HUFFMAN ROAD RECONSTRUCTION
OLD SEWARD HIGHWAY
TO
LAKE OTIS PARKWAY
ADOT&PF PROJECT NO. 53933
FEDERAL PROJECT NO. NH-0538(7)

3R STUDY AND CAPACITY REPORT

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3R STUDY AND CAPACITY REPORT

Prepared for:

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LIST OF ACRONYMS

3R ..... Resurfacing, Restoration, and Rehabilitation
AADT ..... annual average daily traffic
AASHTO ..... American Association of State Highway and Transportation Officials
acc/MEV ..... accidents per million entering vehicles
ADAAG ..... Americans with Disabilities Act
ADOT&PF ..... Alaska Department of Transportation and Public Facilities
ADT ..... average daily traffic
AFD ..... Anchorage Fire Department
AHDM ..... Alaska Highway Drainage Manual
AREMA ..... American Railway Engineering and Maintenance-of-Way Association
ATP ..... Anchorage Trails Plan
cm ..... centimeters
CRTR ..... Central Region Traffic Report
CTWCLT ..... continuous two-way center, center left-turn
DHV ..... Design Hourly Volume
e ..... superelevation
h ..... horizontal
ha ..... Hectare
HCM ..... Highway Capacity Manual
HRTFR ..... Hillside Roads Traffic Forecast Report
hwy ..... highway
kg ..... Kilogram
kN ..... Kilonewton
kph ..... kilometers per hour
LOS ..... levels of service
lx ..... Lux
m ..... meter
m^2 ..... Square Meter
m^3 ..... Cubic Meter
min ..... minimum
MVK ..... million vehicle kilometers
MOA ..... Municipality of Anchorage
MPa ..... Mega Pascals
mph ..... miles per hour
N ..... Newton
N/A ..... Not Applicable
PCM ..... Preconstruction Manual
RDG ..... ADOT&PF Roadside Design Guide
RFP ..... Request for Proposal
RIRO ..... right in, right out
ROW ..... right-of-way
TFDG ..... Transit Facilities Design Guide
typ. ..... typical
v ..... vertical

v/c ..... volume to capacity
v:h ..... vertical:horizontal
V_d ..... Design Speed
yrs ..... years

CONVERSION FROM METRIC TO ENGLISH QUANTITIES

This 3R Study and Accident Analysis is assembled using metric units. The table below provides information for converting standard metric values to the English system of measure.

TO CONVERT TO	FROM	DIVIDE BY
Acre (U.S. Survey)	Square Meter (m^2)	4,046.873
Acre (U.S. Survey)	Hectare (ha)	0.4046873
Cubic Foot	Cubic Meter (m^3)	0.02831685
Cubic Yard	Cubic Meter (m^3)	0.7645549
Foot	Meter (m)	0.3048
Foot (U.S. Survey)	Meter (m)	1200/3937
Foot-candle	Lux (lx)	10.76391
Gallon (U.S. Liquid)	Cubic Meter (m^3)	0.003785412
Inch	Meter (m)	0.0354
Kip-Force	Kilonewton (kN)	4.44822
M. Gal	Cubic Meter (m^3)	3.785412
Metric Ton	Kilogram (kg)	1,000
Mile (U.S. Statute)	Meter (m)	1,609,347
Pound (LB Avoirdupois)	Kilogram (kg)	0.45359237
Pound-Force (LB)	Newton (N)	4.44822
Pounds per square inch	KiloPascals	0.145
Pounds per square foot	Pascals	0.02
Square Foot	Square Meter (m^2)	0.09290304
Square Yard	Square Meter (m^2)	0.8361274
Ton (Short, 2,000 LB)	Kilogram (kg)	907.1847

1.0 INTRODUCTION

This 3R Study and Capacity Report was prepared to document and summarize the accident and capacity analysis and 3R evaluation for the Huffman Road corridor between Old Seward Highway and Lake Otis Parkway. Huffman Road is located in south Anchorage and serves as a collector that connects the residential areas of the Anchorage Hillside to the major north-south arterial of the Anchorage Bowl (New Seward Highway). Figure 1 shows a vicinity map of the project corridor.

2.0 EXISTING CONDITIONS AND BACKGROUND

2.1 Description

Huffman Road within the project corridor is designated as a collector in the Central Region Traffic Report. Based on traffic counts performed by DOWL Engineers (DOWL) and by the Alaska Department of Transportation and Public Facilities (ADOT&PF) in August 2000, the annual average daily traffic (AADT) west of the New Seward Highway is about 13,100 and is about 14,000 east of the New Seward Highway. Huffman Road generally slopes to the west with an average slope of about 2.0 percent and a maximum grade of 4.6 percent. The terrain within the corridor is considered rolling. The roadway at the west end of the corridor (New Seward Highway to Old Seward Highway) is a three-lane section with a mixture of curb and gutter (urban section) and drainage ditches (rural section). Pedestrian facilities consist of discontinuous sections of sidewalk along the north side near the Old and New Seward Highways. The properties adjacent to the west end are predominantly commercial with driveway access to Huffman Road. The roadway at the east end of the corridor (New Seward Highway to Lake Otis Parkway) is a two-lane section with the exception of an eastbound left-turn lane at Lake Otis Parkway and the turn and merge lanes associated with the interchange at the New Seward Highway. Pedestrian facilities consist of a combination of discontinuous, separated trails and sidewalks along the south side of the road.

The yearly growth rate for the corridor was established at 2.0 percent by the Hillside Roads Traffic Forecast Report (Lounsbury, 2000). Based on that 2.0 percent growth rate and traffic count data collected by DOWL in August 2000, Design Designations were prepared for this project and are included in Appendix B. The Design Hourly Volume (DHV) is about 8.5 percent. The directional split at the intersections is 65/35 indicating that in the morning peak hour, 65 percent of the traffic is westbound and 35 percent is eastbound. The split is reversed in the evening peak hour. The peak hour factor averaged about 0.9.

There are five signalized intersections within the corridor at the intersections of Lake Otis Parkway, New Seward Highway east ramps, New Seward Highway west ramps, Brandon Street, and Old Seward Highway. Turning movement volumes at the signalized and unsignalized intersections were field collected during the morning and evening peak hours as part of the traffic count data collected by DOWL in August 2000 (see Appendix C for the raw data). Accidents in the corridor were assembled from January 1, 1995 through December 31, 1999 using combined data from Municipality of Anchorage (MOA) and ADOT&PF records. Collision diagrams were prepared for each intersection and are included in Appendix D.

From the accident data collected, Huffman Road has a study period accident rate of 2.88 accidents per million vehicle kilometers (MVK).

2.1.1 Design Standards

The design standards that were used in developing this 3R Study along the Huffman Road corridor were based on many sources including the following publications and documents:

- *"A Policy on Geometric Design of Highways and Streets",* American Association of State Highway and Transportation Officials (AASHTO), 1994.
- *"Official Streets and Highway Plan - Maps, Policies, and Standards",* Municipality of Anchorage, Department of Community Planning and Development, August 1996.

- *"Americans with Disabilities Act - Accessibility Guidelines",* U.S. Architecture and Transportation Barriers Compliance Board, 1991.

- *"Highway Capacity Manual, 1997 Update",* Transportation Research Board, National Research Council, 1997.

- *"Highway Preconstruction Manual" (The Orange Book),* Alaska Department of Transportation and Public Facilities, 1998.

- *"Alaska Traffic Manual Supplement",* Alaska Department of Transportation and Public Facilities, 2000.

