



Substantially Equivalent Transportation Plan

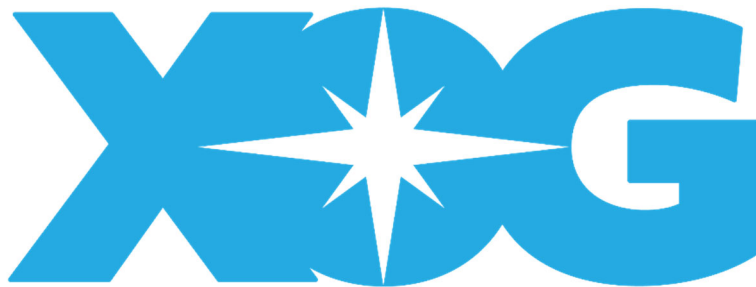
This document is being submitted as a substantially equivalent Transportation Plan for the Washington Pad Form 2A. This transportation plan was developed as a part of the operator agreement process with City of Thornton. This document complies with all requirements outlined in Colorado Oil and Gas Conservation Commission Rule 304.c.(6). For this reason, Extraction believes this satisfies the substantially equivalent information requirements and requests that it is accepted pursuant to Rule 304.e.

**Thornton Operator Agreement Application
Materials**

Section 18 - 870

**Section f (16)
Transportation Plan**

Washington Pad



EXTRACTION OIL & GAS

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1.0 INTRODUCTION

The following document outlines Extraction Oil & Gas, Inc.'s ("Extraction", "Operator", or "The Operator") review and assessment transportation routes and volumes that may exist associated with the development of minerals within the municipal boundaries of the City of Thornton ("Thornton", "City", or "The City") at the location described as the proposed Washington Pad Site ("Washington", "The Development", "Development").

Thornton sets forth requirements for a traffic plan in the Thornton City Code at Chapter 18, Division 2, Section 18-870(16) a. through c. as follows:

- a) *Description of all proposed private and public access and haul routes for all product produced and transported; equipment delivery; water, sand, waste solids, fluids, and E&P waste; and any other materials to be hauled onto or from the site of the oil and gas location.*
- b) *Description of each vehicle type, the unloaded and loaded weight of each vehicle, and the number of wheels and axles for each vehicle, including an estimate of the number of trips per day for each type of vehicle for each phase of the oil and gas operation. This information shall also be provided to the traffic engineer in connection with the process for obtaining an access road permit, once a permit is approved.*
- c) *Description of the proposed routes that will be utilized for all truck traffic and anticipated times of travel for the operator or any subcontractor of the operator. The plan shall demonstrate how such routes and times will be used to ensure that public roads and public intersections will be used in a manner that minimizes delays in the use of public roads by the general public and will not result in an unacceptable level of service for any contemplated intersection. The operator will submit, for approval by the traffic engineer, a plan to meet the applicable level of service for each intersection to ensure the public traffic will not be adversely impacted.*

This document fulfills these review requirements, those outlined in the Colorado Oil and Gas Commission Rule 304.c.(6), and is submitted as part of the application materials in support of an operator agreement.

2.0 ROUTE DETERMINATION

2.1 Route Details

Four distinct transportation route options and two hybrid transportation route options exist that provide access to The Development. These routes have been identified utilizing the name of the inbound thoroughfare associated with each route. The distinct route options are the East 152nd Parkway, Washington Street, East Baseline Road, and the East 144th Avenue transportation routes. The hybrid transportation routes are the Washington Street hybrid, and East 152nd Parkway hybrid transportation routes. These routes can be referenced in Exhibits A through F.

2.2 Proposed Transportation Route

The East 152nd Parkway transportation route is proposed for all development related traffic.

2.2.1 East 152nd Parkway Transportation Route

Development related traffic will utilize East 152nd Parkway, and Washington Street for travel to and from The Development. The route utilizes roughly three miles of public roads and consists of one signalized intersection. A turn will be required at this intersection for both ingress and egress traffic. This route utilizes updated lane configurations provided by the Washington Street Expansion Project. No intersection imagery currently exists for this planned intersection. If intersection details are made available, Figure 1: East 152nd Parkway Transportation Route Intersection Detail will be updated to depict traffic flow at this intersection.

2.2.1.1 East 152nd Parkway Transportation Route Intersection Analysis

East 152nd Parkway consists of a single lane in the direction of travel until it meets the edge of the Washington Street Expansion and the beginning of the intersection with Washington Street. This intersection is noted in Table 1: East 152nd Parkway Transportation Route Traffic Intersection Comparisons. Dedicated turn lanes exist for each turn at this intersection. A traffic merge lane is provided for traffic accelerating north on Washington Street. As development traffic leaves the pad site, Washington Street expands into a four-lane divided roadway.

Table 1: East 152nd Parkway Transportation Route Traffic Intersection Comparisons

Intersection	Lanes in Dir. of Travel	Travel Direction	Type of Intersection	Signalized	Turns Required	Dedicated Turn Lane
E. 152nd Pkwy & Washington St (future)	2.00	Inbound	3-way	Yes	Yes	Yes
Washington St & E. 152nd Pkwy (future)	2.00	Outbound	3-way	Yes	Yes	Yes

Note: Intersections noted as (future) are part of the Washington Street expansion project

Legacy oil field traffic currently utilizes portions of this route to access existing field infrastructure. Turns into and out of The Development are unsignalized. Inbound vehicle traffic

will turn left into The Development utilizing a dedicated turn lane. Outbound vehicle traffic will turn right onto Washington Street. No merge lane currently exists for outbound traffic at this location, nor is one included in the plans for the Washington Street Expansion Project.

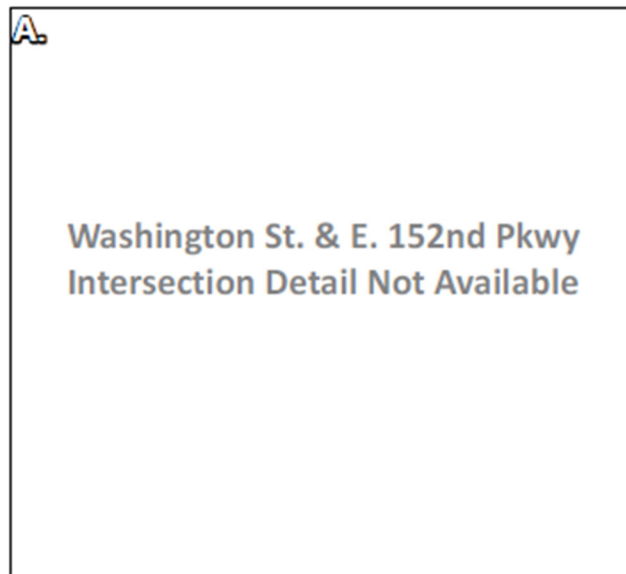


Figure 1: East 152nd Parkway Transportation Route Intersection Detail

2.3 Alternate Transportation Route Options

Additional transportation options are available utilizing local municipal roads.

2.3.1 Washington Street Transportation Route

Development related traffic could alternately utilize East Baseline Road CO Hwy 7 and Washington Street for travel to and from The Development. The route utilizes roughly four miles of public roads and consists of five signalized intersections, not including the I-25 access ramps. Turns are required at eight of these intersections. Figure 2: Washington Street Transportation Route Intersection Detail depicts traffic flow at these intersections.

