
Receiver7	7	1	3,272,828.5	1,420,896.4	6,865.00	4.92	0.00	66	10.0	8.0	Y
Receiver8	8	1	3,273,089.0	1,421,114.8	6,869.50	4.92	0.00	66	10.0	8.0	Y
Receiver9	9	1	3,273,349.2	1,421,333.2	6,868.00	4.92	0.00	66	10.0	8.0	Y

LSC Transportation Consultants, Inc **12 May 2020**
KDF **TNM 2.5**

INPUT: BARRIERS
PROJECT/CONTRACT: **Grandview Reserve**
RUN: **2040 PM Peak Hour**

Barrier Name	Type	Height Min	Height Max	If Wall $ per Unit Area	If Berm $ per Unit Vol.	If Berm Top Width	If Berm Run:Rise	Add'tnl $ per Unit Length	Points Name	No.	Coordinates (bottom) X	Coordinates (bottom) Y	Coordinates (bottom) Z	Height at Point	Segment Seg Ht Increment	Segment Perturbs #Up	Segment Perturbs #Dn	On Struct?	Important Reflections?
		ft	ft	$/sq ft	$/cu yd	ft	ft:ft	$/ft			ft	ft	ft	ft	ft				
Barrier1	W	0.00	99.99	0.00				0.00	point1	1	3,270,064.2	1,417,766.8	6,875.00	6.50	6.50	1	1		
									point3	3	3,270,085.0	1,417,787.0	6,876.00	6.50	6.50	1	1		
									point4	4	3,270,145.0	1,417,845.1	6,876.00	6.50	6.50	1	1		
									point5	5	3,270,181.2	1,417,845.1	6,876.00	6.50	6.50	1	1		
									point6	6	3,270,243.8	1,417,905.9	6,876.00	6.50	6.50	1	1		
									point7	7	3,270,328.2	1,417,987.8	6,876.00	6.50	6.50	1	1		
									point8	8	3,270,424.5	1,418,080.8	6,876.00	6.50	6.50	1	1		
									point9	9	3,270,473.0	1,418,127.8	6,875.00	6.50	6.50	1	1		
									point10	10	3,270,533.0	1,418,185.9	6,875.00	6.50	6.50	1	1		
									point11	11	3,270,555.5	1,418,207.4	6,876.00	6.50	6.50	1	1		
									point12	12	3,270,634.0	1,418,283.8	6,876.00	6.50	6.50	1	1		
									point13	13	3,270,664.5	1,418,313.0	6,875.00	6.50	6.50	1	1		
									point14	14	3,270,700.8	1,418,348.2	6,874.00	6.50	6.50	1	1		
									point15	15	3,270,753.2	1,418,399.0	6,873.00	6.50	6.50	1	1		
									point16	16	3,270,807.2	1,418,451.4	6,872.00	6.50	6.50	1	1		
									point17	17	3,270,844.5	1,418,487.2	6,871.00	6.50	6.50	1	1		
									point18	18	3,270,892.8	1,418,534.1	6,871.00	6.50	6.50	1	1		
									point19	19	3,270,915.2	1,418,555.8	6,872.00	6.50	6.50	1	1		
									point2	2	3,270,971.0	1,418,609.8	6,873.00	6.50					

EXHIBIT R: AREAS OF PALEOTOLOGICAL IMPORTANCE

HISTORY COLORADO
Office of Archaeology and Historic Preservation
1200 Broadway, Denver, Colorado 80203

Greg Panza
HR Green
5619 DTC Pkwy #1150
Greenwood Village, CO 80111

July 8, 2021

Re: Grandview Reserve
File Search No. 23835

At your request, the Office of Archaeology and Historic Preservation has conducted a search of the Colorado Inventory of Cultural Resources within the area shown in the provided maps, located in the following areas:

PM	T	R	S
6th	12S	64W	21, 22, 27, 28

1 sites and 2 surveys were located in the designated area(s).

If information on any district, site, building, structure, or object in the project area was found, detailed information follows the summary. If no properties were found, but surveys are known to have been conducted in the project area, survey information follows the summary. We do not have complete information on surveys conducted in Colorado, and our site files cannot be considered complete because most of the state has not been surveyed for cultural resources. There is the possibility that as yet unidentified cultural resources exist within the proposed impact area.

Our letter should not be interpreted as formal consultation under Section 106 of the National Historic Preservation Act (36 CFR 800) or the Colorado Register of Historic Places (CRS 24-80.1). In the event that there is federal or state agency involvement, please note that it is the responsibility of the agencies to meet the requirements of these regulations.

We look forward to consulting with you regarding the effect of the proposed project on significant cultural resources in accordance with the Advisory Council on Historic Preservation regulations titled "Protection of Historic Properties" or the Colorado Register of Historic Places, as applicable (http://www.historycolorado.org/oahp/consultation-guidance).

If you have any questions, please contact the Office of Archaeology and Historic Preservation at (303) 866-3392. Thank you for your interest in Colorado's cultural heritage.

Steve Turner, AIA
State Historic Preservation Officer

*Information regarding significant archaeological resources is excluded from the Freedom of Information Act. Therefore, legal locations of these resources must not be included in documents for public distribution.

23835_s_sy

Per the Office of Archaeology and Historic Preservation:
- 80.8 AC SURVEYED
- AN INTENSIVE ARCHAEOLOGICAL RESOURCE SURVEY AT SEVERAL INTERSECTIONS ALONG US HIGHWAY 24 BETWEEN FALCON & CALHAN, EL PASO COUNTY, COLORADO. (NH 0243-060)

Area of Historical Significance: Existing America the Beautiful Trail - Rock Island Trail - constructed alongside the former Chicago and Rock Island Railroad Line.

Per the Office of Archaeology and Historic Preservation:
- HISTORIC SITE ID: 5EP.1815.1
- 508.10 AC SURVEYED
- AN INTENSIVE ARCHAEOLOGICAL RESOURCE INVENTORY ALONG US HIGHWAY 24 BETWEEN POWERS BOULEVARD & CALHAN, EL PASO COUNTY, COLORADO. (NH 0243-00058 AND NH 0243-059)

Xrefs: 01-DV-SURF; 01-XL-CONCEPT; xgt-1-dh01

DRAWN BY: SJF
JOB DATE: 08/05/2021
APPROVED: CMM
JOB NUMBER: 201662.05
CAD DATE: 8/12/2021 5:32:30 PM
CAD FILE: J:\2020\201662.05\CAD\Dwgs\OAHP Historic Survey.dwg

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
HRGreen.com

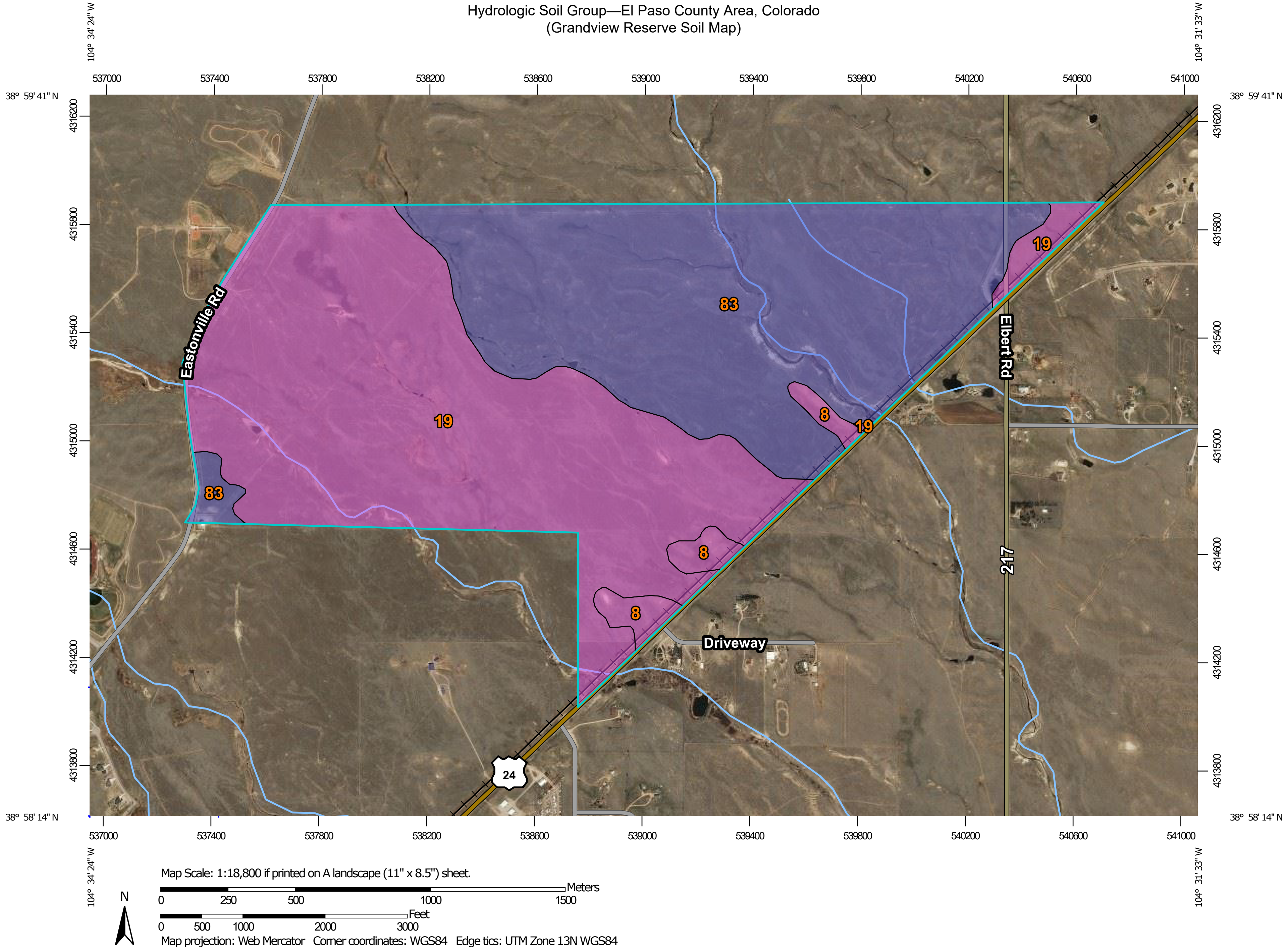
GRANDVIEW 1041 PERMIT
EL PASO COUNTY
FALCON, COLORADO

GRANDVIEW RESERVE METROPOLITAN DISTRICT
AREAS OF HISTORIC OR ARCHEOLOGICAL SIGNIFICANCE EXHIBIT

SHEET NO.
01

EXHIBIT S: SOIL MAP

Hydrologic Soil Group—El Paso County Area, Colorado
(Grandview Reserve Soil Map)



Map Scale: 1:18,800 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

▭ Area of Interest (AOI)

Soils

Soil Rating Polygons

▭ A
▭ A/D
▭ B
▭ B/D
▭ C
▭ C/D
▭ D
▭ Not rated or not available

Soil Rating Lines

〰 A
〰 A/D
〰 B
〰 B/D
〰 C
〰 C/D
〰 D
〰 Not rated or not available

Soil Rating Points

■ A
■ A/D
■ B
■ B/D
■ C
■ C/D
■ D
■ Not rated or not available

Water Features

〰 Streams and Canals

Transportation

┼┼┼ Rails
〰 Interstate Highways
〰 US Routes
〰 Major Roads
〰 Local Roads

Background

▨ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	22.4	2.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	450.7	52.5%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	385.4	44.9%
Totals for Area of Interest			**858.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

EXHIBIT T: WATER RIGHT DETERMINATIONS

COLORADO GROUND WATER COMMISSION
FINDINGS AND ORDER

IN THE MATTER OF AN APPLICATION FOR A CHANGE OF TYPE OF USE OF A DETERMINATION OF WATER RIGHT

DETERMINATION NO.: 510-BD, AMENDMENT NO. 2

AQUIFER: LARAMIE-FOX HILLS

APPLICANT: GRANDVIEW RESERVE METROPOLITAN DISTRICT AND 4SITE INVESTMENTS, LLC

FINDINGS

In compliance with section 37-90-107(7), C.R.S., and the Designated Basin Rules, 2 CCR 410-1, Grandview Reserve Metropolitan District and 4Site Investments, LLC (together as "Applicant") submitted an application to the Colorado Ground Water Commission ("Commission") for a change of water right to change the allowed type of use of groundwater allocated under Determination of Water Right No. 510-BD. Based upon information provided by the Applicant and the records of the Division of Water Resources, the Commission finds as follows.

1. Pursuant to section 37-90-107(7) in a Findings and Order dated July 22, 2004, the Commission issued Determination of Water Right No. 510-BD to Four Way Ranch Partnership / Spring Creek LLC, which determined a right to an allocation of designated groundwater from the Laramie-Fox Hills Aquifer ("Aquifer"), summarized as follows.

    a. The determination quantified an amount of groundwater from beneath 8,095 acres of overlying land, generally described as the W ½ of Section 1; Sections 2 and 3; the E ½, the SE ¼ of the NW ¼, the SW ¼ of the SW 1/4, and the E ½ of the SW ¼ of Section 4; the E ½, a portion of the E ½ of the W ½, and the NW ¼ of the NW ¼ of Section 9, Sections 10 and 11; that part of Sections 12, 13, and 14, located northwest of the Highway 24 right-of-way; the NW ¼ and the W ½ of the SW ¼ of Section 15; most of the E ½ of Section 16; the E ½, a portion of the E ½ of the NW ¼, and a portion of the SW ¼ of Section 21; that part of Sections 22, 23, and 27 located northwest of the Highway 24 right-of-way; the NE ¼ and a portion of the W ½ of Section 28; a portion of the SE ¼ of Section 29; the N ½ of the NE ¼ and a portion of the NE ¼ of the NW ¼ of Section 32; and that part of the N ½ of the NW ¼ of Section 33 located northwest of the Highway 24 right-of-way; all in Township 12 South, Range 64 West of the 6th P.M., in El Paso County, and more completely described in Exhibit A of that Findings and Order.

    b. The allowed average annual amount of withdrawal shall not exceed 2,429 acre-feet per year, which based on an aquifer life of one hundred years results in an amount of groundwater allocated of 242,900 acre-feet (subject to adjustment by the Commission to conform to actual local aquifer characteristics).

    c. The allowed types of beneficial uses of the groundwater are domestic, livestock watering, lawn irrigation, commercial, industrial, and replacement supply.

    d. The allowed place of use of the groundwater is the 8,095 acres of overlying land as described in the Findings and Order dated July 22, 2004.

2. Pursuant to section 37-90-107(7) in a Findings and Order dated December 3, 2008, the Commission approved a change of type and place of use for Determination of Water Right No. 510-BD to Spring Creek LLC and Four Way Ranch General Partnership, summarized as follows.

    a. The allowed types of beneficial uses of the groundwater are domestic, livestock watering, lawn irrigation, commercial, industrial, replacement, augmentation and municipal use by the Four-Way Ranch Metropolitan District and the Woodman Hills Metropolitan District.

    b. The allowed place of use of the groundwater is the 8,095 acres of overlying land and the service area of the Woodman Hills Metropolitan District within the Upper Black Squirrel Creek Designated Groundwater Basin.

3. The subject groundwater is designated groundwater within the boundaries of the Upper Black Squirrel Creek Designated Groundwater Basin, and within the Upper Black Squirrel Creek Ground Water Management District. The Commission has jurisdiction.

4. By an application for change of determination of water right received by the Commission on February 3, 2022, the Applicant has requested to change the allowed type of use of 1,312.5 acre-feet per year based on a 100-year aquifer life, or 131,250 acre-feet of water total, consisting of a portion of the groundwater allocated in the determination, to add the following use: 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.

    a. The currently allowed uses would remain as allowed uses.

    b. The Grandview Reserve Metropolitan District No. 1 is within the currently allowed place of use of the 8,095 acres of overlying land of Determination of Water Right no. 510-BD, and so the application does not request a change in the allowed place of use.

5. The Applicant has provided evidence of ownership of 1,312.5 acre-feet per year based on a 100-year aquifer-life, or 131,250 acre-feet total, of Determination of Water Right no. 510-BD, Exhibit A of this Findings and Order.

6. In accordance with section 37-90-107(8), C.R.S., and the Designated Basin Rules, on July 21, 2022 the application was referred to the Upper Black Squirrel Creek Ground Water Management District for written recommendations. No written recommendations were received from the District.

7. In accordance with section 37-90-107(7)(c)(II) and section 37-90-112(1), C.R.S., the requested change was published in the Ranchland News newspaper on July 28, 2022 and August 4, 2022. No objections to the proposed change were received within the time limit set by statute.

8. No material injury to the vested water rights of other appropriators would result from the approval of the requested change in water right subject to the conditions in the following Order.

ORDER

In accordance with section 37-90-107(7), C.R.S. and the Designated Basin Rules the Commission orders that the allowed type of use of 1,312.5 acre-feet per year based on a 100-year aquifer life, or 131,250 acre-feet of water total, consisting of a portion of the groundwater allocated in Determination of Water Right No. 510-BD, is hereby changed subject to the following conditions.

9. The type of use of the groundwater is limited to the following:

    a. domestic, livestock watering, lawn irrigation, commercial, industrial, replacement, augmentation and municipal use by the Four-Way Ranch Metropolitan District and the Woodman Hills Metropolitan District; and

    b. 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.

10. The Commission’s Findings and Orders dated July 22, 2004 and December 3, 2008 for Determination of Water Right No. 510-BD are hereby amended to incorporate the above change. All other terms and conditions in those Findings and Order shall remain in full force and effect.

11. A copy of this Findings and Order shall be recorded by the Applicant in the public records of the county in which the 8,095 acres of overlying land of the determination is located to that a title examination of that overlying land, or any part thereof, shall reveal the existence of this Findings and Order.

12. Any existing wells with well permits issued pursuant to this determination for which the permitted type or place of use does not conform to the currently allowed type and place of use of the determination must apply for and obtain new permits for uses that are in conformance with the determination.

Dated this 26th day of September, 2022

Kevin G. Rein
Kevin G. Rein, P.E
Executive Director
Colorado Ground Water Commission

By: Joanna Williams
Joanna Williams, P.E.
Chief of Water Supply, Designated Basins

Prepared by: wad
F&O510-BD_Amendment No. 2.docx

222094596 7/13/2022 11:17 AM
PGS 4 $28.00 DF $0.00
Electronically Recorded Official Records El Paso County CO
Chuck Broerman, Clerk and Recorder
TD1000 Y

RCVD DWR
07/20/2022

SPECIAL WARRANTY DEED
Water Rights

THIS SPECIAL WARRANTY DEED dated March 31, 2022 between JMJK Holdings, LLC, a Colorado Limited Liability Company, whose address is 3855 Ambrosia Street, Suite 304, Castle Rock, CO 80109 ("Grantor"), and, 4Site Investments, LLC, a Colorado limited liability company ("Grantee").

WITNESS, that the Grantor, for and in consideration of good and valuable consideration the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed, and by these presents do grant, bargain, sell convey and confirm unto the Grantee, its heirs, successors and assigns forever, the Grantor's water and water rights as specifically described in the attached **Exhibit A**, lying and being in the County of El Paso and State of Colorado ("Water Rights"), and underlying Grantor's real property described in **Exhibit A**. Grantor, for itself, its heirs, successors and assigns, grants and conveys to Grantee, its heirs, successors and assigns, the right to withdraw the Water Rights herein conveyed, and consents to such withdrawal. Grantor expressly retains any and all water rights not specifically described in the attached **Exhibit A**, including as may be associated with or appurtenant to property of the Grantor.

TOGETHER, with all and singular the hereditaments and appurtenances thereunto belonging, or in anywise appertaining, the reversion and reversions, remainder and remainders, rents, issues and profits thereof, and all the estate, right, title, interest, claim and demand whatsoever of the Grantor, either in law or equity, of, in and to the above-described water rights, with the hereditaments and appurtenances;

TO HAVE AND TO HOLD the said Water Rights above bargained and described, with the appurtenances, unto the Grantee, its heirs and assigns forever. The Grantor, for itself, its heirs, personal representatives, successors and assigns does covenant and agree that it shall and will WARRANT AND FOREVER DEFEND the above bargained Water Rights in the quiet and peaceable possession of the Grantee, its heirs and assigns, against all and every person or persons claiming the whole or any part thereof, by, through or under the Grantor, but not otherwise.

IN WITNESS WHEREOF, the Grantor has executed this Special Warranty Deed on the date set forth above.

(remainder of page intentionally blank, signature follows)

GRANTOR, JMJK Holdings, LLC:

Michael Slattery, Manager

STATE OF Colorado)
) ss.
COUNTY OF Douglas)

TERESA GALLEGOS
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20184004387
MY COMMISSION EXPIRES JANUARY 29, 2026

Acknowledged before me this 31 day of March, 2022 by Michael Slattery, as Manager of JMJK Holdings, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My Commission expires: 01/29/2026

Notary Public

EXHIBIT A

WATER RIGHTS and OVERLYING LAND

All following described water and water rights, groundwater and ground water rights, and rights to withdraw, extract and use ground water within the Laramie-Fox Hills aquifer of the Denver Basin and as related to, used upon, underlying or appurtenant to the real property more specifically described below ("Overlying Land"), as quantified and determined by the July 22, 2004 Colorado Ground Water Commission Findings and Orders in Determination No. 510-BD, recorded at Reception No. 204153947 and, as amended December 3, 2008, recorded at Reception No. 208130576 of the El Paso County Clerk and Recorder's Office ("Ground Water Determination"). Said water and water rights expressly include the following Laramie-Fox Hills aquifer groundwater rights:

> Nontributary Groundwater in the Laramie-Fox Hills aquifer as quantified and determined by the Colorado Ground Water Commission ("GWC") in Determination No. 510-BD, as amended, totaling 131,250 acre feet, or 1,312.5 annual acre-feet based upon a 100-year aquifer life.

This conveyance is subject to the terms and provisions of the above-described Groundwater Determination and there is no warranty or guaranty of the quantity or quality of the groundwater to be produced from the respective aquifers. All other water and groundwater rights, including but not limited to that of other Denver Basin aquifers, underlying, associated with, or appurtenant to the following described real property, is expressly reserved by Grantor. Said Overlying Land is more specifically described as follows:

Township 12 South, Range 64 West of the 6th P.M., El Paso County, State of Colorado

Section 1: W½;
Section 2: ALL;
Section 3: ALL; excepting those portions conveyed to El Paso County in Deeds recorded in Book 2116 at Page 991 and in Book 2749 at Page 686;
Section 4: SE¼ , NE¼, SE¼ NW¼, E½ SW¼, SW¼ SW¼;
Section 9: N½ NW¼, that portion of the S½ NW¼ and the SW¼ lying East of the County Road adjoining the Right-of-Way of the Colorado and Southern Railway on the West, E½;
Section 10: ALL;
Section 11: ALL;
Section 12: N½, SW¼, N½ SE¼, SW¼ SE¼, that portion of the SE¼ SE¼ lying North and West of the Chicago, Rock Island, and Pacific Railroad Right-of-Way;
Section 13: All that portion lying North and West of the Chicago, Rock Island, and Pacific Railroad Right-of-Way;
Section 14: SW¼, SW¼ SE¼, N½ SE¼, N½, that portion of the SE ¼ SE ¼ lying North and West of the Chicago, Rock Island, and Pacific Railroad Right-of-Way;
Section 15: NW¼, W½ SW¼;
Section 16: All that portion lying East of said County Road, excepting therefrom that portion thereof conveyed to Mountain View Electric Association, Inc. by Deed recorded June 27, 2003 at Reception No. 203145788;

Section 21: NE¼, that portion of the NW¼ lying East of said County Road;
Section 22: N½, that portion of the E½ SE¼ lying Northwest of the Right-of-Way of the Chicago, Rock Island, and Pacific Railroad;
Section 23: N½ , N½ S½ except that portion conveyed in Warranty Deed recorded in Book 2579 at Page 861, and except that portion conveyed to El Paso County in Deed recorded in Book 842 at Page 356, and except any portion found to be lying within the Right-of-Way of the Chicago, Rock Island, and Pacific Railroad.

COLORADO GROUND WATER COMMISSION
FINDINGS AND ORDER

IN THE MATTER OF AN APPLICATION FOR A CHANGE OF TYPE OF USE OF A DETERMINATION OF WATER RIGHT

DETERMINATION NO.: 511-BD, AMENDMENT NO. 2

AQUIFER: ARAPAHOE

APPLICANT: GRANDVIEW RESERVE METROPOLITAN DISTRICT

FINDINGS

In compliance with section 37-90-107(7), C.R.S., and the Designated Basin Rules, 2 CCR 410-1, Grandview Reserve Metropolitan District ("Applicant") submitted an application to the Colorado Ground Water Commission ("Commission") for a change of water right to change the allowed type of use of groundwater allocated under Determination of Water Right No. 511-BD. Based upon information provided by the Applicant and the records of the Division of Water Resources, the Commission finds as follows.

1. Pursuant to section 37-90-107(7) in a Findings and Order dated July 22, 2004, the Commission issued Determination of Water Right No. 511-BD to Four Way Ranch Partnership / Spring Creek LLC, which determined a right to an allocation of designated groundwater from the Arapahoe Aquifer ("Aquifer"), summarized as follows.

    a. The determination quantified an amount of groundwater from beneath 8,095 acres of overlying land, generally described as the W ½ of Section 1; Sections 2 and 3; the E ½, the SE ¼ of the NW ¼, the SW ¼ of the SW 1/4, and the E ½ of the SW ¼ of Section 4; the E ½, a portion of the E ½ of the W ½, and the NW ¼ of the NW ¼ of Section 9, Sections 10 and 11; that part of Sections 12, 13, and 14, located northwest of the Highway 24 right-of-way; the NW ¼ and the W ½ of the SW ¼ of Section 15; most of the E ½ of Section 16; the E ½, a portion of the E ½ of the NW ¼, and a portion of the SW ¼ of Section 21; that part of Sections 22, 23, and 27 located northwest of the Highway 24 right-of-way; the NE ¼ and a portion of the W ½ of Section 28; a portion of the SE ¼ of Section 29; the N ½ of the NE ¼ and a portion of the NE ¼ of the NW ¼ of Section 32; and that part of the N ½ of the NW ¼ of Section 33 located northwest of the Highway 24 right-of-way; all in Township 12 South, Range 64 West of the 6th P.M., in El Paso County, and more completely described in Exhibit A of that Findings and Order.

    b. The allowed average annual amount of withdrawal shall not exceed 2,615 acre-feet per year, which based on an aquifer life of one hundred years results in an amount of groundwater allocated of 261,500 acre-feet (subject to adjustment by the Commission to conform to actual local aquifer characteristics).

    c. The allowed types of beneficial uses of the groundwater are domestic, livestock watering, lawn irrigation, commercial, industrial, and replacement supply.

    d. The allowed place of use of the groundwater is the 8,095 acres of overlying land as described in the Findings and Order dated July 22, 2004.

2. Pursuant to section 37-90-107(7) in a Findings and Order dated December 3, 2008, the Commission approved a change of type and place of use for Determination of Water Right No. 511-BD to Spring Creek LLC and Four Way Ranch General Partnership, summarized as follows.

    a. The allowed types of beneficial uses of the groundwater are domestic, livestock watering, lawn irrigation, commercial, industrial, replacement, augmentation and municipal use by the Four-Way Ranch Metropolitan District and the Woodman Hills Metropolitan District.

    b. The allowed place of use of the groundwater is the 8,095 acres of overlying land and the service area of the Woodman Hills Metropolitan District within the Upper Black Squirrel Creek Designated Groundwater Basin.

3. The subject groundwater is designated groundwater within the boundaries of the Upper Black Squirrel Creek Designated Groundwater Basin, and within the Upper Black Squirrel Creek Ground Water Management District. The Commission has jurisdiction.

4. By an application for change of determination of water right received by the Commission on February 3, 2022, the Applicant has requested to change the allowed type of use of 1,400 acre-feet per year based on a 100-year aquifer life, or 140,000 acre-feet of water total, consisting of a portion of the groundwater allocated in the determination, to add the following use: 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.

    a. The currently allowed uses would remain as allowed uses.

    b. The Grandview Reserve Metropolitan District No. 1 is within the currently allowed place of use of the 8,095 acres of overlying land of Determination of Water Right no. 511-BD, and so the application does not request a change in the allowed place of use.

5. The Applicant has provided evidence of ownership of 1,400 acre-feet per year based on a 100-year aquifer-life, or 140,000 acre-feet total, of Determination of Water Right no. 511-BD, Exhibit A of this Findings and Order.

6. In accordance with section 37-90-107(8), C.R.S., and the Designated Basin Rules, on July 21, 2022 the application was referred to the Upper Black Squirrel Creek Ground Water Management District for written recommendations. No written recommendations were received from the District.

7. In accordance with section 37-90-107(7)(c)(II) and section 37-90-112(1), C.R.S., the requested change was published in the Ranchland News newspaper on July 28, 2022 and August 4, 2022. No objections to the proposed change were received within the time limit set by statute.

8. No material injury to the vested water rights of other appropriators would result from the approval of the requested change in water right subject to the conditions in the following Order.

ORDER

In accordance with section 37-90-107(7), C.R.S. and the Designated Basin Rules the Commission orders that the allowed type of use of 1,400 acre-feet per year based on a 100-year aquifer life, or 140,000 acre-feet of water total, consisting of a portion of the groundwater allocated in Determination of Water Right No. 511-BD, is hereby changed subject to the following conditions.

9. The type of use of the groundwater is limited to the following:

    a. 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

    b. 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.

10. The Commission's Findings and Orders dated July 22, 2004 and December 3, 2008 for Determination of Water Right No. 511-BD are hereby amended to incorporate the above change. All other terms and conditions in those Findings and Order shall remain in full force and effect.

11. A copy of this Findings and Order shall be recorded by the Applicant in the public records of the county in which the 8,095 acres of overlying land of the determination is located to that a title examination of that overlying land, or any part thereof, shall reveal the existence of this Findings and Order.

12. Any existing wells with well permits issued pursuant to this determination for which the permitted type or place of use does not conform to the currently allowed type and place of use of the determination must apply for and obtain new permits for uses that are in conformance with the determination.

Dated this 26th day of September, 2022

Kevin G. Rein
Kevin G. Rein, P.E
Executive Director
Colorado Ground Water Commission

By:
Joanna Williams, P.E.
Chief of Water Supply, Designated Basins

Prepared by: wad
F&O511-BD_Amendment No. 2.docx

Exhibit A
Determination No. 511-BD, Amdt No. 2
Evidence of Water Rights Ownership
Page 1 of 6

222020228 2/10/2022 9:05 AM
PGS 6 $38.00 DF $0.00
Electronically Recorded Official Records El Paso County CO
Chuck Broerman, Clerk and Recorder
TD1000 N

RCVD DWR
07/01/2022

This is the corrected Deed and replaces the prior Special Warranty Deed recorded on December 10, 2021 under Reception No. 221225486.

SPECIAL WARRANTY DEED
Water Rights

THIS SPECIAL WARRANTY DEED dated **February** 9th, **2022** between 4 SITE INVESTMENTTS, LLC, a Colorado limited liability company ("Grantor"), and GRANDVIEW RESERVE METROPOLITAN DISTRICT 1, a quasi-municipal corporation and political subdivision of the State of Colorado, whose address is 1271 Kelly Johnson Boulevard, Ste. 100, Colorado Springs, CO 80920 ("Grantee").

WITNESS, that the Grantor, for and in consideration of good and valuable consideration the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed, and by these presents does grant, bargain, sell, convey, and confirm unto the Grantee, its heirs and assigns forever, the ground water, rights to extract ground water, and ground water rights, being in the County of El Paso, State of Colorado, described as follows:

> 140,000 acre-feet of groundwater based on a 100-year supply, or an average of 1,400 acre-feet annually, of nontributary groundwater in the Arapahoe aquifer underlying the land described in **Exhibit A**, and as determined by the Colorado Ground Water Commission in the Findings and Order of Determination No. 511-BD dated July 22, 2004, and recorded with the El Paso County Clerk and Recorder's Office on September 10, 2004, Reception No. 204153948, all as quantified in and subject to the terms and provisions of said Groundwater Determination No. 511-BD.

TOGETHER, with all and singular the hereditaments and appurtenances thereunto belonging, or in anywise appertaining, the reversion and reversions, remainder and remainders, rents, issues and profits thereof, and all the estate, right, title, interest, claim and demand whatsoever of the Grantor, either in law or equity, of, in and to the above-described water rights, with the hereditaments and appurtenances;

TO HAVE AND TO HOLD the said Water Rights above bargained and described, with the appurtenances, unto the Grantee, its heirs and assigns forever. The Grantor, for itself, its heirs, personal representatives, successors and assigns do covenant and agree that it shall and will WARRANT AND FOREVER DEFEND the above bargained Water Rights in the quiet and peaceable possession of the Grantee, its heirs and assigns, against all and every person or persons claiming the whole or any part thereof, by, through or under the Grantor, but not otherwise.

IN WITNESS WHEREOF, the Grantors have executed this Special Warranty Deed on the date set forth above.

(Signatures to follow)

GRANTOR:

Paul Howard as Manager of 4 Site Investments LLC

STATE OF COLORADO)
) ss.
COUNTY OF EL PASO)

The foregoing instrument was acknowledged before me this 9th day of Feburary, 2022, by Paul Howard as Manager of 4 Site Investments LLC.

Witness my hand and official seal.

CALEB GOERKE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20204027082
MY COMMISSION EXPIRES AUGUST 07, 2024

Notary Public

Exhibit A

PARCEL A:

A TRACT OF LAND BEING A PORTION OF THE SOUTH HALF OF SECTION 21, THE SOUTH HALF OF SECTION 22, THE NORTH HALF OF SECTION 28 AND SECTION 27, TOWNSHIP 12 SOUTH, RANGE 64 WEST OF THE SIXTH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO, BEING DESCRIBED AS FOLLOWS:

BASIS OF BEARINGS: THE EAST LINE OF SECTION 21, BEING MONUMENTED AT THE SOUTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYOR'S CAP STAMPED "PS INC PLS 30087 1996", BEING APPROPRIATELY MARKED, AND BEING MONUMENTED AT THE NORTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYOR'S CAP STAMPED "PS INC PLS 30087 1996", BEING APPROPRIATELY MARKED, BEING ASSUMED TO BEAR NORTH 00 DEGREES 52 MINUTES 26 SECONDS WEST, A DISTANCE OF 5290.17 FEET.

COMMENCING AT THE SOUTHEAST CORNER OF SAID SECTION 21; THENCE NORTH 00 DEGREES 52 MINUTES 26 SECONDS WEST ON THE EAST LINE OF SAID SECTION, A DISTANCE OF 2645.09 FEET TO THE NORTHEAST CORNER OF THE SOUTHEAST QUARTER OF SAID SECTION 21, SAID POINT BEING THE POINT OF BEGINNING; THENCE NORTH 89 DEGREES 41 MINUTES 03 SECONDS EAST ON THE NORTH LINE OF THE SOUTH HALF OF SAID SECTION 22, A DISTANCE OF 3938.18 FEET; THENCE SOUTH 00 DEGREES 41 MINUTES 58 SECONDS EAST ON THE EAST LINE OF THE WEST HALF OF THE SOUTHEAST QUARTER OF SECTION 22, A DISTANCE OF 2117.68 FEET TO A POINT ON THE NORTHWESTERLY RIGHT OF WAY LINE OF THE ROCK ISLAND REGIONAL TRAIL AS GRANTED TO EL PASO COUNTY IN THAT WARRANTY DEED RECORDED OCTOBER 21, 1994 IN BOOK 6548 AT PAGE 892, RECORDS OF EL PASO COUNTY, COLORADO; THENCE ON SAID NORTHWESTERLY RIGHT OF WAY, THE FOLLOWING FIVE (5) COURSES:

(1) SOUTH 45 DEGREES 55 MINUTES 49 SECONDS WEST, A DISTANCE OF 758.36 FEET TO A POINT ON THE SOUTH LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 22;
(2) NORTH 89 DEGREES 38 MINUTES 06 SECONDS EAST ON SAID SOUTH LINE, A DISTANCE OF 36.18 FEET;
(3) SOUTH 45 DEGREES 55 MINUTES 49 SECONDS WEST, A DISTANCE OF 3818.92 FEET TO A POINT ON THE NORTH LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 27;
(4) SOUTH 89 DEGREES 39 MINUTES 01 SECONDS WEST ON SAID NORTH LINE, A DISTANCE OF 36.17 FEET;
(5) SOUTH 45 DEGREES 55 MINUTES 49 SECONDS WEST, A DISTANCE OF 855.35 FEET TO A POINT ON THE EASTERLY LINE OF SAID SECTION 28;

THENCE NORTH 00 DEGREES 21 MINUTES 45 SECONDS WEST ON THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 28, A DISTANCE OF 591.16 FEET TO THE NORTHEAST CORNER OF SAID SOUTHEAST QUARTER; THENCE NORTH 00 DEGREES 21 MINUTES 38 SECONDS WEST ON THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 28, A DISTANCE OF 1319.24 FEET TO THE SOUTH LINE OF THE NORTH HALF OF THE NORTH HALF OF SAID SECTION 28; THENCE NORTH 89 DEGREES 47 MINUTES 08 SECONDS WEST ON SAID SOUTH LINE, A DISTANCE OF 4692.55 FEET TO A POINT 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 JULY 18, 2001 UNDER RECEPTION NO. 201900096, THE FOLLOWING FIVE (5) COURSES:

(1) ON THE ARC OF A CURVE TO THE LEFT, WHOSE CENTER BEARS NORTH 04 DEGREES 31 MINUTES 28 SECONDS EAST, HAVING A DELTA OF 24 DEGREES 31 MINUTES 32 SECONDS, A RADIUS OF 1630.00 FEET, A DISTANCE OF 697.73 FEET TO A POINT OF TANGENT;
(2) NORTH 07 DEGREES 40 MINUTES 18 SECONDS WEST, 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 DEGREES 01 MINUTES 10 SECONDS, A RADIUS OF 1770.00 FEET, A DISTANCE OF 1205.40 FEET TO A POINT OF TANGENT;
(4) NORTH 31 DEGREES 20 MINUTES 52 SECONDS EAST, A DISTANCE OF 1517.37 FEET TO A POINT OF CURVE;
(5) ON THE ARC OF A CURVE TO THE LEFT, HAVING A DELTA OF 02 DEGREES 07 MINUTES 03 SECONDS, A RADIUS OF 1330.00 FEET, A DISTANCE OF 49.15 FEET TO A POINT ON THE NORTH LINE OF THE SOUTH HALF OF SAID SECTION 21;

THENCE SOUTH 89 DEGREES 50 MINUTES 58 SECONDS EAST ON SAID NORTH LINE, A DISTANCE OF 3635.53 FEET TO THE POINT OF BEGINNING;

EXCEPT THAT PORTION CONVEYED IN DEED RECORDED AUGUST 24, 2005 AT RECEPTION NO. 205132124;

AND EXCEPT A PORTION OF THE NORTHWEST QUARTER OF SECTION 28, TOWNSHIP 12 SOUTH, RANGE 64 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO, AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BASIS OF BEARINGS: THE NORTHERLY LINE OF SECTION 28, TOWNSHIP 12 SOUTH, RANGE 64 WEST OF THE 6TH PRINCIPAL MERIDIAN, BEING MONUMENTED AT THE NORTHWEST CORNER AND THE NORTHEAST CORNER BY A 3-1/4" ALUMINUM CAP STAMPED "PS INC 1996 PLS 30087", BEING ASSUMED TO BEAR SOUTH 89 DEGREES 47 MINUTES 04 SECONDS EAST A DISTANCE OF 5285.07 FEET.

COMMENCING AT THE NORTHWEST CORNER OF SAID SECTION 28; THENCE SOUTH 29 DEGREES 17 MINUTES 14 SECONDS

EAST, A 1315.12 FEET TO THE POINT OF BEGINNING; THENCE NORTH 89 DEGREES 58 MINUTES 12 SECONDS EAST, A DISTANCE OF 288.62 FEET; THENCE SOUTH 41 DEGREES 03 MINUTES 22 SECONDS WEST, A DISTANCE OF 139.03 FEET; THENCE SOUTH 41 DEGREES 52 MINUTES 38 SECONDS WEST, A DISTANCE OF 21.11 FEET; THENCE SOUTH 44 DEGREES 47 MINUTES 01 SECONDS WEST, A DISTANCE OF 42.37 FEET; THENCE SOUTH 89 DEGREES 47 MINUTES 08 SECONDS EAST, A DISTANCE OF 679.35 FEET; THENCE SOUTH 00 DEGREES 12 MINUTES 52 SECONDS WEST, A DISTANCE OF 25.00 FEET TO A POINT ON THE SOUTH LINE OF THE NORTH HALF OF THE NORTH HALF OF SAID SECTION 28; THENCE NORTH 89 DEGREES 47 MINUTES 08 SECONDS WEST AND ON THE SOUTH LINE OF THE NORTH HALF OF THE NORTH HALF OF SAID SECTION 28, A DISTANCE OF 934.84 FEET TO A POINT ON THE EASTERLY RIGHT OF WAY LINE OF EASTONVILLE ROAD AS RECORDED IN THE EL PASO COUNTY RECORDS JULY 18, 2001 UNDER RECEPTION NO. 201900096, SAID POINT BEING A POINT ON CURVE; THENCE ON THE ARC OF A CURVE TO THE LEFT WHOSE CENTER BEARS NORTH 73 DEGREES 08 MINUTES 46 SECONDS WEST HAVING A DELTA OF 06 DEGREES 19 MINUTES 02 SECONDS, A RADIUS OF 1630.00 FEET, A DISTANCE OF 179.72 FEET TO THE POINT OF BEGINNING.

PARCEL B:

A TRACT OF LAND BEING A PORTION OF THE SOUTH HALF 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 PRINICIPAL MERIDIAN, EL PASO COUNTY, COLORADO, BEING MONUMENTED AT THE SOUTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYORS CAP STAMPED ACCORDINGLY, PLS 30087, AND BEING MONUMENTED AT THE NORTHEAST CORNER BY A 3-1/4" ALUMINUM SUVEYORS CAP STAMPED ACCORDINGLY, PLS 30087, 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, A DISTANCE OF 2645.09 FEET TO THE NORTHEAST CORNER OF THE SOUTHEAST QUARTER OF SAID SECTION 21;

THENCE N89°50'58"W ON THE NORTH LINE OF THE SOUTH HALF OF SAID SECTION 21, A DISTANCE OF 1109.51 FEET TO THE POINT OF BEGINNING;

THENCE S00°09'02"W, A DISTANCE OF 3962.55 FEET TO A POINT ON THE SOUTH LINE OF THE NORTH HALF OF THE NORTH HALF OF SECTION 28;

THENCE N89°47'08"W ON SAID SOUTH LINE, A DISTANCE OF 2589.15 FEET;

THENCE N00°12'52"E, A DISTANCE OF 25.00 FEET;

THENCE N89°47'08"W ON A LINE THAT IS 25.00 FEET NORTHERLY OF AND PARALLEL TO SAID SOUTH LINE, 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 THE EASTERLY RIGHT OF WAY LINE OF EXISTING EASTONVILLE ROAD (60.00 FEET WIDE);

THENCE ALONG THE EASTERLY RIGHT OF WAY LINE OF EASTONVILLE ROAD AS DEFINED BY CERTIFIED BOUNDARY SURVEY AS RECORDED JULY 18, 2001 UNER RECEPTION NO. 201900096 OF THE RECORDS OF EL PASO COUNTY, COLORADO THE FOLLOWING FIVE (5) COURSES:

1. ALONG THE ARC OF A NON-TANGENT CURVE TO THE LEFT, HAVING A CENTRAL ANGLE OF 18°12'30", A RADIUS OF 1630.00 FEET, A LENGTH OF 518.00 FEET, WHOSE CHORD BEARS N01°25'57"E WITH A DISTANCE OF 515.83 FEET TO A POINT OF TANGENT;
2. N07°40'18"W, A DISTANCE OF 777.34 FEET TO A POINT OF CURVE;
3. ALONG THE ARC OF A CURVE TO THE RIGHT HAVING A CENTRAL ANGLE OF 39°01'10", A RADIUS OF 1770.00 FEET FOR A LENGTH OF 1205.40 FEET TO A POINT OF TANGENT;
4. N31°20'52"E, A DISTANCE OF 1517.37 FEET TO A POINT OF CURVE;
5. ALONG THE ARC OF A CURVE TO THE LEFT HAVING A CENTRAL ANGLE OF 02°07'03", A RADIUS OF 1330.00 FEET FOR A LENGTH OF 49.15 FEET TO A POINT ON THE NORTH LINE OF THE SOUTH HALF OF SAID SECTION 21;

THENCE S89°50'58"E ON SAID NORTH LINE, A DISTANCE OF 2526.02 FEET TO THE POINT OF BEGINNING.

PARCEL C:

A TRACT OF LAND BEING A PORTION OF THE SOUTH HALF OF SECTION 22 AND A PORTION OF SECTION 27, 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 PRINICIPAL MERIDIAN, EL PASO COUNTY, COLORADO, BEING MONUMENTED AT THE SOUTHEAST CORNER BY A 3-1/4" ALUMINUM SURVEYORS CAP STAMPED ACCORDINGLY, PLS 30087, AND BEING MONUMENTED AT THE NORTHEAST CORNER BY A 3-1/4" ALUMINUM SUVEYORS CAP STAMPED ACCORDINGLY, PLS 30087, 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, A DISTANCE OF 2645.09 FEET TO THE NORTHEAST CORNER OF THE SOUTHEAST QUARTER OF SAID SECTION 21;

THENCE N89°41'03" ON THE NORTH LINE OF THE SOUTH HALF OF SAID SECTION 22, A DISTANCE OF 701.60 FEET TO THE POINT OF BEGINNING;

THENCE CONTINUE N89°41'03"E ON SAID NORTH LINE, A DISTANCE OF 3236.58 FEET;

THENCE S00°41'58"E ON THE EAST LINE OF THE WEST HALF OF THE SOUTHEAST QUARTER OF SECTION 22, A DISTANCE OF 2117.66 FEET TO A POINT ON THE NORTHWESTERLY RIGHT OF WAY LINE OF THE ROCK ISLAND REGIONAL TRAIL AS GRANTED TO EL PASO COUNTY IN THAT WARRANTY DEED RECORDED OCTOBER 21, 1994 IN BOOK 6548 AT PAGE 892 OF THE RECORDS OF EL PASO COUNTY, COLORADO;

THENCE ON SAID NORTHWESTERLY RIGHT OF WAY THE FOLLOWING FIVE (5) COURSES:

1. S45°55'49"W, A DISTANCE OF 758.36 FEET TO A PONT ON THE SOUTH LINE OF THE SOUTEAST QUARTER OF SAID SECTION 22;
2. N89°38'06"E, A DISTANCE OF 36.18 FEET;
3. S45°55'49"W, A DISTANCE OF 3818.92 FEET TO A POINT ON THE NORTH LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 27;
4. S89°39'01"W ON SAID NORTH LINE, A DISTANCE OF 36.17 FEET;
5. S45°55'49"W, A DISTANCE OF 344.32 FEET TO THE NORTHEASTERLY CORNER OF A PARCEL OF LAND AS RECORDED UNDER RECEPTION NO. 205132124 OF SAID RECORDS;

THENCE N72°01'49"W ON THE NORTH LINE OF SAID PARCEL, A DISTANCE OF 389.16 TO THE NORTHWESTERLY CORNER OF SAID PARCEL AND BEING A POINT ON THE EASTERLY LINE OF SAID SECTION 28;

THENCE N00°21'45"W ON THE EAST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 28, A DISTANCE OF 115.65 FEET TO THE NORTHEAST CORNER OF SAID SOUTHEAST QUARTER;

THENCE N00°21'38"W ON THE EAST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 28, A DISTANCE OF 1319.24 TO THE SOUTH LINE OF THE NORTH HALF OF THE NORTH HALF OF SAID SECTION 28;

THENCE S89°47'08"E, A DISTANCE OF 642.53 FEET;

THENCE N00°09'02"E, A DISTANCE OF 3970.28 FEET TO THE POINT OF BEGINNING.

EXHIBIT U: GEOTECHNICAL REPORT

CTL | THOMPSON
INCORPORATED

PRELIMINARY GEOTECHNICAL INVESTIGATION
GRANDVIEW RESERVE
EASTONVILLE ROAD AND U.S. HIGHWAY 24
FALCON, COLORADO

Prepared For:

D.R. HORTON
9555 S. Kingston Court
Englewood, Colorado

Attention: Michael Bird

Project No. CS19345-115

December 23, 2020

TABLE OF CONTENTS

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.

Jeff

COLORADO LICENSED
JEFFREY MARK JONES
47539
12-23-2020
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JMJ:WCH:cw
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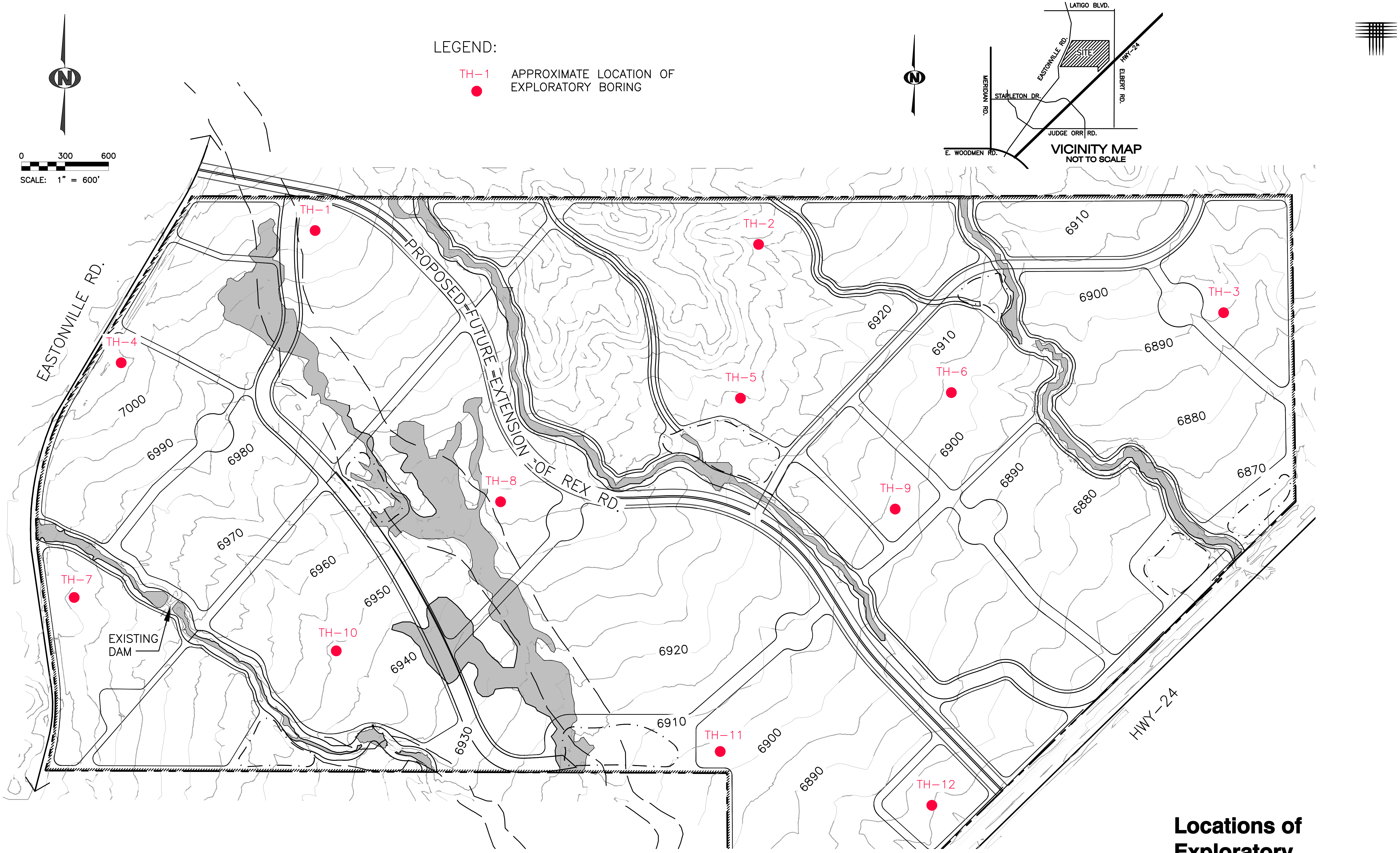
Via e-mail: mwbird@drhorton.com



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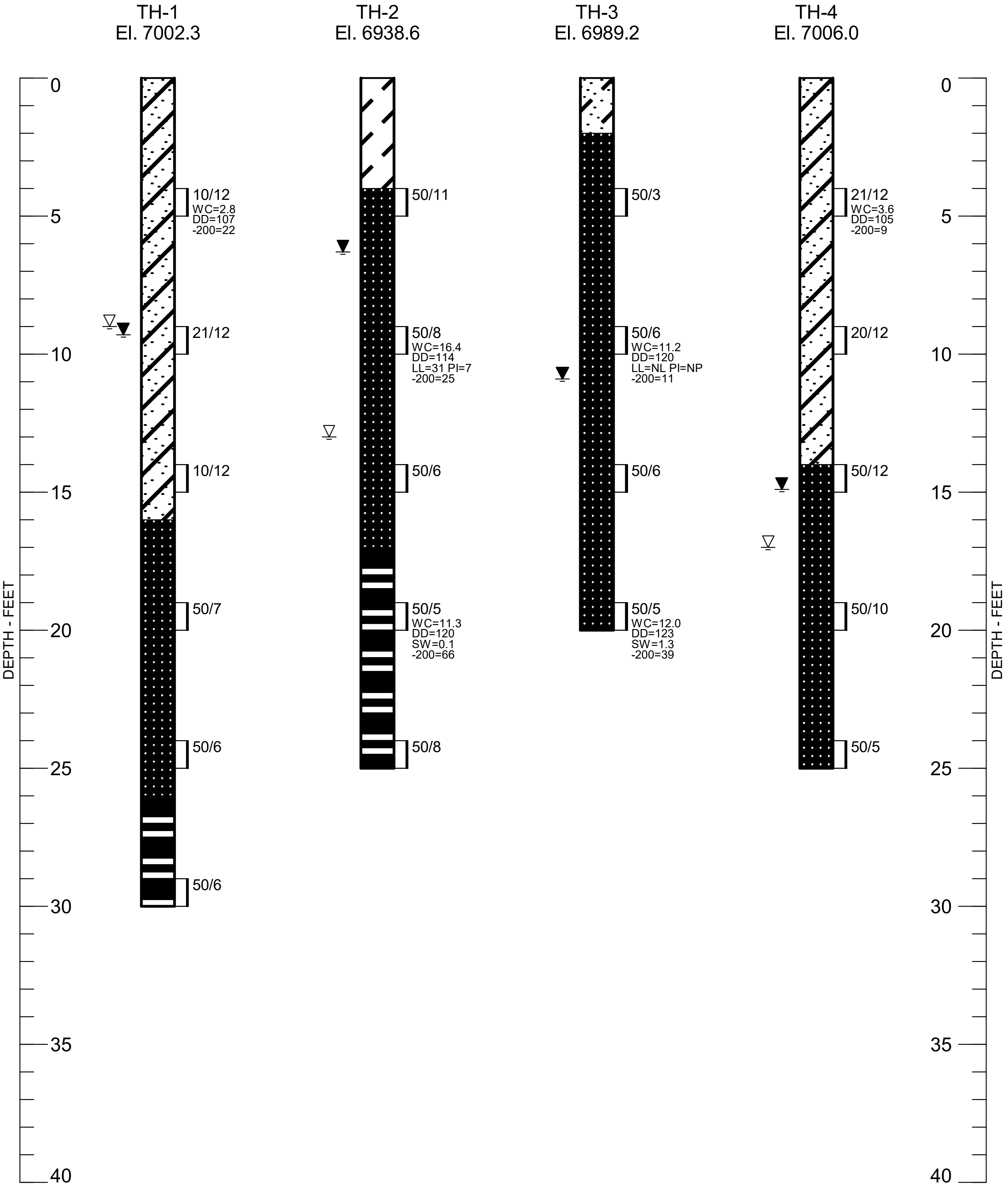
GRANDVIEW RESERVE
CTL|T Project No. CS19345-115

Locations of Exploratory Borings

Fig. 1

APPENDIX A

SUMMARY LOGS OF EXPLORATORY BORINGS



SUMMARY LOGS OF EXPLORATORY BORINGS

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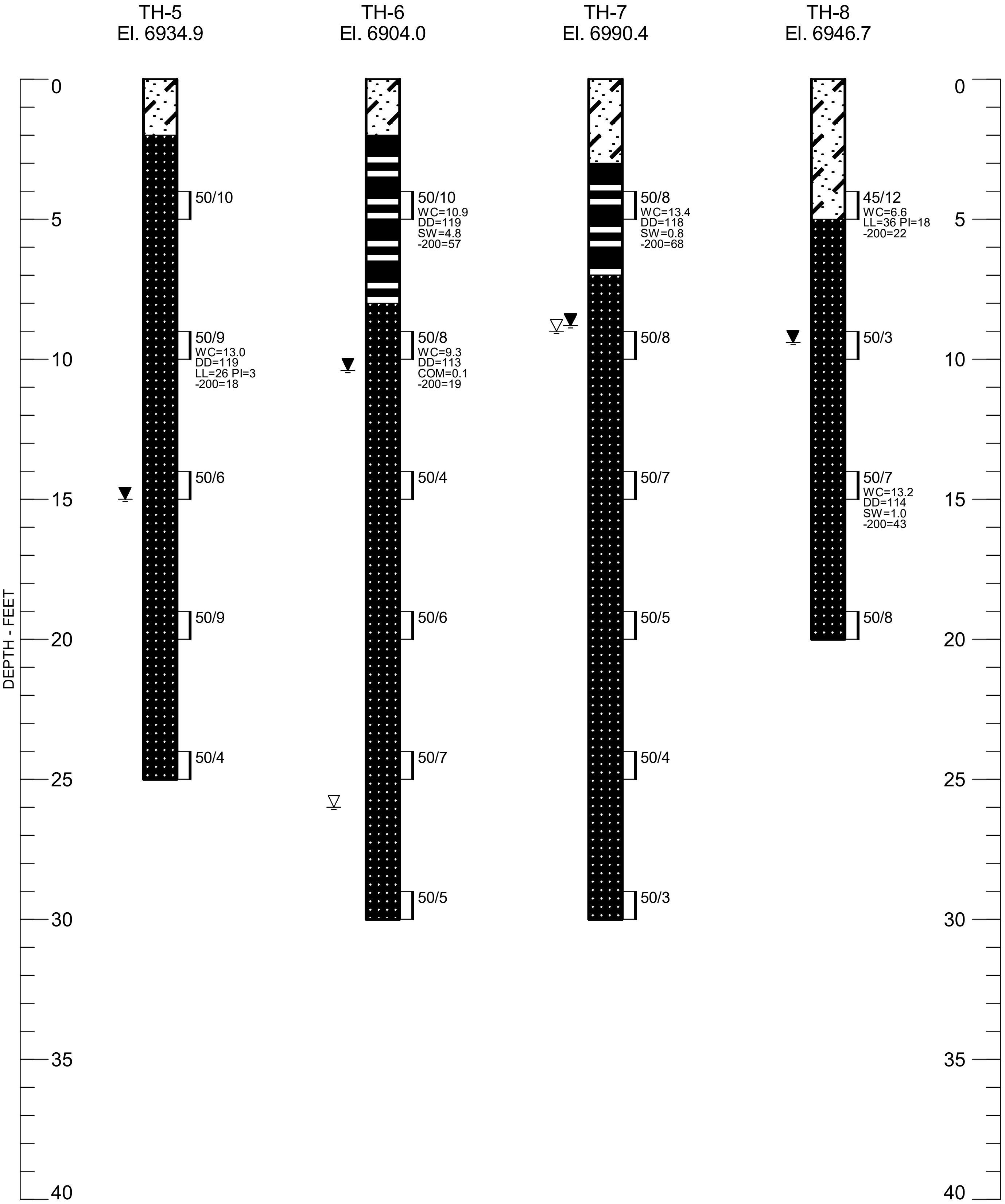
GRANDVIEW RESERVE
CTL|T PROJECT NO. CS19345-115

FIG. A- 1



SUMMARY LOGS OF EXPLORATORY BORINGS

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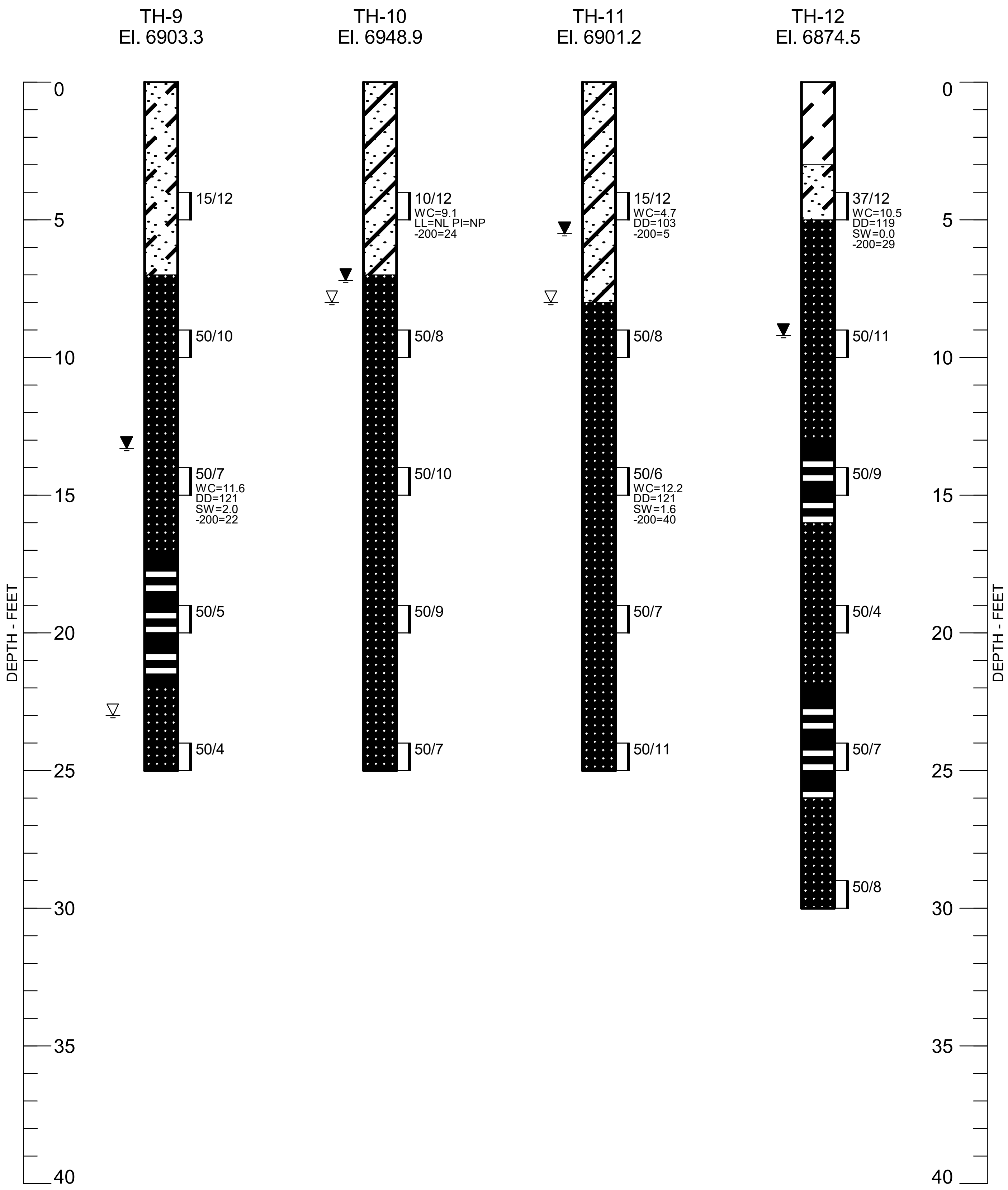
FIG. A- 2



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.

D.R. HORTON
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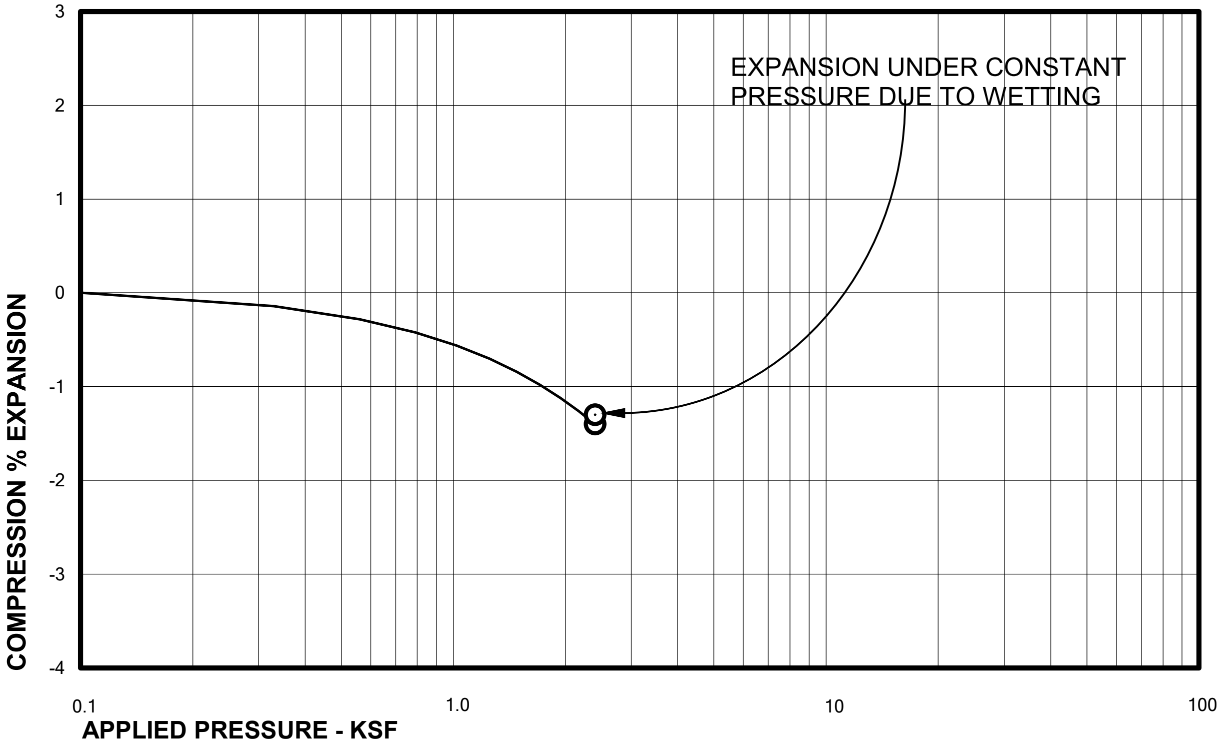
FIG. A- 3

APPENDIX B

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

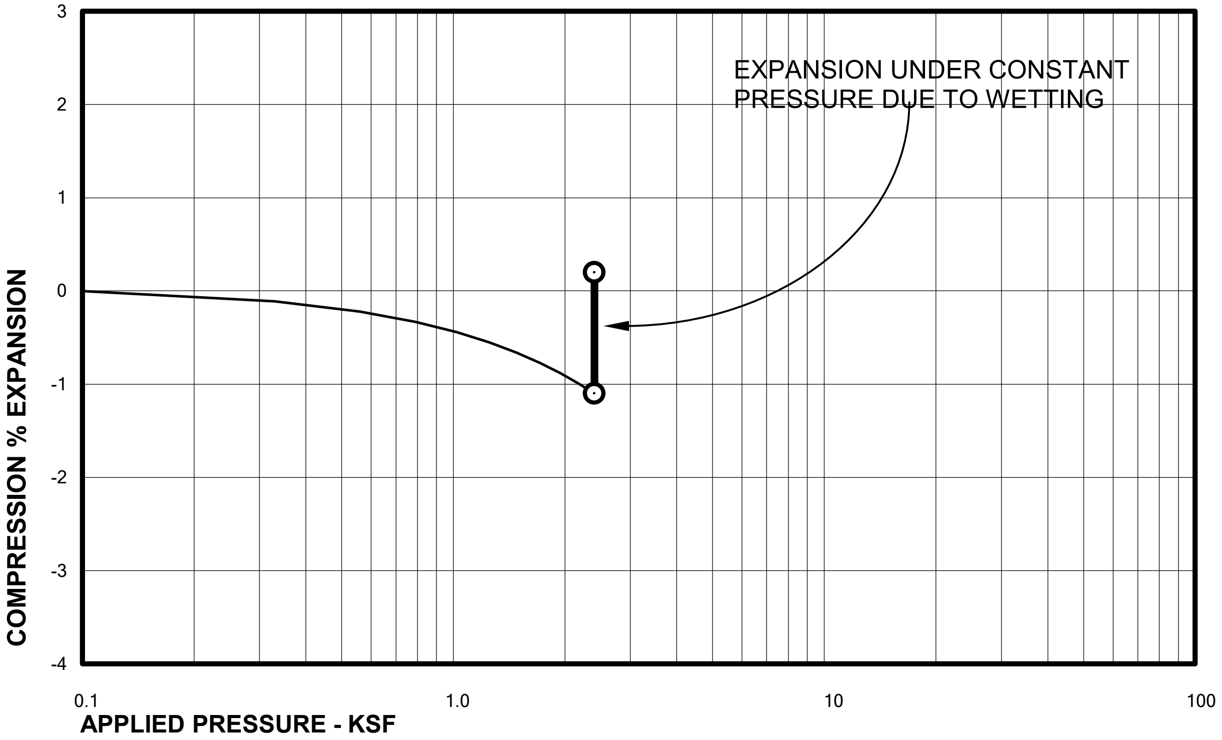


Sample of CLAYSTONE, SANDY

From TH-2 AT 19 FEET

DRY UNIT WEIGHT= 120 PCF

MOISTURE CONTENT= 11.3 %



Sample of SANDSTONE, VERY CLAYEY

From TH-3 AT 19 FEET

DRY UNIT WEIGHT= 123 PCF

MOISTURE CONTENT= 12.0 %

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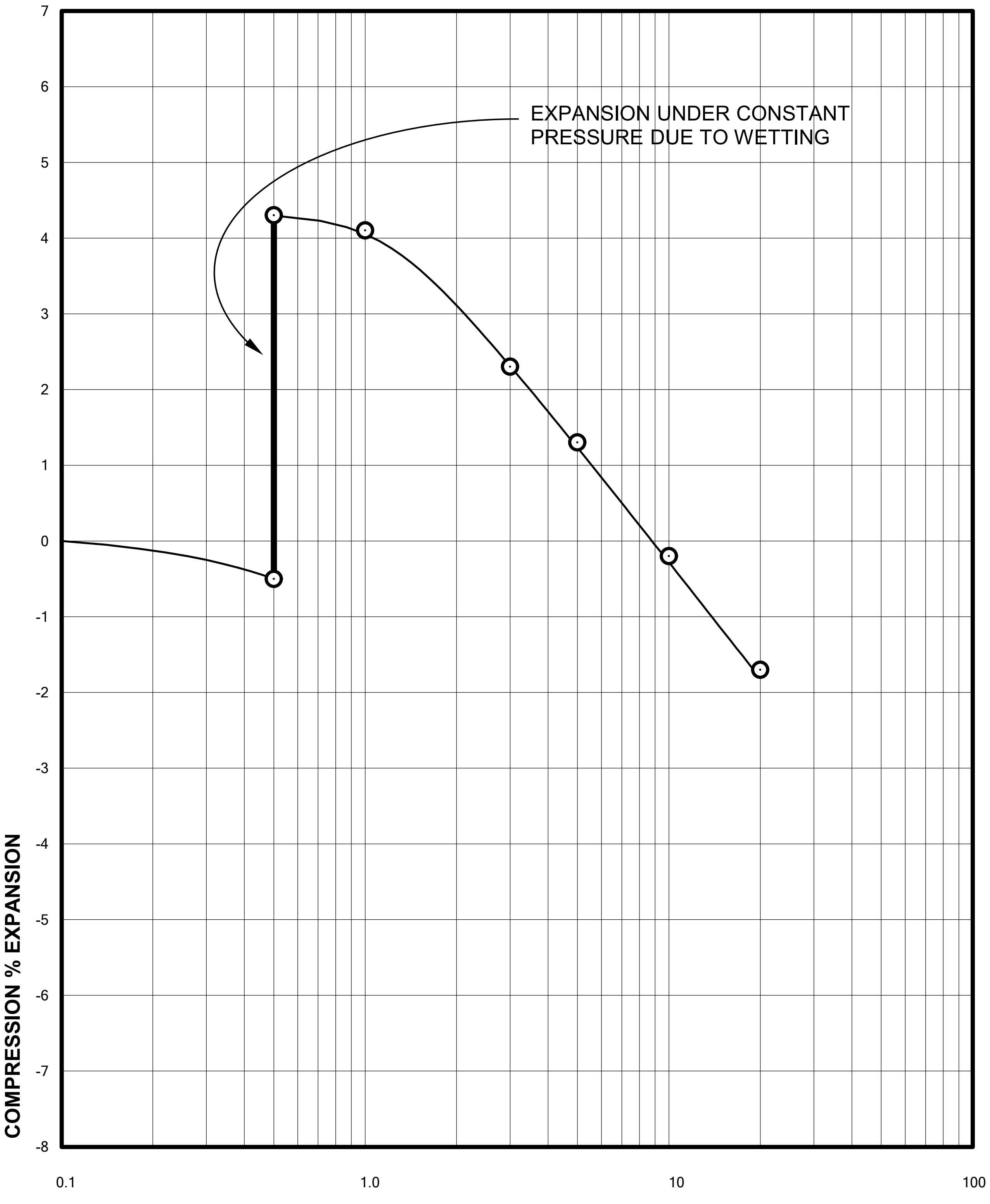
Swell Consolidation Test Results

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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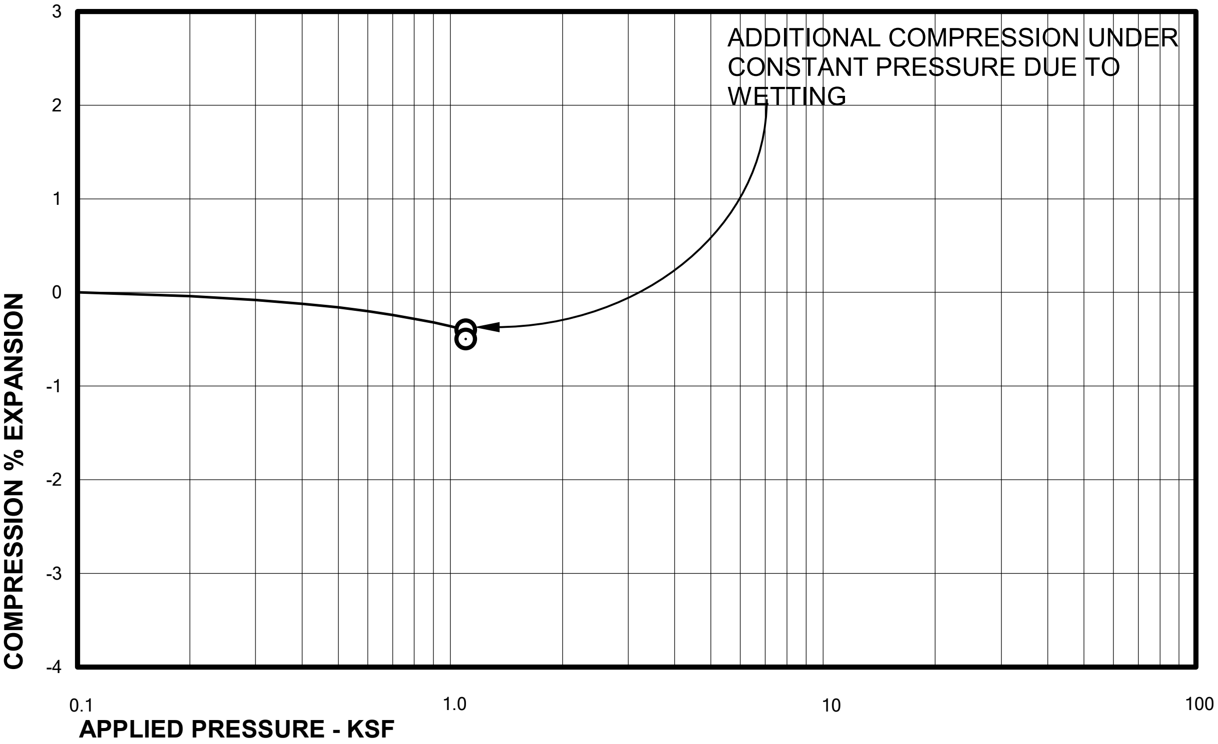
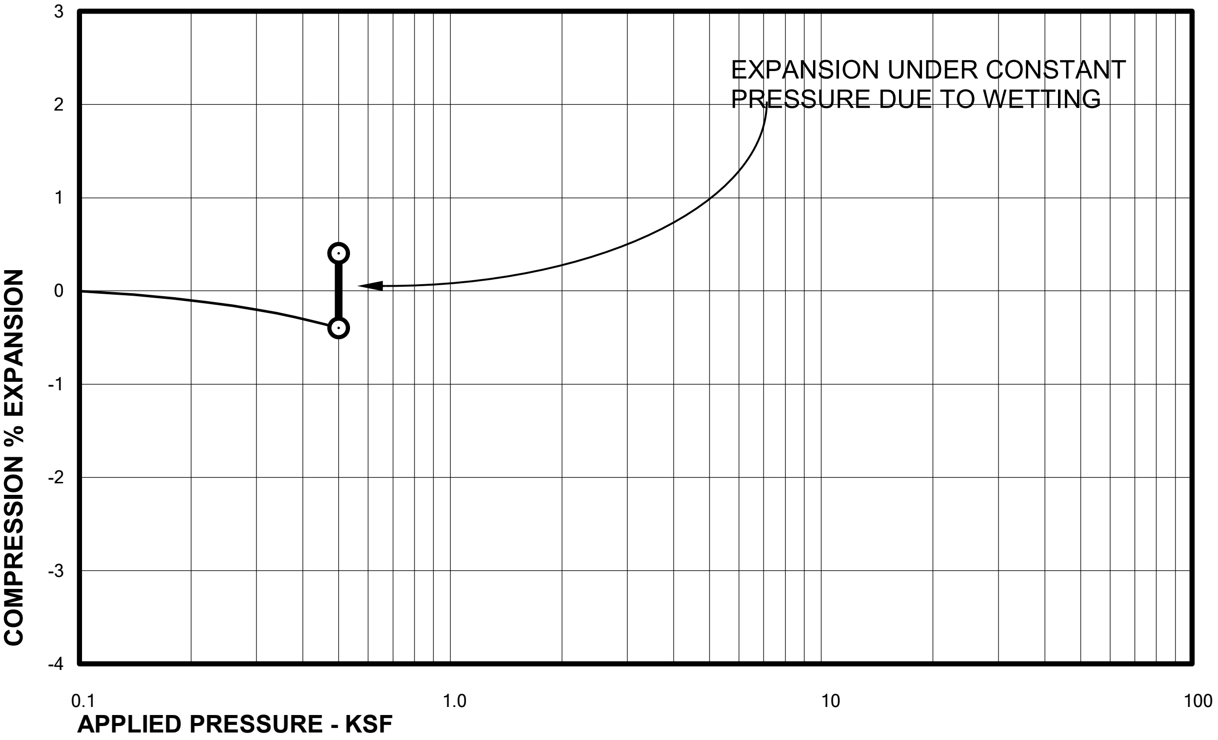
Swell Consolidation Test Results

FIG. B-2



Sample of SANDSTONE, SILTY
From TH-6 AT 9 FEET

DRY UNIT WEIGHT= 113 PCF
MOISTURE CONTENT= 9.3 %



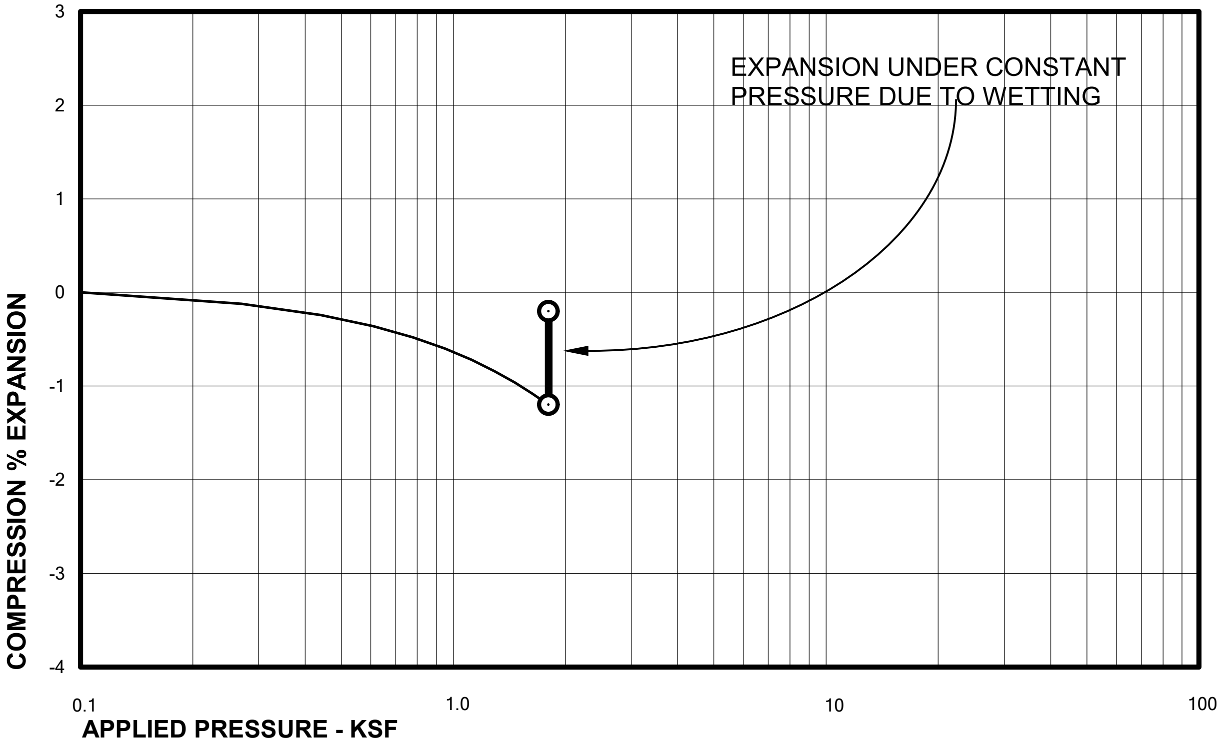
Sample of CLAYSTONE, SANDY
From TH-7 AT 4 FEET

