Sensitivity Analysis of Proposed Three-Lane Cross Section

Gambell Street Redevelopment and Implementation Plan

Date:	April 23rd, 2014	Project #:13489
To:	Paul Fuhs; Christopher Constant; Craig Lyon; Patrick Flynn; AMATS Technical Committee; AMATS Policy Committee	
From:	Kelly Laustsen; Lillian Tsang, PE; Bob Kniefel, PE; and Marc Butorac, PE, PTOE; Kittelson & Associates, Inc.	

This memorandum responds to the recent comments and questions raised by the Anchorage Metropolitan Area Transportation Solutions (AMATS) Advisory Committee related to the 4- to 3-lane conversion concept developed for Gambell Street between 3rd and 15th Avenue. Specifically, this memorandum responds to comments from AMATS requesting additional sensitivity analysis of future traffic volumes and operations on Gambell Street with a 3-lane cross section.

BACKGROUND

The AMATS adopted 2035 Metropolitan Transportation Plan (MTP) includes Project #576 Fairview Pedestrian Safety Study. The *Gambell Street Redevelopment and Implementation Plan* was developed to perform this analysis and to identify and evaluate improvements for Gambell Street that would improve the corridor's safety, efficiency, appearance, and pedestrian business friendliness. The Plan was formed based on extensive public involvement through the summer of 2013 and input from a Project Management Team (PMT) including representation from Alaska Department of Transportation & Public Facilities (DOT&PF), Municipality of Anchorage (MOA), and Municipal Light and Power. The plan was ultimately adopted by the Fairview Business Association, Fairview Community Council, and the MOA Assembly. In addition, the Fairview Community Council Neighborhood Plan, which includes the Gambell Street project, is currently up for review before the Planning and Zoning Commission. A key component of the redevelopment and implementation plan Street plan is the conversion of Gambell Street from 4 to 3 lanes between 3rd and 15th Avenue in order to improve pedestrian safety and the streetscape of the roadway.

The Plan includes an assessment of existing operations on Gambell Street, as well as projected 2035 operations with a 3-lane cross section. The 2035 traffic volumes were developed based on historical

growth and the 2035 MTP projections in the "no build" model, which assumes no changes to the transportation network. The analysis showed that all intersections operate acceptably with the exception of Gambell Street/15th Avenue, which can be mitigated with the addition of a southbound left-turn lane. Additional analysis was conducted to assess the impact of the conversion on vehicular capacity, which is recorded in the memo *Gambell Street Redevelopment Plan: Preferred Alternative and Analysis* (provided in *Appendix A*). This memorandum discusses the impact of the conversion on intersection operations, roadway speeds, lane usage, roadway consistency, and access management. It concludes that Gambell Street can operate effectively with a three-lane cross section under both existing and future (2035) conditions without the Seward Highway/Glenn Highway connection, provided that an exclusive left-turn lane is provided at 15th Avenue.

Agency Comments and Response

The DOT&PF) and MOA reviewed the plan and preferred alternative and analysis memorandum. Kenneth Morton from the DOT&PF provided comments in a letter dated July 9th, 2013, and Stephanie Mormilo from the MOA provided comments in an email dated June 28th, 2013. An Agency Response Letter was provided on September 19th, 2013 addressing the DOT&PF and MOA comments (provided in *Appendix B).* Following this, AMATS requested that additional modeling and operational assessment be performed to further analyze the operational impact and sensitivity of the 4- to 3-lane conversion. This memorandum documents the additional analysis, including a sensitivity assessment of operations on Gambell Street as both a 4-lane and 3-lane cross-section in year 2025 and 2035. As part of the sensitivity assessment, turning movement volumes at intersections along Gambell Street were developed from the model used in the 2035 MTP, providing a more refined and detailed analysis.

MODEL DEVELOPMENT AND FUTURE VOLUMES

The AMATS Policy Committee approved the 2035 MTP in May, 2012 (Reference 1). The plan guides almost $4 billion in transportation network improvements through 2035 for the Anchorage metropolitan area. The MTP considers the visions of community plans and unique subareas within the metropolitan area to provide one integrated, long-range transportation plan. As part of the MTP, AMATS developed a model forecasting traffic volumes in 2035 under a build scenario (includes planned projects in MTP) and no build (does not include any improvements or infrastructure changes). The model illustrates that with the Seward Highway-Glenn Highway connection in place, operations on Gambell Street improve significantly over the no build scenario. However, because this project has been delayed, AMATS requested an analysis of operations on Gambell Street without the Seward Highway-Glenn Highway connection. Therefore, the *Gambell Street Redevelopment and Implementation Plan* included an analysis of 2035 operations on Gambell Street using traffic volumes developed based on the growth projected in the 2035 MTP No Build model. The analysis described in this memorandum provides a more detailed operational assessment, using turning movement volumes derived from the MTP model. The next sections further describe the process used to develop the data used in this assessment.

Analysis Scenarios

For this sensitivity analysis, more detailed model work was conducted to develop model link and turning movement volumes on Gambell Street for a number of scenarios. Per AMATS's request, and to provide a conservative assessment, the Seward Highway-Glenn Highway connection was *not* assumed to be in place and the MTP 2035 No Build network served as the basis for the volume development. Volumes were developed for the following scenarios:

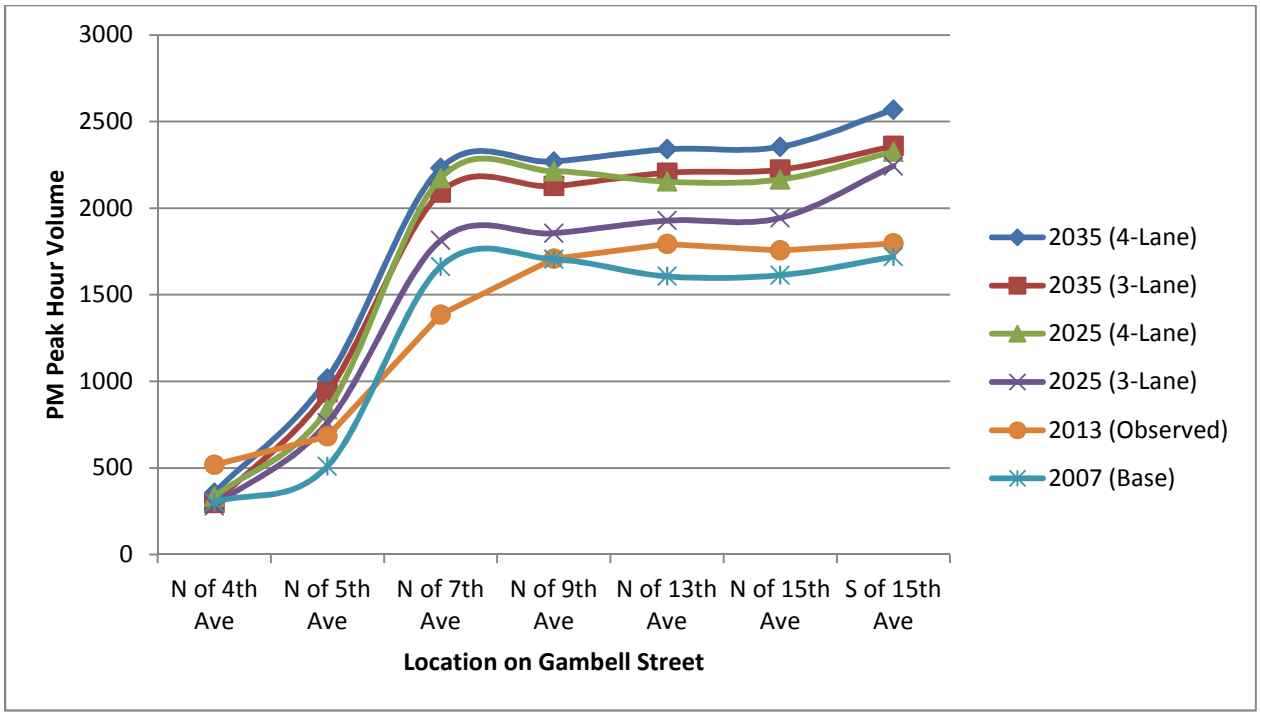
- Year 2025 with Gambell Street as a four-lane cross section;
- Year 2025 with Gambell Street as a three-lane cross section;
- Year 2035 with Gambell Street as a four-lane cross section; and
- Year 2035 with Gambell Street as a three-lane cross section.