- *"Manual on Uniform Traffic Control Devices",* U.S. Department of Transportation, Federal Highway Administration, 1988.

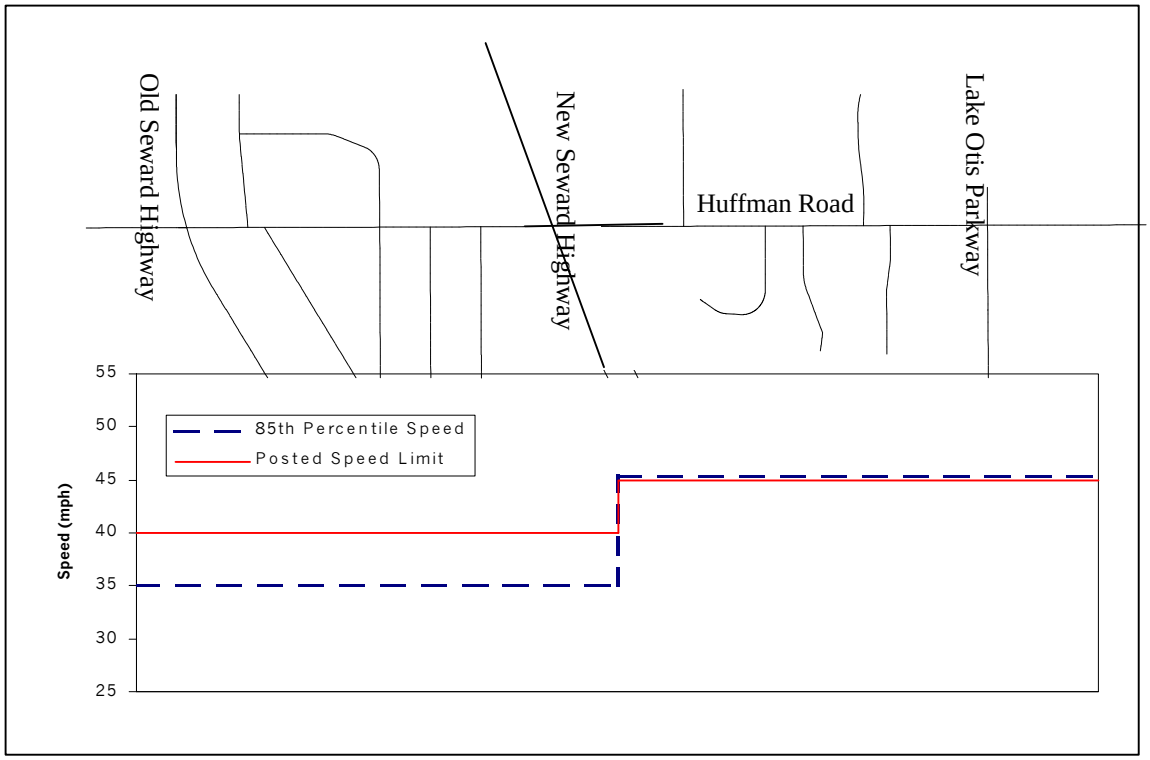
Project design criteria for Huffman Road are included in Appendix A. This project is designated as a 3R project. The main purpose of 3R projects is to restore the structural integrity of the roadway, but the purpose can also be to enhance safety and capacity. Design criteria for 3R projects allows existing geometric and roadway elements that do not meet current standards to remain, unless historical accident rates exceed predicted values, and the upgrade to current standards is cost effective. This 3R Study and Capacity Report evaluated geometric elements in accordance with the procedures in the Preconstruction Manual (PCM) Section 1160. Pending the outcome of this report, capacity and safety modifications may be necessary that are beyond the scope of a 3R project. In other words, there may be sufficient safety and capacity upgrades to warrant reconstruction of Huffman Road rather than the planned 3R project.

2.1.2 Design Speed

The design speed is defined by AASHTO as “the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.” The PCM recommends that the 85th percentile speed be used for the design speed for evaluation of 3R projects. The posted speed limits on

Huffman Road are 45 mph (70 kph) east of New Seward Highway and 40 mph (65 kph) west of New Seward Highway. Speed data was collected in August 2000 as part of the 24-hour traffic counts that were performed by DOWL. The speed data was reduced and 85th percentile speed versus the posted speed is graphed for each segment of Huffman Road in Figure 1. Figures 2 and 3 show the distribution of the speed over the range of the collected data. East of the New Seward Highway the 85th percentile speed is approximately the same as the posted speed, 45 mph (70 kph). West of New Seward Highway the 85th percentile speed is about 35 mph (56 kph), which is less than the posted speed of 40 mph (65 kph). Proximity of driveways relative to the location of the measured data can have a large impact on the speed data. If a heavily used driveway is close to the hose counters, then a large number of low speed traffic can significantly reduce the 85th percentile speed at that location which may or may not be representative of that segment of the corridor. Given the large number of commercial driveways between the Old and New Seward Highways, it was difficult to place the hoses in a location that was not impacted by driveways. Thus, the design speed in this area may vary significantly from what was measured.

Figure 1: Posted Speed Versus 85th Percentile Speed for the Huffman Road Corridor



AASHTO recommends that the design speed be 5 mph (8 kph) over the posted speed limit or the 85th percentile speed. In this case the 85th percentile speed is roughly equal to the posted speed. Based on the collected speed data, approximately 5 to 10 percent of the traffic was traveling at least 5 mph (8 kph) over the posted. This percentage was substantially higher during off-peak hours. Based on AASHTO's definition of the design speed, it is reasonable to assume that the maximum safe speed that can be maintained on Huffman Road should be 5 mph (8 kph) over the posted speed limit. For this reason, the design speed used in this analysis was 50 mph (80 kph) east of New Seward Highway and 45 mph (70 kph) west of New Seward Highway.