DRY UNIT WEIGHT= 118 PCF
MOISTURE CONTENT= 13.4 %

Swell Consolidation Test Results

FIG. B-3

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

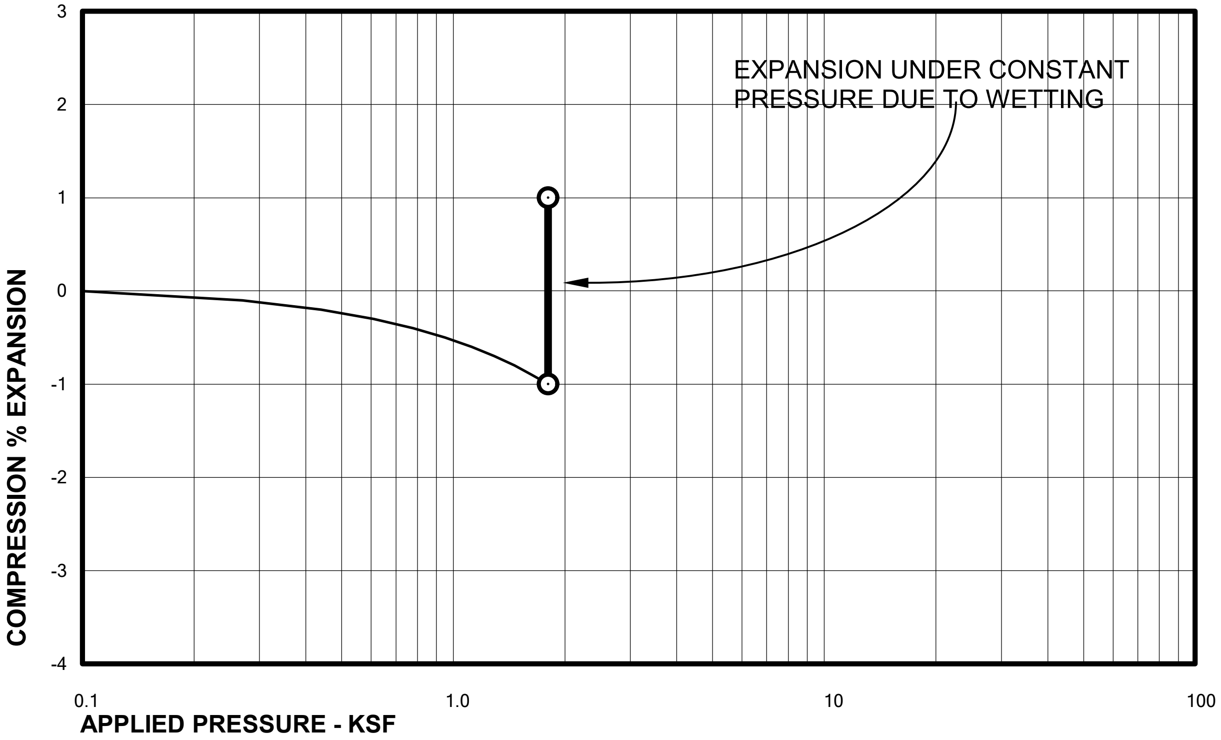


Sample of SANDSTONE, VERY CLAYEY

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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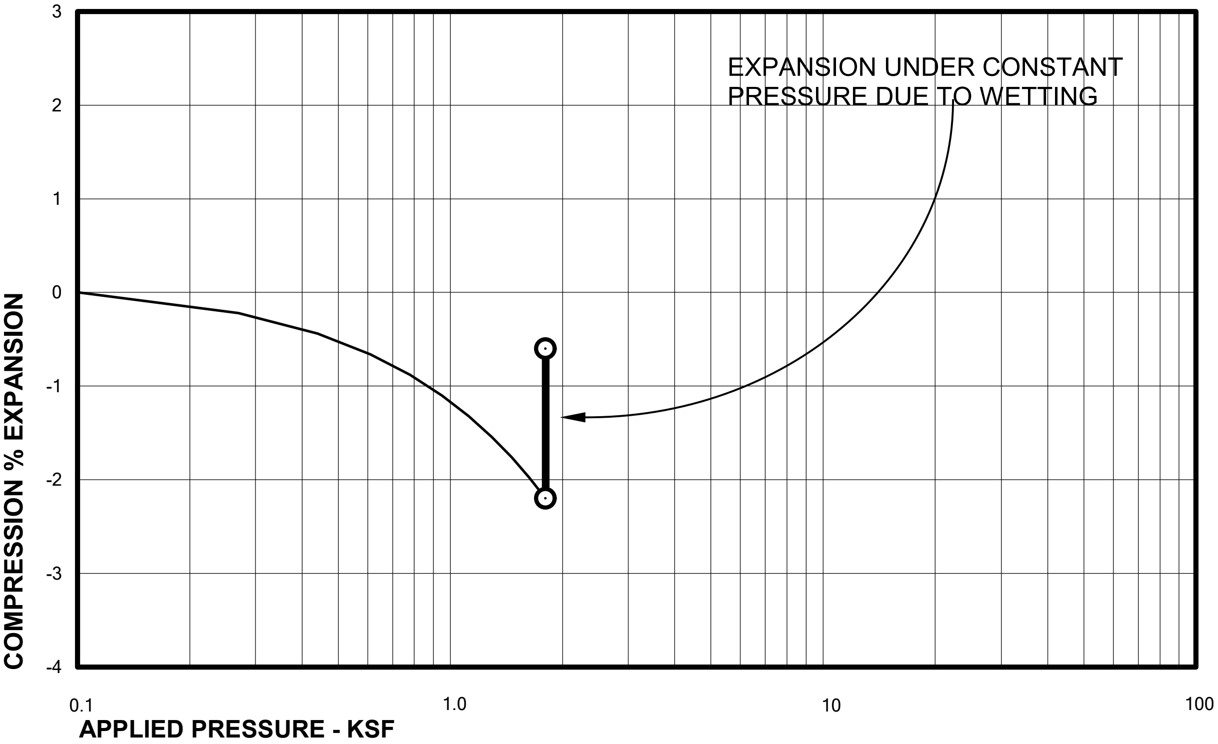
FIG. B-4

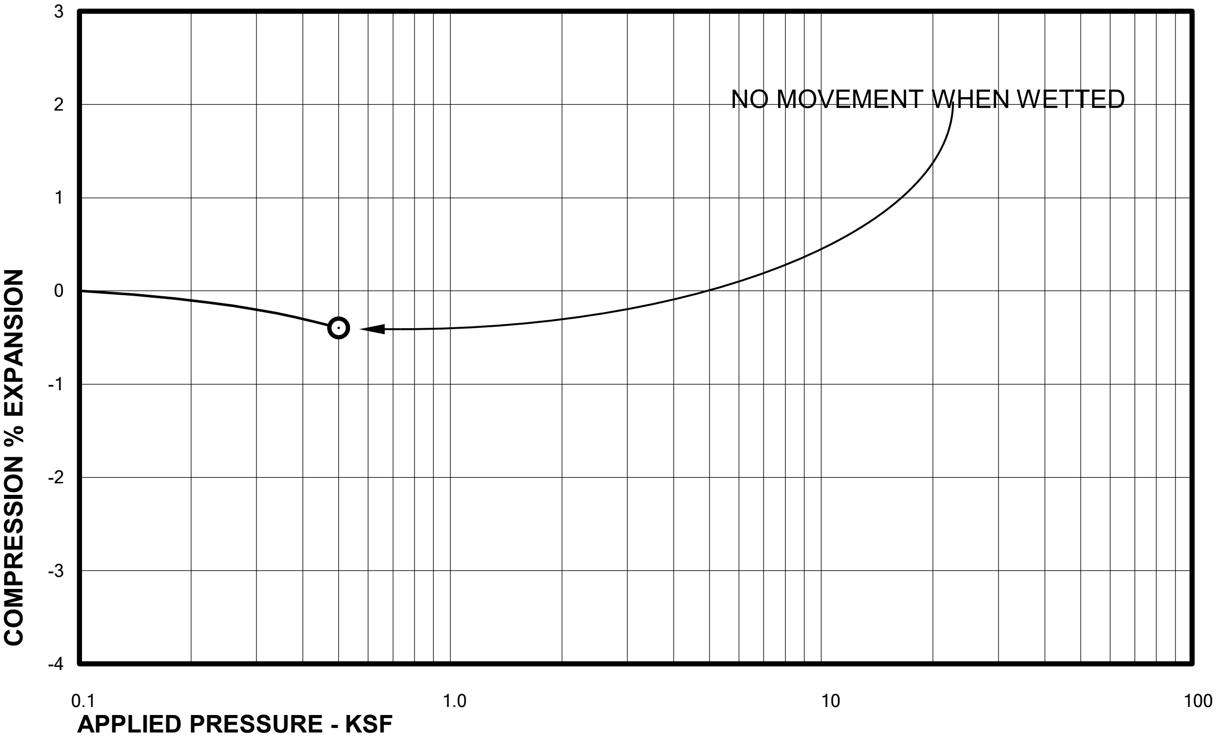


Sample of SANDSTONE, VERY CLAYEY

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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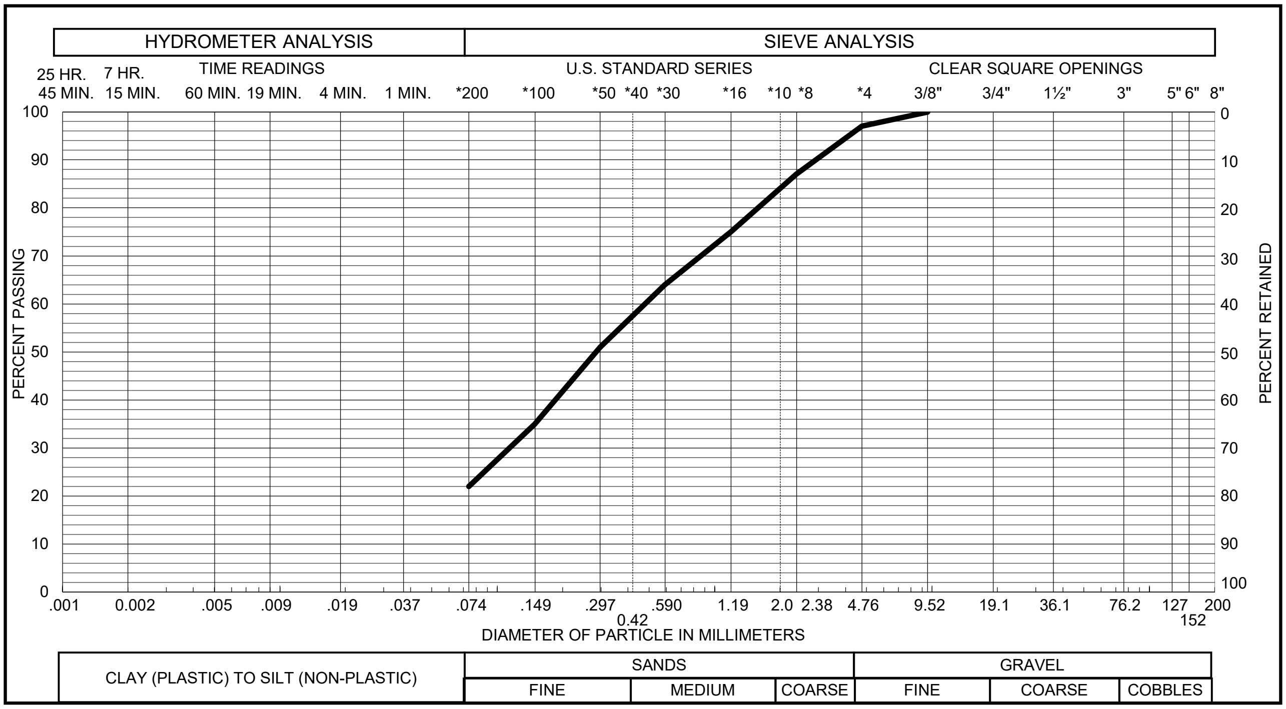
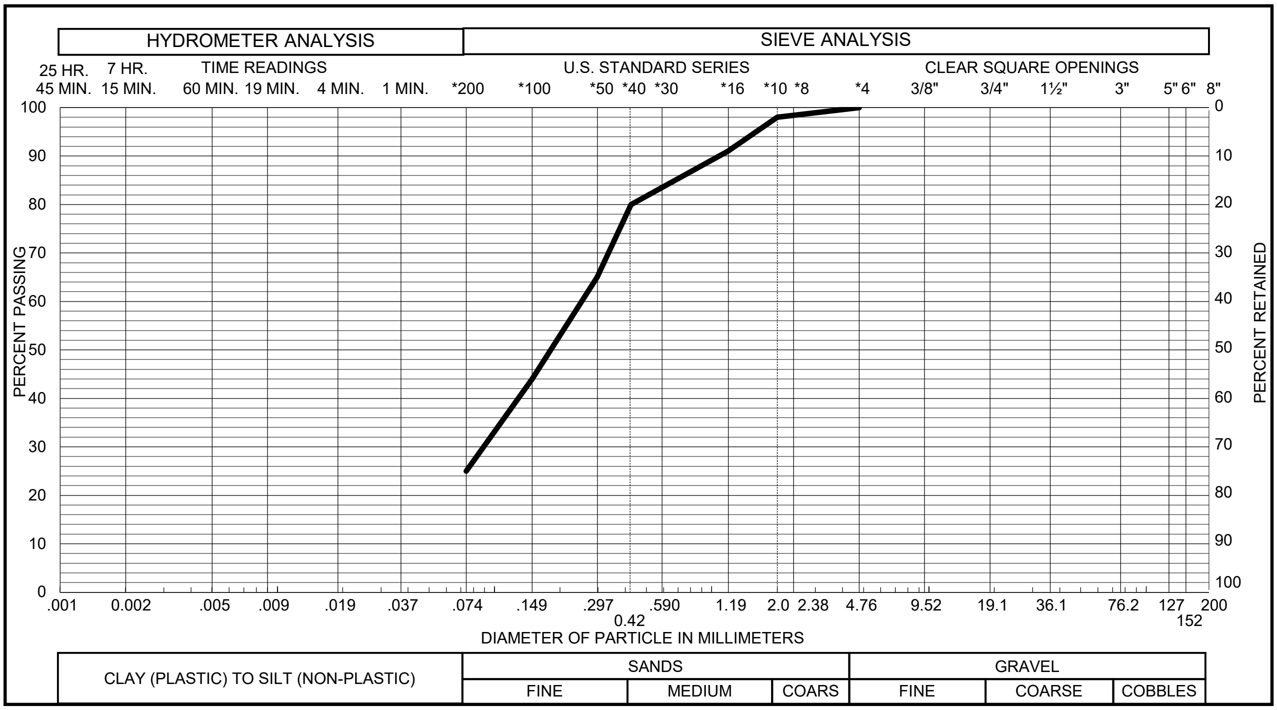
Swell Consolidation Test Results

FIG. B-5



Sample of SAND, SILTY (SM)
From TH - 1 AT 4 FEET

GRAVEL 3 %
SAND 75 %
SILT & CLAY 22 %
LIQUID LIMIT
PLASTICITY INDEX



Sample of SANDSTONE, SILTY
From TH - 2 AT 9 FEET

GRAVEL 0 %
SAND 75 %
SILT & CLAY 25 %
LIQUID LIMIT 31
PLASTICITY INDEX 7

Gradation Test Results

FIG. B-6

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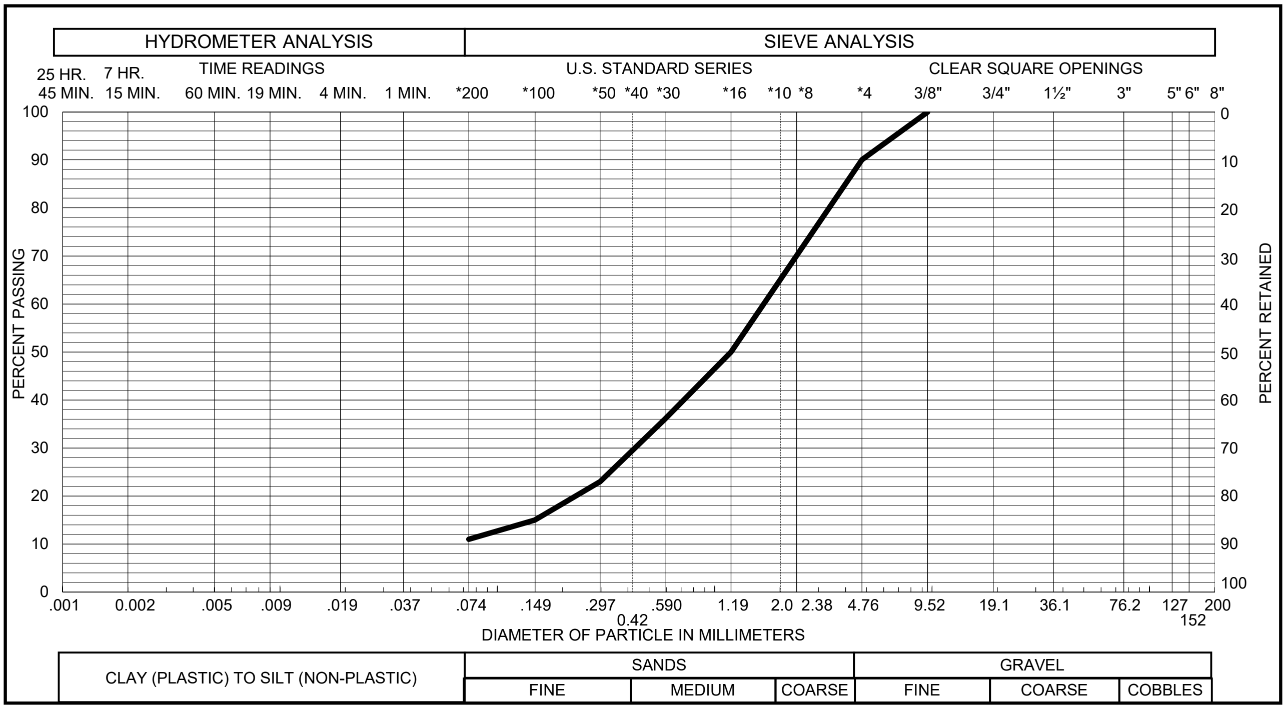
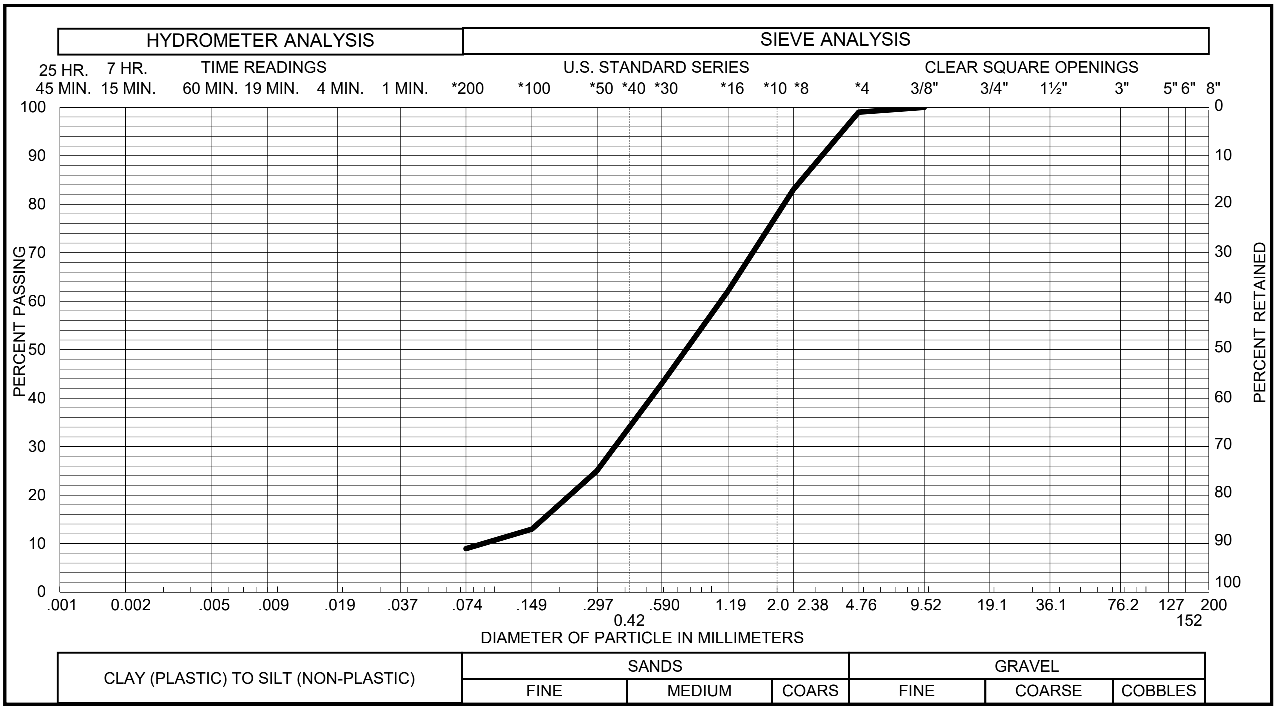


Sample of SANDSTONE, SLIGHTLY SILTY
From TH - 3 AT 9 FEET

GRAVEL 10 % SAND 79 %
SILT & CLAY 11 % LIQUID LIMIT NL
PLASTICITY INDEX NP



Sample of SAND, SLIGHTLY SILTY (SP-SM)
From TH - 4 AT 4 FEET

GRAVEL 1 % SAND 90 %
SILT & CLAY 9 % LIQUID LIMIT
PLASTICITY INDEX

Gradation Test Results

FIG. B-7

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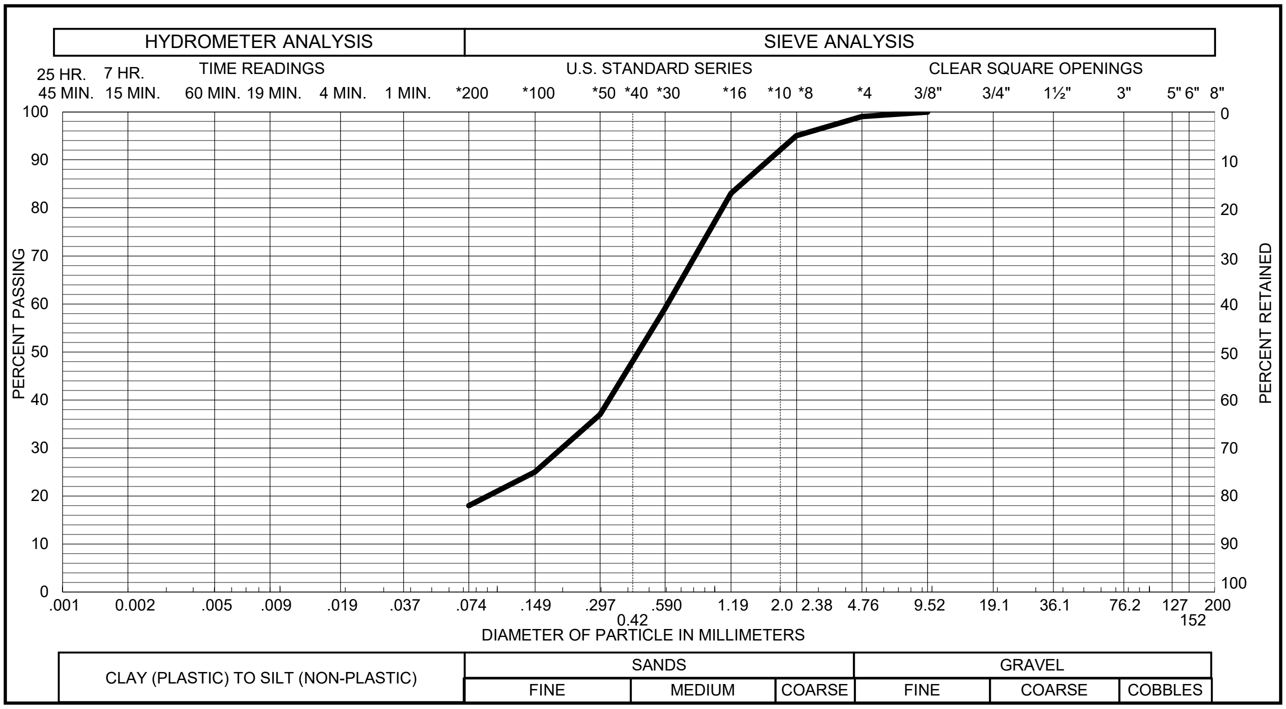
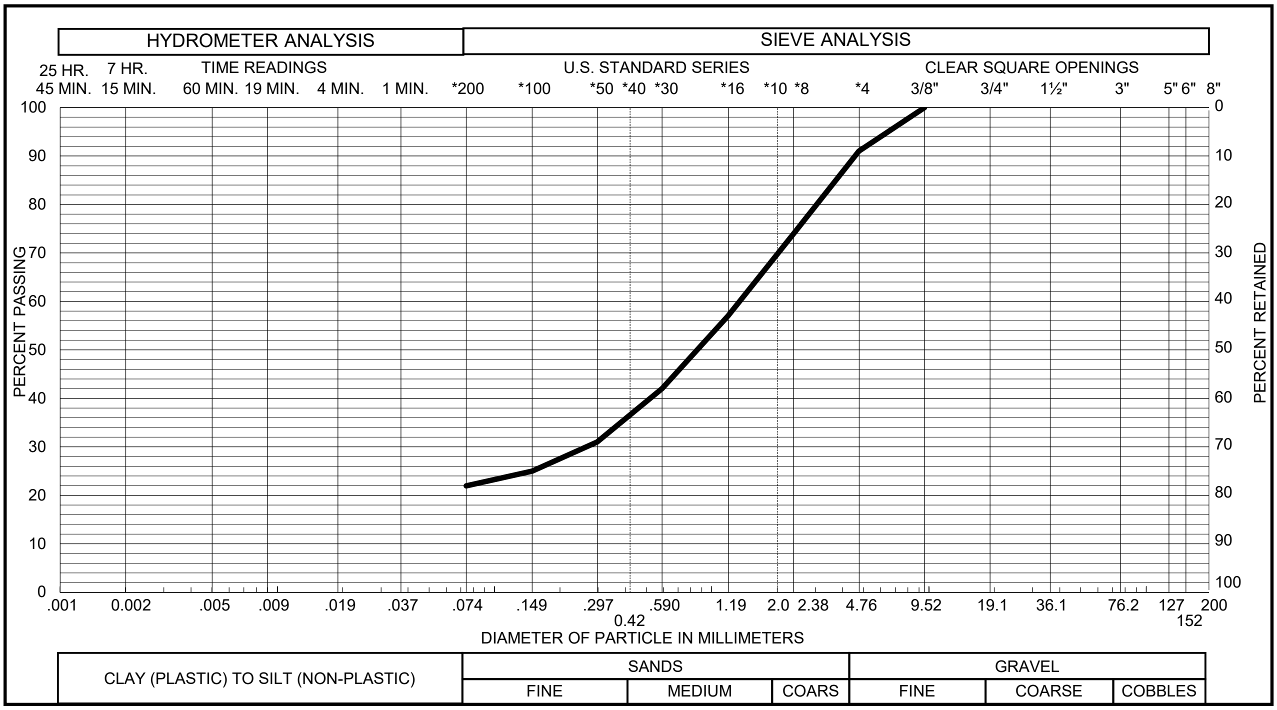
CTL|T PROJECT NO. CS19345-115



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

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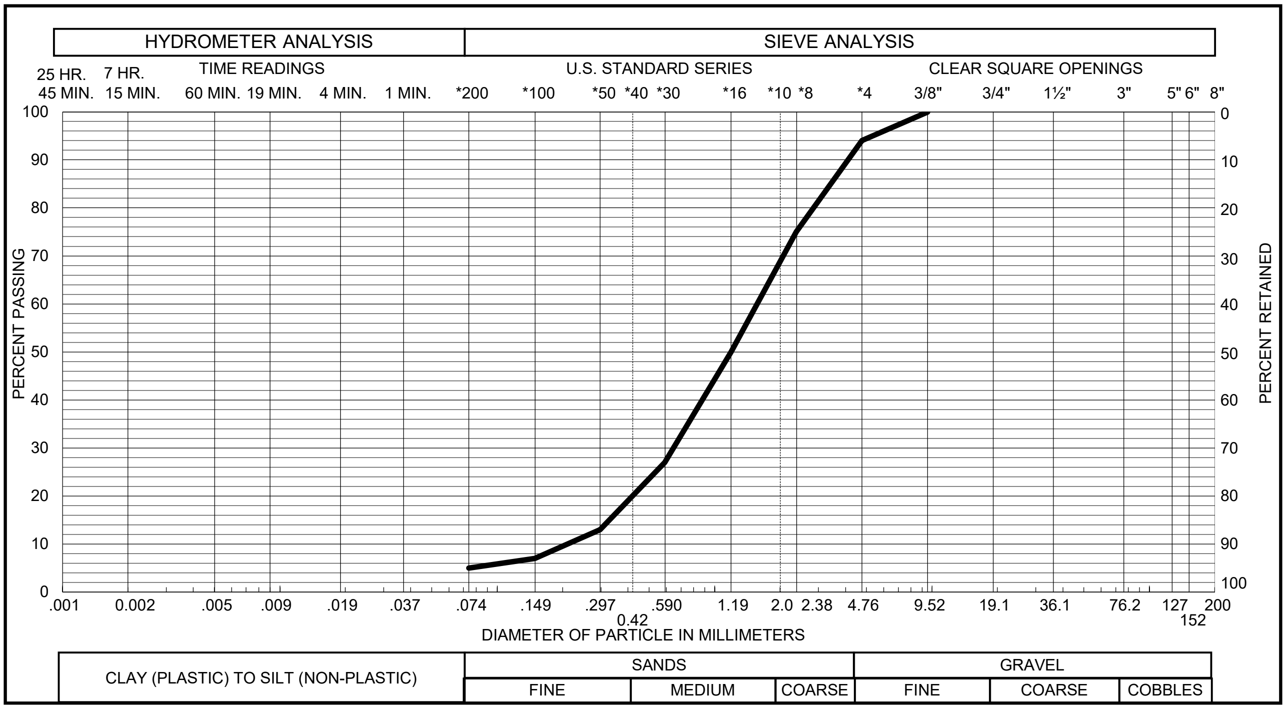
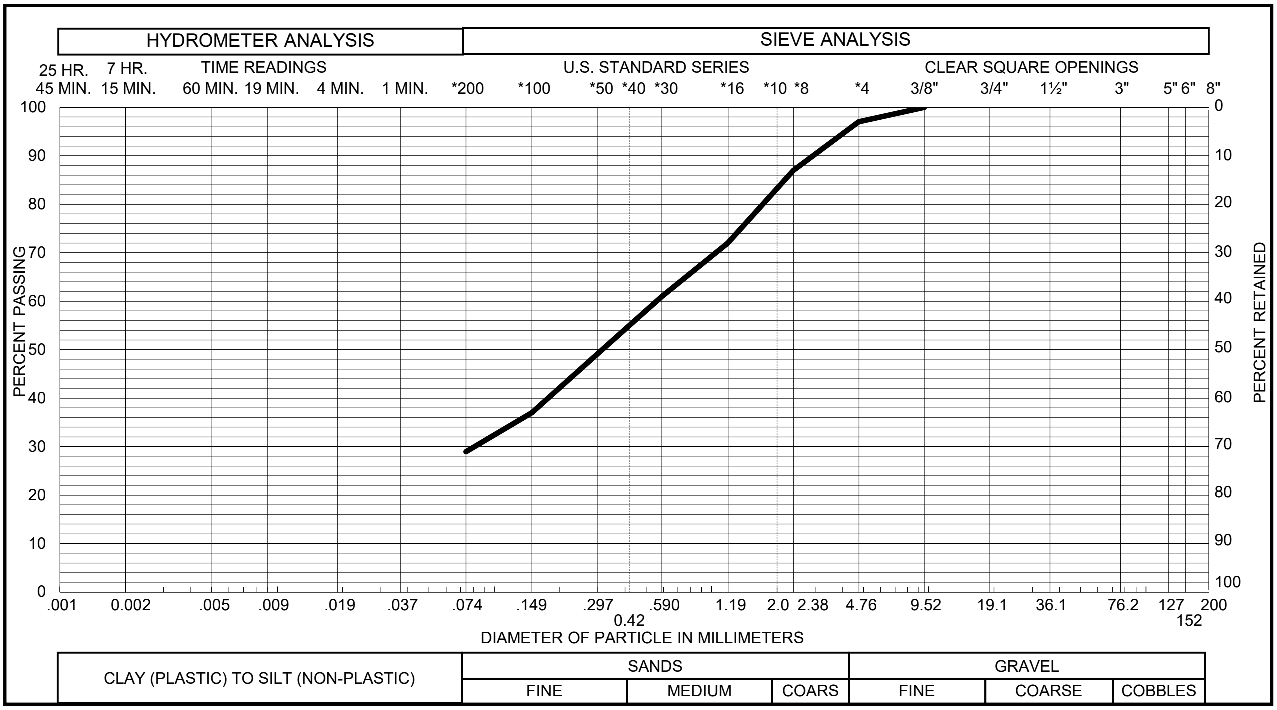
CTL|T PROJECT NO. CS19345-115



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



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

Gradation Test Results

FIG. B-9

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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				ATTERBERG LIMITS		PASSING NO. 200 SIEVE (%)	SOIL TYPE
				SWELL (%)	COMPRESSION (%)	APPLIED PRESSURE (psf)	SWELL PRESSURE (psf)	LIQUID LIMIT	PLASTICITY INDEX		
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)

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

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

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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.

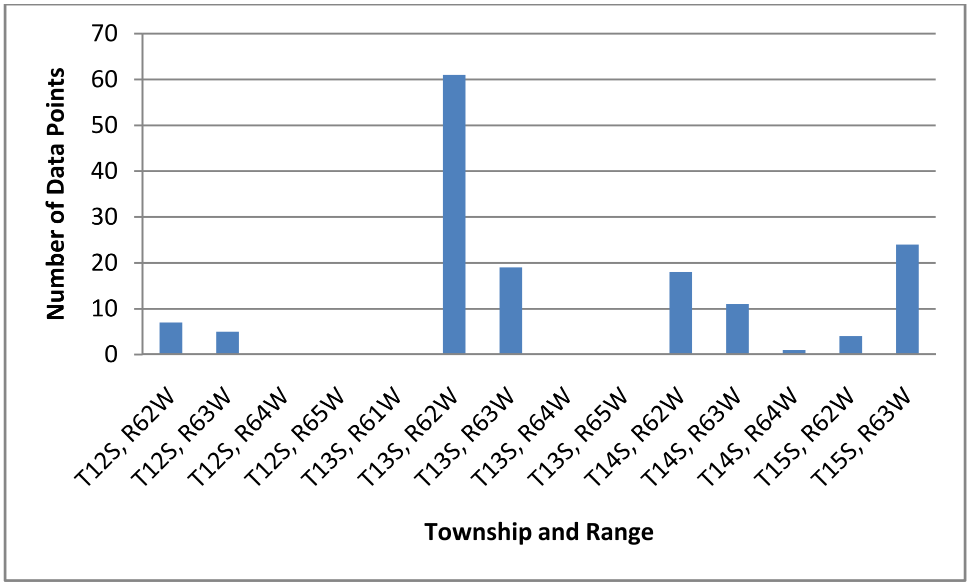


Figure 3.2 – Spatial distribution of water quality data

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.

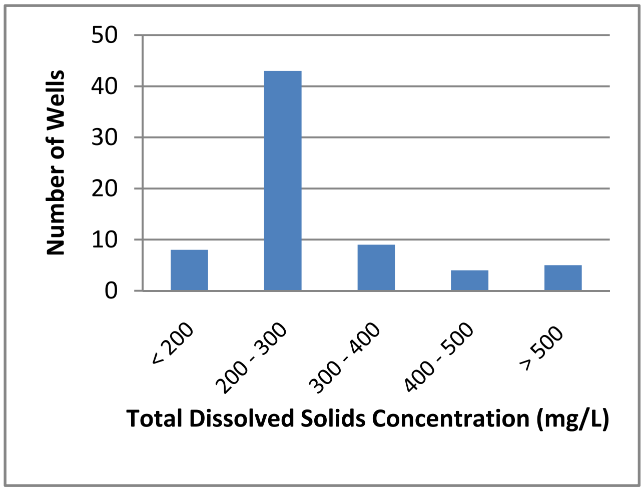


Figure 4.1 – Distribution of TDS

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

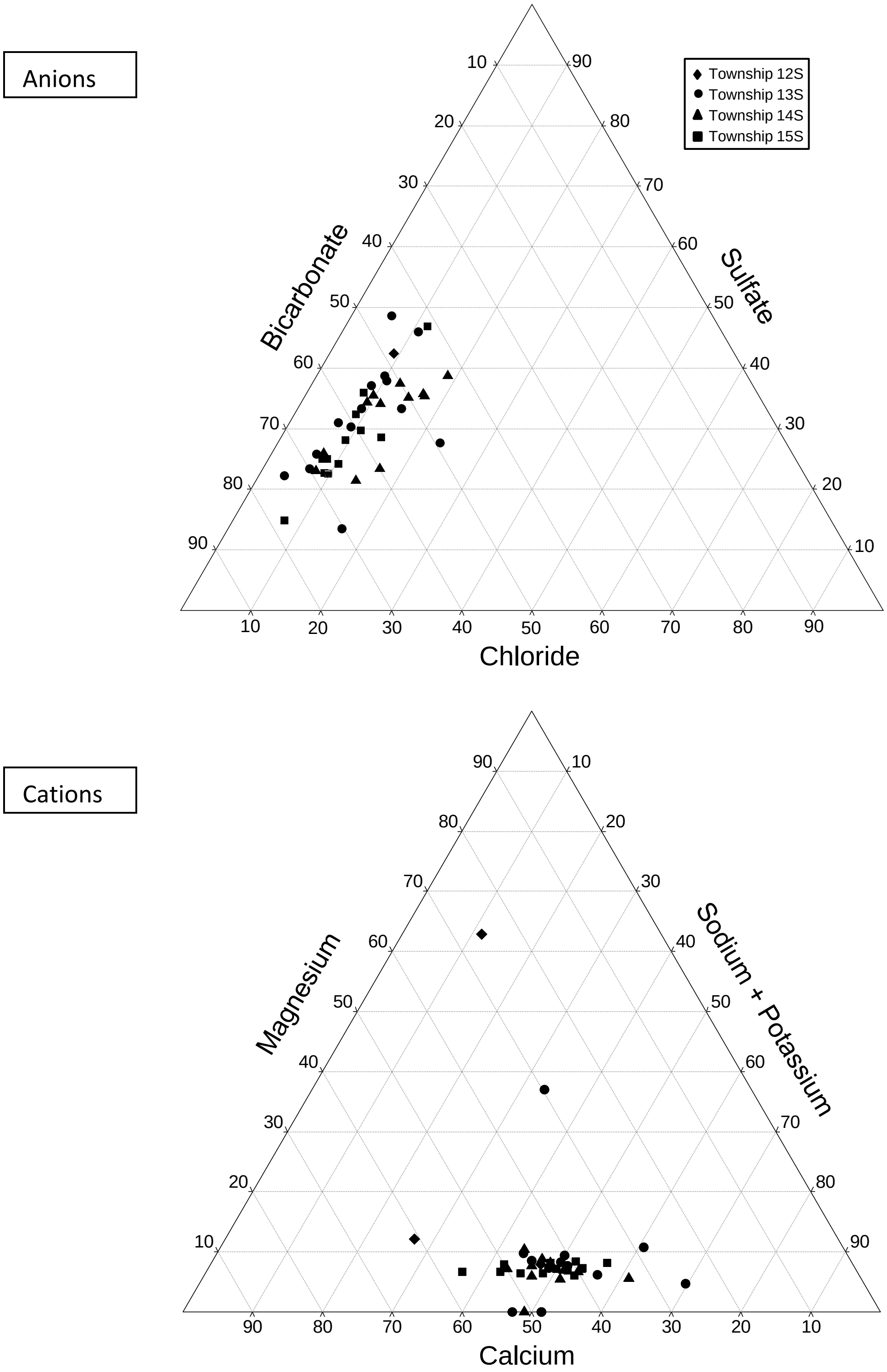


Figure 4.3 - Relative proportions of dissolved anions and cations in water from the alluvial aquifer in the Upper Black Squirrel Creek Basin.
(Units along axes are percentage of total milliequivalents per liter)

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.

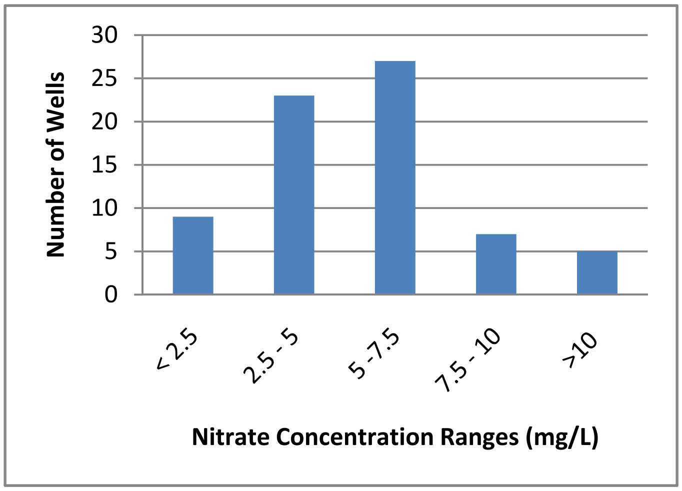
Available hardness data are mapped in Figure 4.4. The data indicate that groundwater in the UBSC basin alluvial aquifer is generally classified as “moderately hard” with isolated areas containing water classified as “hard” or “very hard.” Locations with hard and very hard water coincide with locations 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.

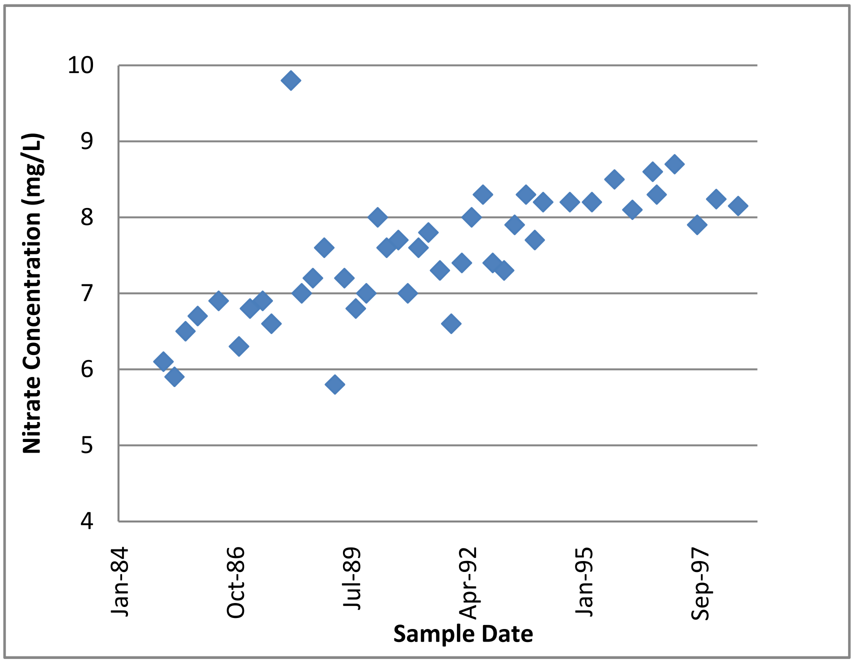


4.5 - Frequency Distribution of Nitrate Values

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.



4.10 - Nitrate Concentrations with Time at Well SC01306230ACC1

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 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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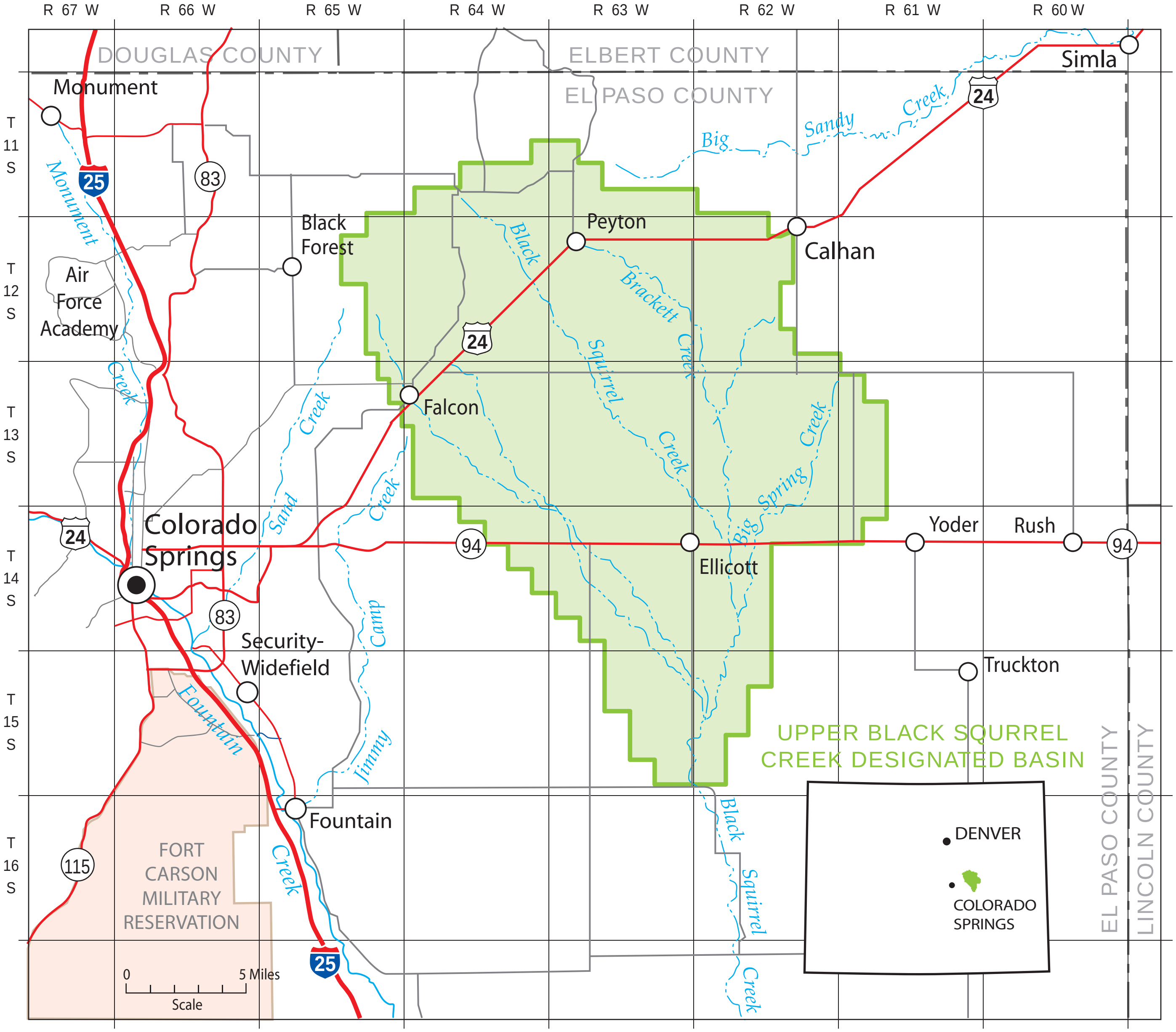

Figure 1.1 Location of the Upper Black Squirrel Creek Basin and Study Area

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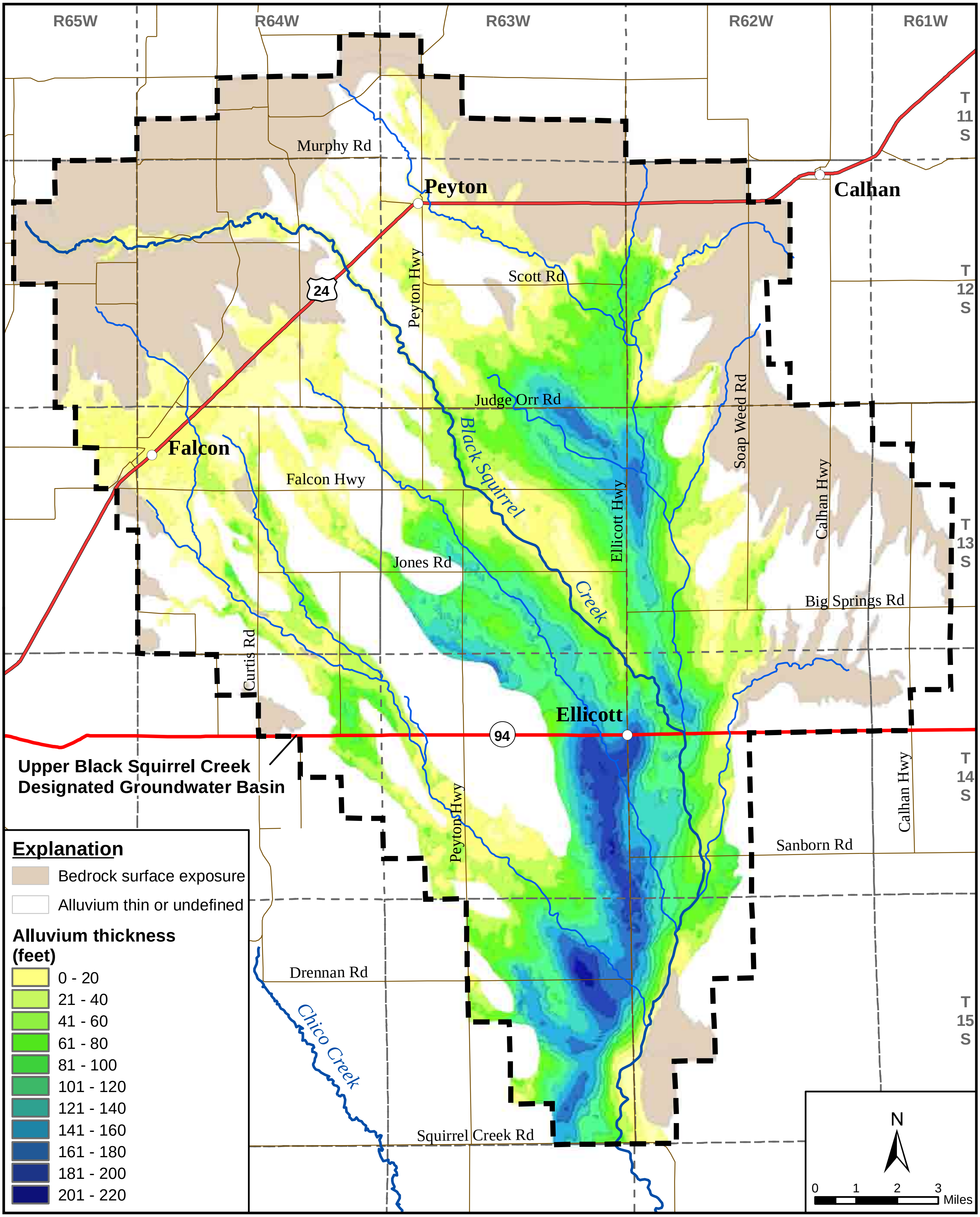

Figure 1.2 Extent and Thickness of the Alluvial Aquifer System in the Upper Black Squirrel Creek Basin

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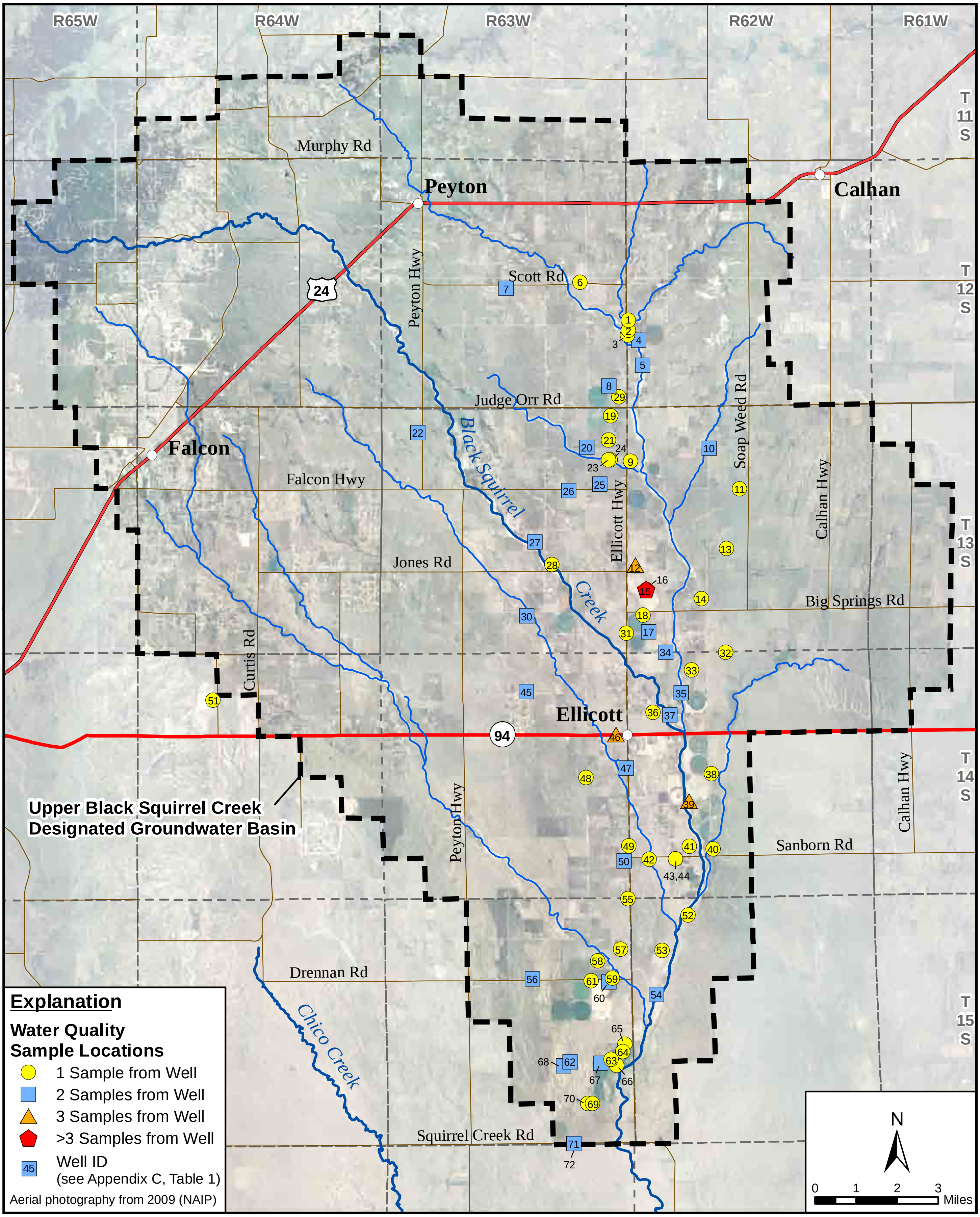

Figure 3.1 Water Quality Sample Location Map

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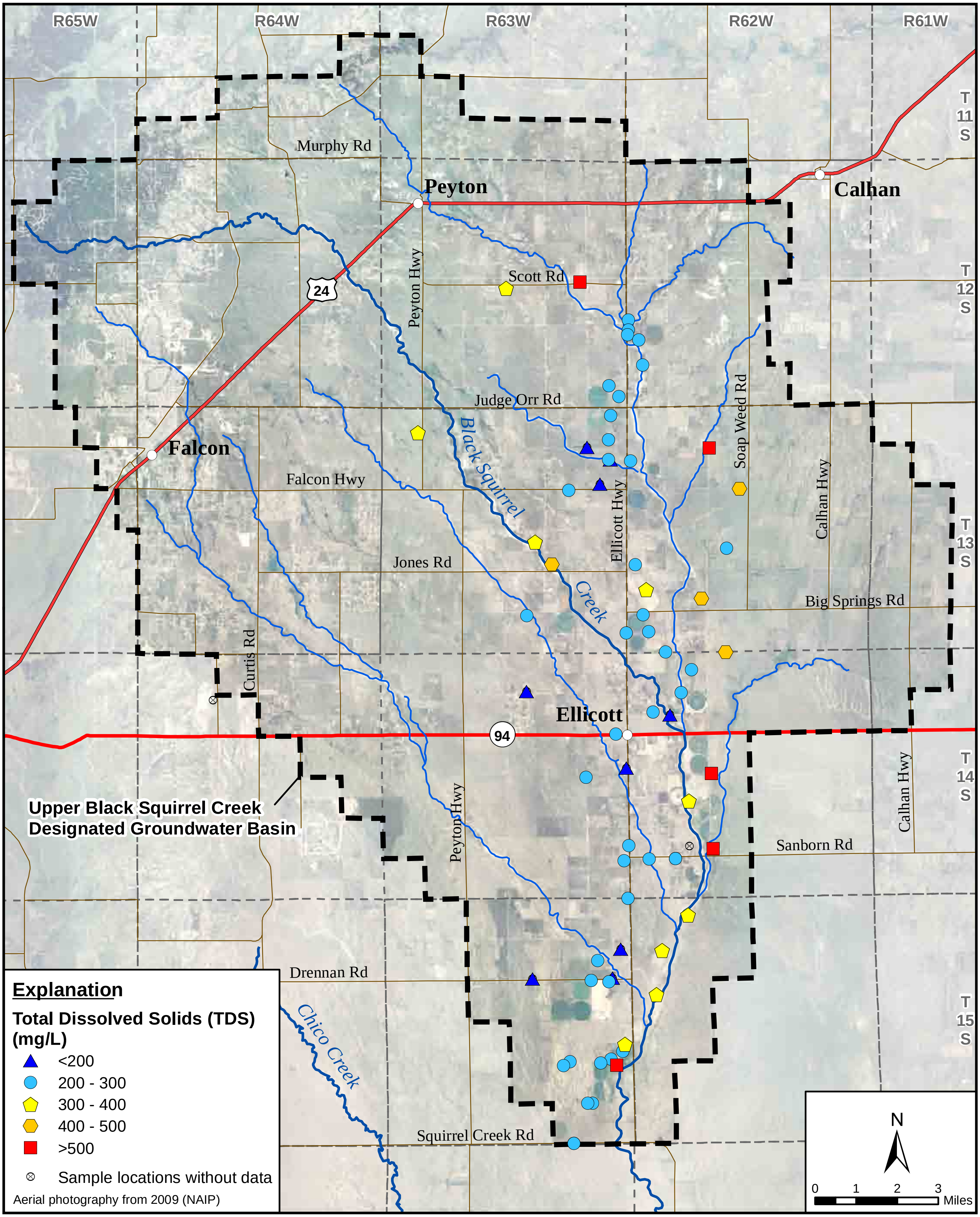

Figure 4.2 Total Dissolved Solids Distribution, 1954-2009

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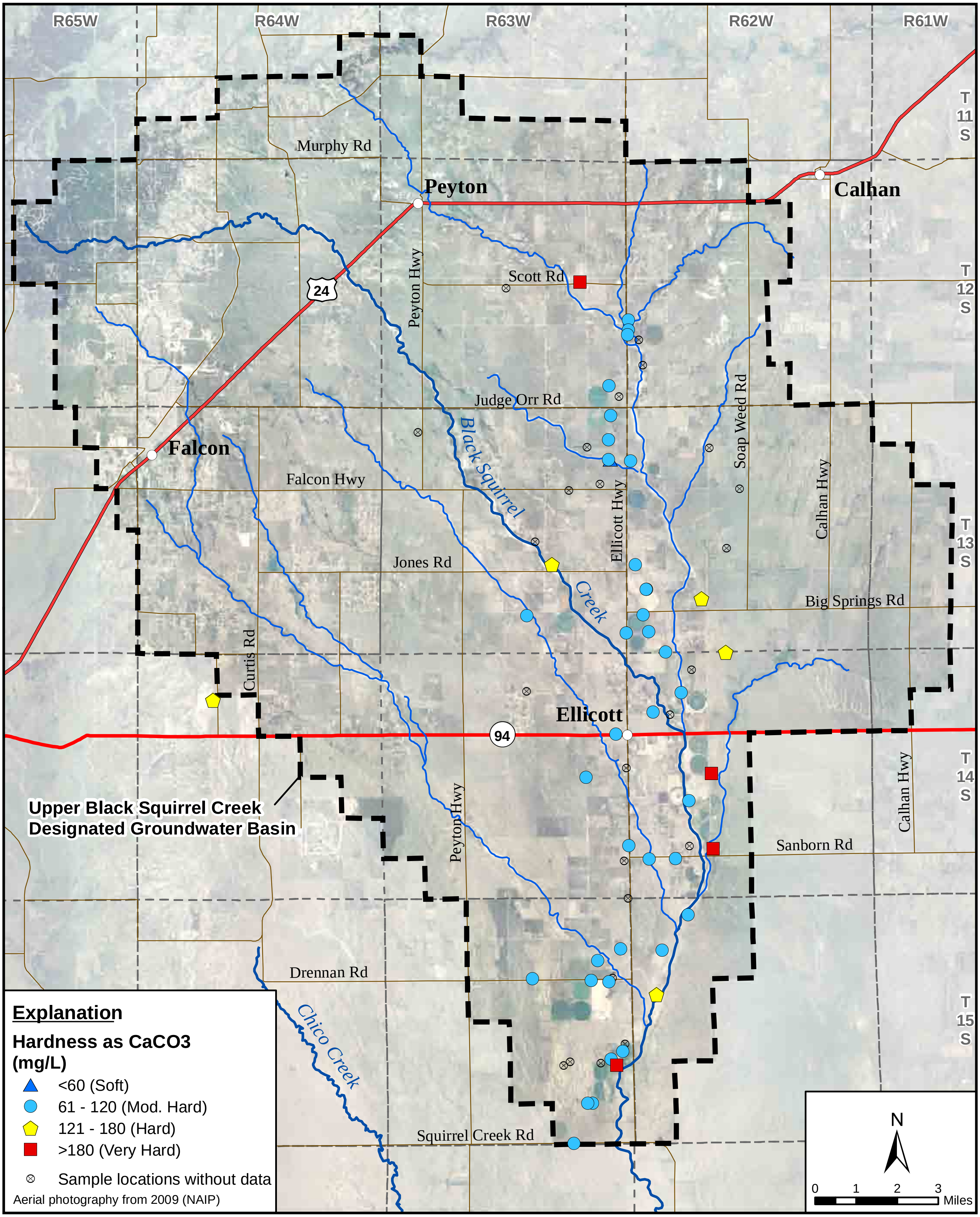

Figure 4.4 Hardness Value Distribution, 1954-2009

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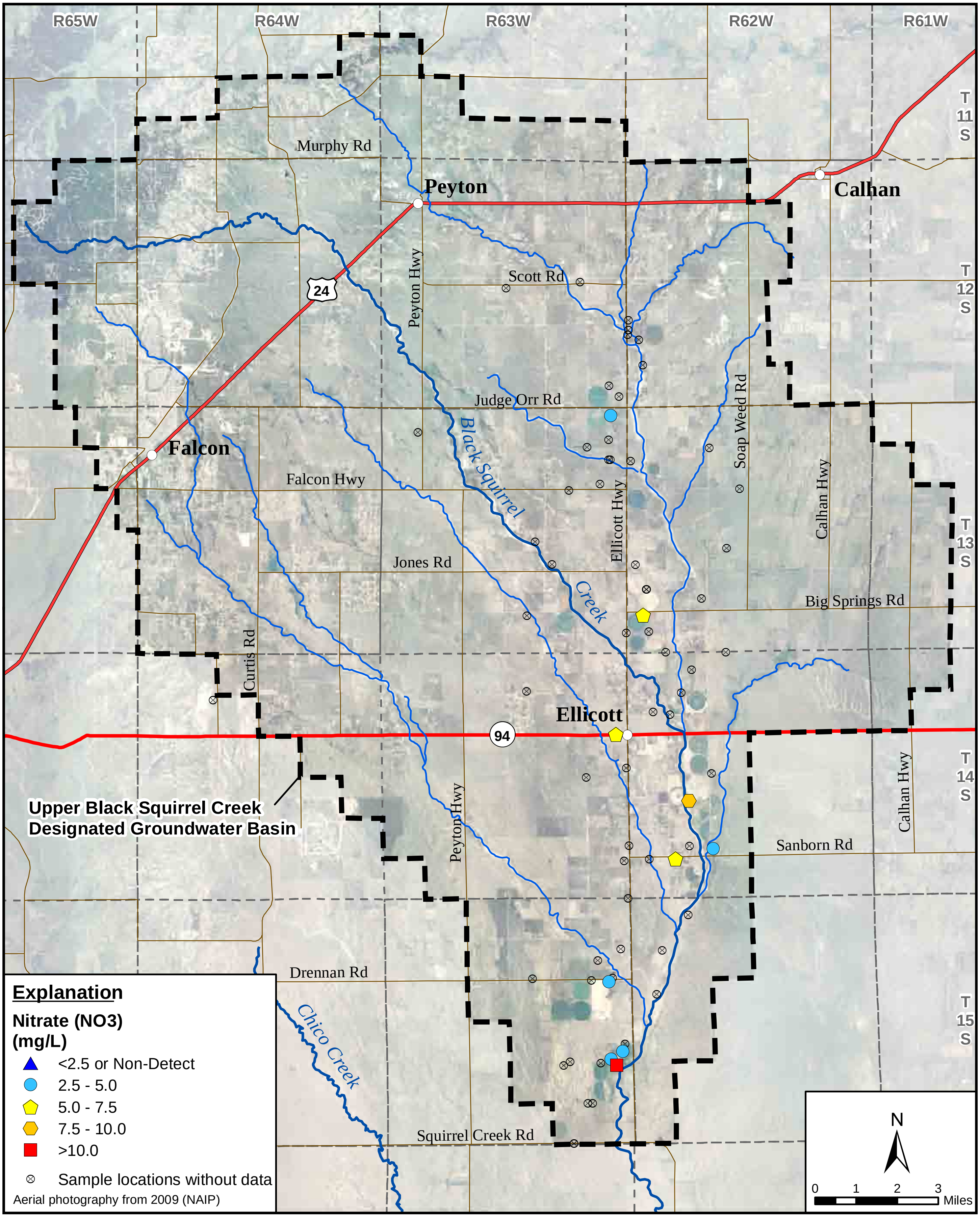

Figure 4.6 Nitrate Distribution, Pre-1980

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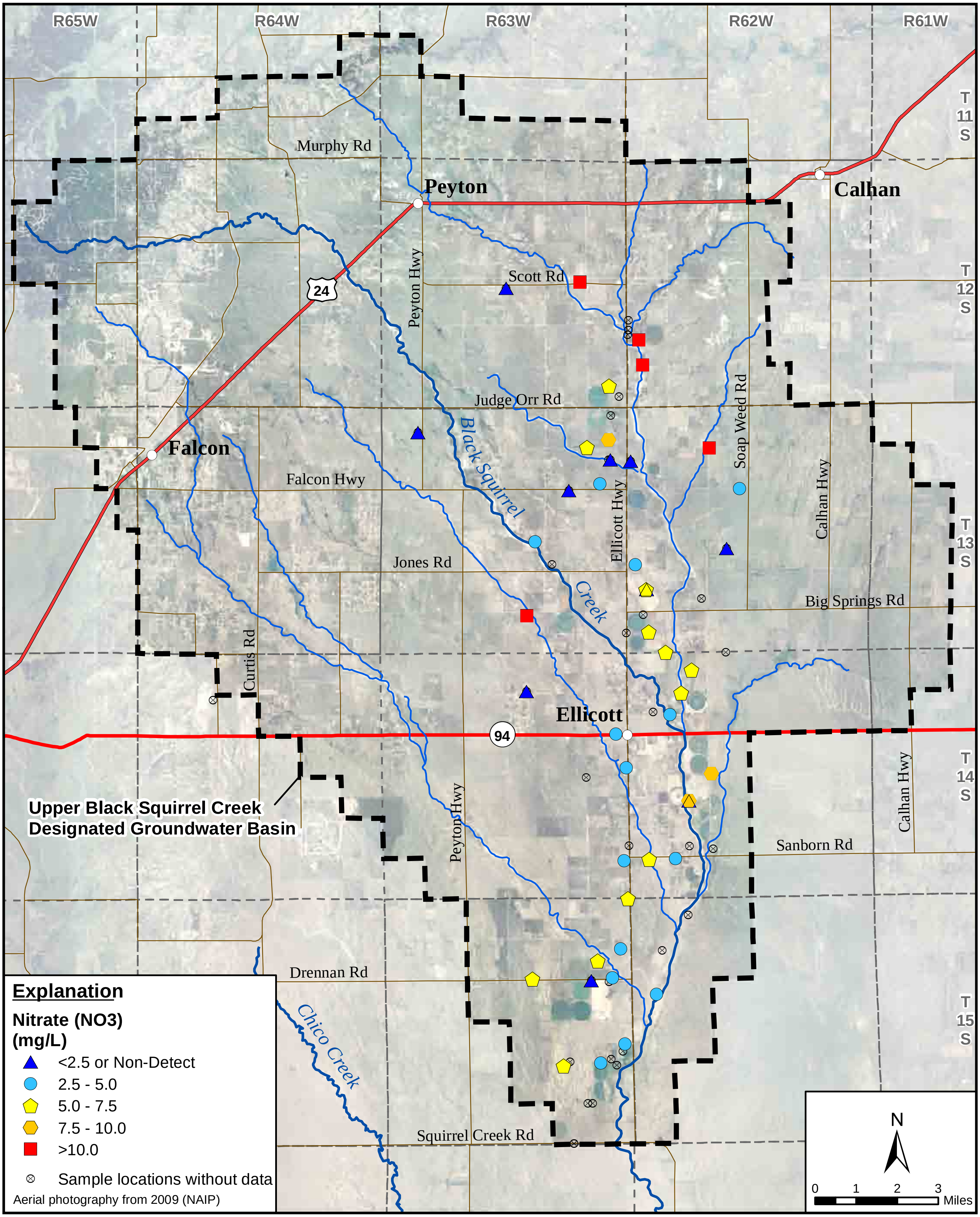

Figure 4.7 Nitrate Distribution, 1980s

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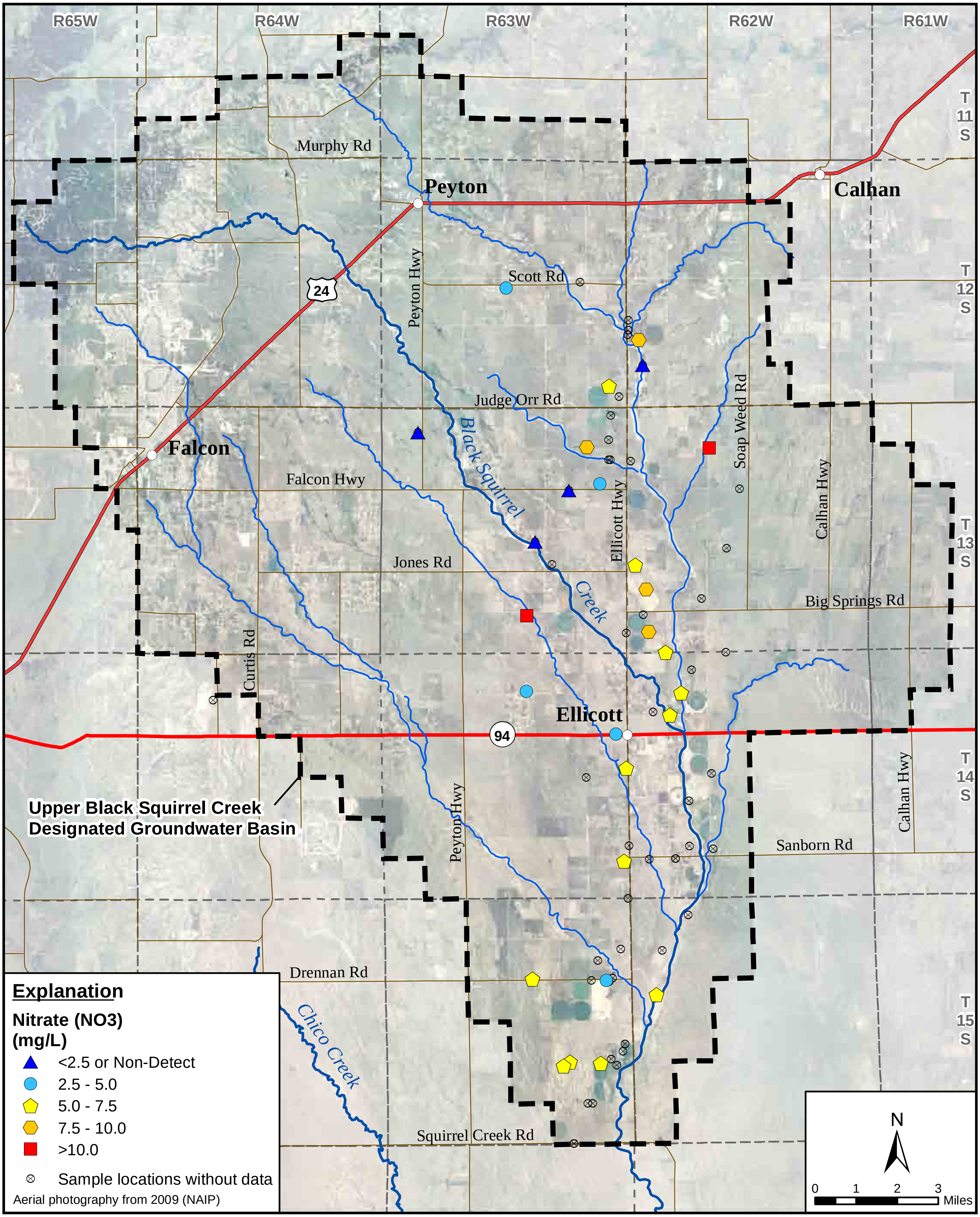

Figure 4.8 Nitrate Distribution, 1990s

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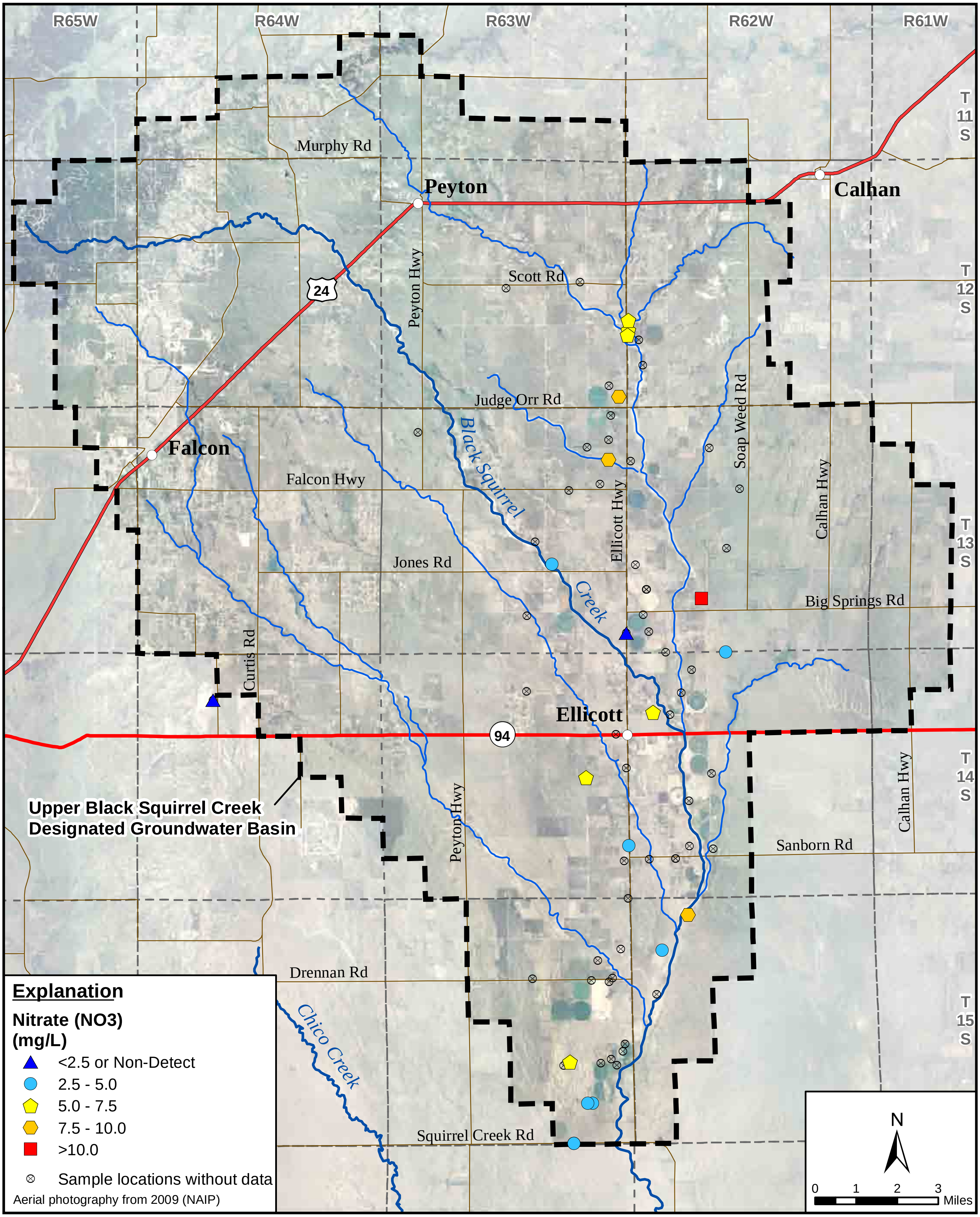

Figure 4.9 Nitrate Distribution, 2000s

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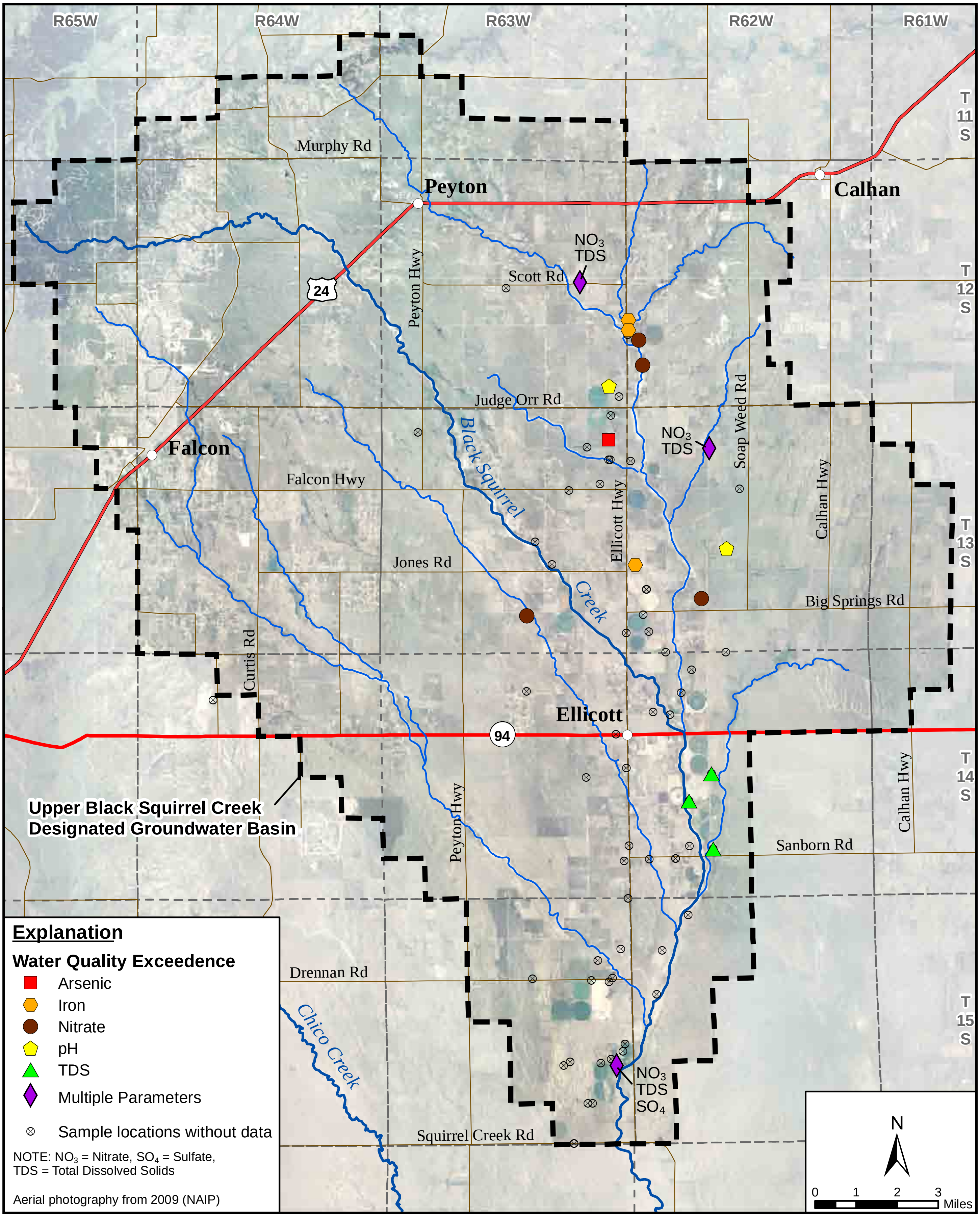