The model network was obtained from the AMATS transportation staff and was modified to produce the three-lane scenario and the trip table assignments were modified to produce the 2025 scenarios. Model outputs are provided in *Appendix C.*

Roadway Volumes

The roadway link volumes produced by the model for the four analysis scenarios were assessed to evaluate projected future growth on Gambell Street. The graph in Exhibit 1 compares volumes on the corridor at key locations under the four model scenarios and based on observed counts from 2013

Exhibit 1: Existing and Projected Roadway Volumes on Gambell Street



As seen in Exhibit 1, volumes are not projected to increase significantly on Gambell Street over the next twenty years. Volumes are slightly lower for the three-lane scenarios than the four-lane scenarios. Overall, future PM peak hour volumes are projected to drop approximately 10% with the conversion to a three-lane cross-section in 2025 and about 6% in 2035. As evidenced in the model outputs provided in *Appendix C,* some vehicles re-route to other parallel roadways in the three-lane scenario, particularly to Cordova Street and C Street and nearly half rejoin the corridor at 15th Avenue. This suggests that these roadways have unutilized capacity which vehicles would take advantage of with the Gambell Street project.

Table 1 further examines the projected growth in traffic volumes on Gambell Street.

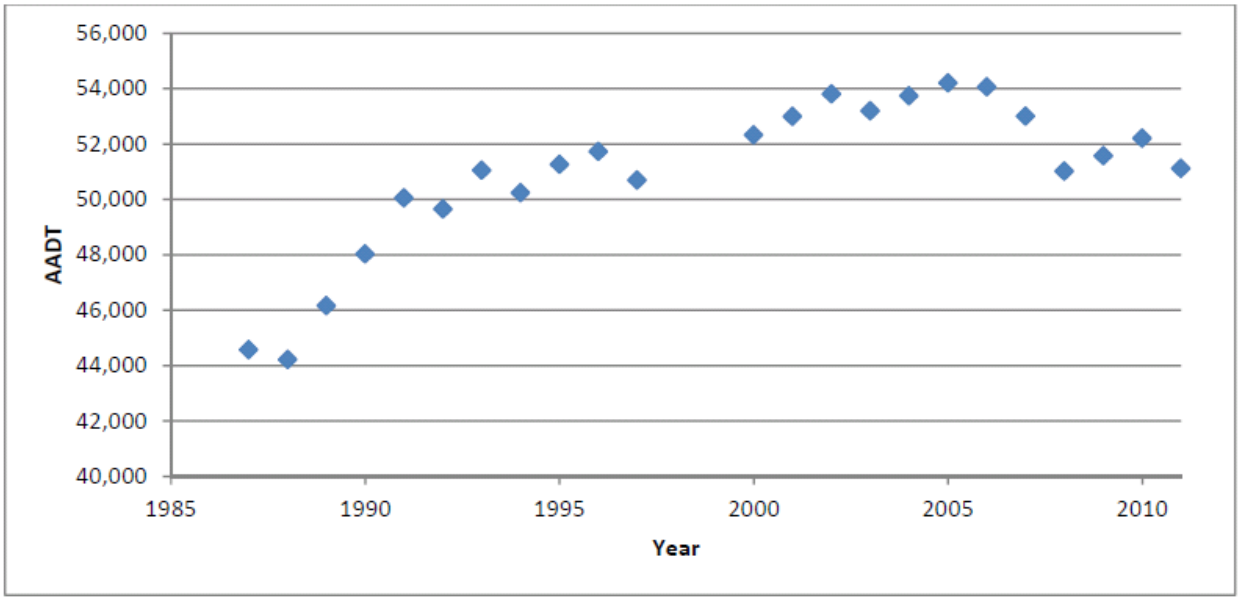
Table 1: Average Volumes on Gambell Street

Scenario	Average Volume[1]	Annual Growth (from 2007 Base)
2007 (Base)	1398	0%
2013 (Observed) [2]	1453	0.65%
2025 (3-Lane)	1674	1.01%
2025 (4-Lane)	1901	1.72%
2035 (3-Lane)	1910	1.12%
2035 (4-Lane)	2040	1.36%

[1]Average of southbound volume on Gambell Street at key study intersections
[2]Based on turning movement volumes collected along the Gambell Street corridor in 2013

As indicated in the table, volumes are projected to grow roughly 1% a year. This is higher than historical growth on Gambell Street, which suggests the model likely overestimates future growth. The permanent traffic recorder located at Ingra Street and Gambell Street near Chester Creek collects bi-directional daily traffic volumes. AADT information from 1987 through 2011 is shown in Exhibit 2.

Exhibit 2: Historical AADT data at Gambell St/Ingra St/15th (Reference 2)



As seen in the graph, overall traffic volumes on the corridor generally increased up until 2006, before dropping off through 2008. Traffic volumes again grew from 2008 through 2010 before dipping in 2011. On average, traffic volumes grew about 0.6% annually between 1987 and 2011.

Turning Movement Volumes

The software program *Turns* was used to developing turning movement volumes for study intersections on Gambell Street. Turns implements the NCHRP 255 methodology, which is a standard procedure for developing future turning movement volumes based on existing counts and base and future model volumes. This methodology compares the actual traffic counts and model outputs and uses the difference to adjust future traffic projections. Therefore, at locations where actual traffic counts exceed base model counts, the program will adjust up future counts. For example, at 15th Avenue, existing counts are significantly higher than the base model predicted. As a result, *Turns* projects higher volumes in the future than indicated in the model, producing a conservative analysis which may over estimate future volumes.

