Midtown Corridor Improvements, Denali St Area – Benson Blvd to Tudor Rd
PM&E Project No. 16-28

Traffic Signals and Illumination

1.0 Existing Conditions

For the project's existing conditions, we have evaluated the current state of the traffic signals, interconnect, lighting, and load centers by inventorying the various system elements. The collected data will serve as the basis from which to develop improvement recommendations and preliminary cost estimates.

Located in midtown Anchorage, Denali Street is oriented north-south and the project area spans from Benson Blvd to Tudor Rd. 36th Avenue is oriented east-west and the project area spans from A St to Old Seward Highway. Both roadways are Class II, Minor Arterials.

1.1 Traffic Signals

There are seven signalized intersections within the project study area. They are Denali Street/Tudor Road, Denali Street/36th Avenue, Denali Street/33rd Avenue, Denali Street/Benson Boulevard, Denali Street/Northern Lights Boulevard, 36th Avenue/A Street, and 36th Avenue/Old Seward Highway.

All the traffic signal systems at the seven signalized intersections within the project area are using the Econolite ATC Cobalt controller in the TS2 Type 2 configuration and the standard modem Actelis ML688 Ethernet access device. The controller cabinets within the project area, except for at 36th Avenue and A Street, are TS1 controller cabinets that utilize shelf mount detector amplifiers. The 36th Avenue and A Street controller cabinet is a TS2 version which utilizes detector racks with TS2 detector cards.

Denali Street/Tudor Road:

At Denali Street and Tudor Road there are three signal mast arm poles with a total of ten vehicular signal heads. The two roads make a T-intersection at this location, with Denali Street terminating. Denali Street and Tudor Road are two-way streets with heavy traffic flows in both directions. The north and west legs of the intersection have pedestrian crossings with push buttons. The only pole on the northeast corner is a 10-foot push button pole that also has a signal head on top.

The traffic control cabinet is located on the northeast corner of Denali Street and Tudor Road. The maintenance for this intersection falls under the Transfer of Responsibility Agreement (TORA), which means that it is owned by the Department of Transportation (DOT) and maintained by the Municipality of Anchorage (MOA). The northwest and southeast signal poles have luminaires on top. The interconnect system travels east and west along Tudor Road along the northside of the street, connecting this signal to the signals at Tudor Road/Old Seward Highway to the east and Tudor Road/C

Street to the west. According to the as-builts there are in ground inductance loop detectors on each approach.

Denali Street/36th Avenue:

Denali Street and 36th Avenue are two way streets that cross each other at a signalized intersection. There are sixteen signal heads divided evenly among the four signal poles at this intersection. All four legs have pedestrian crossings and corresponding push buttons on the signal poles.

The traffic control cabinet for this intersection is located on the northwest corner. Maintenance and operation responsibilities for this intersection belong to the MOA. The southeast and southwest signal poles both have dual luminaires on them. There are overhead electric transmissions running east-west on the north side of 36th that limit the ability to add lighting on the signal poles on the northeast and northwest quadrants of the intersection.

The interconnect system runs north, east and west from the traffic controller cabinet. One interconnect cable runs north along Denali Street on the west side of the road. A second interconnect goes from the controller cabinet to a j-box on the southwest corner of the intersection before heading west on the south side of 36th Avenue on its way to A Street. The interconnect cable going to A Street is routed through multiple Type 2 j-boxes also containing roadway lighting cables. A third interconnect runs from the control cabinet to the northeast corner j-box then to the j-box on the southeast corner where it heads east along 36th Avenue. As-builts indicate there are loop detectors present on each of the approaches.

Denali Street/33rd Avenue:

The junction of Denali Street and 33rd Avenue is a signalized intersection with two-way traffic in each direction. The intersection consists of four signal poles with three signal heads and a luminaire on top of each pole. Pedestrian crossings are present at all four corners with push buttons located on each signal pole.

The traffic controller cabinet for Denali Street and 33rd Avenue is on the northwest corner. The interconnect system starts at the controller cabinet and travels south along Denali Street on the west side of Denali Street to connect with 36th Avenue's signal controller. This intersection is owned and operated by the MOA. Loop detectors are present on each approach, according to as-builts.

Denali Street/Benson Boulevard:

Denali Street is a two-way street and Benson Boulevard is an eastbound, one-way street with the intersection being signal controlled. There are three signal poles, one on each corner except the northwest corner. Each signal pole has a luminaire on top, and there is a total of eleven signal heads present. The pole on the northeast corner has two mast arms, one over Benson Boulevard and the other over Denali Street. All four legs of the intersection have pedestrian crossings with the push buttons located on the signal poles, except for the northwest corner where they are located on a luminaire pole.

The traffic controller cabinet is located on the northwest corner of Benson Boulevard and Denali Street. Several interconnect cables connect to the traffic controller. One cable runs from the cabinet to the signal junction box on the northeast corner, then north towards Northern Lights Boulevard along Denali Street. A second interconnect cable leaves the cabinet, goes to the southwest corner signal junction box,

then heads west to tie in with A Street interconnect. A third interconnect cable travels from the controller cabinet to the southwest corner signal junction box and to the southeast corner signal junction box, then continues east towards New Seward Highway. This intersection is designated as a TORA location, which gives the MOA responsibility for maintenance while ownership is through the DOT. As-builts show loop detectors present on all approaches to this intersection.