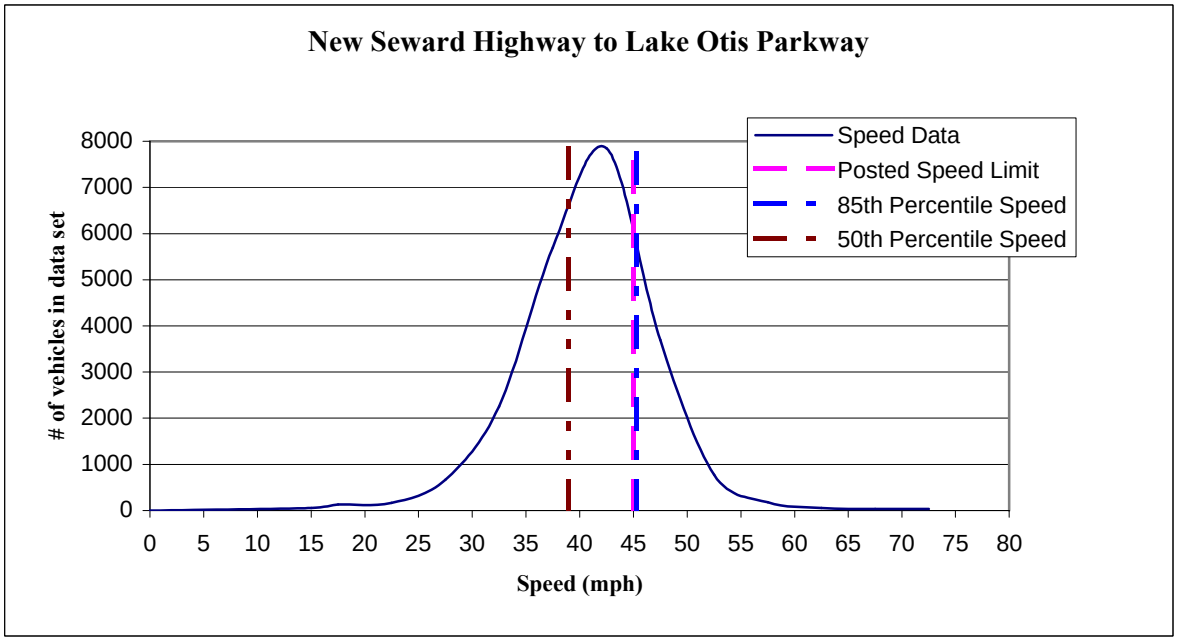


Figure 2: Posted Speed Versus 85th Percentile Speed East of New Seward Highway

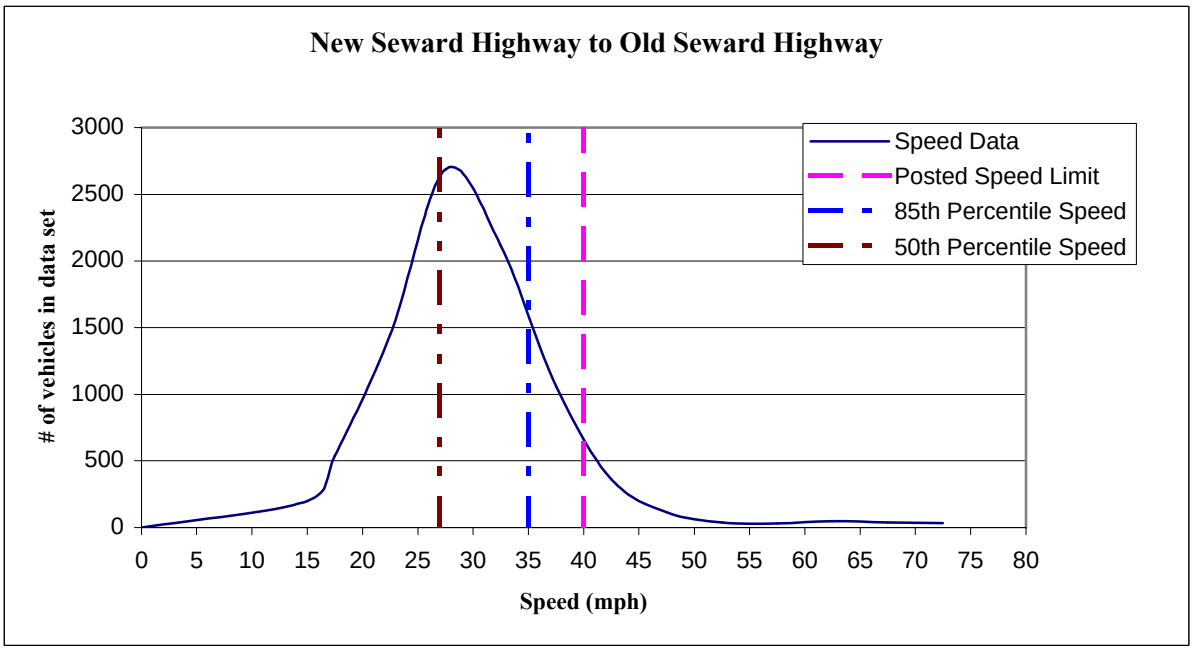


Figure 3: Posted Speed Versus 85th Percentile Speed West of New Seward Highway

3.0 SAFETY STUDY

3.1 Methodology of Study

The PCM states that 3R projects may improve safety with cost-effective countermeasures for geometrics that do not meet design criteria. The PCM includes a specific methodology for the safety evaluation of 3R projects that was followed for this report. The methodology is summarized as follows:

- Roadways that meet or exceed minimum design criteria require no improvement.
- Roadways that do not meet minimum design criteria but have no documented accidents require no improvement.
- Roadways that have fewer accidents or a lower accident rate than predicted require no improvement. Predicted numbers of accidents or rates are calculated using formulas found in PCM Section 1160.

- Where the design element does not meet standards and the actual number of accidents exceed the predicted values yielded by the formulas, then improvements are considered for cost effectiveness.

Predicted number of accidents or accident rates use historic traffic information. For this 3R Study, the 5-year period between 1995 and 1999 was considered. The 3R accident analysis only considers accidents that are attributable to a geometric element. For example, a moose accident may occur at an intersection but would not be attributable to the design of the intersection and, therefore, would not be counted as one of the actual accidents.

Huffman Road was split into two segments based on traffic volumes; west of New Seward Highway (STA 5 + 000 to STA 5 + 800) and east of New Seward Highway (STA 5 + 800 to STA 6 + 600). These segments of Huffman Road have different characteristics. The east segment is characteristic of a rural collector while the west segment is more characteristic of an urban collector except there is no curb and gutter.

3.2 Lane and Shoulder Widths

Huffman Road has various lane and shoulder widths from Old Seward Highway to Lake Otis Parkway. For a rural collector, AASHTO recommends lane and shoulder widths of 3.6 meters (12 feet) wide and 2.4 meters (8 feet) wide, respectively. For urban collectors, the width of the gutter pan is sufficient off set distance between the traveled way and the face of curb. A summary of the existing lane and shoulder widths is shown in Table 1.

Table 1: Existing Lane and Shoulder Widths

Location	Feature	Dimensions m (ft)	Limits
OSH to NSH	Travel Lanes	3.5 to 3.8 (11.5 to 12.5)	
	Paved Shoulder	0.6 (2)	North side of road between OSH and Huffman Park Drive
		0.2 to 0.4 (0.6 to 1)	South side of road
	Gravel Shoulder	0.9 to 3.6 (3 to 12)	South side of road between OSH and Hace Street
	Curb and Gutter	0.6 (2) wide	North side of road between Huffman Park Drive and NSH
		0.6 (2) wide	South side of road between Hace Street and NSH
NSH to Lake Otis	Travel Lanes	3.0 to 3.6 (10 to 12)	
	Paved Shoulder	2.1 to 2.6 (7 to 9)	North side of road
		1.7 to 1.8 (5 to 6)	South side of road

Typically, the PCM evaluates the lane and shoulder widths based on the number of same direction sideswipes, opposite direction sideswipes, and run off road accidents (excluding all intersection accidents) since these type of accidents may be attributed to substandard lane and shoulder widths. This procedure was followed for the east section of Huffman Road and the results are shown in Table 2. However, for the west section of Huffman Road, this evaluation approach is meaningless due to the large number of intersections and the presence of a continuous two-way center, center left-turn (CTWCLT) lane. There are no accidents in this section that can be separated from the intersections. Additionally, the presence of the CTWCLT lane provides a buffer between opposite directions and cushions through lane traffic by allowing through motorists to encroach into the CTWCLT particularly in the winter when the lane lines are frequently not visible.

Table 2: Predicted Versus Actual Accident Rate

Segment	Predicted Accident Rate (acc/km/yr)	Actual Accident Rate (acc/km/yr)
Old Seward Highway to New Seward Highway	N/A	N/A
New Seward Highway to Lake Otis Parkway	3.68	1.5

Based on the comparison information in Table 2, lane and shoulder widths do not appear to need modification for the segment of Huffman Road east of New Seward Highway.

3.3 Horizontal Curves

There are no horizontal curves on Huffman Road between Old Seward Highway and Lake Otis Parkway.