Existing traffic counts on the corridor (at 4th, 6th, and 9th), as well as turning movement counts conducted on a typical mid-week day in early May 2013 were used for the post-processing. Counts were conducted during the weekday PM peak hour for all study intersections. Copies of all counts are provided in *Appendix D.*

Analysis Scope and Methodology

As previously completed in the *Gambell Street Redevelopment and Implementation Plan* analysis, intersection operations were assessed at the ten four-legged intersections on the corridor, as well as at

3rd Avenue and 15th Avenue. The following intersections on the Gambell Street corridor are currently signalized and were assumed to be signalized in the 2025 and 2035 analysis:

- 4th Avenue
- 5th Avenue
- 6th Avenue
- 9th Avenue
- 13th Avenue
- 15th Avenue

No modifications were made to existing lane configurations and traffic control devices. Signal timing was optimized with the assumption that signals on the corridor will be retimed in the next ten to twenty years. Figure 1 shows the existing lane configurations and traffic control devices at the study intersections and Figure 2 shows the proposed lane configuration and traffic control devices with a three-lane cross section on Gambell Street. As seen in the figure, an exclusive-left turn lane is recommended at Gambell Street/15th Avenue.

Synchro 7 was used for the operations analysis at all signalized and stop-controlled intersections, which applies the *Highway Capacity Manual 2000* (Reference 3).

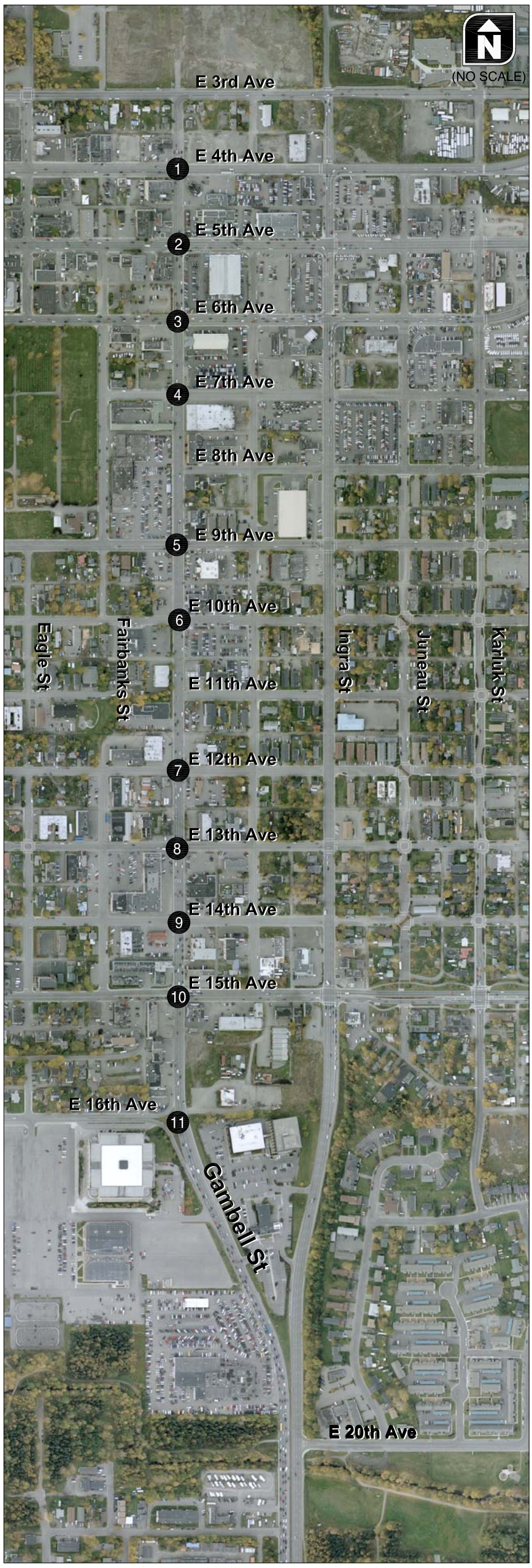
FUTURE TRAFFIC CONDTIONS

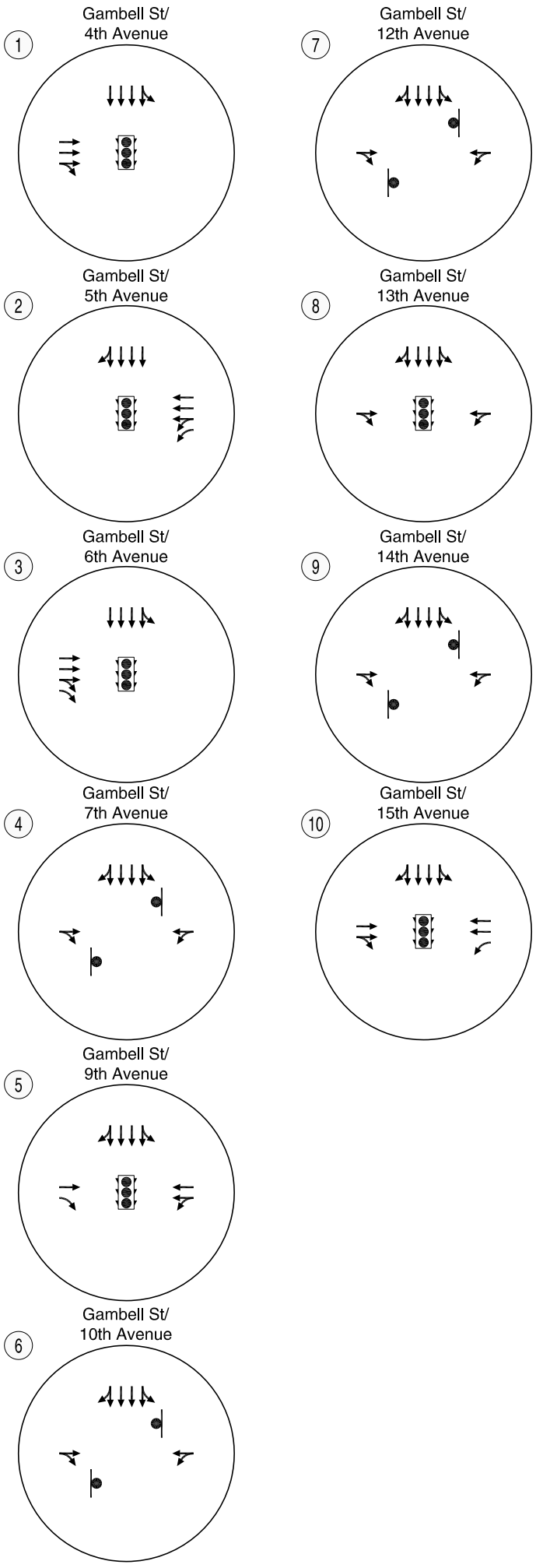
Intersection operations during the weekday PM peak hour were assessed at the study intersections for the four scenarios outlined above. The findings are discussed below. Analysis output sheets for all scenarios are provided in *Appendix E.*

Year 2025 Intersection Operations

Figure 3 summarizes intersection operations for the year 2025 with the existing four-lane cross-section on Gambell Street. As seen in the figure, all intersections are operating at LOS C or better, with the exception of the intersections of Gambell Street/12th Avenue and Gambell Street/15th Avenue. Gambell Street/12th Avenue is a stop-controlled intersection with single-lane approaches on 12th Avenue. While the southbound through movement on Gambell Street operates at a LOS A, both the eastbound and westbound approaches are operating at a LOS F due to long delays for through traffic. All approaches of the intersection are far under capacity and total volumes on the eastbound and westbound approaches is less than forty vehicles during the PM peak hour. Alternative routes exist for eastbound and westbound vehicles to cross Gambell Street at a traffic signal in the vicinity. Given that the intersection is under-capacity, the volume of vehicles experiencing delays to cross Gambell Street is low, and the presence of alternative routes, no mitigations are recommended at this intersection. If desired, restrictions on eastbound and westbound through movements could be considered during the peak hour to encourage vehicles to take alternative routes.