Denali Street/Northern Lights Boulevard:

Traffic on Denali Street at this intersection travels both directions, and Northern Lights Boulevard is a one-way road with vehicles west bound. There are eleven signal heads affixed to the three signal poles present at this intersection. There is a signal pole on each corner except the southeast corner. The signal pole on the southwest corner is the only one with luminaires, and it has two signal mast arms; one over Northern Lights Boulevard and one over Denali Street. Pedestrian crosswalks are present on all four legs with push buttons on the signal poles except on the southeast corner, where they are located on a luminaire pole.

The traffic controller cabinet is located on the southeast corner of Denali Street and Northern Lights Boulevard. Two interconnect cables run from the controller cabinet, one goes north to the northeast corner signal junction box then on to Fireweed Lane. The second cable heads south to connect with the Benson Boulevard signal controller. The maintenance for this intersection falls under the TORA. Each approach to this intersection has loop detectors installed.

36th Avenue/A Street:

The crossing of 36th Avenue and A Street is a signalized intersection with two-way traffic on 36th Avenue and one-way northbound traffic on A Street. At this intersection, there are three traffic signal poles with eleven signal heads between them. There is no signal pole on the southwest corner and the poles on the east side both have luminaires. Pedestrian crosswalks are provided on all four legs of the intersection with push buttons on each of the signal poles and on the southwest corner luminaire pole. The signal pole in the southeast quadrant was replaced in 2016 by a DOT&PF Highway Safety Improvement Project(HSIP).

The traffic controller cabinet is located on the southeast corner of A Street and 36th Avenue. Interconnect cables connect this intersection to others in the area. One departs the controller cabinet and heads east to tie in with the Denali Street signal controller. A second interconnect cable goes from the cabinet to the northeast corner and then north on to 32nd Avenue. A third interconnect cable travels from the cabinet to the southwest corner before continuing to the C Street intersection. The fourth interconnect cable leaves the cabinet and heads south to link up with the 40th Avenue signal controller. Maintenance for this intersection falls under TORA which means that it is DOT owned and MOA maintained. Loop detectors are installed for all approaches with traffic entering the intersection.

36th Avenue/Old Seward Highway:

Old Seward Highway and 36th Avenue are both two-way streets that meet at a signalized intersection. There are sixteen signal heads evenly distributed among the four signal poles present. The northeast corner signal pole is the only one that does not have a luminaire. All legs of the intersection allow for pedestrian travel by way of crosswalks with the push buttons mounted on the signal poles.

The traffic controller cabinet is positioned on the northwest corner of 36th Avenue and Old Seward Highway. There are two interconnect cables leading from the cabinet, one goes to the signal junction box on the southwest corner and then west to the Denali Street intersection. The second interconnect cable leaves the cabinet and goes directly to the New Seward Highway along the northside of 36th Avenue. This intersection is owned and maintained by the MOA. Loop detectors are present on each leg of the intersection. New loop detectors were installed in 2013 for the south bound Old Seward Highway approach.

According to MOA Traffic, the signal hardware at this intersection is 30 years old and in failing condition. This includes a foundation failure for one of the signal poles.

1.2 Illumination

There is a mix of existing street/pedestrian/bus stop lighting present along both the Denali Street and 36th Avenue corridors. The lighting was examined for both physical characteristics and issues, as well as the corridor illumination levels. All lighting is powered and metered through the intersection load centers present throughout the project area. These load centers are a mix of DOT and MOA installations and are described in greater detail under section 1.3. All examined street light poles in the project area are mounted on MOA standard breakaway “slip-bases” on concrete foundations.

Denali Street Lighting:

Along Denali Street, from Tudor Road to Northern Lights Boulevard, there are thirty street light poles on the west side of the road and one pole on the southeast corner of Denali Street and 32nd Avenue. All are operated and maintained by the MOA. The poles on the west side of Denali Street are spaced around 150 feet apart and almost all are approximately one foot behind the sidewalk. Some light poles are obscured or have their bases covered with vegetation.

Across the five signalized intersections along this stretch of Denali Street, seventeen of the signal poles have luminaires on the upper sections. Some of the signal pole luminaires fall under the TORA for maintenance at these intersections. The TORA street lights include two at Tudor Road, four at Benson Boulevard, and three at Northern Lights Boulevard. The intersections of Denali Street with 36th Avenue and 33rd Avenue each have four lights on the signal pole upper sections. 33rd Avenue has one light for each of the four signal poles. At 36th Avenue, the two signal poles on the south side of the intersection each have two lights on top and the two northern poles do not have any street lights. The reason for the absence of lights on these north side poles is the proximity to overhead electric lines. The lights at both the 33rd and 36th Avenue intersections are maintained and operated by the MOA. There are also street light poles on the southeast corner at Northern Lights Boulevard and the northwest corner at Benson Boulevard that fall under the TORA. These are standard street light poles that have the pedestrian crossing signal heads and push buttons mounted to them.

Between Northern Lights Boulevard and Benson Boulevard, on the east side of Denali Street there is a bus stop shelter with attached lighting. In this same area of Denali Street, there are four separate sections of sidewalk retaining wall with built-in accent lighting. The bus shelter and wall lights are the responsibility of the MOA.