Figure 4.11 Groundwater Quality MCL and SMCL Exceedences, 1954-2009

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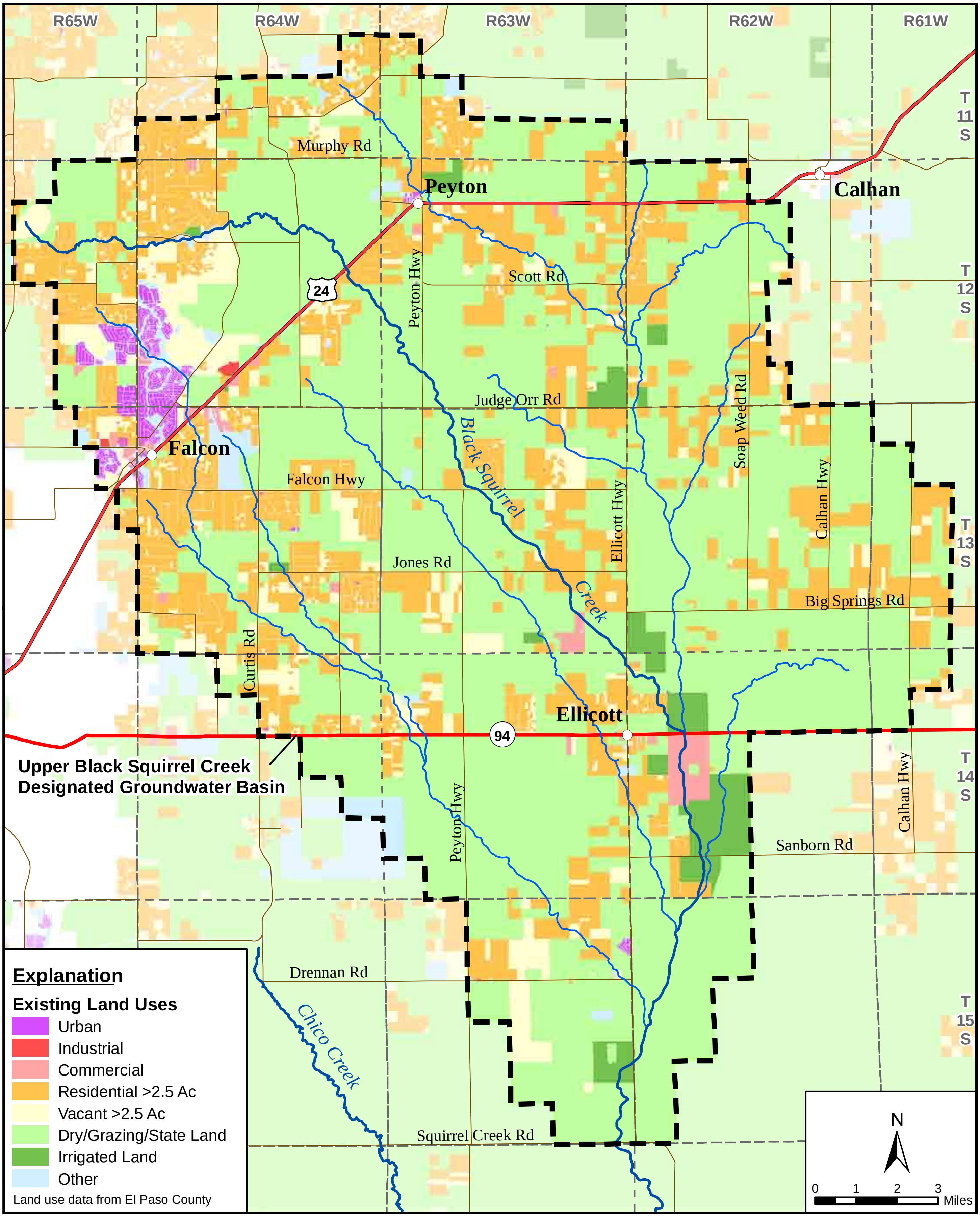

Figure 5.1 Existing Land Use

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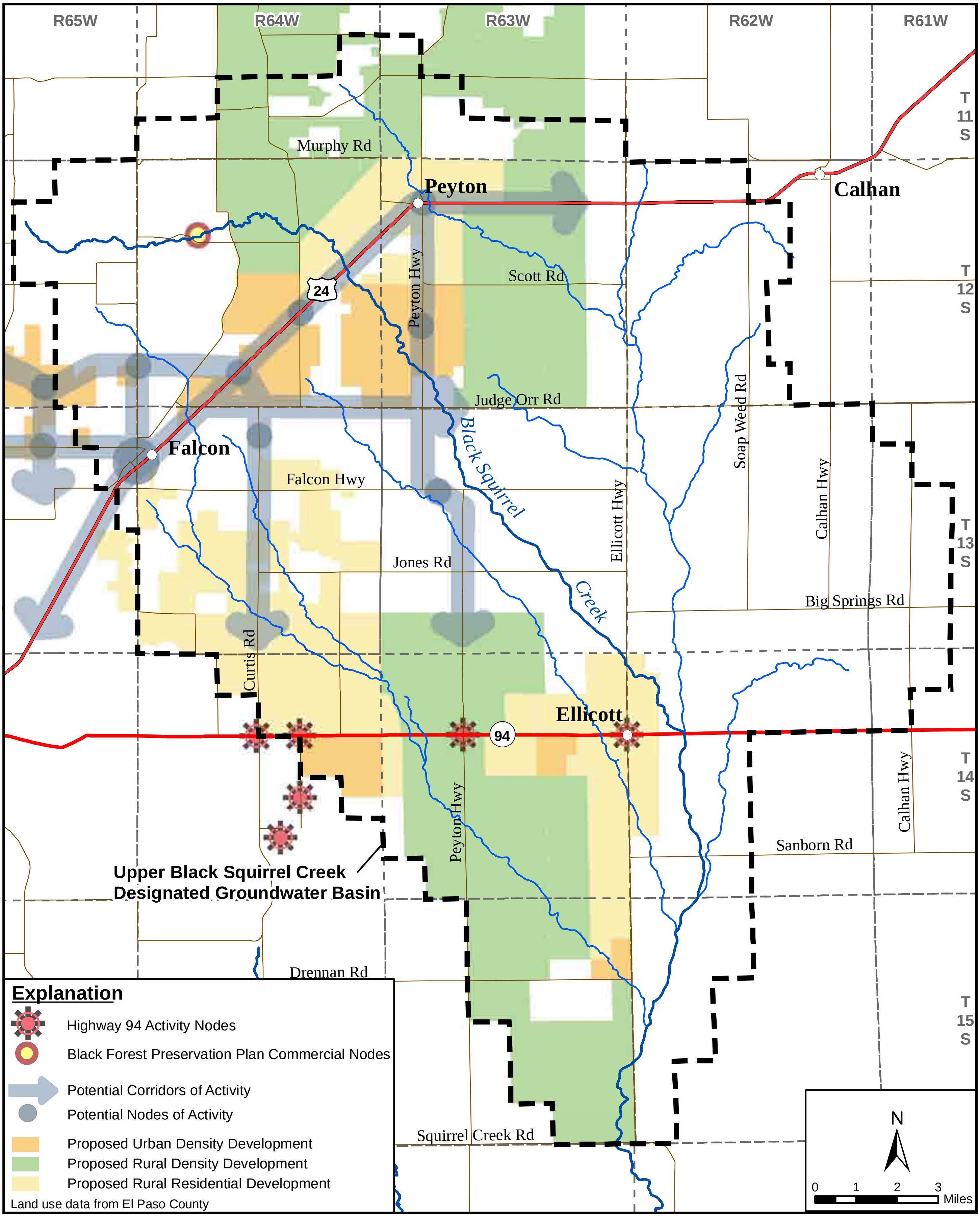

Figure 5.2 Anticipated Future Land Use

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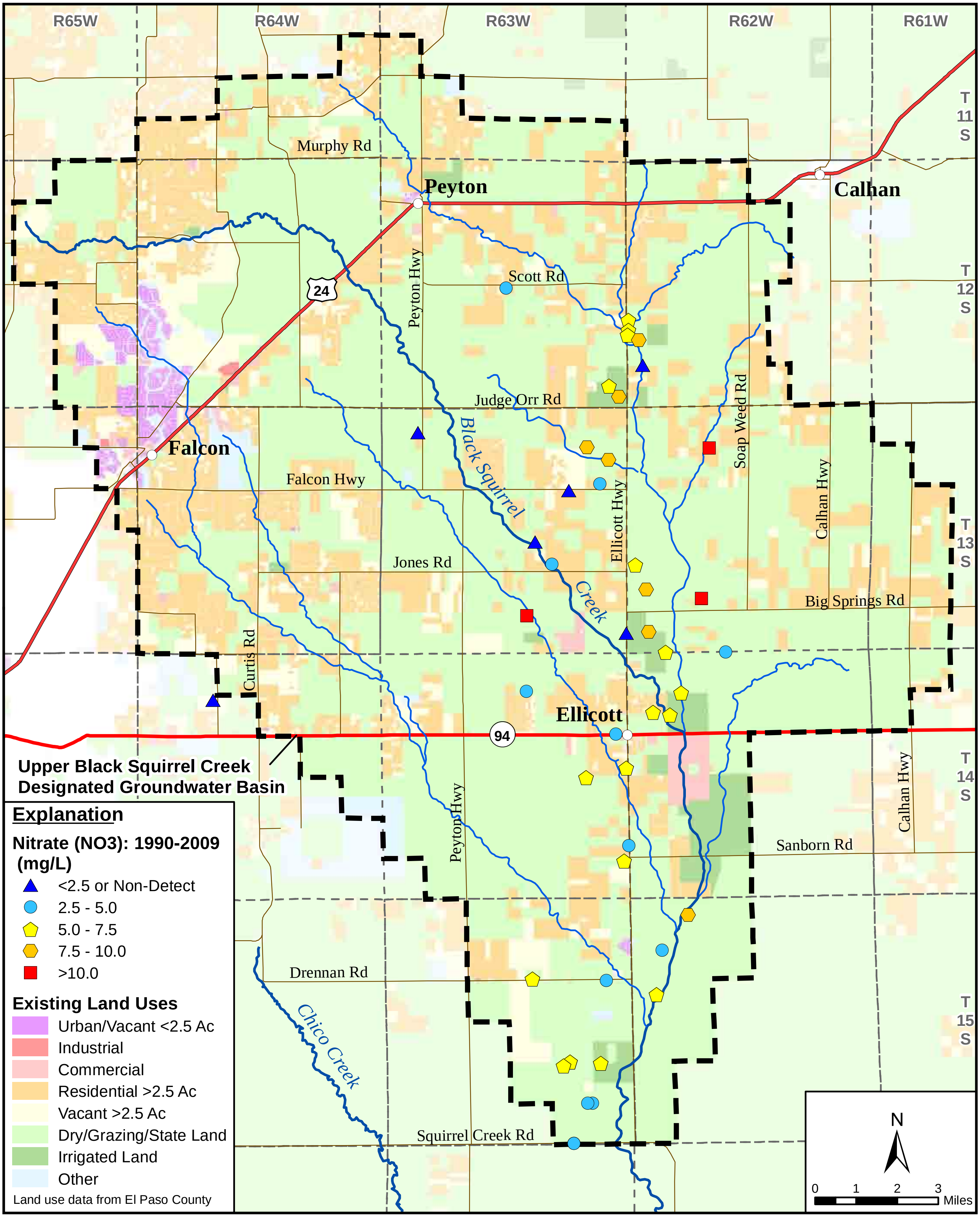

Figure 6.1 Relationship of Nitrate Concentrations to Existing Land Use

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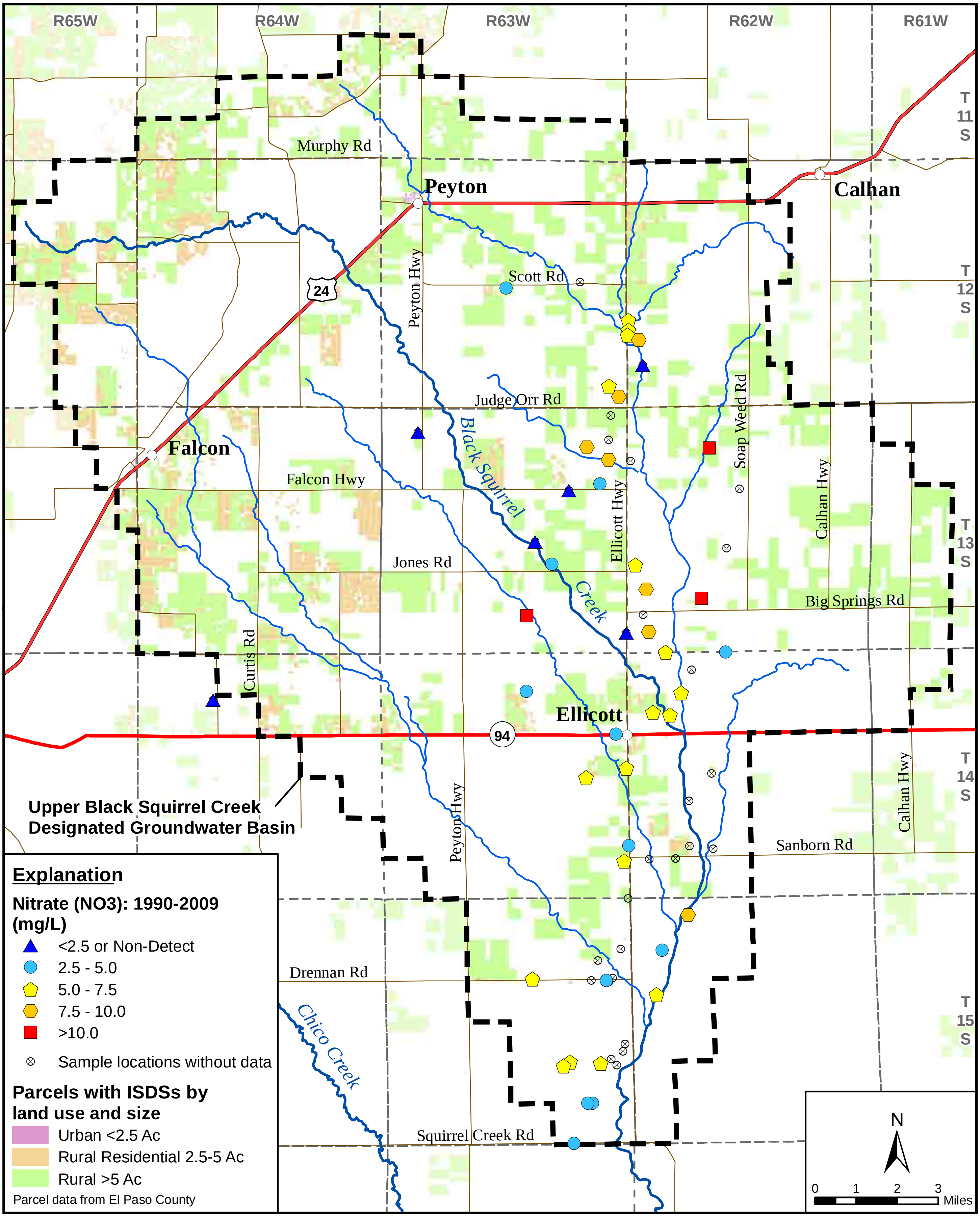

Figure 6.2 Relationship of Nitrate Concentrations with Parcels Containing ISDSs

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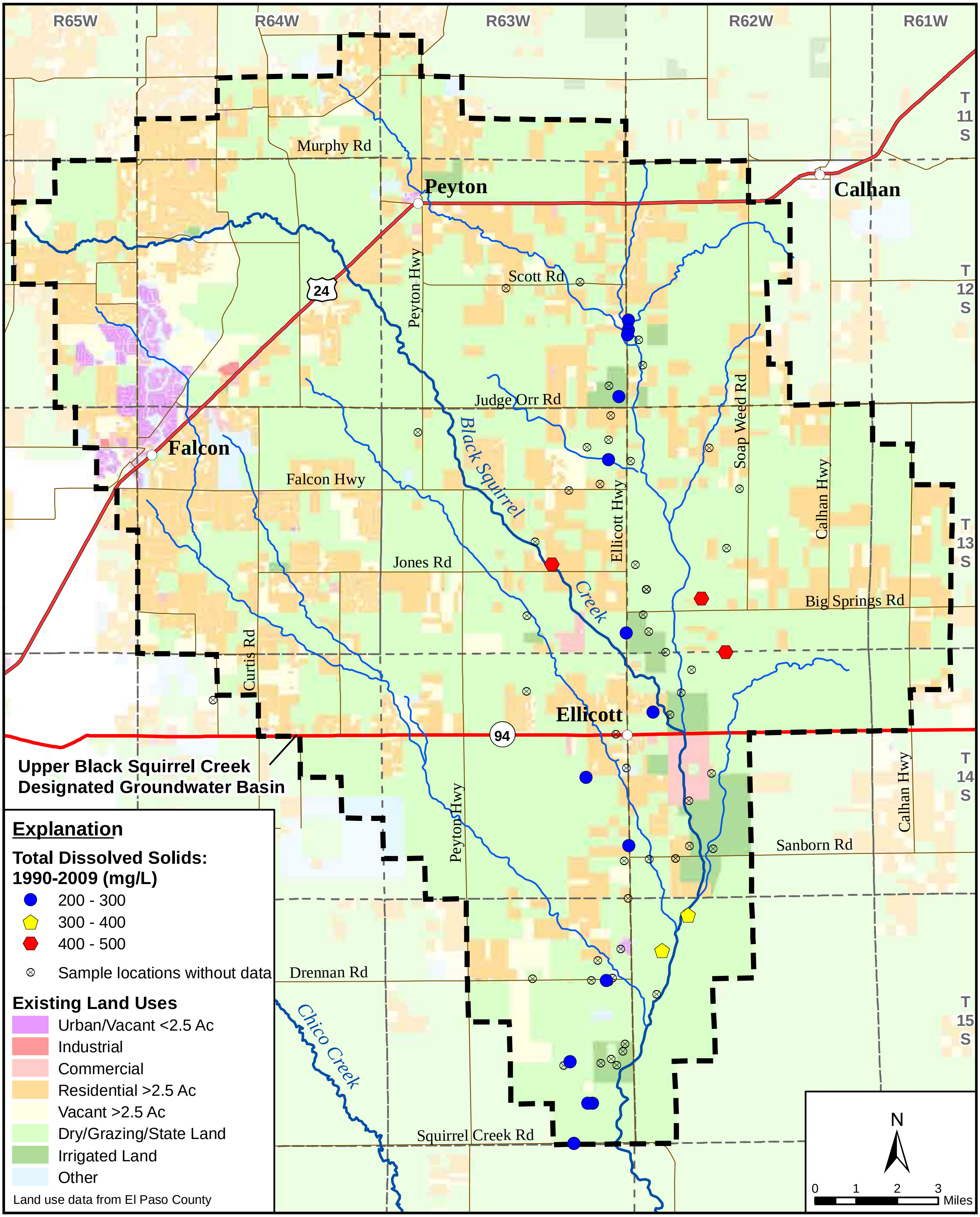

Figure 6.3 Relationship of Total Dissolved Solids Concentrations to Existing Land Use

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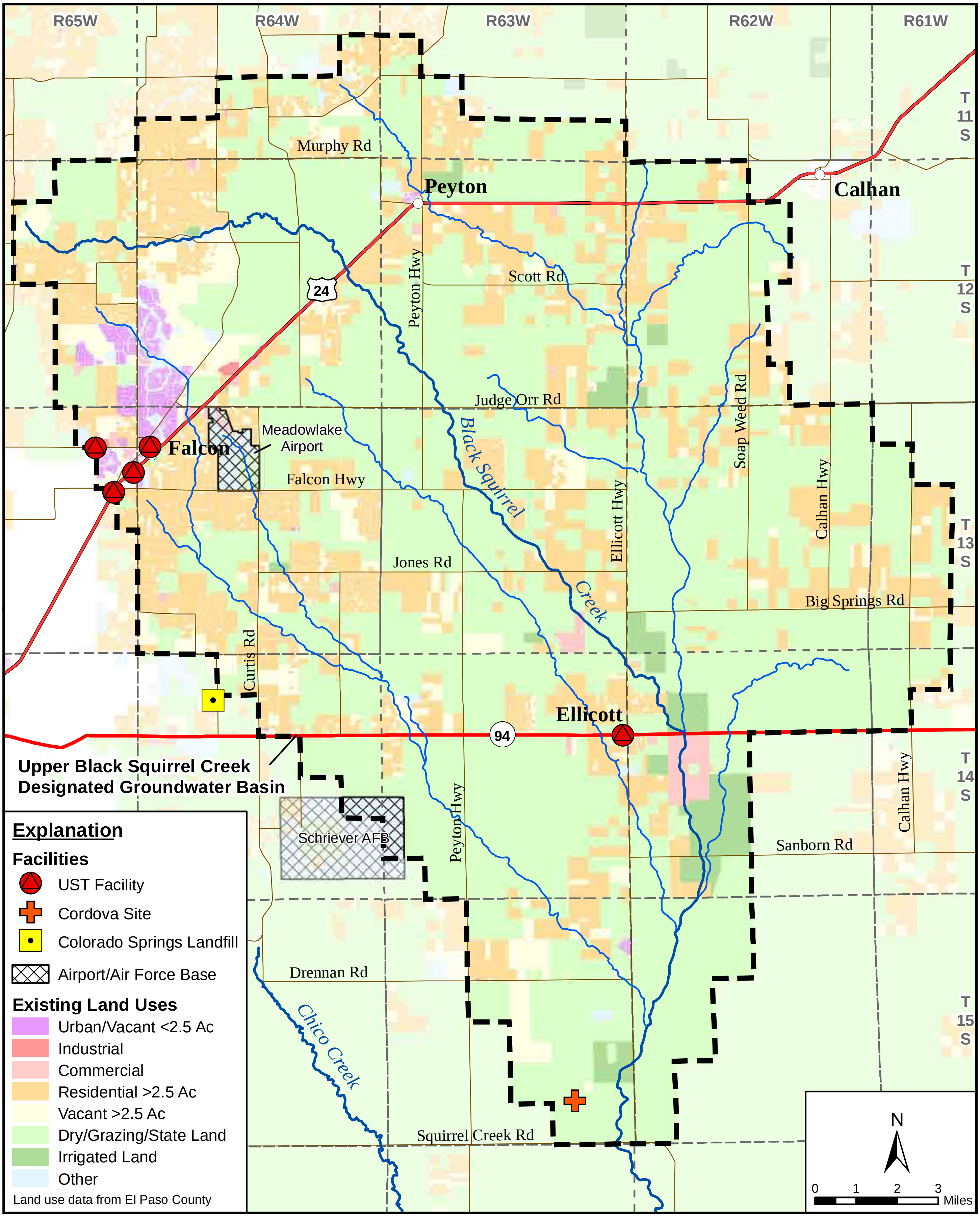

Figure 6.4 Select Facilities in the Upper Black Squirrel Creek Basin

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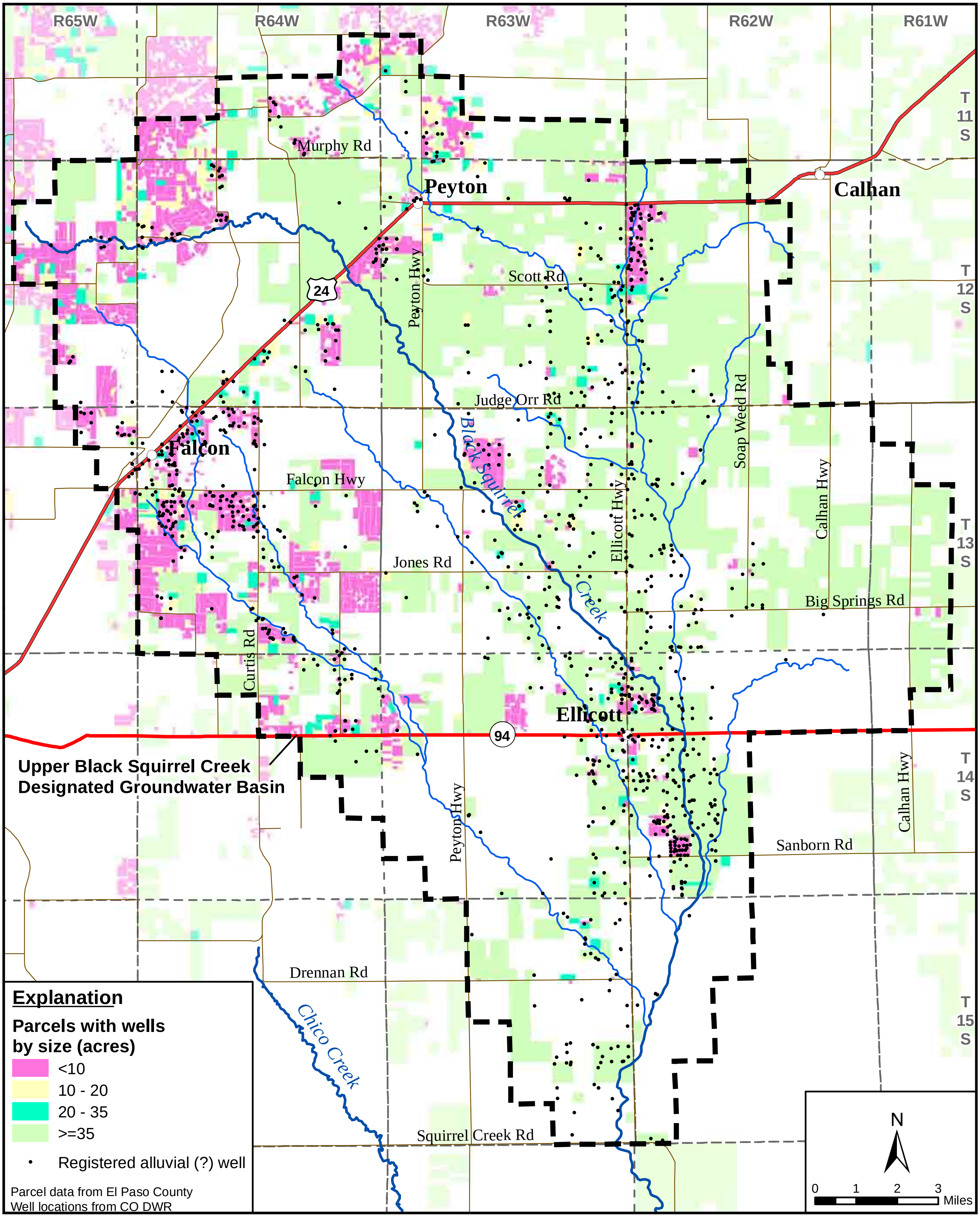

Parcel data from El Paso County
Well locations from CO DWR

Figure 6.5 DWR Well Locations and Parcels Listed with Wells

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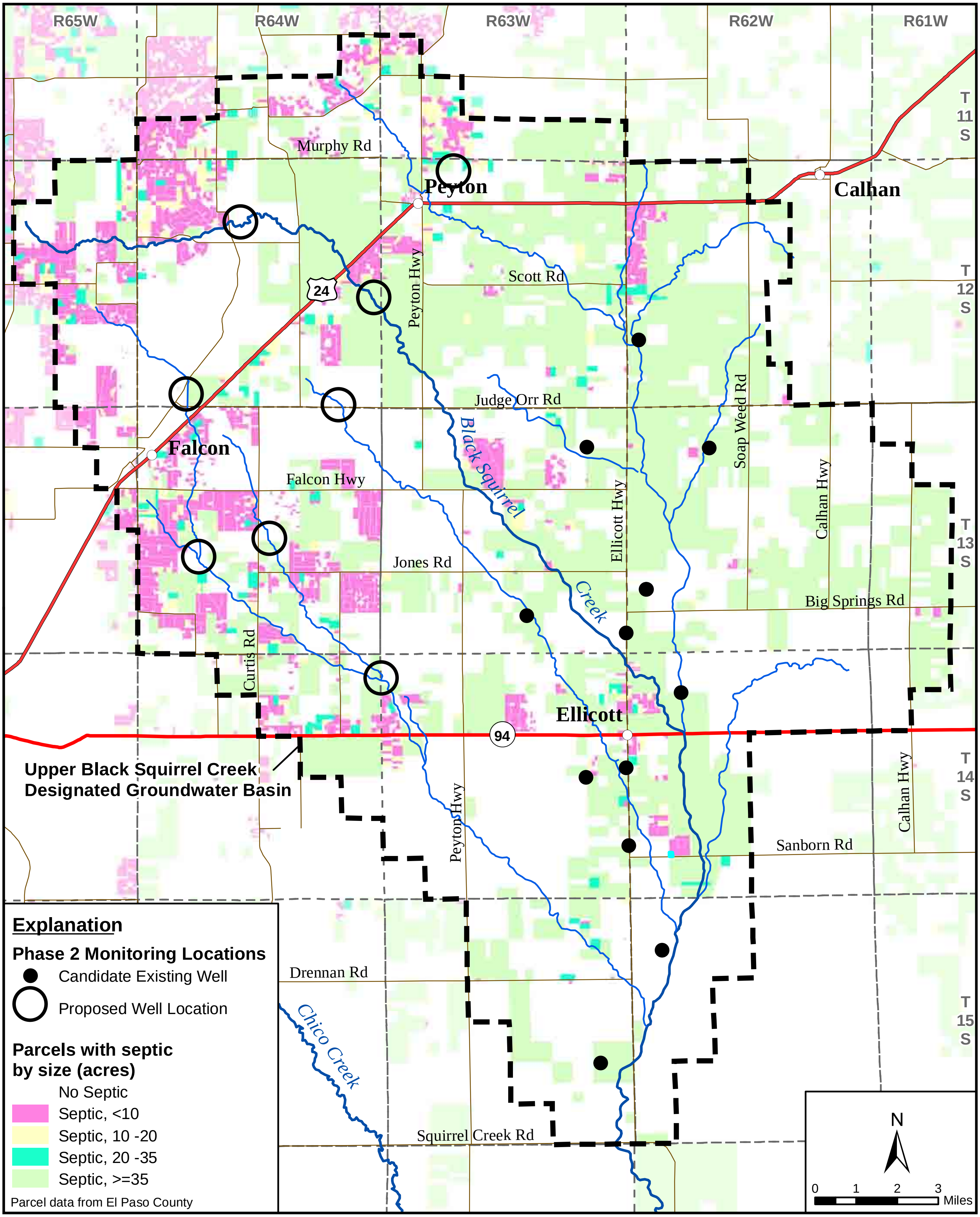

Figure 7.1 Proposed Phase 2 Monitoring Locations

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Appendix A

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

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Appendix A
Bureau of Land Management Well Identification System
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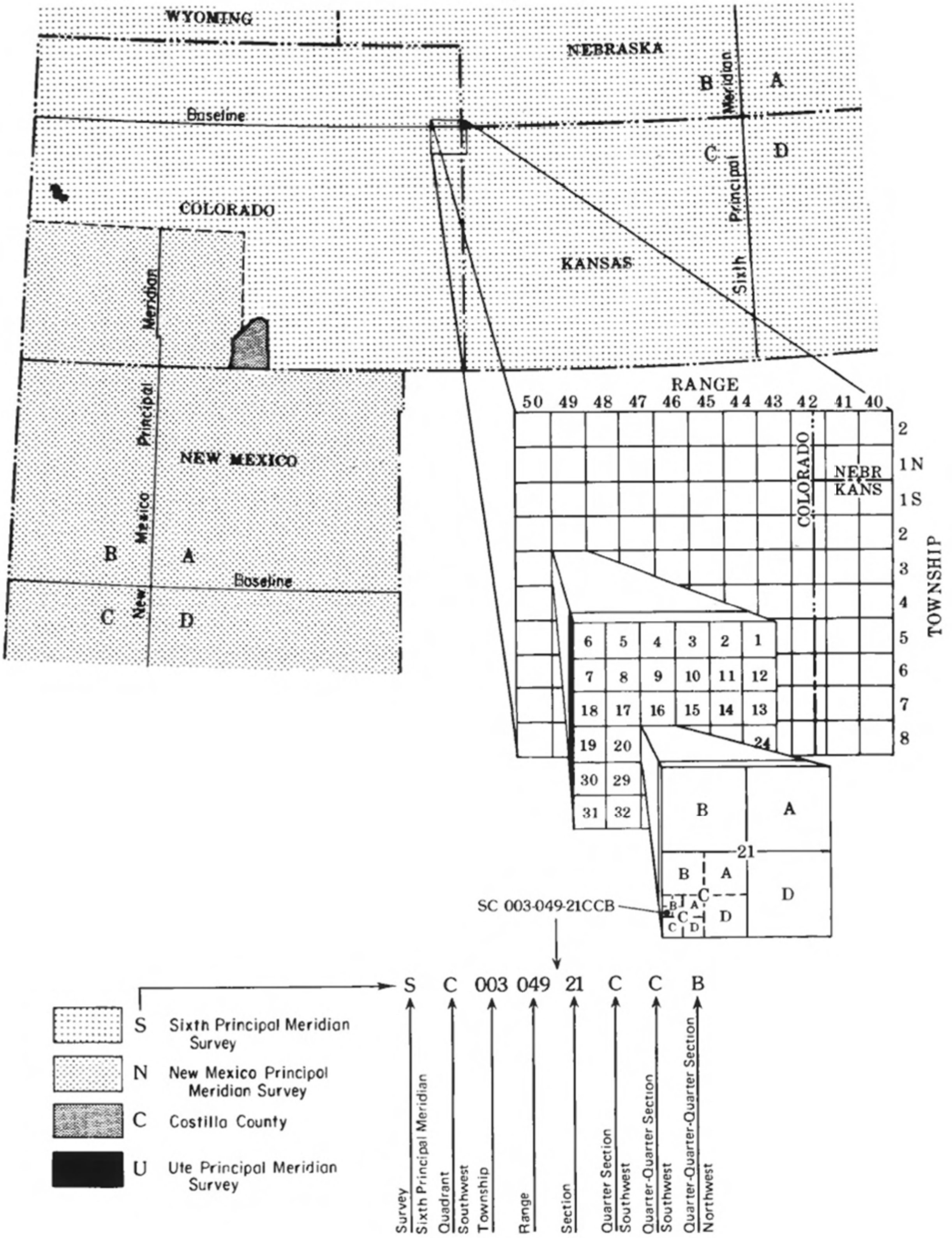

Appendix B

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

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
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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Appendix C, Table 2
El Paso County Groundwater Quality Study

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

Appendix C, Table 2
El Paso County Groundwater Quality Study

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
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

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					

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)
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

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

Appendix C, Table 4
El Paso County Groundwater Quality Study

General Groundwater Chemistry Data

								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									

								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)
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									

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General Groundwater Chemistry Data

								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)
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									

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General Groundwater Chemistry Data

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)
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

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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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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

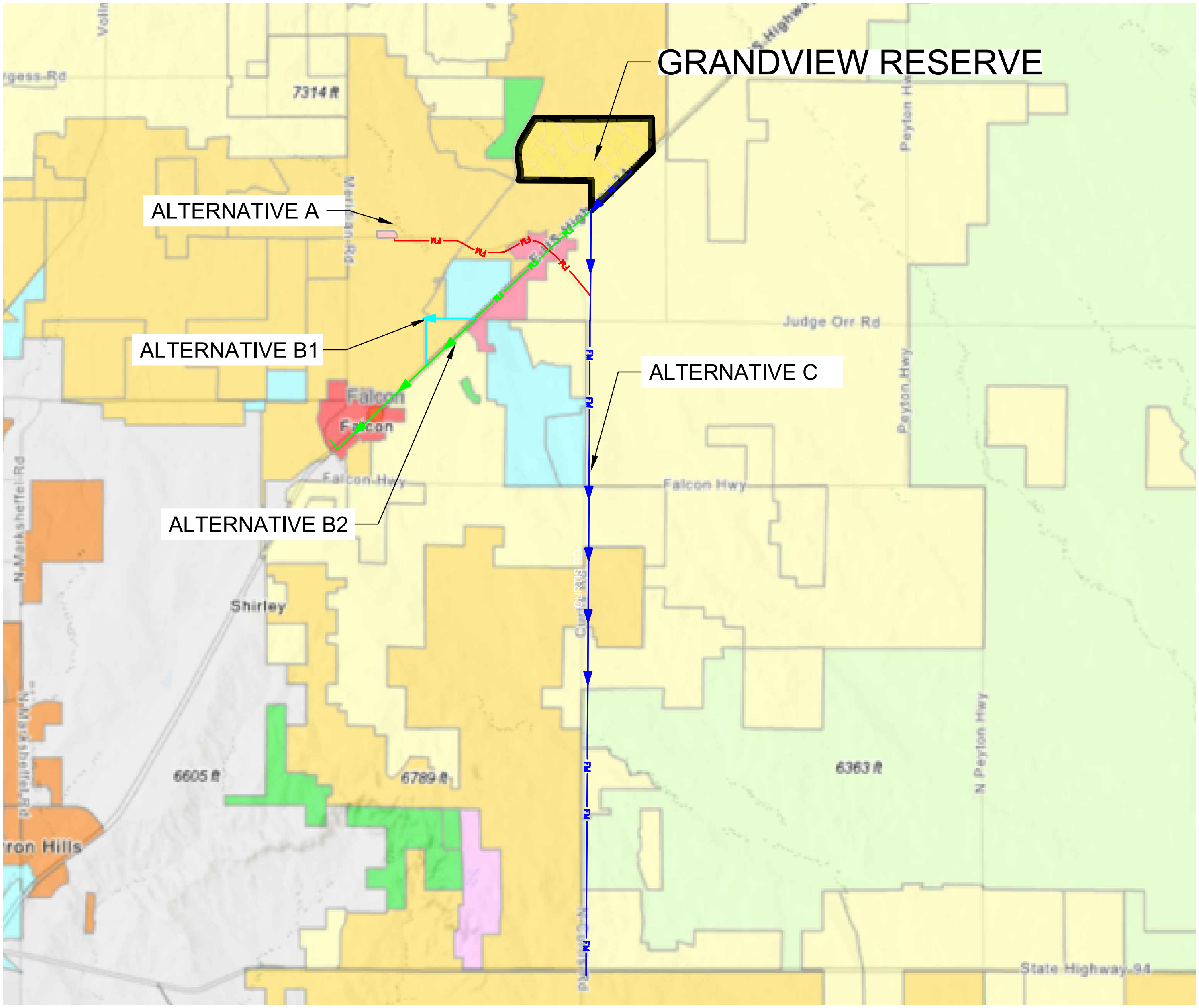
—▶—▶—▶—▶—▶—

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

HRGreen.com

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

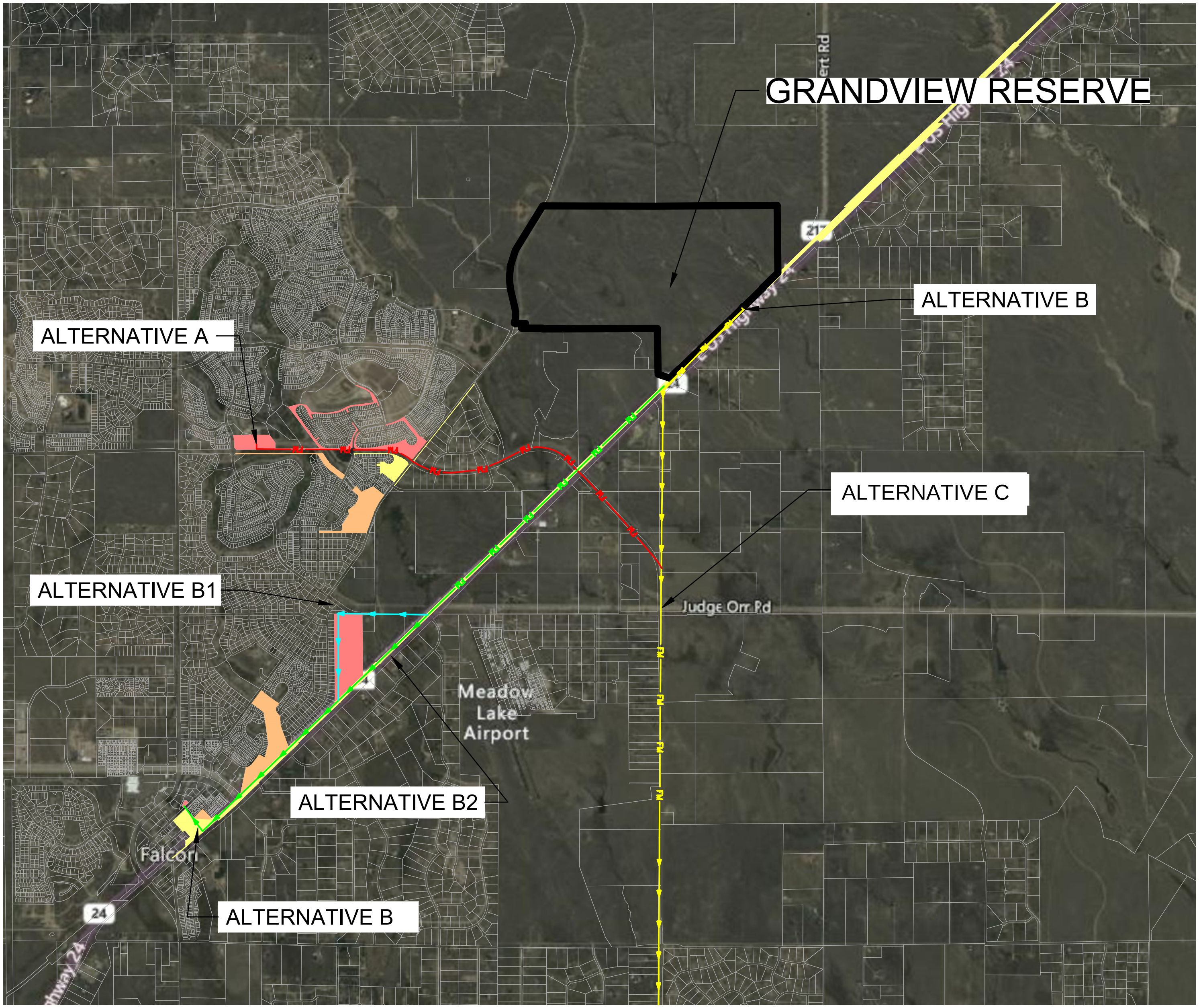
PROPOSED GRAVITY LINE

PROPOSED DUAL FORCEMAINS

—— FM —— FM —— FM ——

PUBLICLY OWNED PARCELS:

🟨	EL PASO COUNTY
🟥	MERIDIAN SERVICE METROPOLITAN DISTRICT
🟧	WOODMEN HILLS METROPOLITAN DISTRICT



HR GREEN Xrefs: xgt-1-AV01; EPC_Parcels

HRGreen

HRGreen.com

GRANDVIEW RESERVE
METROPOLITAN DISTRICT
PUBLIC PARCELS

SHEET
2
SCALE: 1" = 5000'
DATE: 2/20/2023

LEGEND

METRO DISTRICT BOUNDARY

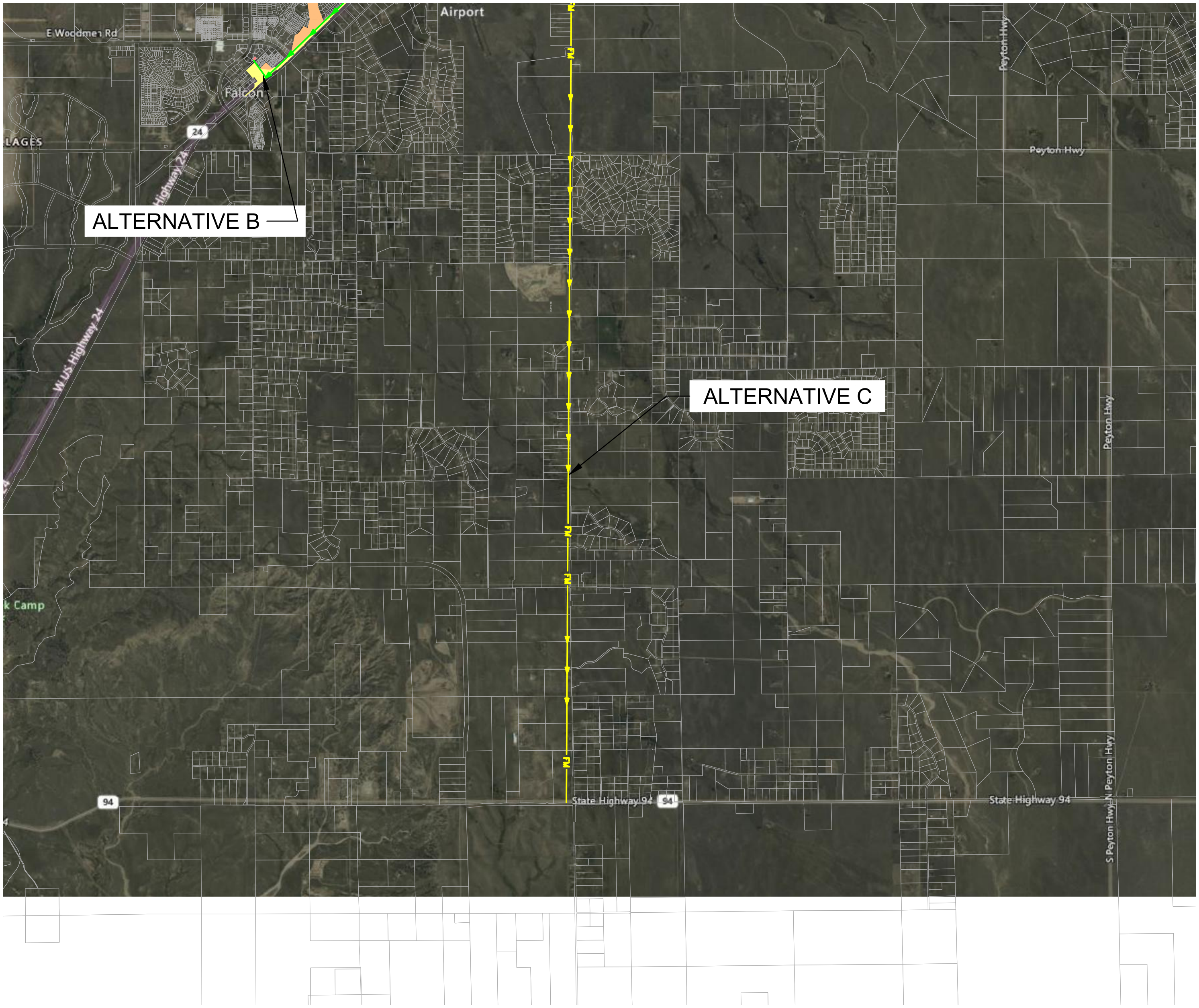
PROPOSED GRAVITY LINE

PROPOSED DUAL FORCEMAINS

FM FM FM

PUBLICLY OWNED PARCELS:

🟨	EL PASO COUNTY
🟧	MERIDIAN SERVICE METROPOLITAN DISTRICT
🟥	WOODMEN HILLS METROPOLITAN DISTRICT



ALTERNATIVE B

ALTERNATIVE C

HRG

HRGreen

HRGreen.com

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

TRANSPORTATION CONSULTANTS, INC.

Grandview Reserve
Master Traffic Impact Analysis
PCD No.: SKP-20-001

(LSC #184840)

September 16, 2020

Traffic Engineer's Statement

This traffic report and supporting information were prepared under my responsible charge and they comport with the standard of care. So far as is consistent with the standard of care, said report was prepared in general conformance with the criteria established by the County for traffic reports.

COLORADO LICENSED PROFESSIONAL ENGINEER
JEFFREY C. HODSDON
31684
9/18/20

Developer's Statement

I, the Developer, have read and will comply with all commitments made on my behalf within this report.

Paul Howard as MNGR:
4 Site Investments LLC

09/17/20
Date

Grandview Reserve

Updated Master Traffic Impact Analysis

Prepared for:
4 Site Investments LLC
1271 Kelly Johnson Boulevard, Suite 100
Colorado Springs, CO 80920

Contacts: Mr. Paul Howard & Mr. Peter Martz

SEPTEMBER 16, 2020

LSC Transportation Consultants, Inc.

Prepared by: Jeffrey C. Hodsdon, P.E. and Kirstin D. Ferrin, P.E.

LSC #184840

CONTENTS

Tables 2-5

Appendix Table 1

Figures 1-13

Appendix Map - 2040 MTCP Roadway Plan

MTCP Maps

MTCP-Adopted-Report-12-6-2016

    Map 15 Bicycle and Pedestrian Network Improvements

NCHRP Report 684 Internal Trip Capture Estimation Tool

PPACG Model Output

Traffic Count Reports

Colorado Department of Transportation Straight Line Diagram

Level of Service Reports

Queuing Reports

MSTA School Traffic Calculations

Memorandum RE: Request for Amendment to the US Highway 24 Access Control Plan Modification to the Rex Road Intersection Location with Grandview Estates

TRANSPORTATION
CONSULTANTS, INC.

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

September 16, 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
PCD No.: SKP-20-001
LSC #184840

Dear Peter:

In response to your request, LSC Transportation Consultants, Inc. has prepared this updated 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 (US Hwy 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; and
- 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. The previous area studies generally assumed Rex Road would not extend from Eastonville Road to US Hwy 24 in the 20-year horizon as is now planned. The previous studies also assumed fewer dwelling units on this site.

LAND USE AND ACCESS

Site Plan

Figure 2 shows the proposed Grandview Reserve sketch plan. Phase 1 of the development is planned to include up to 1,585 lots for single-family homes in Parcels I, J, K, and L. Buildout of Phase 1 is anticipated to be completed in five to seven years. At buildout, the site is planned to be developed with up to 3,260 residential dwelling units, 17 acres of commercial uses, a school site, and a church. This report assumes full buildout of the site by 2040.

Site Access

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. Based on the criteria contained in the El Paso County *Engineering Criteria Manual* (ECM), the required intersection spacing for an Urban Minor Arterial is ¼ mile (1,320 feet). Additional access may be permitted, if entering sight distance requirements are met. Both proposed site access points to Eastonville Road meet the intersection spacing criteria. The spacing of the proposed residential collector between Eastonville Road and US Hwy 24 meets the ¼ mile spacing criteria. However, the intermediary access points are all less than ¼ mile apart. Intersection and stopping sight distance should be evaluated at the PUD, Preliminary Plan, and/or subdivision level, as applicable. The roads and access points shown in the Sketch Plan are conceptual and may change during the subdivision process.

Pedestrian and Bicycle Accommodations

There are two existing school sites located within two miles of the site, Falcon High School and Meridian Ranch Elementary. A future K-8 school is planned just north of Falcon High School. These schools are located north of Londonderry Drive and west of Eastonville Road. There is also a regional park located just west of the site.

The likely pedestrian path to the school and park sites is Eastonville Road to Londonderry Drive. There are currently sidewalks and school crossings on Londonderry Drive. There are currently no sidewalks on Eastonville Road. However, the *2016 Major Transportation Corridors Plan* (MTCP) shows a proposed primary regional trail along this corridor. Figure 2 shows the proposed trails within the Grandview Reserve development. Detailed pedestrian plans for the internal school and connections to the schools mentioned above should be evaluated at the Preliminary Plan/PUD/subdivision level.

The Rock Island Regional Trail extends southwest to northeast along the US Highway 24 site frontage (on the north side of the highway).

ROADWAY AND TRAFFIC CONDITIONS

Area Roadways

The major roadways in the site's vicinity are shown in 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* (CPP) 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. Eastonville Road is currently unpaved north of Londonderry Drive. Pikes Peak Rural Transportation Authority (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. The posted speed limit on Rex Road is 45 mph between Meridian

Road and Mt. Gateway Drive and 35 mph east of Mt. Gateway Drive. The future section of Rex Road between Eastonville Road and US Hwy 24 is classified as a 4-Lane Minor Arterial roadway on the *2016 MTCP 2060 Corridor Preservation Plan* (CPP). The 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 about 4,255 feet south of Elbert Road and 6,407 feet north of Stapleton Drive. This change will require approval from the Colorado Department of Transportation.

- **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 (2018) Traffic Volumes

Figure 3a shows the existing morning and afternoon peak-hour traffic volumes at key intersections in the vicinity of the site. The morning peak hour was assumed to occur for one hour between 6:30 a.m. and 8:30 a.m. The afternoon peak hour was assumed to occur for one hour between 4:00 p.m. and 6:00 p.m. These volumes are based on manual intersection turning-movement counts conducted by LSC in May 2017, November 2018, December 2018, October 2019, and July 2020. The count data sheets are attached for reference.

Turning-movement counts were conducted at the intersection of US Hwy 24/Stapleton at the following times:

- Thursday, November 15, 2018 – 6:30 to 8:30 a.m.
- Wednesday, November 28, 2018 – 4:00 to 6:00 p.m.

Turning movement counts were conducted at the intersection of Eastonville/Stapleton at the following times:

- Thursday, May 23, 2017 – 6:30 to 8:30 a.m.
- Thursday, May 11, 2017 – 4:00 to 6:00 p.m.

Turning movement counts were conducted at the intersection of Eastonville/Londonderry at the following times:

- Tuesday, December 11, 2018 – 6:30 to 8:30 a.m.
- Tuesday, December 11, 2018 – 4:00 to 6:00 p.m.

Turning movement counts were conducted at the intersection of Eastonville/Judge Orr at the following times:

- Wednesday, October 2, 2019 – 6:30 to 8:30 a.m.
- Wednesday, October 2, 2019 – 4:00 to 6:00 p.m.

Turning movement counts were conducted at the intersection of Eastonville/McLaughlin at the following times:

- Tuesday, July 30, 2020 – 6:30 to 8:30 a.m.
- Tuesday, July 30, 2020 – 4:00 to 6:00 p.m.

Figure 3a 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, assuming the afternoon peak hour represents 11 percent of the daily traffic volume. This is based on the design-hour volume on US Hwy 24 adjacent to the site. The design-hour volume is the 30th highest annual hourly traffic volume reported as a percentage of the average annual daily traffic volume. A copy of the CDOT data for US Hwy 24 adjacent to the site has been attached.

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 sec or less	10 sec or less
B	10-20 sec	10-15 sec
C	20-35 sec	15-25 sec
D	35-55 sec	25-35 sec
E	55-80 sec	35-50 sec
F	80 sec or more	50 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 3b 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 peak-hour factors used for each approach are based on the traffic volumes for the peak fifteen minutes of the entire intersection. If the peak 15 minutes for an approach occurs during an interval other than the peak 15 minutes of the entire intersection, the suggested peak-hour value based on the total approach volume from Table 9-1 of the Synchro Studio 10 User Guide was used instead. The level of service reports are attached.

US Hwy 24/Stapleton

The southeast-bound left-turn and through movements and the northwest-bound 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 morning peak hour. The southeast-bound left-turn movement and the northwest-bound through movement are currently operating at LOS F during the afternoon peak hour.

Eastonville/Stapleton

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.

Eastonville/Londonderry

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.

Eastonville/Meridian Ranch/Judge Orr

All movements at the all-way, stop-sign controlled intersection of Eastonville/Meridian Ranch/Judge Orr are currently operating at LOS C or better during the peak hours.

Eastonville/McLaughlin

All movements at the two-way, stop-sign controlled intersection of Eastonville/McLaughlin are currently operating at LOS D or better during the peak hours.

SHORT-TERM (YEAR 2028) 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 4a shows the projected background traffic volumes one year following the anticipated buildout of Phase 1 (2028).

The addition of new roadways (notably the completion of Lambert Road between Stapleton Drive and Londonderry Drive and the completion of Rex Road between Meridian Road and Eastonville Road) will greatly impact the existing traffic patterns. In lieu of a general/"blanket" growth rate, LSC has developed small area traffic models for Meridian Ranch, Waterbury, and the Trails as part of previous work completed in the area. The results of these modeling efforts have been combined to estimate the background traffic volumes. These background traffic volumes have been based on the existing traffic volumes (from Figure 3a) plus increases in traffic due to regional growth, including buildout of the following subdivisions in the vicinity of the site:

- The existing and currently proposed subdivisions within Waterbury (located just south of the Grandview Reserve);
- Meridian Ranch Filings 1-3 and Filings 6-8;
- Meridian Ranch Estates Filings 2-3;
- Meridian Ranch Filing 11;
- Stonebridge at Meridian Ranch 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.

Increases in through traffic on US Hwy 24 were estimated based a yearly growth rate of 2 percent per year. This growth rate was calculated from the CDOT 20-year growth factor for US Hwy 24 adjacent to the site. 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.

Figure 3b shows the lane geometry, traffic control, and level of service at the key area intersections, based on the short-term background volumes.

2040 BACKGROUND TRAFFIC

Figure 5a 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 2040 traffic volumes shown in the PEL were based on the PPACG traffic demand model. The projected volume on US Hwy 24 adjacent to the site was shown to increase from 9,500 vehicles per day to 23,000 vehicles per day. This represents a 20-year growth rate of about 4.5 percent per year. The background traffic scenarios hypothetically assume Rex Road through the site, but the background traffic scenarios include only the non-site traffic. In general, through traffic volumes and volumes to and from Curtis Road were based on the PEL report and all other background volumes were based on previous work completed by LSC. The 2040 background traffic volumes do not include traffic from Grandview Reserve.

Figure 5b shows the lane geometry, traffic control, and level of service at the key area intersections, based on the 2040 background volumes.

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. It is currently unknown if the school site will be developed as a neighborhood school, a charter school, or some other type of educational use. To be conservative (at the request of County staff), the trip generation estimate for the school site was based on the ITE trip generation rates for a private K-8 school for the daily traffic volumes and the afternoon peak hour. The morning trip generation estimate was calculated using the Municipal and School Transportation School Traffic Calculator provided by the Traffic Management Unit, Transportation Mobility and Safety Division of Highway, North Carolina Department of Transportation.

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 10 percent of the school trips were also assumed to be internal to the site. The internal trip reduction assumes the school site is developed as a charter school with a small percentage of the students coming from the Grandview Reserve neighborhood.

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 in 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. This phase is estimated to be completed in five to seven years. The short-term horizon year of 2028 was selected to occur one year after buildout. 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 32,240 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 970 vehicles would enter and 2,033 vehicles would exit the site. During the afternoon peak hour, about 2,201 vehicles would enter and 1,450 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' (PPACG) 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. An initial trip distribution estimate based on data from the PPACG travel demand model was calculated by running a select zone analysis for the zone that includes this site (661) and a nearby zone that includes more retail uses (637) and then comparing those results to the 2040 model volumes. Engineering judgement and LSC estimates were then applied using the other factors listed to modify these percentages. The PPACG model output is attached.

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 9a shows the projected short-term (Year 2028) total traffic volumes. The short-term total traffic volumes are the sum of the short-term background traffic volumes (from Figure 4a) plus the Phase 1 site-generated traffic volumes (from Figure 7).

Figures 9b-9d show the lane geometry, traffic control, and level of service at the key area intersections, based on the short-term (Year 2028) total volumes.

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

Figures 10b-10e show the lane geometry, traffic control, and level of service at the key area intersections, based on the short-term (Year 2028) total volumes.

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. Based on the criteria contained in the ECM, a peak hour factor of 0.85 was used for the short-term (Year 2028) analysis except for those intersections whose existing peak hour factor calculated from traffic counts conducted by LSC was higher than 0.85. In those cases, the existing peak hour factor was used. A peak hour factor of 0.95 was used for the long-term (Year 2040) analysis, except for the southbound through traffic on US Hwy 24 during the morning peak hour and the northbound through traffic on US Hwy 24 in the afternoon peak hour. Based on the existing peak hour factor and high traffic volumes projected for these movements, a future peak hour factor of 0.98 was used. The results of the analysis are contained in Figures 4b, 5b, 9b-9d, and 10b-10e. 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 southeast bound left-turn movement at the intersection of Rex/US Hwy 24 is projected to operate at LOS D during the morning peak hour and LOS E during the afternoon peak hour, based on the projected short-term total traffic volumes. The analysis assumes the intersection is a stop sign-controlled "T" intersection with left-turn and right-turn deceleration and acceleration lanes on US Hwy 24. 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 morning peak hour. 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 afternoon peak hour, 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. To maintain an overall LOS D or better as a “conventional” four-leg signalized intersection, it would be necessary to provide three through lanes in all directions. 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.

Judge Orr/Meridian Ranch/Eastonville

The intersection of Judge Orr/Meridian Ranch/Eastonville is currently all-way, stop sign-controlled. The level of service for several of the approach lanes are projected to degrade to LOS E or LOS F during the peak hours, based on the projected 2028 background traffic volumes. If this intersection were to be converted to traffic-signal control, all movements are projected to operate at LOS D or better during peak hours, based on the projected 2028 and 2040 total traffic volumes

McLaughlin/Eastonville

The intersection of McLaughlin/Eastonville is currently two-way, stop-sign controlled. Based on the projected 2028 background afternoon peak-hour traffic volumes, the northbound left-turn movement is projected to operate at LOS F and the northbound through and right-turn lane and the southbound approach are projected to operate at LOS E. If this intersection were to be converted to traffic-signal control, all movements are projected to operate at LOS D or better during peak hours based on the projected 2028 and 2040 total traffic volumes.

QUEUING ANALYSIS

A queuing analysis was performed using Synchro/SimTraffic for Rex Road between Eastonville and US Hwy 24. The 2040 total morning and afternoon peak-hour traffic volumes were entered into the Synchro model. Each simulation was run five times and the results were averaged. Please refer to the attached SimTraffic queuing reports for queuing results for intersection numbers 1, 6, 8, and 9.

The projected maximum northeast-bound left-turn queue on US Hwy 24 approaching Rex Road is 238 feet during the morning peak hour and 549 feet during the afternoon peak hour.

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 “cursory”/planning-level analysis has been provided at the Sketch Plan level, as previous reports completed by LSC in the area indicate that these intersections may be close to meeting Traffic-Signal Warrant(s). Detailed analysis of all applicable signal warrants should be evaluated with each Preliminary Plan or Subdivision plan submitted. 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 3 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 met, based on the projected short-term (Year 2028) total traffic volumes.

Stapleton/US Hwy 24

Table 4 shows the signal warrant analysis for the intersection of Stapleton/US Hwy 24, based on the existing traffic volumes. 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. A fourth hour is projected to meet the thresholds based on the short-term (Year 2028) background traffic volumes.

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.

Figure 13 shows a comparison of the projected average weekday traffic volume (ADT) and the design ADT from the ECM for the key street segments in the vicinity of the site.

The projected ADT volume on Rex Road is about 13,695 vehicles per day (vpd) just east of Eastonville Road and about 21,955 vpd just west of US Hwy 24. The design ADT for an Urban Minor Arterial is 20,000 per day.

The projected average weekday traffic volume (ADT) on Eastonville Road is about 22,100 vpd just north of Stapleton Drive. The design ADT for an Urban Minor Arterial is 20,000 per day.

MULTI-MODAL AND PEDESTRIAN/BIKE TRANSPORTATION

- A park n’ ride facility is planned for a site near Meridian 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.

TRANSPORTATION IMPROVEMENT FEE PROGRAM

The Grandview Reserve development will be required to participate in the Countywide Transportation Improvement Fee Program. The fees will be determined at the subdivision stage and payable following plat recording and/or building permit issuance.

CONCLUSIONS AND RECOMMENDATIONS

Trip Generation

- At buildout, Grandview Reserve is expected to generate about 32,240 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 970 vehicles would enter and 2,033 vehicles would exit the site. During the afternoon peak hour, about 2,201 vehicles would enter and 1,450 vehicles would exit the site.

Required Improvements

Table 5 contains a summary of the recommended improvements.

Traffic Signals

- This Master TIS identifies intersections potentially needing traffic signal (or roundabout) control in the future. Several key area intersections including Eastonville/Stapleton, US Hwy 24/Stapleton, Eastonville/Meridian Ranch/Judge Orr, and Eastonville/McLaughlin are projected to operate at LOS E or F for some movements in the short-term, if these intersections remain stop sign-controlled. As the Grandview Reserve subdivision develops, evaluation of these intersections will occur with each Preliminary Plan/plat submittal. Each study, as applicable, would project if, based on short-term baseline plus site-generated traffic projections, a signal(s) would likely be warranted or would be close to meeting warrants. Studies would estimate timing, based on occupied dwelling units, and subsequently recommend a monitoring program for traffic volumes, crash history, and other factors such that a signal construction could commence once warrants are met, based on actual data in the field. Following the acceptance of the final plat traffic report finding that a signal is likely to meet warrants in the short term, the applicant will begin the design plans for the traffic control signal(s) and obtain County approval. Therefore, once warrants are met in the field, the signal(s) can be installed. The study should make a recommendation regarding the timing for placing order(s) for materials such as signal poles, which may have long lead times.

Auxiliary Turn Lanes

- Based on the short-term total traffic volumes shown in Figure 9a 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 (including 600 feet of stacking distance) plus a 300-foot taper, for a total speed change lane length of 1,700 feet. In the future, it will be necessary to provide dual eastbound left-turn lanes. Based on the queueing analysis of the intersection of Rex Road/US Hwy 24, 600 feet of stacking distance will be adequate for the projected maximum northeast-bound left-turn queue.

- Based on the short-term total traffic volumes shown in Figure 9a 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 plus a 300-foot taper, for a total speed change lane length of 1,680 feet.

- Based on the short-term total traffic volumes shown in Figure 9a 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 plus a 300-foot taper, for a total speed change lane length of 1,100 feet.

- 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 US Hwy 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 plus a 300-foot taper, for a total speed change lane length of 1,680 feet. 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 10a 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 right-turn and left-turn deceleration lanes approaching all access points and intersections.

- Based on the 2040 total traffic volumes shown in Figure 10a 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.

Access Control Plan Modification

- A request for a change to the US Highway 24 Access Control Plan, to allow the location of Rex/US Hwy 24 as shown in Figure 2, has been submitted to CDOT as per meetings with and direction from EPC and CDOT. A copy of the memorandum has been attached.

* * * * *

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 2-5
Appendix Table 1
Figures 1-13
Appendix Map - 2040 MTCP Roadway Plan
MTCP Maps
MTCP-Adopted-Report-12-6-2016
    Map 15 Bicycle and Pedestrian Network Improvements
NCHRP Report 684 Internal Trip Capture Estimation Tool
PPACG Model Output
Traffic Count Reports
Colorado Department of Transportation Straight Line Diagram
Level of Service Reports
Queuing Reports
MSTA School Traffic Calculations
Memorandum RE: Request for Amendment to the US Highway 24 Access
    Control Plan Modification to the Rex Road Intersection Location
    with Grandview Estates

Tables

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Table 2
Trip Generation Estimate
Grandview Reserve

			Trip Generation Rates (1)					Total Trips Generated					Internal Trips Generated[2]					External Trips Generated						New External Trips Generated
Land Use Code	Land Use Description	Trip Generation Units	Average Weekday Traffic	Morning Peak Hour In	Morning Peak Hour Out	Afternoon Peak Hour In	Afternoon Peak Hour Out	Average Weekday Traffic	Morning Peak Hour In	Morning Peak Hour Out	Afternoon Peak Hour In	Afternoon Peak Hour Out	Average Weekday Traffic	Morning Peak Hour In	Morning Peak Hour Out	Afternoon Peak Hour In	Afternoon Peak Hour Out	Average Weekday Traffic	Morning Peak Hour In	Morning Peak Hour Out	Afternoon Peak Hour In	Afternoon Peak Hour Out	Pass-By Trips (3)	Average Weekday Traffic
Short-Term Trip Generation Estimate																								
210	Single-Family Detached Housing	1,585 DU[4]	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																								
534	Private School (K-8)[5]	500 Students	4.11	- - -	- - -	0.12	0.14	2,055	292	226	60	70	206	29	11	3	7	1,849	263	215	57	63	0%	1,849
820	Shopping Center	133 KSF[6]	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	3,260 DU	7.87	0.18	0.53	0.56	0.33	25,651	580	1,740	1,815	1,066	0	0	0	0	0	25,651	580	1,740	1,815	1,066	0%	25,651
		3,260 DU						**35,323**	**1,017**	**2,056**	**2,207**	**1,497**	**805**	**47**	**23**	**6**	**47**	**34,518**	**970**	**2,033**	**2,201**	**1,450**		**32,240**

Notes:

(1) Source: "Trip Generation, 10th Edition, 2017" by the Institute of Transportation Engineers (ITE). The trip generation rates shown were calculated using on the fitted curve equations.

(2) Internal trips to and from the commercial parcels were based on the attached NCHRP 684 Internal Trip Capture Estimation Tool. About 10 percent 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) The morning peak hour trips for the school site was estimated using the Municipal and School Transportation School Traffic Calculator provided by the Traffic Management Unit, Transportation Mobility and Safety Division of Highway, North Carolina Department of Transportation (see attached).

(6) DU = dwelling unit

Source: LSC Transportation Consultants, Inc.

July 2020

Table 3
Grandview Reserve
Traffic Signal Warrant Analysis of Eastonville/Stapleton
Peak-Hour Four-Hour Vehicular Volume Evaluation

Time	2017 Traffic Volumes						2028 Background Traffic						2028 Total Traffic					
	2017 Traffic Volumes(1)			Warrant 2, Four-Hour Vehicular Volume Evaluation(2)			2028 Background Traffic Volumes(3)			Warrant 2, Four-Hour Vehicular Volume Evaluation			2028 Total Traffic Volumes(3)			Warrant 2, Four-Hour Vehicular Volume Evaluation		
		Minor		Minor St	EB	WB		Minor		Minor St	EB	WB		Minor		Minor St	EB	WB
	Major(4)	EB(5)	WB(6)	Minimum	Met?	Met?	Major	EB	WB	Minimum	Met?	Met?	Major	EB	WB	Minimum	Met?	Met?
6:30 AM - 7:30 AM	536	101	39	322	No	No	842	381	190	190	**Yes**	**Yes**	1136	419	190	113	**Yes**	**Yes**
7:30 AM - 8:30 AM	155	97	67	513	No	No	394	179	89	393	No	No	532	196	89	324	No	No
3:00 PM - 4:00 PM	- - -	- - -	- - -	- - -	- - -	- - -	543	239	298	319	No	No	787	341	298	207	**Yes**	**Yes**
4:00 PM - 5:00 PM	213	61	119	484	No	No	650	286	357	270	**Yes**	**Yes**	943	408	357	164	**Yes**	**Yes**
5:00 PM - 6:00 PM	215	56	82	483	No	No	588	259	323	296	No	**Yes**	852	369	323	187	**Yes**	**Yes**

Notes:

(1) The volumes are based on manual turning movements counts conducted by LSC in May 2017

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

(3) The 6:30 AM - 7:30 AM and 7:30 AM - 8:30 AM volumes are based on the projected AM peak hour volumes times the ratio of the same time period from the 2017 count and the AM peak hour (6:35 AM -7:35 AM) from the 2017 count
The 4:00 PM - 5:00 PM and 5:00 P-M - 6:00 PM volumes are based on the projected PM peak hour volumes times the ratio of the same time period from the 2017 count and the PM peak hour (4:30 PM -5:30 PM) from the 2017 count
The 3:00 PM - 4:00 PM volumes are based on 80% of the projected PM peak hour volumes. This is an estimate by LSC based on the hourly distribution of entering and exiting vehicle trips by land use published by the Institute of Transportation Engineers (ITE) in August 2018 for Single-Family Detached Housing

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

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

(6) 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 4
Grandview Reserve
Traffic Signal Warrant Analysis of Stapleton/US Hwy 24
Peak-Hour Four-Hour Vehicular Volume Evaluation

	2018 Traffic Volumes[1]			Warrant 2, Four-Hour Vehicular Volume Evaluation[2]			2028 Background Traffic Volumes[3]			Warrant 2, Four-Hour Vehicular Volume Evaluation			2028 Total Traffic Volumes[3]			Warrant 2, Four-Hour Vehicular Volume Evaluation		
		Minor		Minor St	SEB	NWB		Minor		Minor St	SEB	NWB		Minor		Minor St	SEB	NWB
Time	**Major[4]**	**SEB[5]**	**NWB[6]**	**Minimum**	**Met?**	**Met?**	**Major**	**SEB**	**NWB**	**Minimum**	**Met?**	**Met?**	**Major**	**SEB**	**NWB**	**Minimum**	**Met?**	**Met?**
6:30 AM - 7:30 AM	838	166	75	96	**Yes**	No	1,086	215	91	80	**Yes**	**Yes**	1714	215	91	80	**Yes**	**Yes**
7:30 AM - 8:30 AM	691	77	63	143	No	No	883	98	69	84	**Yes**	No	1388	98	69	80	**Yes**	No
3:00 PM - 4:00 PM	802	87	49	105	No	No	1,388	69	106	80	No	**Yes**	2,063	69	106	80	No	**Yes**
4:00 PM - 5:00 PM	882	43	109	85	No	**Yes**	1,571	64	133	80	No	**Yes**	2310	64	133	80	No	**Yes**
5:00 PM - 6:00 PM	932	57	87	80	No	**Yes**	1,538	79	106	80	No	**Yes**	2344	79	106	80	No	**Yes**

Notes:

(1) The volumes are based on manual turning movements counts conducted by LSC in November 2018, except the 3:00-4:00 PM volumes which are an estimate by LSC (see note 3)

(2) Based on 2 or more lanes on the major approach and 2 or more lanes on the minor approach (70% Factor).

(3) The 6:30 AM - 7:30 AM and 7:30 AM - 8:30 AM volumes are based on the projected AM peak hour volumes times the ratio of the same time period from the 2018 count and the AM peak hour (6:45 AM -7:45 AM) from the 2017 count
The 4:00 PM - 5:00 PM and 5:00 P-M - 6:00 PM volumes are based on the projected PM peak hour volumes times the ratio of the same time period from the 2018 count and the PM peak hour (4:45 PM -5:45 PM) from the 2018 count
The 3:00 PM - 4:00 PM volumes are based on 86% of the projected PM peak hour volumes. This is an estimate by LSC based on 48 hour continuous traffic counts conducted by CDOT on US Hwy 24 Northeast of Judge Orr Road in July 2017

(4) The major street volumes include all (left/through/right) movements on US Hwy 24

(5) The SEB minor street volumes include only the easbound left-turn and through movements on Stapleton Dr. The right-turn movements have been excluded

(6) 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.

Table 5
Grandview Reserve
Roadway Improvements

Item #	Improvement	Trigger	Timing	Responsibility
	Roadway Segment Improvements			
1	Eastonville - Stapleton to Latigo final grading and paving	dependent on PPRTA funding priorities	TBD by EPC; PPRTA "A-List" Project	PPRTA
2	Eastonville - Stapleton to Londonderry upgrade to Rural Minor Arterial (per MUTCD)	average daily traffic > 6,000 vehicles per day	dependent on PPRTA funding priorities	PPRTA
3	Eastonville - Londonderry to Latigo upgrade from unimproved roadway to Rural Minor Arterial (per MUTCD)	average daily traffic > 300 vehicles per day	With initial Grandview Reserve filing	PPRTA
4	Eastonville - Stapleton to Grandview Reserve south boundary upgrade to 4-Lane Rural Minor Arterial (per MUTCD)	average daily traffic > 20,000 vehicles per day	dependent on PPRTA funding priorities	PPRTA
5	Construct Rex from Eastonville to US Hwy 24 Adequate right-of-way should be reserved to allow for the construction of left-turn and right-turn deceleration lanes at all potential future access points	With Grandview Reserve development	With initial Grandview Reserve filing	Grandview Reserve
6	Construct Rex from Sunrise Ridge to Eastonville	With adjacent Meridian Ranch development	With future Meridian Ranch filings	Meridian Ranch
7	Stapleton Drive - US Hwy 24 to Eastonville Road complete southern (eastbound) half	average daily traffic > 18,000 vehicles per day	Shown in 2040 MTCP	El Paso County west of Eastonville Road; Waterbury Metro District east of Eastonville Road.
8	Widen US Hwy 24 to provide two lanes in each direction west of Stapleton.	dependent on CDOT funding priorities	Shown in US Highway 24 PEL Study; 2040 MTCP	CDOT
9	Widen US Hwy 24 to provide two lanes in each direction between Stapleton and Rex.	dependent on CDOT funding priorities	Shown in US Highway 24 PEL Study; 2040 MTCP	CDOT
10	Widen US Hwy 24 to provide two lanes in each direction east of Rex.	dependent on CDOT funding priorities	Shown in US Highway 24 PEL Study; 2040 MTCP	CDOT
	Stapleton/US Hwy 24 Intersection			
11	Convert from Two-Way, Stop-Sign Control to Signal Control	When Traffic Signal Warrant(s) are met. The decision on timing of traffic signal installation rests with the Colorado Department of Transportation	anticipated in the short-term	CDOT; along with any available escrow collected from area developments through the access permitting process.
12	Potential long-term capacity upgades (jughandle, a Jr Interchange, etc.)	When level of service degrades below acceptable levels	Shown in US Highway 24 PEL Study;	CDOT; along with any available escrow collected from area developments through the access permitting process.
	Eastonville/Stapleton			
13	Construct northbound and southbound left-turn lanes on Eastonville Rd. approaching Stapleton Dr.	- - -	Short-Term	PPRTA/El Paso County(1)
14	Signalization of the intersection of Stapleton/Eastonville.	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	anticipated in the short-term	eligible intersection under the free impact program
	US Hwy 24/Rex Intersection			
15	Construct a northeastbound left-turn deceleration lane on US Hwy 24 approaching Rex	With the opening of the access	With initial Grandview Reserve filing	Grandview Reserve
16	Construct a second northeastbound left-turn deceleration lane on US Hwy 24 approaching Rex	Once the intersection is traffic signal controlled and level of service and/or queueing issues arrise	Future	Grandview Reserve
17	Construct a southwestbound right-turn deceleration lane on US Hwy 24 approaching Rex	southwestbound right-turn volume > 10 vph	With initial Grandview Reserve filing	Grandview Reserve
18	Construct a southwestbound right-turn acceleration lane on US Hwy 24 at Rex	southeastbound right-turn volume >10 vph	With initial Grandview Reserve filing	Grandview Reserve
19	Signalization of the intersection of US Hwy 24/Rex	When Traffic Signal Warrant(s) are met. The decision on timing of traffic signal installation rests with the Colorado Department of Transportation	Long-Term Future (to be evaluated with each filing)	Grandview Reserve
	Eastonville/Rex Intersection			
20	Construct a northbound right-turn deceleration lane on Eastonville approaching Rex Road (not needed if constructed as a modern roundabout)	northbound right-turn volume > 50 vph	With Phase 1 development	Grandview Reserve
21	Construct a southbound left-turn deceleration lane on Eastonville approaching Rex Road (not needed if constructed as a modern roundabout)	southbound left-turn volume > 25 vph	NOT REQUIRED but will be needed once Eastonville is constructed to the west by Meridian Ranch to match a northbound left-turn lane that will be required	Potentially included as part of the PPRTA design of Eastonville Road OR Grandview Reserve
22	Convert to traffic signal control (not needed if constructed as a modern roundabout)	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	With Phase 2 development	likely to be considered an "eligible intersection" under the free impact program
	Eastonville/Meridian Ranch/Judge Orr Intersection			
23	Convert to traffic signal control (or reconstruct as a modern roundabout)	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	Future	likely to be considered an "eligible intersection" under the free impact program
	Eastonville/McLaughlin Intersection			
24	Convert to traffic signal control (or reconstruct as a modern roundabout)	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	Future	likely to be considered an "eligible intersection" under the free impact program
	Eastonville/North Site Access Intersection			
25	Construct a northbound right-turn deceleration lane on Eastonville approaching the north site access (not needed if constructed as a modern roundabout)	northbound right-turn volume > 50 vph	With Phase 2 development	Grandview Reserve
26	Construct a southbound left-turn deceleration lane on Eastonville approaching the north site access (not needed if constructed as a modern roundabout)	southbound left-turn volume > 25 vph	With Phase 2 development or potentially in conjunction with the Eastonville PPRTA project.	Potentially included as part of the PPRTA design of Eastonville Road OR Grandview Reserve
	Eastonville/South Site Access Intersection			
27	Construct a northbound right-turn deceleration lane on Eastonville approaching the south site access (not needed if constructed as a modern roundabout)	northbound right-turn volume > 50 vph	With Phase 2 development	Grandview Reserve
28	Construct a southbound left-turn deceleration lane on Eastonville approaching the south site access (not needed if constructed as a modern roundabout)	southbound left-turn volume > 25 vph	With Phase 2 development or potentially in conjunction with the Eastonville PPRTA project.	Potentially included as part of the PPRTA design of Eastonville Road OR Grandview Reserve

Notes:

(1) The design of Eastonville Road will be performed by the Meridian Ranch developer. LSC anticipates that these turn lanes will be included in the project design. The project will be constructed by El Paso County as PPRTA project.