Gambell Street/15th Avenue is operating at a LOS F and over-capacity, largely due to high volumes projected on 15th Avenue in the future. If volumes grow on 15th Avenue as projected, additional capacity will likely be required on 15th Avenue. Exclusive turn-lanes on Gambell Street would also allow





Legend

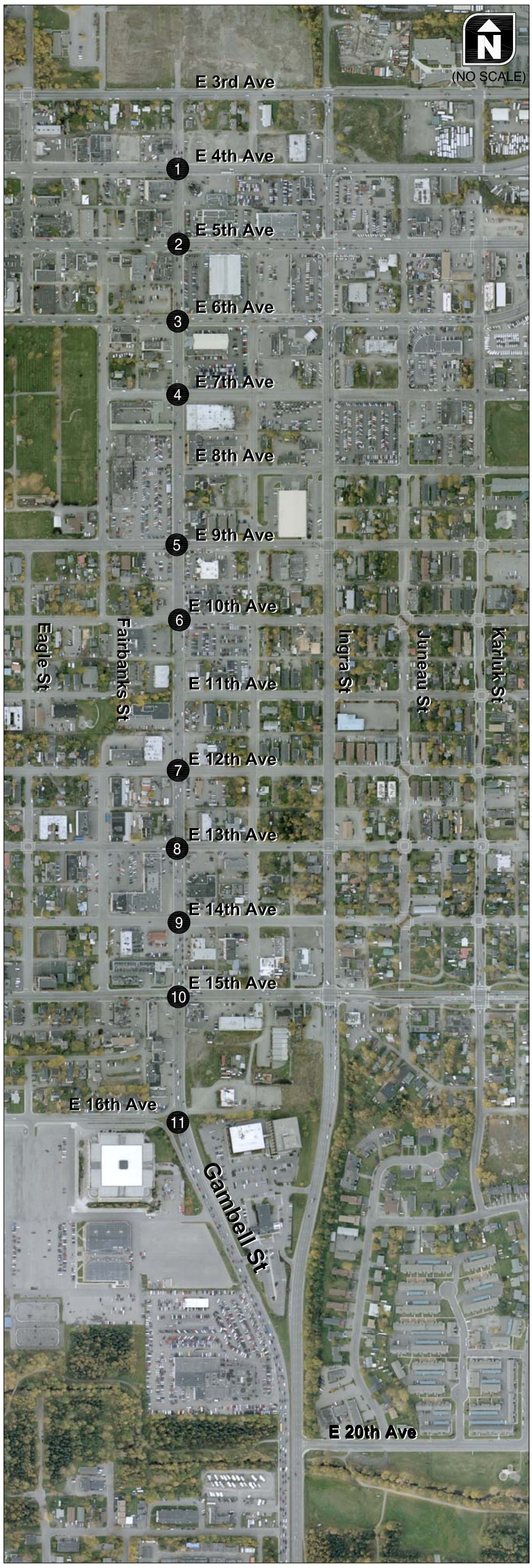
- STOP SIGN
- TRAFFIC SIGNAL
- YIELD CONTROL

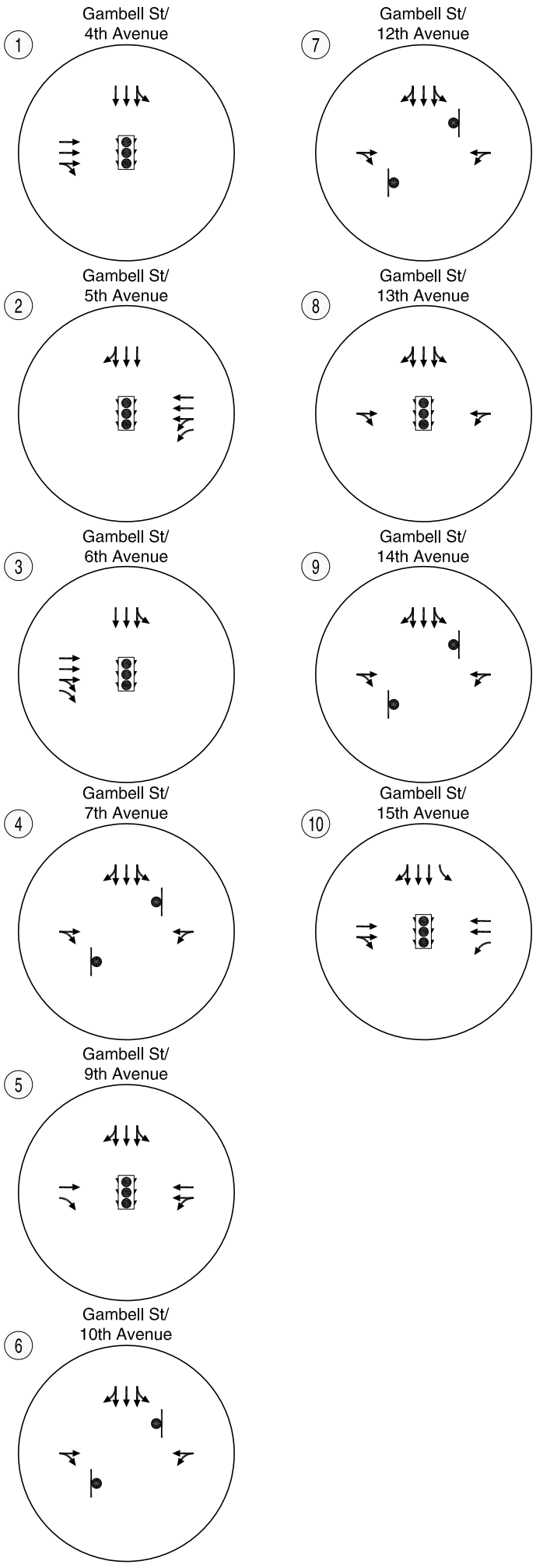
Existing Lane Configurations and Traffic Control Devices (4 Lane Cross Section)

Source: Field Review and Google Earth

gambellstreet REDEVELOPMENT

Figure 1





Legend

- STOP SIGN
- TRAFFIC SIGNAL
- YIELD CONTROL

Proposed Lane Configurations and Traffic Control Devices (3 Lane Cross Section)