On the west side of Denali Street, approximately 100 feet south of 36th Avenue, there is another bus stop shelter with an interior light. This same bus stop pad also has a single bus stop light pole to the north of the shelter. These facilities are operated and maintained by the MOA.

36th Avenue Lighting:

Between A Street and Old Seward Highway there are fifteen street light poles along the southside of 36th Avenue, all the property of the MOA. From A Street to Denali Street, the light poles are located several feet behind the sidewalk in the vegetated area. The light poles between Denali Street and Old Seward Highway are positioned in the sidewalk near the back edge. Some of the poles and their foundations are significantly narrowing the usable travel way of the sidewalk. One such pole is directly in the center of the sidewalk. The street light poles are spaced approximately 150 feet apart along the corridor.

On the southwest corner of A Street and 36th Avenue, there is a street light pole with pedestrian crossing signal heads and push buttons attached. The signal poles on the northeast and southeast corners each have a single luminaire mounted on the upper section. The signal poles at this intersection are part of the city's TORA.

At Old Seward Highway and 36th Avenue, the luminaires on the signals poles on all corners belong to the MOA, except for the northeast corner. The northeast corner has a wood utility pole with a mast arm mounted street light. This light belongs to the Municipal Light and Power company (ML&P).

36th Avenue has one bus stop with a lighted shelter within the project area. This bus shelter is located 100 feet east of A Street on the south side of 36th Avenue and was installed recently. There is also a bus stop light pole near this bus stop shelter, both of which are the property of the MOA.

Existing Lighting Levels Analysis:

The January 2007 version of Chapter 5 of the MOA Design Criteria Manual (DCM) contains requirements for lighting design in Anchorage. This manual provides guidance and minimum criteria which should be met when designing any type of illumination including street lighting, pedestrian lighting, tunnel lighting, bus stop lighting, and railroad crossing lighting in Anchorage. These criteria also present a useful baseline for analyzing existing lighting systems of various configurations and checking their adherence to the minimum design standards. There are different measurement methods and criteria tables given to allow analysis of facilities with varying classification and volume of pedestrian use. Our analysis of these midtown roadways has been based on the "Illuminance Method" recommended values and sidewalks/pathways were evaluated using the "Maintained Illuminance Values for Pedestrian Facilities Adjacent to Roadways" table. Intersections have been analyzed using the "Illuminance for Intersections" table. The roadway classification is based on the MOA's "Official Streets and Highways Plan" and pedestrian conflict area is assumed based on DCM guidelines. Both roadways are arterials and are assumed to have a medium pedestrian conflict. We have assumed a "Major/Major" classification at the signalized intersections. The pertinent criteria tables from the DCM Chapter 5 follow.

TABLE 5-1 ILLUMINANCE METHOD – RECOMMENDED VALUES

Roadway Classification	Pedestrian Conflict Area	Illuminance (lux or footcandles) (minimum)	Uniformity Ratio (avg/min) (maximum)	Veiling Luminance Ratio (vmax/min) (maximum)
Freeway Class A	--	9.0 / 0.9	3.0	0.3
Freeway Class B	--	6.0 / 0.6	3.0	0.3
Expressway	High	14.0 / 1.4	3.0	0.3
	Medium	12.0 / 1.2	3.0	0.3
	Low	9.0 / 0.9	3.0	0.3
Arterials	High	17.0 / 1.7	3.0	0.3
	Medium	13.0 / 1.3	3.0	0.3
	Low	9.0 / 0.9	3.0	0.3
Collector	High	12.0 / 1.2	4.0	0.4
	Medium	9.0 / 0.9	4.0	0.4
	Low	6.0 / 0.6	4.0	0.4
Local	High	9.0 / 0.9	6.0	0.4
	Medium	7.0 / 0.7	6.0	0.4
	Low	4.0 / 0.4	6.0	0.4

TABLE 5-4 MAINTAINED ILLUMINANCE VALUES FOR PEDESTRIAN FACILITIES ADJACENT TO ROADWAYS

Pedestrian Conflict Area	Land Use, Area, or Time	Average Horizontal Illuminance (lux or fc) (minimum)	Vertical Illuminance* (lux or fc) (minimum)	Uniformity Ratio (avg/min) (maximum)
High	Pedestrian Facilities Adjacent to Roadway	20.0 / 2.0	10.0 / 1.0	4.0
	Pedestrian Only	10.0 / 1.0	5.0 / 0.5	4.0
Medium	Pedestrian Areas	5.0 / 0.5	2.0 / 0.2	4.0
Low	Rural/Semi Rural	2.0 / 0.2	0.6 / 0.06	10.0
	Low Density Residential	3.0 / 0.3	0.8 / 0.08	6.0
	Medium Density Residential	4.0 / 0.4	1.0 / 0.1	4.0
Underpasses	Day	100.0 / 10.0	50.0 / 5.0	3.0
	Night	40.0 / 4.0	20.0 / 2.0	3.0

*The minimum vertical illuminance is measured 5-ft above the walkway/bikeway in both directions parallel to the main pedestrian flow.