2.3.1.1 Washington Street Transportation Route Intersection Analysis

The Washington Street transportation route navigates five signalized intersections. These intersections are noted in Table 2: Washington Street Transportation Route Traffic Intersection Comparisons. Four of these intersections do not require lane changes or turns. Traffic will need to navigate a turn at the intersection with East Baseline Road CO Hwy 7 and Washington Street.

Except for a small section of Washington Street south of the intersection with West 160th Avenue, traffic following the Washington Street Transportation route utilizes a divided highway

with two dedicated lanes of travel in each direction. A dedicated turn lane exists for southbound traffic turning onto Washington Street. Two dedicated turn lanes exist for north-bound traffic turning west onto East Baseline Road. The Washington Street transportation route would require development traffic to travel roughly 2,000 feet on an undivided two-lane highway.

Table 2: Washington Street Transportation Route Traffic Intersection Comparisons

Intersection	Lanes in Dir. of Travel	Travel Direction	Type of Intersection	Signalized	Turns Required	Dedicated Turn Lane
E. Baseline Rd. & Washington St.	2	Inbound	3-way	Yes	Right	Yes
Washington St. & Larkridge Parking Lot Rd. (1)	2	Inbound	4-way	No	None	N/A
Washington St. & Larkridge Parking Lot Rd. (2)	2	Inbound	3-way	Yes	None	N/A
Washington St. & E. 164th Ave.	2	Inbound	4-way	Yes	None	N/A
Washington St. & Larkridge Parking Lot Rd. (3)	2	Inbound	3-way	No	None	N/A
Washington St. & E. 162nd Ave.	2	Inbound	3-way	Yes	None	N/A
Washington St. & Larkridge Parking Lot Rd. (4)	2	Inbound	3-way	No	None	N/A
Washington St. & E. 160th Ave.	2	Inbound	4-way	Yes	None	N/A
Washington St. & E. 160th Ave.	2	Outbound	4-way	Yes	None	N/A
Washington St. & E. 164th Ave.	2	Outbound	4-way	Yes	None	N/A
Washington St. & Larkridge Parking Lot Rd. (1)	2	Outbound	4-way	No	None	N/A
Washington St. & E. Baseline Rd.	2	Outbound	3-way	Yes	Left	Yes

Note: 3-way intersections not included in analysis if roadway is divided or merging traffic bisects lane opposite direction of travel

Legacy oil field traffic currently utilizes portions of this route to access existing field infrastructure. Turns into and out of The Development are unsignalized. Inbound vehicle traffic will turn right into The Development. Outbound vehicle traffic will turn left across on-coming traffic. Traffic controls may be necessary when excess size vehicles or increased vehicle volume depart The Development utilizing this route.



Figure 2: Washington Street Transportation Route Intersection Detail

2.3.2 East Baseline Road Transportation Route

Development related traffic could alternately utilize East Baseline Road CO Hwy 7, East 160th Avenue, and Washington Street for travel to The Development. Traffic departing The Development will utilize Washington Street, East 160th Avenue, and York Street. This route utilizes almost six miles of public roads and consists of four signalized intersections, not including the I-25 access ramp. Turns are required at two of these signalized intersections. A turn is also required at an unsignalized intersection. Figure 3: East Baseline Road Transportation Route Intersection Detail depicts traffic flow at these locations.

2.3.2.1 East Baseline Road Transportation Route Intersection Analysis

The East Baseline Road Transportation Route navigates four signalized intersections. These intersections are noted in Table 3: East Baseline Road Transportation Route Traffic Intersection Comparisons. Two of these intersections require turns. Additionally, one non-signalized intersection will require a turn.

East Baseline Road begins as a four-lane divided roadway with two lanes of dedicated traffic in each direction. After roughly one mile of travel traffic merges into one lane in each direction of

travel. Traffic remains in a single lane for the remainder of the identified route except for a small section of Washington Street south of the intersection with West 160th Avenue. Inbound and outbound traffic will need to navigate a turn at the unsignalized intersection at East Baseline Road and East 160th Avenue. A traffic merge lane exists on East Baseline Road for outbound traffic. Traffic will also navigate a turn at the signalized intersections at Washington Street and East 160th Avenue. Inbound traffic at this location will turn left across stopped traffic utilizing traffic controls. Outbound traffic at East 160th Avenue and York Street utilizes a dedicated turn lane. No traffic merge lane exists on York Street.

Table 3: East Baseline Road Transportation Route Traffic Intersection Comparisons

Intersection	Lanes in Dir. of Travel	Travel Direction	Type of Intersection	Signalized	Turns Required	Dedicated Turn Lane
E. Baseline Rd. & Washington St.	2	Inbound	3-way	Yes	None	N/A
E. Baseline Rd. & E. 164th / E. 166th Ave.	2	Inbound	4-way	Yes	None	N/A
E. Baseline Rd. & E. 160th Ave.	2	Inbound	3-way	No	Right	No
Washington St. & E. 160th Ave.	2	Inbound	4-way	Yes	Left	Yes
Washington St. & E. 160th Ave.	1	Outbound	4-way	Yes	Right	Yes
E. 160th Ave. & E. 160th Ave.	2	Outbound	3-way	No	Right	Yes
E. 160th Ave. & York St.	1	Outbound	4-way	Yes	Right	Yes

Note: 3-way intersections not included in analysis if roadway is divided or merging traffic bisects lane opposite direction of travel

Legacy oil field traffic currently utilizes portions of this route to access existing field infrastructure. Turns into and out of The Development are unsignalized. Inbound vehicle traffic will turn right into The Development. Outbound vehicle traffic will turn left across on-coming traffic. Traffic controls may be necessary when excess size vehicles or increased vehicle volume depart The Development utilizing this route.