Source: Field Review and Google Earth

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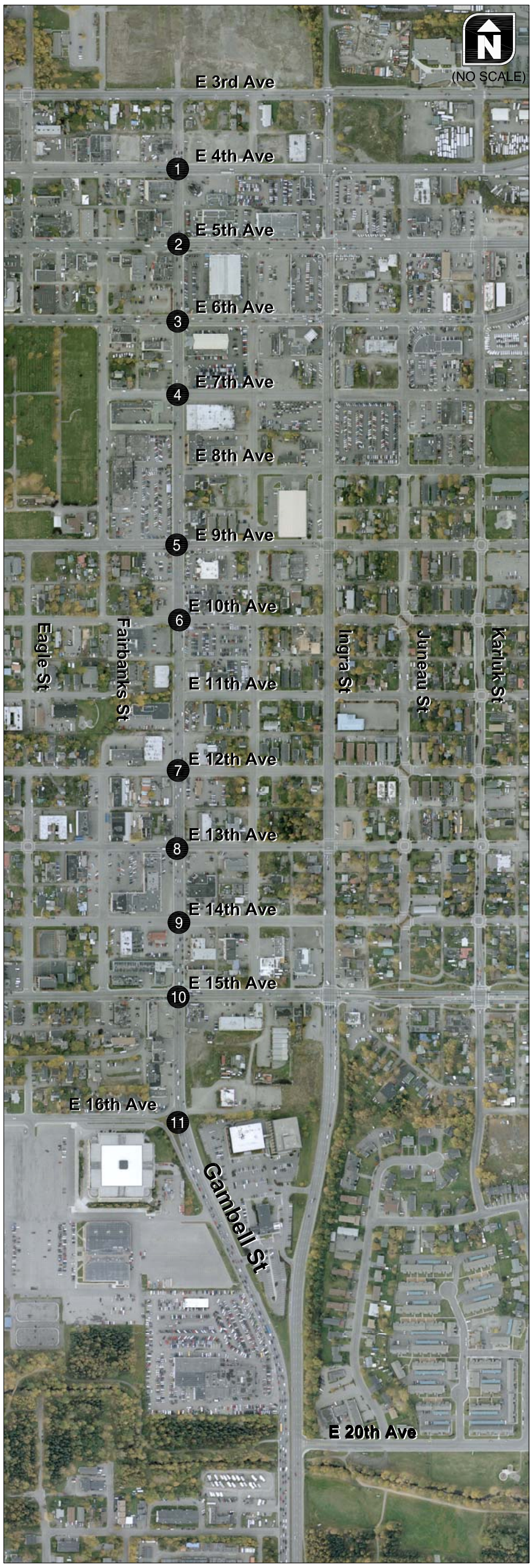
Figure 2



Gambell St/ 4th Avenue (1)
490 5
890 515
LOS=B
Del=10.4
V/C=0.56

Gambell St/ 5th Avenue (2)
90 905
LOS=B
Del=17.4
V/C=0.79
1410 1005

Gambell St/ 6th Avenue (3)
1590 375
1550 285
LOS=C
Del=27.9
V/C=0.88

Gambell St/ 7th Avenue (4)
5 1820 10
<5 10
CM=WB
LOS=B
Del=12.3
V/C=0.07
10 25

Gambell St/ 9th Avenue (5)
60 1940 15
125 200
LOS=B
Del=17.8
V/C=0.62
140 80

Gambell St/ 10th Avenue (6)
5 2165 15
10 25
CM=WB
LOS=C
Del=23.4
V/C=0.18
10 30

Gambell St/ 12th Avenue (7)
10 2245 10
5 5
CM=WB
LOS=F
Del=>50
V/C=0.26
10 10

Gambell St/ 13th Avenue (8)
50 2215 25
85 70
LOS=B
Del=12.2
V/C=0.70
60 15

Gambell St/ 14th Avenue (9)
25 2255 20
10 30
CM=WB
LOS=C
Del=15.4
V/C=0.10
10 25

Gambell St/ 15th Avenue (10)
110 1835 295
895 180
LOS=F
Del=>80
V/C=>1.0
830 265

Legend

CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Year 2025 Traffic Operations Weekday PM Peak Hour (4 Lane Cross Section)

Source: Municipality of Anchorage and Traffic Counts Collected May 2013

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Figure 3

more signal timing to be devoted to 15th Avenue. As noted above, the turning movement volumes used in this analysis may over-estimate future volumes at this specific intersection due to the post-processing methodology used and the fact that actual traffic counts collected exceeded model projections for the base analysis. Therefore, it is recommended that traffic volumes on 15th Avenue be monitored in the future to assess growth and identify potential improvements.

Figure 4 summarizes intersection operations for the year 2025 with the proposed three-lane cross-section on Gambell Street. As seen in the figure, intersection operations do not change significantly with the three-lane cross section. Operations at some intersections, such as 10th Avenue and 12th Avenue, improve slightly with the conversion due to the lower projected through volumes on Gambell Street with the three-lane cross-section. As discussed above, this is due to some vehicles re-routing to other parallel roadways in the three-lane scenario. As with the existing cross-section, the intersections of Gambell Street/12th Avenue and Gambell Street/15th Avenue operate at a LOS F. Again, the southbound through movement on Gambell Street operates at LOS A at 12th Avenue and the failures at 15th Avenue are largely caused by high volumes projected on 15th Street. Therefore, this issue is independent of the proposed three-lane cross-section on Gambell Street. In addition, the exclusive southbound left-turn lane proposed at Gambell Street/15th Avenue with the three-lane section improves operations for left-turning vehicles.