TABLE 5-5 ILLUMINANCE FOR INTERSECTIONS				
Functional Classification	Average Maintained Illuminance at Pavement by Pedestrian Area Classification (lux or fc) (minimum)			Uniformity (avg/min) (maximum)
	High	Medium	Low	
Major/Major	34.0 / 3.4	26.0 / 2.6	18.0 / 1.8	3.0
Major/Collector	29.0 / 2.9	22.0 / 2.2	15.0 / 1.5	3.0
Major/Local	26.0 / 2.6	20.0 / 2.0	13.0 / 1.3	3.0
Collector/Collector	24.0 / 2.4	18.0 / 1.8	12.0 / 1.2	4.0
Collector/Local	21.0 / 2.1	16.0 / 1.6	10.0 / 1.0	4.0
Local/Local	18.0 / 1.8	14.0 / 1.4	8.0 / 0.8	6.0

Existing Light Levels – From site investigation and as-built review it appears that a few different physical configurations of lighting exist in the project area. It is likely that the existing lighting levels are also variable depending on when the design was done and the inconsistency in luminaire wattage and pole spacing throughout the corridors. Pole heights, mast arm lengths, luminaire type, as well as offset, and spacing, were reviewed and there is some variation. The typical light pole installation present is a 40-foot mounting height, 12-foot mast arm, and 250 or 400-watt high pressure sodium (HPS) lamp in a General Electric “cobra-head” fixture with flat glass.

The “site lighting” analysis performed is also dependent on street configurations and variability in lane number and widths, the presence of turn lanes, and side walk widths. To provide a useful analysis and relevant recommendations, a total of four locations were selected based on physical lighting configuration that are representative of the roadways and pedestrian level lighting throughout the project area. These four locations and their existing characteristics are summarized in the two tables below. Street geometry was estimated using a ROW base map, as-builts, and Google Earth. Luminaire assumptions included a standard light loss factor of 0.64 for HPS bulbs, and generally type III medium cutoff distributions.

Location	System	Pole	Arm	Luminaire
36th Ave, Denali St to Old Seward	Street, one side uniform	40 ft. Street	12 ft. mast arms	400W HPS Street
Denali St, Tudor Rd to 40th Ave	Street, one side uniform	40 ft. Street	12 ft. mast arms	250W HPS Street
Denali St, 33rd to Benson	Street, one side uniform	40 ft. Street	12 ft. mast arms	400W HPS Street
36th Ave at Denali St INT	Signal Pole Luminaires	40 ft. Street	15 ft. mast arms	400W HPS Street

Representative Existing Lighting Systems

Location	Classification & Pedestrian Conflict	Travel Lanes & Widths	Parking Isles & Widths	Sidewalks & Widths
36th Ave, Denali St to Old Seward	Arterial & Medium Ped	5 Lanes & 55 ft. Total	None	2 Walks & 8 ft.
Denali St, Tudor Rd to 40th Ave	Arterial & Medium Ped	4 Lanes & 46 ft. Total	None	2 Walks & 5 ft.
Denali St, 33rd to Benson	Arterial & Medium Ped	5 Lanes & 55 ft. Total	None	2 Walks & 5 ft.
36th Ave at Denali St INT	Major Int. & Medium Ped	N/A	None	(4) 10' Crosswalks

Representative Existing Roadway Configurations

Calculated Light Levels – Lighting analysis software "AGi32" was used to calculate and approximate the existing lighting levels at the four representative locations. Light levels were analyzed on the roadway as well as the sidewalks. The results are summarized in the following tables.

Location	Classification & Pedestrian Conflict	Average Illuminance (Fc)	Uniformity Ratio	Veiling Luminance Ratio
36th Ave, Denali St to Old Seward	Arterial & Medium Ped	1.5	3.6	0.2
Denali St, Tudor Rd to 40th Ave	Arterial & Medium Ped	1.0	4.9	0.1
Denali St, 33rd to Benson	Arterial & Medium Ped	1.4	2.3	0.1
36th Ave at Denali St INT	Major Int. & Medium Ped	3.2	5.4	N/A

Calculated Roadway Lighting Levels

Location	Pedestrian Conflict	Average Illuminance (Fc)	Vertical Illuminance	Uniformity Ratio
36th Ave, Denali St to Old Seward Sidewalk (N)	Medium	0.7	0.5	1.8
Denali St, Tudor Rd to 40th Ave Sidewalk (E)	Medium	0.4	0.5	2.1
Denali St, 33rd to Benson Sidewalk (E)	Medium	0.6	0.4	1.5

Calculated Sidewalk Lighting Levels

Analysis Summary - In general, the calculated roadway lighting levels meet and exceed the minimum average illuminance levels required, except for the Denali Street, Tudor Road to 40th Avenue section. Uniformity and Veiling Luminance are ok, with a couple areas being slightly outside of the recommended values. For the sidewalk lighting levels, the values reported are for the poorer lit of the two walkways for each street. The lighting levels are adequate to good in all locations. Uniformity ratios are also very good. These results are expected due to the nature of high pressure sodium lamps and the existing mounting heights and spacing throughout the project location. Generally, a taller mounting height may decrease the illuminance values while improving uniformities. Our analysis shows that these four representative areas are adequately lit, according to current criteria. Most lighting installations are old and beyond their design life; and design guidance may have been different at the time of design and installation.