3.4 Vertical Curves

Vertical curves were analyzed to determine if they met the current PCM minimum sight distance requirements. Table 3 below summarizes the vertical curve date within the project limits.

Table 3: Vertical Curve Data

VPI Station	Curve Type	Curve Length	Minimum Curve Length (m)		Maximum Speed for Existing Curve (kph)	Actual Number of Accidents	Change in Slope %
			70 kph	80 kph			
5+075	Sag	50	87	--	55	0	3.5
5+133	Crest	30	45	--	50	0	1.6
5+370	Crest	40	45	--	65	0	0.9
5+690	Sag	60	60	--	70	0	3.0
6+040	Crest	40	--	50	65	1	1.1
6+220	Sag	50	--	43	80	0	2.5
6+385	Crest	70	--	110	70	1	2.3

Table 3 shows all three of the crest curves along Huffman Road do not meet the minimum curve length criteria. The actual number of accidents over the five year study period that may be attributable to the length of the vertical curves is just one each at Station 6+040 and Station 6+385. These accidents are property damage only accidents that will not provide cost effective justification for lengthening the curves. However, if the road is reconstructed to satisfy necessary capacity upgrades, then the incremental cost of lengthening these curves to meet the above standards is negligible.

3.5 Intersections and Driveways

3.5.1 Sight Distance

All intersections and driveways were analyzed for compliance with minimum sight distance. The minimum sight distance for a design speed of 70 kilometers per hour (kph) is 100 meters (300 feet) and the desirable sight distance is 290 meters (950 feet). The minimum sight distance for a design speed of 80 kph is 120 meters (400 feet) and the desirable sight distance is 360 meters (1180 feet). Many of the driveways and intersections do not meet the minimum sight distance criteria due to vertical alignment, trees, and other obstructions. Table 4 summarizes the sight distance findings from DOWL's field investigation.

Table 4: Driveways and Intersections Sight Distance Summary

Station	Offset	Horizontal Sight Distance 70 kph / 80 kph	Remarks
5+090	LT	Landscaping to the west	Huffman Square Driveway
5+280	LT	Trees to east	West entrance to First Care
5+430	LT	Light pole to east	East entrance to First Care
5+400	RT	Landscaping, light pole, and electric pole to west	Brandon Street
5+500	LT	Light pole to the east	East entrance to Carrs
5+500	RT	Trees to the west	Hace Street traffic signal
5+540	RT	Landscaping to the east	Entrance to Williams Express
5+600	RT	Light pole to the west	Landmark Street
5+630	LT	Bridge overpass to the east	New Seward Hwy. Southbound off ramp signal
5+800	RT	Bridge overpass to the west	New Seward Hwy. Northbound off ramp signal
6+000	LT	Trees to the east	Gregory Street
6+170	RT	Vertical alignment to the east	Meander Drive
6+250	RT	Trees to the east	Silver Spruce Drive
6+360	LT	Trees to the east and west	Woodward Circle
6+410	RT	Trees to the west	Ravin Drive
6+610	LT	Trees to the east	Lake Otis Pkwy. Traffic signal
6+610	RT	Trees to the west	Lake Otis Pkwy. Traffic signal

3.5.2 Intersections and Driveway Accidents

The PCM does not outline a method for analyzing accidents at intersections. The analysis method used for this study was to compare a calculated actual accident rate to a predicted accident rate. The actual accident rate is the ratio of the number of accidents divided by the millions of entering vehicles at the intersection. Table 5 summarizes the accident data for each of the study intersections (see Appendix D for collision diagrams).

Figures 5 and 6 were formulated by DOWL from MOA accident data for the years 1997 through 1999. They show the average accident rates at unsignalized intersections (Figure 5) and signalized intersections (Figure 6) throughout Anchorage categorized by annual average daily traffic (AADT). The average accident rate for each category was calculated and a trend line generated for use in predicting the accident rate of a signalized or unsignalized intersection based on AADT. Table 6 shows the actual and predicted accident rates for the signalized and unsignalized intersections in the project corridor.

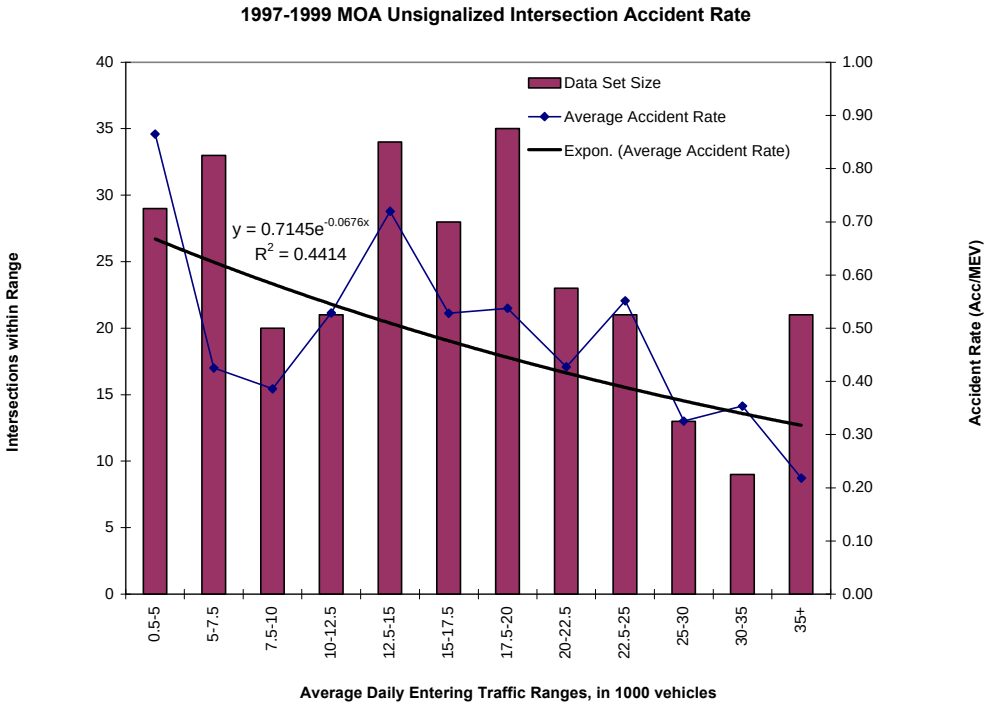


Figure 4: Unsignalized Accident Rates

Table 5: Intersection Accident Summary

Street	Injury			Type						Total	Accidents/ MEV
	PDO*	Injury	Fatality	Angle	Rear-End	Head On	Side-swiped	Pedestrian	Other		
Old Seward Highway	22	14	0	11	24	0	0	1	1	36	1.20
Industry Way	8	0	0	6	2	0	0	0	0	8	0.37
Brandon/Huffman Park	20	4	0	14	5	0	2	1	2	24	0.61
Hace/Carrs Entrance	34	15	0	45	3	0	0	0	1	49	1.45
Landmark	5	1	0	5	1	0	0	0	0	6	0.30
New Seward West Ramp	18	9	0	4	17	1	1	2	2	27	0.69
New Seward North	4	1	0	1	3	0	0	0	1	5	0.18
New Seward South	5	0	0	0	1	0	0	0	4	5	0.18
New Seward East Ramp	21	13	0	21	9	0	0	1	3	34	1.00
Gregory	5	0	0	2	3	0	0	0	0	5	0.21
Meander	0	1	0	0	0	0	0	0	1	1	0.04
Silver Spruce	1	1	0	0	2	0	0	0	0	2	**
Lake Otis Parkway	15	4	0	10	8	0	0	0	1	19	0.65

*PDO = Property damage only
**ADT data is unavailable for Silver Spruce but the number of accidents is not significant to warrant further analysis.