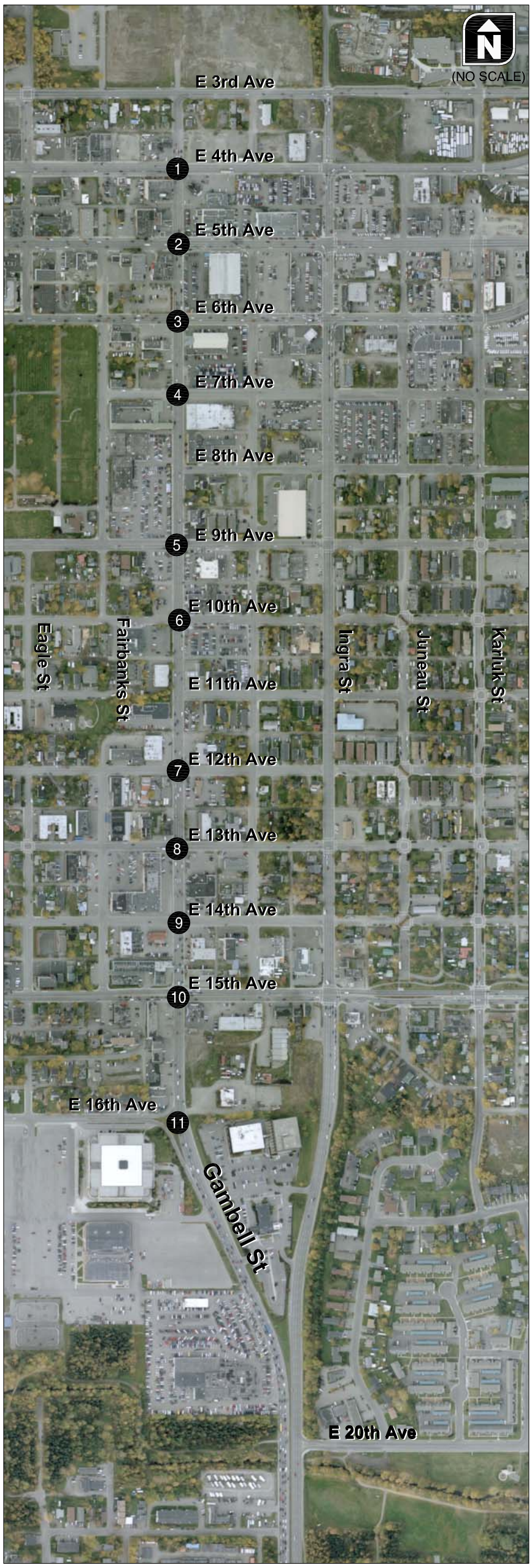
Year 2035 Intersection Operations

Figure 5 summarizes intersection operations for the year 2035 with the existing four-lane cross-section on Gambell Street and Figure 6 summarizes operations with the proposed three-lane cross-section. As seen in the figures, as in 2025, operations at most intersections do not change significantly with the three-lane cross-section. As with the year 2025 analysis, operations at some intersections improve with the conversion to three-lanes due to lower projected through volumes on Gambell Street with the three-lane cross-section. Again, this is due to some vehicles re-routing to other parallel roadways to take advantage of available system capacity.

The same issues at the 12th Avenue and 15th Avenue intersections observed in the year 2025 results remain in 2035. In addition, the intersection of Gambell Street/6th Avenue operates at LOS D but over capacity in 2035 with the three-lane cross-section. Given that this deficiency is not projected in the 2025 analysis, it is recommended that the intersection of Gambell Street/6th Avenue be monitored and that the sidewalks stay in their current location in the 5th and 6th Avenue block to provide the opportunity to introduce an exclusive left-turn lane prior to the construction of the Seward Highway-Glenn Highway Connection project.

CONCLUSIONS

As shown in the sensitivity analysis provided herein as well as the previous analyses, the Gambell Street Corridor operates effectively under the three-lane scenario both under year 2025 and 2035 No-Build conditions. Traffic is metered into the corridor by the existing three-lane westbound section from Glenn Highway (East 5th Street) which only provides dual left-turns onto Gambell Street, and the three-



1 Gambell St/ 4th Avenue
470 5
890 → LOS=B ← 10
470 ↓ Del=10.2 ↓ 10
V/C=0.57

2 Gambell St/ 5th Avenue
95 820
LOS=B
Del=19.0 ← 1595
V/C=0.81 ↓ 775

3 Gambell St/ 6th Avenue
1235 400
1550 → LOS=C
285 ↓ Del=30.5
V/C=0.90

4 Gambell St/ 7th Avenue
5 1480 10
CM=WB
<5 → LOS=B ← 10
10 ↓ Del=12.2 ↓ 25
V/C=0.06

5 Gambell St/ 9th Avenue
50 1680 15
LOS=C
125 → Del=20.1 ← 135
220 ↓ V/C=0.74 ↓ 100

6 Gambell St/ 10th Avenue
5 1950 15
CM=WB
10 → LOS=C ← 10
25 ↓ Del=17.0 ↓ 30
V/C=0.13

7 Gambell St/ 12th Avenue
10 2025 10
CM=WB
5 → LOS=E ← 10
5 ↓ Del=39.4 ↓ 10
V/C=0.15

8 Gambell St/ 13th Avenue
50 1990 25
LOS=B
85 → Del=13.6 ← 60
70 ↓ V/C=0.76 ↓ 20

9 Gambell St/ 14th Avenue
25 2030 20
CM=WB
10 → LOS=C ← 10
30 ↓ Del=16.6 ↓ 25
V/C=0.11

10 Gambell St/ 15th Avenue
100 1665 260
LOS=F
915 → Del=>80 ← 835
260 ↓ V/C=>1.0 ↓ 270

Legend

CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Year 2025 Traffic Operations Weekday PM Peak Hour (3 Lane Cross Section)

Source: Municipality of Anchorage and Traffic Counts Collected May 2013

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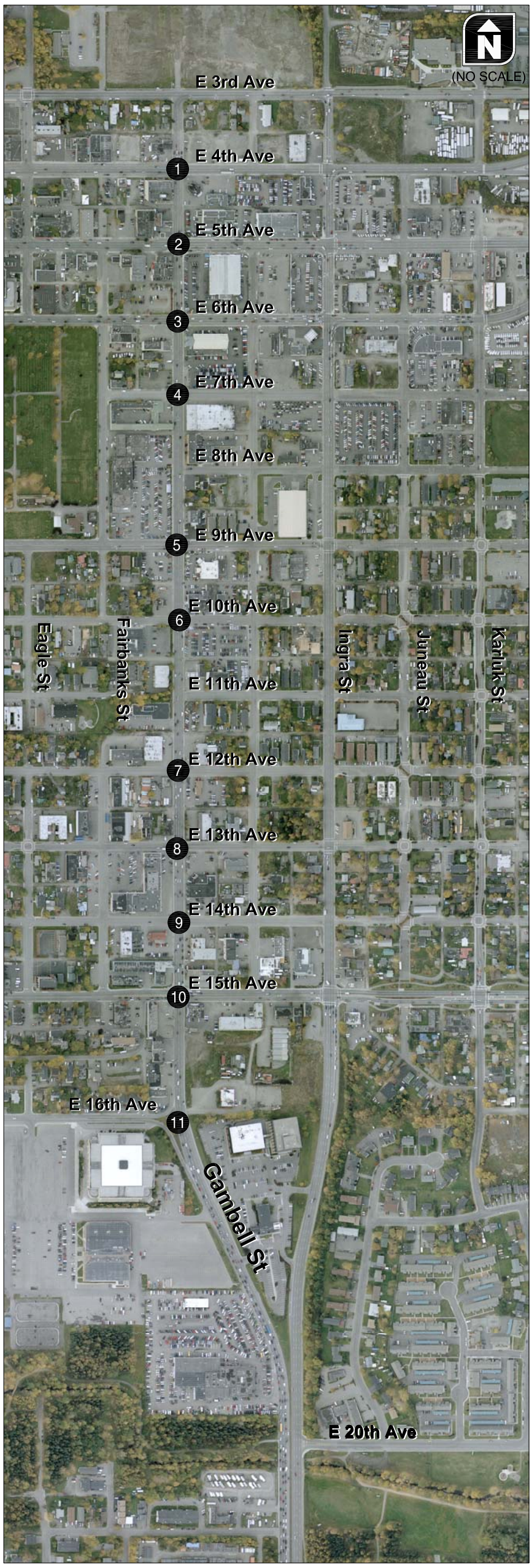
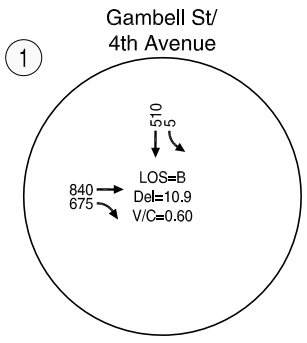
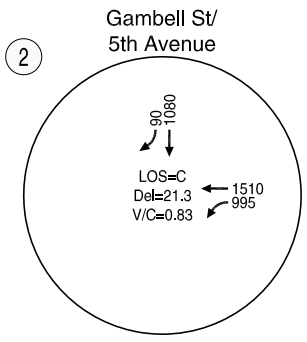
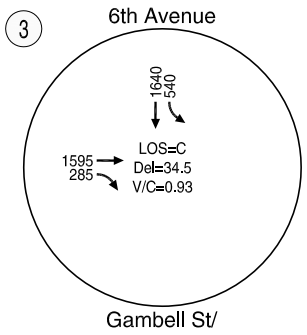
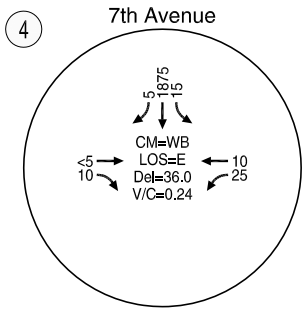
Figure 4