Source: LSC Transportation Consultants, Inc. (1-11-19)

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	June 29, 2020
The Estates at Rolling Hills Ranch Filing No. 1 Traffic Impact Analysis	May 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
Meadowlake Ranch	
Meadowlake Ranch Traffic Impact Analysis	May 29, 2019
Trails	
Trails Filing Nos. 9, 10 and 11	February 12, 2007

Source: LSC Transportation Consultants, Inc. (July 2020)

Figures

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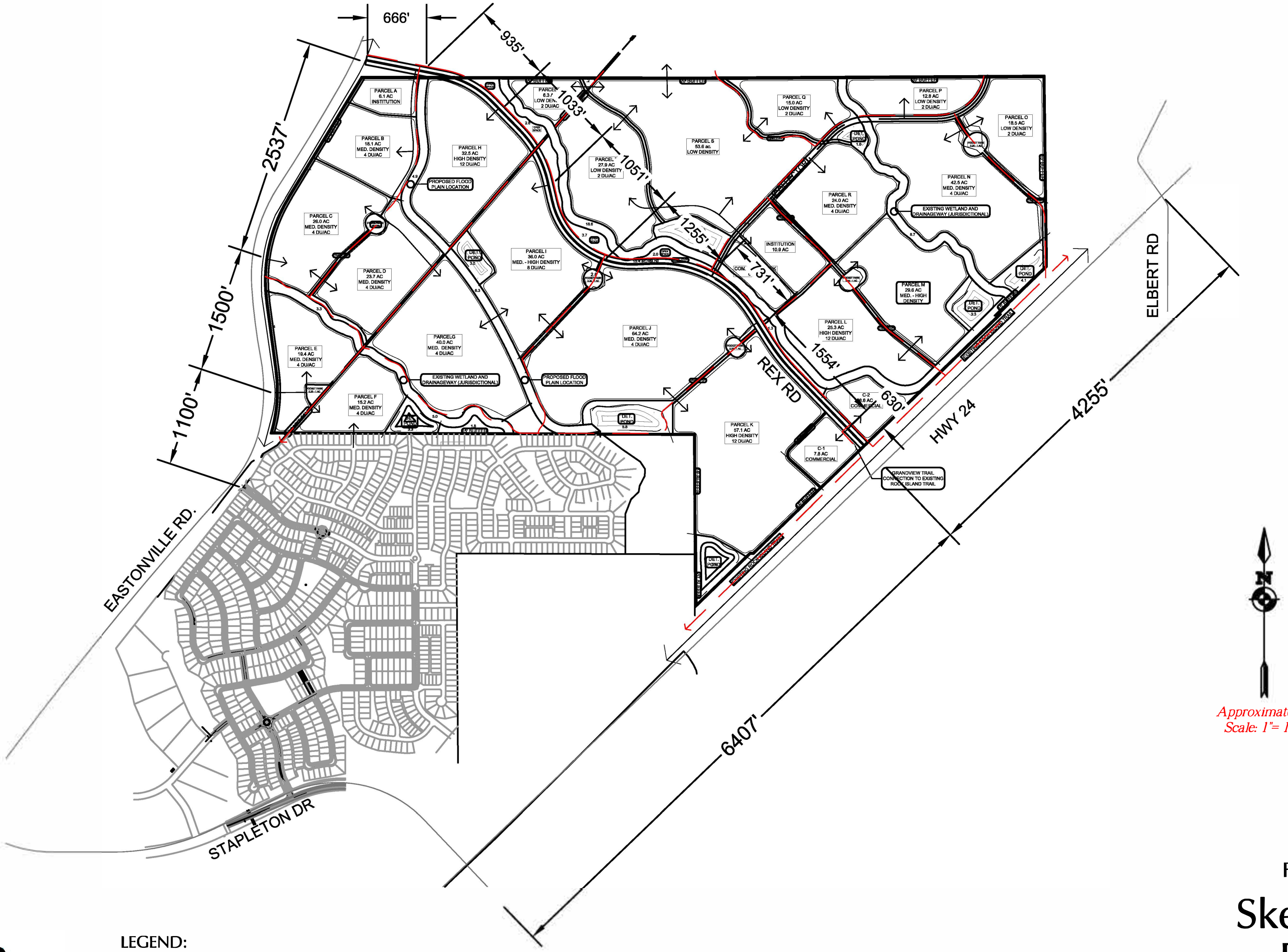
Figure 1

Vicinity Map

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.



LEGEND:

XX = Proposed access/intersection spacing along major roadways

— — = Proposed trails

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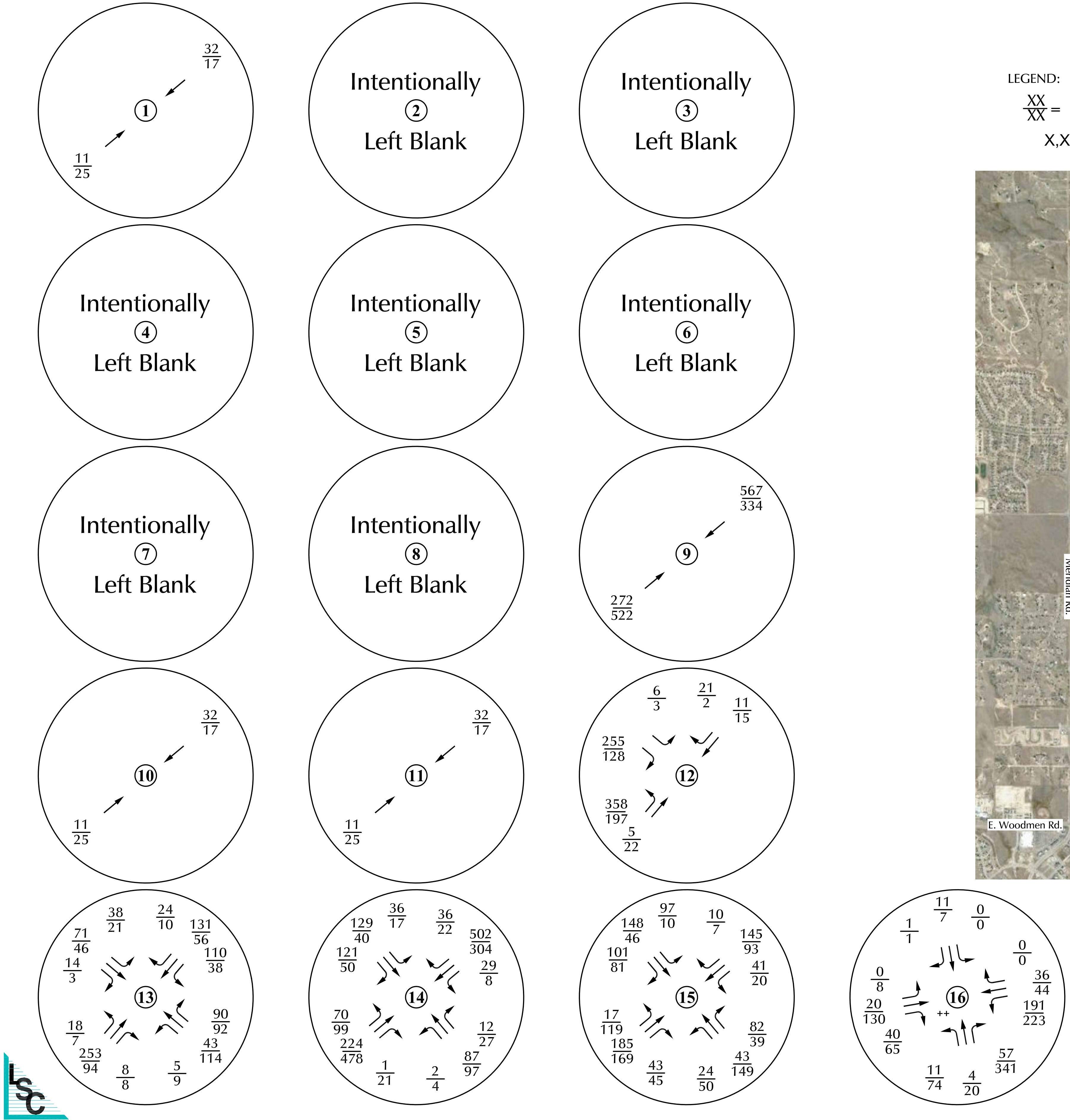
Figure 2

Sketch Plan

Grandview Reserve (LSC #184840)



LEGEND:

$\frac{XX}{XX}$ = 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"= 4,000'

* Estimate by LSC
** CDOT 2018 Average Annual Daily Traffic
$^{++}$ Traffic counts may have been impacted by COVID-19 restrictions
$^{+}$ Please refer to count data sheets (attached) for specific intersection turning movement traffic count dates.

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Figure 3a

Existing (2017-2020)$^{+}$ Traffic

Grandview Reserve (LSC #184840)

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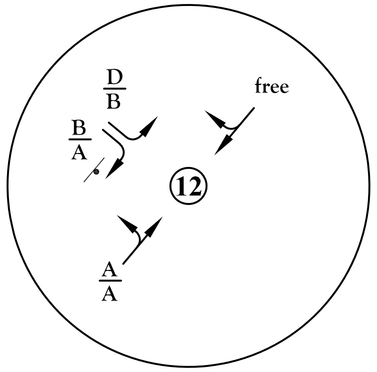
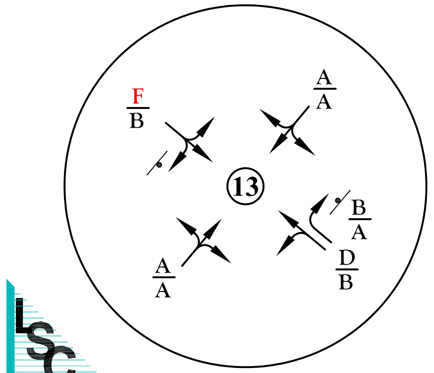
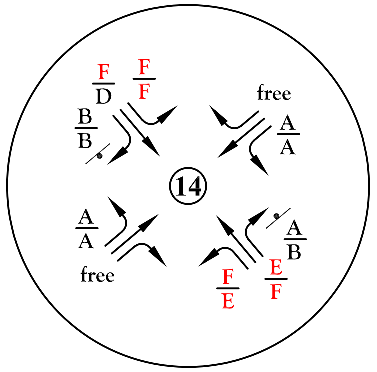
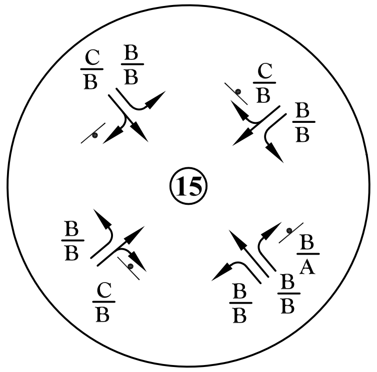
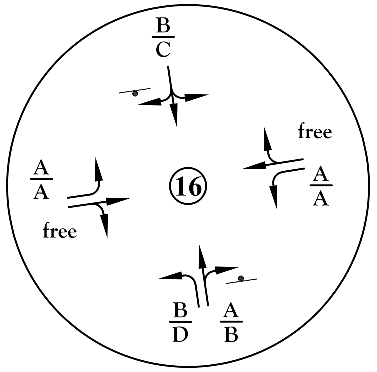










LEGEND:
Traffic Control Used in the Analysis:
= Stop Sign
= Traffic Signal
LOS Analysis Results:
$\frac{A}{B}$ = $\frac{\text{AM Individual Movement Peak-Hour Level of Service}}{\text{PM Individual Movement Peak-Hour Level of Service}}$
$\frac{C}{C}$ = $\frac{\text{AM Entire Intersection Peak-Hour Level of Service}}{\text{PM Entire Intersection Peak-Hour Level of Service}}$

Approximate Scale
Scale: 1" = 4,000'

Figure 3b

Existing Lane Geometry, Traffic Control and Level of Service

Grandview Reserve (LSC #184840)

TRANSPORTATION CONSULTANTS, INC.

LEGEND:

$\frac{XX}{XX}$ = 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"= 4,000'

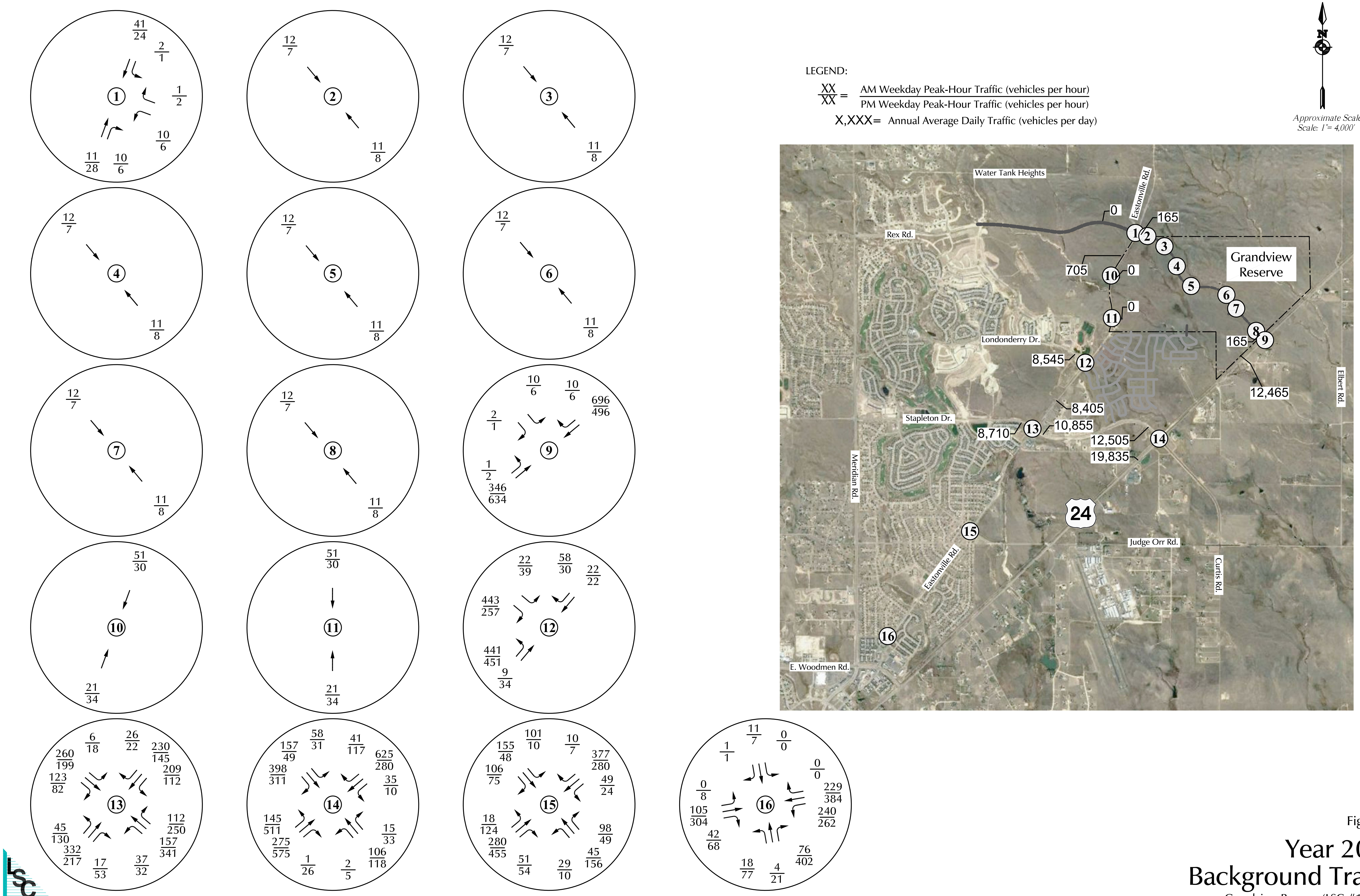


Figure 4a

Year 2028 Background Traffic

Grandview Reserve (LSC #184840)

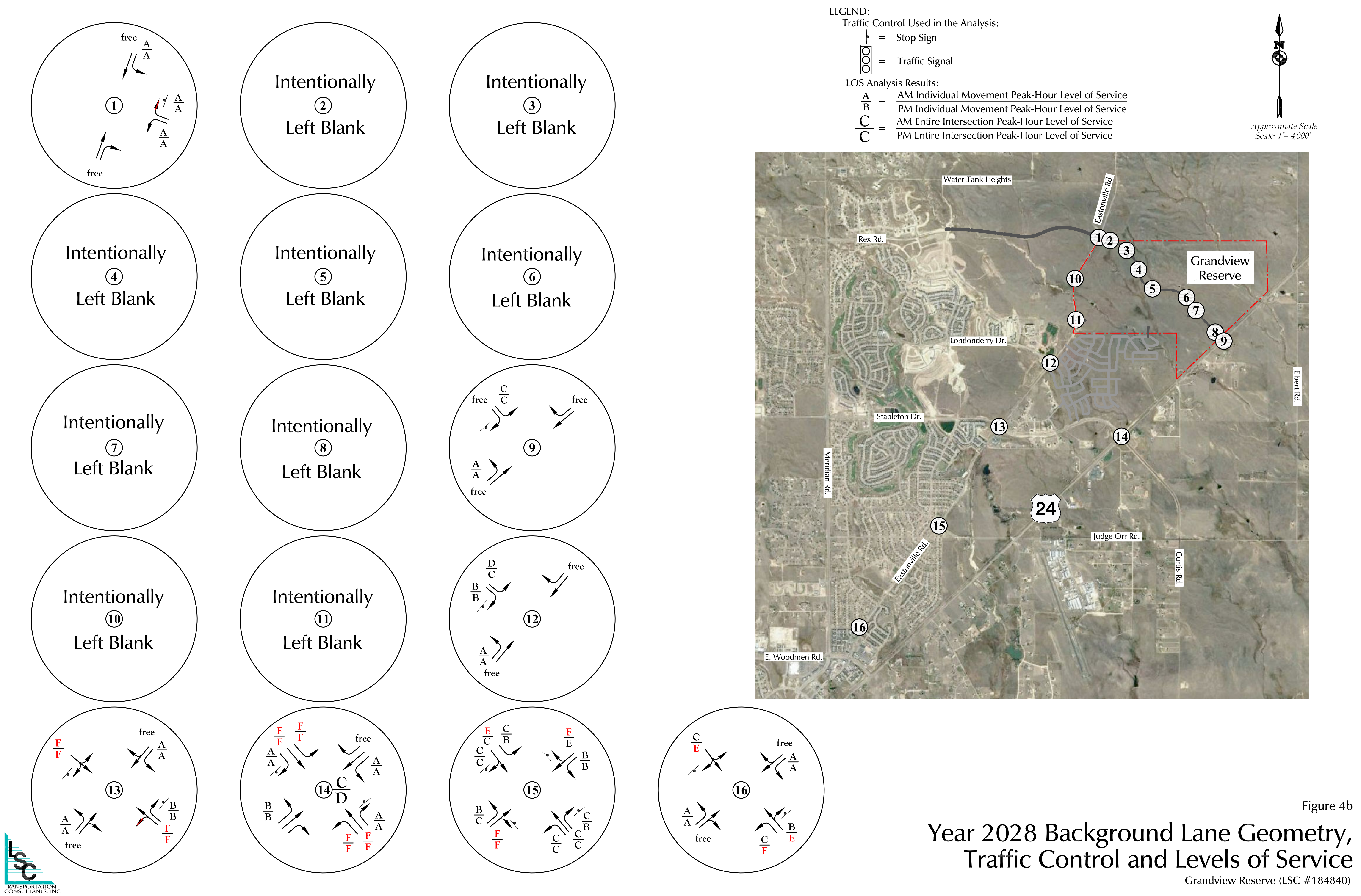
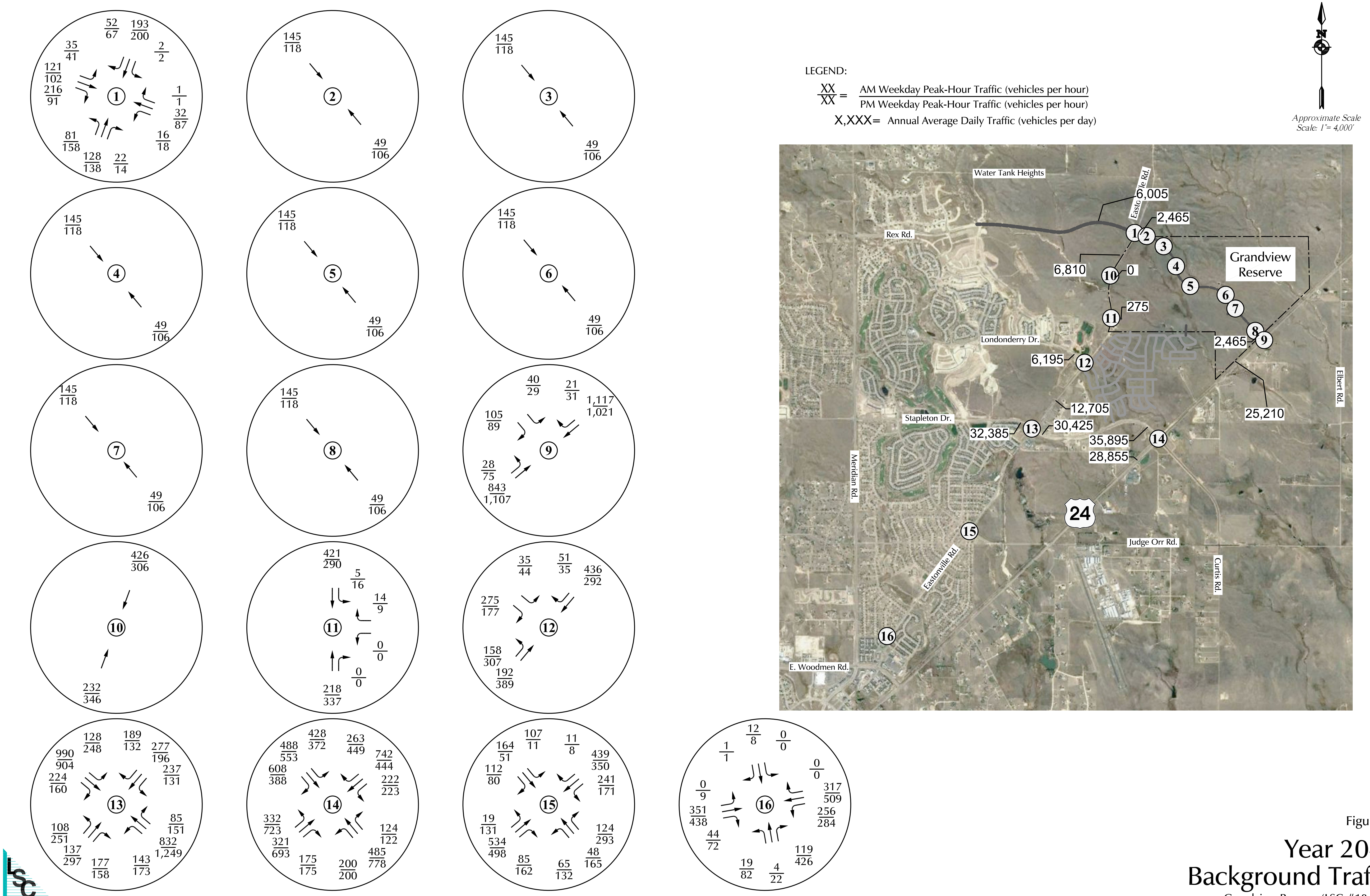


Figure 4b

Year 2028 Background Lane Geometry, Traffic Control and Levels 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)

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Figure 5a

Year 2040 Background Traffic

Grandview Reserve (LSC #184840)

LEGEND:

Traffic Control Used in the Analysis:

- = Stop Sign
- = Traffic Signal

LOS Analysis Results:

$\frac{A}{B}$ = AM Individual Movement Peak-Hour Level of Service / PM Individual Movement Peak-Hour Level of Service

$\frac{C}{C}$ = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service

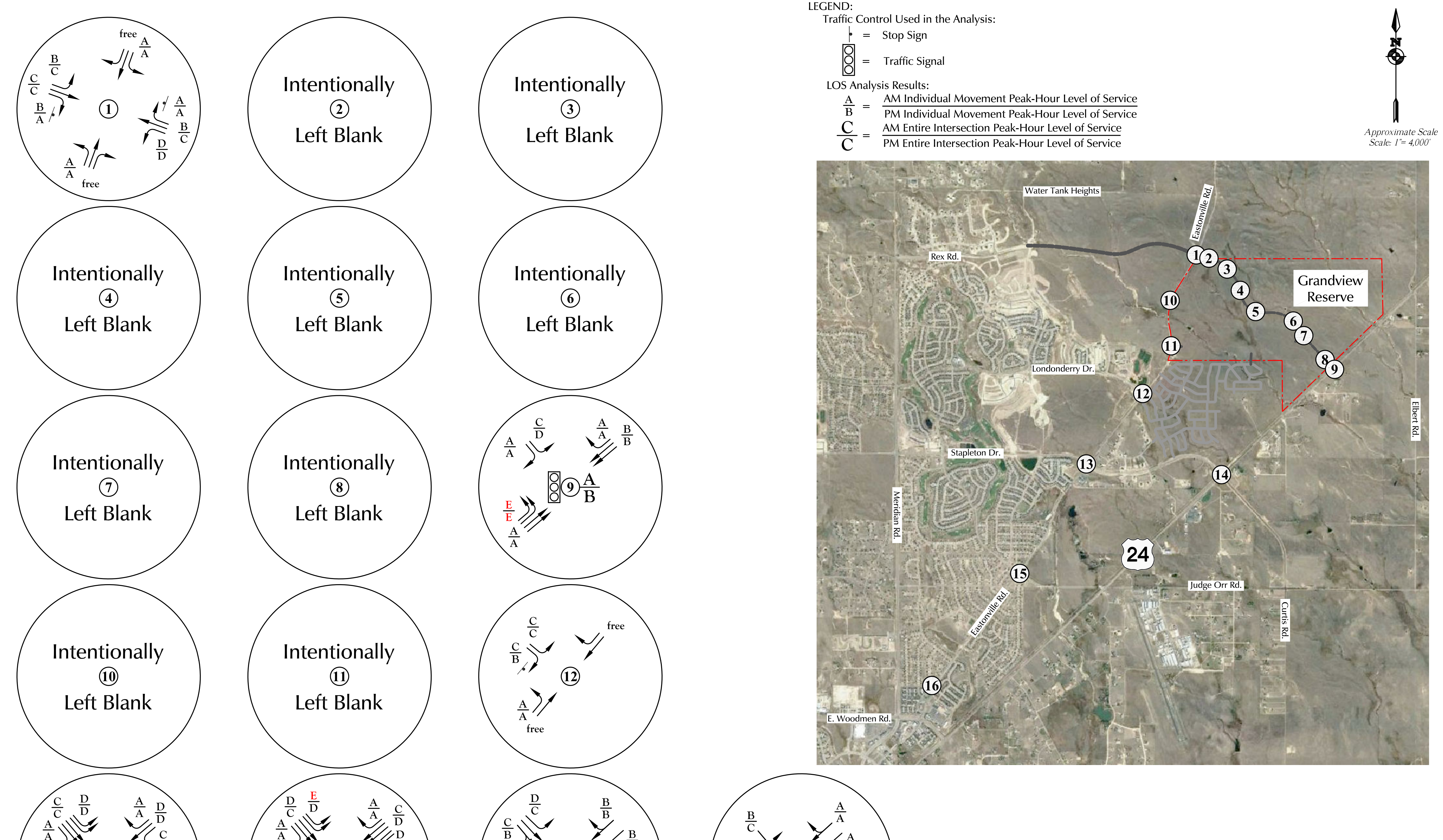


Figure 5b

Year 2040 Background Lane Geometry, Traffic Control and Levels of Service With Two-Way, Stop-Sign and Signal Control

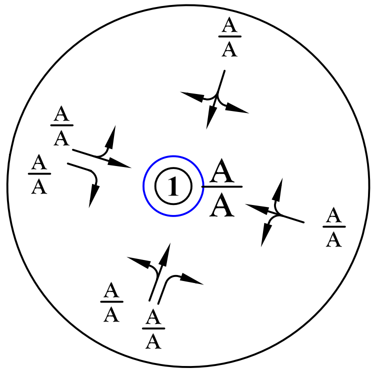
Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.

LEGEND:
Traffic Control Used in the Analysis:
┤ = Stop Sign
⦾ = Traffic Signal
○ = Modern Roundabout

LOS Analysis Results:
$\frac{A}{B}$ = $\frac{\text{AM Individual Movement Peak-Hour Level of Service}}{\text{PM Individual Movement Peak-Hour Level of Service}}$
$\frac{C}{C}$ = $\frac{\text{AM Entire Intersection Peak-Hour Level of Service}}{\text{PM Entire Intersection Peak-Hour Level of Service}}$

Approximate Scale
Scale: 1" = 4,000'



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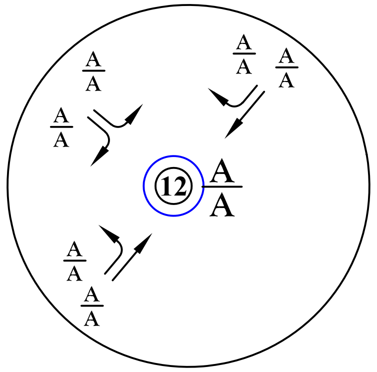

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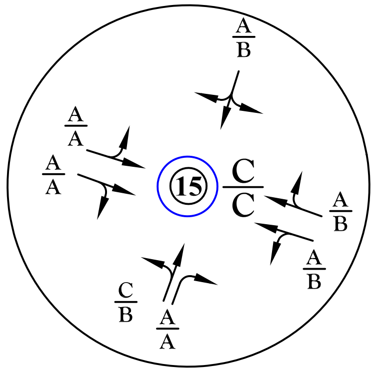

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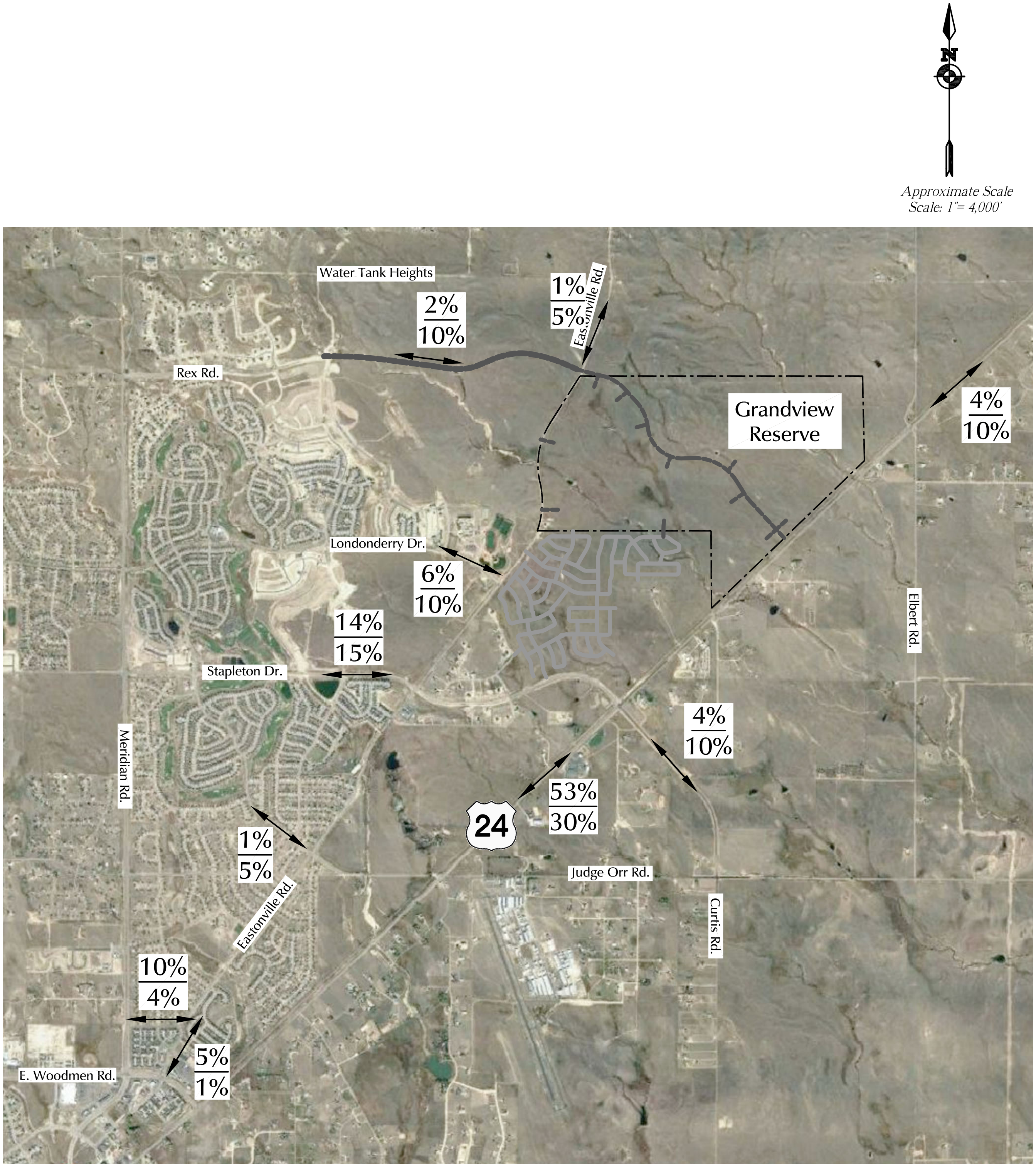
Figure 5c

Year 2040 Background Lane Geometry, Traffic Control and Levels of Service with Modern Roundabouts

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.



LEGEND:

$\longleftrightarrow$ $\frac{XX\%}{XX\%}$ = Residential Percent Directional Distribution / Non-Residential Percent Directional Distribution

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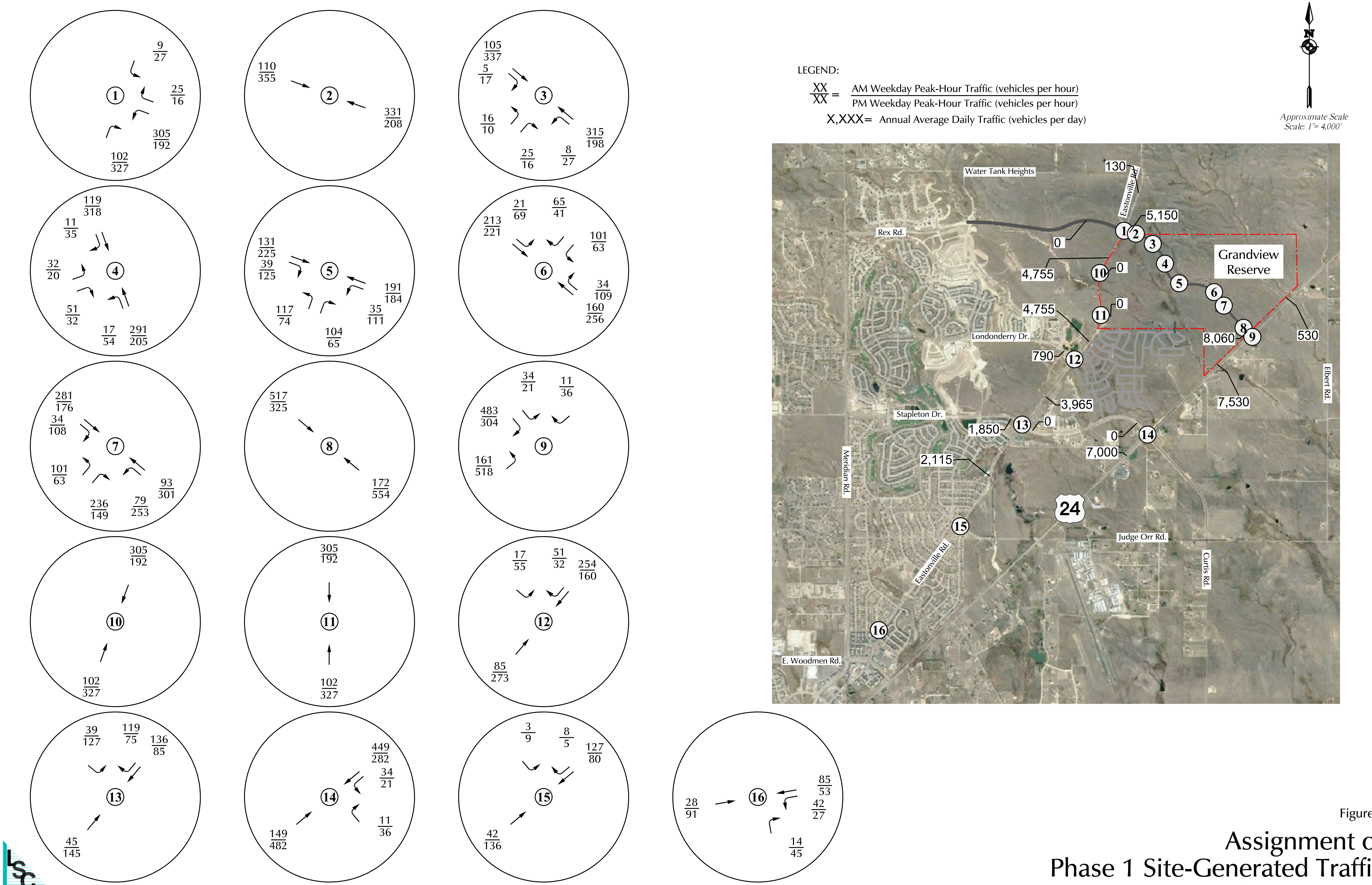
Figure 6

Directional Distribution of Site-Generated Traffic

Grandview Reserve (LSC #184840)

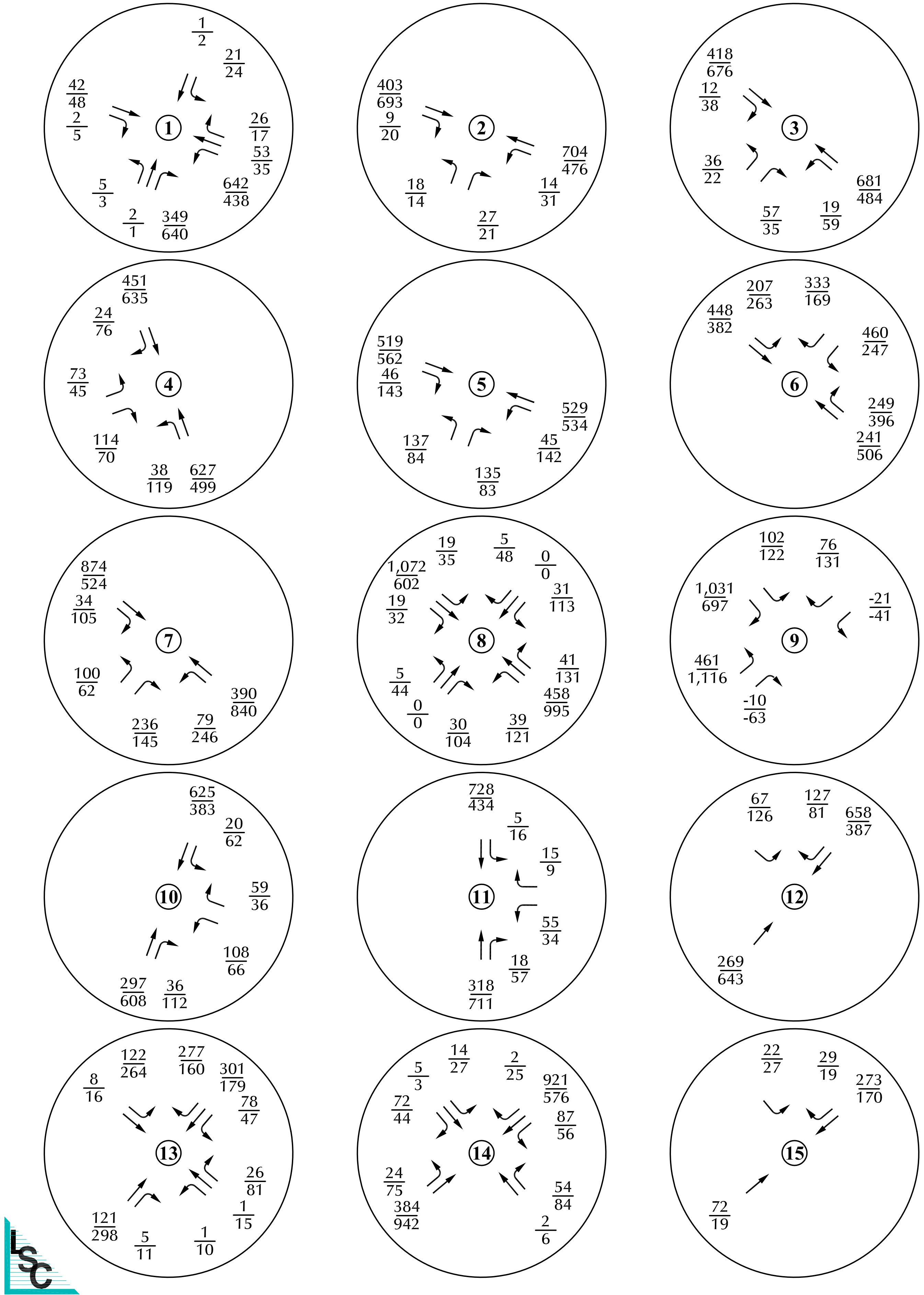


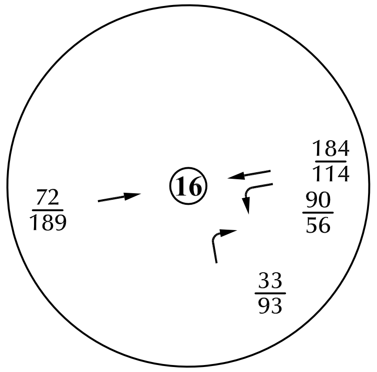
LSC TRANSPORTATION CONSULTANTS, INC.

Figure 7

Assignment of Phase 1 Site-Generated Traffic

Grandview Reserve (LSC #184840)





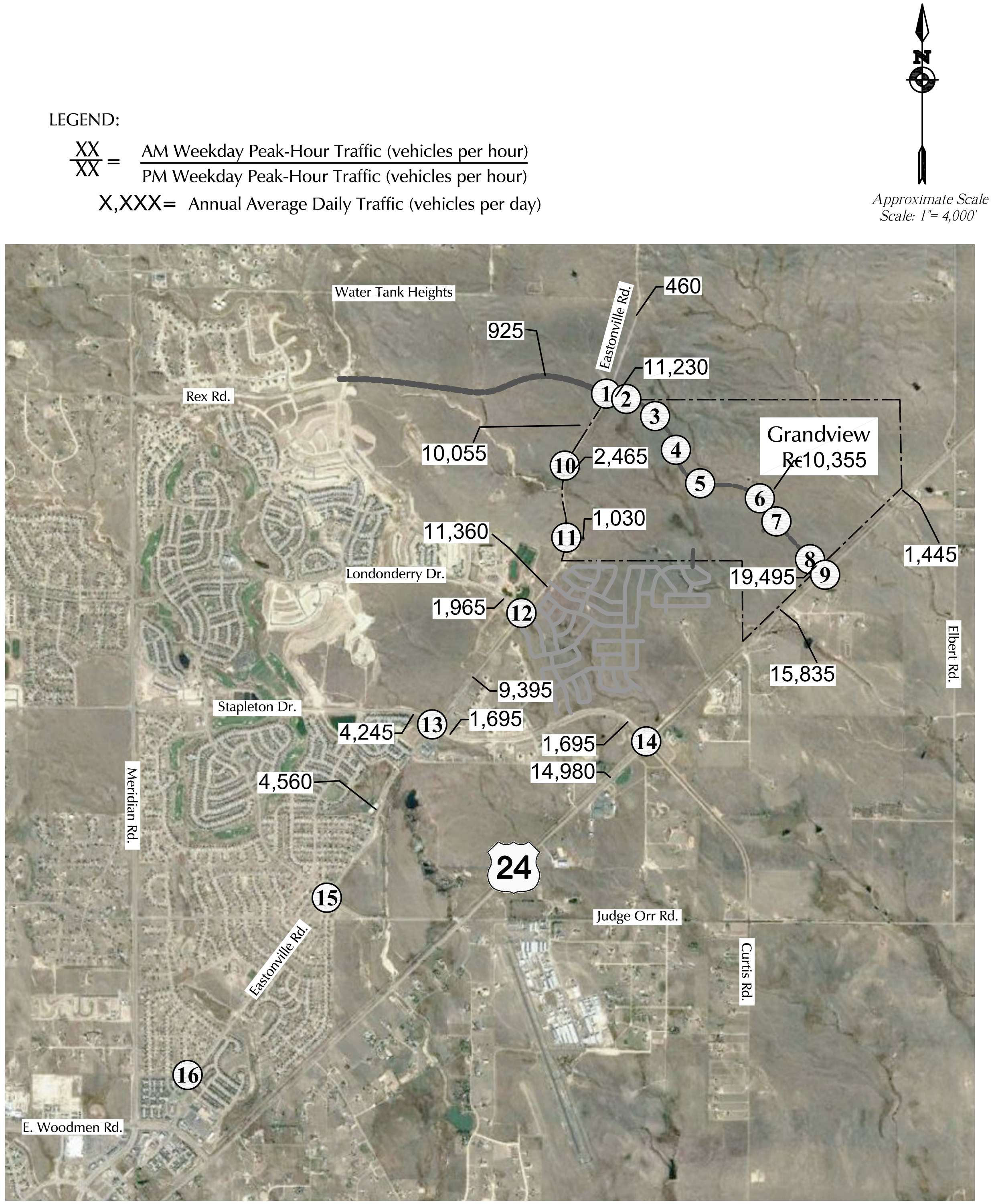
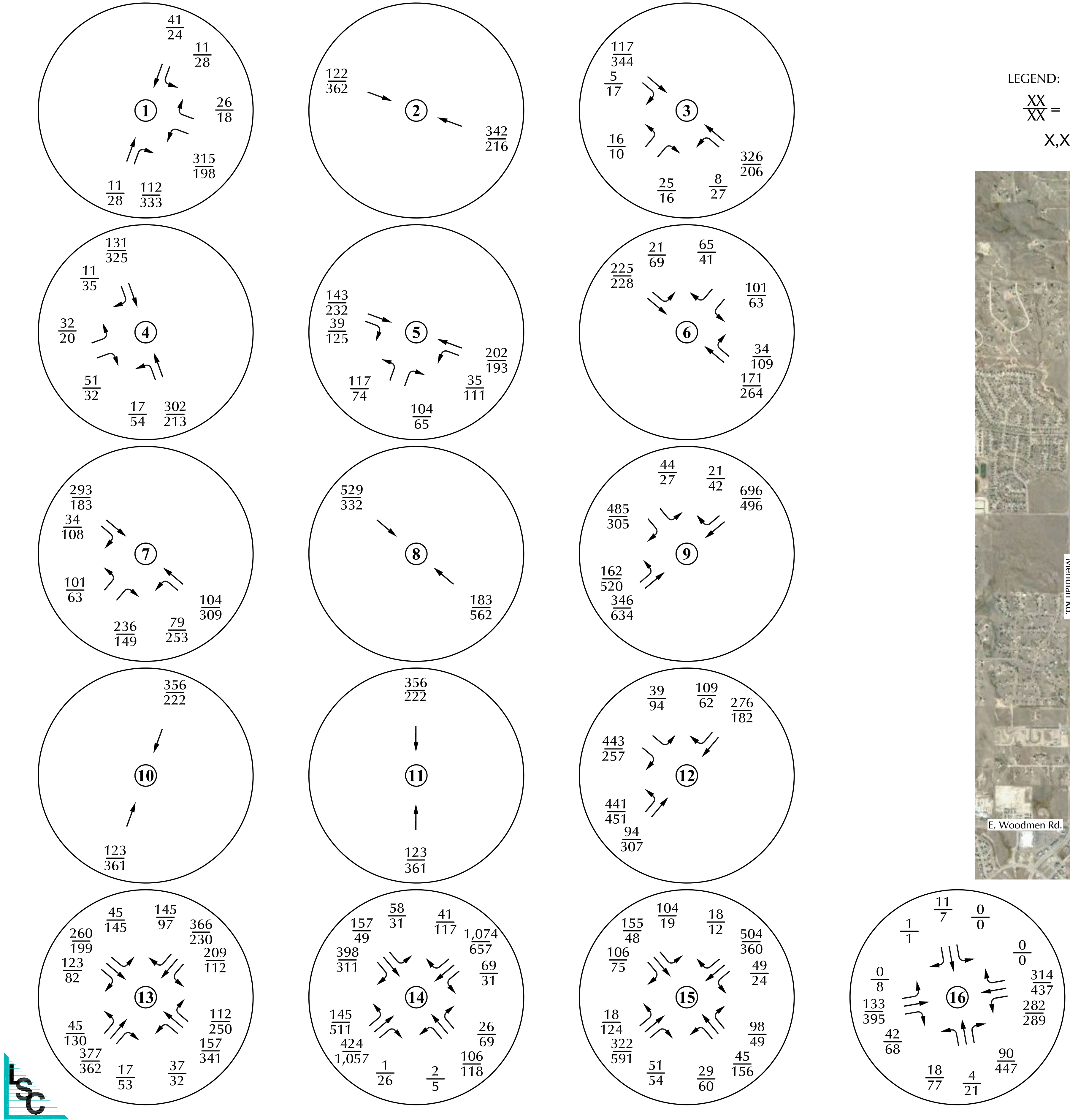


Figure 8

Assignment of Buildout Site-Generated 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)

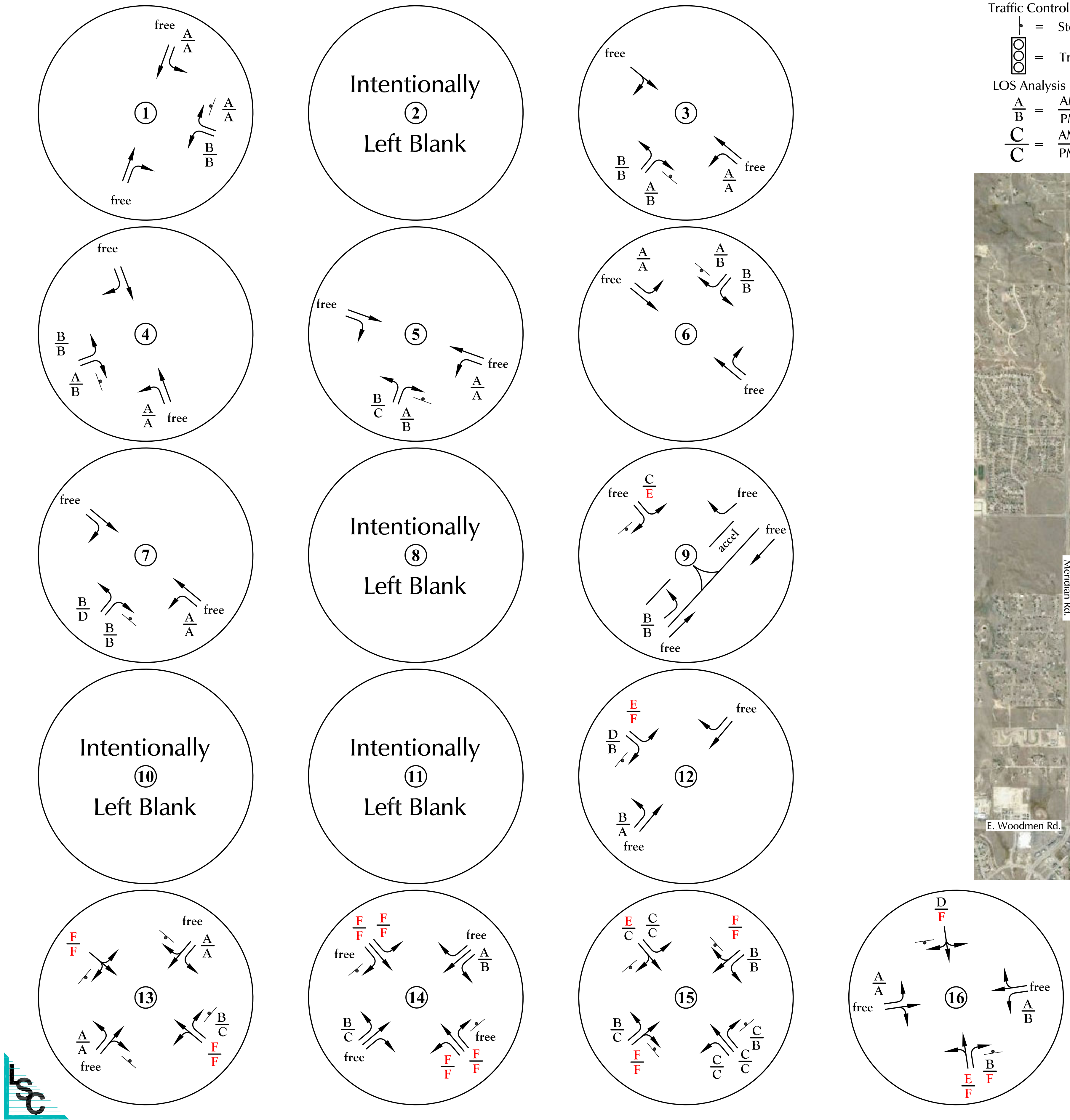
Approximate Scale
Scale: 1"= 4,000'

LSC TRANSPORTATION CONSULTANTS, INC.

Figure 9a

Year 2028 Total Traffic

Grandview Reserve (LSC #184840)



LEGEND:

Traffic Control Used in the Analysis:

| = Stop Sign

= Traffic Signal

LOS Analysis Results:

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

C/C = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service

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Approximate Scale
Scale: 1"= 4,000'

LSC
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Figure 9b

Year 2028 Total Lane Geometry, Traffic Control and Levels of Service with Two-Way Stop-Sign Control

Grandview Reserve (LSC #184840)

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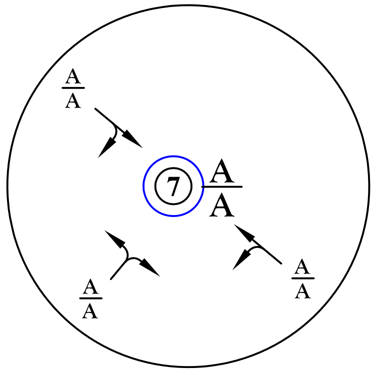

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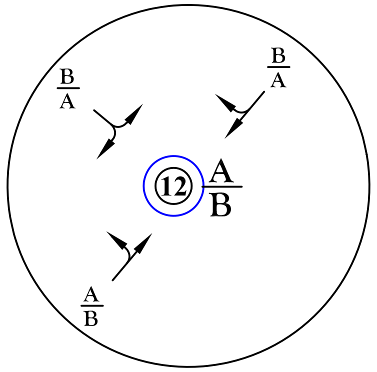

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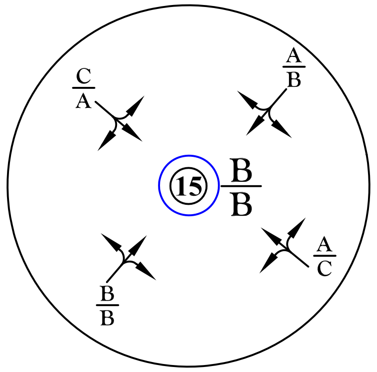

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LEGEND:
Traffic Control Used in the Analysis:
= Stop Sign
= Traffic Signal
○ = Modern Roundabout

LOS Analysis Results:
A/B = AM Individual Movement Peak-Hour Level of Service / PM Individual Movement Peak-Hour Level of Service
C/C = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service

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Approximate Scale
Scale: 1" = 4,000'

Figure 9c

Year 2028 Total Lane Geometry, Traffic Control and Levels of Service with Modern Roundabouts

Grandview Reserve (LSC #184840)

LEGEND:

Traffic Control Used in the Analysis:

╞ = Stop Sign

▯ = Traffic Signal

LOS Analysis Results:

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

C/C = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service

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Scale: 1"= 4,000'

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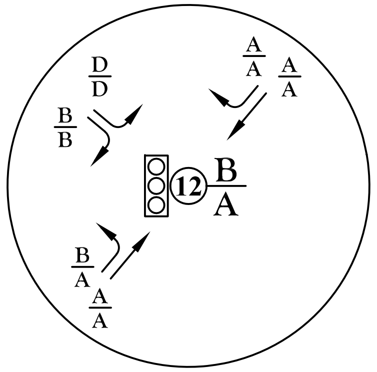
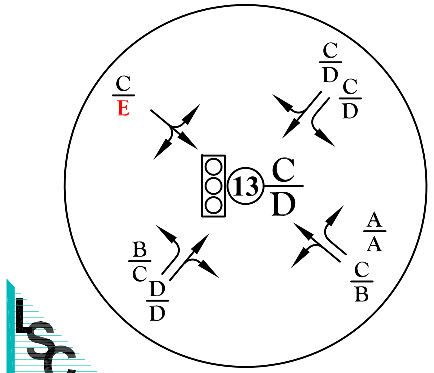
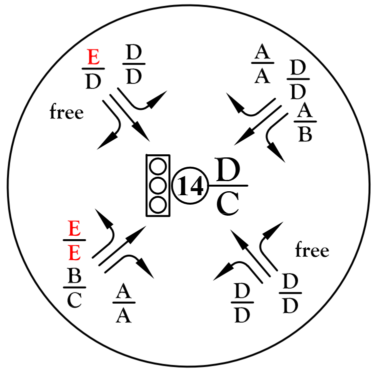
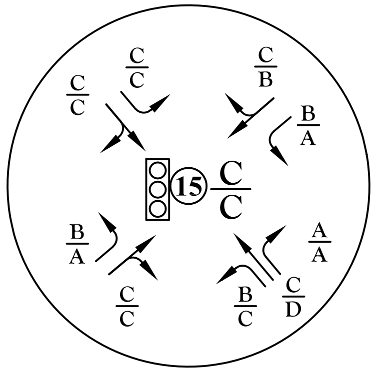
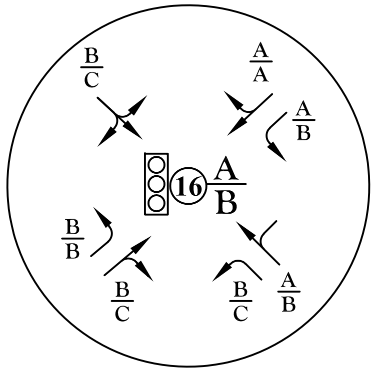








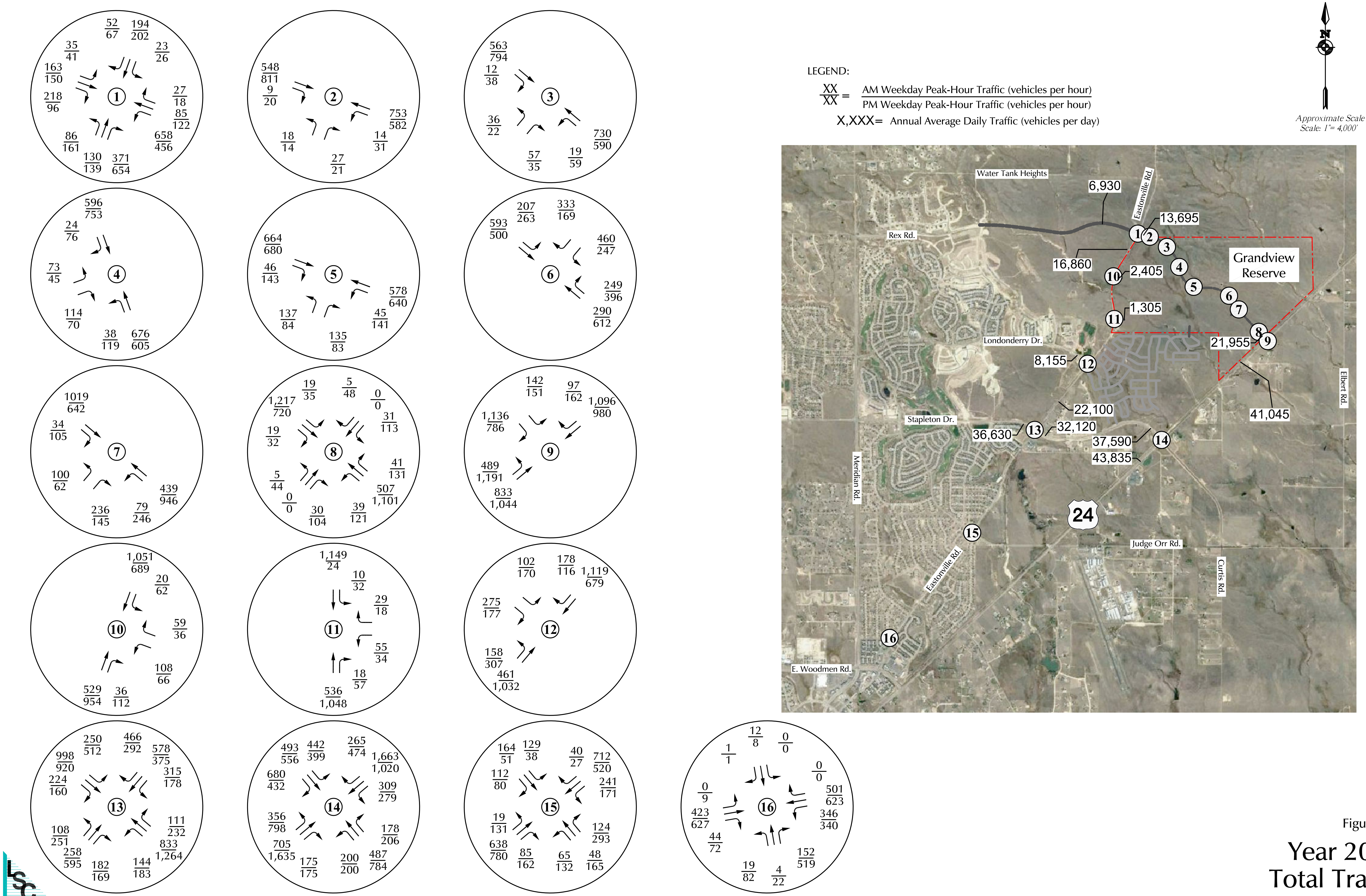


TRANSPORTATION CONSULTANTS, INC.

Figure 9d

Year 2028 Total Lane Geometry, Traffic Control and Levels of Service with Traffic Signal Control

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)

TRANSPORTATION CONSULTANTS, INC.

Figure 10a

Year 2040 Total Traffic

Grandview Reserve (LSC #184840)

LEGEND:

Traffic Control Used in the Analysis:

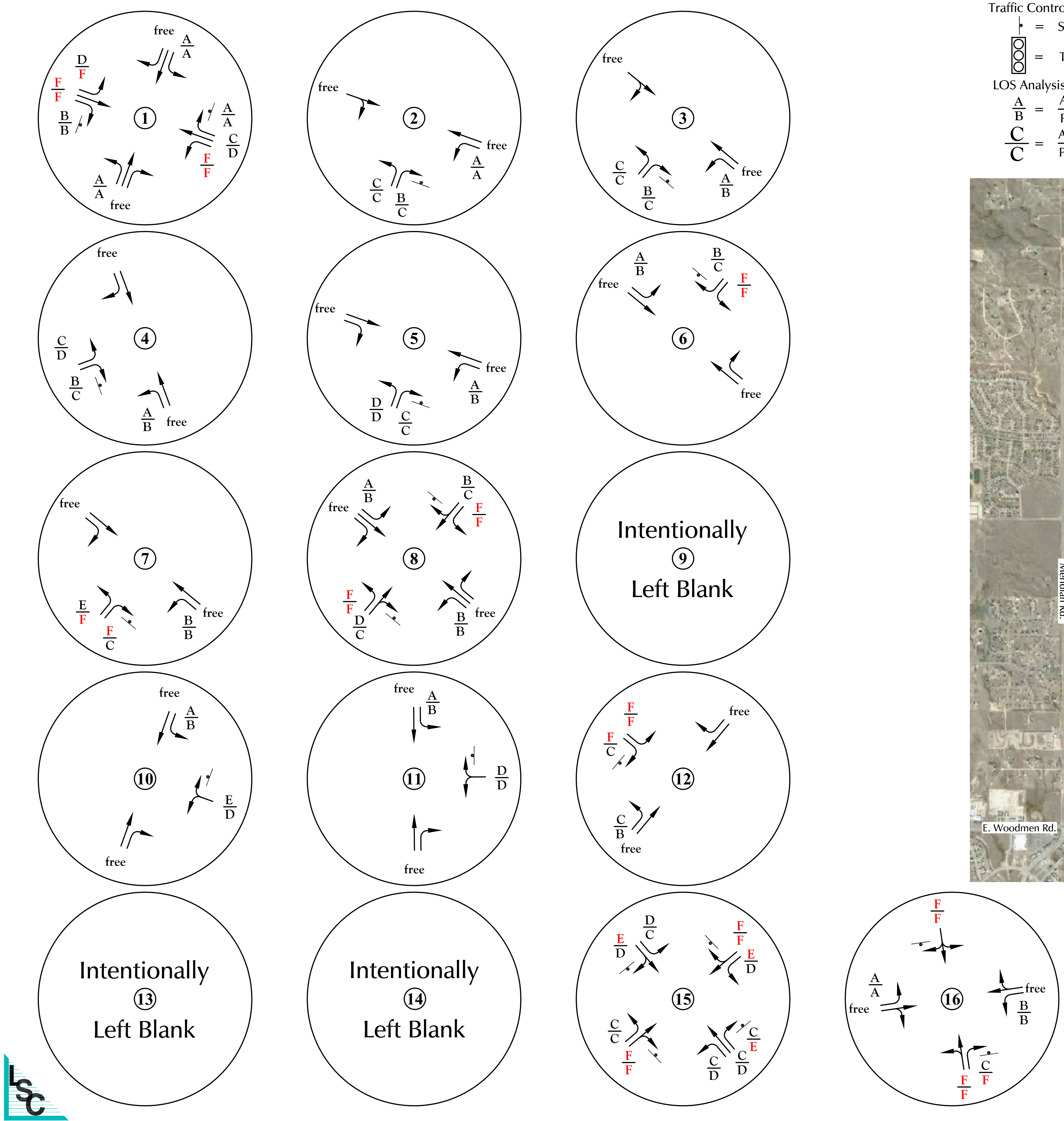
⊥ = Stop Sign

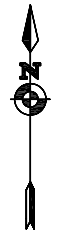
☰ = Traffic Signal

LOS Analysis Results:

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

C/C = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service





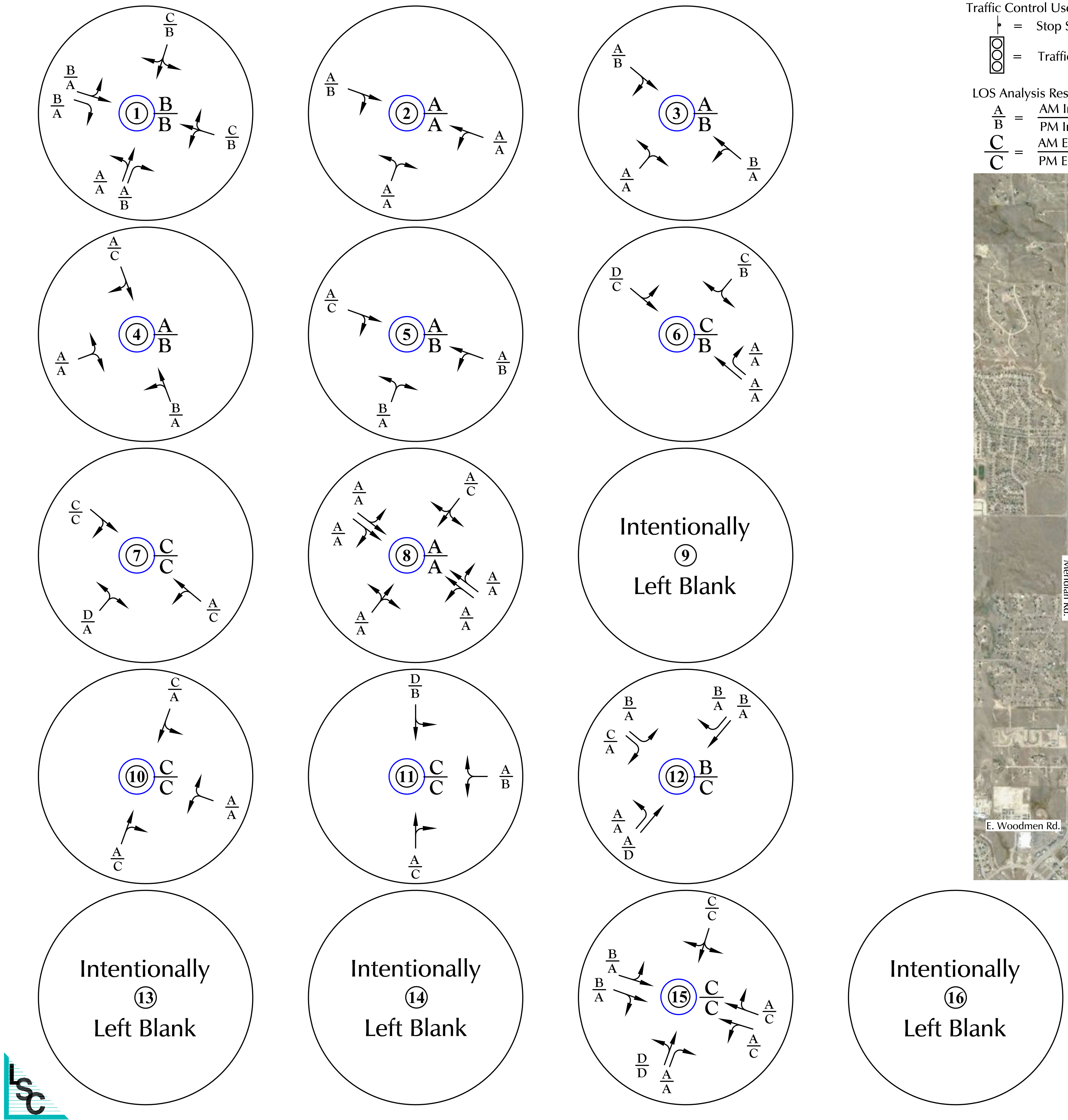
Approximate Scale
Scale: 1" = 4,000'

TRANSPORTATION CONSULTANTS, INC.

Figure 10b

Year 2040 Total Lane Geometry, Traffic Control and Levels of Service with Two-Way Stop-Sign Control

Grandview Reserve (LSC #184840)



LEGEND:

Traffic Control Used in the Analysis:

= Stop Sign

= Traffic Signal

= Modern Roundabout

LOS Analysis Results:

$\frac{A}{B}$ = AM Individual Movement Peak-Hour Level of Service / PM Individual Movement Peak-Hour Level of Service

$\frac{C}{C}$ = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service

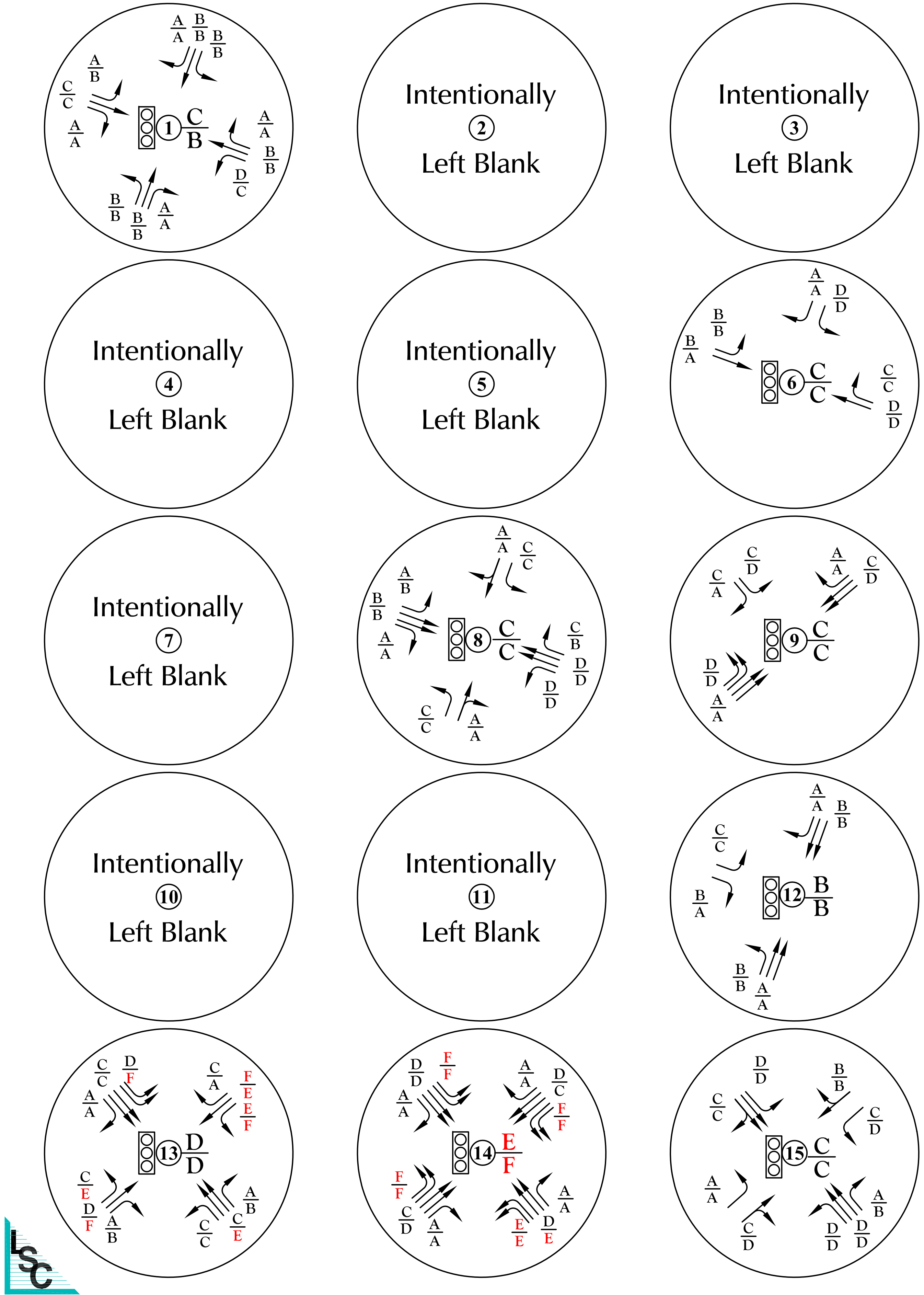
Approximate Scale
Scale: 1"= 4,000'

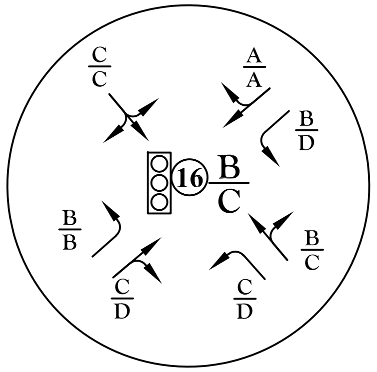
Figure 10c

Year 2040 Total Lane Geometry, Traffic Control and Levels of Service with Modern Roundabouts

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.





LEGEND:
Traffic Control Used in the Analysis:
= Stop Sign
= Traffic Signal
LOS Analysis Results:
A/B = AM Individual Movement Peak-Hour Level of Service / PM Individual Movement Peak-Hour Level of Service
C/C = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service

Approximate Scale
Scale: 1"= 4,000'

Figure 10d

Year 2040 Total Lane Geometry, Traffic Control and Levels of Service with Traffic Signal Control

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.

LEGEND:

Traffic Control Used in the Analysis:

= Stop Sign

= Traffic Signal

LOS Analysis Results:

$\frac{A}{B}$ = AM Individual Movement Peak-Hour Level of Service / PM Individual Movement Peak-Hour Level of Service

$\frac{C}{C}$ = AM Entire Intersection Peak-Hour Level of Service / PM Entire Intersection Peak-Hour Level of Service

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Approximate Scale
Scale: 1" = 4,000'

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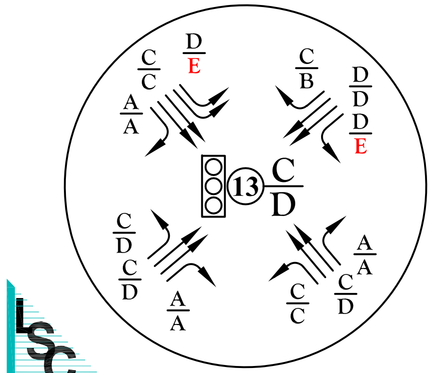
*Note:
The US 24 Planning and Environmental Linkage Study (October 2017) identifies additional options for potential capacity improvements at this intersection including a jughandle or jr interchange



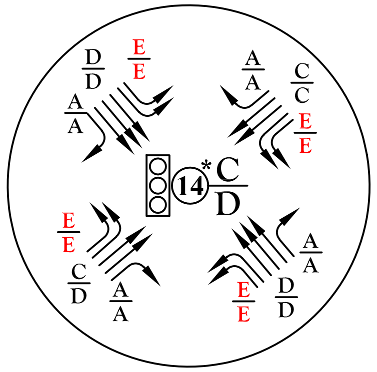


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Figure 10e

Year 2040 Total Lane Geometry, Traffic Control and Levels of Service with Hypothetical Intersection Capacity Improvements

Grandview Reserve (LSC #184840)

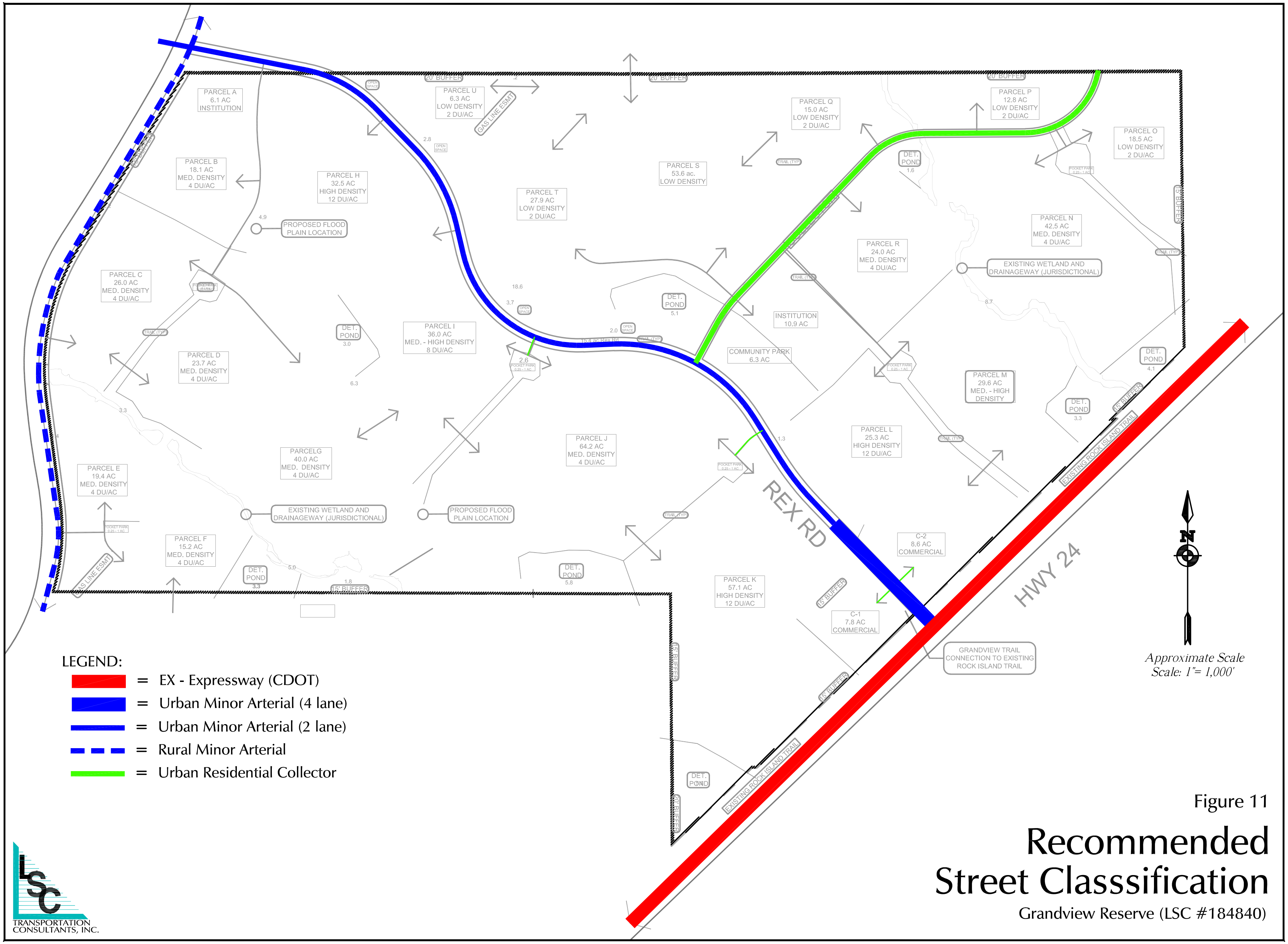
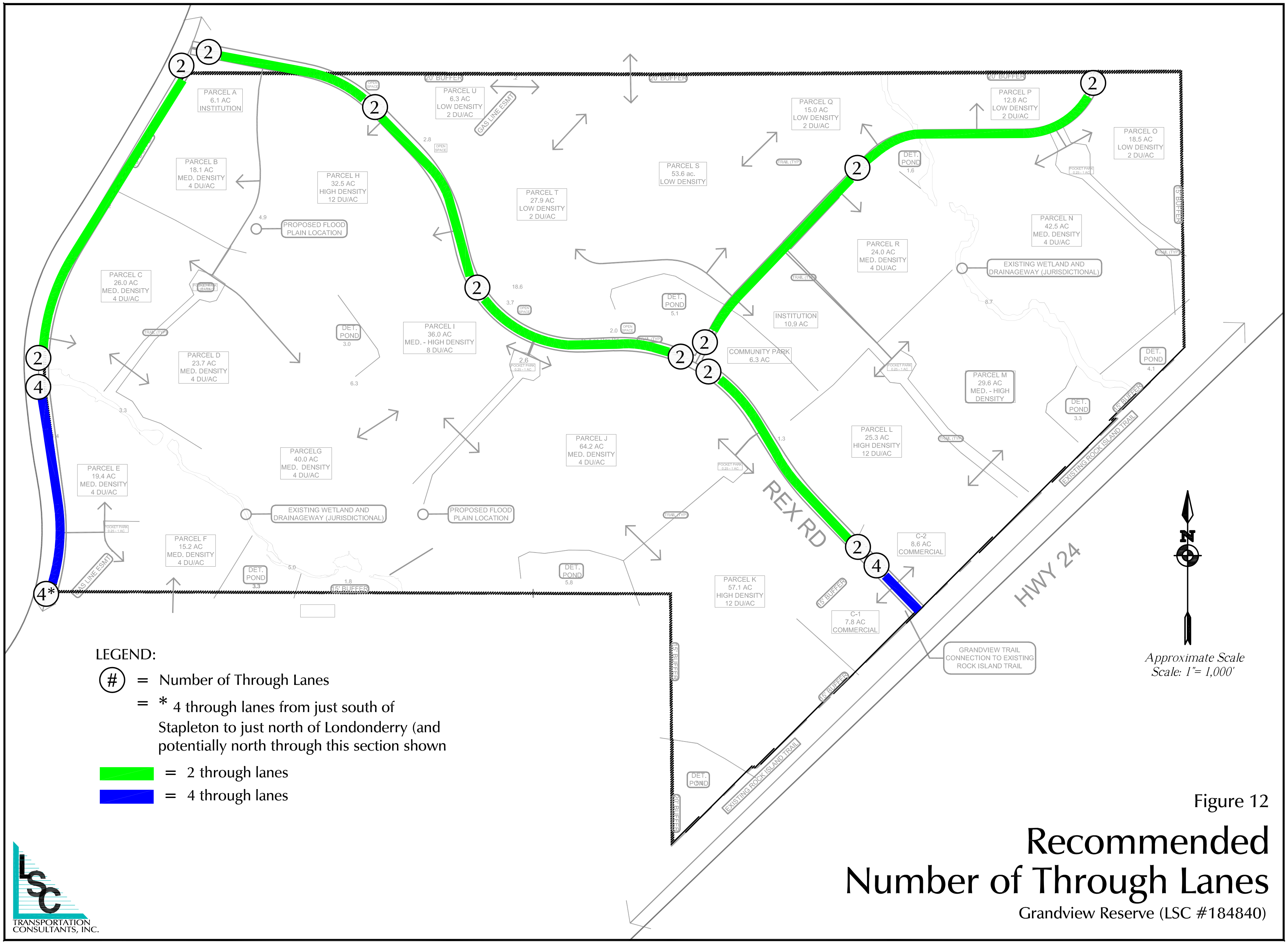


Figure 11

Recommended Street Classsification

Grandview Reserve (LSC #184840)

LSC TRANSPORTATION CONSULTANTS, INC.