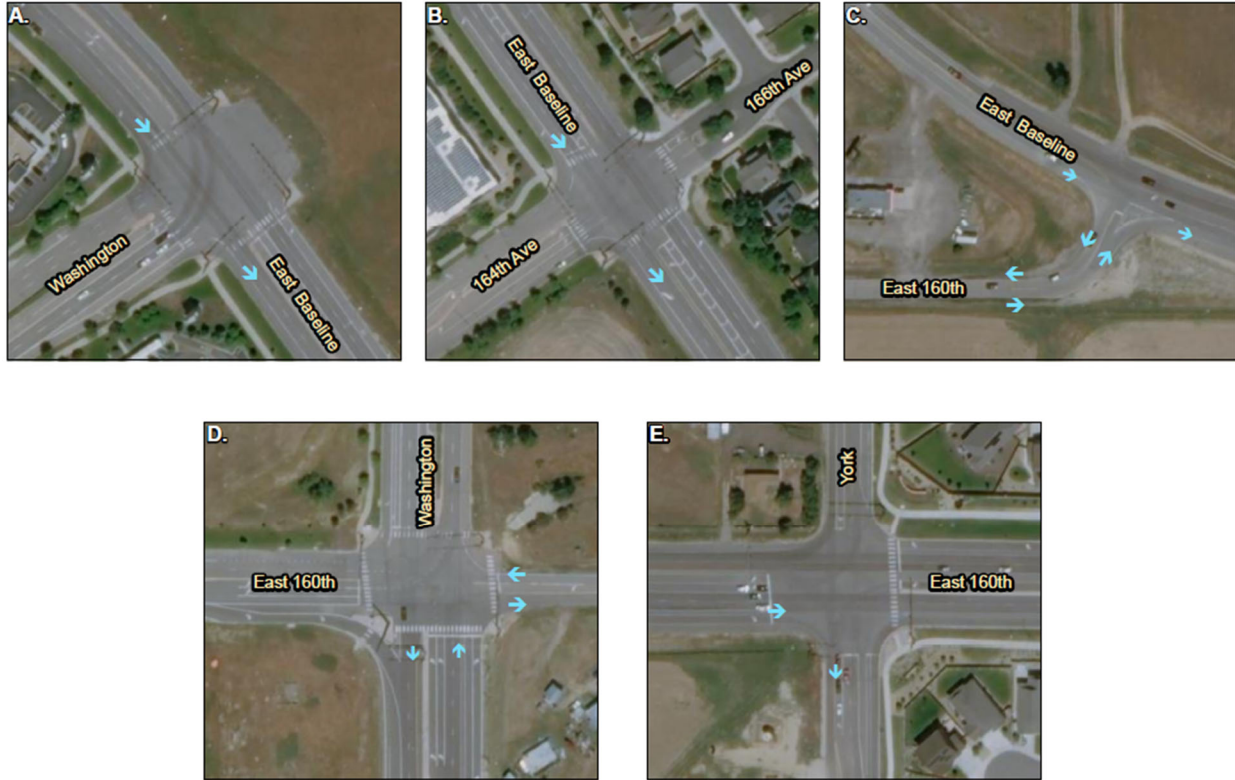


Figure 3: East Baseline Road Transportation Route Intersection Detail

2.3.3 East 144th Avenue Transportation Route

Development related traffic could alternately utilize East 144th Avenue and Washington Street for travel to and from The Development. The route utilizes roughly four miles of public roads and consists of six signalized intersections, not including the I-25 access ramps. Turns are required at one of these intersections. Figure 4: East 144th Avenue Transportation Route Intersection Detail depicts traffic flow at these intersections.

2.3.3.1 East 144th Avenue Transportation Route Intersection Analysis

The East 144th Avenue transportation route navigates six signalized intersections. These intersections are noted in Table 4: East 144th Avenue Transportation Route Traffic Intersection Comparisons. Five of these intersections do not require lane changes or turns. Traffic will need to navigate a turn at the intersection with East 144th Avenue and Washington Street.

Traffic following the East 144th Avenue Transportation route utilizes a divided highway with two dedicated lanes of travel in each direction. A dedicated turn lane exists for northbound traffic turning onto Washington Street. A dedicated turn lanes exist for southbound traffic turning west onto East 144th Avenue.

Table 4: East 144th Avenue Transportation Route Traffic Intersection Comparisons

Intersection	Lanes in Dir. of Travel	Travel Direction	Type of Intersection	Signalized	Turns Required	Dedicated Turn Lane
E. 144th Ave. & Lincoln St.	2.00	Inbound	4-way	Yes	No	N/A
E. 144th Ave. & Grant St.	2.00	Inbound	4-way	Yes	No	N/A
E. 144th Ave. & Washington St.	2.00	Inbound	4-way	Yes	Left	Yes
Washington St. & E. 146th Ave.	2.00	Inbound	4-way	Yes	No	N/A
Washington St. & E. 148th Ave.	2.00	Inbound	3-way	No	No	N/A
Washington St. & E. 152nd Ave. (future)	2.00	Inbound	3-way	Yes	No	N/A
Washington St. & E. 152nd Ave. (future)	2.00	Outbound	3-way	Yes	No	N/A
Washington St. & E. 148th Ave.	2.00	Outbound	3-way	No	No	N/A
Washington St. & E. 146th Ave.	2.00	Outbound	4-way	Yes	No	N/A
Washington St. & E. 144th Ave.	2.00	Outbound	4-way	Yes	Right	Yes
E. 144th Ave. & Grant St.	2.00	Outbound	4-way	Yes	No	N/A
E. 144th Ave. & Lincoln St.	2.00	Outbound	4-way	Yes	No	N/A

Note: 3-way intersections not included in analysis if roadway is divided or merging traffic bisects lane opposite direction of travel

Note: Intersections noted as (future) are part of the Washington Street expansion project

Legacy oil field traffic currently utilizes portions of this route to access existing field infrastructure. Turns into and out of The Development are unsignalized. Inbound vehicle traffic will turn left into The Development utilizing a dedicated turn lane. Outbound vehicle traffic will turn right onto Washington Street. No merge lane currently exists for outbound traffic at this location, nor is one included in the plans for the Washington Street Expansion Project.

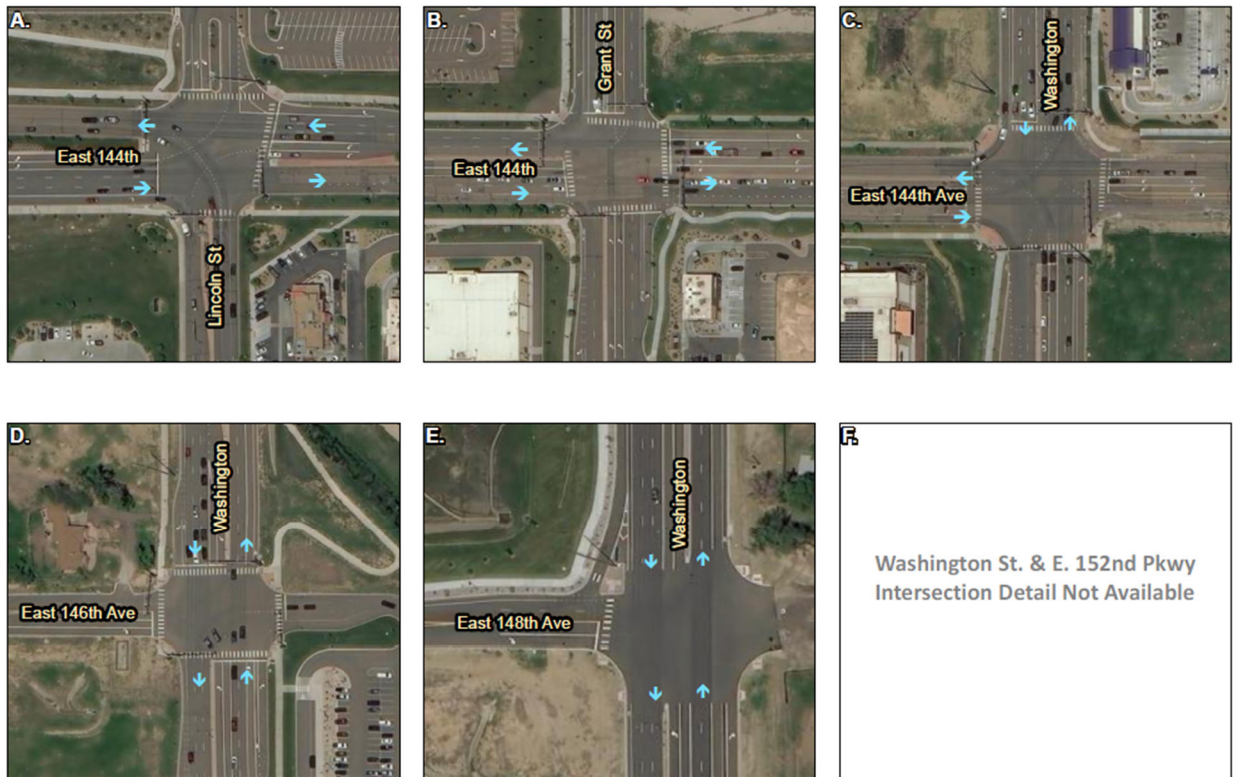


Figure 4: East 144th Avenue Transportation Route Intersection Detail

2.3.4 Washington Street Hybrid Transportation Route

Development related traffic could alternately utilize a modified Washington Street transportation route for travel to and from The Development. The route utilizes roughly seven miles of public roads and consists of eight signalized intersections, not including the E470 and I25 access ramps. Turns are required at two of these intersections. Figure 5: Washington Street Hybrid Transportation Route Intersection Detail depicts traffic flow at these intersections. This route utilizes updated lane configurations provided by the Washington Street Expansion project.