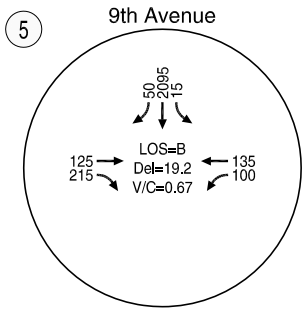


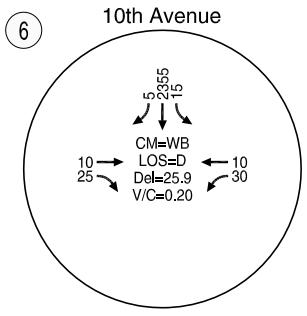


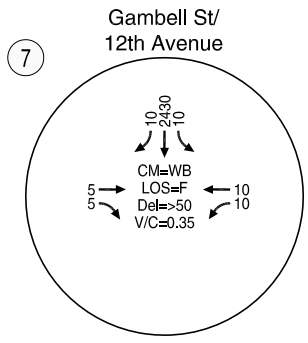


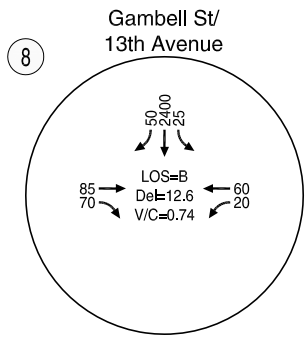


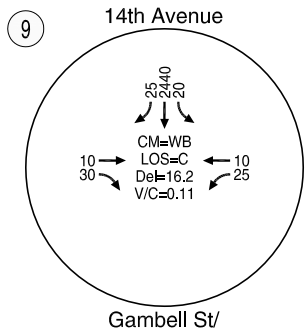


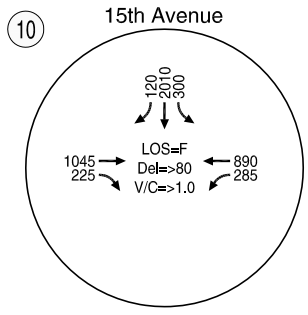












Legend

CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Year 2035 Traffic Operations Weekday PM Peak Hour (4 Lane Cross Section)

Source: Municipality of Anchorage and Traffic Counts Collected May 2013

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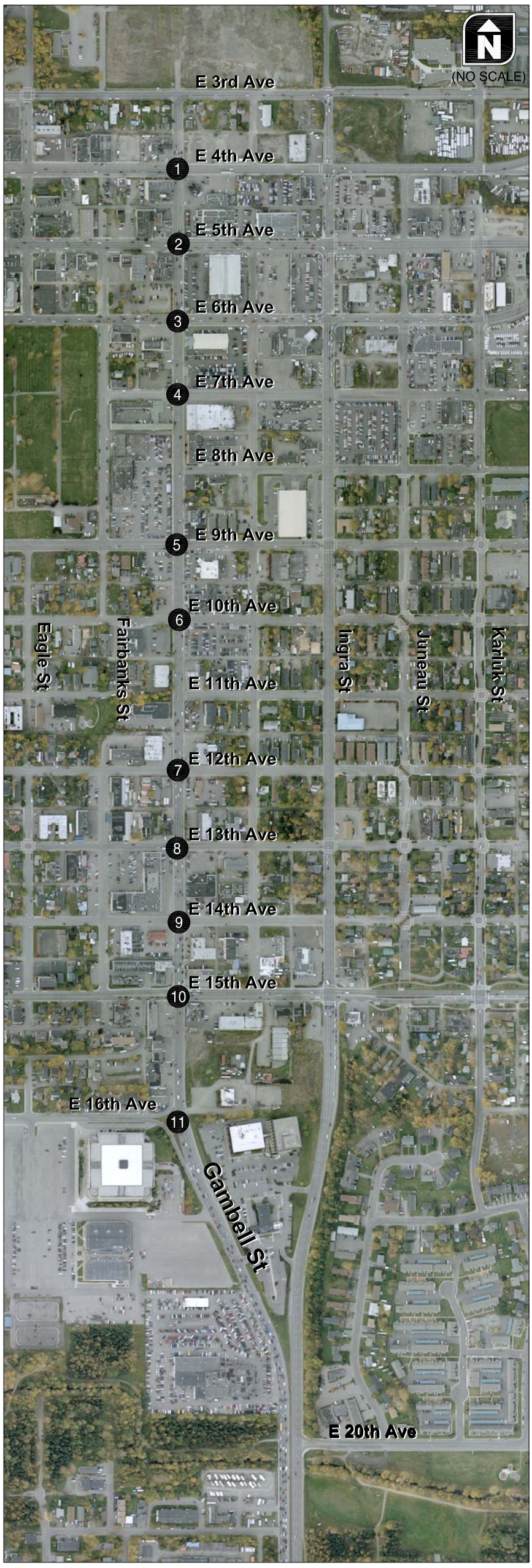
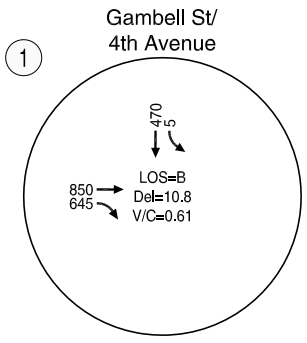
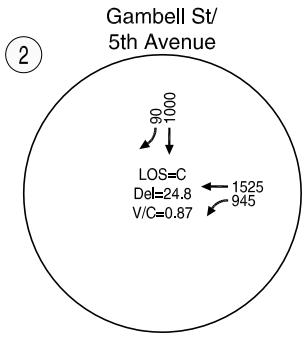
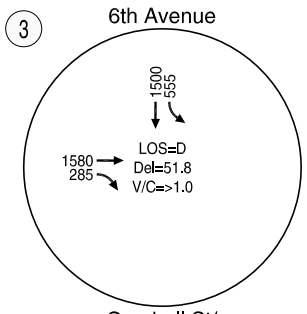
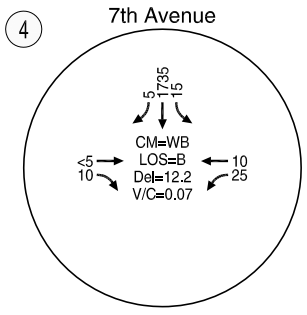
Figure 5