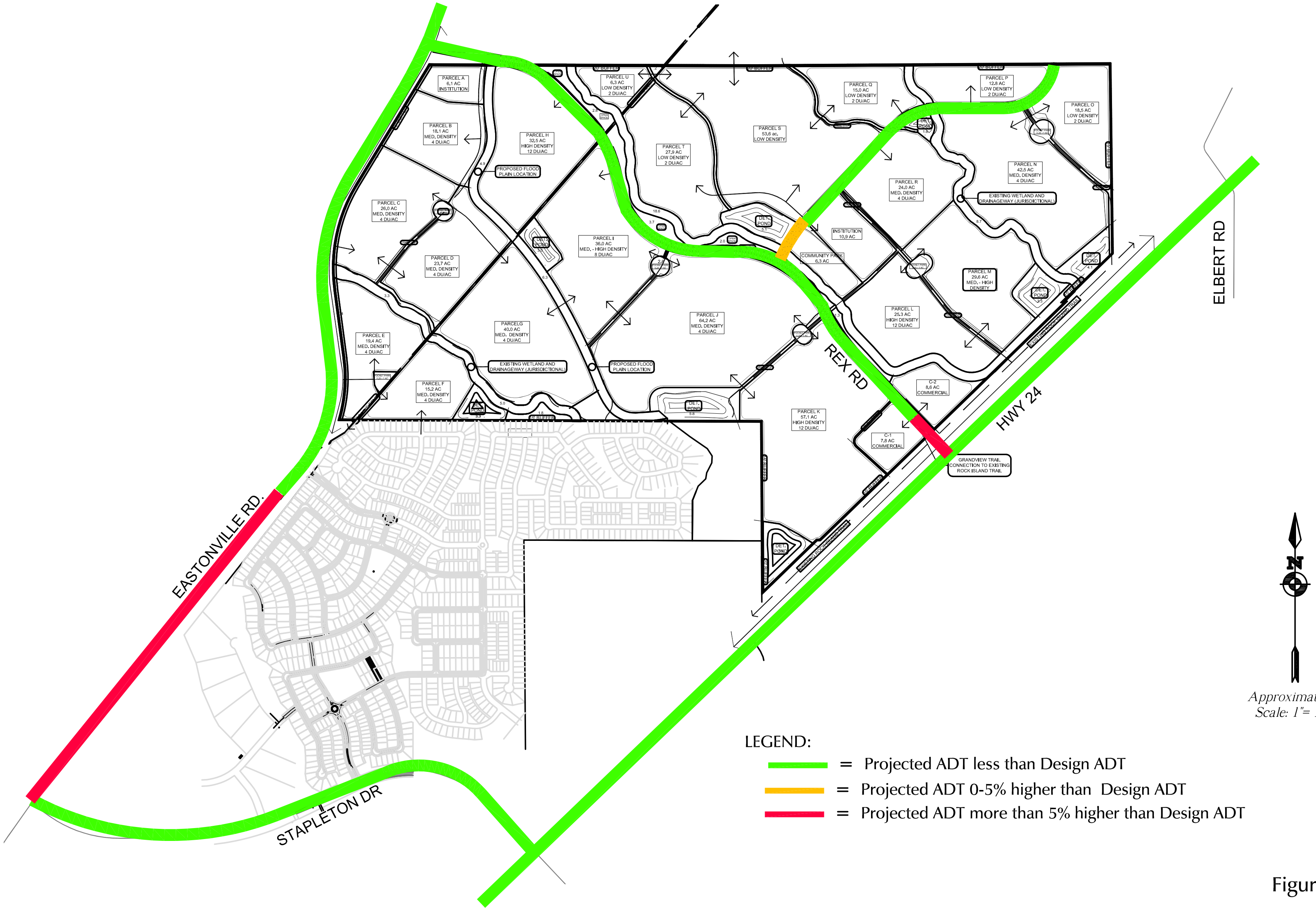
LEGEND:

(#)	=	Number of Through Lanes
	=	* 4 through lanes from just south of Stapleton to just north of Londonderry (and potentially north through this section shown
🟩	=	2 through lanes
🟦	=	4 through lanes

Figure 12

Recommended
Number of Through Lanes

Grandview Reserve (LSC #184840)



LEGEND:

🟩 = Projected ADT less than Design ADT

🟧 = Projected ADT 0-5% higher than Design ADT

🟥 = Projected ADT more than 5% higher than Design ADT

Approximate Scale
Scale: 1"= 1,000'

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Figure 13

Design ADT Comparison

Grandview Reserve (LSC #184840)

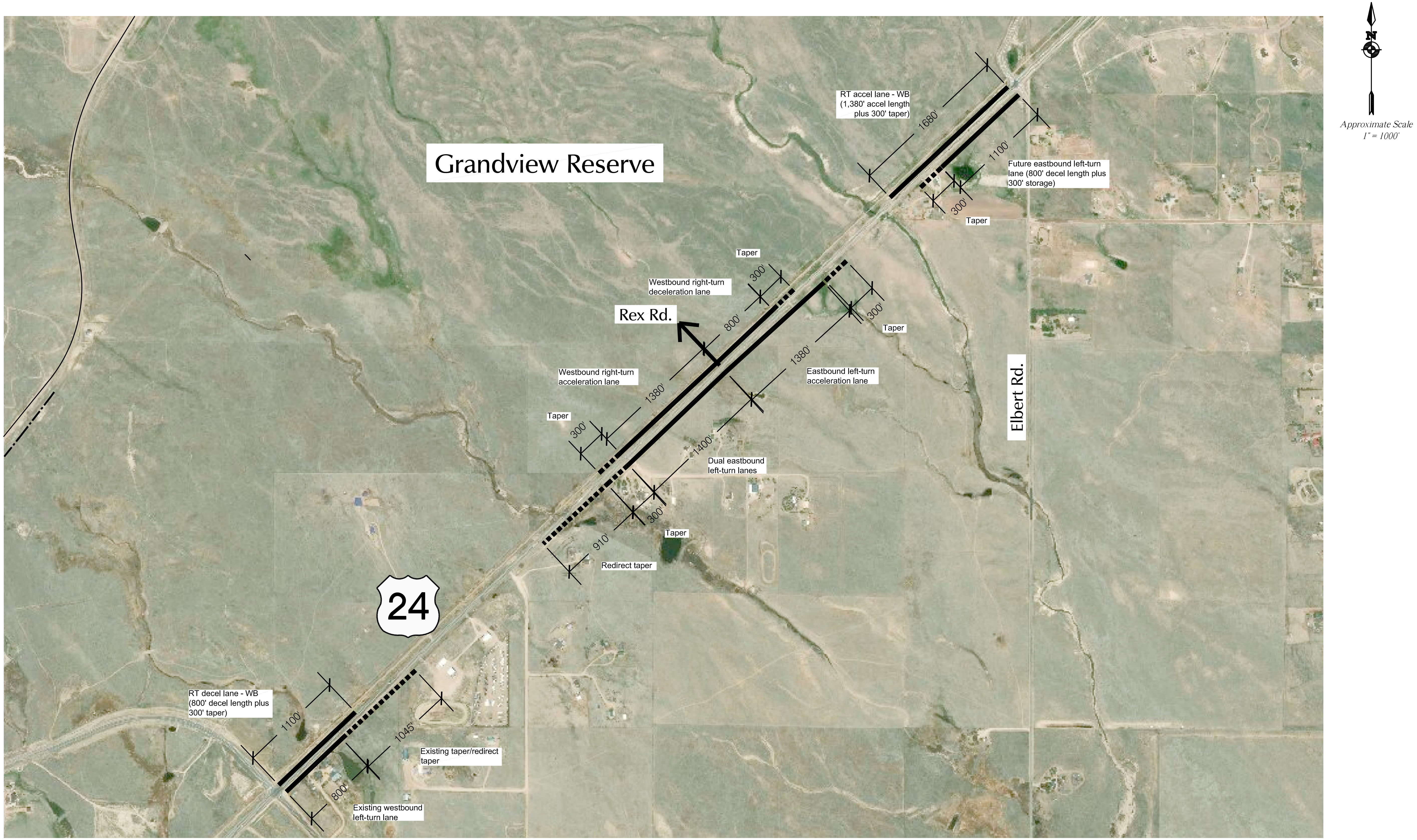

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Figure 14

US Highway 24 Intersection Spacing and Future Auxiliary Turn Lane Requirements

Grandview Reserve (LSC #184840)

Appendix Map - 2040 MTCP Roadway Plan

TRANSPORTATION
CONSULTANTS, INC.

El Paso County
Major Transportation Corridors Plan
Corridors to the Future 2010 - 2040

EL PASO COUNTY
EST. 1861
COLORADO

El Paso County 2040 Major Transportation Corridors Plan

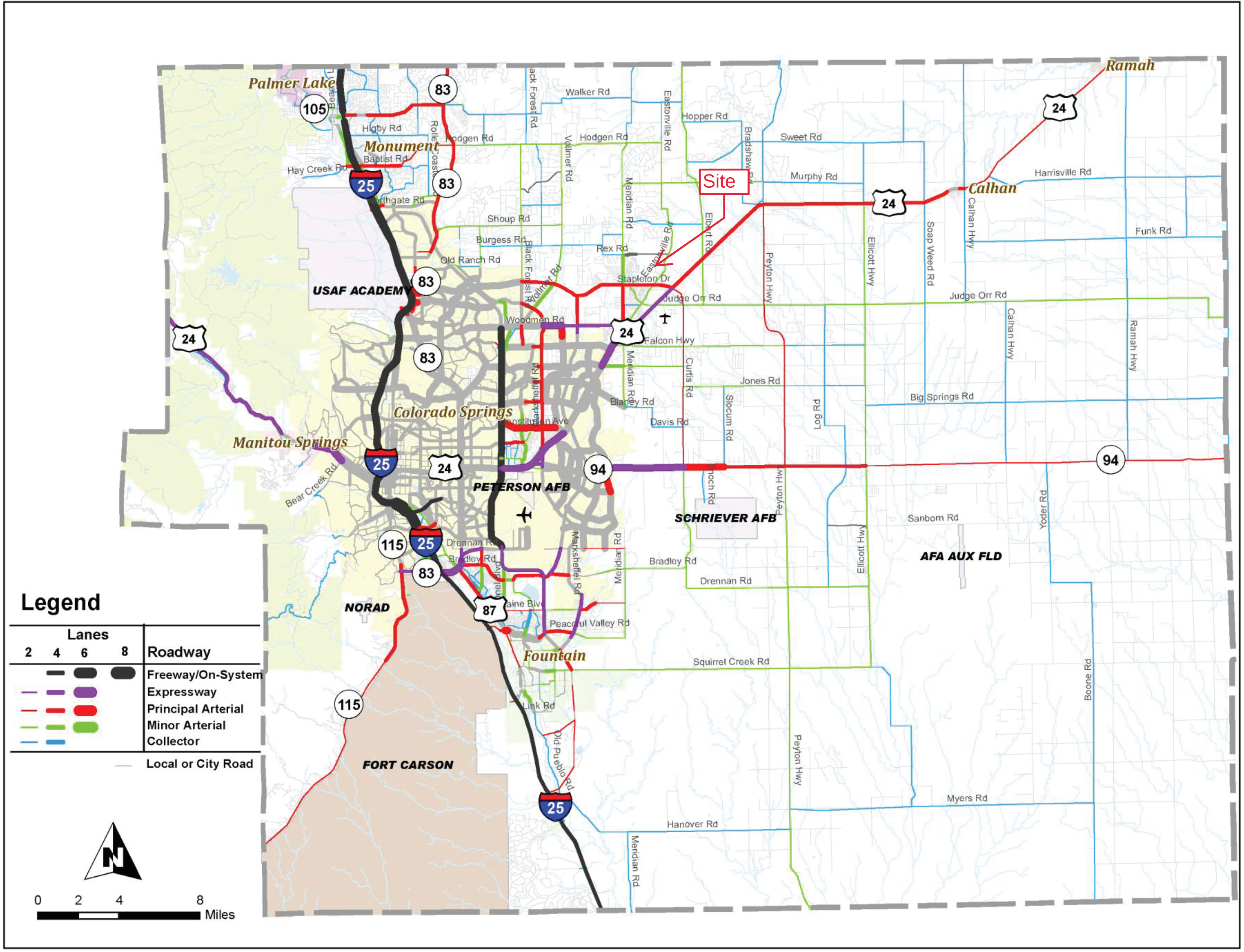
Adopted October 4, 2011
By the Planning Commission

LSA
LSA ASSOCIATES, INC.

Catalyst, Inc.

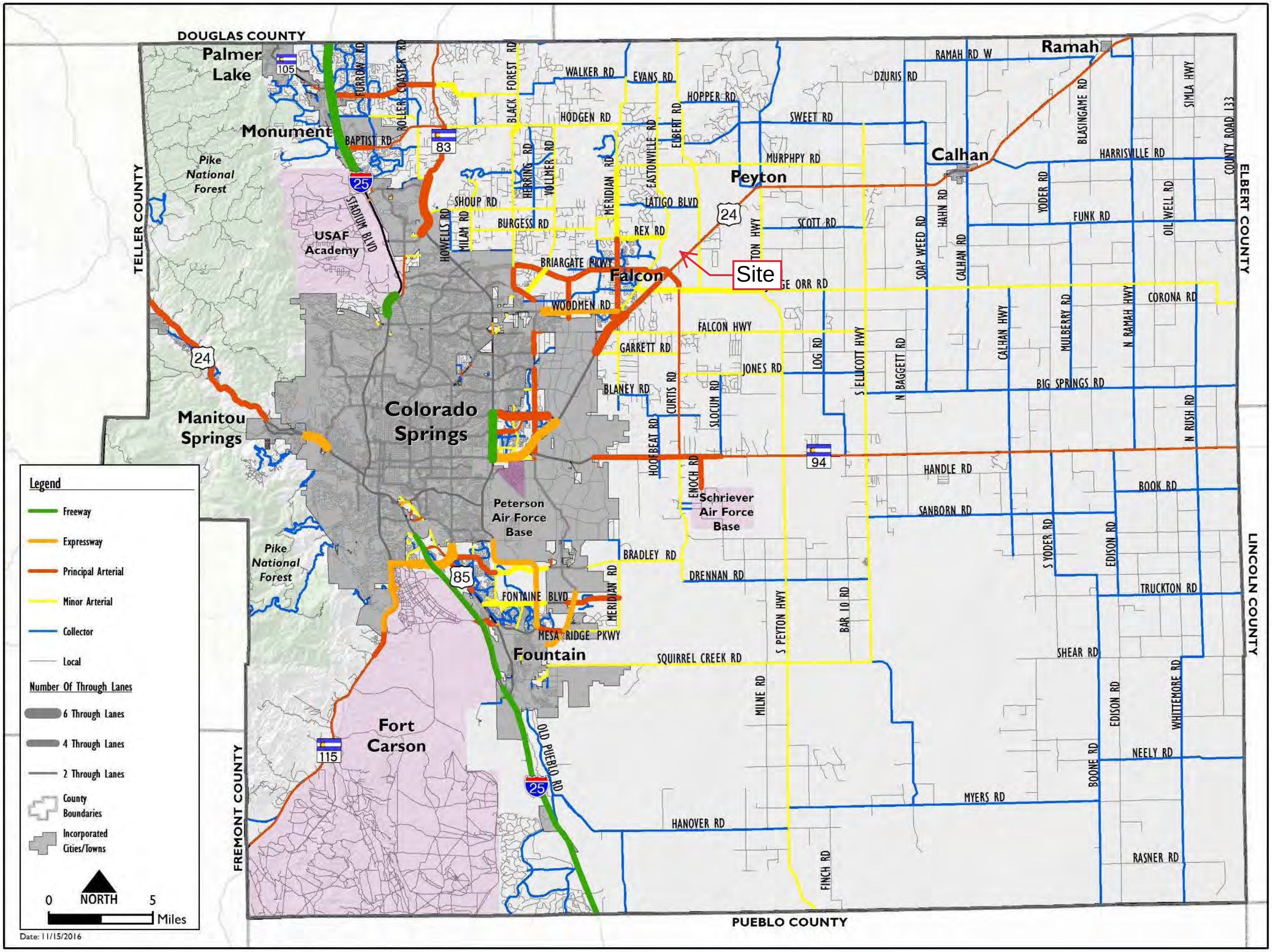
FIGURE 4-8: 2040 MTCP ROADWAY PLAN

Source: PPACG travel model network (with adjustments); El Paso County geographic information system data



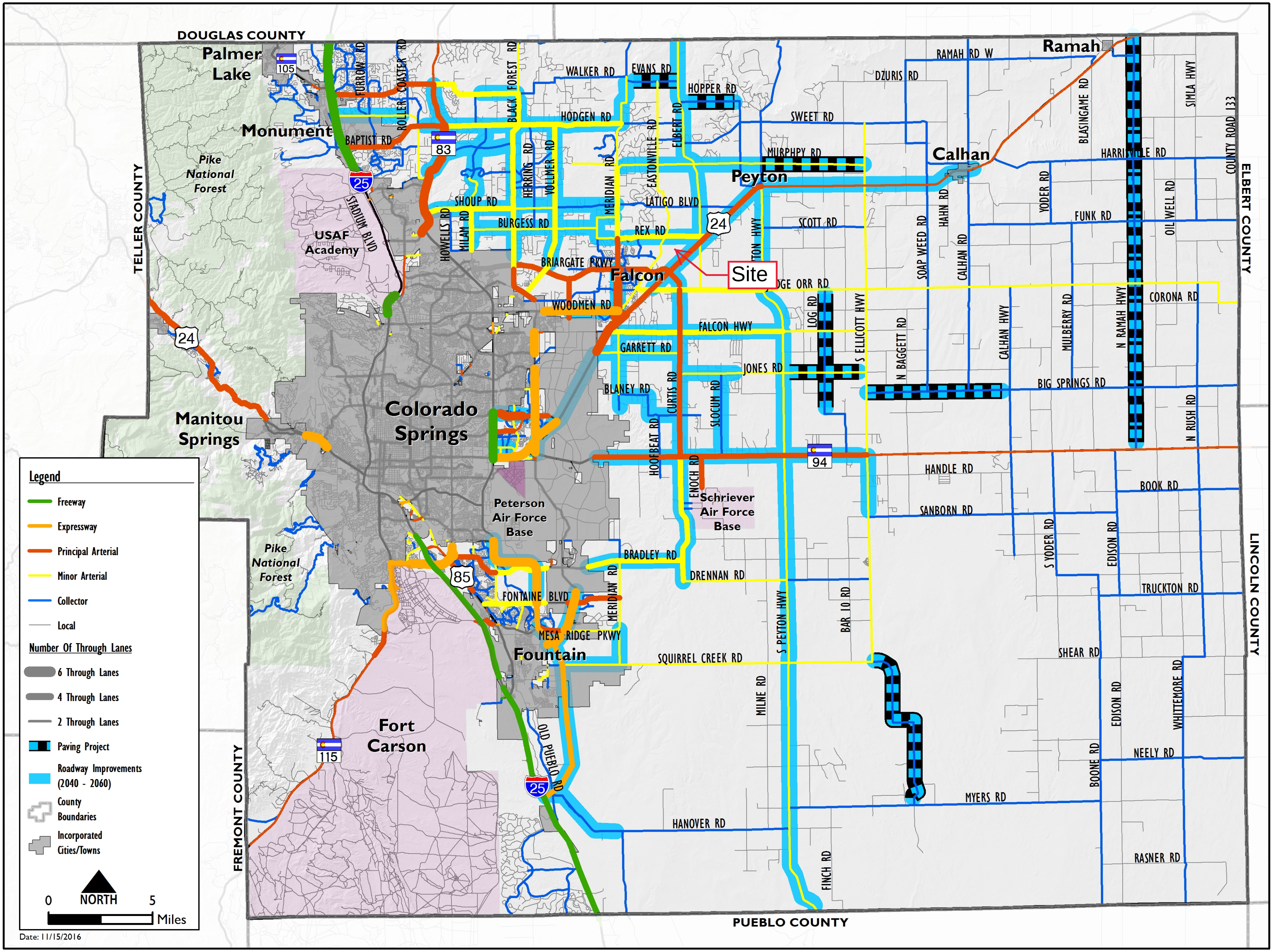
MTCP Maps

TRANSPORTATION
CONSULTANTS, INC.



Map 14: 2040 Roadway Plan (Classification and Lanes)

Map 17: 2060 Corridor Preservation

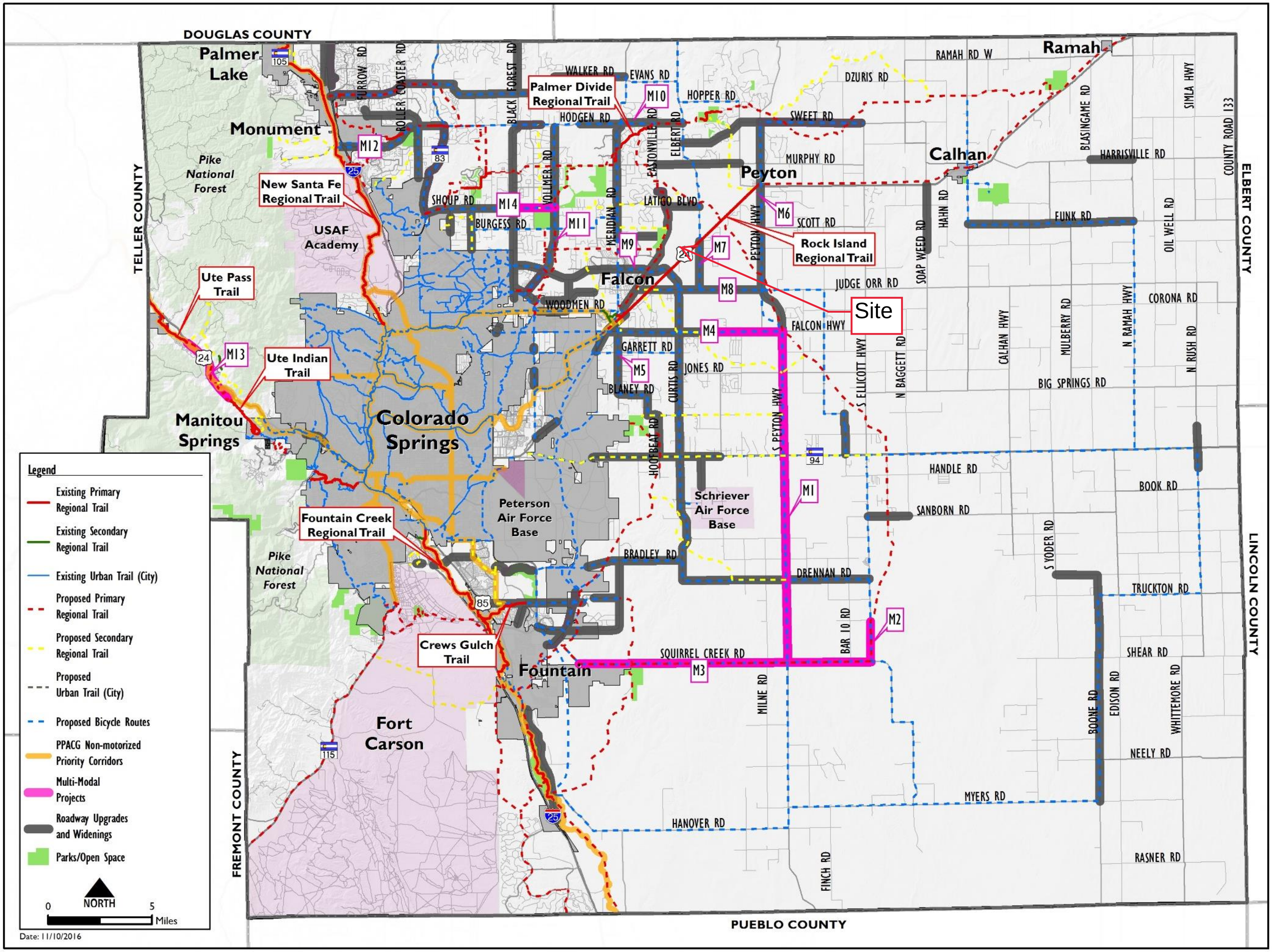


Date: 11/15/2016

MTCP Adopted Report 12-6-2016

Map 15 Bicycle and Pedestrian Network Improvements

TRANSPORTATION
CONSULTANTS, INC.



Map 15: Bicycle and Pedestrian Network and Improvements

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

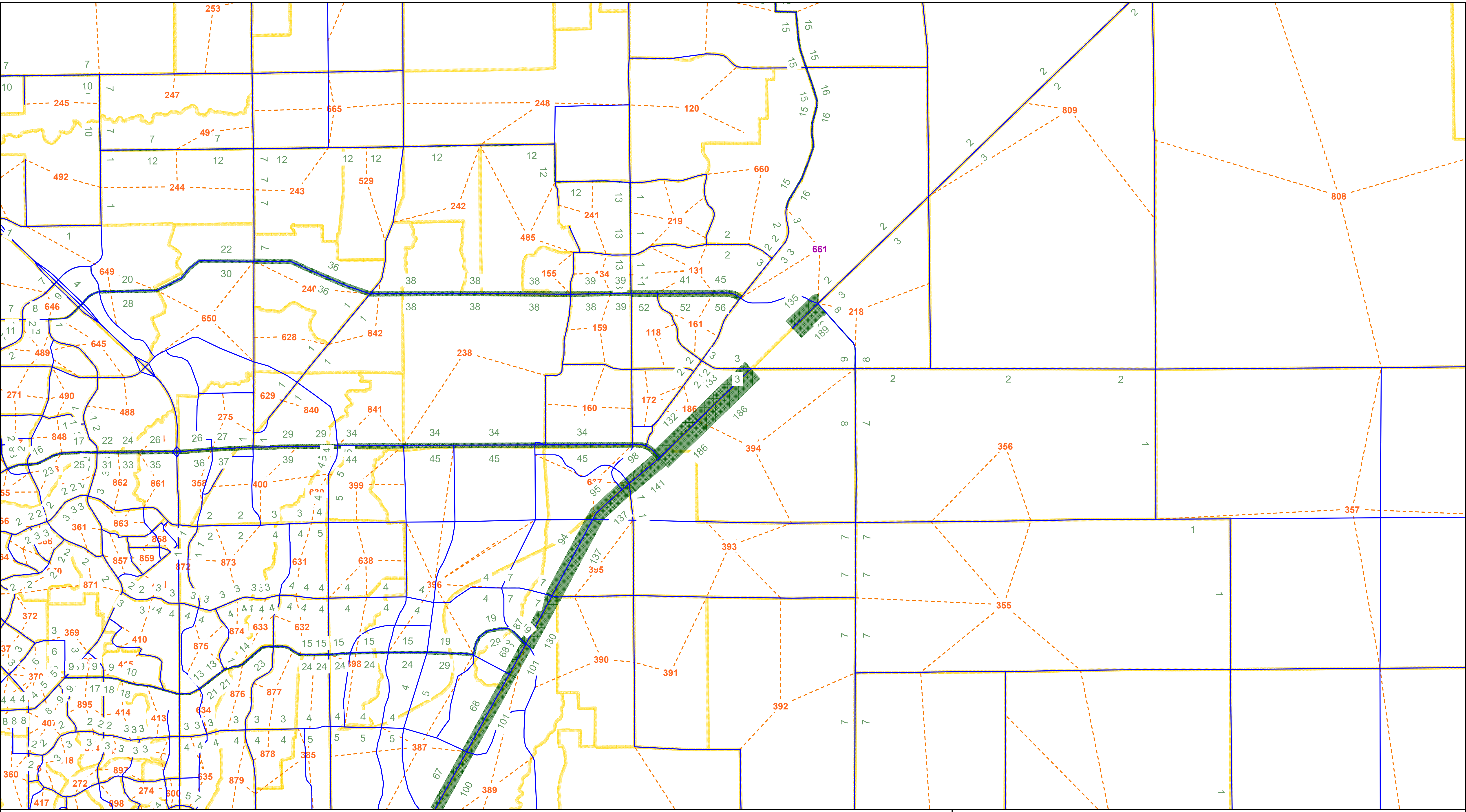
[2] Person-Trips

[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.

PPACG Model Output

TRANSPORTATION
CONSULTANTS, INC.



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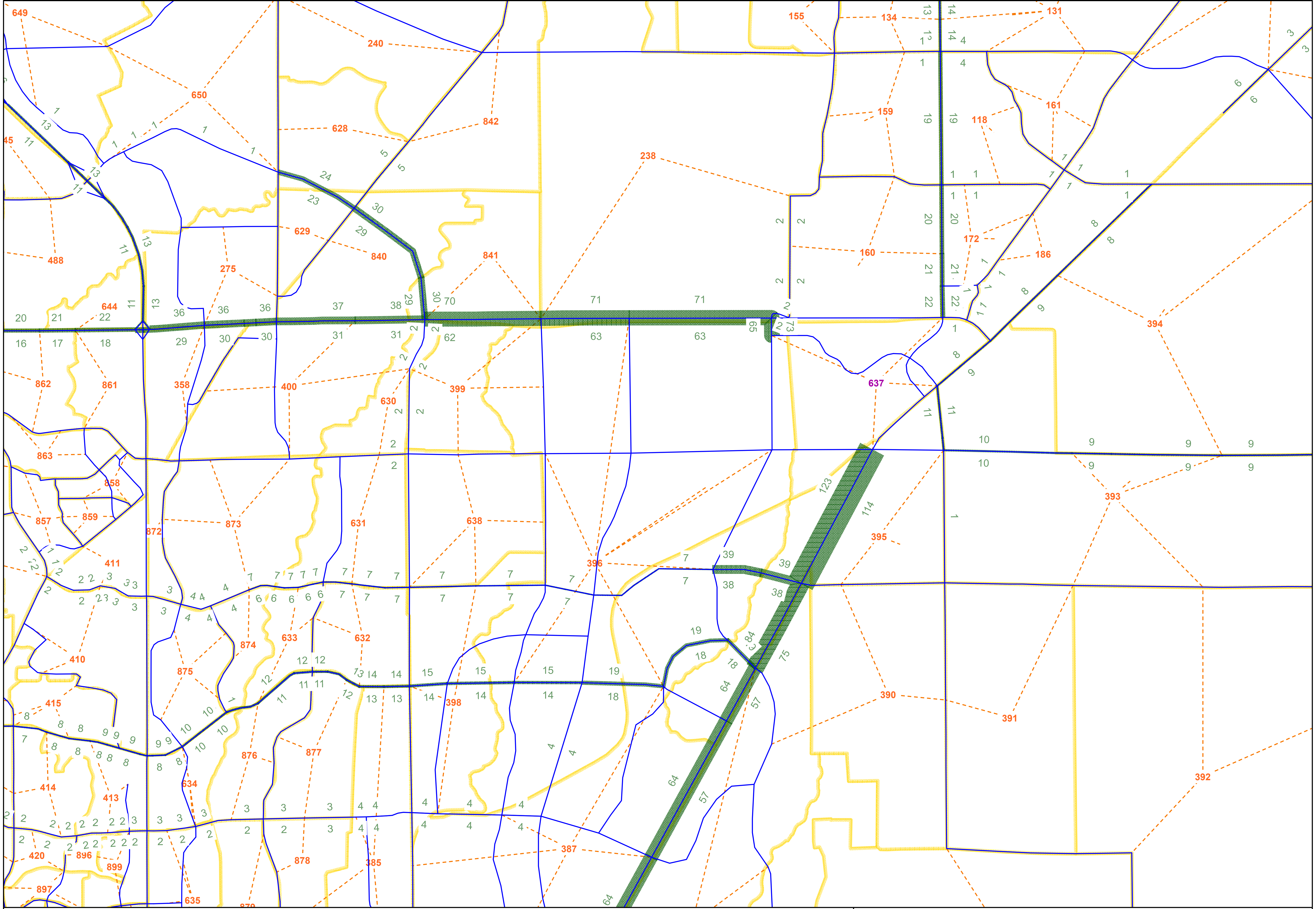

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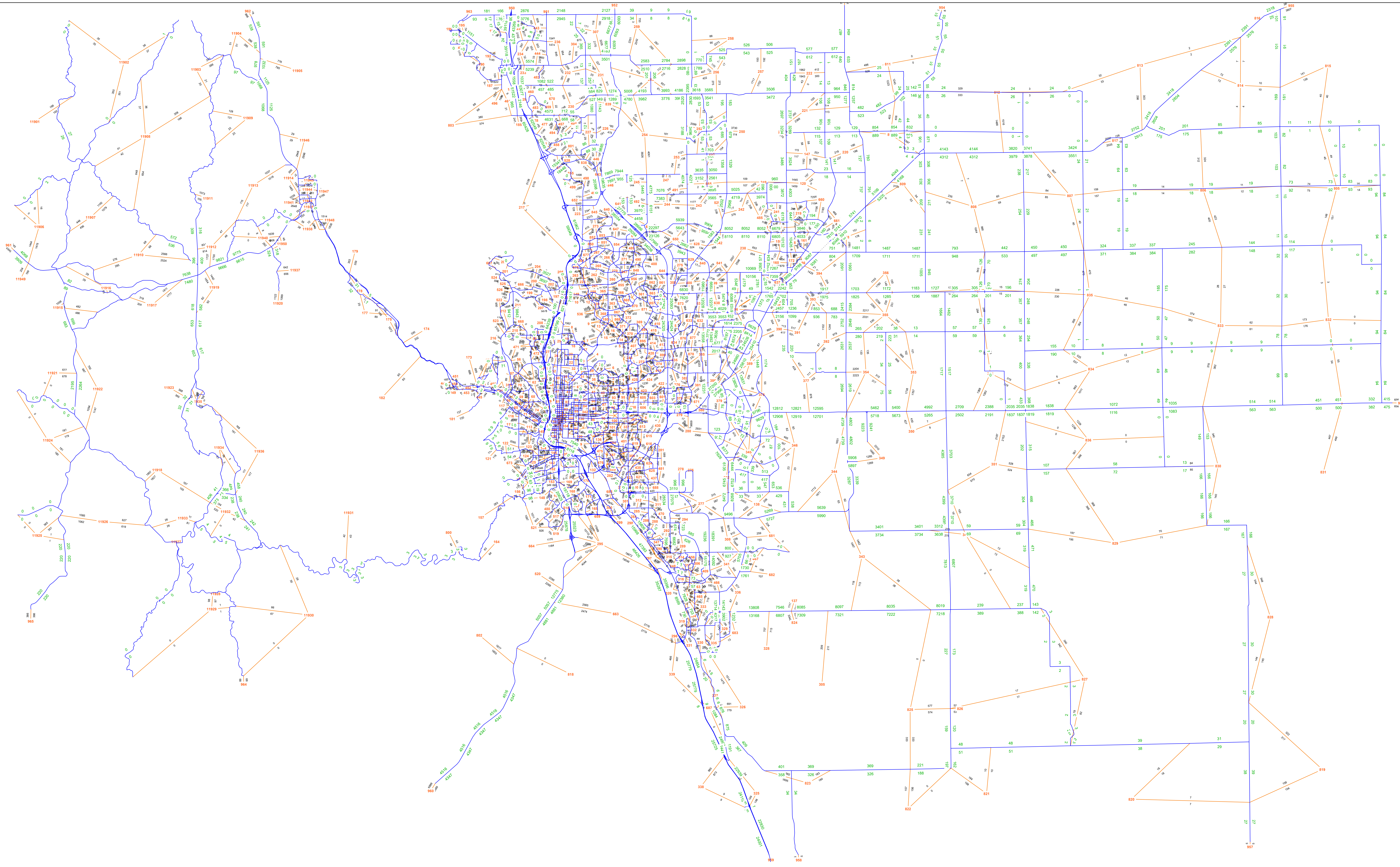

PPACGTR201507 2040_run on 10June2019.ver

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Traffic Counts

TRANSPORTATION
CONSULTANTS, INC.

LSC Transportation Consultants, Inc.

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

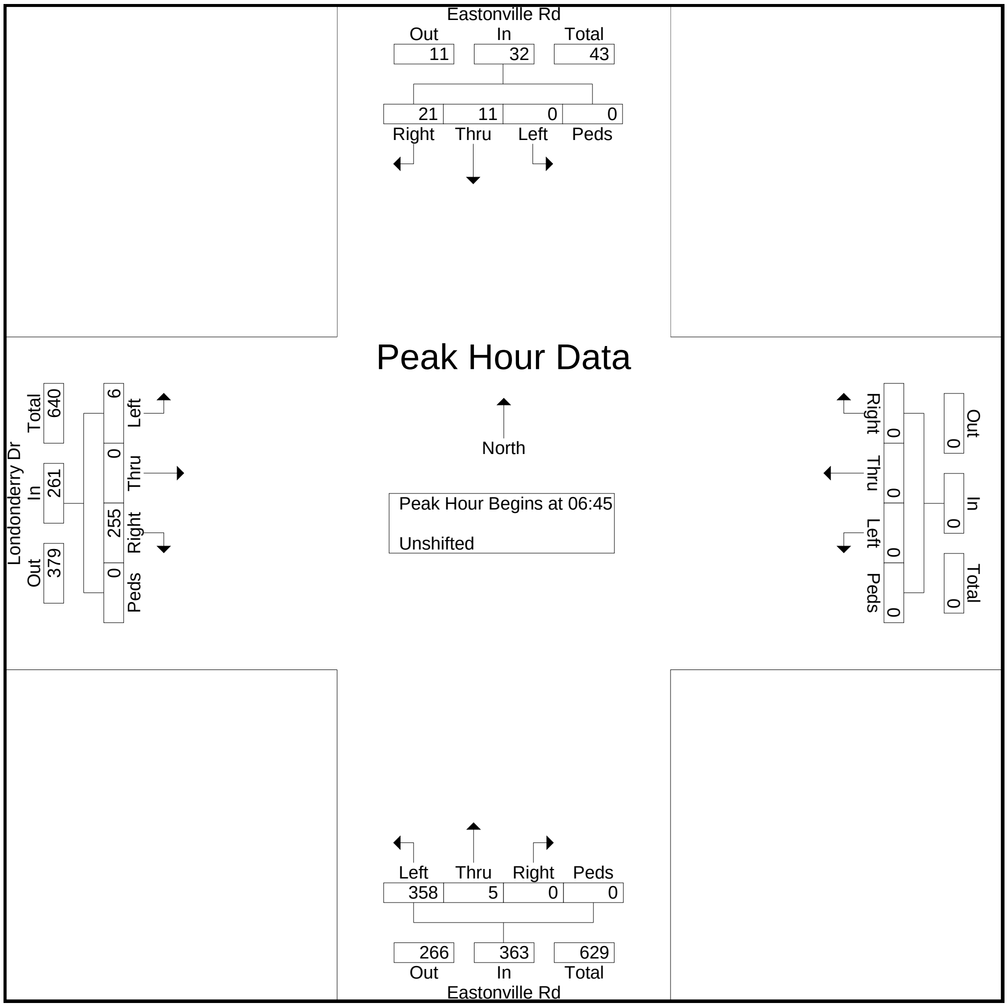
File Name : Eastonville Rd - Londonderry Dr AM 12-18
Site Code : 184750
Start Date : 12/11/2018
Page No : 1

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
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	

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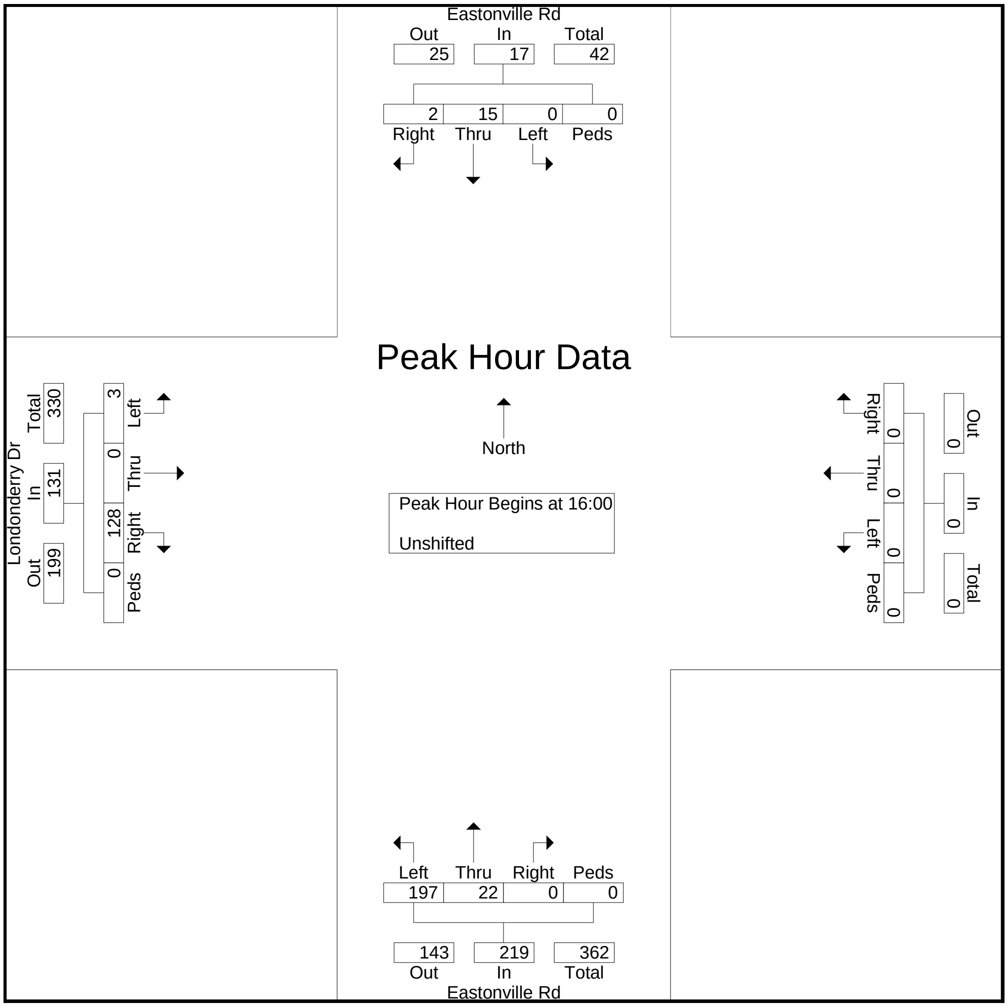
File Name : Eastonville Rd - Londonderry Dr PM 12-18
Site Code : 184750
Start Date : 12/11/2018
Page No : 1

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	

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



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

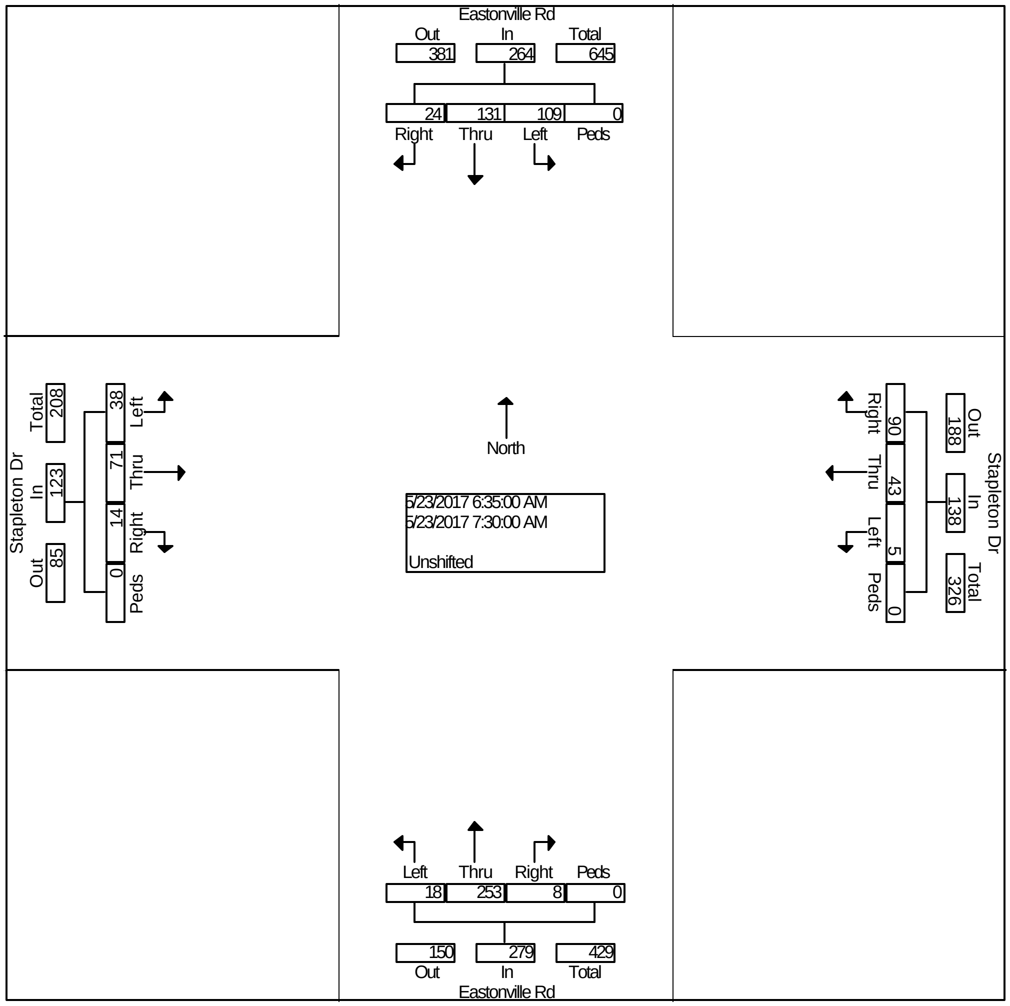
Groups Printed- Unshifted

	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					Stapleton Dr					Eastonville Rd					Stapleton Dr					
	From North					From East					From South					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

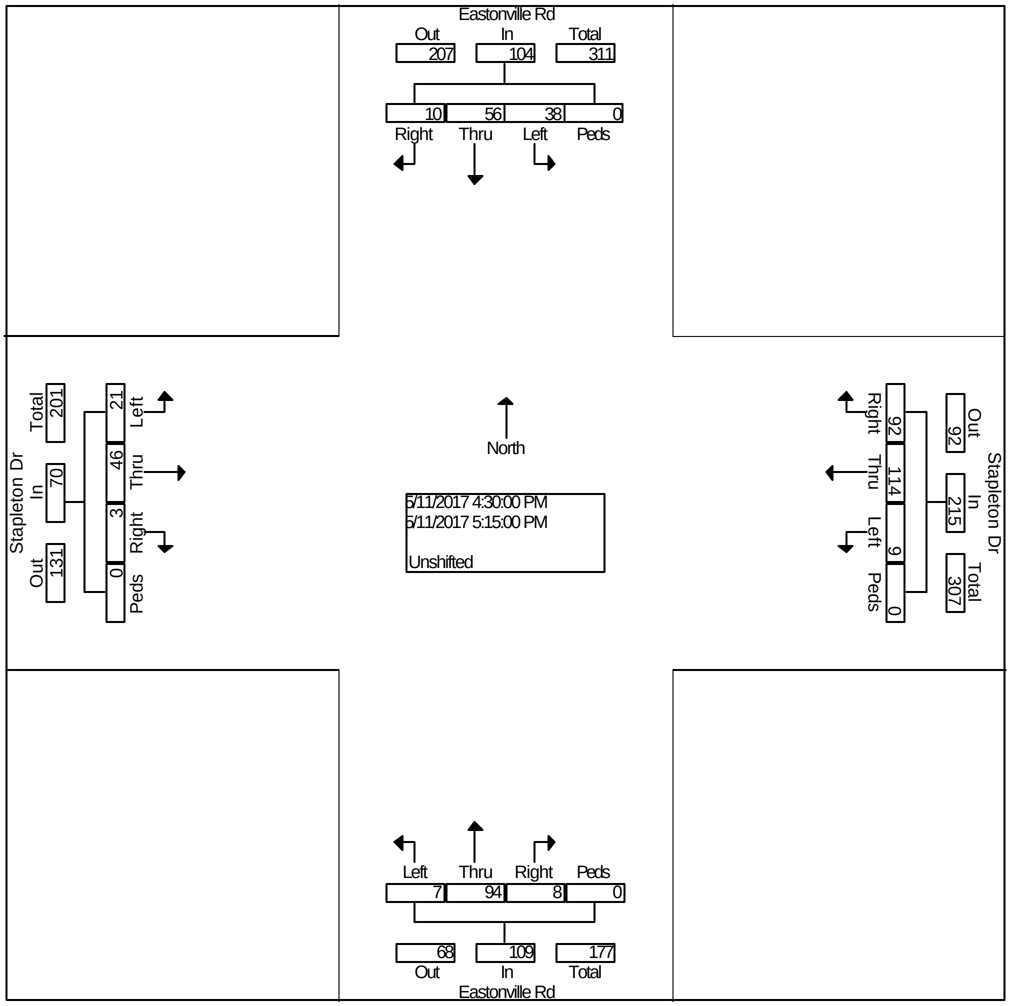
Groups Printed- Unshifted

	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
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 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	



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

File Name : Hwy 24 - Stapleton Rd AM 11-18
Site Code : 184750
Start Date : 11/15/2018
Page No : 1

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	

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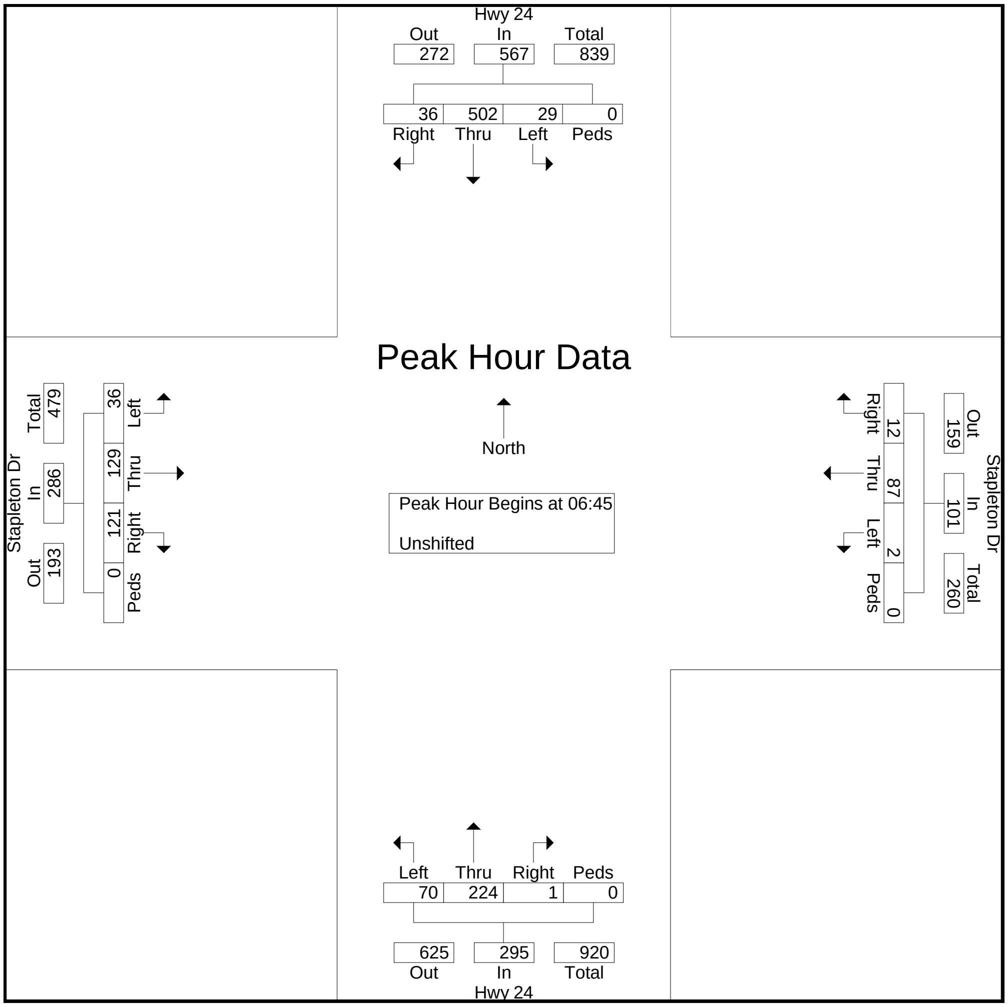
719-633-2868

File Name : Hwy 24 - Stapleton Rd AM 11-18
Site Code : 184750
Start Date : 11/15/2018
Page No : 2

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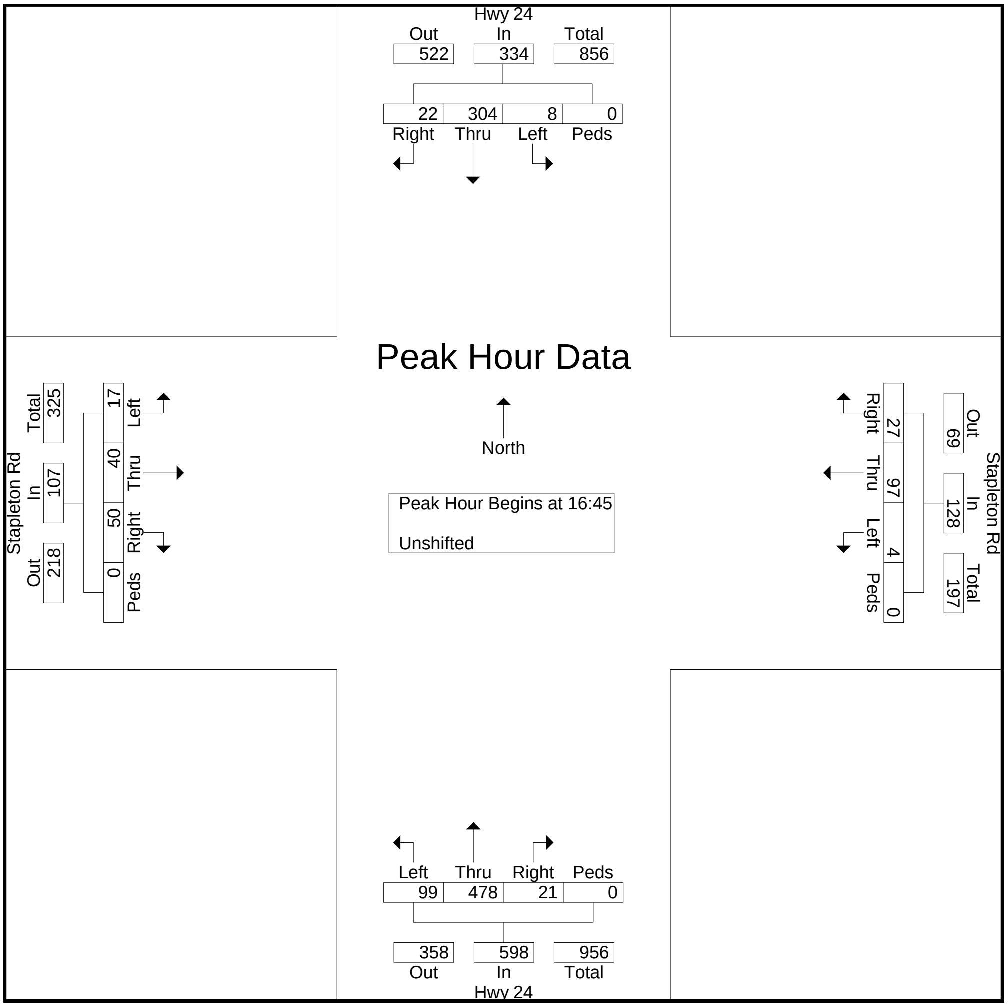
File Name : Hwy 24 - Stapleton Rd PM 11-18
Site Code : 00184750
Start Date : 11/28/2018
Page No : 1

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	

	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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719-633-2868

File Name : Eastonville Rd - Judge Orr Rd AM 10-19
Site Code : 194730
Start Date : 10/2/2019
Page No : 1

Groups Printed- Unshifted

	Eastonville Rd Southbound					Judge Orr Rd Westbound					Eastonville Rd Northbound					Judge Orr Rd Eastbound					
Start Time	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Left	Through	Right	Peds	App. Total	Int. Total
06:30 AM	13	26	0	0	39	3	11	0	0	14	2	35	12	0	49	8	41	22	0	71	173
06:45 AM	20	25	0	0	45	2	12	10	0	24	2	36	13	0	51	6	43	23	0	72	192
Total	33	51	0	0	84	5	23	10	0	38	4	71	25	0	100	14	84	45	0	143	365
07:00 AM	6	35	1	0	42	6	6	24	0	36	3	63	10	0	76	24	37	21	0	82	236
07:15 AM	7	48	6	0	61	10	9	25	0	44	5	54	14	0	73	47	36	26	0	109	287
07:30 AM	8	37	3	0	48	6	16	23	0	45	7	32	6	0	45	20	32	31	0	83	221
07:45 AM	9	30	0	0	39	7	9	11	0	27	5	40	6	0	51	10	28	29	0	67	184
Total	30	150	10	0	190	29	40	83	0	152	20	189	36	0	245	101	133	107	0	341	928
08:00 AM	12	30	1	0	43	6	6	6	0	18	9	13	9	0	31	0	18	25	0	43	135
08:15 AM	5	23	0	0	28	7	10	0	0	17	21	17	10	0	48	0	17	28	0	45	138
Grand Total	80	254	11	0	345	47	79	99	0	225	54	290	80	0	424	115	252	205	0	572	1566
Apprch %	23.2	73.6	3.2	0		20.9	35.1	44	0		12.7	68.4	18.9	0		20.1	44.1	35.8	0		
Total %	5.1	16.2	0.7	0	22	3	5	6.3	0	14.4	3.4	18.5	5.1	0	27.1	7.3	16.1	13.1	0	36.5	

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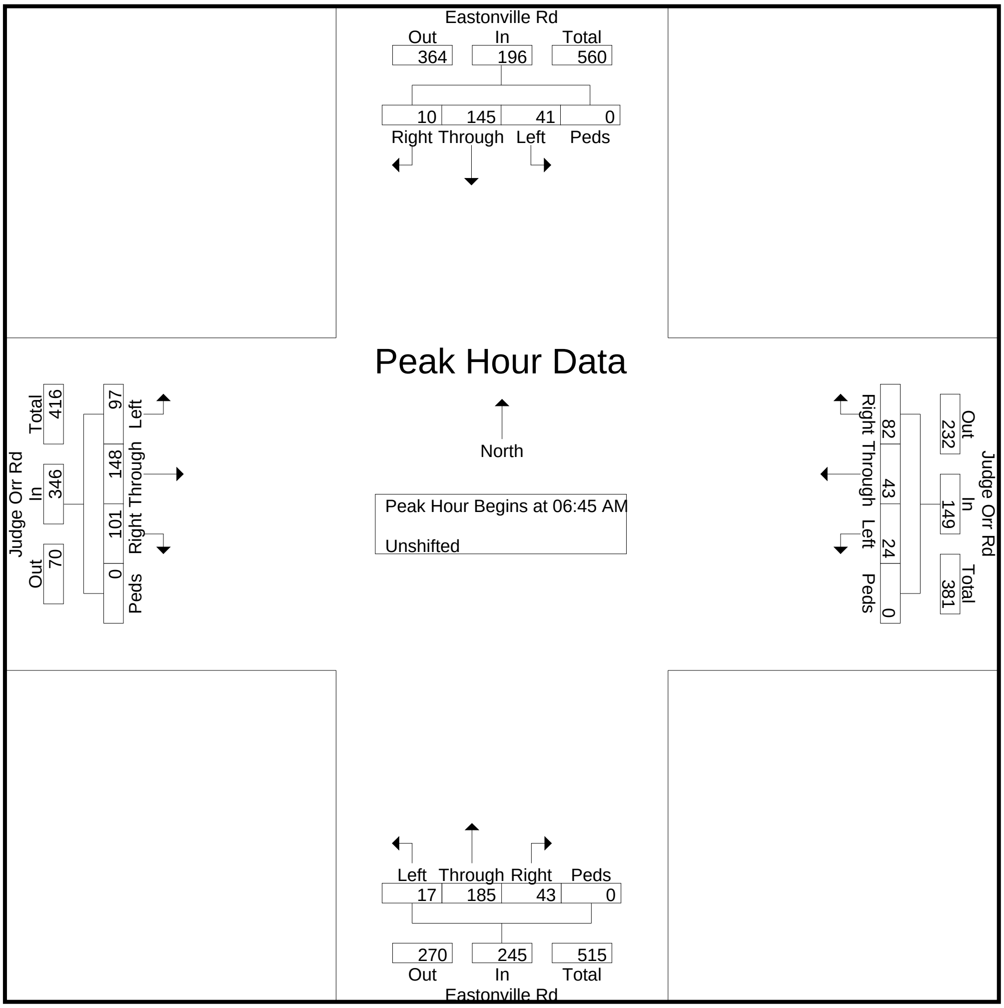
719-633-2868

File Name : Eastonville Rd - Judge Orr Rd AM 10-19
Site Code : 194730
Start Date : 10/2/2019
Page No : 2

	Eastonville Rd Southbound					Judge Orr Rd Westbound					Eastonville Rd Northbound					Judge Orr Rd Eastbound					
Start Time	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Int. Total**
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:45 AM																					
06:45 AM	**20**	25	0	0	45	2	12	10	0	24	2	36	13	0	51	6	**43**	23	0	72	192
07:00 AM	6	35	1	0	42	6	6	24	0	36	3	**63**	10	0	**76**	24	37	21	0	82	236
07:15 AM	7	**48**	**6**	0	**61**	**10**	9	**25**	0	44	5	54	**14**	0	73	**47**	36	26	0	**109**	**287**
07:30 AM	8	37	3	0	48	6	**16**	23	0	**45**	**7**	32	6	0	45	20	32	**31**	0	83	221
Total Volume	41	145	10	0	196	24	43	82	0	149	17	185	43	0	245	97	148	101	0	346	936
% App. Total	20.9	74	5.1	0		16.1	28.9	55	0		6.9	75.5	17.6	0		28	42.8	29.2	0		
PHF	.513	.755	.417	.000	.803	.600	.672	.820	.000	.828	.607	.734	.768	.000	.806	.516	.860	.815	.000	.794	.815



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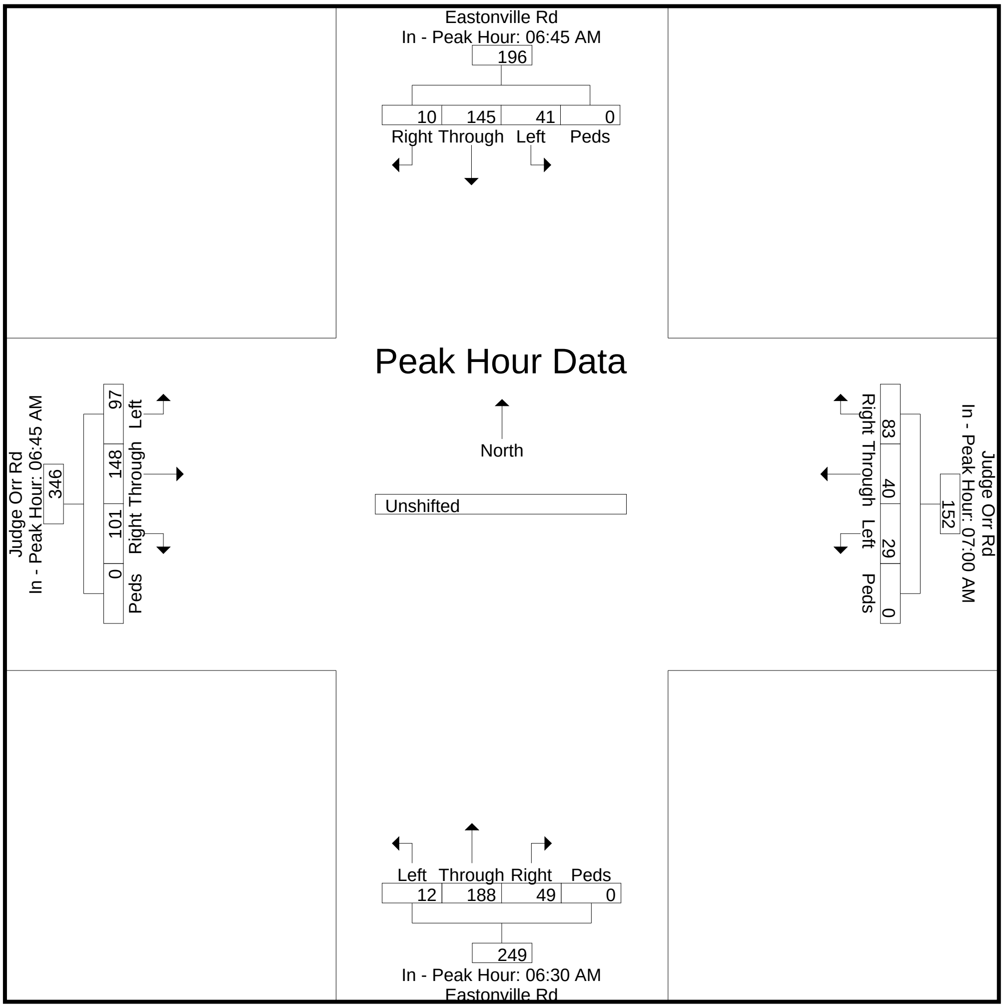
719-633-2868

File Name : Eastonville Rd - Judge Orr Rd AM 10-19
Site Code : 194730
Start Date : 10/2/2019
Page No : 3

	Eastonville Rd Southbound					**Judge Orr Rd Westbound**					**Eastonville Rd Northbound**					**Judge Orr Rd Eastbound**					
Start Time	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Int. Total**
Peak Hour Analysis From 06:30 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Each Approach Begins at:																					
	06:45 AM					07:00 AM					06:30 AM					06:45 AM					
+0 mins.	**20**	25	0	0	45	6	6	24	0	36	2	35	12	0	49	6	**43**	23	0	72	
+15 mins.	6	35	1	0	42	**10**	9	**25**	0	44	2	36	13	0	51	24	37	21	0	82	
+30 mins.	7	**48**	**6**	0	**61**	6	**16**	23	0	**45**	3	**63**	10	0	**76**	**47**	36	26	0	**109**	
+45 mins.	8	37	3	0	48	7	9	11	0	27	**5**	54	**14**	0	73	20	32	**31**	0	83	
Total Volume	41	145	10	0	196	29	40	83	0	152	12	188	49	0	249	97	148	101	0	346	
% App. Total	20.9	74	5.1	0		19.1	26.3	54.6	0		4.8	75.5	19.7	0		28	42.8	29.2	0		
PHF	.513	.755	.417	.000	.803	.725	.625	.830	.000	.844	.600	.746	.875	.000	.819	.516	.860	.815	.000	.794	



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

File Name : Eastonville Rd - Judge Orr Rd PM 10-19
Site Code : 194730
Start Date : 10/2/2019
Page No : 1

Groups Printed- Unshifted

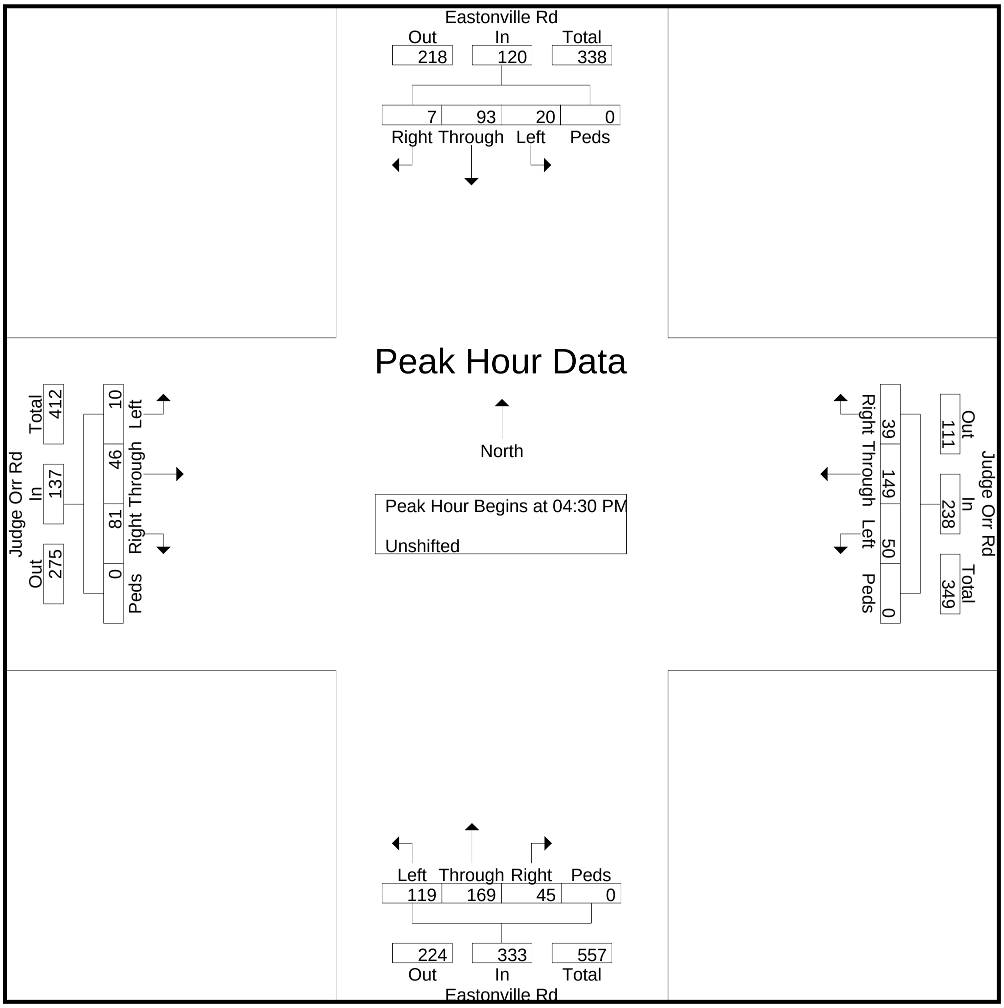
	Eastonville Rd Southbound					Judge Orr Rd Westbound					Eastonville Rd Northbound					Judge Orr Rd Eastbound					
Start Time	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Int. Total**
04:00 PM	10	21	1	0	32	11	25	9	0	45	26	30	16	0	72	2	8	26	0	36	185
04:15 PM	5	18	2	0	25	14	26	6	0	46	24	28	11	0	63	3	10	17	0	30	164
04:30 PM	5	22	2	0	29	18	47	12	0	77	32	40	13	0	85	4	12	19	0	35	226
04:45 PM	7	30	2	0	39	14	36	9	0	59	29	28	13	0	70	1	12	26	0	39	207
Total	27	91	7	0	125	57	134	36	0	227	111	126	53	0	290	10	42	88	0	140	782
05:00 PM	4	20	0	0	24	12	33	11	0	56	26	44	8	0	78	1	11	16	0	28	186
05:15 PM	4	21	3	0	28	6	33	7	0	46	32	57	11	0	100	4	11	20	0	35	209
05:30 PM	5	33	2	0	40	5	28	12	0	45	22	44	7	0	73	2	9	14	0	25	183
05:45 PM	8	36	2	0	46	6	24	5	0	35	25	41	11	0	77	1	16	18	0	35	193
Total	21	110	7	0	138	29	118	35	0	182	105	186	37	0	328	8	47	68	0	123	771
Grand Total	48	201	14	0	263	86	252	71	0	409	216	312	90	0	618	18	89	156	0	263	1553
Apprch %	18.3	76.4	5.3	0		21	61.6	17.4	0		35	50.5	14.6	0		6.8	33.8	59.3	0		
Total %	3.1	12.9	0.9	0	16.9	5.5	16.2	4.6	0	26.3	13.9	20.1	5.8	0	39.8	1.2	5.7	10	0	16.9	

File Name : Eastonville Rd - Judge Orr Rd PM 10-19
Site Code : 194730
Start Date : 10/2/2019

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 04:30 PM

	Eastonville Rd Southbound					Judge Orr Rd Westbound					Eastonville Rd Northbound					Judge Orr Rd Eastbound					
Start Time	**Left**	Through	Right	Peds	App. Total	**Left**	Through	Right	Peds	App. Total	**Left**	Through	Right	Peds	App. Total	**Left**	Through	Right	Peds	App. Total	Int. Total
04:30 PM	5	22	2	0	29	**18**	**47**	**12**	0	**77**	**32**	40	**13**	0	85	**4**	**12**	19	0	35	**226**
04:45 PM	**7**	**30**	2	0	**39**	14	36	9	0	59	29	28	13	0	70	1	12	**26**	0	**39**	207
05:00 PM	4	20	0	0	24	12	33	11	0	56	26	44	8	0	78	1	11	16	0	28	186
05:15 PM	4	21	**3**	0	28	6	33	7	0	46	32	**57**	11	0	**100**	4	11	20	0	35	209
Total Volume	20	93	7	0	120	50	149	39	0	238	119	169	45	0	333	10	46	81	0	137	828
% App. Total	16.7	77.5	5.8	0		21	62.6	16.4	0		35.7	50.8	13.5	0		7.3	33.6	59.1	0		
PHF	.714	.775	.583	.000	.769	.694	.793	.813	.000	.773	.930	.741	.865	.000	.833	.625	.958	.779	.000	.878	.916



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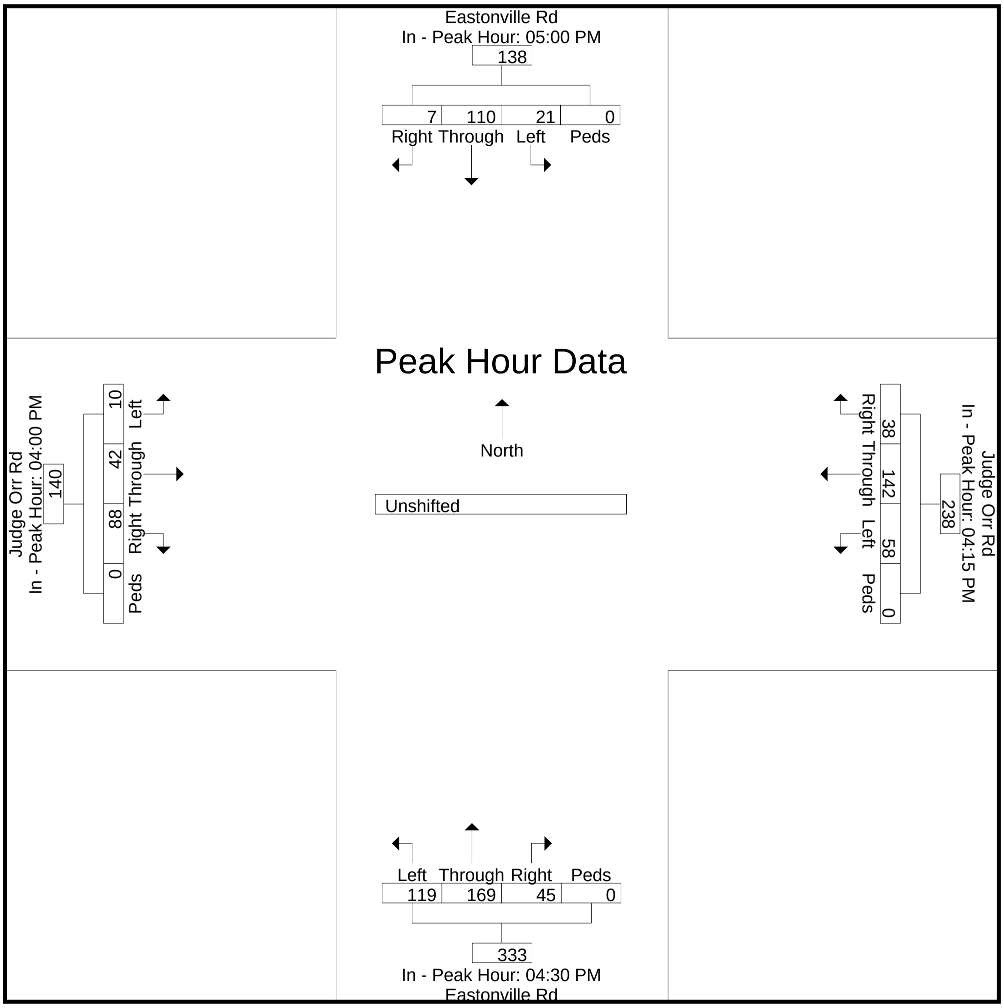
719-633-2868

File Name : Eastonville Rd - Judge Orr Rd PM 10-19
Site Code : 194730
Start Date : 10/2/2019
Page No : 3

	Eastonville Rd Southbound					**Judge Orr Rd Westbound**					**Eastonville Rd Northbound**					**Judge Orr Rd Eastbound**					
Start Time	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Left**	**Through**	**Right**	**Peds**	**App. Total**	**Int. Total**
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Each Approach Begins at:																					
	05:00 PM					04:15 PM					04:30 PM					04:00 PM					
+0 mins.	4	20	0	0	24	14	26	6	0	46	**32**	40	**13**	0	85	2	8	**26**	0	36	
+15 mins.	4	21	**3**	0	28	**18**	**47**	**12**	0	**77**	29	28	13	0	70	3	10	17	0	30	
+30 mins.	5	33	2	0	40	14	36	9	0	59	26	44	8	0	78	**4**	**12**	19	0	35	
+45 mins.	**8**	**36**	2	0	**46**	12	33	11	0	56	32	**57**	11	0	**100**	1	12	26	0	**39**	
Total Volume	21	110	7	0	138	58	142	38	0	238	119	169	45	0	333	10	42	88	0	140	
% App. Total	15.2	79.7	5.1	0		24.4	59.7	16	0		35.7	50.8	13.5	0		7.1	30	62.9	0		
PHF	.656	.764	.583	.000	.750	.806	.755	.792	.000	.773	.930	.741	.865	.000	.833	.625	.875	.846	.000	.897	



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

File Name : mclaughlin rd - eastonville rd am
Site Code : 184840
Start Date : 6/30/2020
Page No : 1

Groups Printed- Unshifted

	McLaughlin Rd Southbound					Eastonville Rd Westbound					McLaughlin Rd Northbound					Eastonville Rd Eastbound					
Start Time	**L**	**T**	**R**	**U**	**App. Total**	**L**	**T**	**R**	**U**	**App. Total**	**L**	**T**	**R**	**U**	**App. Total**	**L**	**T**	**R**	**U**	**App. Total**	**Int. Total**
06:30 AM	0	3	0	0	3	31	15	0	0	46	1	0	5	0	6	0	3	5	0	8	63
06:45 AM	0	3	0	0	3	25	6	0	0	31	1	0	10	0	11	0	8	5	0	13	58
Total	0	6	0	0	6	56	21	0	0	77	2	0	15	0	17	0	11	10	0	21	121
07:00 AM	0	1	0	0	1	41	6	0	0	47	4	0	5	0	9	0	5	4	0	9	66
07:15 AM	0	2	0	0	2	52	9	0	0	61	4	1	8	0	13	0	2	7	0	9	85
07:30 AM	0	1	0	0	1	56	5	0	0	61	4	1	16	0	21	0	5	13	0	18	101
07:45 AM	0	2	0	0	2	42	10	0	0	52	4	2	18	0	24	0	6	9	0	15	93
Total	0	6	0	0	6	191	30	0	0	221	16	4	47	0	67	0	18	33	0	51	345
08:00 AM	0	6	1	0	7	41	12	0	0	53	5	0	15	0	20	0	7	11	0	18	98
08:15 AM	0	1	0	0	1	39	10	0	0	49	3	1	11	0	15	0	10	6	0	16	81
Grand Total	0	19	1	0	20	327	73	0	0	400	26	5	88	0	119	0	46	60	0	106	645
Apprch %	0	95	5	0		81.8	18.2	0	0		21.8	4.2	73.9	0		0	43.4	56.6	0		
Total %	0	2.9	0.2	0	3.1	50.7	11.3	0	0	62	4	0.8	13.6	0	18.4	0	7.1	9.3	0	16.4	

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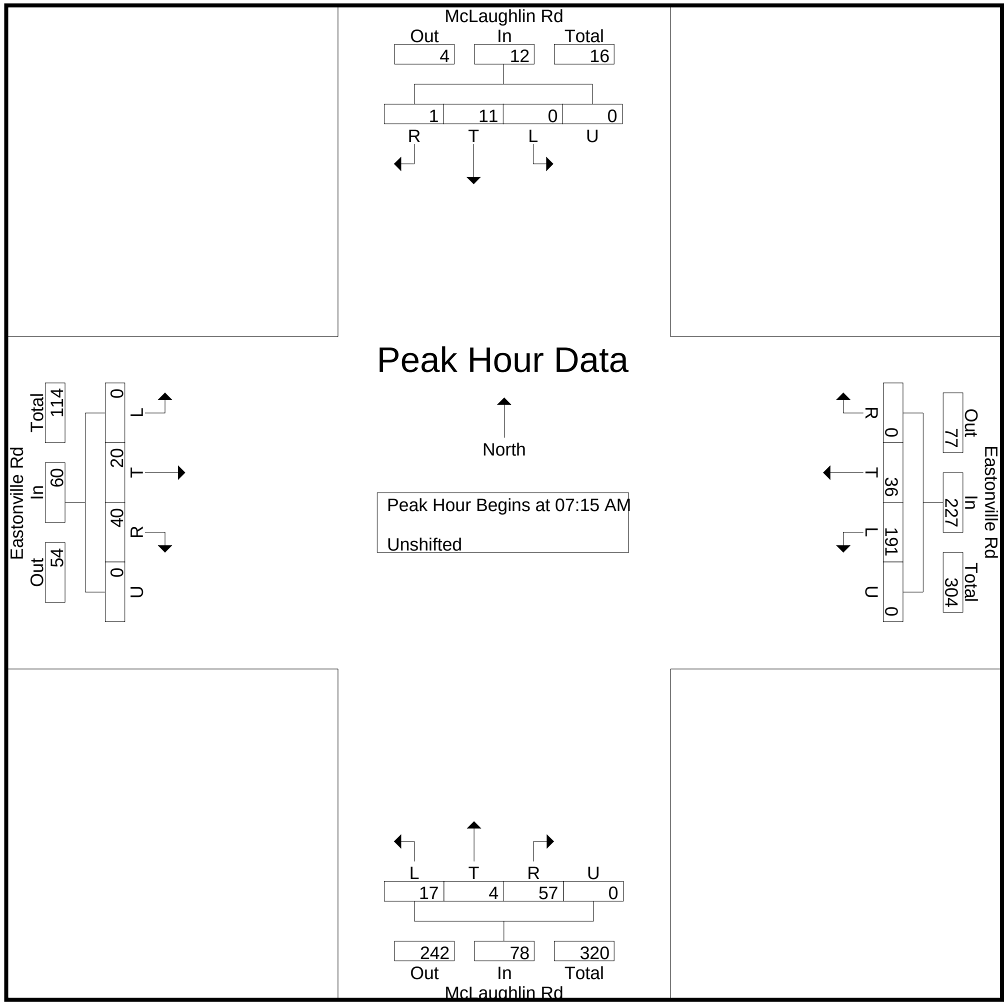
719-633-2868

File Name : mclaughlin rd - eastonville rd am
Site Code : 184840
Start Date : 6/30/2020
Page No : 3



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

File Name : McLaughlin Rd - Eastonville Rd PM
Site Code : 00184840
Start Date : 6/30/2020
Page No : 1

Groups Printed- Unshifted

	McLaughlin Rd Southbound					Eastonville Rd Westbound					McLaughlin Rd Northbound					Eastonville Rd Eastbound					
Start Time	**L**	**T**	**R**	**U**	**App. Total**	**L**	**T**	**R**	**U**	**App. Total**	**L**	**T**	**R**	**U**	**App. Total**	**L**	**T**	**R**	**U**	**App. Total**	**Int. Total**
04:00 PM	0	2	0	0	2	36	9	0	0	45	10	5	40	0	55	1	10	9	0	20	122
04:15 PM	0	1	0	0	1	50	9	0	0	59	11	5	71	0	87	0	24	16	0	40	187
04:30 PM	0	0	0	0	0	49	8	0	0	57	14	7	69	0	90	2	16	13	0	31	178
04:45 PM	0	1	0	0	1	59	12	1	0	72	13	5	67	0	85	1	26	16	0	43	201
Total	0	4	0	0	4	194	38	1	0	233	48	22	247	0	317	4	76	54	0	134	688
05:00 PM	0	5	0	0	5	47	11	0	0	58	20	2	82	0	104	2	30	17	0	49	216
05:15 PM	0	0	1	0	1	54	7	0	0	61	14	5	84	0	103	1	26	14	0	41	206
05:30 PM	0	2	0	0	2	75	9	0	0	84	22	4	87	0	113	4	37	21	0	62	261
05:45 PM	0	0	0	0	0	47	17	0	0	64	18	9	88	0	115	1	37	13	0	51	230
Total	0	7	1	0	8	223	44	0	0	267	74	20	341	0	435	8	130	65	0	203	913
Grand Total	0	11	1	0	12	417	82	1	0	500	122	42	588	0	752	12	206	119	0	337	1601
Apprch %	0	91.7	8.3	0		83.4	16.4	0.2	0		16.2	5.6	78.2	0		3.6	61.1	35.3	0		
Total %	0	0.7	0.1	0	0.7	26	5.1	0.1	0	31.2	7.6	2.6	36.7	0	47	0.7	12.9	7.4	0	21	

LSC Transportation Consultants, Inc.