2.3.4.1 Washington Street Hybrid Route Intersection Analysis

The Washington Street Hybrid transportation route bisects eight signalized intersections. These intersections are noted in Table 5: Washington Street Hybrid Transportation Route Traffic Intersection Comparisons. Six of these intersections do not require lane changes or turns.

Excluding a small section of Washington street south of East 160th Avenue, two dedicated lanes exist in the direction of travel. The intersection at East Baseline Road CO Hwy 7 and Washington Street requires a right turn utilizing traffic controls and a dedicated turn lane, as does the intersection at Washington St and East 144th Avenue.

Table 5: Washington Street Hybrid Transportation Route Traffic Intersection Comparisons

Intersection	Lanes in Dir. of Travel	Travel Direction	Type of Intersection	Signalized	Turns Required	Dedicated Turn Lane
E. Baseline Rd. & Washington St.	2.00	Inbound	3-way	Yes	Right	Yes
Washington St. & Larkridge Parking Lot Rd. (1)	2.00	Inbound	4-way	No	None	N/A
Washington St. & Larkridge Parking Lot Rd. (2)	2.00	Inbound	3-way	No	None	N/A
Washington St. & E. 164th Ave.	2.00	Inbound	4-way	Yes	None	N/A
Washington St. & Larkridge Parking Lot Rd. (3)	2	Inbound	3-way	No	None	N/A
Washington St. & E. 162nd Ave.	2.00	Inbound	3-way	Yes	None	N/A
Washington St. & Larkridge Parking Lot Rd. (4)	2	Inbound	3-way	No	None	N/A
Washington St. & E. 160th Ave.	2.00	Inbound	4-way	Yes	None	N/A
Washington St. & E. 148th Ave.	2.00	Outbound	3-way	No	No	N/A
Washington St. & E. 146th Ave.	2.00	Outbound	4-way	Yes	No	N/A
Washington St. & E. 144th Ave.	2.00	Outbound	4-way	Yes	Right	Yes
E. 144th Ave. & Grant St.	2.00	Outbound	4-way	Yes	No	N/A
E. 144th Ave. & Lincoln St.	2.00	Outbound	4-way	Yes	No	N/A

Note: 3-way intersections not included in analysis if roadway is divided or merging traffic bisects lane opposite direction of travel

Legacy oil field traffic currently utilizes portions of this route to access existing field infrastructure. Turns into and out of The Development are unsignalized. Inbound vehicle traffic will turn right into The Development. Outbound vehicle traffic will turn right onto Washington Street. No merge lane currently exists for outbound traffic at this location.



Figure 5: Washington Street Hybrid Transportation Route Intersection Detail

2.3.5 East 152nd Parkway Hybrid Transportation Route

Development related traffic could alternately utilize a modified East 152nd Parkway transportation route for travel to and from The Development. The route utilizes roughly six miles of public roads and consists of five signalized intersections, not including the E470 and I25 access ramps. Right turns are required at two of these intersections. Figure 6: East 152nd Parkway Hybrid Transportation Route Intersection Detail depicts traffic flow at these intersections. This route utilizes updated lane configurations provided by the Washington Street Expansion project.

2.3.5.1 East 152nd Parkway Hybrid Route Intersection Analysis

The East 152nd Parkway hybrid transportation route bisects five signalized intersections. These intersections are noted in Table 6: East 152nd Parkway Hybrid Transportation Route Traffic Intersection Comparisons. Three of these intersections do not require lane changes or turns.

East 152nd Parkway consists of a single lane in the direction of travel until it meets the edge of the Washington Street Expansion and the beginning of the intersection with Washington Street. Inbound development traffic will navigate the East 152nd Parkway and Washington Street intersection utilizing the dedicated right turn lane with signalized traffic controls. A traffic merge lane is provided for traffic accelerating north on Washington Street. As development traffic leaves the pad site, Washington Street expands into a four-lane divided roadway. Outbound development traffic will navigate the Washington Street and East 144th Avenue intersection utilizing the dedicated right turn lane with signalized traffic controls.

Table 6: East 152nd Parkway Hybrid Transportation Route Traffic Intersection Comparisons

Intersection	Lanes in Dir. of Travel	Travel Direction	Type of Intersection	Signalized	Turns Required	Dedicated Turn Lane
E. 152nd Ave. & Washington St. (future)	1	Inbound	3-way	Yes	Right	No
Washington St. & E. 148th Ave.	2	Outbound	3-way	No	No	N/A
Washington St. & E. 146th Ave.	2	Outbound	4-way	Yes	No	N/A
Washington St. & E. 144th Ave.	2	Outbound	4-way	Yes	Right	Yes
E. 144th Ave. & Grant St.	2	Outbound	4-way	Yes	No	N/A
E. 144th Ave. & Lincoln St.	2	Outbound	4-way	Yes	No	N/A

Note: 3-way intersections not included in analysis if roadway is divided or merging traffic bisects lane opposite direction of travel

Note: Intersections noted as (future) are part of the Washington Street expansion project

Legacy oil field traffic currently utilizes portions of this route to access existing field infrastructure. Turns into and out of The Development are unsignalized. Inbound vehicle traffic will turn left into The Development utilizing a dedicated turn lane. Outbound vehicle traffic will

turn right onto Washington Street. No merge lane currently exists for outbound traffic at this location.