Based on the analysis it can be assumed that illuminance light levels are good throughout the project area. Uniformity is variable but also generally acceptable. Our recommendation for roadway or pedestrian lighting upgrades on this project is to consider other factors than just the existing illumination levels. There exists a capacity for cost savings through retrofits with LED fixtures, especially given the good existing infrastructure, existing mounting heights, and spacings that would naturally accommodate LED distributions. In all areas the roadway lighting is/could be adequate to light the sidewalks as well. Pedestrian scale lighting for the sidewalks is usually preference based, but should be considered in the areas of poor uniformity in the roadway lighting or if desired for an added safety benefit. Any upgrades to the existing street lighting infrastructure or changes in roadway geometry should always be accompanied by a new proposed lighting analysis that considers the latest fixture technologies and design criteria.

1.3 Load Centers

Seven existing load centers, five at Denali Street intersections and two at 36th Avenue intersections, were surveyed for condition and code compliance on 8/25/2017 by Bill Starn, PE and Robert Halcomb. In general, load centers are assumed to have a maximum 25-year service life under normal conditions, considering circuit breaker duty, condensation, and corrosion. Some common discrepancies were observed in all or most of the load centers, including recent code requirements for equipment marking, such as:

- Arc-Flash Hazard Warning: marking not present (NEC 110.16)
- Manufacturer's marking: label deteriorated (NEC 110.21 (A))
- Identification of disconnecting means (NEC 110.22, 230.70(B))
- Available fault current: marking not present (NEC 110.24)
- Circuit directory missing or vague circuit identification (NEC 408.4(A))
- Photoelectric control (PEC) wiring does not include a separate equipment ground conductor (NEC 250.118, with MOA amendment).

Assessment summaries of the individual surveyed load centers are as follows:

Denali Street/Tudor Road:

1993 record drawings indicate the load center installation is 24-years old, with an estimated remaining service life of 1 year. 1996 record drawings indicate the load center was to be replaced, but the existing installation indicates the (then 3-year old) load center was relocated, not replaced. Load center is MOA type 1 with 480/240V service. Manufacturer is Circle-AW Products (now Cooper B-Line) with Siemens circuit breakers and panels, a 25kVA transformer, and PEC installed on a roof-mounted socket. Replacement parts are readily available. The transformer enclosure has significant corrosion. This load center is in fair condition.

Denali Street/36th Avenue:

2003 record drawings indicate the load center installation is 14-years old, with an estimated remaining service life of 11 years. Load center is MOA type 4 with 480/240V service. Manufacturer is Cooper B-Line with Siemens circuit breakers and panels, a 15kVA transformer, and PEC mounted on an RMC mast. Replacement parts are readily available. The switched 480V feeder to the panel A lugs is incorrectly color-coded as 240V at the panel lugs. This load center is in fair condition.

Denali Street/33rd Avenue:

2003 record drawings indicate the load center installation is 14-years old, with an estimated remaining service life of 11 years. Load center is MOA type 3 with 240/120V service. Manufacturer is Cooper B-Line with Siemens circuit breakers and panels, and PEC mounted on an RMC mast. Replacement parts are readily available. This load center is in fair condition.

Denali Street/Benson Blvd:

2003 record drawings indicate the load center installation is 14-years old, with an estimated remaining service life of 11 years. Load center is MOA type 4 with 480/240V service. Manufacturer is Cooper B-Line with Siemens circuit breakers and panels, a 15kVA transformer, and PEC mounted on an RMC mast.

Replacement parts are readily available. The transformer enclosure is lightly corroded. This load center is in fair condition.

Denali Street/Northern Lights Blvd:

2003 record drawings indicate the load center installation is 14-years old, with an estimated remaining service life of 11 years. Load center is MOA type 4 with 480/240V service. Manufacturer is Cooper B-Line with Siemens circuit breakers and panels, a 15kVA transformer, and PEC mounted on an RMC mast. Replacement parts are readily available. The padlock on the door to the main breaker compartment was inoperable, and needs to be replaced. The transformer enclosure is lightly corroded. This load center is in fair condition.

36th Avenue/A Street:

1984 record drawings indicate the duplex load centers installation is 34-years old, and are at the end of the recommended service life. Installation consists of two side by side DOT type 3 post-mount load centers, both with 480/240V service. Meter socket provisions do not meet CEA/MOA current standards for safety sockets. Both load centers appear to have the service and load side conductors routed in the same riser post raceway, typical of this old-style load center, which is prohibited by NEC 230.7. Load center C (on right side) is an obsolete Skyline Electric unit, with Westinghouse circuit breakers and panelboard, and PEC mounted on an RMC mast on back of cabinet; the panel access door was locked and inaccessible. Load center D (on left side) is an obsolete Skyline Electric unit, with Westinghouse circuit breakers and panelboard, a 10kVA transformer, and PEC mounted on an RMC mast on back of cabinet. The 10kVA transformer primary is supplied by the 100Amp, 480V service main breaker, with secondary overcurrent protection provided by a 100Amp, 240V circuit breaker. Both circuit breakers are 40% oversized in violation of NEC 450.3(B). The transformer enclosure is significantly corroded. These load centers are in poor condition.

36th Avenue/Old Seward Highway:

1987 record drawings indicate the load center was probably installed in 1988, so the installation is 29-years old and at the end of the recommended service life. The load center is MOA type 3 with 240/120V service. Manufacturer is Circle-AW Products (now Cooper B-Line) with Siemens/ITE circuit breakers and panels, and PEC installed on a back-mounted socket. The load center has been impact damaged, probably by vehicular incursion since it close to the corner of the intersection, with damage to the pedestal base front and side door, and the entire pedestal and base are noticeably out of plumb. Impact damage has made the side panel access door difficult to open, and the interior lower dead-front panel has been removed and missing, exposing the live parts. Spacers in the upper dead-front panel are missing, also exposing live parts. The pad lock to the front side main breaker compartment was inoperable, and needs to be replaced. This load center is in poor condition.