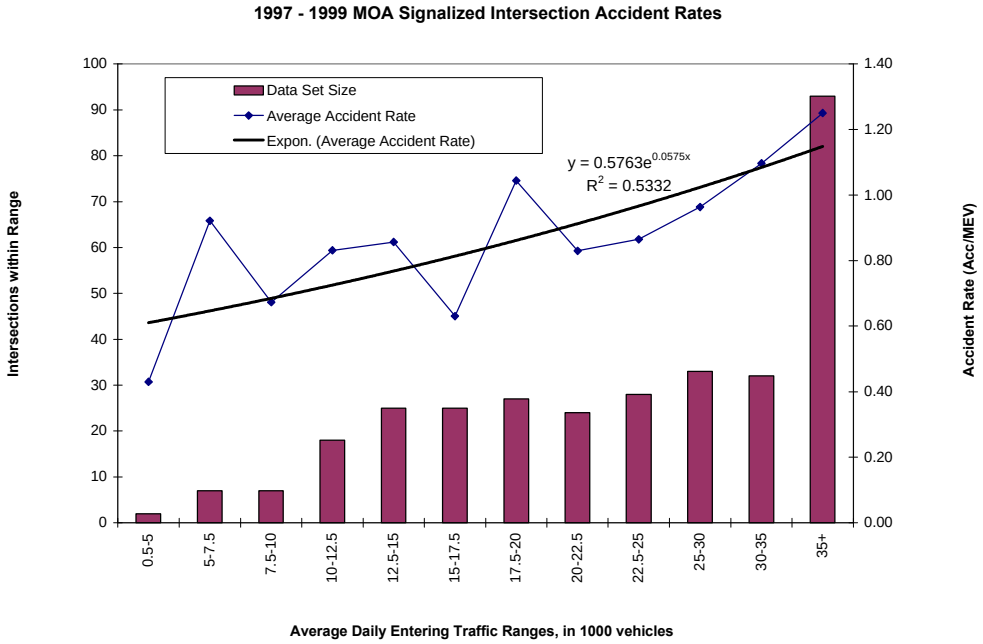


Figure 5: Signalized Accident Rates

Table 6: Predicted Accident Rate Summary

Intersection with Huffman Road	Number of Accidents	Average Entering Vehicles * (veh/day)	Actual Accident Rate (acc/MEV)	Predicted Accident Rate (acc/MEV)
Old Seward Highway	35	16,500	1.17	0.80
Industry Way	7	12,000	0.32	0.52
Brandon/Huffman Park	23	21,500	0.58	0.85
Hace/Carrs Entrance	48	18,500	1.42	0.44
Landmark	6	11,000	0.30	0.52
New Seward West Ramp	25	21,400	0.64	0.85
New Seward East Ramp	32	21,500	0.94	0.85
Gregory	5	13,046	0.21	0.51
Meander	1	13,700	0.04	0.53
Lake Otis Parkway	19	16,000	0.65	0.80

*Average of MOA data from 1995 through 1999.

From the data on Table 6 there are three intersections that exceed the predicted accident rate; namely, Old Seward Highway, New Seward Highway east ramps, and Hace Street. Based on the collision diagrams, the following observations of the data at these intersections is noted.

- Approximately 40 percent of all the accidents at these three intersections appear to be sensitive to engineering solutions.

- Accidents that were drug/alcohol related were not included in the analysis.

- At Old Seward Highway, the primary accidents are rear-end accidents and angle accidents. Speed is listed as a contributing factor at all but two of these accidents and 22 of the 36 accidents (61 percent) at this intersection occurred during snow/icy road conditions.

- At Hace Street, the primary cause of accidents is the vehicles attempting to make a left turn or through movement out of the Carrs driveway. Forty of the 49 accidents over the past five years are angle accidents that can be attributed to through/left movements out of the Carrs driveway.

- At the New Seward Highway east ramps, there is a wide variety of accidents. Six of the accidents are collisions with fixed objects (sign posts and guardrails) All of these accidents occurred when it was dark and/or when there was snow/ice road conditions. Another cluster of accidents are angle accidents between eastbound left-turners and westbound through vehicles.

Since the actual accident rate exceeds the predicted accident rate at the intersections of Old Seward Highway, Hace Street, and the New Seward Highway east ramps, further analysis is warranted. The critical accident rate of the intersection is determined with the following equation[1]:

$$R_c = R_a + K(R_a/M)^{1/2} + 2M^{-1}$$

[1] Transportation Research Board. Traffic Records, Accident Prediction and Analysis, and Statistical Methods. Transportation Record, 1581. Washington, DC: TRB, NRC, 1990.

Where:

R_c = Critical Intersection Rate in Accidents/MEV

R_a = Average Rate of the ADT Range from Figures 4 and 5

K = Desired Confidence Level coefficient, (1.645 for a 95% confidence level)

M = Annual Entering Volume in MEV

Based on the equation above, the critical accident rates for Old Seward Highway, Hace Street, and the New Seward Highway east ramps are 1.48, 0.94, and 1.46, respectively. Of these three intersections, only Hace exceeds the critical accident rate and requires further analysis to determine if countermeasures are cost effective.

The observations described above for the Hace intersection identify the southbound through and left-turning movements as the primary source of the accidents. Measures to mitigate left-turning and through accidents at Hace Street include the following:

- Signalize the Hace Street intersection. This will reduce the predicted accident rate to about 0.83 accidents/MEV (see Figure 5). A typical traffic signal in the Municipality of Anchorage costs about $250,000 to install. The annual cost of the capital investment at 8 percent interest is $58,000 per year with an additional $10,000 per year in signal maintenance costs for a total of $68,000 per year.

- Eliminate southbound through and left-turning movements by converting the Carrs driveway to a right-in right-out (RIRO) intersection and shift those vehicles to the new Brandon Street traffic signal. This will reduce the predicted accident rate at this intersection to about 0.44 accident/MEV. Based on the collision diagrams, the accident rate neglecting the 40 accidents involving southbound through and left-turning vehicles, the accident rate is just 0.27. The capital cost of this modification is estimated at about $40,000, annualized over 20 years this cost is about $9,300.

The annual cost is estimated using the procedures outlined in the PCM where a cost is assigned to each type of accident. In the case of Hace Street, there were 40 southbound left-turning and through movement accidents. Of these, 26 were property damage only (PDO)

accidents with an assigned value of $2,000 each and 14 were minor injury accidents with an assigned value of $18,000 each. If these accidents were eliminated, this equates to an annual benefit to the public of $60,800 over the 5 year accident history. Based on this analysis, either of the countermeasures listed above are cost effective. However, the proximity of Hace Street in relation to the existing traffic signal at Brandon Street is likely too close to maintain adequate progression of traffic through this section of the Huffman Road corridor. This suggests that converting the Carrs driveway to a RIRO intersection should be included in the proposed corridor modifications.

3.6 Lighting

Huffman Road has street lighting primarily at the signalized intersections. West of New Seward Highway there are three traffic signals spaced about 400 meters (1/4 mile) apart. Thus street lighting appears to be adequate on this portion of the corridor. No street lights are present between the New Seward Highway east ramps and Lake Otis Parkway.