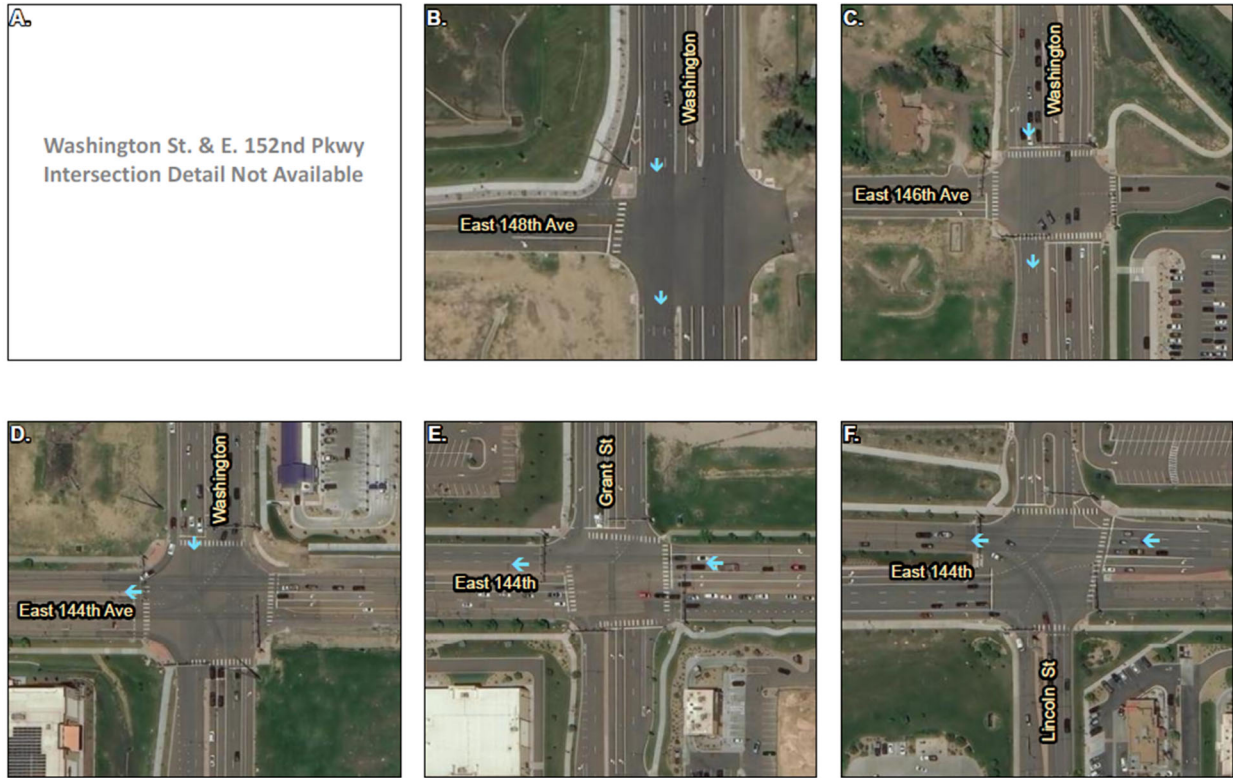


Figure 6: East 152nd Parkway Hybrid Transportation Route Intersection Detail

3.0 VEHICLES

Traffic quantities associated with The Development will fluctuate based on the operational phase. All traffic will utilize the approved transportation route.

3.1 Traffic Profile

The traffic profile for The Development consists of a mixture of employee/contractor traffic (light pickup trucks) and heavier truck traffic. The light trucks are best classified as Federal Highway Administration (FHWA), Class 3 vehicles. The heavier truck traffic, while variable in purpose, consists predominantly of semi-truck and trailer combinations, with five axles and a single trailer (i.e., FHWA Class 9 Vehicles); this may include two-axle tractors pulling three-axle trailers, three-axle tractors pulling two-axle trailers, or three-axle trucks pulling two-axle trailers. The anticipated gross vehicle weight of all heavy trucks is less than 80,000 pounds, and axle-load distributions will comply with all applicable state and federal weight limits.

The relative volume of light traffic and heavier truck traffic varies throughout the course of development and is dependent on the nature of site activities. Development traffic is characterized using seven phases, including: Pad Construction, Facility Construction, Drilling, Completion Operations, Flowback on Production, and Interim Reclamation. The primary variables that impact how much traffic is associated with each phase of development are the overall size (or footprint) of the facility, the number of wells drilled and the total well lateral lengths. These variables in turn impact how much earthwork is required during pad construction and interim reclamation, how long the drilling phase lasts, how much proppant (e.g., sand) and water is required to complete the wells, how long the flow back period will last, and how much time it will take to construct the surface production infrastructure during the facility construction phase. A summary of the anticipated total number of trips, broken down by phase of development, is provided in Table 1: Vehicle Trips by Phase of Operation. Oversized vehicles may be utilized during all development phases. These vehicles are not daily operational traffic and will be permitted individually with the Thornton traffic engineer.

Table 7: Vehicle Trips by Phase of Operation

	Stage	Activity	1-Way Truck Trips	Duration (Days)	Average Truck Trips per Day (by Stage)	Average Truck Trips per Day (by Activity)
Temporary Construction Traffic	Pad Construction	Pad and Road Construction	220	90	11	11
	Facility Construction	Facility Construction	170	60	3	3
	Drilling	Surface Rig	220	60	17	4
		Drilling Rig	100			2
		Drilling Fluid & Materials Drilling Equipment (casing, drill pipe, etc)	720			12
	Completion Operations	Completion Equipment (pump truck, tanks, etc)	86	60	71	1
		Completion Fluids & Materials	200			3
		Sand	3754			63
		Gel & Fuel Loads	200	3		
		Flowback water disposal	200	60	8	3
		Mill Out/Tubing Equipment	290			5
Flowback	Flowback (on production)	15	35	15	15	
Interim Reclamation	Pad reclamation	220	30	0	0	
Permanent Traffic	Production	Produced Water	0	on going	0	0
		Produced Oil	0			0

*Above-captioned traffic counts are preliminary

3.2 Transportation Schedule

Operating times and the resulting transportation schedules will be specific to The Development phases. The anticipated operational schedule by phase is noted in Table 8: Development Phase and Travel Schedule.

Table 8: Development Phase and Travel Schedule

	Pad Construction	Drilling	Completions	Interim Reclamation	On-Going Production
Duration	~12 Weeks	~8 Weeks	~13 Weeks	~6 Weeks	On-going
Operation Hours	Daylight Hours	24 Hours	24 Hours	Daylight Hours	24 Hours

For all phases of operation excluding ongoing production, development traffic will adhere to a transportation schedule designed to mitigate or avoid periods of heightened traffic congestion. Traffic during the hours of 7:00 AM to 9:00 AM and 3:00 PM to 6:00 PM will be restricted to light vehicle traffic only. If nearby stake holders require different traffic restrictions, Extraction will work directly with the stake holder to identify an acceptable traffic schedule solution applicable to all users.

4.0 TRANSPORTATION ROUTE ANALYSIS

4.1 Possible Transportation Routes

Six possible transportation route options exist, including the proposed route that provide access to The Development. Each route has been examined utilizing a set of standard route characteristics and calculated variables. These routes can be referenced in Exhibits A through F. While they share commonalities, each route offers a slightly different set of cumulative transportation attributes. Comparable route characteristics and calculated variables are described herein.

4.2 Possible Transportation Route Observed Attributes

Multiple observed route characteristics and calculated route variables were analyzed to identify the proposed transportation route.

4.2.1 Distance Traveled

When examining specific transportation route options, the distance traveled on local roadways may provide the best indicator of potential external impact. The comparison is basic; less time on local roadways directly relates to a lower potential impact. Indicating that in the absence of contributing considerations, a route designed to minimize travel distance may be most beneficial to related route safety factors. The travel distance associated with each potential transportation route is listed in Table 9: Local Transportation Route Characteristics.