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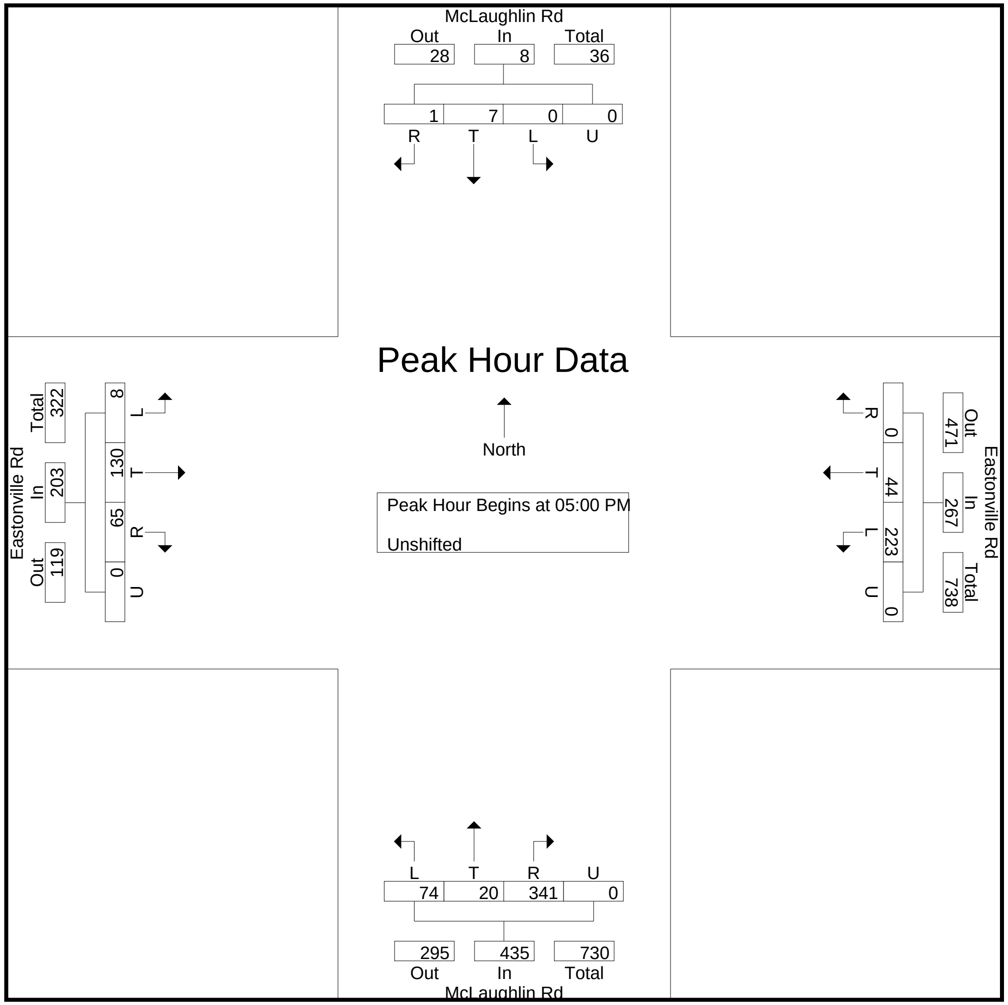
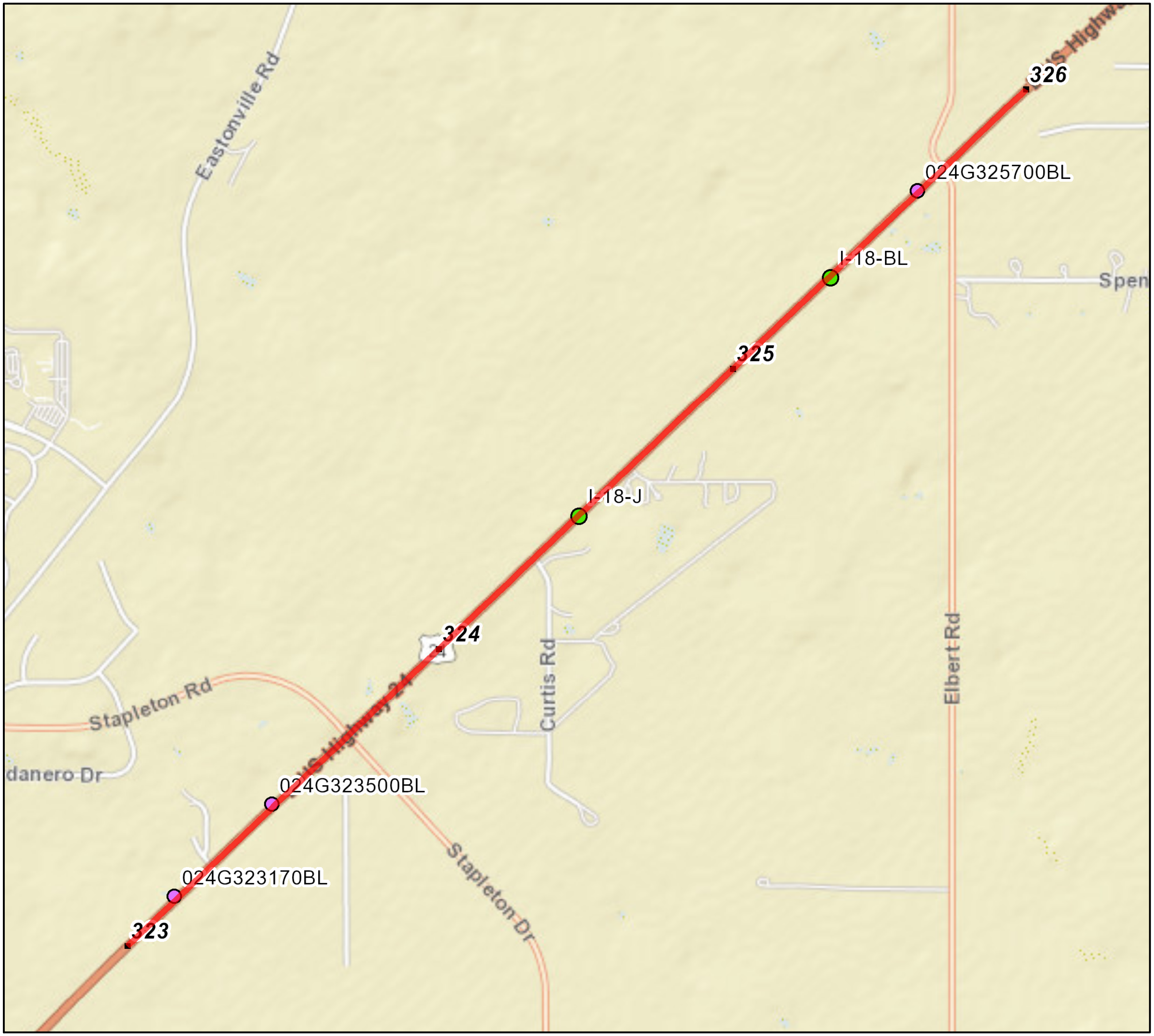


Colorado Department of Transportation Straight Line Diagram

TRANSPORTATION
CONSULTANTS, INC.

Route 024G From 323 to 326



Legend

Route

Milepoint

Structures

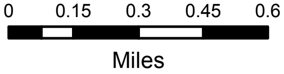
● Major Structure

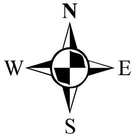
● Minor Structure

Created:

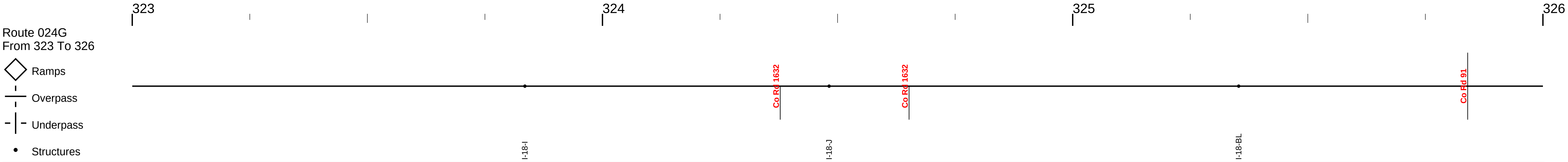
Date: 7/8/2020

Time: 10:19:02 AM





Route 024G
From 323 To 326



CLASSIFICATION

Access Control	E-X: Expressway, Major Bypass

SAFETY

Primary Speed Limit	65	35

TRAFFIC

AADT	11000	8000
DHV	11.0	
Off Peak Truck Percentage	4.70	7.40
Peak Truck Percentage	0.39	0.44
Year 20 Factor	1.45	1.33

It may appear that information is missing from the straight line diagram. If so, reduce the number of miles/page and re-submit the request.

Levels of Service

TRANSPORTATION
CONSULTANTS, INC.

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	68	67	67
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	345	526	7	16	31

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1091	32	47	0	-	0
Stage 1	32	-	-	-	-	-
Stage 2	1059	-	-	-	-	-
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	238	1042	1560	-	-	-
Stage 1	991	-	-	-	-	-
Stage 2	333	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	157	1042	1560	-	-	-
Mov Cap-2 Maneuver	157	-	-	-	-	-
Stage 1	655	-	-	-	-	-
Stage 2	333	-	-	-	-	-

Approach	EB		NB		SB	
HCM Control Delay, s	10.6		8.4		0	
HCM LOS	B					

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1560	-	157	1042	-	-
HCM Lane V/C Ratio	0.337	-	0.052	0.331	-	-
HCM Control Delay (s)	8.5	0	29.2	10.2	-	-
HCM Lane LOS	A	A	D	B	-	-
HCM 95th %tile Q(veh)	1.5	-	0.2	1.5	-	-

13: Eastonville Rd & Stapleton Dr

Intersection	
Int Delay, s/veh	24.8

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	76	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	172	30

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1048	960	187	1019	969	429	202	0	0	435	0	0
Stage 1	465	465	-	489	489	-	-	-	-	-	-	-
Stage 2	583	495	-	530	480	-	-	-	-	-	-	-
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	206	257	855	215	254	626	1370	-	-	1125	-	-
Stage 1	578	563	-	561	549	-	-	-	-	-	-	-
Stage 2	498	546	-	533	554	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	113	215	855	112	212	626	1370	-	-	1125	-	-
Mov Cap-2 Maneuver	113	215	-	112	212	-	-	-	-	-	-	-
Stage 1	561	484	-	545	533	-	-	-	-	-	-	-
Stage 2	342	530	-	348	476	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	129.8	19.5	0.5	3.5
HCM LOS	F	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1370	-	-	180	194	626	1125	-	-
HCM Lane V/C Ratio	0.022	-	-	1.035	0.348	0.202	0.124	-	-
HCM Control Delay (s)	7.7	0	-	129.8	33.2	12.2	8.7	0	-
HCM Lane LOS	A	A	-	F	D	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	8.8	1.5	0.8	0.4	-	-

HCM 6th TWSC
14: US 24 & Stapleton Dr

Intersection	
Int Delay, s/veh	13.9

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	92	92	92
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	32	546	39

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1131	1078	546	1240	1116	287	585	0	0	288	0	0
Stage 1	610	610	-	467	467	-	-	-	-	-	-	-
Stage 2	521	468	-	773	649	-	-	-	-	-	-	-
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	181	219	538	152	208	752	990	-	-	1274	-	-
Stage 1	482	485	-	576	562	-	-	-	-	-	-	-
Stage 2	539	561	-	392	466	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	99	194	538	39	184	752	990	-	-	1274	-	-
Mov Cap-2 Maneuver	99	194	-	39	184	-	-	-	-	-	-	-
Stage 1	438	473	-	524	511	-	-	-	-	-	-	-
Stage 2	394	510	-	195	454	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	44.1	40.2	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)	990	-	-	99	194	538	39	184	752	1274	-	-
HCM Lane V/C Ratio	0.091	-	-	0.418	0.764	0.259	0.055	0.503	0.017	0.025	-	-
HCM Control Delay (s)	9	-	-	65.3	66.4	14	102.6	42.9	9.9	7.9	-	-
HCM Lane LOS	A	-	-	F	F	B	F	E	A	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	1.7	5.1	1	0.2	2.5	0.1	0.1	-	-

Intersection	
Intersection Delay, s/veh	16.5
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	97	148	101	24	43	82	17	185	43	41	145	10
Future Vol, veh/h	97	148	101	24	43	82	17	185	43	41	145	10
Peak Hour Factor	0.79	0.79	0.79	0.85	0.85	0.85	0.84	0.84	0.84	0.80	0.80	0.80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	123	187	128	28	51	96	20	220	51	51	181	13
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	18	11.7	18.5	14.8
HCM LOS	C	B	C	B

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	81%	0%	59%	0%	100%	0%	0%	94%
Vol Right, %	0%	19%	0%	41%	0%	0%	100%	0%	6%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	17	228	97	249	24	43	82	41	155
LT Vol	17	0	97	0	24	0	0	41	0
Through Vol	0	185	0	148	0	43	0	0	145
RT Vol	0	43	0	101	0	0	82	0	10
Lane Flow Rate	20	271	123	315	28	51	96	51	194
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.045	0.555	0.264	0.607	0.066	0.112	0.194	0.116	0.409
Departure Headway (Hd)	8.008	7.365	7.738	6.936	8.461	7.948	7.229	8.155	7.6
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	447	489	464	520	423	450	495	439	473
Service Time	5.766	5.123	5.492	4.69	6.228	5.715	4.996	5.916	5.361
HCM Lane V/C Ratio	0.045	0.554	0.265	0.606	0.066	0.113	0.194	0.116	0.41
HCM Control Delay	11.1	19	13.3	19.9	11.8	11.7	11.7	12	15.6
HCM Lane LOS	B	C	B	C	B	B	B	B	C
HCM 95th-tile Q	0.1	3.3	1.1	4	0.2	0.4	0.7	0.4	2

Intersection	
Int Delay, s/veh	6.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✣	
Traffic Vol, veh/h	0	20	40	191	36	0	17	4	57	0	11	1
Future Vol, veh/h	0	20	40	191	36	0	17	4	57	0	11	1
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	100	-	-	100	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	93	93	93	93	93	93	78	78	78
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	24	48	205	39	0	18	4	61	0	14	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	39	0	0	72	0	0	505	497	48	530	521	39
Stage 1	-	-	-	-	-	-	48	48	-	449	449	-
Stage 2	-	-	-	-	-	-	457	449	-	81	72	-
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	1571	-	-	1528	-	-	478	475	1021	460	460	1033
Stage 1	-	-	-	-	-	-	965	855	-	589	572	-
Stage 2	-	-	-	-	-	-	583	572	-	927	835	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1571	-	-	1528	-	-	417	411	1021	385	398	1033
Mov Cap-2 Maneuver	-	-	-	-	-	-	417	411	-	385	398	-
Stage 1	-	-	-	-	-	-	965	855	-	589	495	-
Stage 2	-	-	-	-	-	-	490	495	-	867	835	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	6.5	10.2	13.9
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	417	930	1571	-	-	1528	-	-	419
HCM Lane V/C Ratio	0.044	0.071	-	-	-	0.134	-	-	0.037
HCM Control Delay (s)	14	9.2	0	-	-	7.7	-	-	13.9
HCM Lane LOS	B	A	A	-	-	A	-	-	B
HCM 95th %tile Q(veh)	0.1	0.2	0	-	-	0.5	-	-	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	7.3

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	83	83	83	87	87	87	68	68	68	83	83	83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	25	55	4	10	131	106	10	138	12	46	67	12

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	448	335	73	359	335	144	79	0	0	150	0	0
Stage 1	165	165	-	164	164	-	-	-	-	-	-	-
Stage 2	283	170	-	195	171	-	-	-	-	-	-	-
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	521	585	989	596	585	903	1519	-	-	1431	-	-
Stage 1	837	762	-	838	762	-	-	-	-	-	-	-
Stage 2	724	758	-	807	757	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	366	561	989	532	561	903	1519	-	-	1431	-	-
Mov Cap-2 Maneuver	366	561	-	532	561	-	-	-	-	-	-	-
Stage 1	831	736	-	832	757	-	-	-	-	-	-	-
Stage 2	525	753	-	718	731	-	-	-	-	-	-	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	13.8			11.8			0.5			2.8		
HCM LOS	B			B								

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1519	-	-	492	559	903	1431	-	-
HCM Lane V/C Ratio	0.007	-	-	0.171	0.253	0.117	0.032	-	-
HCM Control Delay (s)	7.4	0	-	13.8	13.6	9.5	7.6	0	-
HCM Lane LOS	A	A	-	B	B	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.6	1	0.4	0.1	-	-

Intersection	
Int Delay, s/veh	8.7

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	21	8	304	22
Future Vol, veh/h	17	40	50	4	97	27	99	478	21	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	83	83	83	83	83	83	93	93	93	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	20	48	60	5	117	33	106	514	23	9	358	26

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1189	1125	358	1169	1128	514	384	0	0	537	0	0
Stage 1	376	376	-	726	726	-	-	-	-	-	-	-
Stage 2	813	749	-	443	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	165	205	686	170	204	560	1174	-	-	1031	-	-
Stage 1	645	616	-	416	430	-	-	-	-	-	-	-
Stage 2	372	419	-	594	600	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	71	185	686	115	184	560	1174	-	-	1031	-	-
Mov Cap-2 Maneuver	71	185	-	115	184	-	-	-	-	-	-	-
Stage 1	587	610	-	379	391	-	-	-	-	-	-	-
Stage 2	223	381	-	495	595	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	28.6	44.2	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	-	-	71	185	686	115	184	560	1031	-	-
HCM Lane V/C Ratio	0.091	-	-	0.288	0.261	0.088	0.042	0.635	0.058	0.009	-	-
HCM Control Delay (s)	8.4	-	-	75.1	31.2	10.8	37.7	53.5	11.8	8.5	-	-
HCM Lane LOS	A	-	-	F	D	B	E	F	B	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	1	1	0.3	0.1	3.6	0.2	0	-	-

Intersection	
Intersection Delay, s/veh	12.7
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	10	46	81	50	149	39	119	169	45	20	93	7
Future Vol, veh/h	10	46	81	50	149	39	119	169	45	20	93	7
Peak Hour Factor	0.83	0.83	0.83	0.78	0.78	0.78	0.87	0.87	0.87	0.83	0.83	0.83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	12	55	98	64	191	50	137	194	52	24	112	8
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	12.1	12.3	13.5	11.9
HCM LOS	B	B	B	B

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	79%	0%	36%	0%	100%	0%	0%	93%
Vol Right, %	0%	21%	0%	64%	0%	0%	100%	0%	7%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	119	214	10	127	50	149	39	20	100
LT Vol	119	0	10	0	50	0	0	20	0
Through Vol	0	169	0	46	0	149	0	0	93
RT Vol	0	45	0	81	0	0	39	0	7
Lane Flow Rate	137	246	12	153	64	191	50	24	120
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.268	0.437	0.026	0.289	0.13	0.36	0.084	0.051	0.24
Departure Headway (Hd)	7.048	6.395	7.764	6.797	7.401	6.893	6.181	7.73	7.163
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	506	558	464	532	487	525	583	466	504
Service Time	4.842	4.189	5.464	4.497	5.101	4.593	3.881	5.43	4.873
HCM Lane V/C Ratio	0.271	0.441	0.026	0.288	0.131	0.364	0.086	0.052	0.238
HCM Control Delay	12.4	14.1	10.7	12.2	11.2	13.4	9.4	10.8	12.1
HCM Lane LOS	B	B	B	B	B	B	A	B	B
HCM 95th-tile Q	1.1	2.2	0.1	1.2	0.4	1.6	0.3	0.2	0.9

Intersection	
Int Delay, s/veh	10

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✥	
Traffic Vol, veh/h	8	130	65	223	44	0	74	20	341	0	7	1
Future Vol, veh/h	8	130	65	223	44	0	74	20	341	0	7	1
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	100	-	-	100	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	79	79	79	96	96	96	78	78	78
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	10	159	79	282	56	0	77	21	355	0	9	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	56	0	0	238	0	0	844	839	199	1027	878	56
Stage 1	-	-	-	-	-	-	219	219	-	620	620	-
Stage 2	-	-	-	-	-	-	625	620	-	407	258	-
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	1549	-	-	1329	-	-	283	302	842	213	287	1011
Stage 1	-	-	-	-	-	-	783	722	-	476	480	-
Stage 2	-	-	-	-	-	-	473	480	-	621	694	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1549	-	-	1329	-	-	228	236	842	96	225	1011
Mov Cap-2 Maneuver	-	-	-	-	-	-	228	236	-	96	225	-
Stage 1	-	-	-	-	-	-	778	718	-	473	378	-
Stage 2	-	-	-	-	-	-	363	378	-	346	690	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	7	17.2	20.1
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	228	737	1549	-	-	1329	-	-	249
HCM Lane V/C Ratio	0.338	0.51	0.006	-	-	0.212	-	-	0.041
HCM Control Delay (s)	28.6	14.9	7.3	-	-	8.4	-	-	20.1
HCM Lane LOS	D	B	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	1.4	2.9	0	-	-	0.8	-	-	0.1

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	1010	-	-	-	-	-
Stage 2	969	-	-	-	-	-

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	346	696	10
Future Vol, veh/h	10	2	1	346	696	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	85	85	85	78	92	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	2	1	444	757	12

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1203	-	769	0	-	0
Stage 1	757	-	-	-	-	-
Stage 2	446	-	-	-	-	-
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	204	0	845	-	-	-
Stage 1	463	0	-	-	-	-
Stage 2	645	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	204	-	845	-	-	-
Mov Cap-2 Maneuver	335	-	-	-	-	-
Stage 1	463	-	-	-	-	-
Stage 2	645	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.1	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	845	-	335	-	-	-
HCM Lane V/C Ratio	0.001	-	0.035	-	-	-
HCM Control Delay (s)	9.3	-	16.1	0	-	-
HCM Lane LOS	A	-	C	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-	-

Intersection	
Int Delay, s/veh	10.4

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	74	74	68	85	85	67
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	30	599	649	11	26	87

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1335	26	113	0	-	0
Stage 1	26	-	-	-	-	-
Stage 2	1309	-	-	-	-	-
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	169	1050	1476	-	-	-
Stage 1	997	-	-	-	-	-
Stage 2	253	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	95	1050	1476	-	-	-
Mov Cap-2 Maneuver	194	-	-	-	-	-
Stage 1	558	-	-	-	-	-
Stage 2	253	-	-	-	-	-

Approach	EB		NB		SB
HCM Control Delay, s	13.6		9.2		0
HCM LOS	B				

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1476	-	194	1050	-	-
HCM Lane V/C Ratio	0.439	-	0.153	0.57	-	-
HCM Control Delay (s)	9.3	-	26.9	12.9	-	-
HCM Lane LOS	A	-	D	B	-	-
HCM 95th %tile Q(veh)	2.3	-	0.5	3.7	-	-

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	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	306	145	44	185	132	53	391	20	246	271	31

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1445	1296	287	1511	1301	401	302	0	0	411	0	0
Stage 1	779	779	-	507	507	-	-	-	-	-	-	-
Stage 2	666	517	-	1004	794	-	-	-	-	-	-	-
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	110	~ 162	752	99	~ 161	649	1259	-	-	1148	-	-
Stage 1	389	406	-	548	539	-	-	-	-	-	-	-
Stage 2	449	534	-	291	400	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 122	752	-	~ 121	649	1259	-	-	1148	-	-
Mov Cap-2 Maneuver	-	~ 122	-	-	~ 121	-	-	-	-	-	-	-
Stage 1	373	319	-	525	516	-	-	-	-	-	-	-
Stage 2	220	512	-	~ 8	314	-	-	-	-	-	-	-

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)	1259	-	-	-	-	649	1148	-	-
HCM Lane V/C Ratio	0.042	-	-	-	-	0.203	0.214	-	-
HCM Control Delay (s)	8	-	-	-	-	12	9	-	-
HCM Lane LOS	A	-	-	-	-	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	-	-	0.8	0.8	-	-

Notes

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

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Vol, veh/h	58	157	398	2	106	15	145	275	1	35	625	41
Future Vol, veh/h	58	157	398	2	106	15	145	275	1	35	625	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	87	87	87	94	94	94	78	78	78	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	67	180	457	2	113	16	186	353	1	38	679	45

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1537	1481	-	1593	1525	-	724	0	0	354	0	0
Stage 1	755	755	-	725	725	-	-	-	-	-	-	-
Stage 2	782	726	-	868	800	-	-	-	-	-	-	-
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	95	~ 125	0	86	118	0	879	-	-	1205	-	-
Stage 1	401	417	0	416	430	0	-	-	-	-	-	-
Stage 2	387	430	0	347	397	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 95	-	-	~ 90	-	879	-	-	1205	-	-
Mov Cap-2 Maneuver	-	~ 95	-	-	~ 90	-	-	-	-	-	-	-
Stage 1	316	404	-	328	339	-	-	-	-	-	-	-
Stage 2	204	339	-	186	384	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			3.5	0.4
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	879	-	-	-	95	-	-	90	-	1205	-	-
HCM Lane V/C Ratio	0.211	-	-	-	1.9	-	-	1.253	-	0.032	-	-
HCM Control Delay (s)	10.2	-	-	-	$ 516.2	0	-	262.5	0	8.1	-	-
HCM Lane LOS	B	-	-	-	F	A	-	F	A	A	-	-
HCM 95th %tile Q(veh)	0.8	-	-	-	15.1	-	-	8.1	-	0.1	-	-

Notes

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

HCM 6th AWSC
15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Intersection	
Intersection Delay, s/veh	75.9
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	101	155	106	29	45	98	18	280	51	49	377	10
Future Vol, veh/h	101	155	106	29	45	98	18	280	51	49	377	10
Peak Hour Factor	0.79	0.79	0.79	0.85	0.85	0.85	0.84	0.84	0.84	0.80	0.80	0.80
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	128	196	134	34	53	115	21	333	61	61	471	13
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	35.5	16.5	70	136.5
HCM LOS	E	C	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	85%	0%	59%	0%	100%	0%	0%	97%
Vol Right, %	0%	15%	0%	41%	0%	0%	100%	0%	3%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	18	331	101	261	29	45	98	49	387
LT Vol	18	0	101	0	29	0	0	49	0
Through Vol	0	280	0	155	0	45	0	0	377
RT Vol	0	51	0	106	0	0	98	0	10
Lane Flow Rate	21	394	128	330	34	53	115	61	484
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.057	0.981	0.341	0.809	0.101	0.149	0.302	0.165	1.231
Departure Headway (Hd)	10.199	9.567	10.338	9.513	11.443	10.915	10.175	9.7	9.164
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	353	382	350	383	315	330	355	372	402
Service Time	7.899	7.267	8.038	7.213	9.143	8.615	7.875	7.4	6.864
HCM Lane V/C Ratio	0.059	1.031	0.366	0.862	0.108	0.161	0.324	0.164	1.204
HCM Control Delay	13.5	73.1	18.3	42.1	15.4	15.5	17.2	14.3	152
HCM Lane LOS	B	F	C	E	C	C	C	B	F
HCM 95th-tile Q	0.2	11.3	1.5	7.1	0.3	0.5	1.2	0.6	20.3

Intersection	
Int Delay, s/veh	4.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✥	
Traffic Vol, veh/h	0	105	42	240	229	0	18	4	76	0	11	1
Future Vol, veh/h	0	105	42	240	229	0	18	4	76	0	11	1
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	100	-	-	100	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	93	93	93	93	93	93	78	78	78
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	127	51	258	246	0	19	4	82	0	14	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	246	0	0	178	0	0	923	915	153	958	940	246
Stage 1	-	-	-	-	-	-	153	153	-	762	762	-
Stage 2	-	-	-	-	-	-	770	762	-	196	178	-
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	1320	-	-	1398	-	-	250	273	893	237	264	793
Stage 1	-	-	-	-	-	-	849	771	-	397	414	-
Stage 2	-	-	-	-	-	-	393	414	-	806	752	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1320	-	-	1398	-	-	204	222	893	182	215	793
Mov Cap-2 Maneuver	-	-	-	-	-	-	204	222	-	182	215	-
Stage 1	-	-	-	-	-	-	849	771	-	397	337	-
Stage 2	-	-	-	-	-	-	307	337	-	728	752	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	4.2	12.8	21.9
HCM LOS			B	C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	204	776	1320	-	-	1398	-	-	229
HCM Lane V/C Ratio	0.095	0.111	-	-	-	0.185	-	-	0.067
HCM Control Delay (s)	24.5	10.2	0	-	-	8.2	-	-	21.9
HCM Lane LOS	C	B	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	0.3	0.4	0	-	-	0.7	-	-	0.2

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	989	-	-	-	-	-
Stage 2	992	-	-	-	-	-

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	634	496	6
Future Vol, veh/h	6	1	2	634	496	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	85	85	85	93	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	1	2	682	584	7

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1270	-	591	0	-	0
Stage 1	584	-	-	-	-	-
Stage 2	686	-	-	-	-	-
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	186	0	985	-	-	-
Stage 1	557	0	-	-	-	-
Stage 2	500	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	186	-	985	-	-	-
Mov Cap-2 Maneuver	325	-	-	-	-	-
Stage 1	556	-	-	-	-	-
Stage 2	500	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	16.3	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	985	-	325	-	-	-
HCM Lane V/C Ratio	0.002	-	0.022	-	-	-
HCM Control Delay (s)	8.7	-	16.3	0	-	-
HCM Lane LOS	A	-	C	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-	-

Intersection	
Int Delay, s/veh	9.2

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	62	62	94	94	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	63	415	480	36	26	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1022	26	61	0	-	0
Stage 1	26	-	-	-	-	-
Stage 2	996	-	-	-	-	-
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	261	1050	1542	-	-	-
Stage 1	997	-	-	-	-	-
Stage 2	357	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	180	1050	1542	-	-	-
Mov Cap-2 Maneuver	284	-	-	-	-	-
Stage 1	687	-	-	-	-	-
Stage 2	357	-	-	-	-	-

Approach	EB		NB		SB
HCM Control Delay, s	12		7.8		0
HCM LOS	B				

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1542	-	284	1050	-	-
HCM Lane V/C Ratio	0.311	-	0.221	0.395	-	-
HCM Control Delay (s)	8.4	-	21.2	10.6	-	-
HCM Lane LOS	A	-	C	B	-	-
HCM 95th %tile Q(veh)	1.3	-	0.8	1.9	-	-

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	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	234	96	38	401	294	153	255	62	132	171	26

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1388	1071	184	1205	1053	286	197	0	0	317	0	0
Stage 1	448	448	-	592	592	-	-	-	-	-	-	-
Stage 2	940	623	-	613	461	-	-	-	-	-	-	-
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	120	~ 221	858	161	~ 226	753	1376	-	-	1243	-	-
Stage 1	590	573	-	493	494	-	-	-	-	-	-	-
Stage 2	316	478	-	480	565	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 176	858	-	~ 180	753	1376	-	-	1243	-	-
Mov Cap-2 Maneuver	-	~ 176	-	-	~ 180	-	-	-	-	-	-	-
Stage 1	525	512	-	438	439	-	-	-	-	-	-	-
Stage 2	~ 15	425	-	207	505	-	-	-	-	-	-	-

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)	1376	-	-	-	-	753	1243	-	-
HCM Lane V/C Ratio	0.111	-	-	-	-	0.391	0.106	-	-
HCM Control Delay (s)	7.9	-	-	-	-	12.8	8.2	-	-
HCM Lane LOS	A	-	-	-	-	B	A	-	-
HCM 95th %tile Q(veh)	0.4	-	-	-	-	1.9	0.4	-	-

Notes

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

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Vol, veh/h	31	49	311	5	118	33	511	575	26	10	375	117
Future Vol, veh/h	31	49	311	5	118	33	511	575	26	10	375	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	83	83	83	83	83	83	93	93	93	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	59	375	6	142	40	549	618	28	12	441	138

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2266	2209	-	2280	2319	-	579	0	0	646	0	0
Stage 1	465	465	-	1716	1716	-	-	-	-	-	-	-
Stage 2	1801	1744	-	564	603	-	-	-	-	-	-	-
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	~ 29	~ 44	0	28	~ 38	0	995	-	-	939	-	-
Stage 1	578	563	0	114	145	0	-	-	-	-	-	-
Stage 2	102	140	0	510	488	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 19	-	-	~ 17	-	995	-	-	939	-	-
Mov Cap-2 Maneuver	-	~ 19	-	-	~ 17	-	-	-	-	-	-	-
Stage 1	259	556	-	51	~ 65	-	-	-	-	-	-	-
Stage 2	-	63	-	450	482	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			6	0.2
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	995	-	-	-	19	-	-	17	-	939	-	-
HCM Lane V/C Ratio	0.552	-	-	-	3.107	-	-	8.363	-	0.013	-	-
HCM Control Delay (s)	13	-	-		$ 1368.4	0		$ 3755.3	0	8.9	-	-
HCM Lane LOS	B	-	-	-	F	A	-	F	A	A	-	-
HCM 95th %tile Q(veh)	3.5	-	-	-	7.8	-	-	18.5	-	0	-	-

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

Intersection	
Intersection Delay, s/veh	80.9
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Traffic Vol, veh/h	10	48	75	60	156	49	124	455	54	24	280	7
Future Vol, veh/h	10	48	75	60	156	49	124	455	54	24	280	7
Peak Hour Factor	0.83	0.83	0.83	0.78	0.78	0.78	0.87	0.87	0.87	0.83	0.83	0.83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	12	58	90	77	200	63	143	523	62	29	337	8
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	17.8	18.2	145.5	39.2
HCM LOS	C	C	F	E

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	89%	0%	39%	0%	100%	0%	0%	98%
Vol Right, %	0%	11%	0%	61%	0%	0%	100%	0%	2%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	124	509	10	123	60	156	49	24	287
LT Vol	124	0	10	0	60	0	0	24	0
Through Vol	0	455	0	48	0	156	0	0	280
RT Vol	0	54	0	75	0	0	49	0	7
Lane Flow Rate	143	585	12	148	77	200	63	29	346
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.341	1.306	0.033	0.371	0.2	0.491	0.142	0.072	0.816
Departure Headway (Hd)	8.622	8.034	10.765	9.789	10.041	9.52	8.791	9.61	9.077
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	418	456	335	370	360	382	410	375	401
Service Time	6.372	5.783	8.465	7.489	7.741	7.22	6.491	7.31	6.777
HCM Lane V/C Ratio	0.342	1.283	0.036	0.4	0.214	0.524	0.154	0.077	0.863
HCM Control Delay	15.8	177.1	13.8	18.1	15.2	21.1	12.9	13.1	41.4
HCM Lane LOS	C	F	B	C	C	C	B	B	E
HCM 95th-tile Q	1.5	25.6	0.1	1.7	0.7	2.6	0.5	0.2	7.4

Intersection	
Int Delay, s/veh	24.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✥	
Traffic Vol, veh/h	8	304	68	262	384	0	77	21	402	0	7	1
Future Vol, veh/h	8	304	68	262	384	0	77	21	402	0	7	1
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	100	-	-	100	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	96	96	96	78	78	78
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	9	358	80	308	452	0	80	22	419	0	9	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	452	0	0	438	0	0	1489	1484	398	1705	1524	452
Stage 1	-	-	-	-	-	-	416	416	-	1068	1068	-
Stage 2	-	-	-	-	-	-	1073	1068	-	637	456	-
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	1109	-	-	1122	-	-	102	125	652	72	118	608
Stage 1	-	-	-	-	-	-	614	592	-	268	298	-
Stage 2	-	-	-	-	-	-	267	298	-	465	568	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1109	-	-	1122	-	-	~ 74	90	652	17	85	608
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 74	90	-	17	85	-
Stage 1	-	-	-	-	-	-	609	587	-	266	216	-
Stage 2	-	-	-	-	-	-	185	216	-	159	563	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.2	3.8	73.9	47.4
HCM LOS			F	E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	74	498	1109	-	-	1122	-	-	95
HCM Lane V/C Ratio	1.084	0.885	0.008	-	-	0.275	-	-	0.108
HCM Control Delay (s)	227.7	45.9	8.3	-	-	9.4	-	-	47.4
HCM Lane LOS	F	E	A	-	-	A	-	-	E
HCM 95th %tile Q(veh)	5.9	9.8	0	-	-	1.1	-	-	0.4

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	1010	-	-	-	-	-
Stage 2	940	-	-	-	-	-

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	-

HCM 6th TWSC
3: Parcel H & Rex Rd

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	-	-	-	-	564	-
Stage 1	-	-	-	-	886	-
Stage 2	-	-	-	-	672	-

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)	564	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	-	-	-	-	560	-
Stage 1	-	-	-	-	874	-
Stage 2	-	-	-	-	671	-

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)	560	892	-	-	1411	-
HCM Lane V/C Ratio	0.067	0.067	-	-	0.014	-
HCM Control Delay (s)	11.9	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	-	-	-	-	589	-
Stage 1	-	-	-	-	862	-
Stage 2	-	-	-	-	714	-

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)	589	876	-	-	1356	-
HCM Lane V/C Ratio	0.234	0.14	-	-	0.03	-
HCM Control Delay (s)	13	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	-	-	-	-	585	-
Stage 1	-	-	-	-	817	-
Stage 2	-	-	-	-	740	-

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	11.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1326	-	-	-	585	840
HCM Lane V/C Ratio	0.019	-	-	-	0.203	0.091
HCM Control Delay (s)	7.8	-	-	-	12.7	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	-	-	-	-	501	-
Stage 1	-	-	-	-	717	-
Stage 2	-	-	-	-	686	-

Approach	EB		WB		NB
HCM Control Delay, s	0		3.6		13.8
HCM LOS					B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	501	698	-	-	1173	-
HCM Lane V/C Ratio	0.237	0.398	-	-	0.079	-
HCM Control Delay (s)	14.4	13.5	-	-	8.3	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0.9	1.9	-	-	0.3	-

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑	↱
Traffic Vol, veh/h	44	485	162	0	696	21
Future Vol, veh/h	44	485	162	0	696	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
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	78	92	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	52	571	191	0	757	25

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1139	-	782	0	-	0
Stage 1	757	-	-	-	-	-
Stage 2	382	-	-	-	-	-
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	223	0	836	-	-	-
Stage 1	463	0	-	-	-	-
Stage 2	690	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	172	-	836	-	-	-
Mov Cap-2 Maneuver	281	-	-	-	-	-
Stage 1	357	-	-	-	-	-
Stage 2	690	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20.7	10.6	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	836	-	281	-	-	-
HCM Lane V/C Ratio	0.228	-	0.184	-	-	-
HCM Control Delay (s)	10.6	0	20.7	0	-	-
HCM Lane LOS	B	A	C	A	-	-
HCM 95th %tile Q(veh)	0.9	-	0.7	-	-	-

12: Eastonville Rd & Londonderry Dr

Intersection	
Int Delay, s/veh	15.4

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	74	74	68	85	85	67
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	53	599	649	111	325	163

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1734	325	488	0	-	0
Stage 1	325	-	-	-	-	-
Stage 2	1409	-	-	-	-	-
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	96	716	1075	-	-	-
Stage 1	732	-	-	-	-	-
Stage 2	226	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 38	716	1075	-	-	-
Mov Cap-2 Maneuver	133	-	-	-	-	-
Stage 1	290	-	-	-	-	-
Stage 2	226	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	31.7	11.4	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1075	-	133	716	-	-
HCM Lane V/C Ratio	0.603	-	0.396	0.836	-	-
HCM Control Delay (s)	13.3	-	48.8	30.2	-	-
HCM Lane LOS	B	-	E	D	-	-
HCM 95th %tile Q(veh)	4.2	-	1.7	9.3	-	-

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	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	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	53	306	145	44	185	132	53	444	20	246	431	171

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1728	1579	517	1794	1654	454	602	0	0	464	0	0
Stage 1	1009	1009	-	560	560	-	-	-	-	-	-	-
Stage 2	719	570	-	1234	1094	-	-	-	-	-	-	-
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	70	~ 109	558	62	~ 98	606	975	-	-	1097	-	-
Stage 1	290	318	-	513	511	-	-	-	-	-	-	-
Stage 2	420	505	-	216	290	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 80	558	-	~ 72	606	975	-	-	1097	-	-
Mov Cap-2 Maneuver	-	~ 80	-	-	~ 72	-	-	-	-	-	-	-
Stage 1	274	~ 247	-	485	483	-	-	-	-	-	-	-
Stage 2	192	478	-	-	225	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			0.9	2.7
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	975	-	-	-	-	606	1097	-	-
HCM Lane V/C Ratio	0.054	-	-	-	-	0.217	0.224	-	-
HCM Control Delay (s)	8.9	-	-	-	-	12.6	9.2	-	-
HCM Lane LOS	A	-	-	-	-	B	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	-	-	0.8	0.9	-	-

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	58	157	398	2	106	26	145	424	1	69	1074	41
Future Vol, veh/h	58	157	398	2	106	26	145	424	1	69	1074	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	87	87	87	94	94	94	78	78	78	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	67	180	457	2	113	28	186	544	1	75	1167	45

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	2290	2234	-	2346	2278	-	1212	0	0	545	0	0
Stage 1	1317	1317	-	916	916	-	-	-	-	-	-	-
Stage 2	973	917	-	1430	1362	-	-	-	-	-	-	-
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	~ 28	~ 43	0	25	~ 40	0	576	-	-	1024	-	-
Stage 1	194	227	0	326	351	0	-	-	-	-	-	-
Stage 2	303	351	0	167	216	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 27	-	-	~ 25	-	576	-	-	1024	-	-
Mov Cap-2 Maneuver	-	~ 27	-	-	~ 25	-	-	-	-	-	-	-
Stage 1	131	210	-	221	238	-	-	-	-	-	-	-
Stage 2	108	238	-	22	200	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			3.6	0.5
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	576	-	-	-	27	-	-	25	-	1024	-	-
HCM Lane V/C Ratio	0.323	-	-	-	6.684	-	-	4.511	-	0.073	-	-
HCM Control Delay (s)	14.2	-	-		$ 2844.2	0		$ 1896.1	0	8.8	-	-
HCM Lane LOS	B	-	-	-	F	A	-	F	A	A	-	-
HCM 95th %tile Q(veh)	1.4	-	-	-	22.2	-	-	14	-	0.2	-	-

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

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Intersection	
Intersection Delay, s/veh	130
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱	↰	↱		↰	↱	
Traffic Vol, veh/h	104	155	106	29	45	98	18	322	51	49	504	18
Future Vol, veh/h	104	155	106	29	45	98	18	322	51	49	504	18
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	122	182	125	34	53	115	21	379	60	58	593	21
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	33.2	17.3	100.5	246.1
HCM LOS	D	C	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	86%	0%	59%	0%	100%	0%	0%	97%
Vol Right, %	0%	14%	0%	41%	0%	0%	100%	0%	3%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	18	373	104	261	29	45	98	49	522
LT Vol	18	0	104	0	29	0	0	49	0
Through Vol	0	322	0	155	0	45	0	0	504
RT Vol	0	51	0	106	0	0	98	0	18
Lane Flow Rate	21	439	122	307	34	53	115	58	614
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.056	1.087	0.33	0.761	0.101	0.149	0.302	0.151	1.514
Departure Headway (Hd)	10.566	9.944	10.979	10.148	12.088	11.557	10.812	9.794	9.251
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	341	369	329	359	298	312	334	368	399
Service Time	8.266	7.644	8.679	7.848	9.788	9.257	8.512	7.494	6.951
HCM Lane V/C Ratio	0.062	1.19	0.371	0.855	0.114	0.17	0.344	0.158	1.539
HCM Control Delay	13.9	104.7	19	38.9	16.1	16.3	18.1	14.2	267.9
HCM Lane LOS	B	F	C	E	C	C	C	B	F
HCM 95th-tile Q	0.2	14.3	1.4	6.1	0.3	0.5	1.2	0.5	31.9

Intersection	
Int Delay, s/veh	4.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✥	
Traffic Vol, veh/h	0	133	42	282	314	0	18	4	90	0	11	1
Future Vol, veh/h	0	133	42	282	314	0	18	4	90	0	11	1
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	100	-	-	100	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	93	93	93	93	93	93	78	78	78
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	160	51	303	338	0	19	4	97	0	14	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	338	0	0	211	0	0	1138	1130	186	1180	1155	338
Stage 1	-	-	-	-	-	-	186	186	-	944	944	-
Stage 2	-	-	-	-	-	-	952	944	-	236	211	-
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	1221	-	-	1360	-	-	179	204	856	167	197	704
Stage 1	-	-	-	-	-	-	816	746	-	315	341	-
Stage 2	-	-	-	-	-	-	312	341	-	767	728	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1221	-	-	1360	-	-	138	159	856	120	153	704
Mov Cap-2 Maneuver	-	-	-	-	-	-	138	159	-	120	153	-
Stage 1	-	-	-	-	-	-	816	746	-	315	265	-
Stage 2	-	-	-	-	-	-	229	265	-	676	728	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	4	14.7	29.2
HCM LOS			B	D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	138	721	1221	-	-	1360	-	-	164
HCM Lane V/C Ratio	0.14	0.14	-	-	-	0.223	-	-	0.094
HCM Control Delay (s)	35.3	10.8	0	-	-	8.4	-	-	29.2
HCM Lane LOS	E	B	A	-	-	A	-	-	D
HCM 95th %tile Q(veh)	0.5	0.5	0	-	-	0.9	-	-	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	
Intersection Delay, s/veh	11.5
Intersection LOS	B

Approach	EB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	652	760	488
Demand Flow Rate, veh/h	665	775	498
Vehicles Circulating, veh/h	331	54	662
Vehicles Exiting, veh/h	828	942	167
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	12.0	9.1	14.6
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	665	775	498
Cap Entry Lane, veh/h	1072	1356	809
Entry HV Adj Factor	0.980	0.980	0.981
Flow Entry, veh/h	652	760	488
Cap Entry, veh/h	1051	1330	793
V/C Ratio	0.620	0.571	0.616
Control Delay, s/veh	12.0	9.1	14.6
LOS	B	A	B
95th %tile Queue, veh	4	4	4

Intersection	
Intersection Delay, s/veh	11.5
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	429	202	460	672
Demand Flow Rate, veh/h	438	206	469	685
Vehicles Circulating, veh/h	699	532	369	110
Vehicles Exiting, veh/h	96	306	767	628
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	18.1	7.4	10.1	9.4
Approach LOS	C	A	B	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	438	206	469	685
Cap Entry Lane, veh/h	676	802	947	1233
Entry HV Adj Factor	0.980	0.980	0.982	0.981
Flow Entry, veh/h	429	202	460	672
Cap Entry, veh/h	663	786	930	1210
V/C Ratio	0.648	0.257	0.495	0.555
Control Delay, s/veh	18.1	7.4	10.1	9.4
LOS	C	A	B	A
95th %tile Queue, veh	5	1	3	4

Volume
12: Eastonville Rd & Londonderry Dr

Short-Term Total Traffic
AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	39	443	441	94	276	109
Future Volume (vph)	39	443	441	94	276	109
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.74	0.74	0.68	0.85	0.85	0.67
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	53	599	649	111	325	163
Shared Lane Traffic (%)						
Lane Group Flow (vph)	53	599	649	111	325	163

Intersection Summary

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)	9.8	9.8	65.2	65.2	65.2	65.2
Actuated g/C Ratio	0.12	0.12	0.77	0.77	0.77	0.77
v/c Ratio	0.26	0.84	0.81	0.08	0.23	0.13
Control Delay	36.8	15.2	17.7	3.1	3.7	0.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.8	15.2	17.7	3.1	3.7	0.9
LOS	D	B	B	A	A	A
Approach Delay	17.0			15.5	2.7	
Approach LOS	B			B	A	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 85

Natural Cycle: 80

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 12.7 Intersection LOS: B

Intersection Capacity Utilization 55.6% ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 12: Eastonville Rd & Londonderry Dr

13: Eastonville Rd & Stapleton Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	45	260	123	37	157	112	45	377	17	209	366	145
Future Volume (vph)	45	260	123	37	157	112	45	377	17	209	366	145
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	53	306	145	44	185	132	53	444	20	246	431	171
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	504	0	0	229	132	53	464	0	246	602	0
Intersection Summary												

13: Eastonville Rd & Stapleton Dr

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)		26.5		26.5	26.5	27.9	22.7	36.6	31.8
Actuated g/C Ratio		0.36		0.36	0.36	0.38	0.31	0.49	0.43
v/c Ratio		0.81		0.42	0.20	0.20	0.81	0.68	0.77
Control Delay		31.3		20.3	3.9	14.2	38.3	25.0	30.0
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		31.3		20.3	3.9	14.2	38.3	25.0	30.0
LOS		C		C	A	B	D	C	C
Approach Delay		31.3		14.3			35.8		28.5
Approach LOS		C		B			D		C

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 74

Natural Cycle: 70

Control Type: Actuated-Uncoordinated

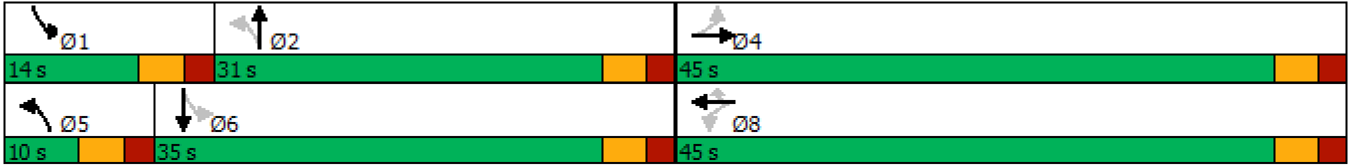
Maximum v/c Ratio: 0.81

Intersection Signal Delay: 28.6 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



Volume
14: US 24 & Stapleton Dr

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	58	157	398	2	106	26	145	424	1	69	1074	41
Future Volume (vph)	58	157	398	2	106	26	145	424	1	69	1074	41
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.87	0.87	0.87	0.94	0.94	0.94	0.78	0.78	0.78	0.92	0.92	0.92
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	67	180	457	2	113	28	186	544	1	75	1167	45
Shared Lane Traffic (%)												
Lane Group Flow (vph)	67	180	457	2	113	28	186	544	1	75	1167	45
Intersection Summary												

14: US 24 & Stapleton Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	58	157	398	2	106	26	145	424	1	69	1074	41
Future Volume (vph)	58	157	398	2	106	26	145	424	1	69	1074	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)	1.0	1.0		1.0	1.0	1.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	6.0	6.0		6.0	6.0	6.0	10.0	20.0	20.0	10.0	20.0	20.0
Total Split (s)	34.0	34.0		34.0	34.0	34.0	13.0	76.0	76.0	10.0	73.0	73.0
Total Split (%)	28.3%	28.3%		28.3%	28.3%	28.3%	10.8%	63.3%	63.3%	8.3%	60.8%	60.8%
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)	15.5	15.5	106.6	15.5	15.5	15.5	79.5	72.2	72.2	73.1	67.1	67.1
Actuated g/C Ratio	0.15	0.15	1.00	0.15	0.15	0.15	0.75	0.68	0.68	0.69	0.63	0.63
v/c Ratio	0.39	0.67	0.29	0.02	0.42	0.10	0.93	0.43	0.00	0.13	1.00	0.04
Control Delay	47.9	55.3	0.5	38.0	45.9	0.7	74.5	10.3	0.0	4.6	46.7	1.3
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	47.9	55.3	0.5	38.0	45.9	0.7	74.5	10.3	0.0	4.6	46.7	1.3
LOS	D	E	A	D	D	A	E	B	A	A	D	A
Approach Delay		19.0			36.9			26.6			42.6	
Approach LOS		B			D			C			D	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 106.6
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 32.4 Intersection LOS: C
Intersection Capacity Utilization 87.8% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 14: US 24 & Stapleton Dr

Volume

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

	↰	→	↘	↙	←	↖	↰	↑	↱	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	104	155	106	29	45	98	18	322	51	49	504	18
Future Volume (vph)	104	155	106	29	45	98	18	322	51	49	504	18
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	122	182	125	34	53	115	21	379	60	58	593	21
Shared Lane Traffic (%)												
Lane Group Flow (vph)	122	307	0	34	53	115	21	439	0	58	614	0

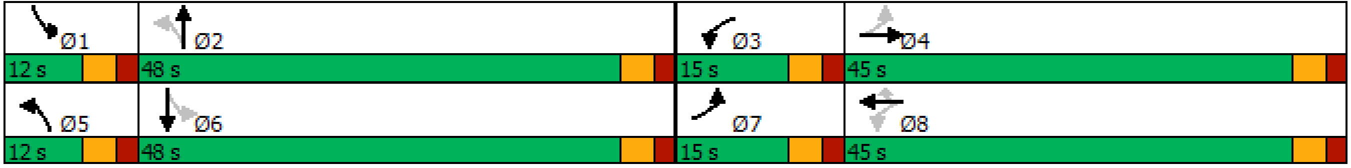
Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	104	155	29	45	98	18	322	49	504
Future Volume (vph)	104	155	29	45	98	18	322	49	504
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	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	20.0	10.0	20.0	20.0	10.0	20.0	10.0	20.0
Total Split (s)	15.0	45.0	15.0	45.0	45.0	12.0	48.0	12.0	48.0
Total Split (%)	12.5%	37.5%	12.5%	37.5%	37.5%	10.0%	40.0%	10.0%	40.0%
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	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
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	None	Min
Act Effct Green (s)	25.8	21.0	21.1	15.9	15.9	34.3	31.1	35.6	33.5
Actuated g/C Ratio	0.34	0.28	0.28	0.21	0.21	0.45	0.41	0.47	0.44
v/c Ratio	0.26	0.60	0.10	0.14	0.27	0.07	0.58	0.15	0.75
Control Delay	20.6	31.3	19.8	30.2	8.3	12.7	24.1	12.9	27.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.6	31.3	19.8	30.2	8.3	12.7	24.1	12.9	27.7
LOS	C	C	B	C	A	B	C	B	C
Approach Delay		28.2		16.0			23.6		26.4
Approach LOS		C		B			C		C

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 75.5
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 24.9 Intersection LOS: C
Intersection Capacity Utilization 67.2% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd



Volume
16: McLaughlin Rd & Eastonville Dr

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	1	133	42	282	314	0	18	4	90	0	11	1
Future Volume (vph)	1	133	42	282	314	0	18	4	90	0	11	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.93	0.93	0.93	0.93	0.93	0.93	0.78	0.78	0.78
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	1	160	51	303	338	0	19	4	97	0	14	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	1	211	0	303	338	0	19	101	0	0	15	0

Intersection Summary

	↗	→	↙	←	↖	↑	↓
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	✣
Traffic Volume (vph)	1	133	282	314	18	4	11
Future Volume (vph)	1	133	282	314	18	4	11
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	NA
Protected Phases		4	3	8		2	6
Permitted Phases	4		8		2		
Detector Phase	4	4	3	8	2	2	6
Switch Phase							
Minimum Initial (s)	5.0	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	20.0
Total Split (s)	75.0	75.0	15.0	90.0	30.0	30.0	30.0
Total Split (%)	62.5%	62.5%	12.5%	75.0%	25.0%	25.0%	25.0%
Yellow Time (s)	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
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	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	Min	Min	Min
Act Effct Green (s)	9.6	9.6	23.3	23.3	6.2	6.2	6.2
Actuated g/C Ratio	0.24	0.24	0.59	0.59	0.16	0.16	0.16
v/c Ratio	0.00	0.47	0.45	0.31	0.09	0.30	0.05
Control Delay	12.0	15.5	6.4	5.0	16.6	7.9	15.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.0	15.5	6.4	5.0	16.6	7.9	15.5
LOS	B	B	A	A	B	A	B
Approach Delay		15.5		5.7		9.3	15.5
Approach LOS		B		A		A	B

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 39.6

Natural Cycle: 50

Control Type: Actuated-Uncoordinated

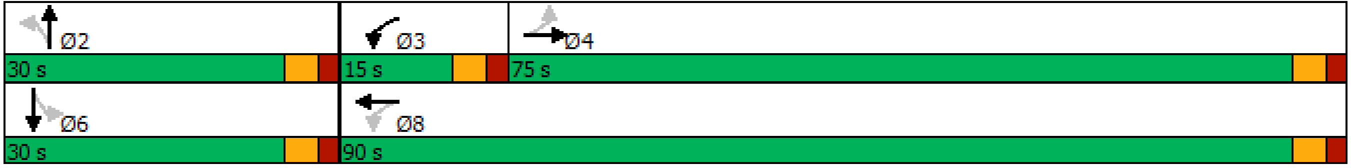
Maximum v/c Ratio: 0.47

Intersection Signal Delay: 8.4 Intersection LOS: A

Intersection Capacity Utilization 45.3% ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 16: McLaughlin Rd & Eastonville Dr



Intersection	
Int Delay, s/veh	3.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑
Traffic Vol, veh/h	198	7	28	333	10	24
Future Vol, veh/h	198	7	28	333	10	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	8	33	392	12	28

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	85	33	0	0	425	0
Stage 1	33	-	-	-	-	-
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	916	1041	-	-	1134	-
Stage 1	989	-	-	-	-	-
Stage 2	970	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	906	1041	-	-	1134	-
Mov Cap-2 Maneuver	906	-	-	-	-	-
Stage 1	989	-	-	-	-	-
Stage 2	959	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.2	0	2.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	906	1041	1134	-
HCM Lane V/C Ratio	-	-	0.257	0.008	0.01	-
HCM Control Delay (s)	-	-	10.3	8.5	8.2	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	1	0	0	-

Intersection	
Int Delay, s/veh	0.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱		↰	↑	↰	↱
Traffic Vol, veh/h	344	17	27	206	10	16
Future Vol, veh/h	344	17	27	206	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	405	20	32	242	12	19

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	425	0	721	415
Stage 1	-	-	-	-	415	-
Stage 2	-	-	-	-	306	-
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	-	-	1134	-	394	637
Stage 1	-	-	-	-	666	-
Stage 2	-	-	-	-	747	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1134	-	383	637
Mov Cap-2 Maneuver	-	-	-	-	491	-
Stage 1	-	-	-	-	666	-
Stage 2	-	-	-	-	726	-

Approach	EB		WB		NB	
HCM Control Delay, s	0		1		11.5	
HCM LOS					B	

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	491	637	-	-	1134	-
HCM Lane V/C Ratio	0.024	0.03	-	-	0.028	-
HCM Control Delay (s)	12.5	10.8	-	-	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	325	35	54	213	20	32
Future Vol, veh/h	325	35	54	213	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	382	41	64	251	24	38

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	423	0	761	382
Stage 1	-	-	-	-	382	-
Stage 2	-	-	-	-	379	-
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	-	-	1136	-	373	665
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	692	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1136	-	352	665
Mov Cap-2 Maneuver	-	-	-	-	467	-
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	653	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.7	11.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	467	665	-	-	1136	-
HCM Lane V/C Ratio	0.05	0.057	-	-	0.056	-
HCM Control Delay (s)	13.1	10.7	-	-	8.4	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	0.2	-	-	0.2	-

Intersection	
Int Delay, s/veh	3.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	232	125	111	193	74	65
Future Vol, veh/h	232	125	111	193	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	273	147	131	227	87	76

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	420	0	762	273
Stage 1	-	-	-	-	273	-
Stage 2	-	-	-	-	489	-
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	-	-	1139	-	373	766
Stage 1	-	-	-	-	773	-
Stage 2	-	-	-	-	616	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1139	-	330	766
Mov Cap-2 Maneuver	-	-	-	-	433	-
Stage 1	-	-	-	-	773	-
Stage 2	-	-	-	-	545	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.1	13
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	433	766	-	-	1139	-
HCM Lane V/C Ratio	0.201	0.1	-	-	0.115	-
HCM Control Delay (s)	15.4	10.2	-	-	8.6	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	0.7	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	228	264	109	63	41
Future Vol, veh/h	69	228	264	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	268	311	128	74	48

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	439	0	-	0	741	311
Stage 1	-	-	-	-	311	-
Stage 2	-	-	-	-	430	-
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	1121	-	-	-	384	729
Stage 1	-	-	-	-	743	-
Stage 2	-	-	-	-	656	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1121	-	-	-	356	729
Mov Cap-2 Maneuver	-	-	-	-	469	-
Stage 1	-	-	-	-	690	-
Stage 2	-	-	-	-	656	-

Approach	EB	WB	SB
HCM Control Delay, s	2	0	12.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1121	-	-	-	469	729
HCM Lane V/C Ratio	0.072	-	-	-	0.158	0.066
HCM Control Delay (s)	8.5	-	-	-	14.1	10.3
HCM Lane LOS	A	-	-	-	B	B
HCM 95th %tile Q(veh)	0.2	-	-	-	0.6	0.2

Intersection	
Int Delay, s/veh	5.2

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	-	-	-	-	239	-
Stage 1	-	-	-	-	821	-
Stage 2	-	-	-	-	281	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4	15.3
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	239	825	-	-	1217	-
HCM Lane V/C Ratio	0.31	0.212	-	-	0.245	-
HCM Control Delay (s)	26.7	10.5	-	-	8.9	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	1.3	0.8	-	-	1	-

Intersection	
Int Delay, s/veh	8.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰	↑	↱
Traffic Vol, veh/h	27	305	520	0	496	42
Future Vol, veh/h	27	305	520	0	496	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
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	85	85	85	93	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	32	359	612	0	584	49

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1808	-	633	0	-	0
Stage 1	584	-	-	-	-	-
Stage 2	1224	-	-	-	-	-
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	87	0	950	-	-	-
Stage 1	557	0	-	-	-	-
Stage 2	278	0	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 31	-	950	-	-	-
Mov Cap-2 Maneuver	119	-	-	-	-	-
Stage 1	198	-	-	-	-	-
Stage 2	278	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	45.9	15.4	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	950	-	119	-	-	-
HCM Lane V/C Ratio	0.644	-	0.267	-	-	-
HCM Control Delay (s)	15.4	0	45.9	0	-	-
HCM Lane LOS	C	A	E	A	-	-
HCM 95th %tile Q(veh)	4.9	-	1	-	-	-

Notes

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

Intersection	
Int Delay, s/veh	10

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	163	-	-	-	-	-
Stage 1	480	-	-	-	-	-
Stage 2	222	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	25.9	5.8	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1275	-	163	826	-	-
HCM Lane V/C Ratio	0.416	-	0.678	0.366	-	-
HCM Control Delay (s)	9.8	-	64.2	11.9	-	-
HCM Lane LOS	A	-	F	B	-	-
HCM 95th %tile Q(veh)	2.1	-	3.9	1.7	-	-

Notes

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

13: Eastonville Rd & Stapleton 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	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	171	234	96	38	401	294	153	426	62	132	271	114

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1703	1386	328	1520	1412	457	385	0	0	488	0	0
Stage 1	592	592	-	763	763	-	-	-	-	-	-	-
Stage 2	1111	794	-	757	649	-	-	-	-	-	-	-
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	~ 72	~ 143	713	97	~ 138	604	1173	-	-	1075	-	-
Stage 1	493	494	-	397	413	-	-	-	-	-	-	-
Stage 2	254	400	-	400	466	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 109	713	-	~ 105	604	1173	-	-	1075	-	-
Mov Cap-2 Maneuver	-	~ 109	-	-	~ 105	-	-	-	-	-	-	-
Stage 1	429	433	-	345	~ 359	-	-	-	-	-	-	-
Stage 2	-	348	-	139	409	-	-	-	-	-	-	-

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)	1173	-	-	-	-	604	1075	-	-
HCM Lane V/C Ratio	0.13	-	-	-	-	0.487	0.123	-	-
HCM Control Delay (s)	8.5	-	-	-	-	16.5	8.8	-	-
HCM Lane LOS	A	-	-	-	-	C	A	-	-
HCM 95th %tile Q(veh)	0.4	-	-	-	-	2.7	0.4	-	-

Notes

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

Intersection	
Int Delay, s/veh	4.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Vol, veh/h	31	49	311	5	118	69	511	1057	26	31	657	117
Future Vol, veh/h	31	49	311	5	118	69	511	1057	26	31	657	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	83	83	83	83	83	83	93	93	93	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	59	375	6	142	83	549	1137	28	36	773	138

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	3165	3108	-	3179	3218	-	911	0	0	1165	0	0
Stage 1	845	845	-	2235	2235	-	-	-	-	-	-	-
Stage 2	2320	2263	-	944	983	-	-	-	-	-	-	-
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	~ 6	~ 12	0	~ 6	~ 10	0	748	-	-	600	-	-
Stage 1	357	379	0	56	~ 79	0	-	-	-	-	-	-
Stage 2	50	77	0	315	327	0	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	-	~ 3	-	-	~ 3	-	748	-	-	600	-	-
Mov Cap-2 Maneuver	-	~ 3	-	-	~ 3	-	-	-	-	-	-	-
Stage 1	95	356	-	15	~ 21	-	-	-	-	-	-	-
Stage 2	-	~ 20	-	247	307	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s			7	0.4
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	748	-	-	-	3	-	-	3	-	600	-	-
HCM Lane V/C Ratio	0.735	-	-	-	19.679	-	-	47.39	-	0.061	-	-
HCM Control Delay (s)	21.9	-	-	-	$ 10726.5	0	-	$ 23241.6	0	11.4	-	-
HCM Lane LOS	C	-	-	-	F	A	-	F	A	B	-	-
HCM 95th %tile Q(veh)	6.6	-	-	-	9.4	-	-	20.1	-	0.2	-	-

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

HCM 6th AWSC
15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Intersection	
Intersection Delay, s/veh	174
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	19	48	75	60	156	49	124	591	54	24	360	12
Future Vol, veh/h	19	48	75	60	156	49	124	591	54	24	360	12
Peak Hour Factor	0.83	0.83	0.83	0.78	0.78	0.78	0.87	0.87	0.87	0.83	0.83	0.83
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	23	58	90	77	200	63	143	679	62	29	434	14
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	19.9	20.6	304.9	96
HCM LOS	C	C	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	92%	0%	39%	0%	100%	0%	0%	97%
Vol Right, %	0%	8%	0%	61%	0%	0%	100%	0%	3%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	124	645	19	123	60	156	49	24	372
LT Vol	124	0	19	0	60	0	0	24	0
Through Vol	0	591	0	48	0	156	0	0	360
RT Vol	0	54	0	75	0	0	49	0	12
Lane Flow Rate	143	741	23	148	77	200	63	29	448
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.355	1.732	0.066	0.39	0.207	0.511	0.148	0.074	1.078
Departure Headway (Hd)	9.253	8.677	11.988	10.999	11.207	10.68	9.942	10.365	9.822
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	391	423	301	329	322	340	363	348	372
Service Time	6.953	6.377	9.688	8.699	8.907	8.38	7.642	8.065	7.522
HCM Lane V/C Ratio	0.366	1.752	0.076	0.45	0.239	0.588	0.174	0.083	1.204
HCM Control Delay	17	360.2	15.5	20.6	16.8	24	14.4	13.9	101.3
HCM Lane LOS	C	F	C	C	C	C	B	B	F
HCM 95th-tile Q	1.6	44.1	0.2	1.8	0.8	2.8	0.5	0.2	14.1

Intersection	
Int Delay, s/veh	57.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✣	
Traffic Vol, veh/h	8	395	68	289	437	0	77	21	447	0	7	1
Future Vol, veh/h	8	395	68	289	437	0	77	21	447	0	7	1
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	100	-	-	100	-	-	75	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	96	96	96	78	78	78
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	9	465	80	340	514	0	80	22	466	0	9	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	514	0	0	545	0	0	1722	1717	505	1961	1757	514
Stage 1	-	-	-	-	-	-	523	523	-	1194	1194	-
Stage 2	-	-	-	-	-	-	1199	1194	-	767	563	-
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	1052	-	-	1024	-	-	~ 70	90	567	48	85	560
Stage 1	-	-	-	-	-	-	537	530	-	228	260	-
Stage 2	-	-	-	-	-	-	226	260	-	395	509	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1052	-	-	1024	-	-	~ 46	60	567	5	56	560
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 46	60	-	5	56	-
Stage 1	-	-	-	-	-	-	532	525	-	226	174	-
Stage 2	-	-	-	-	-	-	143	174	-	67	504	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	4.1	194.3	72.9
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	46	411	1052	-	-	1024	-	-	63
HCM Lane V/C Ratio	1.744	1.186	0.009	-	-	0.332	-	-	0.163
HCM Control Delay (s)	$ 549.6	135.8	8.5	-	-	10.3	-	-	72.9
HCM Lane LOS	F	F	A	-	-	B	-	-	F
HCM 95th %tile Q(veh)	8	19.1	0	-	-	1.5	-	-	0.5

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	
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

Intersection	
Intersection Delay, s/veh	13.8
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	171	340	884	477
Demand Flow Rate, veh/h	174	347	902	487
Vehicles Circulating, veh/h	552	862	112	429
Vehicles Exiting, veh/h	364	152	614	780
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	18.8	14.3	11.7
Approach LOS	A	C	B	B

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	174	347	902	487
Cap Entry Lane, veh/h	786	573	1231	891
Entry HV Adj Factor	0.982	0.980	0.981	0.980
Flow Entry, veh/h	171	340	884	477
Cap Entry, veh/h	772	561	1207	873
V/C Ratio	0.221	0.606	0.733	0.547
Control Delay, s/veh	7.1	18.8	14.3	11.7
LOS	A	C	B	B
95th %tile Queue, veh	1	4	7	3

Volume
12: Eastonville Rd & Londonderry Dr

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	94	257	451	307	182	62
Future Volume (vph)	94	257	451	307	182	62
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	111	302	531	361	214	73
Shared Lane Traffic (%)						
Lane Group Flow (vph)	111	302	531	361	214	73

Intersection Summary

12: Eastonville Rd & Londonderry Dr

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

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	145	199	82	32	341	250	130	362	53	112	230	97
Future Volume (vph)	145	199	82	32	341	250	130	362	53	112	230	97
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	171	234	96	38	401	294	153	426	62	132	271	114
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	501	0	0	439	294	153	488	0	132	385	0

Intersection Summary

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)		43.0		43.0	43.0	30.7	25.7	30.7	25.7
Actuated g/C Ratio		0.48		0.48	0.48	0.35	0.29	0.35	0.29
v/c Ratio		1.00		0.52	0.32	0.61	0.91	0.72	0.72
Control Delay		66.4		18.9	2.7	30.2	53.8	42.5	35.2
Queue Delay		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		66.4		18.9	2.7	30.2	53.8	42.5	35.2
LOS		E		B	A	C	D	D	D
Approach Delay		66.4		12.4			48.2		37.1
Approach LOS		E		B			D		D

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 88.7

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

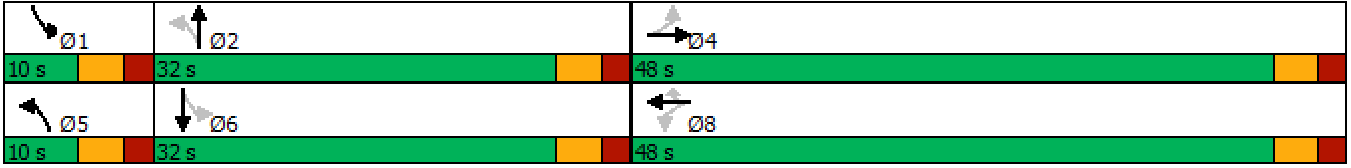
Maximum v/c Ratio: 1.00

Intersection Signal Delay: 38.6 Intersection LOS: D

Intersection Capacity Utilization 88.3% ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 13: Eastonville Rd & Stapleton Dr



Volume

14: US 24 & Stapleton Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	31	49	311	5	118	69	511	1057	26	31	657	117
Future Volume (vph)	31	49	311	5	118	69	511	1057	26	31	657	117
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.93	0.93	0.93	0.85	0.85	0.85
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	37	59	375	6	142	83	549	1137	28	36	773	138
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	59	375	6	142	83	549	1137	28	36	773	138

Intersection Summary

14: US 24 & Stapleton Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	31	49	311	5	118	69	511	1057	26	31	657	117
Future Volume (vph)	31	49	311	5	118	69	511	1057	26	31	657	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)	33.0	33.0		33.0	33.0	33.0	34.0	77.0	77.0	10.0	53.0	53.0
Total Split (%)	27.5%	27.5%		27.5%	27.5%	27.5%	28.3%	64.2%	64.2%	8.3%	44.2%	44.2%
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)	13.3	13.3	105.4	13.3	13.3	13.3	82.1	75.2	75.2	53.1	47.1	47.1
Actuated g/C Ratio	0.13	0.13	1.00	0.13	0.13	0.13	0.78	0.71	0.71	0.50	0.45	0.45
v/c Ratio	0.31	0.25	0.24	0.04	0.61	0.27	0.98	0.86	0.02	0.18	0.93	0.18
Control Delay	48.4	43.8	0.4	39.8	54.7	5.3	64.7	21.8	0.2	10.2	47.4	3.8
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	48.4	43.8	0.4	39.8	54.7	5.3	64.7	21.8	0.2	10.2	47.4	3.8
LOS	D	D	A	D	D	A	E	C	A	B	D	A
Approach Delay		9.6			36.6			35.2			39.6	
Approach LOS		A			D			D			D	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 105.4
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 32.9 Intersection LOS: C
Intersection Capacity Utilization 84.6% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 14: US 24 & Stapleton Dr

Volume

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Short-Term Total Traffic
PM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	19	48	75	60	156	49	124	591	54	24	360	12
Future Volume (vph)	19	48	75	60	156	49	124	591	54	24	360	12
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.83	0.83	0.83	0.78	0.78	0.78	0.87	0.87	0.87	0.83	0.83	0.83
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	23	58	90	77	200	63	143	679	62	29	434	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	23	148	0	77	200	63	143	741	0	29	448	0

Intersection Summary

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↱	↰	↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	19	48	60	156	49	124	591	24	360
Future Volume (vph)	19	48	60	156	49	124	591	24	360
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	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	20.0	10.0	20.0	20.0	10.0	20.0	10.0	20.0
Total Split (s)	10.0	25.0	10.0	25.0	25.0	10.0	75.0	10.0	75.0
Total Split (%)	8.3%	20.8%	8.3%	20.8%	20.8%	8.3%	62.5%	8.3%	62.5%
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	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
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	None	Min
Act Effct Green (s)	16.4	12.6	18.8	17.3	17.3	42.5	40.0	39.1	33.3
Actuated g/C Ratio	0.21	0.16	0.25	0.23	0.23	0.55	0.52	0.51	0.43
v/c Ratio	0.08	0.46	0.25	0.48	0.14	0.33	0.77	0.11	0.56
Control Delay	28.1	28.8	29.5	36.8	2.2	10.0	22.6	8.0	17.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.1	28.8	29.5	36.8	2.2	10.0	22.6	8.0	17.8
LOS	C	C	C	D	A	A	C	A	B
Approach Delay		28.7		28.7			20.6		17.2
Approach LOS		C		C			C		B

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 76.7

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.77

Intersection Signal Delay: 21.9 Intersection LOS: C

Intersection Capacity Utilization 67.6% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	8	395	68	289	437	0	77	21	447	0	7	1
Future Volume (vph)	8	395	68	289	437	0	77	21	447	0	7	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.96	0.96	0.96	0.78	0.78	0.78
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	9	465	80	340	514	0	80	22	466	0	9	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	9	545	0	340	514	0	80	488	0	0	10	0

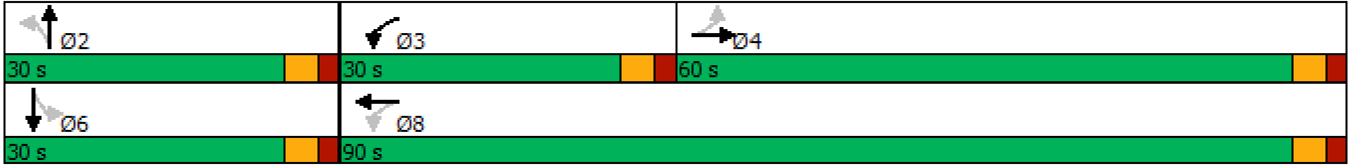
Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	✥
Traffic Volume (vph)	8	395	289	437	77	21	7
Future Volume (vph)	8	395	289	437	77	21	7
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	NA
Protected Phases		4	3	8		2	6
Permitted Phases	4		8		2		
Detector Phase	4	4	3	8	2	2	6
Switch Phase							
Minimum Initial (s)	5.0	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	20.0
Total Split (s)	60.0	60.0	30.0	90.0	30.0	30.0	30.0
Total Split (%)	50.0%	50.0%	25.0%	75.0%	25.0%	25.0%	25.0%
Yellow Time (s)	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
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	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	Min	Min	Min
Act Effct Green (s)	25.3	25.3	42.3	42.3	11.9	11.9	11.9
Actuated g/C Ratio	0.39	0.39	0.65	0.65	0.18	0.18	0.18
v/c Ratio	0.03	0.76	0.68	0.43	0.31	0.73	0.03
Control Delay	14.4	25.6	15.0	7.1	30.1	11.0	25.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.4	25.6	15.0	7.1	30.1	11.0	25.8
LOS	B	C	B	A	C	B	C
Approach Delay		25.4		10.2		13.7	25.8
Approach LOS		C		B		B	C

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 65.2
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 15.6 Intersection LOS: B
Intersection Capacity Utilization 82.2% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 16: McLaughlin Rd & Eastonville Dr



1: Eastonville Rd & Rex Rd

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	35	121	216	16	32	1	81	128	22	2	193	52
Future Volume (vph)	35	121	216	16	32	1	81	128	22	2	193	52
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	37	127	227	17	34	1	85	135	23	2	203	55
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	127	227	17	34	1	85	135	23	2	203	55
Intersection Summary												

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	-	-

Volume
9: US 24 & Rex Rd

	⤴	⤵	↰	↑	↓	↲
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	40	105	28	843	1117	21
Future Volume (vph)	40	105	28	843	1117	21
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.98	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	42	111	29	860	1176	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	42	111	29	860	1176	22
Intersection Summary						

9: US 24 & Rex Rd

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	23.8	0.1	58.4	6.1	10.2	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.8	0.1	58.4	6.1	10.2	3.7
LOS	C	A	E	A	B	A
Approach Delay	6.6			7.8	10.0	
Approach LOS	A			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: 8.9 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

12: Eastonville Rd & Londonderry Dr

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	35	275	158	192	463	51
Future Volume (vph)	35	275	158	192	463	51
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	37	289	166	202	487	54
Shared Lane Traffic (%)						
Lane Group Flow (vph)	37	289	166	202	487	54

Intersection Summary

Intersection	
Int Delay, s/veh	5.7

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	351	-	-	-	-	-
Stage 1	519	-	-	-	-	-
Stage 2	588	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	17.1	4.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1028	-	351	581	-	-
HCM Lane V/C Ratio	0.162	-	0.105	0.498	-	-
HCM Control Delay (s)	9.2	-	16.5	17.2	-	-
HCM Lane LOS	A	-	C	C	-	-
HCM 95th %tile Q(veh)	0.6	-	0.3	2.8	-	-