Accidents were analyzed to determine the lighting conditions present at the time of the accident (e.g. daylight, twilight or dark). During the five-year period analyzed, a total of 221 accidents occurred. Of the 221 accidents, 140 occurred under daylight and 10 under twilight conditions. Breaking the number of accidents into percentages yields, 63 percent of all accidents occurred during daylight conditions, 5 percent occurred during twilight conditions, and 32 percent occurred during dark conditions. This indicates that the proportion of accidents occurring during dark or twilight hours along Huffman Road does not exceed the statewide proportion of daylight versus twilight and dark hour accidents.

3.7 Clear Zones

The minimum clear zone requirements for new construction of a rural roadway with greater than 6,000 AADT on a 1:4 cut slope is 20 feet (6 meters) and on a 1:4 fill slope is 30 feet (9 meters). Clear zones were evaluated along the length of the corridor. The north side of Huffman Road between the east entrance to the Tesoro gas station and the west entrance to the First Care is the only location that meets minimum clear zone standards. All other areas within the project corridor do not meet current clear zone requirements, but since widening

the roadway is not warranted based on this 3R analysis, further analysis of the cross-sectional elements is not required. Furthermore, the design alternatives discussed later in this report upgrade the typical section to urban collector standards, so the clear zone issues are resolved.

Much of the roadway has side slopes exceeding the recoverable maximum of 1:4 vertical:horizontal (v:h). The side slopes of the road varies between 1:2 and 1:6. Obstacles found within the clear zone and near the toe of the slopes consist of trees and shrubs, wooden electrical poles, and retaining walls.

3.8 Passing Sight Distance

There are no areas within the study corridor where passing is allowed.

3.9 Signs

A field survey was done to evaluate the condition of the signs within the project corridor. The reflectivity of most of the signs is currently good but some of the signs are chipped, cracked or scratched. No missing or obscured signage was observed.

4.0 CAPACITY ANALYSIS

Capacity analyses were performed on two levels. First, roadway segments were evaluated, and, second, local unsignalized and signalized street intersections were evaluated.

4.1 Segment Levels of Service

Huffman Road is a two-lane roadway that resembles the two-lane highway model of the Highway Capacity Manual (HCM). The road has frequent driveways and local street intersections that function more for accessibility than for mobility. Additionally, the minimum speed for the HCM model is 50 mph (80 kph) which is greater than the 40 to 45 mph (65 to 70 kph) posted speed limit for Huffman Road. The HCM recommends that present time delay and volume to capacity (v/c) ratios be used for level of service (LOS) measures where there are speed restrictions and the road has a high accessibility function.

Table 7 presents the roadway LOS as calculated by the Highway Capacity Software for existing conditions in 2000, 2006, and 2026.

Table 7: **Existing Conditions Level Peak Hour of Service for the Current Year, the Construction Year (2006), and the Design Year (2026)**

Segment	Peak Hour Volume (veh)			Volume/Capacity (v/c)			Level of Service (LOS)		
	2000	2006	2026	2000	2006	2026	2000	2006	2026
West of NSH	1097	1235	1835	0.61	0.65	0.91	D	E	E
East of NSH	899	1012	1504	0.44	0.51	0.71	D	D	E

4.2 Intersections Levels of Service

The intersections and driveways not addressed in this section have less than 30 entering vehicles during a 2006 peak hour and will have LOS "A". At normal project growth rates (2.0 percent per year), these intersections will not experience poor LOS over the design period. It is assumed that subdivision expansions that may increase the entering volumes substantially above normal growth rates will be improved by the developer if needed.

Five signalized intersections were analyzed for LOS; namely: Lake Otis Parkway; New Seward Highway east ramps; New Seward Highway west ramps; Gregory Road; Brandon Street; and, Old Seward Highway. These intersections will experience growth in volumes over the 20-year life that may affect LOS.

Table 8: **Existing Alignment A.M. Peak Hour Capacity Summary**

Intersection	v/c Ratio/LOS		
	2006	2016	2026
Huffman Road and NSH West	0.47/B	0.58/B	0.70/B
Huffman Road and NSH East	0.57/B	0.67/C	0.82/E
Huffman Road and Lake Otis Parkway	0.77/D	0.94/E	1.14/F
Huffman Road and Brandon Street	0.29/B	0.36/B	0.44/B
Huffman Road and Old Seward Highway	0.34/C	0.42/C	0.51/C

Table 9: Existing Alignment P.M. Peak Hour Capacity Summary

Intersection	v/c Ratio/LOS		
	2006	2016	2026
Huffman Road and NSH West	0.93/C	1.14/E	1.38/F
Huffman Road and NSH East	0.68/B	0.83/C	1.01/E
Huffman Road and Lake Otis Parkway	0.74/D	0.82/E	1.09/F
Huffman Road and Brandon Street	0.45/E	0.55/F	0.67/F
Huffman Road and Old Seward Highway	0.56/D	0.69/D	0.84/F

It is important to note from Tables 8 and 9 that in many cases there are low LOS despite low v/c ratios. This is typically caused by excessive delay at one or more movements at an intersection that cause the overall intersection delay to be relatively high despite sufficient capacity being available at the remaining movements. This phenomenon can often be improved by modifying the signal timing to redistribute green time to the critical movements.

In addition to the signalized intersection analysis above, five unsignalized intersections were evaluated for signal warrants; namely, Industry Way; Hace Road (Carrs Driveway); and, Gregory Road. Table 10 summarizes the signal warrants that were met at each of the signalized intersections.

Table 10: **Signal Warrants**

Intersection	Signal Warrants Met?		
	Warrant 1	Warrant 2	Warrant 11
Industry Way	Yes	Yes	Yes
Hace Road/Carrs Entrance	No	Yes	No
Gregory Road	No	Yes	No

Warrant 1 - Minimum Vehicular Volume
Warrant 2 - Interruption of Continuous Flow
Warrant 11 - Peak Hour Volume

Since signal warrants are met at these intersections, a LOS analysis was performed at each of these intersections as well. Based on the LOS results tabulated in Table 11, capacity upgrades will be required in the project corridor to accommodate the design year traffic volumes at a minimum LOS C.

Table 11: Unsignalized Intersection Level of Service Summary

Intersection	2006 Level of Service			
	Left Turn off Huffman		Cross Street	
	AM	PM	AM	PM
Industry Way	A	A	A	B
Hace Road/Carrs Entrance	A	B	C	F
Gregory Road	B	A	C	C
	2016 Level of Service			
	Left Turn off Huffman		Cross Street	
	AM	PM	AM	PM
Industry Way	A	B	A	F
Hace Road/Carrs Entrance	A	B	E	F
Gregory Road	B	B	D	C
	2026 Level of Service			
	Left Turn off Huffman		Cross Street	
	AM	PM	AM	PM
Industry Way	A	B	A	F
Hace Road/Carrs Entrance	B	C	F	F
Gregory Road	B	B	F	D

Despite the results of the signal warrant analysis, the proximity of Gregory, Industry Way, and Hace Road in relation to existing traffic signals within the corridor preclude installation of traffic signals at these locations. Any benefits of signals at these locations would likely be outweighed by deterioration to traffic progression. The existing traffic signals within the corridor are spaced roughly on a quarter mile interval with 80 to 90 second cycle lengths. The signals at the diamond interchange (New Seward Highway) are interconnected, but the signals at Lake Otis Parkway, Brandon, and Old Seward Highway are not interconnected. Progression improvements and reduced delay could likely be achieved by coordinating the signals at Old Seward Highway and Brandon with the signals at the diamond interchange.