Table 9: Local Transportation Route Characteristics

Transportation Route	Total Miles Traveled	Intersections Navigated	Required Turns		Avg. Lane Cap. Per Intersection	Through Lanes / City Mile
			Left	Right		
E. 152nd Pkwy	2.88	2	1	1	2.00	0.28
Washington St.	3.90	11	1	1	2.00	0.82
East Baseline Rd.	5.60	7	2	2	1.71	0.39
144th Ave.	3.68	12	1	1	2.00	1.00
Washington St. Hybrid	3.70	13	0	3	2.00	0.89
E. 152nd Pkwy Hybrid	3.27	7	0	2	2.00	0.88

Note: Turn counts do not include turns directly associated with the pad site or controlled access highways

4.2.2 Intersections

Intersections are more dangerous than uninterrupted travel on a two-way road. Intersections are where vehicles, which are often moving quickly cross paths. Approximately 40 percent of all crashes occur at intersections, including 50 percent of crashes involving serious injury and 20 percent of those involving fatalities (Choi, 2010). Safety devices such as signals, and designated lanes reduce the potential for conflict by giving vehicles instructions for how they should move. The Intersections Navigated characteristic denotes the number of intersections incorporated into

each proposed transportation route. This number accounts for intersections which may be navigated twice, once in each direction. Each navigation of an intersection was accounted for separately to ensure that the distinct transportation profile at the intersection was analyzed. This characteristic can be referenced in in Table 9: Local Transportation Route Characteristics.

Turns at intersections, usually left turns introduce further conflict. Approximately 61 percent of all crashes that occur at intersections involve left turns (Choi, 2010). This indicates that transportation routes with fewer intersections and limited left turns are preferred. The Required Turns variable identifies the quantity of turns navigated for each proposed transportation route. This characteristic can be referenced in Table 9: Local Transportation Route Characteristics.

Controlling for lane quantity allows for a better understanding of the associated traffic conditions at the identified intersections. Intersections introduce confusion into vehicle travel. More vehicles traveling in more directions increase the possibility for conflict. The risk of intersection conflicts can be mitigated for by a reduction in travel directions or the addition of navigation controls such as dedicated lanes.

Dedicated lanes, while not as effective as a reduction in traffic volume mitigate traffic conflicts. More available lanes in each direction of travel can be understood to offer more dedicated lanes at intersections. In this analysis, the number of lanes at a given intersection is described by the Average Lane Capacity per Intersection variable. This variable can be referenced in Table 9: Local Transportation Route Characteristics. The average lane capacity per intersection is calculated by averaging the lanes available in the direction of travel at each intersection.

4.2.3 Lane Capacity and Distance Traveled

Lane capacity in terms of vehicles per hour is defined by the U.S. Department of Transportation as the maximum sustainable flow rate at which vehicles or persons reasonably can be expected to traverse a point or uniform segment of a lane or roadway during a specified time period under given roadway, geometric, traffic, environmental, and control conditions (US Dept of Transportation, 2021). A key variable of lane capacity is the quantity of through-lanes for the segment of roadway being analyzed.

A greater quantity of through-lanes, or lanes dedicated to a single direction of travel equates to a higher lane capacity. The quantity of through-lanes varies over the course of the routes analyzed in this review. Through-lane quantity was analyzed by examining the city miles traversed on roadways with more than one through-lane. This distance in miles was compared to the total city mile distance of each analyzed route. The resulting ratio provides insight into which routes may correspond to higher potential lane capacity in terms of allowable vehicles per hour. Through-Lanes per City Mile can be referenced in Table 10: Lane Capacity Breakdown by Route and Distance Traveled.

Table 10: Lane Capacity Breakdown by Route and Distance Traveled

Transportation Route	Total Miles Traveled	Miles with ≥ 2 Th. Lanes	Through-Lanes / City Mile	Residential Parcels	Residential Parcels / City Mile
E. 152nd Pkwy	2.88	0.81	0.28	3.00	1.04
Washington St.	3.90	3.20	0.82	4.00	1.03
East Baseline Rd.	5.60	2.20	0.39	30.00	5.36
144th Ave.	3.68	3.68	1.00	13.00	3.53
Washington St. Hybrid	3.70	3.30	0.89	17.00	4.59
E. 152nd Pkwy Hybrid	3.27	2.89	0.88	13.00	3.98

Note: Residential parcel quantity only includes parcels accessed directly from specified route

4.2.4 Residential Parcels and Miles Traveled

Lane Capacity is further described by the Base Capacity variable. Base Capacity can be thought of in terms of passenger cars per hour per lane (U.S. Department of Transportation, 2021). Higher existing vehicle traffic will result in a higher overall capacity in terms of vehicles per hour when any additional traffic volume is added. As such, transportation routes with lower existing levels of vehicular traffic should be prioritized.

Base Capacity analysis provides insights into expected future capacity levels but does not describe the nature of existing vehicular use patterns. It is reasonable to assume that base capacity levels are a mix of personal, commercial, and industrial traffic use components. Cataloging these uses poses difficulties. Some variable level of traffic may clearly fall into definable categories. However, discerning use patterns without knowledge of motorist intent is nearly impossible.

In the absence of specific traffic use data, controlling for external use factors becomes a more beneficial metric. While areas of mixed commercial, industrial, and residential use exist in the neighborhoods bordering the proposed development, general use characteristics can still be assumed by evaluating specific quantifiable indicators. These characteristics can be examined to anticipate likely traffic use patterns.

The general use characteristic of greatest interest is personal residential travel. While not a perfect indicator, the presence of residential parcels along a transportation route is a fair and measurable indicator of the potential impact increased transportation poses to personal residential travel. Assuming that an absence of impact is an unobtainable outcome, and arguably not possible based on existing levels of regional commercial and industrial expansion, the reduction of development related impact to the greatest extent becomes the optimum targeted condition.

The quantity of residential parcels directly accessed along a given transportation route was obtained by reviewing the publicly available Adams County parcel and building footprint GIS

data. The parcels identified along each route were cross referenced with the building footprint data to identify which parcels contain residential structures. Table 10: Lane Capacity Breakdown by Route and Distance Traveled tabulates the surveyed residential parcel quantities. For this review, a residential parcel was identified if the parcel in question contained at least one residential structure and was directly served by the associated transportation route. The surveyed residential parcels are noted in the exhibits specific to each transportation plan. This information is indicative of the potential for impact but does not provide a comparable metric. Examining residential parcel quantity against total route miles allows for more direct route comparisons to be made.

5.0 CONCLUSIONS

5.1 Possible Transportation Route Observed Attribute Analysis

All six possible transportation route options, including the proposed route provide for adequate means of accessing The Development. The route attributes discussed herein allow for the selection of the transportation route that best prioritizes safe and responsible access to The Development.

5.1.1 Distance Traveled

Of the six routes identified for consideration, the East 152nd Parkway Route utilizes the fewest public roadway miles. The East 152nd Parkway hybrid route utilizes the next fewest. Followed by the 144th Avenue route and Washington Street hybrid route. Examined independently, this characteristic would indicate that the East 152nd Parkway route would offer the least opportunity for roadway conflict. However, other variables demand consideration. The mileage totals associated with each route are available in Table 9: Local Transportation Route Characteristics

5.1.2 Intersections

All possible transportation routes require the navigation of intersections. The East 152nd Parkway route bisects one intersection during inbound travel and one during outbound travel, the least of any other route. The East Baseline and East 152nd Parkway hybrid transportation routes each navigate seven intersections. While the Washington Street, 144th Avenue, and Washington Street Hybrid routes all navigates more than 10 intersections.

5.1.2.1 Turns at Intersections

Each proposed transportation route requires turns at intersections. While two routes eliminate left turns, only one route prioritizes both the quantity of intersections navigated and total turns. The East 152nd Parkway route navigates one intersection twice, requiring a right turn during inbound travel and a left turn during outbound travel. The Washington Street Hybrid and the East 152nd Parkway Hybrid routes eliminate left turns completely, however they both require the navigation of at least seven intersections. Like the East 152nd Parkway route, the Washington Street and the 144th Avenue routes each require one left and one right turn. But these routes also require the navigation of at least 11 intersections. The quantity of intersections and turns navigated in each route is noted in Table 9: Local Transportation Route Characteristics.