1.4 Interconnect

A major component of signal synchronization is the interconnect cabling that links signalized intersections together along a roadway network. The interconnect wires travel in conduits, from one signal control cabinet to another through a series of type II junction boxes, allowing signals to be timed together to optimize the flow of traffic. Both Denali Street and 36th Avenue have an interconnect system

in place throughout the project area. The interconnect currently running along 36th Avenue from A Street to Old Seward Highway shares junction boxes with the street lighting wiring in this area, which is undesirable. The interconnect running along Denali Street also shares junction boxes with the street lighting from Tudor Road north to 36th Avenue. The signal interconnect system should ideally have its own separate junction boxes.

2.0 Proposed Improvements

Two alternatives were developed for the proposed improvements. The first alternative is the minimum improvements needed to bring the signals, illumination and interconnect into line with current DOT and MOA design practices and standards. Alternative 2 consists of the improvements necessary to accommodate the Complete Street Alternative.

2.1 Traffic Signals

Within the project area there are seven signalized intersections. They consist of Denali Street/Tudor Road, Denali Street/36th Avenue, Denali Street/33rd Avenue, Denali Street/Benson Boulevard, Denali Street/Northern Lights Boulevard, 36th Avenue/A Street, and 36th Avenue/Old Seward Highway.

Bicycle Detection-

Multiple options are available for bike detection. These include: radar, video and in ground inductance loops.

- The induction loops would need to be placed to cover the available area and cannot be adjusted to account for winter snow storage.
- Video detection is more flexible and can be set to detect over a large area. For example, bike detection can be adjusted to only pick up bikes waiting in a designate bike box, or expanded to pick up bikes in the vehicle travel lane. Video detection can have false calls generated by shadows, especially with the low angle sun that Anchorage receives much of the year.
- Radar detection provides the same advantages as video detection (the detection zone can be set to pick up specific areas); however, radar detection is not subject to false calls generated by shadows.

Radar detection has been shown to be successful for detecting bikes in northern climates.

Denali Street/Tudor Road:

Under Alternative 1 the intersection of Denali Street and Tudor Road needs some improvements to bring it more in line with current DOT/MOA practices. When possible, it is preferred that signal heads be placed directly over each lane of traffic. The northwest corner signal pole would require one additional signal head as well as a longer mast arm to meet this standard. It is likely the entire signal pole and foundation would need replacement. It appears that clear zone requirements may also not be met with this current signal pole location, as Tudor Road is uncurbed on the north side.

The northwest, northeast, and southwest corners all need pedestrian facility improvements in order to bring the facilities in compliance with the Americans with Disabilities Act (ADA) requirements. The pedestrian crossing push buttons are all attached to the signal poles located in gravel or grass sections

of ground without a paved path to reach them. It is recommended that the areas next to the poles be paved to allow for better pedestrian access.

The northeast corner push button pole should be replaced with a current DOT standard breakaway pedestrian signal pole and foundation. This push button pole has a signal head on top of it in addition to the crosswalk push button and pedestrian signal head. All appurtenances on the pole should be replaced as a part of the upgrade.

For the Complete Street Alternative, the north side of the intersection requires significant improvement to bring it into line with ADA requirements. Bringing raised curb around the radius from Denali will provide better delineation between the pathway and the roadway. The pedestrian signals should be relocated to the top of the pedestrian ramps and better aligned to the crosswalks. The existing signal pole on the northeast quadrant may need to be replaced to accommodate the extended curb and gutter. In order to encourage proper bike lane usage northbound on Denali Street, a pedestrian crossing should be added on the east leg of Tudor Road.

Denali and 40th:

Under the Complete Streets configuration, the proposed single lane roundabout will require new lighting to provide proper lighting levels for vehicles, bicycles, and pedestrians.

Denali Street/36th Avenue:

For the intersection of Denali Street and 36th Avenue it is recommended that the traffic signals be upgraded to include flashing yellow arrow operation and signal heads for all four directions of travel. This will likely require replacing most infrastructure within the intersection to account for these upgrades. At least eight signal heads will need to be replaced to facilitate the flashing yellow arrow operation. Extra signal heads could be added to provide one over each lane of travel at this busy intersection.

These signal head modifications will likely require all four signal poles, mast arms, and foundations to be replaced. With the addition of the flashing yellow arrow operation, the traffic controller cabinet will need to be upgraded from the TS1 model to the TS2. The existing cabinet foundation should be sufficient for the proposed new cabinet to attach to.

The northeast signal pole has an encroaching private retaining wall that surrounds more than half the pole base, making it challenging for pedestrian access. The retaining wall should be relocated if the pole and foundation do not get replaced.

With the additions of pedestrian islands in the north east and southwest quadrants of the intersection under the Complete Streets Layout, the entire signal system will need to be replaced. In order to minimize the pedestrian crossing time, pedestrian pushbuttons and signals will be mounted on separate poles in the northwest and southeast quadrants, signal mast arm poles can potentially be utilized for pedestrian signals where they can be placed in line with the crossing. Providing Flashing Yellow Arrows (FYA) instead of the current 5-head “Doghouse” signals will provide flexibility in signal phasing.