Volume
13: Eastonville Rd & Stapleton Dr

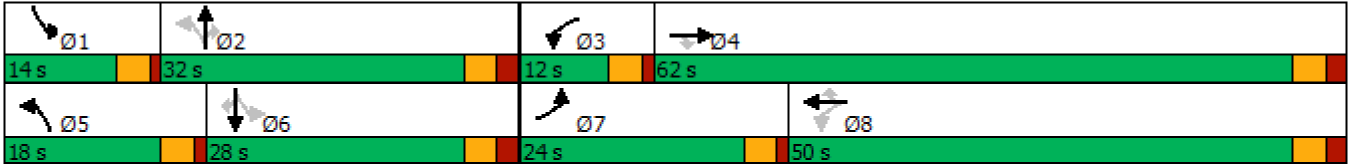
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Traffic Volume (vph)	128	990	224	143	832	85	108	137	177	237	277	189
Future Volume (vph)	128	990	224	143	832	85	108	137	177	237	277	189
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	135	1042	236	151	876	89	114	144	186	249	292	199
Shared Lane Traffic (%)												
Lane Group Flow (vph)	135	1042	236	151	876	89	114	144	186	249	292	199

Intersection Summary

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)	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)	9.3	36.4	36.4	44.0	35.1	35.1	30.7	19.5	19.5	30.6	19.4	19.4
Actuated g/C Ratio	0.10	0.39	0.39	0.48	0.38	0.38	0.33	0.21	0.21	0.33	0.21	0.21
v/c Ratio	0.39	0.75	0.31	0.61	0.65	0.13	0.35	0.37	0.39	0.55	0.75	0.41
Control Delay	46.0	28.1	3.7	25.0	27.0	1.8	24.5	35.6	7.7	29.5	49.5	8.2
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	46.0	28.1	3.7	25.0	27.0	1.8	24.5	35.6	7.7	29.5	49.5	8.2
LOS	D	C	A	C	C	A	C	D	A	C	D	A
Approach Delay		25.8			24.7			21.1			31.6	
Approach LOS		C			C			C			C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 92.6	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.75	
Intersection Signal Delay: 26.1	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



14: US 24 & Stapleton Dr

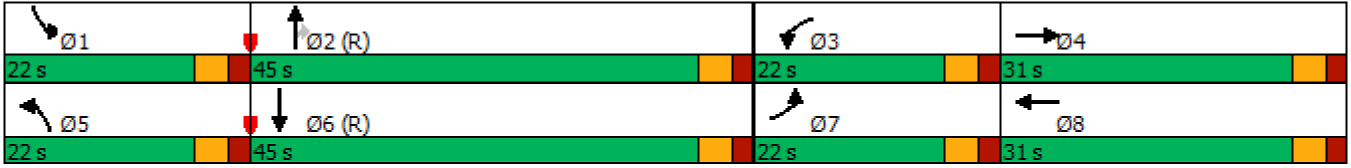
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	428	488	608	200	485	124	332	321	175	222	742	263
Future Volume (vph)	428	488	608	200	485	124	332	321	175	222	742	263
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.98	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	451	514	640	211	511	131	349	338	184	234	757	277
Shared Lane Traffic (%)												
Lane Group Flow (vph)	451	514	640	211	511	131	349	338	184	234	757	277

Intersection Summary

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	Free	Prot	NA	Perm	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			Free
Detector Phase	7	4		3	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	
Minimum Split (s)	10.0	10.0		10.0	10.0		10.0	11.0	11.0	10.0	11.0	
Total Split (s)	22.0	31.0		22.0	31.0		22.0	45.0	45.0	22.0	45.0	
Total Split (%)	18.3%	25.8%		18.3%	25.8%		18.3%	37.5%	37.5%	18.3%	37.5%	
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	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	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max	C-Max	None	C-Max	
Act Effct Green (s)	17.0	26.8	120.0	12.7	22.4	120.0	16.1	47.2	47.2	13.4	44.5	120.0
Actuated g/C Ratio	0.14	0.22	1.00	0.11	0.19	1.00	0.13	0.39	0.39	0.11	0.37	1.00
v/c Ratio	0.93	0.65	0.40	0.58	0.77	0.08	0.76	0.24	0.25	0.61	0.58	0.17
Control Delay	77.5	46.7	0.8	57.5	54.6	0.1	61.4	26.3	4.9	50.8	27.3	0.2
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	77.5	46.7	0.8	57.5	54.6	0.1	61.4	26.3	4.9	50.8	27.3	0.2
LOS	E	D	A	E	D	A	E	C	A	D	C	A
Approach Delay		37.0			46.9			35.8			25.7	
Approach LOS		D			D			D			C	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 110 (92%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Natural Cycle: 60	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.93	
Intersection Signal Delay: 35.5	Intersection LOS: D
Intersection Capacity Utilization 72.3%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 14: US 24 & Stapleton Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	107	164	112	65	48	124	19	534	85	241	439	11
Future Volume (vph)	107	164	112	65	48	124	19	534	85	241	439	11
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	113	173	118	68	51	131	20	562	89	254	462	12
Shared Lane Traffic (%)												
Lane Group Flow (vph)	113	291	0	68	51	131	20	651	0	254	474	0

Intersection Summary

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↱	↰	↑↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	107	164	65	48	124	19	534	241	439
Future Volume (vph)	107	164	65	48	124	19	534	241	439
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	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	20.0	10.0	20.0	20.0	10.0	20.0	10.0	20.0
Total Split (s)	10.0	30.0	10.0	30.0	30.0	10.0	60.0	20.0	70.0
Total Split (%)	8.3%	25.0%	8.3%	25.0%	25.0%	8.3%	50.0%	16.7%	58.3%
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	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
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	None	Min
Act Effct Green (s)	14.2	10.5	14.2	10.5	10.5	41.0	35.6	52.1	48.8
Actuated g/C Ratio	0.18	0.13	0.18	0.13	0.13	0.51	0.44	0.64	0.60
v/c Ratio	0.43	0.55	0.32	0.11	0.39	0.04	0.81	0.62	0.42
Control Delay	35.9	26.2	33.6	37.1	8.2	6.8	28.8	15.0	11.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.9	26.2	33.6	37.1	8.2	6.8	28.8	15.0	11.5
LOS	D	C	C	D	A	A	C	B	B
Approach Delay		28.9		21.0			28.1		12.7
Approach LOS		C		C			C		B

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 80.8

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 21.9 Intersection LOS: C

Intersection Capacity Utilization 75.6% ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Volume
16: McLaughlin Rd & Eastonville Dr

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	1	351	44	256	317	0	19	4	119	0	12	1
Future Volume (vph)	1	351	44	256	317	0	19	4	119	0	12	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	1	369	46	269	334	0	20	4	125	0	13	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	1	415	0	269	334	0	20	129	0	0	14	0

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	✥
Traffic Volume (vph)	1	351	256	317	19	4	12
Future Volume (vph)	1	351	256	317	19	4	12
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	NA
Protected Phases		4	3	8		2	6
Permitted Phases	4		8		2		
Detector Phase	4	4	3	8	2	2	6
Switch Phase							
Minimum Initial (s)	5.0	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	20.0
Total Split (s)	60.0	60.0	30.0	90.0	30.0	30.0	30.0
Total Split (%)	50.0%	50.0%	25.0%	75.0%	25.0%	25.0%	25.0%
Yellow Time (s)	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
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	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	Min	Min	Min
Act Effct Green (s)	15.6	15.6	29.3	29.3	6.7	6.7	6.7
Actuated g/C Ratio	0.34	0.34	0.63	0.63	0.15	0.15	0.15
v/c Ratio	0.00	0.67	0.47	0.28	0.10	0.38	0.05
Control Delay	10.0	18.9	6.5	4.5	20.9	9.3	19.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.0	18.9	6.5	4.5	20.9	9.3	19.5
LOS	A	B	A	A	C	A	B
Approach Delay		18.9		5.4		10.9	19.5
Approach LOS		B		A		B	B

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 46.2

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

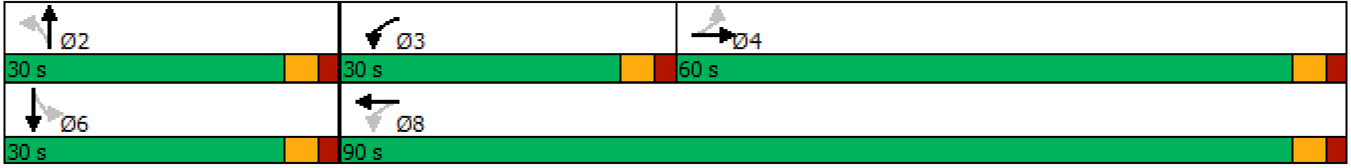
Maximum v/c Ratio: 0.67

Intersection Signal Delay: 11.0 Intersection LOS: B

Intersection Capacity Utilization 55.5% ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 16: McLaughlin Rd & Eastonville Dr



Intersection	
Intersection Delay, s/veh	4.7
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	2	1	2	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	391	52	243	260
Demand Flow Rate, veh/h	400	53	248	265
Vehicles Circulating, veh/h	226	263	170	139
Vehicles Exiting, veh/h	178	155	456	177
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	4.8	3.9	4.5	5.0
Approach LOS	A	A	A	A

Lane	Left	Right	Left	Left	Right	Left
Designated Moves	LT	R	LTR	LT	R	LTR
Assumed Moves	LT	R	LTR	LT	R	LTR
RT Channelized						
Lane Util	0.420	0.580	1.000	0.907	0.093	1.000
Follow-Up Headway, s	2.535	2.535	2.609	2.535	2.535	2.609
Critical Headway, s	4.544	4.544	4.976	4.544	4.544	4.976
Entry Flow, veh/h	168	232	53	225	23	265
Cap Entry Lane, veh/h	1156	1156	1055	1217	1217	1197
Entry HV Adj Factor	0.979	0.978	0.987	0.979	1.000	0.981
Flow Entry, veh/h	164	227	52	220	23	260
Cap Entry, veh/h	1132	1131	1042	1191	1217	1175
V/C Ratio	0.145	0.201	0.050	0.185	0.019	0.221
Control Delay, s/veh	4.4	5.0	3.9	4.6	3.1	5.0
LOS	A	A	A	A	A	A
95th %tile Queue, veh	1	1	0	1	0	1

Intersection	
Intersection Delay, s/veh	5.3
Intersection LOS	A

Approach	EB	NB	SB
Entry Lanes	2	2	2
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	326	368	541
Demand Flow Rate, veh/h	333	375	552
Vehicles Circulating, veh/h	497	38	169
Vehicles Exiting, veh/h	224	792	244
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.1	3.9	5.2
Approach LOS	A	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	0.114	0.886	0.451	0.549	0.469	0.531
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	38	295	169	206	259	293
Cap Entry Lane, veh/h	855	931	1303	1375	1155	1230
Entry HV Adj Factor	0.974	0.980	0.982	0.980	0.982	0.979
Flow Entry, veh/h	37	289	166	202	254	287
Cap Entry, veh/h	832	912	1280	1348	1135	1204
V/C Ratio	0.044	0.317	0.130	0.150	0.224	0.238
Control Delay, s/veh	4.8	7.4	3.9	3.9	5.2	5.1
LOS	A	A	A	A	A	A
95th %tile Queue, veh	0	1	0	1	1	1

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Intersection	
Intersection Delay, s/veh	11.8
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	2	2	2	1
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	404	250	671	728
Demand Flow Rate, veh/h	411	255	684	742
Vehicles Circulating, veh/h	799	708	550	141
Vehicles Exiting, veh/h	84	526	660	822
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.2	6.8	17.4	9.9
Approach LOS	A	A	C	A

Lane	Left	Right	Left	Right	Left	Right	Left
Designated Moves	LT	TR	LT	TR	LT	R	LTR
Assumed Moves	LT	TR	LT	R	LT	R	LTR
RT Channelized							
Lane Util	0.470	0.530	0.475	0.525	0.867	0.133	1.000
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.667	2.535	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.645	4.328	4.328
Entry Flow, veh/h	193	218	121	134	593	91	742
Cap Entry Lane, veh/h	647	720	704	778	814	890	1260
Entry HV Adj Factor	0.983	0.981	0.983	0.978	0.981	0.978	0.981
Flow Entry, veh/h	190	214	119	131	582	89	728
Cap Entry, veh/h	636	706	692	760	798	870	1236
V/C Ratio	0.298	0.303	0.172	0.172	0.729	0.102	0.589
Control Delay, s/veh	9.5	8.8	7.1	6.6	19.2	5.1	9.9
LOS	A	A	A	A	C	A	A
95th %tile Queue, veh	1	1	1	1	6	0	4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	41	102	91	18	87	1	158	138	14	2	200	67
Future Volume (vph)	41	102	91	18	87	1	158	138	14	2	200	67
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	43	107	96	19	92	1	166	145	15	2	211	71
Shared Lane Traffic (%)												
Lane Group Flow (vph)	43	107	96	19	92	1	166	145	15	2	211	71

Intersection Summary

HCM 6th TWSC
1: Eastonville Rd & Rex Rd

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	-	-

Volume
9: US 24 & Rex Rd

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	29	89	75	1107	1021	31
Future Volume (vph)	29	89	75	1107	1021	31
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.98	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	31	94	79	1130	1075	33
Shared Lane Traffic (%)						
Lane Group Flow (vph)	31	94	79	1130	1075	33

Intersection Summary

	↗	↘	↖	↑	↓	↙
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

12: Eastonville Rd & Londonderry Dr

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	44	177	307	389	292	35
Future Volume (vph)	44	177	307	389	292	35
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	46	186	323	409	307	37
Shared Lane Traffic (%)						
Lane Group Flow (vph)	46	186	323	409	344	0

Intersection Summary

Intersection	
Int Delay, s/veh	4.8

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	238	-	-	-	-	-
Stage 1	537	-	-	-	-	-
Stage 2	335	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.2	4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1215	-	238	715	-	-
HCM Lane V/C Ratio	0.266	-	0.195	0.261	-	-
HCM Control Delay (s)	9	-	23.7	11.8	-	-
HCM Lane LOS	A	-	C	B	-	-
HCM 95th %tile Q(veh)	1.1	-	0.7	1	-	-

Volume

13: Eastonville Rd & Stapleton Dr

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
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
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.98	0.95	0.95	0.98	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	261	922	168	182	1274	159	264	313	166	138	206	139
Shared Lane Traffic (%)												
Lane Group Flow (vph)	261	922	168	182	1274	159	264	313	166	138	206	139

Intersection Summary

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

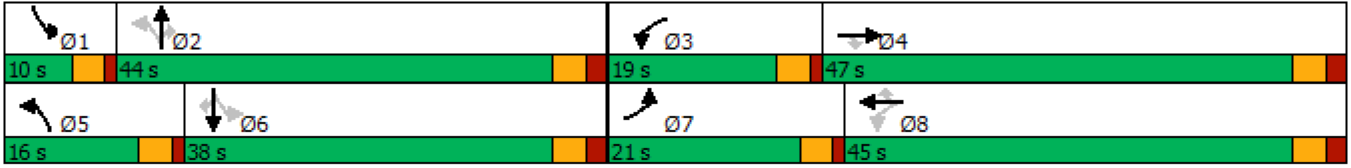
Maximum v/c Ratio: 0.90

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



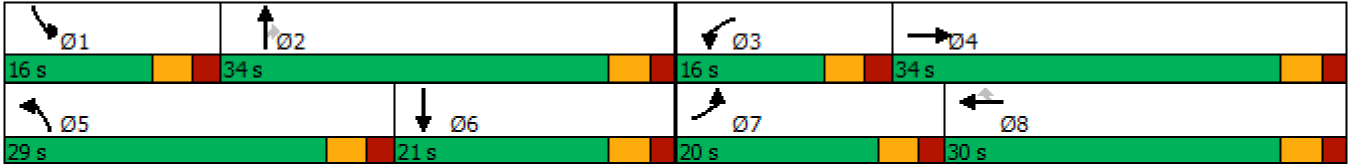
	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	372	553	388	200	778	122	723	693	175	223	444	449
Future Volume (vph)	372	553	388	200	778	122	723	693	175	223	444	449
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.98	0.98	0.95	0.95	0.98	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	392	582	408	211	819	128	738	707	184	235	453	473
Shared Lane Traffic (%)												
Lane Group Flow (vph)	392	582	408	211	819	128	738	707	184	235	453	473

Intersection Summary

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



	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	11	51	80	132	165	293	131	498	162	171	350	8
Future Volume (vph)	11	51	80	132	165	293	131	498	162	171	350	8
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	12	54	84	139	174	308	138	524	171	180	368	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	12	138	0	139	174	308	138	695	0	180	376	0

Intersection Summary

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↱	↰	↑↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	11	51	132	165	293	131	498	171	350
Future Volume (vph)	11	51	132	165	293	131	498	171	350
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	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	20.0	10.0	20.0	20.0	10.0	20.0	10.0	20.0
Total Split (s)	10.0	30.0	10.0	30.0	30.0	15.0	65.0	15.0	65.0
Total Split (%)	8.3%	25.0%	8.3%	25.0%	25.0%	12.5%	54.2%	12.5%	54.2%
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	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
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	None	Min
Act Effct Green (s)	13.7	8.4	18.2	17.5	17.5	45.7	36.9	45.7	36.9
Actuated g/C Ratio	0.17	0.10	0.23	0.22	0.22	0.57	0.46	0.57	0.46
v/c Ratio	0.05	0.33	0.53	0.23	0.53	0.25	0.83	0.59	0.44
Control Delay	30.0	19.4	38.8	31.3	8.3	7.1	28.1	17.4	16.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.0	19.4	38.8	31.3	8.3	7.1	28.1	17.4	16.2
LOS	C	B	D	C	A	A	C	B	B
Approach Delay		20.3		21.6			24.6		16.6
Approach LOS		C		C			C		B

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 80.4

Natural Cycle: 75

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 21.4 Intersection LOS: C

Intersection Capacity Utilization 73.7% ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

16: McLaughlin Rd & Eastonville Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	9	438	72	284	509	0	82	22	426	0	8	1
Future Volume (vph)	9	438	72	284	509	0	82	22	426	0	8	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	9	461	76	299	536	0	86	23	448	0	8	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	9	537	0	299	536	0	86	471	0	0	9	0

Intersection Summary

16: McLaughlin Rd & Eastonville Dr

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBT
Lane Configurations	↰	↑↱	↰	↑↱	↰	↑↱	↰↑↱
Traffic Volume (vph)	9	438	284	509	82	22	8
Future Volume (vph)	9	438	284	509	82	22	8
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	NA
Protected Phases		4	3	8		2	6
Permitted Phases	4		8		2		
Detector Phase	4	4	3	8	2	2	6
Switch Phase							
Minimum Initial (s)	5.0	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	20.0
Total Split (s)	70.0	70.0	20.0	90.0	30.0	30.0	30.0
Total Split (%)	58.3%	58.3%	16.7%	75.0%	25.0%	25.0%	25.0%
Yellow Time (s)	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
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	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	Min	Min	Min
Act Effct Green (s)	24.3	24.3	40.0	40.0	11.2	11.2	11.2
Actuated g/C Ratio	0.39	0.39	0.64	0.64	0.18	0.18	0.18
v/c Ratio	0.03	0.75	0.61	0.45	0.34	0.72	0.03
Control Delay	13.3	23.7	11.3	7.2	29.2	10.9	24.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.3	23.7	11.3	7.2	29.2	10.9	24.1
LOS	B	C	B	A	C	B	C
Approach Delay		23.5		8.7		13.8	24.1
Approach LOS		C		A		B	C

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 62.1

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

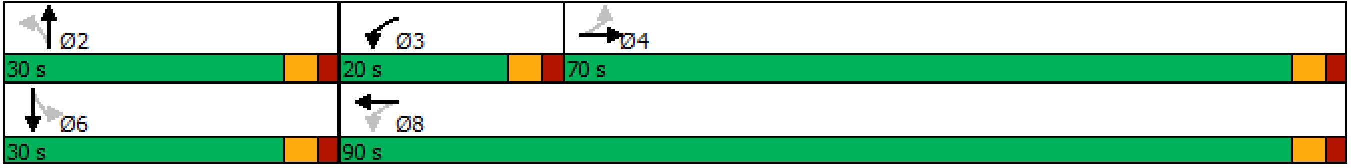
Maximum v/c Ratio: 0.75

Intersection Signal Delay: 14.4 Intersection LOS: B

Intersection Capacity Utilization 83.2% ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 16: McLaughlin Rd & Eastonville Dr



HCM 6th Roundabout
1: Eastonville Rd & Rex Rd

Intersection	
Intersection Delay, s/veh	5.2
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	2	1	2	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	246	112	326	284
Demand Flow Rate, veh/h	251	114	332	289
Vehicles Circulating, veh/h	236	361	155	282
Vehicles Exiting, veh/h	335	126	332	193
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	4.2	4.9	5.2	6.3
Approach LOS	A	A	A	A

Lane	Left	Right	Left	Left	Right	Left
Designated Moves	LT	R	LTR	LT	R	LTR
Assumed Moves	LT	R	LTR	LT	R	LTR
RT Channelized						
Lane Util	0.610	0.390	1.000	0.955	0.045	1.000
Follow-Up Headway, s	2.535	2.535	2.609	2.535	2.535	2.609
Critical Headway, s	4.544	4.544	4.976	4.544	4.544	4.976
Entry Flow, veh/h	153	98	114	317	15	289
Cap Entry Lane, veh/h	1146	1146	955	1233	1233	1035
Entry HV Adj Factor	0.979	0.980	0.984	0.981	1.000	0.982
Flow Entry, veh/h	150	96	112	311	15	284
Cap Entry, veh/h	1122	1122	939	1210	1233	1016
V/C Ratio	0.134	0.086	0.119	0.257	0.012	0.279
Control Delay, s/veh	4.4	3.9	4.9	5.3	3.0	6.3
LOS	A	A	A	A	A	A
95th %tile Queue, veh	0	0	0	1	0	1

Intersection	
Intersection Delay, s/veh	5.1
Intersection LOS	A

Approach	EB	NB	SB
Entry Lanes	2	2	2
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	232	732	344
Demand Flow Rate, veh/h	237	746	351
Vehicles Circulating, veh/h	313	47	329
Vehicles Exiting, veh/h	367	503	464
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	4.8	5.3	5.1
Approach LOS	A	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	0.198	0.802	0.441	0.559	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	47	190	329	417	165	186
Cap Entry Lane, veh/h	1012	1088	1293	1364	997	1074
Entry HV Adj Factor	0.979	0.979	0.982	0.980	0.979	0.980
Flow Entry, veh/h	46	186	323	409	162	182
Cap Entry, veh/h	991	1065	1269	1338	977	1052
V/C Ratio	0.046	0.175	0.255	0.306	0.165	0.173
Control Delay, s/veh	4.0	5.0	5.1	5.4	5.2	5.0
LOS	A	A	A	A	A	A
95th %tile Queue, veh	0	1	1	1	1	1

Intersection	
Intersection Delay, s/veh	10.6
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	2	2	2	1
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	150	621	833	556
Demand Flow Rate, veh/h	153	633	849	567
Vehicles Circulating, veh/h	701	687	251	460
Vehicles Exiting, veh/h	326	413	603	860
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	6.0	10.4	10.6	12.1
Approach LOS	A	B	B	B

Lane	Left	Right	Left	Right	Left	Right	Left
Designated Moves	LT	TR	LT	TR	LT	R	LTR
Assumed Moves	LT	R	LT	TR	LT	R	LTR
RT Channelized							
Lane Util	0.438	0.562	0.471	0.529	0.795	0.205	1.000
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.667	2.535	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.645	4.328	4.328
Entry Flow, veh/h	67	86	298	335	675	174	567
Cap Entry Lane, veh/h	708	783	718	792	1072	1147	960
Entry HV Adj Factor	0.984	0.977	0.979	0.982	0.980	0.983	0.980
Flow Entry, veh/h	66	84	292	329	662	171	556
Cap Entry, veh/h	697	764	702	777	1050	1127	941
V/C Ratio	0.095	0.110	0.415	0.423	0.630	0.152	0.590
Control Delay, s/veh	6.2	5.8	10.8	10.1	12.2	4.5	12.1
LOS	A	A	B	B	B	A	B
95th %tile Queue, veh	0	0	2	2	5	1	4

1: Eastonville Rd & Rex Rd

Intersection	
Int Delay, s/veh	1103.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Vol, veh/h	35	163	218	658	85	27	86	130	371	23	194	52
Future Vol, veh/h	35	163	218	658	85	27	86	130	371	23	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	172	229	693	89	28	91	137	391	24	204	55

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	825	962	204	799	626	137	259	0	0	528	0	0
Stage 1	252	252	-	319	319	-	-	-	-	-	-	-
Stage 2	573	710	-	480	307	-	-	-	-	-	-	-
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	292	256	837	~ 304	401	911	1306	-	-	1039	-	-
Stage 1	752	698	-	693	653	-	-	-	-	-	-	-
Stage 2	505	437	-	~ 567	661	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	214	233	837	~ 83	365	911	1306	-	-	1039	-	-
Mov Cap-2 Maneuver	214	233	-	~ 83	365	-	-	-	-	-	-	-
Stage 1	699	682	-	~ 644	607	-	-	-	-	-	-	-
Stage 2	388	406	-	~ 301	646	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	29	$ 2909.6	1.2	0.7
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1306	-	-	214	233	837	83	365	911	1039	-	-
HCM Lane V/C Ratio	0.069	-	-	0.172	0.736	0.274	8.345	0.245	0.031	0.023	-	-
HCM Control Delay (s)	8	-	-	25.3	54.1	10.9	$ 3402.2	18	9.1	8.5	-	-
HCM Lane LOS	A	-	-	D	F	B	F	C	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.6	5.1	1.1	79.5	0.9	0.1	0.1	-	-

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

2: Parcel A & B & Rex Rd

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱		↰	↑	↰	↱
Traffic Vol, veh/h	548	9	14	753	18	27
Future Vol, veh/h	548	9	14	753	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	577	9	15	793	19	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	586	0	1405	582
Stage 1	-	-	-	-	582	-
Stage 2	-	-	-	-	823	-
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	-	-	989	-	154	513
Stage 1	-	-	-	-	559	-
Stage 2	-	-	-	-	431	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	989	-	152	513
Mov Cap-2 Maneuver	-	-	-	-	288	-
Stage 1	-	-	-	-	559	-
Stage 2	-	-	-	-	425	-

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)	288	513	-	-	989	-
HCM Lane V/C Ratio	0.066	0.055	-	-	0.015	-
HCM Control Delay (s)	18.4	12.4	-	-	8.7	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱		↰	↑	↰	↱
Traffic Vol, veh/h	563	12	19	730	36	57
Future Vol, veh/h	563	12	19	730	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	612	13	21	793	39	62

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	625	0	1454	619
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	835	-
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	-	-	956	-	143	489
Stage 1	-	-	-	-	537	-
Stage 2	-	-	-	-	426	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	956	-	140	489
Mov Cap-2 Maneuver	-	-	-	-	277	-
Stage 1	-	-	-	-	537	-
Stage 2	-	-	-	-	417	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	16
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	277	489	-	-	956	-
HCM Lane V/C Ratio	0.141	0.127	-	-	0.022	-
HCM Control Delay (s)	20.1	13.4	-	-	8.8	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	0.5	0.4	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	596	24	38	676	73	114
Future Vol, veh/h	596	24	38	676	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	627	25	40	712	77	120

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	652	0	1419	627
Stage 1	-	-	-	-	627	-
Stage 2	-	-	-	-	792	-
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	-	-	935	-	151	484
Stage 1	-	-	-	-	532	-
Stage 2	-	-	-	-	446	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	935	-	145	484
Mov Cap-2 Maneuver	-	-	-	-	281	-
Stage 1	-	-	-	-	532	-
Stage 2	-	-	-	-	427	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	17.9
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	281	484	-	-	935	-
HCM Lane V/C Ratio	0.273	0.248	-	-	0.043	-
HCM Control Delay (s)	22.6	14.9	-	-	9	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	1.1	1	-	-	0.1	-

Intersection	
Int Delay, s/veh	4.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	664	46	45	578	137	135
Future Vol, veh/h	664	46	45	578	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	699	48	47	608	144	142

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	747	0	1401	699
Stage 1	-	-	-	-	699	-
Stage 2	-	-	-	-	702	-
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	-	-	861	-	154	440
Stage 1	-	-	-	-	493	-
Stage 2	-	-	-	-	491	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	861	-	146	440
Mov Cap-2 Maneuver	-	-	-	-	285	-
Stage 1	-	-	-	-	493	-
Stage 2	-	-	-	-	464	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	23.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	285	440	-	-	861	-
HCM Lane V/C Ratio	0.506	0.323	-	-	0.055	-
HCM Control Delay (s)	29.9	17	-	-	9.4	-
HCM Lane LOS	D	C	-	-	A	-
HCM 95th %tile Q(veh)	2.7	1.4	-	-	0.2	-

Intersection	
Int Delay, s/veh	107.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰	↱
Traffic Vol, veh/h	207	593	290	249	460	333
Future Vol, veh/h	207	593	290	249	460	333
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	218	624	305	262	484	351

Major/Minor	Major1			Major2	Minor2	
Conflicting Flow All	567	0	-	0	1365	305
Stage 1	-	-	-	-	305	-
Stage 2	-	-	-	-	1060	-
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	1005	-	-	-	~ 162	735
Stage 1	-	-	-	-	748	-
Stage 2	-	-	-	-	~ 333	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1005	-	-	-	~ 127	735
Mov Cap-2 Maneuver	-	-	-	-	~ 246	-
Stage 1	-	-	-	-	586	-
Stage 2	-	-	-	-	~ 333	-

Approach	EB		WB		SB	
HCM Control Delay, s	2.5		0		286.4	
HCM LOS					F	

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	1005	-	-	-	246	735
HCM Lane V/C Ratio	0.217	-	-	-	1.968	0.477
HCM Control Delay (s)	9.6	-	-	-	$ 483.3	14.3
HCM Lane LOS	A	-	-	-	F	B
HCM 95th %tile Q(veh)	0.8	-	-	-	35	2.6

Notes

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

Intersection	
Int Delay, s/veh	12.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	1019	34	79	439	100	236
Future Vol, veh/h	1019	34	79	439	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	1073	36	83	462	105	248

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1109	0	1701	1073
Stage 1	-	-	-	-	1073	-
Stage 2	-	-	-	-	628	-
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	-	-	630	-	~ 101	268
Stage 1	-	-	-	-	328	-
Stage 2	-	-	-	-	532	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	630	-	~ 88	268
Mov Cap-2 Maneuver	-	-	-	-	214	-
Stage 1	-	-	-	-	328	-
Stage 2	-	-	-	-	462	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.8	66.2
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	214	268	-	-	630	-
HCM Lane V/C Ratio	0.492	0.927	-	-	0.132	-
HCM Control Delay (s)	37.1	78.6	-	-	11.6	-
HCM Lane LOS	E	F	-	-	B	-
HCM 95th %tile Q(veh)	2.5	8.5	-	-	0.5	-

Notes

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

Intersection	
Int Delay, s/veh	5.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	19	1217	19	39	507	41	5	0	30	31	0	5
Future Vol, veh/h	19	1217	19	39	507	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	1281	20	41	534	43	5	0	32	33	0	5

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	577	0	0	1301	0	0	1961	1980	1281	1963	1957	534
Stage 1	-	-	-	-	-	-	1321	1321	-	616	616	-
Stage 2	-	-	-	-	-	-	640	659	-	1347	1341	-
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	996	-	-	532	-	-	48	62	202	47	64	546
Stage 1	-	-	-	-	-	-	193	226	-	478	482	-
Stage 2	-	-	-	-	-	-	464	461	-	186	221	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	996	-	-	532	-	-	44	56	202	37	58	546
Mov Cap-2 Maneuver	-	-	-	-	-	-	44	56	-	37	58	-
Stage 1	-	-	-	-	-	-	189	221	-	468	445	-
Stage 2	-	-	-	-	-	-	424	426	-	154	217	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	0.8	36.3	237.6
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	44	202	996	-	-	532	-	-	37	546
HCM Lane V/C Ratio	0.12	0.156	0.02	-	-	0.077	-	-	0.882	0.01
HCM Control Delay (s)	97.6	26.1	8.7	-	-	12.3	-	-	274	11.7
HCM Lane LOS	F	D	A	-	-	B	-	-	F	B
HCM 95th %tile Q(veh)	0.4	0.5	0.1	-	-	0.2	-	-	3.2	0

Intersection	
Int Delay, s/veh	3.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↱		↑	↱	↰	↑
Traffic Vol, veh/h	108	59	529	36	20	1051
Future Vol, veh/h	108	59	529	36	20	1051
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	557	38	21	1106

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1705	557	0	0	595	0
Stage 1	557	-	-	-	-	-
Stage 2	1148	-	-	-	-	-
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	~ 101	530	-	-	981	-
Stage 1	574	-	-	-	-	-
Stage 2	302	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 99	530	-	-	981	-
Mov Cap-2 Maneuver	217	-	-	-	-	-
Stage 1	574	-	-	-	-	-
Stage 2	296	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	39	0	0.2
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	274	981	-
HCM Lane V/C Ratio	-	-	0.642	0.021	-
HCM Control Delay (s)	-	-	39	8.8	-
HCM Lane LOS	-	-	E	A	-
HCM 95th %tile Q(veh)	-	-	4	0.1	-

Notes

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

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↑	↱	↰	↑
Traffic Vol, veh/h	55	29	536	18	10	1149
Future Vol, veh/h	55	29	536	18	10	1149
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	631	21	12	1352

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	2007	631	0	0	652	0
Stage 1	631	-	-	-	-	-
Stage 2	1376	-	-	-	-	-
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	65	481	-	-	935	-
Stage 1	530	-	-	-	-	-
Stage 2	234	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 64	481	-	-	935	-
Mov Cap-2 Maneuver	171	-	-	-	-	-
Stage 1	530	-	-	-	-	-
Stage 2	231	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	34.1	0	0.1
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	220	935	-
HCM Lane V/C Ratio	-	-	0.449	0.013	-
HCM Control Delay (s)	-	-	34.1	8.9	-
HCM Lane LOS	-	-	D	A	-
HCM 95th %tile Q(veh)	-	-	2.1	0	-

Notes

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

Intersection	
Int Delay, s/veh	27.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Traffic Vol, veh/h	102	275	158	461	1119	178
Future Vol, veh/h	102	275	158	461	1119	178
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	107	289	166	485	1178	187

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1995	1178	1365	0	-	0
Stage 1	1178	-	-	-	-	-
Stage 2	817	-	-	-	-	-
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	~ 66	~ 232	503	-	-	-
Stage 1	292	-	-	-	-	-
Stage 2	434	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 44	~ 232	503	-	-	-
Mov Cap-2 Maneuver	140	-	-	-	-	-
Stage 1	196	-	-	-	-	-
Stage 2	434	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	158.2	4	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	503	-	140	232	-	-
HCM Lane V/C Ratio	0.331	-	0.767	1.248	-	-
HCM Control Delay (s)	15.7	-	86.1	185	-	-
HCM Lane LOS	C	-	F	F	-	-
HCM 95th %tile Q(veh)	1.4	-	4.6	14.6	-	-

Notes

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

Intersection	
Intersection Delay, s/veh	326.7
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	129	164	112	65	48	124	19	638	85	241	712	40
Future Vol, veh/h	129	164	112	65	48	124	19	638	85	241	712	40
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	136	173	118	68	51	131	20	672	89	254	749	42
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Righ	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	41.1	22.3	495.6	389.6
HCM LOS	E	C	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	88%	0%	59%	0%	100%	0%	0%	95%
Vol Right, %	0%	12%	0%	41%	0%	0%	100%	0%	5%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	19	723	129	276	65	48	124	241	752
LT Vol	19	0	129	0	65	0	0	241	0
Through Vol	0	638	0	164	0	48	0	0	712
RT Vol	0	85	0	112	0	0	124	0	40
Lane Flow Rate	20	761	136	291	68	51	131	254	792
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.057	2.053	0.389	0.77	0.21	0.148	0.358	0.691	2.038
Departure Headway (Hd)	11.65	11.042	13.827	12.979	14.984	14.442	13.685	11.92	11.35
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	309	335	262	282	242	250	265	307	332
Service Time	9.35	8.742	11.527	10.679	12.684	12.142	11.385	9.62	9.05
HCM Lane V/C Ratio	0.065	2.272	0.519	1.032	0.281	0.204	0.494	0.827	2.386
HCM Control Delay	15.1	508.2	25.1	48.6	21.6	19.6	23.8	37.5	502.5
HCM Lane LOS	C	F	D	E	C	C	C	E	F
HCM 95th-tile Q	0.2	48.1	1.8	5.8	0.8	0.5	1.6	4.8	46.4

Intersection	
Int Delay, s/veh	6.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✣	
Traffic Vol, veh/h	1	423	44	346	501	0	19	4	152	0	12	1
Future Vol, veh/h	1	423	44	346	501	0	19	4	152	0	12	1
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	100	-	-	100	-	-	75	-	-	-	-	-
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	1	445	46	364	527	0	20	4	160	0	13	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	527	0	0	491	0	0	1732	1725	468	1807	1748	527
Stage 1	-	-	-	-	-	-	470	470	-	1255	1255	-
Stage 2	-	-	-	-	-	-	1262	1255	-	552	493	-
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	1040	-	-	1072	-	-	69	89	595	61	86	551
Stage 1	-	-	-	-	-	-	574	560	-	210	243	-
Stage 2	-	-	-	-	-	-	208	243	-	518	547	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1040	-	-	1072	-	-	43	59	595	31	57	551
Mov Cap-2 Maneuver	-	-	-	-	-	-	43	59	-	31	57	-
Stage 1	-	-	-	-	-	-	573	559	-	210	160	-
Stage 2	-	-	-	-	-	-	126	160	-	375	546	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	4.1	30.4	80.3
HCM LOS			D	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	43	483	1040	-	-	1072	-	-	61
HCM Lane V/C Ratio	0.465	0.34	0.001	-	-	0.34	-	-	0.224
HCM Control Delay (s)	147.3	16.2	8.5	-	-	10.1	-	-	80.3
HCM Lane LOS	F	C	A	-	-	B	-	-	F
HCM 95th %tile Q(veh)	1.7	1.5	0	-	-	1.5	-	-	0.8

HCM 6th Roundabout
1: Eastonville Rd & Rex Rd

Intersection	
Intersection Delay, s/veh	13.4
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	2	1	2	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	438	810	619	283
Demand Flow Rate, veh/h	447	827	632	288
Vehicles Circulating, veh/h	939	271	237	891
Vehicles Exiting, veh/h	240	598	1149	207
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	11.5	19.2	6.1	16.0
Approach LOS	B	C	A	C

Lane	Left	Right	Left	Left	Right	Left
Designated Moves	LT	R	LTR	LT	R	LTR
Assumed Moves	LT	R	LTR	LT	R	LTR
RT Channelized						
Lane Util	0.477	0.523	1.000	0.369	0.631	1.000
Follow-Up Headway, s	2.535	2.535	2.609	2.535	2.535	2.609
Critical Headway, s	4.544	4.544	4.976	4.544	4.544	4.976
Entry Flow, veh/h	213	234	827	233	399	288
Cap Entry Lane, veh/h	604	604	1047	1145	1145	556
Entry HV Adj Factor	0.979	0.979	0.980	0.980	0.980	0.982
Flow Entry, veh/h	209	229	810	228	391	283
Cap Entry, veh/h	592	591	1025	1121	1122	546
V/C Ratio	0.353	0.387	0.790	0.204	0.349	0.518
Control Delay, s/veh	11.1	11.8	19.2	5.0	6.7	16.0
LOS	B	B	C	A	A	C
95th %tile Queue, veh	2	2	9	1	2	3

Intersection	
Intersection Delay, s/veh	8.6
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	586	808	47
Demand Flow Rate, veh/h	598	824	48
Vehicles Circulating, veh/h	15	19	589
Vehicles Exiting, veh/h	828	618	24
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.0	9.9	5.5
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	598	824	48
Cap Entry Lane, veh/h	1359	1353	757
Entry HV Adj Factor	0.981	0.981	0.979
Flow Entry, veh/h	586	808	47
Cap Entry, veh/h	1333	1327	741
V/C Ratio	0.440	0.609	0.063
Control Delay, s/veh	7.0	9.9	5.5
LOS	A	A	A
95th %tile Queue, veh	2	4	0

Intersection	
Intersection Delay, s/veh	9.0
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	625	814	101
Demand Flow Rate, veh/h	637	830	103
Vehicles Circulating, veh/h	21	40	624
Vehicles Exiting, veh/h	849	687	34
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.5	10.4	6.6
Approach LOS	A	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	637	830	103
Cap Entry Lane, veh/h	1351	1325	730
Entry HV Adj Factor	0.981	0.981	0.981
Flow Entry, veh/h	625	814	101
Cap Entry, veh/h	1325	1299	716
V/C Ratio	0.472	0.627	0.141
Control Delay, s/veh	7.5	10.4	6.6
LOS	A	B	A
95th %tile Queue, veh	3	5	0

Intersection	
Intersection Delay, s/veh	9.1
Intersection LOS	A

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	652	752	197
Demand Flow Rate, veh/h	666	767	201
Vehicles Circulating, veh/h	41	79	640
Vehicles Exiting, veh/h	805	762	66
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.1	10.2	8.5
Approach LOS	A	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	666	767	201
Cap Entry Lane, veh/h	1323	1273	718
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	652	752	197
Cap Entry, veh/h	1296	1248	704
V/C Ratio	0.503	0.603	0.280
Control Delay, s/veh	8.1	10.2	8.5
LOS	A	B	A
95th %tile Queue, veh	3	4	1

Intersection	
Intersection Delay, s/veh	10.0
Intersection LOS	B

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	747	655	286
Demand Flow Rate, veh/h	762	668	292
Vehicles Circulating, veh/h	48	147	713
Vehicles Exiting, veh/h	767	858	97
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	9.5	9.8	11.9
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	762	668	292
Cap Entry Lane, veh/h	1314	1188	667
Entry HV Adj Factor	0.980	0.980	0.979
Flow Entry, veh/h	747	655	286
Cap Entry, veh/h	1288	1164	653
V/C Ratio	0.580	0.562	0.438
Control Delay, s/veh	9.5	9.8	11.9
LOS	A	A	B
95th %tile Queue, veh	4	4	2

Intersection	
Intersection Delay, s/veh	21.2
Intersection LOS	C

Approach	EB	WB	SB
Entry Lanes	1	2	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	842	567	835
Demand Flow Rate, veh/h	858	578	852
Vehicles Circulating, veh/h	494	222	311
Vehicles Exiting, veh/h	669	1130	489
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	34.6	5.6	18.1
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	0.538	0.462	1.000
Follow-Up Headway, s	2.535	2.667	2.535	2.535
Critical Headway, s	4.328	4.645	4.328	4.328
Entry Flow, veh/h	858	311	267	852
Cap Entry Lane, veh/h	933	1101	1176	1090
Entry HV Adj Factor	0.981	0.980	0.981	0.980
Flow Entry, veh/h	842	305	262	835
Cap Entry, veh/h	915	1079	1154	1068
V/C Ratio	0.920	0.283	0.227	0.782
Control Delay, s/veh	34.6	6.1	5.2	18.1
LOS	D	A	A	C
95th %tile Queue, veh	14	1	1	8

Intersection	
Intersection Delay, s/veh	20.3
Intersection LOS	C

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	1076	545	353
Demand Flow Rate, veh/h	1098	556	360
Vehicles Circulating, veh/h	85	107	1061
Vehicles Exiting, veh/h	578	1314	122
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	22.4	7.6	33.4
Approach LOS	C	A	D

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	1098	556	360
Cap Entry Lane, veh/h	1265	1237	468
Entry HV Adj Factor	0.980	0.980	0.981
Flow Entry, veh/h	1076	545	353
Cap Entry, veh/h	1240	1212	459
V/C Ratio	0.868	0.449	0.770
Control Delay, s/veh	22.4	7.6	33.4
LOS	C	A	D
95th %tile Queue, veh	12	2	7

HCM 6th Roundabout
8: Commercial & Rex Rd

Intersection	
Intersection Delay, s/veh	7.5
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	1365	638	38	39
Demand Flow Rate, veh/h	1391	651	39	40
Vehicles Circulating, veh/h	78	26	1405	610
Vehicles Exiting, veh/h	572	1418	64	67
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	8.8	4.8	9.9	4.8
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	0.470	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	654	737	306	345	39	40
Cap Entry Lane, veh/h	1256	1329	1318	1389	430	845
Entry HV Adj Factor	0.981	0.981	0.980	0.980	0.974	0.975
Flow Entry, veh/h	641	723	300	338	38	39
Cap Entry, veh/h	1232	1304	1291	1361	419	824
V/C Ratio	0.521	0.555	0.232	0.248	0.091	0.047
Control Delay, s/veh	8.7	8.9	4.8	4.8	9.9	4.8
LOS	A	A	A	A	A	A
95th %tile Queue, veh	3	4	1	1	0	0

HCM 6th Roundabout
10: Eastonville Rd & Parcels C

Intersection	
Intersection Delay, s/veh	17.4
Intersection LOS	C

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	176	595	1127
Demand Flow Rate, veh/h	179	607	1149
Vehicles Circulating, veh/h	568	21	116
Vehicles Exiting, veh/h	60	1244	631
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.3	6.8	24.8
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	607	1149
Cap Entry Lane, veh/h	876	1395	1287
Entry HV Adj Factor	0.983	0.980	0.981
Flow Entry, veh/h	176	595	1127
Cap Entry, veh/h	862	1367	1262
V/C Ratio	0.204	0.435	0.893
Control Delay, s/veh	6.3	6.8	24.8
LOS	A	A	C
95th %tile Queue, veh	1	2	14

Intersection	
Intersection Delay, s/veh	24.5
Intersection LOS	C

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	89	583	1220
Demand Flow Rate, veh/h	91	594	1244
Vehicles Circulating, veh/h	575	11	59
Vehicles Exiting, veh/h	30	1292	607
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.0	6.9	34.2
Approach LOS	A	A	D

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	91	594	1244
Cap Entry Lane, veh/h	768	1364	1299
Entry HV Adj Factor	0.978	0.981	0.981
Flow Entry, veh/h	89	583	1220
Cap Entry, veh/h	751	1339	1274
V/C Ratio	0.119	0.435	0.957
Control Delay, s/veh	6.0	6.9	34.2
LOS	A	A	D
95th %tile Queue, veh	0	2	18

Intersection	
Intersection Delay, s/veh	10.2
Intersection LOS	B

Approach	EB	NB	SB
Entry Lanes	2	2	2
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	396	651	1365
Demand Flow Rate, veh/h	404	664	1393
Vehicles Circulating, veh/h	1202	109	169
Vehicles Exiting, veh/h	360	1497	604
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	17.4	5.9	10.2
Approach LOS	C	A	B

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	0.270	0.730	0.255	0.745	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	109	295	169	495	655	738
Cap Entry Lane, veh/h	447	511	1221	1294	1155	1230
Entry HV Adj Factor	0.982	0.980	0.982	0.980	0.980	0.981
Flow Entry, veh/h	107	289	166	485	642	724
Cap Entry, veh/h	439	501	1199	1269	1132	1206
V/C Ratio	0.244	0.577	0.138	0.382	0.567	0.600
Control Delay, s/veh	12.1	19.4	4.2	6.5	10.1	10.4
LOS	B	C	A	A	B	B
95th %tile Queue, veh	1	4	0	2	4	4

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Intersection	
Intersection Delay, s/veh	21.1
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	2	2	2	1
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	427	250	781	1045
Demand Flow Rate, veh/h	435	255	796	1066
Vehicles Circulating, veh/h	1092	844	574	141
Vehicles Exiting, veh/h	115	526	953	958
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	13.8	7.9	30.1	20.6
Approach LOS	B	A	D	C

Lane	Left	Right	Left	Right	Left	Right	Left
Designated Moves	LT	TR	LT	TR	LT	R	LTR
Assumed Moves	LT	TR	LT	R	LT	R	LTR
RT Channelized							
Lane Util	0.469	0.531	0.475	0.525	0.886	0.114	1.000
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.667	2.535	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.645	4.328	4.328
Entry Flow, veh/h	204	231	121	134	705	91	1066
Cap Entry Lane, veh/h	494	561	621	693	796	872	1260
Entry HV Adj Factor	0.983	0.979	0.983	0.978	0.981	0.978	0.980
Flow Entry, veh/h	200	226	119	131	692	89	1045
Cap Entry, veh/h	486	549	611	677	781	853	1235
V/C Ratio	0.413	0.412	0.195	0.193	0.886	0.104	0.846
Control Delay, s/veh	14.6	13.1	8.3	7.6	33.3	5.2	20.6
LOS	B	B	A	A	D	A	C
95th %tile Queue, veh	2	2	1	1	11	0	11

Volume
1: Eastonville Rd & Rex Rd

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	35	163	218	658	85	27	86	130	371	23	194	52
Future Volume (vph)	35	163	218	658	85	27	86	130	371	23	194	52
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	37	172	229	693	89	28	91	137	391	24	204	55
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	172	229	693	89	28	91	137	391	24	204	55

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	35	163	218	658	85	27	86	130	371	23	194	52
Future Volume (vph)	35	163	218	658	85	27	86	130	371	23	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)	16.0	30.0	30.0	16.0	30.0	30.0	74.0	74.0	74.0	74.0	74.0	74.0
Total Split (%)	13.3%	25.0%	25.0%	13.3%	25.0%	25.0%	61.7%	61.7%	61.7%	61.7%	61.7%	61.7%
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)	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)	16.0	9.9	9.9	25.8	21.9	21.9	11.3	11.3	11.3	11.3	11.3	11.3
Actuated g/C Ratio	0.34	0.21	0.21	0.54	0.46	0.46	0.24	0.24	0.24	0.24	0.24	0.24
v/c Ratio	0.07	0.44	0.45	1.01	0.10	0.04	0.33	0.31	0.58	0.08	0.46	0.13
Control Delay	7.0	21.1	6.3	52.6	11.4	1.6	18.9	17.3	6.1	15.1	19.5	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	7.0	21.1	6.3	52.6	11.4	1.6	18.9	17.3	6.1	15.1	19.5	5.1
LOS	A	C	A	D	B	A	B	B	A	B	B	A
Approach Delay		12.2			46.3			10.4			16.3	
Approach LOS		B			D			B			B	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 47.5

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.01

Intersection Signal Delay: 25.1 Intersection LOS: C

Intersection Capacity Utilization 76.7% ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 1: Eastonville Rd & Rex Rd

	↗	→	←	↖	↘	↙
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Traffic Volume (vph)	207	593	290	249	460	333
Future Volume (vph)	207	593	290	249	460	333
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	218	624	305	262	484	351
Shared Lane Traffic (%)						
Lane Group Flow (vph)	218	624	305	262	484	351

Intersection Summary

6: Rex Rd & Residential Collector

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰	↱
Traffic Volume (vph)	207	593	290	249	460	333
Future Volume (vph)	207	593	290	249	460	333
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	75.0	60.0	60.0	45.0	45.0
Total Split (%)	12.5%	62.5%	50.0%	50.0%	37.5%	37.5%
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	C-Max	None	None	Max	Max
Act Effct Green (s)	70.0	70.0	55.2	55.2	40.0	40.0
Actuated g/C Ratio	0.58	0.58	0.46	0.46	0.33	0.33
v/c Ratio	0.39	0.57	0.36	0.30	0.82	0.46
Control Delay	14.1	18.3	48.2	27.0	49.7	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.1	18.3	48.2	27.0	49.7	5.1
LOS	B	B	D	C	D	A
Approach Delay		17.2	38.4		30.9	
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: 0.82

Intersection Signal Delay: 27.7 Intersection LOS: C

Intersection Capacity Utilization 65.0% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 6: Rex Rd & Residential Collector

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	19	1217	19	39	507	41	5	0	30	31	0	5
Future Volume (vph)	19	1217	19	39	507	41	5	0	30	31	0	5
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	20	1281	20	41	534	43	5	0	32	33	0	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	20	1281	20	41	534	43	5	32	0	33	5	0

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	19	1217	19	39	507	41	5	0	31	0
Future Volume (vph)	19	1217	19	39	507	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)	64.5	64.5	64.5	64.5	64.5	64.5	45.5	45.5	45.5	45.5
Actuated g/C Ratio	0.54	0.54	0.54	0.54	0.54	0.54	0.38	0.38	0.38	0.38
v/c Ratio	0.05	0.67	0.02	0.34	0.28	0.05	0.01	0.05	0.06	0.01
Control Delay	7.3	16.4	1.5	49.9	38.6	22.4	30.2	0.1	29.5	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	7.3	16.4	1.5	49.9	38.6	22.4	30.2	0.1	29.5	0.0
LOS	A	B	A	D	D	C	C	A	C	A
Approach Delay		16.0			38.3			4.2		25.6
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: 0.67	
Intersection Signal Delay: 22.8	Intersection LOS: C
Intersection Capacity Utilization 50.4%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 8: C-1/C-2 & Rex Rd

Volume
9: US 24 & Rex Rd

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	142	1136	489	833	1096	97
Future Volume (vph)	142	1136	489	833	1096	97
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.98	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	149	1196	515	850	1154	102
Shared Lane Traffic (%)						
Lane Group Flow (vph)	149	1196	515	850	1154	102
Intersection Summary						

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰↰	↑↑	↑↑	↱
Traffic Volume (vph)	142	1136	489	833	1096	97
Future Volume (vph)	142	1136	489	833	1096	97
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	23.6	90.0	61.4	61.4
Actuated g/C Ratio	0.17	1.00	0.20	0.75	0.51	0.51
v/c Ratio	0.51	0.76	0.76	0.32	0.64	0.12
Control Delay	34.5	21.8	48.9	4.2	24.0	5.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.5	21.8	48.9	4.2	24.0	5.4
LOS	C	C	D	A	C	A
Approach Delay	23.2			21.1	22.5	
Approach LOS	C			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: 0.76
Intersection Signal Delay: 22.2 Intersection LOS: C
Intersection Capacity Utilization 64.6% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 9: US 24 & Rex Rd

Volume
12: Eastonville Rd & Londonderry Dr

	↗	↘	↖	↑	↓	↙
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	102	275	158	461	1119	178
Future Volume (vph)	102	275	158	461	1119	178
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	107	289	166	485	1178	187
Shared Lane Traffic (%)						
Lane Group Flow (vph)	107	289	166	485	1178	187

Intersection Summary

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Traffic Volume (vph)	102	275	158	461	1119	178
Future Volume (vph)	102	275	158	461	1119	178
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)	10.3	10.3	44.9	44.9	31.7	31.7
Actuated g/C Ratio	0.16	0.16	0.68	0.68	0.48	0.48
v/c Ratio	0.38	0.69	0.47	0.20	0.69	0.22
Control Delay	31.4	19.7	10.1	4.1	15.5	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.4	19.7	10.1	4.1	15.5	2.3
LOS	C	B	B	A	B	A
Approach Delay	22.8			5.7	13.7	
Approach LOS	C			A	B	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 65.6

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 13.0	Intersection LOS: B
Intersection Capacity Utilization 57.8%	ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 12: Eastonville Rd & Londonderry Dr

Volume
13: Eastonville Rd & Stapleton Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	250	998	224	144	833	111	108	258	182	315	578	466
Future Volume (vph)	250	998	224	144	833	111	108	258	182	315	578	466
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	263	1051	236	152	877	117	114	272	192	332	608	491
Shared Lane Traffic (%)												
Lane Group Flow (vph)	263	1051	236	152	877	117	114	272	192	332	608	491

Intersection Summary

13: Eastonville Rd & Stapleton Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	250	998	224	144	833	111	108	258	182	315	578	466
Future Volume (vph)	250	998	224	144	833	111	108	258	182	315	578	466
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)	12.9	37.8	37.8	41.7	32.8	32.8	34.2	23.2	23.2	34.5	23.4	23.4
Actuated g/C Ratio	0.13	0.39	0.39	0.43	0.34	0.34	0.35	0.24	0.24	0.35	0.24	0.24
v/c Ratio	0.58	0.76	0.31	0.66	0.74	0.19	0.44	0.61	0.38	0.92	1.36	0.81
Control Delay	46.3	29.8	3.6	30.3	33.0	4.4	27.1	41.7	9.3	59.9	208.5	26.5
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	46.3	29.8	3.6	30.3	33.0	4.4	27.1	41.7	9.3	59.9	208.5	26.5
LOS	D	C	A	C	C	A	C	D	A	E	F	C
Approach Delay		28.6			29.7			28.1			111.6	
Approach LOS		C			C			C			F	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 97.4

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

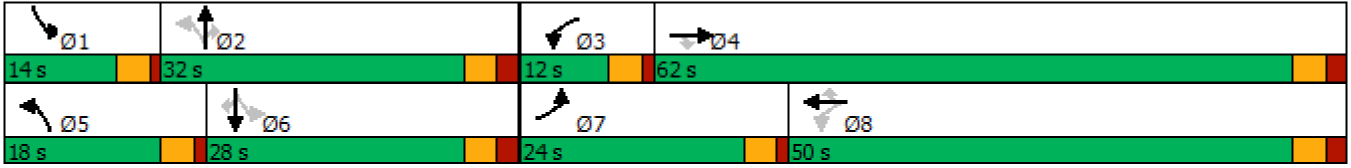
Maximum v/c Ratio: 1.36

Intersection Signal Delay: 54.0 Intersection LOS: D

Intersection Capacity Utilization 87.0% 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
Traffic Volume (vph)	442	493	680	200	487	178	356	705	175	309	1663	265
Future Volume (vph)	442	493	680	200	487	178	356	705	175	309	1663	265
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.98	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	465	519	716	211	513	187	375	742	184	325	1697	279
Shared Lane Traffic (%)												
Lane Group Flow (vph)	465	519	716	211	513	187	375	742	184	325	1697	279

Intersection Summary

14: US 24 & 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	178	356	705	175	309	1663	265
Future Volume (vph)	442	493	680	200	487	178	356	705	175	309	1663	265
Turn Type	Prot	NA	Free	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			Free
Detector Phase	7	4		3	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	
Minimum Split (s)	10.0	10.0		10.0	10.0		10.0	11.0	11.0	10.0	11.0	
Total Split (s)	17.0	30.0		18.0	31.0		10.0	62.0	62.0	10.0	62.0	
Total Split (%)	14.2%	25.0%		15.0%	25.8%		8.3%	51.7%	51.7%	8.3%	51.7%	
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	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	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max	C-Max	None	C-Max	
Act Effct Green (s)	12.0	23.0	120.0	11.8	22.8	120.0	8.2	57.0	57.0	8.2	57.0	120.0
Actuated g/C Ratio	0.10	0.19	1.00	0.10	0.19	1.00	0.07	0.48	0.48	0.07	0.48	1.00
v/c Ratio	1.36	0.77	0.45	0.63	0.76	0.12	1.60	0.44	0.22	1.38	1.01	0.18
Control Delay	219.0	54.1	0.9	60.4	53.9	0.2	321.9	22.0	3.1	228.3	53.0	0.2
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	219.0	54.1	0.9	60.4	53.9	0.2	321.9	22.0	3.1	228.3	53.0	0.2
LOS	F	D	A	E	D	A	F	C	A	F	D	A
Approach Delay		76.8			44.4			105.8			71.4	
Approach LOS		E			D			F			E	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 110 (92%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Natural Cycle: 130	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 1.60	
Intersection Signal Delay: 76.1	Intersection LOS: E
Intersection Capacity Utilization 98.9%	ICU Level of Service F
Analysis Period (min) 15	

Splits and Phases: 14: US 24 & Stapleton Dr

Volume

15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	129	164	112	65	48	124	19	638	85	241	712	40
Future Volume (vph)	129	164	112	65	48	124	19	638	85	241	712	40
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	136	173	118	68	51	131	20	672	89	254	749	42
Shared Lane Traffic (%)												
Lane Group Flow (vph)	136	291	0	68	51	131	20	761	0	254	791	0
Intersection Summary												

	↗	→	↙	←	↖	↖	↑	↘	↓
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↱	↰	↑↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	129	164	65	48	124	19	638	241	712
Future Volume (vph)	129	164	65	48	124	19	638	241	712
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	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	20.0	10.0	20.0	20.0	10.0	20.0	10.0	20.0
Total Split (s)	10.0	30.0	10.0	30.0	30.0	10.0	60.0	20.0	70.0
Total Split (%)	8.3%	25.0%	8.3%	25.0%	25.0%	8.3%	50.0%	16.7%	58.3%
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	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
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	None	Min
Act Effct Green (s)	17.0	13.2	15.6	10.5	10.5	50.7	45.5	64.4	60.9
Actuated g/C Ratio	0.18	0.14	0.16	0.11	0.11	0.53	0.48	0.68	0.64
v/c Ratio	0.55	0.52	0.35	0.13	0.42	0.06	0.87	0.69	0.67
Control Delay	45.6	28.4	39.4	42.0	8.9	6.8	34.3	25.1	15.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.6	28.4	39.4	42.0	8.9	6.8	34.3	25.1	15.7
LOS	D	C	D	D	A	A	C	C	B
Approach Delay		33.9		24.0			33.6		18.0
Approach LOS		C		C			C		B

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 95.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 26.2 Intersection LOS: C
Intersection Capacity Utilization 81.0% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Volume
16: McLaughlin Rd & Eastonville Dr

2040 Total Traffic
AM Peak Hour

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	1	423	44	346	501	0	19	4	152	0	12	1
Future Volume (vph)	1	423	44	346	501	0	19	4	152	0	12	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	1	445	46	364	527	0	20	4	160	0	13	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	1	491	0	364	527	0	20	164	0	0	14	0

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	✣
Traffic Volume (vph)	1	423	346	501	19	4	12
Future Volume (vph)	1	423	346	501	19	4	12
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	NA
Protected Phases		4	3	8		2	6
Permitted Phases	4		8		2		
Detector Phase	4	4	3	8	2	2	6
Switch Phase							
Minimum Initial (s)	5.0	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	20.0
Total Split (s)	70.0	70.0	20.0	90.0	30.0	30.0	30.0
Total Split (%)	58.3%	58.3%	16.7%	75.0%	25.0%	25.0%	25.0%
Yellow Time (s)	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
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	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	Min	Min	Min
Act Effct Green (s)	19.0	19.0	34.2	34.2	6.9	6.9	6.9
Actuated g/C Ratio	0.37	0.37	0.66	0.66	0.13	0.13	0.13
v/c Ratio	0.00	0.72	0.65	0.43	0.11	0.47	0.06
Control Delay	11.0	20.7	10.7	5.2	24.4	10.4	22.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.0	20.7	10.7	5.2	24.4	10.4	22.8
LOS	B	C	B	A	C	B	C
Approach Delay		20.7		7.4		11.9	22.8
Approach LOS		C		A		B	C

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 51.5

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

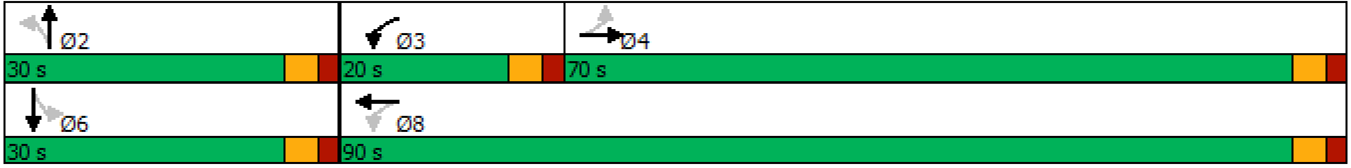
Maximum v/c Ratio: 0.72

Intersection Signal Delay: 12.2 Intersection LOS: B

Intersection Capacity Utilization 66.2% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 16: McLaughlin Rd & Eastonville Dr



13: Eastonville Rd & Stapleton Dr

AM Peak Hour 2 NB/SB TH

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	250	998	224	144	833	111	108	258	182	315	578	466
Future Volume (vph)	250	998	224	144	833	111	108	258	182	315	578	466
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)	12.9	37.8	37.8	41.6	32.7	32.7	33.6	22.2	22.2	33.4	22.1	22.1
Actuated g/C Ratio	0.13	0.39	0.39	0.43	0.34	0.34	0.35	0.23	0.23	0.35	0.23	0.23
v/c Ratio	0.57	0.76	0.31	0.64	0.73	0.19	0.40	0.33	0.38	0.77	0.75	0.79
Control Delay	46.1	29.4	3.6	29.1	32.6	4.4	26.0	33.5	8.6	40.4	43.2	22.4
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	46.1	29.4	3.6	29.1	32.6	4.4	26.0	33.5	8.6	40.4	43.2	22.4
LOS	D	C	A	C	C	A	C	C	A	D	D	C
Approach Delay		28.3			29.3			23.8			35.4	
Approach LOS		C			C			C			D	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 96.5

Natural Cycle: 65

Control Type: Actuated-Uncoordinated

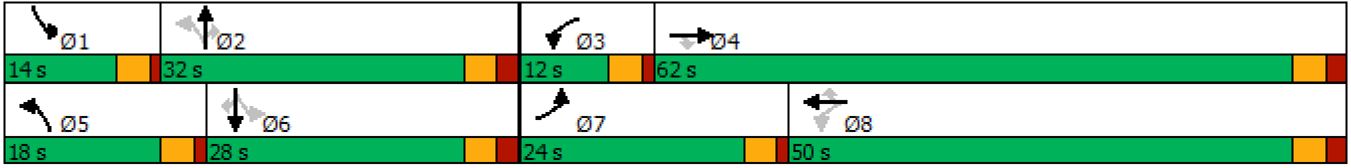
Maximum v/c Ratio: 0.79

Intersection Signal Delay: 30.1 Intersection LOS: C

Intersection Capacity Utilization 75.1% ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 13: Eastonville Rd & Stapleton Dr

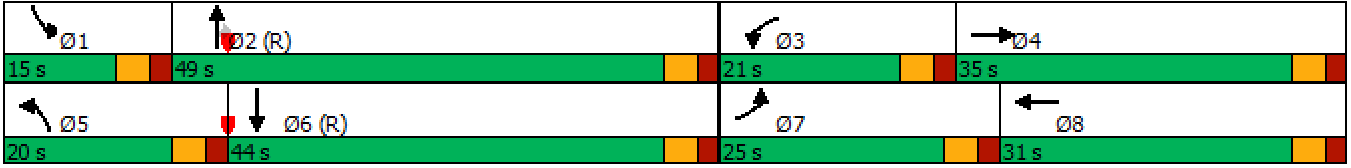


	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑↑	↱	↰↰	↑↑↑	↱	↰↰	↑↑↑	↱	↰↰	↑↑↑	↱
Traffic Volume (vph)	442	493	680	200	487	178	356	705	175	309	1663	265
Future Volume (vph)	442	493	680	200	487	178	356	705	175	309	1663	265
Turn Type	Prot	NA	Free	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			Free
Detector Phase	7	4		3	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	
Minimum Split (s)	10.0	10.0		10.0	10.0		10.0	11.0	11.0	10.0	11.0	
Total Split (s)	25.0	35.0		21.0	31.0		20.0	49.0	49.0	15.0	44.0	
Total Split (%)	20.8%	29.2%		17.5%	25.8%		16.7%	40.8%	40.8%	12.5%	36.7%	
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	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	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max	C-Max	None	C-Max	
Act Effct Green (s)	19.2	24.5	120.0	12.6	17.9	120.0	18.2	44.9	44.9	18.0	44.7	120.0
Actuated g/C Ratio	0.16	0.20	1.00	0.10	0.15	1.00	0.15	0.37	0.37	0.15	0.37	1.00
v/c Ratio	0.85	0.50	0.45	0.58	0.68	0.12	0.72	0.39	0.26	0.63	0.90	0.18
Control Delay	63.8	44.0	0.9	57.5	52.8	0.2	56.9	28.5	4.6	64.0	31.7	0.2
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	63.8	44.0	0.9	57.5	52.8	0.2	56.9	28.5	4.6	64.0	31.7	0.2
LOS	E	D	A	E	D	A	E	C	A	E	C	A
Approach Delay		31.3			43.1			33.3			32.4	
Approach LOS		C			D			C			C	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Offset: 110 (92%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 33.9 Intersection LOS: C
Intersection Capacity Utilization 81.0% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 14: US 24 & Stapleton Dr



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	41	150	96	456	122	18	161	139	654	26	202	67
Future Vol, veh/h	41	150	96	456	122	18	161	139	654	26	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	158	101	480	128	19	169	146	688	27	213	71

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1169	1439	213	916	822	146	284	0	0	834	0	0
Stage 1	267	267	-	484	484	-	-	-	-	-	-	-
Stage 2	902	1172	-	432	338	-	-	-	-	-	-	-
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	170	~ 133	827	~ 253	309	901	1278	-	-	799	-	-
Stage 1	738	688	-	564	552	-	-	-	-	-	-	-
Stage 2	332	266	-	602	641	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	90	~ 111	827	-	259	901	1278	-	-	799	-	-
Mov Cap-2 Maneuver	90	~ 111	-	-	259	-	-	-	-	-	-	-
Stage 1	641	665	-	490	479	-	-	-	-	-	-	-
Stage 2	206	231	-	~ 389	619	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	173.9		1.4	0.9
HCM LOS	F	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	EBLn3	WBLn1	WBLn2	WBLn3	SBL	SBT	SBR
Capacity (veh/h)	1278	-	-	90	111	827	-	259	901	799	-	-
HCM Lane V/C Ratio	0.133	-	-	0.48	1.422	0.122	-	0.496	0.021	0.034	-	-
HCM Control Delay (s)	8.2	-	-	77.4	$ 305.1	10	-	31.8	9.1	9.7	-	-
HCM Lane LOS	A	-	-	F	F	B	-	D	A	A	-	-
HCM 95th %tile Q(veh)	0.5	-	-	2	11.2	0.4	-	2.6	0.1	0.1	-	-

Notes

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

Intersection	
Int Delay, s/veh	0.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↱		↰	↑	↰	↱
Traffic Vol, veh/h	811	20	31	582	14	21
Future Vol, veh/h	811	20	31	582	14	21
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	854	21	33	613	15	22

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	875	0	1544	865
Stage 1	-	-	-	-	865	-
Stage 2	-	-	-	-	679	-
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	-	-	771	-	126	353
Stage 1	-	-	-	-	412	-
Stage 2	-	-	-	-	504	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	771	-	121	353
Mov Cap-2 Maneuver	-	-	-	-	258	-
Stage 1	-	-	-	-	412	-
Stage 2	-	-	-	-	482	-

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)	258	353	-	-	771	-
HCM Lane V/C Ratio	0.057	0.063	-	-	0.042	-
HCM Control Delay (s)	19.8	15.9	-	-	9.9	-
HCM Lane LOS	C	C	-	-	A	-
HCM 95th %tile Q(veh)	0.2	0.2	-	-	0.1	-

3: Parcel H & Rex Rd

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↱		↰	↑	↰	↱
Traffic Vol, veh/h	794	38	59	590	22	35
Future Vol, veh/h	794	38	59	590	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	836	40	62	621	23	37

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	876	0	1601	856
Stage 1	-	-	-	-	856	-
Stage 2	-	-	-	-	745	-
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	-	-	771	-	117	357
Stage 1	-	-	-	-	416	-
Stage 2	-	-	-	-	469	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	771	-	108	357
Mov Cap-2 Maneuver	-	-	-	-	242	-
Stage 1	-	-	-	-	416	-
Stage 2	-	-	-	-	431	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	18.2
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	242	357	-	-	771	-
HCM Lane V/C Ratio	0.096	0.103	-	-	0.081	-
HCM Control Delay (s)	21.4	16.2	-	-	10.1	-
HCM Lane LOS	C	C	-	-	B	-
HCM 95th %tile Q(veh)	0.3	0.3	-	-	0.3	-

Intersection	
Int Delay, s/veh	2.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	753	76	119	605	45	70
Future Vol, veh/h	753	76	119	605	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	793	80	125	637	47	74

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	873	0	1680	793
Stage 1	-	-	-	-	793	-
Stage 2	-	-	-	-	887	-
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	-	-	773	-	104	389
Stage 1	-	-	-	-	446	-
Stage 2	-	-	-	-	402	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	773	-	87	389
Mov Cap-2 Maneuver	-	-	-	-	214	-
Stage 1	-	-	-	-	446	-
Stage 2	-	-	-	-	337	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.7	20.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	214	389	-	-	773	-
HCM Lane V/C Ratio	0.221	0.189	-	-	0.162	-
HCM Control Delay (s)	26.5	16.4	-	-	10.6	-
HCM Lane LOS	D	C	-	-	B	-
HCM 95th %tile Q(veh)	0.8	0.7	-	-	0.6	-

Intersection	
Int Delay, s/veh	3.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	680	143	141	640	84	83
Future Vol, veh/h	680	143	141	640	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	716	151	148	674	88	87

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	867	0	1686	716
Stage 1	-	-	-	-	716	-
Stage 2	-	-	-	-	970	-
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	-	-	777	-	103	430
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	368	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	777	-	~ 83	430
Mov Cap-2 Maneuver	-	-	-	-	204	-
Stage 1	-	-	-	-	484	-
Stage 2	-	-	-	-	298	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.9	25.6
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	204	430	-	-	777	-
HCM Lane V/C Ratio	0.433	0.203	-	-	0.191	-
HCM Control Delay (s)	35.5	15.5	-	-	10.7	-
HCM Lane LOS	E	C	-	-	B	-
HCM 95th %tile Q(veh)	2	0.8	-	-	0.7	-

Notes

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

Intersection	
Int Delay, s/veh	39.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰	↱
Traffic Vol, veh/h	263	500	612	396	247	169
Future Vol, veh/h	263	500	612	396	247	169
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	277	526	644	417	260	178

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1061	0	-	0	1724	644
Stage 1	-	-	-	-	644	-
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	657	-	-	-	~ 98	473
Stage 1	-	-	-	-	523	-
Stage 2	-	-	-	-	326	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	657	-	-	-	~ 57	473
Mov Cap-2 Maneuver	-	-	-	-	~ 169	-
Stage 1	-	-	-	-	302	-
Stage 2	-	-	-	-	326	-

Approach	EB	WB	SB
HCM Control Delay, s	5	0	196.4
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	657	-	-	-	169	473
HCM Lane V/C Ratio	0.421	-	-	-	1.538	0.376
HCM Control Delay (s)	14.4	-	-	-	$ 319	17.1
HCM Lane LOS	B	-	-	-	F	C
HCM 95th %tile Q(veh)	2.1	-	-	-	17.1	1.7

Notes

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

Intersection	
Int Delay, s/veh	4.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	642	105	246	946	62	145
Future Vol, veh/h	642	105	246	946	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	676	111	259	996	65	153

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	787	0	2190	676
Stage 1	-	-	-	-	676	-
Stage 2	-	-	-	-	1514	-
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	-	-	832	-	~ 50	453
Stage 1	-	-	-	-	505	-
Stage 2	-	-	-	-	201	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	832	-	~ 34	453
Mov Cap-2 Maneuver	-	-	-	-	109	-
Stage 1	-	-	-	-	505	-
Stage 2	-	-	-	-	138	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.3	35.3
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	109	453	-	-	832	-
HCM Lane V/C Ratio	0.599	0.337	-	-	0.311	-
HCM Control Delay (s)	78.3	16.9	-	-	11.3	-
HCM Lane LOS	F	C	-	-	B	-
HCM 95th %tile Q(veh)	2.9	1.5	-	-	1.3	-

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

Intersection	
Int Delay, s/veh	181.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	35	720	32	121	1101	131	44	0	104	113	0	48
Future Vol, veh/h	35	720	32	121	1101	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	758	34	127	1159	138	46	0	109	119	0	51

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1297	0	0	792	0	0	2340	2383	758	2317	2279	1159
Stage 1	-	-	-	-	-	-	832	832	-	1413	1413	-
Stage 2	-	-	-	-	-	-	1508	1551	-	904	866	-
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	534	-	-	829	-	-	~ 25	34	407	~ 26	40	238
Stage 1	-	-	-	-	-	-	363	384	-	171	204	-
Stage 2	-	-	-	-	-	-	151	175	-	331	370	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	534	-	-	829	-	-	~ 16	27	407	~ 16	32	238
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 16	27	-	~ 16	32	-
Stage 1	-	-	-	-	-	-	338	358	-	159	173	-
Stage 2	-	-	-	-	-	-	101	148	-	225	344	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.5	0.9	$ 412	$ 2369.3
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	16	407	534	-	-	829	-	-	16	238
HCM Lane V/C Ratio	2.895	0.269	0.069	-	-	0.154	-	-	7.434	0.212
HCM Control Delay (s)	$ 1345.4	17.1	12.2	-	-	10.1	-	-	$ 3365.5	24.2
HCM Lane LOS	F	C	B	-	-	B	-	-	F	C
HCM 95th %tile Q(veh)	6.5	1.1	0.2	-	-	0.5	-	-	15.7	0.8

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

Intersection	
Int Delay, s/veh	2.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖↗		↑	↱	↰	↑
Traffic Vol, veh/h	66	36	954	112	62	689
Future Vol, veh/h	66	36	954	112	62	689
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	1004	118	65	725

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1859	1004	0	0	1122	0
Stage 1	1004	-	-	-	-	-
Stage 2	855	-	-	-	-	-
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	81	294	-	-	623	-
Stage 1	354	-	-	-	-	-
Stage 2	417	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	73	294	-	-	623	-
Mov Cap-2 Maneuver	199	-	-	-	-	-
Stage 1	354	-	-	-	-	-
Stage 2	374	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	34.8	0	0.9
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	225	623	-
HCM Lane V/C Ratio	-	-	0.477	0.105	-
HCM Control Delay (s)	-	-	34.8	11.5	-
HCM Lane LOS	-	-	D	B	-
HCM 95th %tile Q(veh)	-	-	2.4	0.3	-

Intersection	
Int Delay, s/veh	1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	⑂		↑	↱	↰	↑
Traffic Vol, veh/h	34	18	1048	57	32	724
Future Vol, veh/h	34	18	1048	57	32	724
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	1103	60	34	762

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1933	1103	0	0	1163	0
Stage 1	1103	-	-	-	-	-
Stage 2	830	-	-	-	-	-
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	73	257	-	-	601	-
Stage 1	318	-	-	-	-	-
Stage 2	428	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	69	257	-	-	601	-
Mov Cap-2 Maneuver	193	-	-	-	-	-
Stage 1	318	-	-	-	-	-
Stage 2	404	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	27.9	0	0.5
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	211	601	-
HCM Lane V/C Ratio	-	-	0.259	0.056	-
HCM Control Delay (s)	-	-	27.9	11.3	-
HCM Lane LOS	-	-	D	B	-
HCM 95th %tile Q(veh)	-	-	1	0.2	-

12: Eastonville Rd & Londonderry Dr

Intersection	
Int Delay, s/veh	34.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↑	↱
Traffic Vol, veh/h	170	177	307	1032	679	116
Future Vol, veh/h	170	177	307	1032	679	116
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	179	186	323	1086	715	122

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	2447	715	837	0	-	0
Stage 1	715	-	-	-	-	-
Stage 2	1732	-	-	-	-	-
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	~ 34	431	797	-	-	-
Stage 1	485	-	-	-	-	-
Stage 2	~ 156	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 20	431	797	-	-	-
Mov Cap-2 Maneuver	~ 101	-	-	-	-	-
Stage 1	289	-	-	-	-	-
Stage 2	~ 156	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	233.5	2.9	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	797	-	101	431	-	-
HCM Lane V/C Ratio	0.405	-	1.772	0.432	-	-
HCM Control Delay (s)	12.6	-	$ 456.3	19.6	-	-
HCM Lane LOS	B	-	F	C	-	-
HCM 95th %tile Q(veh)	2	-	14.4	2.1	-	-

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

Intersection	
Intersection Delay, s/veh	373.4
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↱		↰	↑	↱	↰	↑↱		↰	↑↱	
Traffic Vol, veh/h	38	51	80	132	165	293	131	780	162	171	520	27
Future Vol, veh/h	38	51	80	132	165	293	131	780	162	171	520	27
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	40	54	84	139	174	308	138	821	171	180	547	28
Number of Lanes	1	1	0	1	1	1	1	1	0	1	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	3	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	3
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	3	2
HCM Control Delay	26	37.2	704	237.2
HCM LOS	D	E	F	F

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	WBLn3	SBLn1	SBLn2
Vol Left, %	100%	0%	100%	0%	100%	0%	0%	100%	0%
Vol Thru, %	0%	83%	0%	39%	0%	100%	0%	0%	95%
Vol Right, %	0%	17%	0%	61%	0%	0%	100%	0%	5%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	131	942	38	131	132	165	293	171	547
LT Vol	131	0	38	0	132	0	0	171	0
Through Vol	0	780	0	51	0	165	0	0	520
RT Vol	0	162	0	80	0	0	293	0	27
Lane Flow Rate	138	992	40	138	139	174	308	180	576
Geometry Grp	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.4	2.708	0.131	0.415	0.398	0.474	0.781	0.517	1.569
Departure Headway (Hd)	11.477	10.83	15.757	14.738	13.72	13.183	12.432	13.153	12.585
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	316	347	229	247	264	276	293	277	294
Service Time	9.177	8.53	13.457	12.438	11.42	10.883	10.132	10.853	10.285
HCM Lane V/C Ratio	0.437	2.859	0.175	0.559	0.527	0.63	1.051	0.65	1.959
HCM Control Delay	21.6	798.9	20.8	27.5	25.2	27.2	48.3	29.1	302.3
HCM Lane LOS	C	F	C	D	D	D	E	D	F
HCM 95th-tile Q	1.9	75.4	0.4	1.9	1.8	2.4	6.1	2.8	26.7