Analyzing the average lane capacity per intersection of each proposed transportation route reveals that an average of 2 lanes of dedicated travel, not including dedicated turn lanes are available for five of the six proposed transportation routes. At 1.71 lanes per intersection, the East Baseline Road route is the only possible route averaging less than 2 lanes of dedicated travel at each intersection. Dedicated lanes mitigate traffic conflicts for vehicles navigating intersections without utilizing turns. Vehicles adhering to the West 152nd Parkway route only

navigate turns at intersections. The turns associated with this route utilize a dedicated turn lane and lighted intersection movement controls and are not subject to through-lane travel.

5.1.3 Lane Capacity and Distance Traveled

Increased lane capacity over the entirety of a transportation route, provided for by factors including increased through-lane quantity can reasonably be expected to allow for fewer roadway conflicts. A higher ratio of Through-Lanes per City Mile can be understood to indicate a greater lane capacity for an associated route. Reviewing the calculated ratios for the proposed transportation routes reveals that the 144th Avenue route has an associated through-lanes per city mile ratio greater than any other route. This indicates that two dedicated lanes of travel exist over the entirety of the route. The Washington Street and East 152nd Avenue Hybrid routes have the next highest ratio of dedicated through-lanes to city miles, followed by the Washington Street route. Through-lanes per City Mile ratios can be referenced in Table 10: Lane Capacity Breakdown by Route and Distance Traveled.

5.1.4 Residential Parcels and Miles Traveled

The East Baseline Road Transportation route presents the highest quantity of residential parcels directly accessed for all examined transportation routes. Unsurprisingly, it also reflects the highest ratio of residential parcels to city miles traveled. The Washington Street Hybrid route presents the next highest quantity of residential parcels directly accessed. This is followed by the 144th Avenue route and the East 152nd Parkway Hybrid route. All these described routes incorporate ten or more directly accessed residential parcels. The Washington street and the East 152nd Parkway routes present the lowest number of directly accessed residential parcels, four and three respectively. When the associated total route miles are considered, the order of precedence swaps. The East 152nd Parkway route provides for 1.04 directly accessed residential parcels per city mile while the Washington Street route provides for 1.03 directly accessed residential parcels per city mile.

The East 152nd Parkway route indirectly serves the development of North Creek Farms. The potential for portions of this route to be used for transportation associated with this residential development is not incorporated into the Residential Parcels per City Mile variable. The location of and access to the North Creek Farms development complicates the interpretation of this metric. Closer examination reveals that the East 152nd Parkway access near the E470 Tollway is the northern most of two major points of access available to North Creek Farms residents. The southern point of access is located along East 144th Avenue. It is hard to determine to what amount any potential use by residents in this development may have to the base transportation capacity on East 152nd Parkway. Based on distance traveled to potential nearby destinations, it is more advantageous for almost every North Farms resident to utilize the south development entrance to access most nearby amenities. It appears probable that North Creek Farms residents utilizing the East 152nd Parkway access are traveling north. Meaning that any increased level of base capacity on East 152nd Parkway will only share the thoroughfare with Development related

traffic for roughly 1000 feet. Additionally, a traffic merge lane exists for vehicles turning north onto East 152nd Parkway at this location.

It is reasonable to assume that a low ratio of residential parcels to city miles indicates a low portion of a route's base capacity is attributable to personal residential traffic. Effectively minimizing the variable of highest concern to the greatest discernable degree for any transportation route analyzed. Overall, a low ratio of residential parcels directly accessed by an examined route when compared to city miles provides reassurances that lane capacity exists to handle Development related traffic. For those individuals residing at the residential parcels directly accessed by any of the discussed transportation routes concerns may still exist. Extraction has many resources available to further mitigate transportation related impacts. These resources range from transportation guidelines and allowable operational windows to the pursuit of responsive personal relationships with residents of critical concern. A low ratio of private residences to city miles traveled allows for attainable levels of responsiveness and engagement to ensure that external operational impacts are mitigated to the greatest degree practicable.

5.1.5 Proposed Route Determination

Five transportation route related characteristics were analyzed in this review including distance traveled, the quantity of intersections navigated for each route, left and right turn quantity, and the residential parcel quantity associated with each route. Based on these characteristics, four transportation route related variables were calculated. These include the average lane capacity per intersection, through-lanes per city mile, transportation route miles with two or more through-lanes, and residential parcels per city mile. An analysis of these characteristics and calculated variables indicates the East 152nd Parkway route to be the most advantageous of any distinct transportation route reviewed.

The East 152nd Parkway navigates the lowest quantity of municipal street miles. This route also prioritizes both the quantity of intersections navigated and total turns. Only intersections that are directly pertinent to the transportation route are navigated. Traffic following the East 152nd Parkway transportation route utilizes the Washington Street and East 152nd Parkway intersection for each direction of travel. Turns at this intersection utilize a designated turn lane for each direction of travel. Additionally, inbound traffic benefits from a traffic merge lane after navigating the turn onto northbound Washington Street. While this route possesses the lowest ratio of through-lanes to city mile, the potential for traffic conflicts over the course of single lane traffic are low. No additional intersections are navigated during travel over roadways with only one available lane in the direction of travel. The East 152nd Parkway transportation route also presents the fewest quantity of directly served Residential Parcels of any potential transportation route. Finally, the residential parcels accessed per city mile is one tenth of one parcel per mile lower than that of the Washington Street Transportation routes best calculated ratio.