5.0 ROADWAY ALTERNATIVES

The development of four alternatives for improvements to Huffman Road has been accomplished through analysis of existing conditions, accident data, current design criteria, future traffic, cost, public input, and environmental considerations. Alternatives range from leaving the road as it currently exists (no build) to expanding the entire corridor to five lanes with curb and gutter, sidewalks, and separated trails. All of the build alternatives will include

improvements to sight distance, signage, and drainage. Minor lighting improvements will be given consideration during design. Preliminary design drawings of each of the alternatives is included in Appendix G.

5.1 Alternative A

Alternative A is the “no build” alternative. The existing roadway design would remain in place. Existing LOS and accident rates will continue at these existing levels or increase with increased congestion.

5.2 Alternative B

5.2.1 Description

West Segment - Old Seward Highway to New Seward Highway:

- Add curb and gutter and convert road to an urban section.
- Add separated multi-use trail on the north side and sidewalk on the south side of road.
- Eliminate "free" right-turn lane westbound on Huffman Road at New Seward Highway.
- Convert Carrs east driveway into a "right in, right out" (RIRO) only driveway.

East Segment - New Seward Highway to Lake Otis Parkway:

- Add a 4.2 meter two-way center, left-turn lane
- Add curb and gutter and convert road to an urban section.
- Add a separated multi-use trail on the north side and sidewalk on the south side of road.

5.2.2 Safety and Capacity Impacts

The following safety and capacity impacts will result from installation of Alternative B:

- Most of the clear zone issues will be resolved east and west of New Seward Highway as a result of upgrading the road to urban arterial standards.

- Elimination of the free right turn for southbound traffic on the New Seward Highway off-ramp has already taken place with the recent installation of a yield sign. This gives through traffic on Huffman the priority and meets drivers expectations of typical intersection control. It also effectively eliminates the weaving movement that was previously required for westbound Huffman Road traffic in order to turn into Carrs. This modification will likely reduce the accident rate at the New Seward Highway west ramps intersection and may significantly reduce accidents at the Hace Road intersection as well.

- Conversion of the Carrs east driveway from the current design to a new RIRO intersection is an improvement to that intersection since it will eliminate the most accident prone turning movement at that intersection. However, from a capacity standpoint, this modification will further deteriorate the LOS at the southbound left-turn movement on Brandon that is already LOS F at the construction year (2006).

- This option does not provide adequate LOS at the midlife or design year for the intersections of Old Seward Highway, Brandon, Lake Otis Parkway, or at the New Seward Highway East ramp.

5.3 Alternative C

5.3.1 Description

West Segment - Old Seward Highway to New Seward Highway - 5-Lane Section:

- Expand to a five-lane section, including four 3.6-meter lanes and a 4.2 meter two-way center, left-turn lane.

- Add curb and gutter and convert road to an urban section.
- Add a separated multi-use trail on the north side and sidewalk on the south side of road.
- Eliminate "free" right-turn lane westbound on Huffman Road at New Seward Highway.
- Convert Carrs east driveway into a RIRO only driveway.
- Construct a dual, left-turn lane for westbound traffic at the intersection of Old Seward Highway and Huffman Road.
- Modify the islands at the diamond interchange to include three through lanes for eastbound traffic on Huffman Road at the west ramps intersection and dual, left-turn lanes for eastbound Huffman road traffic at the eastern ramp intersections.

East Segment - New Seward Highway to Lake Otis Parkway - 3-Lane Section:

- Add a 4.2-meter two-way, center left-turn lane.
- Add curb and gutter and convert road to an urban section.
- Add a separated multi-use trail on the north side and sidewalk on the south side of road.
- Construct right-turn only lanes for east and westbound traffic on Huffman Road at the Lake Otis Parkway intersection.
- Interconnect the traffic signals at Old Seward Highway, Brandon Street, and the diamond interchange and perform a progression analysis during the design phase to optimize traffic movements.

5.3.2 Safety and Capacity Impacts

The following safety and capacity impacts will result from installation of Alternative C:

- Alternative C appears to provide adequate LOS for the entire corridor throughout the design period with one possible exception. With the construction of a RIRO driveway at the Carrs east entrance, the left-turning traffic will be pushed to an already over capacity left-turning movement on southbound Brandon Street. It appears from the capacity analysis that there will be the ability to reallocate additional green time to Brandon Street that will become available through the addition of a second, through lane in each direction. A more detailed progression analysis will be necessary to complete during the design phase of this project to confirm whether there will be sufficient green time. If there is not enough green time, then an alternate/supplemental solution would be to construct a dual, southbound left-turn lane.

- Most of the clear zone issues will be resolved east and west of New Seward Highway as a result of upgrading the road to urban arterial standards.

- The accident rate benefits described for Alternative B will likewise apply to the construction of Alternative C.

- This alternative resolves the all of the existing signal warrants.

5.4 Alternative D

5.4.1 Description

West Segment - Old Seward Highway to New Seward Highway:

- Expand to a five-lane section including four 3.6-meter lanes and a 4.2-meter, two way center, left-turn lane.

- Add curb and gutter and convert road to an urban section.

- Add sidewalks on both sides of road.

- Eliminate "free" right-turn lane westbound on Huffman Road at New Seward Highway.

- Convert Carrs east driveway into a "right in, right out" (RIRO) only driveway.

- Construct a dual, left-turn lane for westbound traffic at the intersection of Old Seward Highway and Huffman Road.

- Modify the islands at the diamond interchange to include three through lanes for eastbound traffic on Huffman Road at the west ramps intersection and dual, left-turn lanes for eastbound Huffman road traffic at the eastern ramp intersections.

East Segment - New Seward Highway to Lake Otis Parkway:

- Expand to a five-lane section including four, 3.6-meter lanes and a 4.2-meter, two-way center left-turn lane.

- Add curb and gutter and convert road to an urban section.

- Add sidewalks on both sides of road.

5.4.2 Safety and Capacity Impacts

The following safety and capacity impacts will result from installation of Alternative D:

- All of the safety and capacity impacts associated with Alternative C also apply to Alternative D.

- Alternative D has the additional benefits of improved LOS for the segment of the corridor east of the New Seward Highway.

6.0 NON-ROADWAY ALTERNATIVES

6.1 Sight Distance

Sight distance inadequacies at intersections and driveways can be improved by clearing vegetation within the right-of-way at the locations identified in Table 3 shown previously in this report.

6.2 Pedestrian Facilities

The only formal pedestrian facility within the project limits is a 2.3 meter paved sidewalk on the south side of Huffman Road between New Seward Highway and Lake Otis Parkway. There are also intermittent paved pathways located on the north side of Huffman Road between Old Seward Highway and New Seward Highway. In the areas where no formal pathway is provided, the majority of the pedestrian and bicycle movement occurs along the edge of the roadway.

The Bowman Elementary School, located on Gregory Street near the east end of the project, is a destination/origin for children living along Huffman Road. A sidewalk has been installed on the south side of Huffman Road between New Seward Highway and Lake Otis Parkway to accommodate pedestrian traffic. All build alternatives investigated and analyzed as part of this project add additional pedestrian facilities on the north and south side of Huffman Road.

The Anchorage Trails Plan (ATP) recommends a paved multi-use pathway on the north side of Huffman Road and an unpaved multi-use pathway on the south side of Huffman Road.

Alternatives B and C include a multi-use paved trail on the north side of Huffman Road and a sidewalk on the south side throughout the project corridor. They do not include the unpaved multi-use pathway on the south side of the road due to the increased right-of-way (ROW) impacts that would result.