Intersection	
Int Delay, s/veh	183.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱			✣	
Traffic Vol, veh/h	9	627	72	340	623	0	82	22	519	0	8	1
Future Vol, veh/h	9	627	72	340	623	0	82	22	519	0	8	1
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	100	-	-	100	-	-	75	-	-	-	-	-
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	9	660	76	358	656	0	86	23	546	0	8	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	656	0	0	736	0	0	2093	2088	698	2373	2126	656
Stage 1	-	-	-	-	-	-	716	716	-	1372	1372	-
Stage 2	-	-	-	-	-	-	1377	1372	-	1001	754	-
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	931	-	-	870	-	-	~ 38	53	~ 440	24	50	465
Stage 1	-	-	-	-	-	-	421	434	-	180	214	-
Stage 2	-	-	-	-	-	-	179	214	-	293	417	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	931	-	-	870	-	-	~ 20	31	~ 440	-	29	465
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 20	31	-	-	29	-
Stage 1	-	-	-	-	-	-	417	430	-	178	126	-
Stage 2	-	-	-	-	-	-	98	126	-	-	413	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	4.2	$ 671.3	
HCM LOS			F	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	20	286	931	-	-	870	-	-	-
HCM Lane V/C Ratio	4.316	1.991	0.01	-	-	0.411	-	-	-
HCM Control Delay (s)	$ 1883	$ 487.6	8.9	-	-	12	-	-	-
HCM Lane LOS	F	F	A	-	-	B	-	-	-
HCM 95th %tile Q(veh)	11.2	40.7	0	-	-	2	-	-	-

Notes

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

Intersection	
Intersection Delay, s/veh	11.5
Intersection LOS	B

Approach	EB	WB	NB	SB
Entry Lanes	2	1	2	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	302	627	1003	311
Demand Flow Rate, veh/h	308	640	1023	317
Vehicles Circulating, veh/h	735	365	233	793
Vehicles Exiting, veh/h	375	891	810	212
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	7.8	14.8	9.5	14.7
Approach LOS	A	B	A	B

Lane	Left	Right	Left		Left	Right	Left
Designated Moves	LT	R	LTR		LT	R	LTR
Assumed Moves	LT	R	LTR		LT	R	LTR
RT Channelized							
Lane Util	0.666	0.334	1.000		0.314	0.686	1.000
Follow-Up Headway, s	2.535	2.535	2.609		2.535	2.535	2.609
Critical Headway, s	4.544	4.544	4.976		4.544	4.544	4.976
Entry Flow, veh/h	205	103	640		321	702	317
Cap Entry Lane, veh/h	727	727	951		1149	1149	615
Entry HV Adj Factor	0.980	0.981	0.980		0.982	0.980	0.980
Flow Entry, veh/h	201	101	627		315	688	311
Cap Entry, veh/h	713	713	932		1128	1126	602
V/C Ratio	0.282	0.142	0.673		0.279	0.611	0.516
Control Delay, s/veh	8.4	6.6	14.8		5.8	11.1	14.7
LOS	A	A	B		A	B	B
95th %tile Queue, veh	1	0	5		1	4	3

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	875	646	37
Demand Flow Rate, veh/h	892	659	37
Vehicles Circulating, veh/h	34	15	871
Vehicles Exiting, veh/h	640	893	55
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	11.5	7.6	7.1
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	892	659	37
Cap Entry Lane, veh/h	1333	1359	568
Entry HV Adj Factor	0.981	0.980	1.000
Flow Entry, veh/h	875	646	37
Cap Entry, veh/h	1307	1332	568
V/C Ratio	0.669	0.485	0.065
Control Delay, s/veh	11.5	7.6	7.1
LOS	B	A	A
95th %tile Queue, veh	6	3	0

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	876	683	60
Demand Flow Rate, veh/h	894	696	61
Vehicles Circulating, veh/h	63	23	853
Vehicles Exiting, veh/h	656	891	104
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	12.4	8.2	7.6
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	894	696	61
Cap Entry Lane, veh/h	1294	1348	578
Entry HV Adj Factor	0.980	0.981	0.984
Flow Entry, veh/h	876	683	60
Cap Entry, veh/h	1268	1322	569
V/C Ratio	0.691	0.516	0.106
Control Delay, s/veh	12.4	8.2	7.6
LOS	B	A	A
95th %tile Queue, veh	6	3	0

Intersection	
Intersection Delay, s/veh	12.1
Intersection LOS	B

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	873	762	121
Demand Flow Rate, veh/h	891	778	123
Vehicles Circulating, veh/h	127	48	809
Vehicles Exiting, veh/h	698	884	209
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	14.6	9.7	8.6
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	891	778	123
Cap Entry Lane, veh/h	1212	1314	605
Entry HV Adj Factor	0.980	0.980	0.984
Flow Entry, veh/h	873	762	121
Cap Entry, veh/h	1188	1287	595
V/C Ratio	0.735	0.592	0.203
Control Delay, s/veh	14.6	9.7	8.6
LOS	B	A	A
95th %tile Queue, veh	7	4	1

Intersection	
Intersection Delay, s/veh	13.2
Intersection LOS	B

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	867	822	175
Demand Flow Rate, veh/h	884	838	179
Vehicles Circulating, veh/h	151	90	730
Vehicles Exiting, veh/h	777	819	305
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	15.4	11.8	9.1
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	884	838	179
Cap Entry Lane, veh/h	1183	1259	655
Entry HV Adj Factor	0.980	0.980	0.978
Flow Entry, veh/h	867	822	175
Cap Entry, veh/h	1160	1234	641
V/C Ratio	0.747	0.666	0.273
Control Delay, s/veh	15.4	11.8	9.1
LOS	C	B	A
95th %tile Queue, veh	7	5	1

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Approach	EB	WB	SB
Entry Lanes	1	2	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	803	1061	438
Demand Flow Rate, veh/h	820	1082	447
Vehicles Circulating, veh/h	265	283	657
Vehicles Exiting, veh/h	839	802	708
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	14.8	10.4	12.7
Approach LOS	B	B	B

Lane	Left	Left	Right	Left
Designated Moves	LT	LT	R	LR
Assumed Moves	LT	LT	R	LR
RT Channelized				
Lane Util	1.000	0.607	0.393	1.000
Follow-Up Headway, s	2.535	2.667	2.535	2.535
Critical Headway, s	4.328	4.645	4.328	4.328
Entry Flow, veh/h	820	657	425	447
Cap Entry Lane, veh/h	1134	1040	1116	812
Entry HV Adj Factor	0.980	0.980	0.981	0.980
Flow Entry, veh/h	803	644	417	438
Cap Entry, veh/h	1111	1020	1095	796
V/C Ratio	0.723	0.631	0.381	0.550
Control Delay, s/veh	14.8	12.5	7.2	12.7
LOS	B	B	A	B
95th %tile Queue, veh	7	5	2	3

Intersection	
Intersection Delay, s/veh	23.9
Intersection LOS	C

Approach	EB	WB	NB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	787	1255	218
Demand Flow Rate, veh/h	803	1280	222
Vehicles Circulating, veh/h	264	66	690
Vehicles Exiting, veh/h	1082	846	377
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	14.2	32.8	7.9
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	803	1280	222
Cap Entry Lane, veh/h	1135	1343	790
Entry HV Adj Factor	0.981	0.981	0.982
Flow Entry, veh/h	787	1255	218
Cap Entry, veh/h	1113	1316	776
V/C Ratio	0.708	0.953	0.281
Control Delay, s/veh	14.2	32.8	7.9
LOS	B	D	A
95th %tile Queue, veh	6	18	1

Intersection	
Intersection Delay, s/veh	9.0
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	829	1424	155	170
Demand Flow Rate, veh/h	846	1453	158	173
Vehicles Circulating, veh/h	251	85	932	1359
Vehicles Exiting, veh/h	1281	1005	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	7.2	9.3	8.8	15.2
Approach LOS	A	A	A	C

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	398	448	683	770	158	173
Cap Entry Lane, veh/h	1072	1147	1248	1321	643	447
Entry HV Adj Factor	0.979	0.981	0.980	0.980	0.981	0.983
Flow Entry, veh/h	390	439	669	755	155	170
Cap Entry, veh/h	1049	1125	1223	1295	631	440
V/C Ratio	0.371	0.391	0.547	0.583	0.246	0.387
Control Delay, s/veh	7.3	7.2	9.2	9.5	8.8	15.2
LOS	A	A	A	A	A	C
95th %tile Queue, veh	2	2	3	4	1	2

Intersection	
Intersection Delay, s/veh	15.5
Intersection LOS	C

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	2	2	2
Adj Approach Flow, veh/h	107	1122	790
Demand Flow Rate, veh/h	109	1144	806
Vehicles Circulating, veh/h	1024	66	70
Vehicles Exiting, veh/h	186	809	1063
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.5	20.1	9.8
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	1144	806
Cap Entry Lane, veh/h	595	1343	1338
Entry HV Adj Factor	0.982	0.981	0.981
Flow Entry, veh/h	107	1122	790
Cap Entry, veh/h	584	1317	1312
V/C Ratio	0.183	0.852	0.602
Control Delay, s/veh	8.5	20.1	9.8
LOS	A	C	A
95th %tile Queue, veh	1	12	4

Intersection	
Intersection Delay, s/veh	18.1
Intersection LOS	C

Approach	WB	NB	SB
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	55	1163	796
Demand Flow Rate, veh/h	56	1186	812
Vehicles Circulating, veh/h	1125	35	37
Vehicles Exiting, veh/h	96	814	1144
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.2	24.0	10.1
Approach LOS	B	C	B

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	1186	812
Cap Entry Lane, veh/h	438	1331	1329
Entry HV Adj Factor	0.982	0.981	0.980
Flow Entry, veh/h	55	1163	796
Cap Entry, veh/h	430	1306	1302
V/C Ratio	0.128	0.891	0.611
Control Delay, s/veh	10.2	24.0	10.1
LOS	B	C	B
95th %tile Queue, veh	0	14	4

Intersection						
Intersection Delay, s/veh	16.1					
Intersection LOS	C					

Approach		EB		NB		SB
Entry Lanes		2		2		2
Conflicting Circle Lanes		2		2		2
Adj Approach Flow, veh/h		365		1409		837
Demand Flow Rate, veh/h		373		1437		853
Vehicles Circulating, veh/h		729		183		329
Vehicles Exiting, veh/h		453		919		1291
Ped Vol Crossing Leg, #/h		0		0		0
Ped Cap Adj		1.000		1.000		1.000
Approach Delay, s/veh		8.1		23.0		8.1
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	0.491	0.509	0.229	0.771	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	183	190	329	1108	401	452
Cap Entry Lane, veh/h	690	764	1141	1216	997	1074
Entry HV Adj Factor	0.978	0.979	0.982	0.980	0.981	0.981
Flow Entry, veh/h	179	186	323	1086	393	443
Cap Entry, veh/h	675	748	1120	1192	978	1053
V/C Ratio	0.265	0.249	0.288	0.912	0.402	0.421
Control Delay, s/veh	8.6	7.6	6.0	28.1	8.1	8.0
LOS	A	A	A	D	A	A
95th %tile Queue, veh	1	1	1	15	2	2

HCM 6th Roundabout
15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Intersection	
Intersection Delay, s/veh	22.8
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	2	2	2	1
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	178	621	1122	755
Demand Flow Rate, veh/h	182	633	1144	771
Vehicles Circulating, veh/h	884	1011	280	460
Vehicles Exiting, veh/h	347	413	786	1184
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	7.5	17.1	29.4	21.4
Approach LOS	A	C	D	C

Lane	Left	Right	Left	Right	Left	Right	Left
Designated Moves	LT	TR	LT	TR	LT	R	LTR
Assumed Moves	LT	TR	LT	TR	LT	R	LTR
RT Channelized							
Lane Util	0.473	0.527	0.471	0.529	0.848	0.152	1.000
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.667	2.535	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.645	4.328	4.328
Entry Flow, veh/h	86	96	298	335	970	174	771
Cap Entry Lane, veh/h	599	670	533	601	1043	1119	960
Entry HV Adj Factor	0.972	0.982	0.979	0.982	0.980	0.983	0.979
Flow Entry, veh/h	84	94	292	329	951	171	755
Cap Entry, veh/h	582	658	521	590	1023	1100	941
V/C Ratio	0.144	0.143	0.560	0.557	0.930	0.155	0.803
Control Delay, s/veh	7.9	7.1	18.1	16.3	33.9	4.7	21.4
LOS	A	A	C	C	D	A	C
95th %tile Queue, veh	0	0	3	3	15	1	9

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	41	150	96	456	122	18	161	139	654	26	202	67
Future Volume (vph)	41	150	96	456	122	18	161	139	654	26	202	67
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	43	158	101	480	128	19	169	146	688	27	213	71
Shared Lane Traffic (%)												
Lane Group Flow (vph)	43	158	101	480	128	19	169	146	688	27	213	71

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	41	150	96	456	122	18	161	139	654	26	202	67
Future Volume (vph)	41	150	96	456	122	18	161	139	654	26	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)	16.5	10.0	10.0	24.7	21.3	21.3	17.0	17.0	17.0	17.0	17.0	17.0
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	0.45	0.27	0.81	0.17	0.03	0.46	0.24	0.75	0.07	0.36	0.13
Control Delay	10.7	25.4	7.7	28.3	16.5	0.1	18.3	13.8	8.4	12.3	15.1	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	10.7	25.4	7.7	28.3	16.5	0.1	18.3	13.8	8.4	12.3	15.1	4.2
LOS	B	C	A	C	B	A	B	B	A	B	B	A
Approach Delay		17.4			25.1			10.8			12.4	
Approach LOS		B			C			B			B	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 52.8

Natural Cycle: 55

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 15.9 Intersection LOS: B

Intersection Capacity Utilization 69.4% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Eastonville Rd & Rex Rd

Volume
6: Rex Rd & Residential Collector

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Traffic Volume (vph)	263	500	612	396	247	169
Future Volume (vph)	263	500	612	396	247	169
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	277	526	644	417	260	178
Shared Lane Traffic (%)						
Lane Group Flow (vph)	277	526	644	417	260	178

Intersection Summary

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰	↱
Traffic Volume (vph)	263	500	612	396	247	169
Future Volume (vph)	263	500	612	396	247	169
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	89.0	74.0	74.0	31.0	31.0
Total Split (%)	12.5%	74.2%	61.7%	61.7%	25.8%	25.8%
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	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Recall Mode	None	C-Max	None	None	Max	Max
Act Effct Green (s)	84.0	84.0	69.2	69.2	26.0	26.0
Actuated g/C Ratio	0.70	0.70	0.58	0.58	0.22	0.22
v/c Ratio	0.63	0.40	0.60	0.40	0.68	0.37
Control Delay	13.0	8.6	41.0	21.2	53.2	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.0	8.6	41.0	21.2	53.2	8.0
LOS	B	A	D	C	D	A
Approach Delay		10.2	33.3		34.8	
Approach LOS		B	C		C	

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: 0.68

Intersection Signal Delay: 25.5 Intersection LOS: C

Intersection Capacity Utilization 73.0% ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 6: Rex Rd & Residential Collector

8: C-1/C-2 & Rex Rd

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	35	720	32	121	1101	131	44	0	104	113	0	48
Future Volume (vph)	35	720	32	121	1101	131	44	0	104	113	0	48
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	37	758	34	127	1159	138	46	0	109	119	0	51
Shared Lane Traffic (%)												
Lane Group Flow (vph)	37	758	34	127	1159	138	46	109	0	119	51	0

Intersection Summary

	↗	→	↘	↙	←	↖	↖	↑	↘	↓
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	35	720	32	121	1101	131	44	0	113	0
Future Volume (vph)	35	720	32	121	1101	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)	59.2	59.2	59.2	59.2	59.2	59.2	50.8	50.8	50.8	50.8
Actuated g/C Ratio	0.49	0.49	0.49	0.49	0.49	0.49	0.42	0.42	0.42	0.42
v/c Ratio	0.30	0.43	0.04	0.48	0.66	0.16	0.08	0.13	0.22	0.07
Control Delay	16.9	14.7	1.3	42.3	44.6	16.8	26.0	0.3	26.9	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	16.9	14.7	1.3	42.3	44.9	16.8	26.0	0.3	26.9	0.2
LOS	B	B	A	D	D	B	C	A	C	A
Approach Delay		14.2			41.9			7.9		18.9
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 60.0% 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
Traffic Volume (vph)	151	786	1191	1044	980	162
Future Volume (vph)	151	786	1191	1044	980	162
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.98	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	159	827	1254	1065	1032	171
Shared Lane Traffic (%)						
Lane Group Flow (vph)	159	827	1254	1065	1032	171

Intersection Summary

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰↰	↑↑	↑↑	↱
Traffic Volume (vph)	151	786	1191	1044	980	162
Future Volume (vph)	151	786	1191	1044	980	162
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		50.0	95.0	45.0	45.0
Total Split (%)	20.8%		41.7%	79.2%	37.5%	37.5%
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	45.0	90.0	40.0	40.0
Actuated g/C Ratio	0.17	1.00	0.38	0.75	0.33	0.33
v/c Ratio	0.54	0.52	0.98	0.40	0.87	0.27
Control Delay	39.5	6.1	31.7	7.3	47.2	6.8
Queue Delay	0.0	0.0	14.0	0.0	0.0	1.5
Total Delay	39.5	6.1	45.7	7.3	47.2	8.4
LOS	D	A	D	A	D	A
Approach Delay	11.5			28.1	41.7	
Approach LOS	B			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: 0.98

Intersection Signal Delay: 28.1 Intersection LOS: C

Intersection Capacity Utilization 81.9% ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 9: US 24 & Rex Rd

Volume
12: Eastonville Rd & Londonderry Dr

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Traffic Volume (vph)	170	177	307	1032	679	116
Future Volume (vph)	170	177	307	1032	679	116
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%			0%	0%	
Adj. Flow (vph)	179	186	323	1086	715	122
Shared Lane Traffic (%)						
Lane Group Flow (vph)	179	186	323	1086	715	122

Intersection Summary

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑↑	↑↑	↱
Traffic Volume (vph)	170	177	307	1032	679	116
Future Volume (vph)	170	177	307	1032	679	116
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)	11.1	11.1	34.4	34.4	19.1	19.1
Actuated g/C Ratio	0.20	0.20	0.62	0.62	0.34	0.34
v/c Ratio	0.51	0.40	0.63	0.50	0.59	0.20
Control Delay	26.4	6.9	12.8	7.0	17.3	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.4	6.9	12.8	7.0	17.3	4.0
LOS	C	A	B	A	B	A
Approach Delay	16.5			8.3	15.3	
Approach LOS	B			A	B	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 55.6
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 11.7 Intersection LOS: B
Intersection Capacity Utilization 57.7% 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
Traffic Volume (vph)	512	920	160	183	1264	232	251	595	169	178	375	292
Future Volume (vph)	512	920	160	183	1264	232	251	595	169	178	375	292
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.98	0.95	0.95	0.98	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	539	939	168	193	1290	244	264	626	178	187	395	307
Shared Lane Traffic (%)												
Lane Group Flow (vph)	539	939	168	193	1290	244	264	626	178	187	395	307

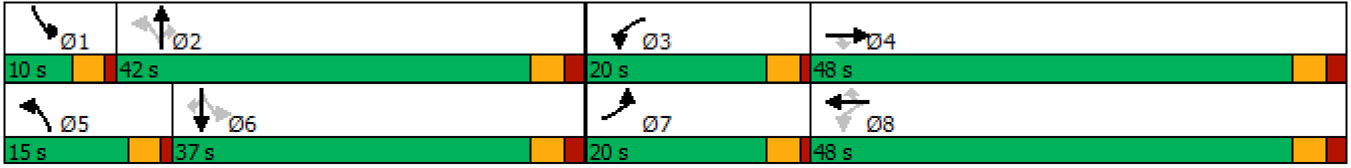
Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑	↱	↰	↑	↱
Traffic Volume (vph)	512	920	160	183	1264	232	251	595	169	178	375	292
Future Volume (vph)	512	920	160	183	1264	232	251	595	169	178	375	292
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	48.0	48.0	20.0	48.0	48.0	15.0	42.0	42.0	10.0	37.0	37.0
Total Split (%)	16.7%	40.0%	40.0%	16.7%	40.0%	40.0%	12.5%	35.0%	35.0%	8.3%	30.8%	30.8%
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)	16.0	46.5	46.5	56.5	43.0	43.0	48.0	37.0	37.0	39.0	32.0	32.0
Actuated g/C Ratio	0.13	0.39	0.39	0.47	0.36	0.36	0.40	0.31	0.31	0.32	0.27	0.27
v/c Ratio	1.18	0.68	0.24	0.65	1.02	0.36	1.00	1.09	0.31	1.23	0.80	0.49
Control Delay	146.5	34.3	5.5	26.1	68.1	11.2	84.4	104.2	12.4	176.3	54.2	8.5
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	146.5	34.3	5.5	26.1	68.1	11.2	84.4	104.2	12.4	176.3	54.2	8.5
LOS	F	C	A	C	E	B	F	F	B	F	D	A
Approach Delay		68.1			55.4			84.0			64.1	
Approach LOS		E			E			F			E	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 120
Natural Cycle: 130
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.23
Intersection Signal Delay: 66.5 Intersection LOS: E
Intersection Capacity Utilization 105.7% 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
Traffic Volume (vph)	399	556	432	200	784	206	798	1635	175	279	1020	474
Future Volume (vph)	399	556	432	200	784	206	798	1635	175	279	1020	474
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.98	0.98	0.95	0.95	0.98	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	420	585	455	211	825	217	814	1668	184	294	1041	499
Shared Lane Traffic (%)												
Lane Group Flow (vph)	420	585	455	211	825	217	814	1668	184	294	1041	499

Intersection Summary

	↗	→	↘	↙	←	↖	↖	↑	↗	↘	↓	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱	↰↰	↑↑	↱
Traffic Volume (vph)	399	556	432	200	784	206	798	1635	175	279	1020	474
Future Volume (vph)	399	556	432	200	784	206	798	1635	175	279	1020	474
Turn Type	Prot	NA	Free	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			Free			2			Free
Detector Phase	7	4		3	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	
Minimum Split (s)	10.0	10.0		10.0	10.0		10.0	11.0	11.0	10.0	11.0	
Total Split (s)	15.0	33.0		15.0	33.0		22.0	62.0	62.0	10.0	50.0	
Total Split (%)	12.5%	27.5%		12.5%	27.5%		18.3%	51.7%	51.7%	8.3%	41.7%	
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	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	
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	None		None	None		None	C-Max	C-Max	None	C-Max	
Act Effct Green (s)	10.0	28.1	120.0	9.9	28.0	120.0	17.0	57.0	57.0	5.0	45.0	120.0
Actuated g/C Ratio	0.08	0.23	1.00	0.08	0.23	1.00	0.14	0.48	0.48	0.04	0.38	1.00
v/c Ratio	1.47	0.71	0.29	0.75	1.00	0.14	1.67	0.99	0.22	2.06	0.78	0.32
Control Delay	267.5	47.6	0.5	70.6	77.5	0.2	345.4	51.8	6.5	524.8	20.4	0.4
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	267.5	47.6	0.5	70.6	77.5	0.2	345.4	51.8	6.5	524.8	20.4	0.4
LOS	F	D	A	E	E	A	F	D	A	F	C	A
Approach Delay		96.2			63.0			138.3			95.8	
Approach LOS		F			E			F			F	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 110 (92%), Referenced to phase 2:NBT and 6:SBT, Start of Green	
Natural Cycle: 140	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 2.06	
Intersection Signal Delay: 105.9	Intersection LOS: F
Intersection Capacity Utilization 102.9%	ICU Level of Service G
Analysis Period (min) 15	

Splits and Phases: 14: US 24 & Stapleton Dr

Volume
15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	38	51	80	132	165	293	131	780	162	171	520	27
Future Volume (vph)	38	51	80	132	165	293	131	780	162	171	520	27
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	40	54	84	139	174	308	138	821	171	180	547	28
Shared Lane Traffic (%)												
Lane Group Flow (vph)	40	138	0	139	174	308	138	992	0	180	575	0

Intersection Summary

Timings
15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Configurations	↰	↑↱	↰	↑↑	↱	↰	↱	↰	↱
Traffic Volume (vph)	38	51	132	165	293	131	780	171	520
Future Volume (vph)	38	51	132	165	293	131	780	171	520
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	pm+pt	NA
Protected Phases	7	4	3	8		5	2	1	6
Permitted Phases	4		8		8	2		6	
Detector Phase	7	4	3	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	20.0	10.0	20.0	20.0	10.0	20.0	10.0	20.0
Total Split (s)	10.0	30.0	10.0	30.0	30.0	15.0	65.0	15.0	65.0
Total Split (%)	8.3%	25.0%	8.3%	25.0%	25.0%	12.5%	54.2%	12.5%	54.2%
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	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
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	None	Min
Act Effct Green (s)	15.7	10.7	17.8	14.9	14.9	68.3	60.2	71.5	61.8
Actuated g/C Ratio	0.15	0.10	0.17	0.14	0.14	0.65	0.57	0.68	0.59
v/c Ratio	0.20	0.34	0.66	0.35	0.64	0.28	0.96	0.77	0.53
Control Delay	36.6	21.0	54.1	44.1	12.3	7.3	42.3	46.0	16.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.6	21.0	54.1	44.1	12.3	7.3	42.3	46.0	16.5
LOS	D	C	D	D	B	A	D	D	B
Approach Delay		24.5		30.6			38.0		23.5
Approach LOS		C		C			D		C

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 105.6
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 31.3 Intersection LOS: C
Intersection Capacity Utilization 88.5% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 15: Eastonville Dr & Meridian Ranch Rd/Judge Orr Rd

Volume
16: McLaughlin Rd & Eastonville Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Volume (vph)	9	627	72	340	623	0	82	22	519	0	8	1
Future Volume (vph)	9	627	72	340	623	0	82	22	519	0	8	1
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	9	660	76	358	656	0	86	23	546	0	8	1
Shared Lane Traffic (%)												
Lane Group Flow (vph)	9	736	0	358	656	0	86	569	0	0	9	0

Intersection Summary

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱	✥
Traffic Volume (vph)	9	627	340	623	82	22	8
Future Volume (vph)	9	627	340	623	82	22	8
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	NA
Protected Phases		4	3	8		2	6
Permitted Phases	4		8		2		
Detector Phase	4	4	3	8	2	2	6
Switch Phase							
Minimum Initial (s)	5.0	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	20.0
Total Split (s)	65.0	65.0	25.0	90.0	30.0	30.0	30.0
Total Split (%)	54.2%	54.2%	20.8%	75.0%	25.0%	25.0%	25.0%
Yellow Time (s)	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
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	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	Min	Min	Min
Act Effct Green (s)	42.8	42.8	64.6	64.6	18.0	18.0	18.0
Actuated g/C Ratio	0.46	0.46	0.69	0.69	0.19	0.19	0.19
v/c Ratio	0.03	0.87	0.86	0.51	0.32	0.88	0.03
Control Delay	15.7	36.1	43.5	8.9	40.7	28.3	35.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.7	36.1	43.5	8.9	40.7	28.3	35.0
LOS	B	D	D	A	D	C	C
Approach Delay		35.8		21.1		29.9	35.0
Approach LOS		D		C		C	C

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 93.7

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

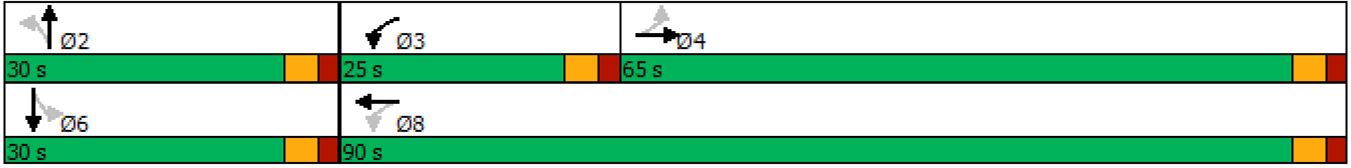
Maximum v/c Ratio: 0.88

Intersection Signal Delay: 28.1 Intersection LOS: C

Intersection Capacity Utilization 102.0% ICU Level of Service G

Analysis Period (min) 15

Splits and Phases: 16: McLaughlin Rd & Eastonville Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (vph)	512	920	160	183	1264	232	251	595	169	178	375	292
Future Volume (vph)	512	920	160	183	1264	232	251	595	169	178	375	292
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)	20.0	56.9	56.9	53.9	45.0	45.0	40.2	25.3	25.3	32.4	21.4	21.4
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	0.83	0.37	0.87	0.62	0.60
Control Delay	72.6	23.4	3.2	23.8	52.8	9.8	51.4	54.7	7.9	67.0	49.2	12.6
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	72.6	23.4	3.2	23.8	52.8	9.8	51.4	54.7	7.9	67.0	49.2	12.6
LOS	E	C	A	C	D	A	D	D	A	E	D	B
Approach Delay		37.5			43.5			46.1			40.3	
Approach LOS		D			D			D			D	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 118.2

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

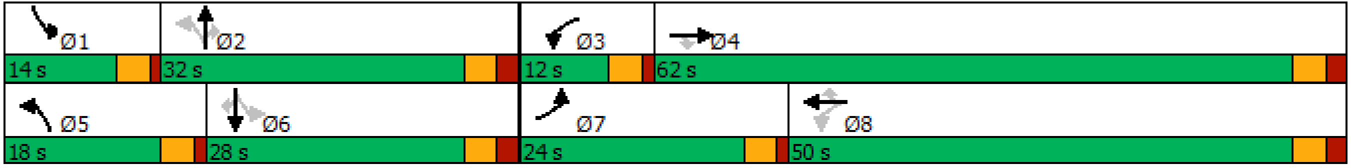
Maximum v/c Ratio: 0.96

Intersection Signal Delay: 41.6 Intersection LOS: D

Intersection Capacity Utilization 90.9% ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 13: Eastonville Rd & Stapleton Dr



14: US 24 & 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	206	798	1635	175	279	1020	474
Future Volume (vph)	399	556	432	200	784	206	798	1635	175	279	1020	474
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			Free			2			Free
Detector Phase	7	4	4	3	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)	21.0	33.0	33.0	21.0	33.0		34.0	44.0	44.0	22.0	32.0	
Total Split (%)	17.5%	27.5%	27.5%	17.5%	27.5%		28.3%	36.7%	36.7%	18.3%	26.7%	
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	Lag	Lead	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	C-Max	C-Max	None	C-Max	
Act Effct Green (s)	16.0	28.8	28.8	12.6	25.5	120.0	30.5	43.6	43.6	14.9	28.0	120.0
Actuated g/C Ratio	0.13	0.24	0.24	0.10	0.21	1.00	0.25	0.36	0.36	0.12	0.23	1.00
v/c Ratio	0.92	0.48	0.65	0.58	0.77	0.14	0.93	0.90	0.28	0.69	0.88	0.32
Control Delay	77.7	40.7	9.9	57.5	49.5	0.2	62.1	44.9	8.8	73.3	33.4	0.4
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	77.7	40.7	9.9	57.5	49.5	0.2	62.1	44.9	8.8	73.3	33.4	0.4
LOS	E	D	A	E	D	A	E	D	A	E	C	A
Approach Delay		41.7			42.3			47.6			30.8	
Approach LOS		D			D			D			C	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 110 (92%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

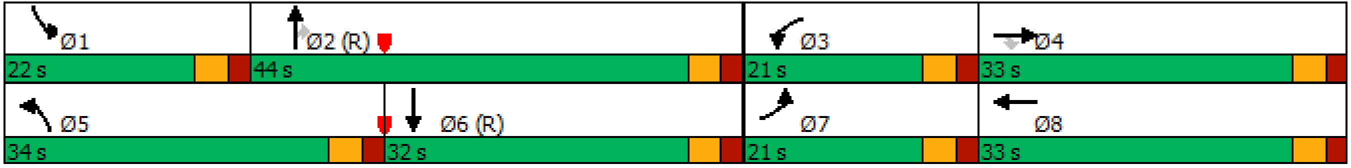
Maximum v/c Ratio: 0.93

Intersection Signal Delay: 41.2 Intersection LOS: D

Intersection Capacity Utilization 85.7% ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 14: US 24 & Stapleton Dr



Queuing and Blocking Report

Intersection: 9: US 24 & Rex Rd

Movement	EB	EB	NB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	L	L	T	T	T	T	R
Maximum Queue (ft)	177	428	492	413	71	79	451	419	143
Average Queue (ft)	92	261	247	213	18	31	285	230	46
95th Queue (ft)	161	476	437	376	55	65	420	366	98
Link Distance (ft)	426	426			5314	5314	955	955	955
Upstream Blk Time (%)		2							
Queuing Penalty (veh)		8							
Storage Bay Dist (ft)			800	800					
Storage Blk Time (%)									
Queuing Penalty (veh)									

Queuing Reports

TRANSPORTATION
CONSULTANTS, INC.

Intersection: 1: Eastonville Rd & Rex Rd

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	T	R	L	T	R	L	T	R
Maximum Queue (ft)	73	192	190	462	99	59	125	154	148	74	210	54
Average Queue (ft)	20	86	83	251	34	8	56	57	66	25	101	19
95th Queue (ft)	51	154	151	413	82	32	112	118	122	61	175	42
Link Distance (ft)		719			610			1444			1166	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	205		155	450		155	315		155	205		155
Storage Blk Time (%)		1	1	0				0	0		3	
Queuing Penalty (veh)		3	2	0				1	1		2	

Intersection: 6: Rex Rd & Residential Collector

Movement	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	R	L	R
Maximum Queue (ft)	175	367	327	158	399	196
Average Queue (ft)	85	207	179	73	257	89
95th Queue (ft)	149	325	293	128	379	155
Link Distance (ft)		1438	819	819	596	596
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)	405					
Storage Blk Time (%)		0				
Queuing Penalty (veh)		0				

Intersection: 8: C-1/C-2 & Rex Rd/#1 Rex Rd

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	T	R	L	TR	L	TR
Maximum Queue (ft)	44	587	629	208	78	223	211	38	28	62	56	22
Average Queue (ft)	9	165	301	15	30	37	38	5	4	19	22	3
95th Queue (ft)	32	483	565	99	68	139	136	24	19	48	49	14
Link Distance (ft)		1738	1738			427	427	427	348	348	341	341
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	350			155	400							
Storage Blk Time (%)		0	22									
Queuing Penalty (veh)		0	4									

Queuing and Blocking Report

Intersection: 9: #1 US 24/US 24 & #1 Rex Rd

Movement	EB	EB	NB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	L	L	T	T	T	T	R
Maximum Queue (ft)	141	85	237	238	169	186	472	452	81
Average Queue (ft)	68	3	160	165	92	104	308	270	27
95th Queue (ft)	127	62	234	232	149	159	439	413	55
Link Distance (ft)	427	427			5312	5312	955	955	
Upstream Blk Time (%)		0							
Queuing Penalty (veh)		0							
Storage Bay Dist (ft)			1000	1000					800
Storage Blk Time (%)									
Queuing Penalty (veh)									

Zone Summary

Zone wide Queuing Penalty: 14

Queuing and Blocking Report

Intersection: 1: Eastonville Rd & Rex Rd

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	T	R	L	T	R	L	T	R
Maximum Queue (ft)	69	178	94	415	234	32	184	229	248	86	159	52
Average Queue (ft)	24	91	32	211	60	10	83	60	125	30	72	17
95th Queue (ft)	55	154	66	366	151	31	152	162	218	72	134	39
Link Distance (ft)		719			610			1444			1166	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	205		155	450		155	315		155	205		155
Storage Blk Time (%)		1		0	0		0		4		0	
Queuing Penalty (veh)		2		1	1		0		11		0	

Intersection: 6: Rex Rd & Residential Collector

Movement	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	R	L	R
Maximum Queue (ft)	289	270	587	255	301	142
Average Queue (ft)	127	113	280	172	165	63
95th Queue (ft)	233	211	523	325	265	114
Link Distance (ft)		1438	819		596	596
Upstream Blk Time (%)			0			
Queuing Penalty (veh)			2			
Storage Bay Dist (ft)	405			155		
Storage Blk Time (%)			20	0		
Queuing Penalty (veh)			81	1		

Intersection: 8: C-1/C-2 & Rex Rd/#1 Rex Rd

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	T	R	L	TR	L	TR
Maximum Queue (ft)	82	272	393	76	265	451	431	218	66	95	116	62
Average Queue (ft)	28	45	139	11	74	251	201	32	21	37	52	18
95th Queue (ft)	70	155	277	62	178	399	372	120	52	70	95	44
Link Distance (ft)		831	831			427	427	427	348	348	341	341
Upstream Blk Time (%)					0	1	0	0				
Queuing Penalty (veh)					0	3	1	0				
Storage Bay Dist (ft)	350			155	400							
Storage Blk Time (%)		0	6			1						
Queuing Penalty (veh)		0	2			2						

Queuing and Blocking Report

Intersection: 9: #1 US 24/US 24 & #1 Rex Rd

Movement	EB	NB	NB	NB	NB	SB	SB	SB
Directions Served	L	L	L	T	T	T	T	R
Maximum Queue (ft)	214	549	507	1636	625	542	505	136
Average Queue (ft)	115	378	341	114	78	339	305	48
95th Queue (ft)	198	517	474	836	443	493	457	94
Link Distance (ft)	427			2647	2647	955	955	
Upstream Blk Time (%)				0	0			
Queuing Penalty (veh)				0	0			
Storage Bay Dist (ft)		1000	1000					800
Storage Blk Time (%)								
Queuing Penalty (veh)								

Zone Summary

Zone wide Queuing Penalty: 106

MSTA School Traffic Calculations

TRANSPORTATION
CONSULTANTS, INC.

MSTA School Traffic Calculations

AM and PM Peak Traffic Estimates

(These numbers do not reflect peak hour traffic volumes)

School Name: Grandview Reserve

Type: **Private / Non-urban Charter**

Version: 102816

MSTA School Queue Input / Calculations

AM Cars / Student	PM Cars / Student	Avg. Car Length	PM At one Time	Grade Level	Student Population	Number of Buses	Staff Members	Student Drivers	PM Total Vehicles	PM Peak Vehicles	Average Queue Length	Total AM Trips	Total PM Trips	High Demand Length
														30%
55.94%	39.15%	22.19	48.67%	**Pre-K & K**	75		10		30	15	**333**	94	70	**433**
						1								
43.35%	26.30%	22.00	37.87%	**1-10**	425		56		112	43	**946**	425	280	**1230**
						6								
52.91%	47.50%	22.19	46.12%	**11th**										
50.08%	47.58%	22.83	55.71%	**12th**										
				Sum >>	500		66		142	58	**1279**	**518**	**350**	**1663**

Pre-K & K loading is usually park and walk "PM Peak Vehicles" indicates minimum number of parking spaces needed.

Yes - If Pre-K & K students are provided parking spaces at or above their PM Peak Vehicles >>>>>> 384

Private & Non-Urban Charter data is based on few to no buses and uses the same percentages for all school types except 11th and 12th grades which makes adjustments for student drivers.

Pre-K & K

	AM Trips Generated				PM Trips Generated			
Direction	**Parents**	**Buses**	**Staff**	**Trips**	**Parents**	**Buses**	**Staff**	**Trips**
IN	42		10	52	30			30
OUT	42			42	30		10	40
		AM Pre-K-K Trips		**94**		PM PK-K Trips		**70**

1-10

	AM Trips Generated				PM Trips Generated			
Direction	**Parents**	**Buses**	**Staff**	**Trips**	**Parents**	**Buses**	**Staff**	**Trips**
IN	184		56	240	112			112
OUT	184			184	112		56	168
		AM K-10 Trips		**425**		PM K-10 Trips		**280**

	AM Trips Generated					PM Trips Generated				
Direction	**Parents**	**Buses**	**Staff**		**Trips**	**Parents**	**Buses**	**Staff**		**Trips**
IN										
OUT										
			AM 11 Trips					PM 11 Trips		

	AM Trips Generated					PM Trips Generated				
Direction	**Parents**	**Buses**	**Staff**		**Trips**	**Parents**	**Buses**	**Staff**		**Trips**
IN										
OUT										
			AM 12 Trips					PM 12 Trips		

All AM TRIPS		
	In	292
	Out	226
	Total	518

All PM TRIPS		
	In	142
	Out	208
	Total	350

ADT
164
705
868

NOTES

- **Average Queue Length does not** include an alternative traffic pattern required for high traffic demand days which is usually 30% additional length.
- **Average Queue Length does not** include the Student Loading Zone.
- Peak traffic volumes at schools normally occur within a 30-minute time period. (justifying a PHF of 0.5)

Calculated 7/2/2020 By:_______

Additional Attachment

Memorandum RE: Request for Amendment to the US Highway 24 Access Control Plan Modification to the Rex Road Intersection Location with Grandview Estates

TRANSPORTATION
CONSULTANTS, INC.

TRANSPORTATION
CONSULTANTS, INC.

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MEMORANDUM

DATE:	August 28, 2020
TO:	Arthur Gonzales, Access Manager, CDOT R2
FROM:	Jeffrey C. Hodsdon, P.E.
SUBJECT:	Request for Amendment to the *US Highway 24 Access Control Plan* Modification to the Rex Road Intersection Location with Grandview Estates LSC #184840

Introduction & Background

This memorandum contains the following:

- Description of change requested of the Access Control Plan (ACP) with exhibits;
- Ultimate buildout exhibits for the new Rex Road and the improvements to the roadway;
- Justification for the Amendment;
- Traffic Impact Study – the latest version is attached (dated August 17, 2020); and
- Drainage study with all documents and exhibits needed for review.

Other Points:

- This request is for a "**sectional amendment"** to the ACP **for the location of Rex Road** in the 2005 SH 24 ACP relative to the Stapleton and Elbert Road intersections, rather than a complete amendment to the entire ACP.

- This memorandum contains detailed exhibits and verbiage to incorporate into the NEW SH24 ACP for the shift in the location of Rex Rd. further east along SH24.

Background

- The governing document with respect to access is the *US Highway 24 Access Control Plan* (ACP), dated January 2005. It is our understanding that criteria in the Colorado State Highway Access Code for EX Highways applies, if not specifically addressed, for this particular roadway corridor by the ACP.

- The Colorado Department of Transportation *US Hwy 24 Planning and Environmental Linkages Study Final Corridor Conditions Report* (PEL), dated December 2016, labels a future roadway intersecting US Hwy 24 at mile post 324.72 (about one mile southwest of Elbert Road) as "Rex Road." This is consistent with the *US Highway 24 Access Control Plan* (ACP) dated January 2005.

- The *Final Planning & Environmental Linkages (PEL) Report US 24 Planning and Environmental Linkages Study,* dated March 2018, contained a page (37) listing specific recommended changes to the ACP. No proposed changes were listed for this subject section of US Highway 24. A copy of this is attached for reference.

Requested Amendment to the ACP

- This request is for a "sectional amendment" to the ACP for the location of Rex Road in the 2005 SH 24 ACP relative to the Stapleton and Elbert Road intersections, rather than a complete amendment to the entire ACP. Exhibit 1 shows the subject section of US Highway 24 and the location of the Grandview Reserve project.

- The request is to shift the planned Rex Road (full-movement, future signalized) intersection shown aligning with intersection 69 (shown in Exhibit 2) to a new location between Intersection 69 and 70 on the north side of US Hwy 24 at MP 325. Exhibit 3 shows the proposed shifted location requested with this amendment.

Reason for this Request

- Rex Road is currently proposed to be extended southeast through the Grandview Reserve sketch plan area to intersect US Hwy 24 about one-quarter mile northeast of the location shown on the PEL and ACP. The reason for the request to move the location of the intersection of US Hwy 24/Rex is partly due to an existing bridge (Structure I-18-J) located at mile marker 324.476 that would limit the ability to provide auxiliary turn lanes on US Hwy 24 that would meet the criteria contained in the *Colorado State Highway Access Code,* if the intersection were built at the location shown in the PEL and ACP. A copy of the *Grandview Reserve Master Traffic Impact Analysis* by LSC Transportation Consultants, Inc. (dated August 17, 2020) that contains analysis of the proposed US Hwy 24/Rex intersection has been attached.

.

- El Paso County staff wants the proposed Rex Road connected through the Grandview site to an intersection with Highway 24 between Elbert and Stapleton.

- El Paso County and CDOT staff indicated support for the proposed Rex Road location and this requested change to the ACP at meetings with the applicant. Based on those meetings and support, the applicant has updated the Grandview Reserve Sketch Plan and the TIS report has been updated.

Objectives, Principles and Strategies described in the US Highway 24 Access Control Plan and the State Highway Access Code which apply to this request:

State Highway Access Code Section 2.12 Access Control Plan

(1) *Either the Department or the appropriate local authority may, at its discretion, develop an access control plan for a designated portion of state highway. An access control plan provides the appropriate local authority and the Department with a comprehensive roadway access design plan for a designated portion of state highway for the purpose of bringing that portion of highway into conformance with its access category and its functional needs to the extent feasible given existing conditions.* ***The plan should achieve the optimum balance between state and local transportation planning objectives, and preserve and support the current and future functional integrity of the highway****.*

(2) *The access control plan shall indicate existing and future access locations and all access related roadway access design elements, including traffic signals, that are to be modified and reconstructed, relocated, removed, added, or remain. The plan shall not preclude the current or future accommodation of other transportation modes of*

bicycles, pedestrian, and transit. All traffic control devices or modifications shall meet the requirements of the M.U.T.C.D. as required by state and federal statutes. ***To the extent practical, the plan shall meet the functional characteristics and design standards of the assigned category and conform to all standards and specifications in the Code****. To determine the sufficiency and ensure that the plan will be successful, a study will be completed incorporating the appropriate elements of Code section 2.3 and included as supporting information for Department review. At least one advertised public meeting shall be held during the development phase of the plan. All property owners of record abutting the state highway within the plan limits shall be notified by the Department or the appropriate local authority of the proposed plan and afforded the opportunity to submit any information, data, and agreements regarding the proposed plan.*

(3) *The plan must receive the approval of both the Department and the appropriate local authority to become effective. This approval shall be in the form of a formal written agreement signed by the local authority and the Chief Engineer of the Department.* ***After an access control plan is in effect, modifications to the plan must receive the approval of the local authority and the Department****. Where an access control plan is in effect, all action taken in regard to access shall be in conformance with the plan and current Code design standards unless both the Department and the local authority approve a geometric design waiver under the waiver subsection of the Code*.

State Highway Access Code Section 3.7 **Category E-X – Expressway, Major Bypass**
Access Granting Criteria Including Category Related Access Location, Operations, and Design Standards

2. *Typical spacing of intersecting streets, roads and highways shall be planned on intervals of one mile and normally based upon section lines where appropriate.* ***One-half mile spacing of public ways may be permitted*** *to the highway only when no reasonable alternative access to the general street system exists.*

8. *Signals at intersections with major cross streets or roads of equal importance may be programmed to optimize traffic on both streets equally. Cross-streets of lesser importance need not be optimized equally.* ***Traffic signals on the highway should be programmed to allow a desirable highway bandwidth of at least 40 percent****. The efficiency of the signal system should be analyzed utilizing traffic volume, capacity, and level of service calculations. A study including all the relevant information listed in subsection 2.3(5) shall be completed. The analysis shall determine the optimum progression speed under both existing and proposed conditions.*

US Highway 24 Access Control Plan

- Recitals:

C. *The coordinated regulation of vehicular access to public highways is necessary to maintain the efficient and smooth flow of traffic, to reduce the potential for traffic accidents, to protect the functional level and optimize the traffic capacity, to provide an deficient spacing of traffic signals;*

- *EXHIBIT A US Highway 24 Access Control Plan*:

IV. ***Access Locations***

B. ***Any access*** *described in Section IV, which requires changes or closure as part of this agreement or if significant public safety concerns develop,* ***may be*** *closed,* ***relocated****, or consolidated, or turning movements may be restricted, or the access may be brought into conformance with this ACP, when in the opinion of the City and County with Department concurrence, or in the opinion of the Department, and any of the following conditions occur: a) the access is determined to be detrimental to the public's health, safety and welfare, or b) the access has developed an accident history that is correctable by restricting the access, or c) the access restrictions are necessitated by a change in road or traffic conditions, or d)* ***there is a change in the use of the property that would result in a change in the type of access operations*** *or e)* ***a highway reconstruction project provides the opportunity to make highway and access improvements in support of this ACP****. Access construction shall be consistent with the design and specification of the Access Code.*

C. All highway design and construction where practicable will be based on the assumption that the roadway will have a cross section for a minimum of two through lanes in each direction, right-turn auxiliary lanes, single and dual left-turn lanes, a non-traversable center median, and sufficient room to accommodate longitudinal installation of utilities.

D. Access Point Descriptions:

69. Access 69 (Exhibit B, figure 9, MP 324.72): Rex Road, Existing private road with full-movement access on the southeast side of US HWY 24. Future public roadway extension on the northwest side of US HWY 24. Access will be changed to a full-movement signalized intersection.

Justification

- Section 2.12 of the State Highway Access Control plan states, "The [Access Control] plan should achieve the optimum balance between state and local transportation planning objectives, and preserve and support the current and future functional integrity of the highway." The requested change to the access control plan balances the desire of EPC to have Rex Road connected through the Grandview Site with the intersection spacing of 4,255 exceeding the ½ mile referenced as an alternative in the State Highway Access Code- Although the proposed location does not meet the typical intersection spacing of one-mile on highways classified as E-X Expressway, section 3.7.2 does allow for ½ mile spacing of access points when no reasonable alternative access to the general street system exists. Note that this amendment would not **add** an intersection, resulting in ½ mile spacing for two segments, rather it would **shift** the planned Rex intersection from one-mile spacing each direction to 4,255 (greater than half mile) from Elbert road and 6,407 feet (greater than one-mile) from Stapleton Drive.

- The attached Exhibit 4 shows the anticipated long term and buildout auxiliary turn lanes for US Hwy 24 at the proposed Rex Road intersection. This exhibit also includes potential auxiliary lanes for the Amendment subject section of US 24 (between Stapleton and Elbert Road) which also shows anticipated buildout auxiliary lanes which meet current Access Code criteria. Also, from the TIS report, a table of improvements for the proposed Rex Road intersection is provided. Please refer to a copy of this table shown in Exhibit 5.

- As shown in Exhibit 4, the proposed location for the Rex Road and US Hwy 24 intersection will accommodate the ultimate laneage needed on US Hwy 24 between Stapleton Drive and Elbert Road. All lanes are shown to meet the Colorado State Highway Access Code criteria for an EX Highway with a posted speed limit of 65 mph and less than three percent grade with **no overlap and no reduction in Code-prescribed lengths**.

- LSC measured the existing sight distance at the proposed location for Rex Road. The available sight distance (based on a passenger vehicle drivers' eye height of 3.5 feet) is about 883 feet to the east and 1,895 feet to the west. Based on a posted speed limit of 65 mph and a grade of less than 3 percent, the entering sight distance required by the State Highway Access Code for a two-lane highway is 650 feet for passenger vehicles and pick-up trucks, 845 feet for single-unit trucks, and 1,105 feet for multi-unit vehicles. The available sight distance (measured based on a passenger vehicle drivers' eye height of 3.5 feet) meets the criteria for both passenger vehicles and single unit trucks. The driver's eye for multi-unit trucks would be significantly higher than 3.5 feet and considering that during the field sight distance measurement looking east (from a height of 3.5 feet), the roof of an approaching passenger vehicle was visible for a distance significantly greater than 1,105 feet, the entering sight distance for multi-unit trucks would also be met.

- Section 3.7.8 of the State Highway Access Code states that traffic signals on EX highways have a desirable bandwidth of 40%. As shown in the attached time-space diagram, the projected bandwidth through the future signalized intersections at Stapleton Drive, the proposed Rex Road and Elbert Road is at least 40 percent assuming a standard signal-timing plan with a leading eastbound left-turn phase at Rex Road. If lagging left phasing is allowed, the bandwidth could be improved to 62 percent northeast bound with 48 percent southwest bound.

- The proposed Amendment would allow Rex Road to be built in its "final location," without the need for bridge reconstruction or a design waiver for substandard auxiliary turn lanes as would be the case absent this Amendment. CDOT has already indicated that a design waiver for substandard turn lanes would not be approved.

- It is our understanding that El Paso County and CDOT staff have indicated support for the proposed Rex Road location and this requested change to the ACP at meetings with the applicant. Based on those meetings and support, the applicant has updated the Grandview Reserve Sketch Plan and the TIS and drainage reports have been updated.

Associated Modifications to the ACP document

- Modify the description of Intersection 69, which currently indicates "*Future public roadway extension on the northwest side of US HWY 24" and "Access will be changed to a full-movement signalized intersection"* should be removed from the intersection 69 description. This description of Intersection 69, *existing private road shown in alignment with Rex Road (full-movement access on the south side of US Hwy 24)* will, as part of this request, likely need to be programmed for "restriction to right-in/right-out or closure (if/when alternate local road connections become available)."

- Exhibit 2 of this memo is a copy of Exhibit B Figure 9 from the 2005 ACP is attached **with the approximate new intersection location marked**. The reference to Rex Road, "Future Rex Rd." on the north side of US HWY 24 at intersection 69 should be shifted east to the proposed new location. A symbol indicating future right-in/right-out or closure for Intersection 69 would likely need to be added.

- This Amendment to the ACP, once approved and adopted, should also be added to Table 4 of the ***US Highway 24 PEL Study*** (page attached for reference).

* * * * *

Please contact me with any questions regarding this report

JCH

Attachments: Exhibits
Time/Space Diagrams (signal progression analysis)
Table 4 from the PEL Study
TIS Report for Grandview Reserve
Drainage Report for Grandview Reserve

Exhibit 1 - Subject Section of Highway 24 & Grandview Reserve Location

Subject Section of Highway 24

Figure 1

Vicinity Map

Grandview Reserve (LSC #184840)

TRANSPORTATION CONSULTANTS, INC.

from Figure 1 from the Grandview Reserve TIS Report

US HWY 24

ACCESS CONTROL PLAN

PETERSON BLVD. to ELBERT HWY.

24 corridor improvements

JAN
2005

Aerial Photo 2003

LEGEND

Ⓢ	Current Signalized, Full Movement	#	Access I.D. Number
⊛	Future Signalized, Full Movement	▬	Access Closed
△	RIRO (right-in-right-out only)	- -	Future Roadway
		▬	Median Barrier
		▬	Combined Access
		→	Possible Access

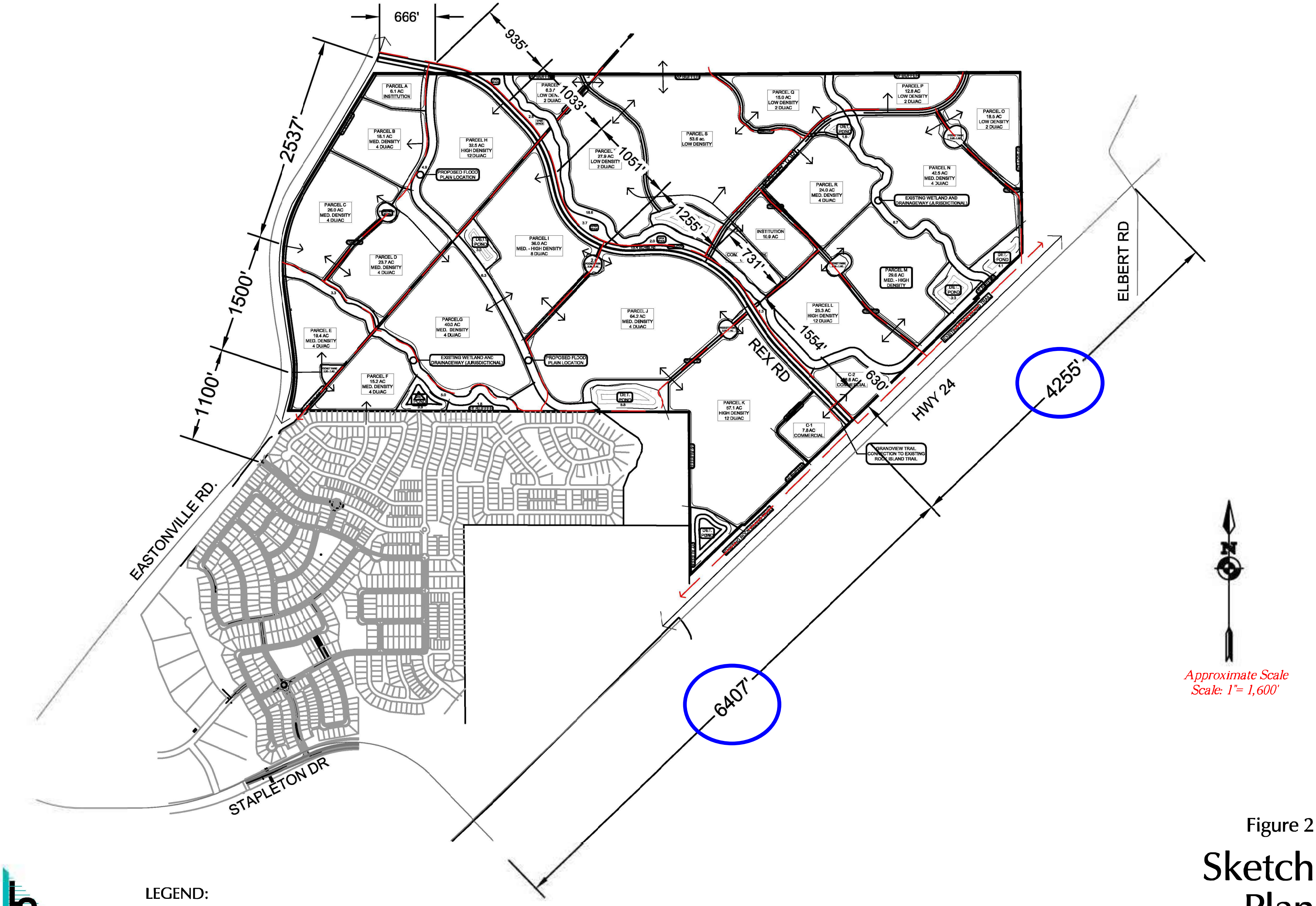
URS

EXHIBIT B

FIGURE 9

\\S03intfile1\OUT-OF-STATE\Denver\US24AMP\2004\New Fig 7-9.dwg 10/01/2004 11:13:01 AM MDT

Exhibit 3 - Figure 2 from the Grandview Reserve TIS Report
Proposed Rex Road Intersection Spacing along US Highway 24



LEGEND:

XX = Proposed access/intersection spacing along major roadways

— — = Proposed trails

Figure 2

Sketch Plan

Grandview Reserve (LSC #184840)

TRANSPORTATION CONSULTANTS, INC.

from Figure 2 of the Grandview Reserve TIS Report

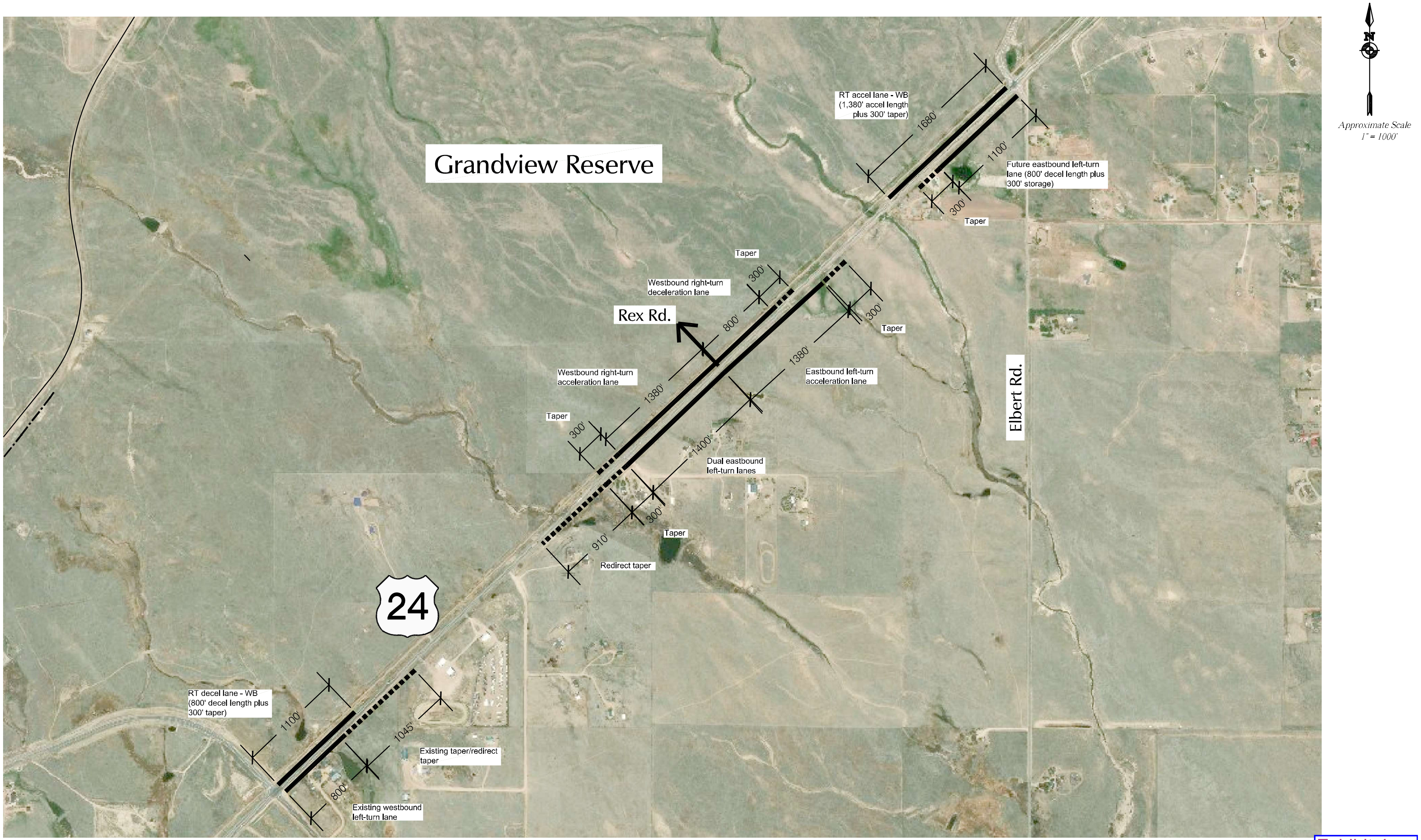


Exhibit 4

LSC
TRANSPORTATION CONSULTANTS, INC.

US Highway 24 Intersection Spacing and Future Auxiliary Turn Lane Requirements

Grandview Reserve (LSC #184840)

Exhibit 5 - Improvements Table 5 from the Grandview Reserve TIS Report - with US Highway 24 related improvements highlighted.

Table 5
Grandview Reserve
Roadway Improvements

Item #	Improvement	Trigger	Timing	Responsibility
Roadway Segment Improvements				
1	Eastonville - Stapleton to Latigo final grading and paving	dependent on PPRTA funding priorities	TBD by EPC; PPRTA "A-List" Project	PPRTA
2	Eastonville - Stapleton to Londonderry upgrade to Rural Minor Arterial (per MUTCD)	average daily traffic > 6,000 vehicles per day	dependent on PPRTA funding priorities	PPRTA
3	Eastonville - Londonderry to Latigo upgrade from unimproved roadway to Rural Minor Arterial (per MUTCD)	average daily traffic > 300 vehicles per day	With initial Grandview Reserve filing	PPRTA
4	Eastonville - Stapleton to Grandview Reserve south boundary upgrade to 4-Lane Rural Minor Arterial (per MUTCD)	average daily traffic > 20,000 vehicles per day	dependent on PPRTA funding priorities	PPRTA
5	Construct Rex from Eastonville to US Hwy 24 Adequate right-of-way should be reserved to allow for the construction of left-turn and right-turn deceleration lanes at all potential future access points	With Grandview Reserve development	With initial Grandview Reserve filing	Grandview Reserve
6	Construct Rex from Sunrise Ridge to Eastonville	With adjacent Meridian Ranch development	With future Meridian Ranch filings	Meridian Ranch
7	Stapleton Drive - US Hwy 24 to Eastonville Road complete southern (eastbound) half	average daily traffic > 18,000 vehicles per day	Shown in 2040 MTCP	El Paso County west of Eastonville Road; Waterbury Metro District east of Eastonville Road.
8	Widen US Hwy 24 to provide two lanes in each direction west of Stapleton.	dependent on CDOT funding priorities	Shown in US Highway 24 PEL Study; 2040 MTCP	CDOT
9	Widen US Hwy 24 to provide two lanes in each direction between Stapleton and Rex.	dependent on CDOT funding priorities	Shown in US Highway 24 PEL Study; 2040 MTCP	CDOT
10	Widen US Hwy 24 to provide two lanes in each direction east of Rex.	dependent on CDOT funding priorities	Shown in US Highway 24 PEL Study; 2040 MTCP	CDOT
Stapleton/US Hwy 24 Intersection				
11	Convert from Two-Way, Stop-Sign Control to Signal Control	When Traffic Signal Warrant(s) are met. The decision on timing of traffic signal installation rests with the Colorado Department of Transportation	anticipated in the short-term	CDOT; along with any available escrow collected from area developments through the access permitting process.
12	Potential long-term capacity upgades (jughandle, a Jr Interchange, etc.)	When level of service degrades below acceptable levels	Shown in US Highway 24 PEL Study;	CDOT; along with any available escrow collected from area developments through the access permitting process.
Eastonville/Stapleton				
13	Construct northbound and southbound left-turn lanes on Eastonville Rd. approaching Stapleton Dr.	- - -	Short-Term	PPRTA/El Paso County(1)
14	Signalization of the intersection of Stapleton/Eastonville.	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	anticipated in the short-term	eligible intersection under the free impact program
US Hwy 24/Rex Intersection				
15	Construct a northeastbound left-turn deceleration lane on US Hwy 24 approaching Rex	With the opening of the access	With initial Grandview Reserve filing	Grandview Reserve
16	Construct a second northeastbound left-turn deceleration lane on US Hwy 24 approaching Rex	Once the intersection is traffic signal controlled and level of service and/or queueing issues arrise	Future	Grandview Reserve
17	Construct a southwestbound right-turn deceleration lane on US Hwy 24 approaching Rex	southwestbound right-turn volume > 10 vph	With initial Grandview Reserve filing	Grandview Reserve
18	Construct a southwestbound right-turn acceleration lane on US Hwy 24 at Rex	southeastbound right-turn volume >10 vph	With initial Grandview Reserve filing	Grandview Reserve
19	Signalization of the intersection of US Hwy 24/Rex	When Traffic Signal Warrant(s) are met. The decision on timing of traffic signal installation rests with the Colorado Department of Transportation	Long-Term Future (to be evaluated with each filing)	Grandview Reserve
Eastonville/Rex Intersection				
20	Construct a northbound right-turn deceleration lane on Eastonville approaching Rex Road (not needed if constructed as a modern roundabout)	northbound right-turn volume > 50 vph	With Phase 1 development	Grandview Reserve
21	Construct a southbound left-turn deceleration lane on Eastonville approaching Rex Road (not needed if constructed as a modern roundabout)	southbound left-turn volume > 25 vph	NOT REQUIRED but will be needed once Eastonville is constructed to the west by Meridian Ranch to match a northbound left-turn lane that will be required	Potentially included as part of the PPRTA design of Eastonville Road OR Grandview Reserve
22	Convert to traffic signal control (not needed if constructed as a modern roundabout)	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	With Phase 2 development	likely to be considered an "eligible intersection" under the free impact program
Eastonville/Meridian Ranch/Judge Orr Intersection				
23	Convert to traffic signal control (or reconstruct as a modern roundabout)	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	Future	likely to be considered an "eligible intersection" under the free impact program
Eastonville/McLaughlin Intersection				
24	Convert to traffic signal control (or reconstruct as a modern roundabout)	Once warrants are met. The decision on timing of traffic signal installation rests with El Paso County Public Works.	Future	likely to be considered an "eligible intersection" under the free impact program
Eastonville/North Site Access Intersection				
25	Construct a northbound right-turn deceleration lane on Eastonville approaching the north site access (not needed if constructed as a modern roundabout)	northbound right-turn volume > 50 vph	With Phase 2 development	Grandview Reserve
26	Construct a southbound left-turn deceleration lane on Eastonville approaching the north site access (not needed if constructed as a modern roundabout)	southbound left-turn volume > 25 vph	With Phase 2 development or potentially in conjunction with the Eastonville PPRTA project.	Potentially included as part of the PPRTA design of Eastonville Road OR Grandview Reserve
Eastonville/South Site Access Intersection				
27	Construct a northbound right-turn deceleration lane on Eastonville approaching the south site access (not needed if constructed as a modern roundabout)	northbound right-turn volume > 50 vph	With Phase 2 development	Grandview Reserve
28	Construct a southbound left-turn deceleration lane on Eastonville approaching the south site access (not needed if constructed as a modern roundabout)	southbound left-turn volume > 25 vph	With Phase 2 development or potentially in conjunction with the Eastonville PPRTA project.	Potentially included as part of the PPRTA design of Eastonville Road OR Grandview Reserve

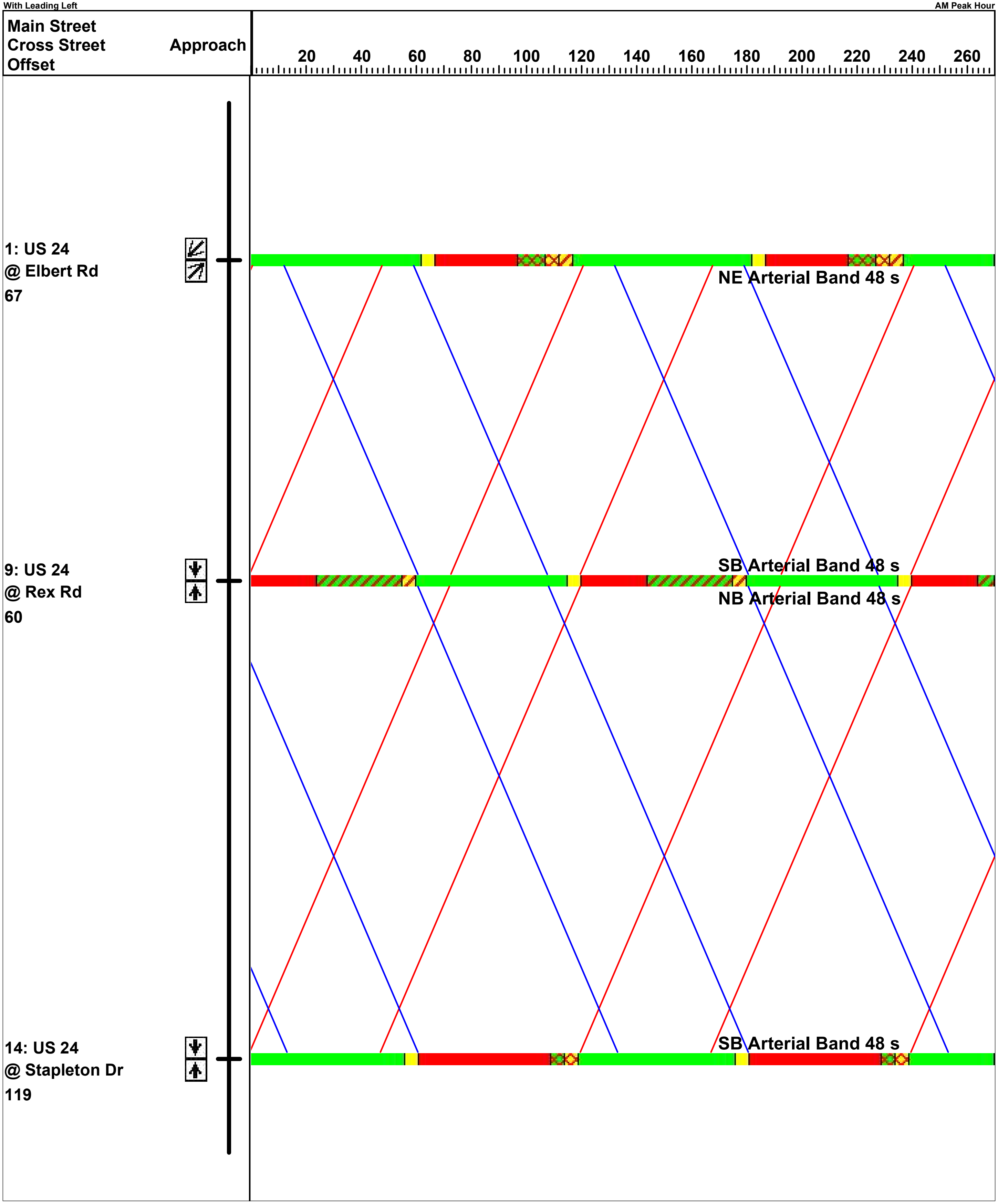
Notes:

(1) The design of Eastonville Road will be performed by the Meridian Ranch developer. LSC anticipates that these turn lanes will be included in the project design. The project will be constructed by El Paso County as PPRTA project.

Source: LSC Transportation Consultants, Inc. (1-11-19)

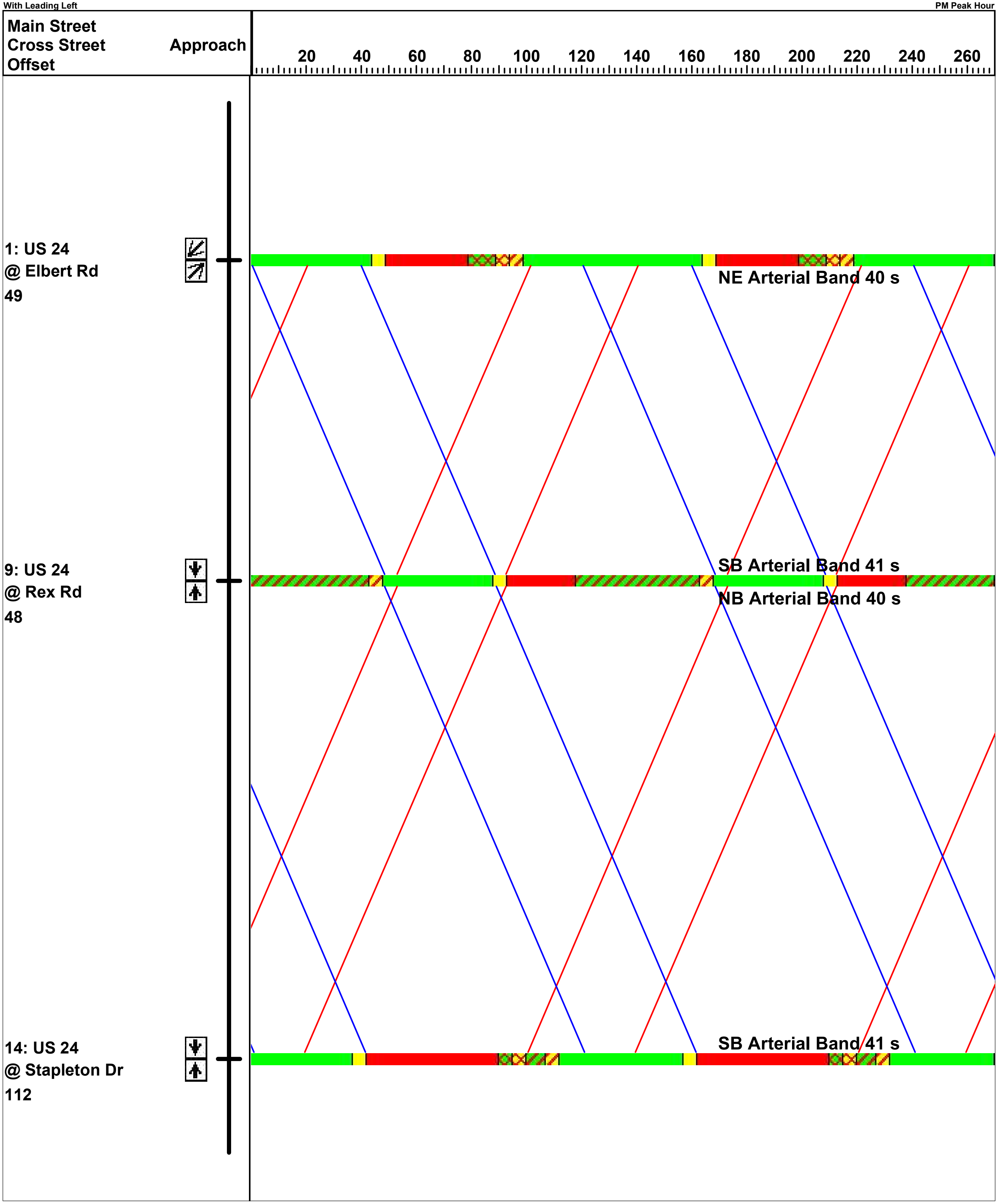
Time-Space Diagram - US 24
With Leading Left

2040 Total Traffic
AM Peak Hour



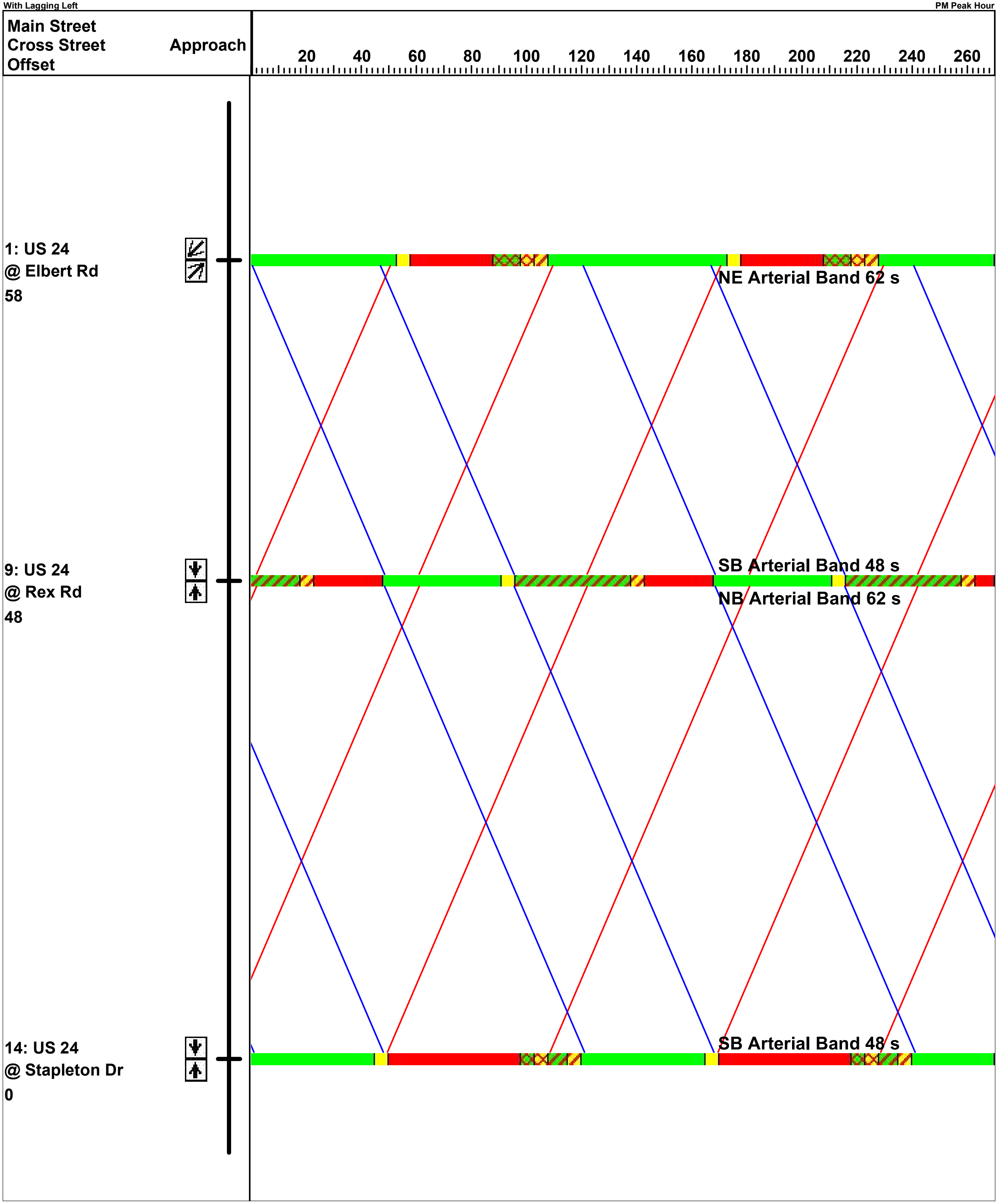
Time-Space Diagram - US 24
With Leading Left

2040 Total Traffic
PM Peak Hour



Time-Space Diagram - US 24
With Lagging Left

2040 Total Traffic
PM Peak Hour



US 24 Access Control Plan Recommendations

In January 2005, CDOT, El Paso County, and the City of Colorado Springs created the US 24 Access Control Plan, which regulates access to US 24 between Peterson Boulevard and Elbert Road. It was officially approved on June 1, 2006. **Table 4** summarizes the minor modifications recommended to the existing Access Control Plan in order to reflect the PEL Study recommendations for roadway and intersection configurations. No changes are proposed to the number or types of accesses shown in the Access Control Plan.

Table 4. Access Control Plan Recommended Revisions

MILEPOST	SIDE	DESCRIPTION	ACCESS CONTROL PLAN RECOMMENDATION	PEL STUDY RECOMMENDATION
MP 313.23	North/South	Marksheffel Road	Signalized, full movement	Signalized, full movement with future interchange, when warranted
MP 313.92	North	Claremont Ranch neighborhood, Right-in, right-out	May be closed when Constitution interchange constructed	May be closed with highway and/or Constitution or Marksheffel intersection improvements
MP 320.81	North	Old Meridian Road	Right-in, right-out with mountable curb for Falcon Fire emergency vehicles when new Meridian Road constructed (not available for use by any other property owner)	Mountable curb access conditional for Falcon Fire Department on adjacent property
MP 322.50	South	Bluegill Road	Future signalized, full movement	Access closed with road realignment to Judge Orr Road
MP 322.54	North/South	Judge Orr Road	Access closed with realignment to Blue Gill Road	Signalized, full movement

Following recommendations from this study, CDOT will work with El Paso County to establish a new Access Control Plan along US 24 from Elbert Road to the County line. CDOT will also work with El Paso County and the City of Colorado Springs to complete the recommended modifications to the existing Access Control Plan between Peterson Boulevard and Elbert Road. Only the changes outlined in Table 4 will be made to the existing Access Control Plan.

Bicycle and Pedestrian Accommodations

Construction of crosswalks at intersections and appropriate sidewalk connections and bike route signing/striping on area streets is recommended in conjunction with the corresponding area roadway improvements. Construction of a parallel adjacent multi-use path connection between Peterson Boulevard and Falcon and extension of the Rock Island Trail east of Falcon is also recommended in conjunction with the highway improvements along US 24.

As described with the Roadway Elements, an assumed impact area of 25 feet from the edge of pavement was established and included on both sides of the roadway in the proposed typical

NOTE:
TIS and Drainage Study attachments have been removed from this copy to reduce PDF file size.