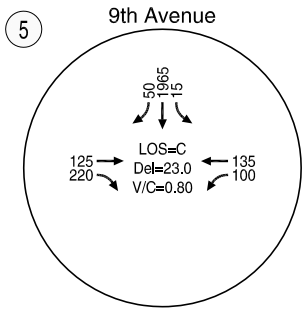


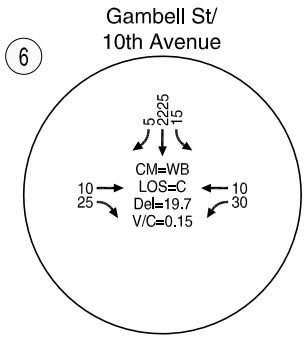


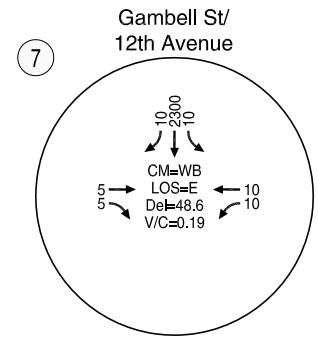


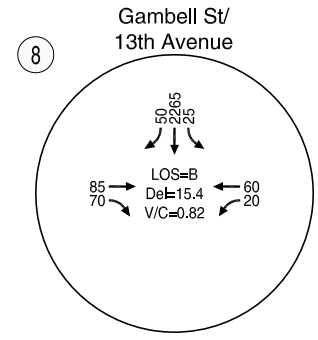


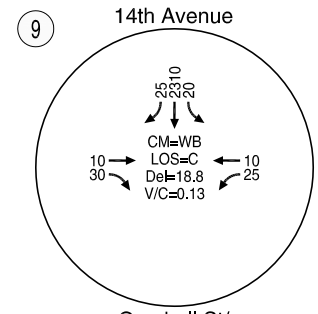


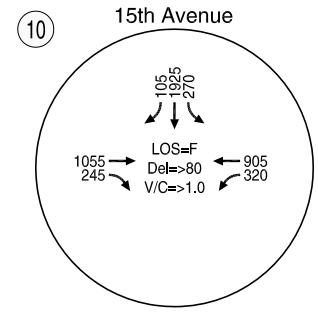












Legend

CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Year 2035 Traffic Operations Weekday PM Peak Hour (3 Lane Cross Section)

Source: Municipality of Anchorage and Traffic Counts Collected May 2013

gambellstreet REDEVELOPMENT

Figure 6

lane eastbound section on East 6th Avenue from downtown, which provides a single right-turn lane and a shared through/right turn lane onto Gambell Street. Until the Glenn Highway capacity is increased via the Seward Highway-Glenn Highway Connection Project, the Gambell Street corridor will continue to function adequately. With the Seward Highway-Glenn Highway Connection Project in-place, the volumes on Gambell Street will reduce significantly as the facility will no longer serve as the connection between the two highways. As a result, there isn't a scenario based on the current AMATS MTP that would result in demand exceeding the capacity of a three-lane Gambell Street cross-section.

The other issue to consider is the proposed Knik Arm Crossing which, under later development stages, connects directly to the north ends of Gambell Street and Ingra Street. As noted in the environmental document for that project, this connection would not be constructed until the Seward Highway-Glenn Highway Connection Project facility is in place. At that time, the traffic volumes on Gambell/Ingra would decrease significantly as they become local traffic oriented streets with the through traffic handled by the Seward Highway-Glenn Highway Connection Project facility.

While the four- and three-lane scenarios operate similarly, there are a few intersections that experience capacity related issues that should be recognized:

- *6th Avenue/Gambell Street* - Given the potential long-term need for an exclusive southbound left-turn lane at the intersection in 2035, it is recommended that this intersection be monitored and that the sidewalks stay in their current position between 5th and 6th Avenues to provide the opportunity for an exclusive left-turn lane to be developed through restriping in the future prior to the construction of the Seward Highway-Glenn Highway Connection project.
- *12th Avenue/Gambell Street* – Eastbound and Westbound through vehicles may experience relatively long delays in the future (with Gambell as a four-lane or three-lane roadway). Given that the intersection is under-capacity, the volume of vehicles experiencing delays to cross Gambell Street is low, and the presence of alternative routes, no mitigations are recommended at this intersection. If desired, restrictions on eastbound and westbound through movements could be considered during the peak hour to encourage vehicles to take alternative routes.
- *15th Avenue/Gambell Street* - Based on projected increases in volumes on 15th Avenue, future improvements may be necessary on 15th Avenue to improve operations at the Gambell Street/15th Avenue intersection under both the four- and three-lane scenarios in 2035 without the Seward Highway-Glenn Highway Connection project. Given the uncertainty associated with future improvements and growth on 15th Avenue, it is recommended that traffic volumes on 15th Avenue be monitored in the future to assess growth and identify potential improvements.

Beyond the minor operational differences identified sensitivity analysis and the fact that the ultimate solution will rely on the Seward Highway-Glenn Highway Connection Project, the three-lane conversion of Gambell Street addresses existing safety, ADA, and pedestrian circulation needs while providing

immediate ***long-term certainty*** to allow economic development to occur in the near-term. The project as outlined in the redevelopment and implementation plan:

- Provides snow storage in 3.5 foot shoulders and the portion of sidewalks closest to the curb allowing adequate pedestrian connectivity and utilization of all three vehicular travel lanes during winter time conditions versus the three out of four currently utilized due to the lack of snow storage;
- Maintains long-term flexibility (i.e., conversion to a two-way street with on-street parking as part of the Seward Highway-Glenn Highway Connection project);
- Changes the pedestrian and vehicular environment to better match the needs of the business district, and allows additional aesthetic enhancements to occur along Gambell Street;
- Provides sufficient space for pedestrians year round, addresses ADA deficiencies, eliminates splash conflicts with outside vehicular lanes, and reduces crossing distances and exposure for pedestrians, bicycles, and vehicles; and
- Reduces the need for additional right-of-way acquisition to address existing ADA deficiencies in proximity of the signalized intersections along the corridor.

NEXT STEPS

We trust that this memorandum fulfills AMATS's request for additional analysis related to the proposed three-lane cross section on Gambell Street and will facilitate AMATS endorsement of the Gambell Redevelopment Plan. Please do not hesitate to contact us with additional questions or comments.

REFERENCES

1. Municipality of Anchorage, *2035 Metropolitan Transportation Plan*, 2012.
2. Alaska Department of Transportation & Public Facilities. *Annual Traffic Volume Report.* 2011.
3. Transportation Research Board, *Highway Capacity Manual*, 2000.