Denali Street/33rd Avenue/Calais Drive:

Under Alternative 1, there are no proposed improvements for the traffic signal system at Denali Street and 33rd Avenue. This intersection has no significant issues that need addressing.

The reduction of Denali to 1 through lane northbound and southbound under the Complete Streets Alternative will allow a shorter crossing distance for pedestrians. Combined with placing the pedestrian pushbuttons and signals on separate poles will shorten the minimum green time on the side streets. The existing 5-section "doghouse" signals can be replaced with 4-section FYA signals, providing much more flexibility in signal programming.

Denali Street/Benson Boulevard:

The proposed improvements at Denali Street and Benson Boulevard are to install a current DOT standard breakaway pedestrian signal pole and foundation on the northwest corner. To go along with this new pedestrian push button pole, the pedestrian signal heads and push buttons should be relocated off the street light pole and replaced on the new pedestrian push button pole.

The Complete Streets Alternative will remove a southbound thru lane, shortening the pedestrian crossing time of Denali and replace the existing signal with new signal infrastructure that ties the intersection into the entire corridor.

Denali Street/Northern Lights Boulevard:

At Denali Street and Northern Lights Boulevard the proposed improvement is to install a current DOT standard breakaway pedestrian signal pole and foundation on the southeast corner. To go along with this new pedestrian push button pole, the pedestrian signal heads and push buttons should be relocated off the street light pole and replaced on the new pedestrian push button pole.

The northeast corner also needs a new current DOT standard breakaway pedestrian signal pole and foundation because the pedestrian signal heads on this corner's signal pole are not properly mounted for clearance. There is a private business sign next to the signal pole preventing it from being mounted to the appropriate height.

The Complete Streets Alternative will replace the signal system to bring it in line with current design standards and tie it into the corridor.

36th Avenue/A Street:

36th Avenue and A Street has several recommended improvements at the intersection. A new signal pole, mast arms, and foundation should be installed on the northwest corner. The existing pole has a large dent near its base and some visible damage to the concrete foundation. A new DOT standard larger pole and mast arms would be needed to accommodate additional signal heads. There currently is not a signal head over each lane of traffic here; each mast arm would require one additional signal head.

The northeast corner has an older existing signal pole located about 15 feet north of where it ideally would be placed. A new signal pole and foundation should be installed closer to the intersection at the back of the sidewalk. All appurtenances on this signal pole would be replaced.

On the southwest corner, the pedestrian push buttons are attached to a street light pole that is several feet behind the sidewalk. The project should install a current DOT standard breakaway pedestrian signal

pole and foundation on this corner. To go along with this new pedestrian push button pole, the pedestrian signal heads and push buttons should be relocated off the street light pole and replaced on the new pedestrian push button pole.

36th Avenue/Old Seward Highway:

The intersection of 36th Avenue and Old Seward Highway has not been updated in a long time and needs a complete renovation. All traffic signal equipment and hardware should be replaced, as much of it has surpassed its design life or is damaged after so many years in service.

All four signal poles and mast arms should be replaced along with foundations and the attached signal heads. The 16 existing signal heads would be replaced with 17 new signal heads. The additional signal head would be added to the southeast corner signal pole. The current configuration does not have a signal head over each lane and this leg of the intersection needs an additional signal head. The signal pole on the southeast corner would need a longer mast arm so the new signal heads can be properly aligned for each travel lane.

Most of the signage at the intersection needs replacing, especially the street name signs mounted on the signal pole mast arms. One of these overhead signs is currently missing. Signs at this intersection should be updated to meet all current design practices.

The northwest corner is where the traffic controller and load centers cabinets are currently located. The existing load center has been hit by more than one motor vehicle over the years. The addition of protective bollards is a recommended preventative measure for cabinets on this corner.

The complete streets alternative will also completely replace the signal at this intersection.

2.2 Illumination

The current design practice within the MOA is to transition outdoor roadway lighting to light emitting diode (LED) lighting fixtures, in compliance with the DCM. This would apply to all street light fixtures within the project area. LED luminaires tend to cost more than HPS or metal halide fixtures, but they provide several benefits that make up for the price:

- LEDs usually meet standards while using 50-percent less electricity.
- LEDs are rated to last 2 to 4 times longer than HPS lamps.
- LEDs can be fitted with remote monitoring and dimming controls.

While LED light fixtures have a larger upfront expense, they have a lower operating and maintenance cost over the life of the system.

In addition to changing all the street light fixtures to LED, it is recommended to add a remote monitoring and control system to all the illumination poles within the project area. This system for lighting involves installing a module on each light fixture that communicates wirelessly with a gateway radio, allowing two-way communication between the light fixture and a central server. Benefits of this system include automated maintenance logs, alerts when fixtures fail, and the ability to lower light levels (and power usage) during low traffic volume times. If some area light levels are well above MOA standard minimums, it would be feasible to dim the streetlights during off-hours and still meet requirements.

To avoid any visibility discomfort in switching between LED and HPS lighting systems, all traffic signal pole luminaires in the project area should be swapped to LED fixtures, along with the street lighting systems discussed below.