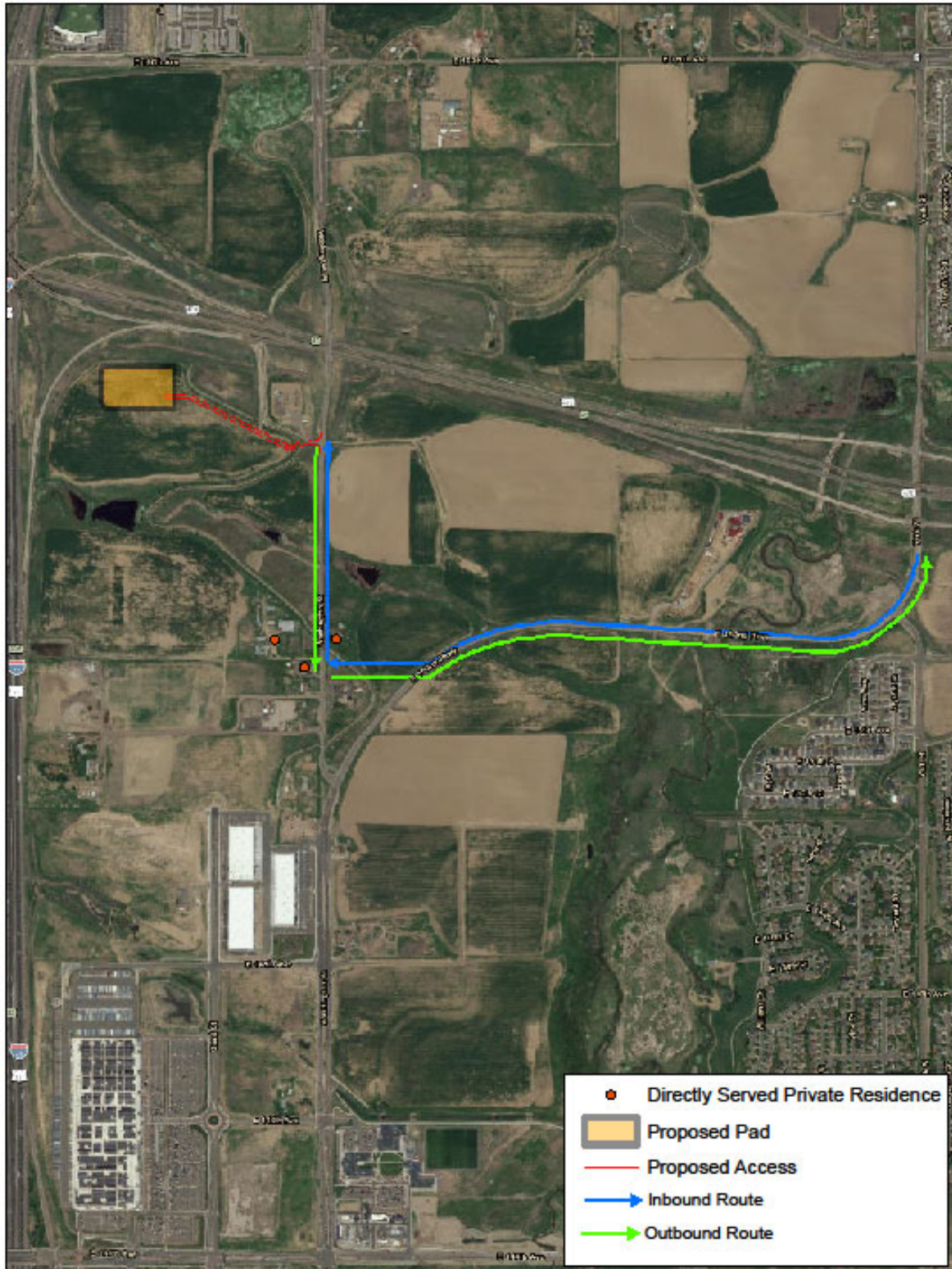
Of all possible transportation routes available for Development traffic, the East 152nd Parkway route prioritizes the most beneficial combination of route characteristics and calculated variables. This route considers existing regional traffic patterns and makes acceptable accommodations for existing private residences and related traffic. The use of the East 152nd Parkway transportation route, in combination with Extraction's documented operational windows and community outreach ensures that Development related traffic impacts are mitigated to the greatest extent possible.

6.0 REFERENCES CITED

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5. U.S. DEPARTMENT OF TRANSPORTATION. FEDERAL HIGHWAY ADMINISTRATION. (2021, AUGUST 22). TRAFFIC ANALYSIS TOOLBOX VOLUME VI: DEFINITION, INTERPRATION, AND CALCULATION OF TRAFFIC ANALYSIS TOOLS MEASURES OF EFFECTIVENESS. § 4.1.1 HCS.

7.0 EXHIBITS

7.1 Exhibit A: East 152nd Parkway Transportation Route (Proposed)



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7.2 Exhibit B: Washington Street Transportation Route

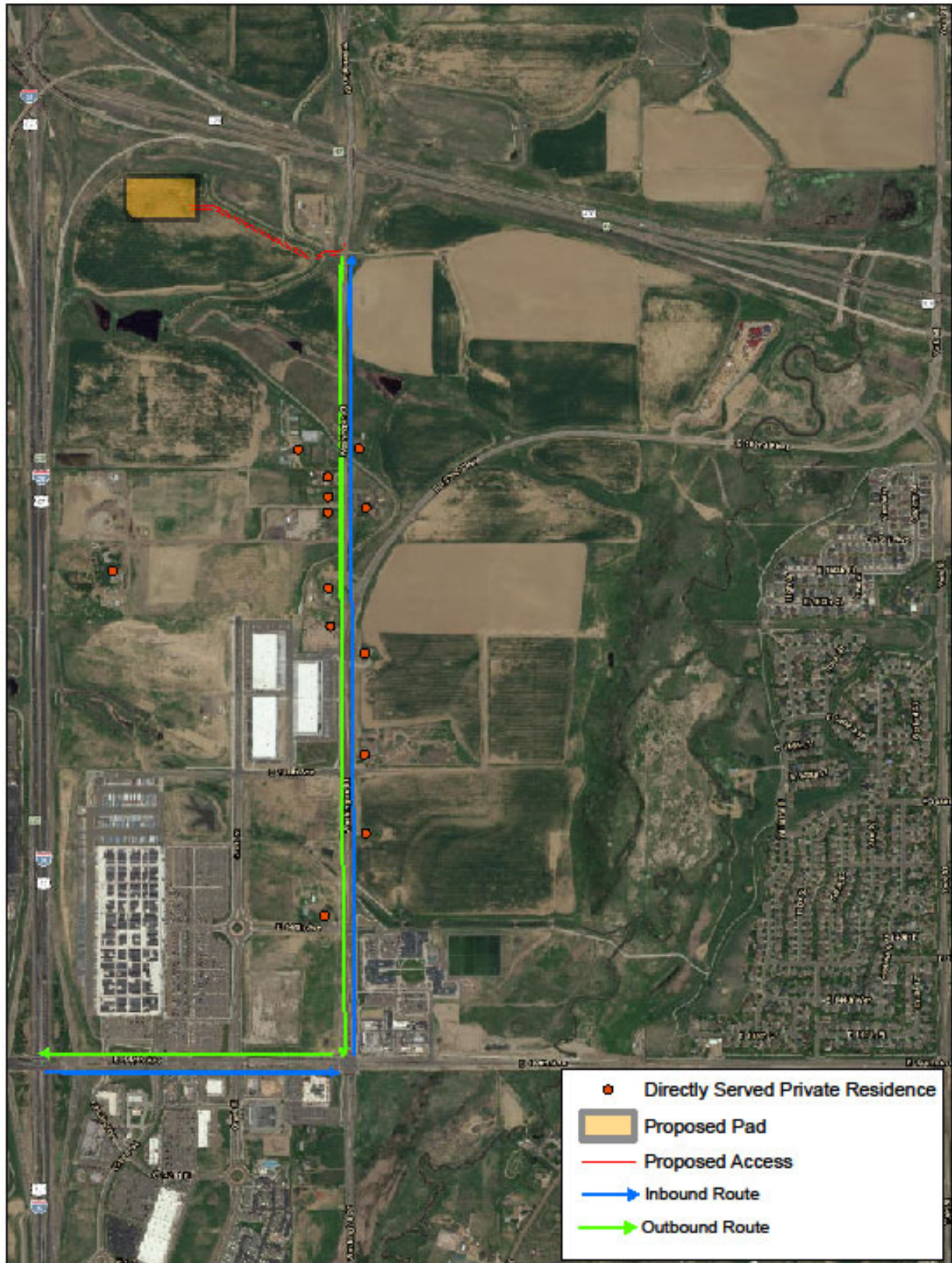


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7.3 Exhibit C: East Baseline Road Transportation Route



7.4 Exhibit D: East 144th Avenue Transportation Route



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7.5 Exhibit E: Washington Street Hybrid Transportation Route



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7.6 Exhibit F: East 152nd Parkway Hybrid Transportation Route