Alternative D includes sidewalks on both the north and south side of Huffman Road for the entire project length. To minimize the ROW impacts, the ATP recommendation for a paved

multi-use pathway on the north side of Huffman Road and an unpaved, multi-use pathway on the south side was not incorporated into the design.

6.3 Bus Turnouts

6.3.1 Transit Bus Turnouts

At one time, transit bus service was in operation along Huffman Road but there are currently no active transit routes in the corridor. The Assembly has received a proposal to reinstate the transit bus service along Huffman Road. Presently, there are only two bus turnouts. One is located at Lake Otis Parkway on the north side of Huffman Road and the other is located immediately east of Meander Drive on the south side of Huffman Road.

6.3.2 School Bus Turnouts

There are currently five school bus stops within the Huffman Road project limits. These bus stops are located at the following intersections along Huffman Road: Silver Fox Lane, Brandon Street, Hace Street, Silver Spruce Drive, and Northern Raven Drive. Participants of the public involvement process expressed a desire for waiting areas for children.

6.4 Signalization and Lighting

Discussions with the Anchorage Fire Department (AFD), located between the Old Seward Highway and Brandon Street on Huffman Road, indicate that they currently experience delays in their response times due to the traffic queues associated with the new traffic signal at Brandon Street. The Brandon Street traffic signal does not have emergency vehicle pre-emption capability. AFD reported that the queues often block the entrance/exit to their driveway. To resolve this problem all of the alternatives should include pre-emption upgrades to the Brandon Street traffic signal.

All of the alternatives include new continuous street lighting the full length of the corridor. Existing lighting appears to be sufficient between NSH and OSH but additional lighting will be necessary from NSH to Lake Otis Parkway to fill in the gaps between existing street lighting.

7.0 SUMMARY

The following summarize the findings of this 3R Study and Capacity Report:

- Over the 20 year design life of the Huffman Road facility there are level of service deficiencies that warrant capacity upgrades to the corridor.

- Alternative A and B do not provide adequate level of service for the entire corridor. Alternative C is the most cost-effective alternative that provides adequate level of service for the entire corridor over the design life of the proposed improvements. Alternative D provides improved level of service over Alternative C but does not provide a separated, multi-use trail on the north side of Huffman Road.

- Alternative C consists primarily of constructing a 5-lane road section from Old Seward Highway to the New Seward Highway with a CTWCLT lane and a 3-lane road section from New Seward Highway to the Lake Otis Parkway intersection. This alternative includes reconstruction of the median in the vicinity of New Seward Highway and construction of right-turn lanes on the east and west approaches to Lake Otis Parkway.

- Accident rates at the Carrs driveway located at the Hace Street intersection exceed the critical accident rate at that intersection. All of the alternatives include converting that driveway into a RIRO only intersection as a cost effective safety improvement.

- All of the alternatives include improvements to horizontal sight distance, traffic signals and roadway illumination, pedestrian facilities, transit facilities, and signage.

- The modifications included in Alternatives C and D constitute reconstruction of Huffman Road rather than the 3R approach that was originally envisioned.

APPENDIX A

DESIGN CRITERIA TABLE

DESIGN CRITERIA SUMMARY
HUFFMAN ROAD RECONSTRUCTION
OLD SEWARD HIGHWAY TO LAKE OTIS PARKWAY

ELEMENT	*VALUE*	*SOURCE*
Functional Classification	Urban Collector (ADOT&PF)	CRTR
Base Year/Design Year	2006/2026	ADOT&PF RFP
Present Year ADT (2000)	OSH/NSH - 11,000; NSH/Lake Otis - 13,600	Field Data
Mid-Period ADT (2016)	OSH/NSH - 14,994 NSH/Lake Otis - 18,670	HRTFR, p. 11
Design Year ADT (2026)	OSH/NSH - 18,277 NSH/Lake Otis - 22,758	HRTFR, p. 11
Design Hourly Volume (DHV)	8.5% of ADT	Field Data
Directional Split (%D)	OSH/NSH - 52% WB / 48% EB NSH/Lake Otis - 52% WB / 48% EB	Field Data
Trucks (%T)	OSH/NSH - Commercial Trucks / Motorhomes - 2.4%; Buses - 1.2%	Field Data
	NSH/Lake Otis - Commercial Trucks / Motorhomes - 3.4%; Buses 1.1%	Field Data
Equivalent Axle Load, 2026	OSH/NSH - 490,000 NSH/Lake Otis - 600,000	AASHTO Guide to Pavement Design
Pavement Design Year	2018 (12 years after construction)	PCM
Design Vehicle	WB-15, (WB-20 on NSH ramps)	
Design Speed (Terrain)	80 km/hr (Rolling)	AASHTO, p. 461
Stopping Sight Distance Passing Sight Distance	120 m (min.), 360 (desirable) N/A	PCM (1160-18)
Maximum Grade Minimum Grade	6.0% 0.5% (if curb and gutter is present) 0.0% (if curb and gutter is not present)	AASHTO p. 233
Roadway Cross Slope	2%	PCM (1130)
Superelevation	$\leq$ 6.0%	PCM (1120)
Minimum Allowable Radius of Curve	2,480 m (normal cross slope) 250 m (e = 6.0%)	AASHTO, p. 168-172
Minimum K-value for Vertical Curves	Sag: 32 Crest: 49	AASHTO, p. 284-292
Number of Roadways	1 (3 lanes, typical)	N/A
Lane Width	3.6 m	AASHTO, p. 465

DESIGN CRITERIA SUMMARY (continued)

Width of Outside Shoulder	2.4 m (rural) width of gutter pan (urban)	AASHTO, p. 465
Surfacing, Lanes and Shoulders	AC Pavement	N/A
Side Slope Ratios	1:4 (minimum recoverable)	PCM (1130)
Median Treatment	Two-way, center, left-turn lane	N/A
Illumination	Existing	N/A
Curb and Gutter Usage	"Standard", typical "Mountable" and "Depressed", as necessary	ADOT&PF Standard Drawings
Pedestrian/Bicycle Provisions - Sidewalk Width - Unobstructed Width - Max. Cross Slope - Passing Areas - Maximum Vertical Step - Minimum Vertical Clearance	 1.2 m 0.9 m 2% N/A 13 mm 3 m	ADAAG, Ch. 4
Transit Provisions (Bus Stops) - Locations - Spacing - Type - Geometrics	 Far side of int. (preferable) 210 to 300 meters On-Street Per TFDG	TFDG
Roadway Vertical Clearance	5.0 m, typical	PCM (1130-6)
Clear Zone (Rural)	6 m (on 1:4 cut slope) 9 m (on 1:4 fill slope)	PCM (1130)
Driveways - Minimum Return Radii - Minimum Distance Between - Minimum Corner Clearance - Minimum Sight Distance - Maximum Landing Slope	 9 m 15 m 15 m 120 m 2%	PCM (1190)
Erosion Control	On Slopes Steeper than 3:1	AASHTO Highway Drainage Guidelines, Vol. 3

Proposed By: Design Engineer, DOWL Engineers_____

Recommended By: Project Manager, ADOT&PF _____

Accepted By: Regional Preconstruction Engineer, ADOT&PF _____

APPENDIX B

DESIGN DESIGNATIONS

APPENDIX C

TRAFFIC COUNT DATA

APPENDIX D

COLLISION DIAGRAMS

APPENDIX E

SIGNAL WARRANT WORKSHEETS

APPENDIX F

CLEAR ZONE SUMMARY

APPENDIX G

DESIGN ALTERNATIVES

APPENDIX H

RESPONSE TO DRAFT AND FINAL REVIEW COMMENTS