Pedestrian scale LED light fixtures should be considered as an added security and safety benefit to bicyclists and pedestrians. Although the lighting level analysis showed that the existing street lights provide adequate illumination on the sidewalks, there could still be demand for higher light levels. Pedestrian luminaires could be installed at the back of the sidewalks and spaced uniformly between the street light poles.

It is unknown at this time what aesthetic upgrades or landscaping arrangements will be implemented throughout the project corridors. If applied, consideration should be given to replacing street light poles with a new decorative standard that complements the project's themes.

Denali Street:

Along Denali Street from Tudor Road to 36th Avenue, there are sixteen street light poles in good condition and locations, with appropriate mounting heights. Each one should receive a new LED lighting fixture and a remote monitoring module. Denali Street from 36th Avenue to Northern Lights Boulevard has another fifteen street lights that should also be converted over to LED fixtures and a remote monitoring module. None of the light poles along Denali Street need to be moved or replaced based on their current condition and location. Further inspection during the design phase will determine if any of the poles will need to be replaced because of their age, damage, or unfeasible locations.

The Complete Streets Alternative will replace the existing street lights with new LED luminaires at 300-foot spacing on alternating sides of the street. There will also be pedestrian scale lights installed behind the pathway at 100-foot spacing on both sides of the street to enhance pedestrian comfort.

36th Avenue:

Along 36th Avenue from A Street to Denali Street, the street light poles are in good condition and locations, with appropriate mounting heights. Each one should receive a new LED lighting fixture and a remote monitoring module. The bases of the poles should be cleaned up and built up material removed, as well as missing hand hole covers replaced. None of the light poles here need to be moved or replaced based on their current condition and location. Further inspection during the design phase will determine if any of the poles will need to be replaced because of their age, damage or unfeasible locations.

The stretch of 36th Avenue from Denali Street to Old Seward Highway has a need to remove eight illumination poles completely and replace them with new foundations, poles, mast arms, and LED fixtures with remote monitoring modules. New junction boxes, conduit and wiring should also be installed at the back of the sidewalk. These poles need to be moved off the sidewalk as they are currently positioned in the middle of the pedestrian traveled way. Currently they are spaced at about 150 feet apart but increasing that separation to around 200 feet could mean two less illumination poles needed for this section of road. An added benefit to completely replacing this stretch of lighting would be the ability to split the lighting system into its own junction boxes, which are currently shared with the interconnect cabling.

The Complete Streets Alternative will replace the existing street lights with new LED luminaires at 150-foot spacing on the south side of the street to avoid the overhead utilities on the north side of 36th Avenue. There will also be pedestrian scale lights installed behind the pathway on both sides of the street at 100-foot spacing to enhance pedestrian comfort.

2.3 Load Centers

Based on the inspection performed of all the load centers within the project area, we have the following recommendations. There are several in need of replacing, located at Denali Street/Tudor Road, 36th Avenue/A Street, and 36th Avenue/Old Seward Highway.

The load center at Denali Street/Tudor Road is currently listed as fair condition but it only has one year left of its recommended service life. While this load center has not reached the end of its usefulness, it would be beneficial to replace it while other work is completed at this intersection.

At 36th Avenue/A Street, the side by side load centers are graded to be in poor condition and should be replaced. They have more than surpassed the life expectancy and have several code violations due to changes in standards.

The 36th Avenue/Old Seward Highway load center is graded to be in poor condition and should be replaced. This load center has passed its life expectancy and has been hit several times by vehicles. It will need replacing and the addition of bollards to prevent future vehicle impacts.

2.4 Interconnect

Minimal improvements are needed for the interconnect system throughout the project area. The interconnect cables should be isolated from the high voltage street lighting junction boxes, and any poor condition type II interconnect boxes should be replaced.

In conjunction with this project, it is worth consideration of upgrading the copper wire interconnect system along these two corridors to a fiber optic cable and vault system. This upgrade has a straight forward, one-time cost associated with switching to fiber optic, but it also provides significantly greater signal control capabilities. New conduit, wiring, and underground vaults would be necessary to support the system upgrade, along with minor updates to the traffic signal controller hardware.

With the replacement of the signals under the Complete Streets Alternative, the existing copper interconnect would be replaced with new fiber optic interconnect.

3.0 Cost Estimates

The following proposed improvement cost estimates are preliminary and incorporate all the above discussed work for the Complete Streets Alternative. They are broken down in detail in the attached cost estimate spreadsheet summaries.

ITEM	AMOUNT
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & TUDOR	$ 534,978.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & 36TH	$ 624,134.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & 33RD	$ 584,135.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & BENSON	$ 548,798.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & N.LIGHTS	$ 511,060.00
TRAFFIC SIGNAL SYSTEM COMPLETE, 36TH & A ST	$ 546,749.00
TRAFFIC SIGNAL SYSTEM COMPLETE, 36TH & OLD SEWARD HWY	$ 634,651.00
LIGHTING SYSTEM COMPLETE, DENALI ST	$ 790,800.00
LIGHTING SYSTEM COMPLETE, 36TH AVE	$ 849,750.00
PEDESTRIAN LIGHTING SYSTEM COMPLETE, DENALI ST	$ 364,638.00
LOAD CENTER TYPE I	$ 112,000.00
FIBER OPTIC INTERCONNECT	$ 820,000.00

ENGINEER'S ESTIMATE

00456- DENALI-36TH IMPROVEMENTS

ITEM	AMOUNT	
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & TUDOR	$	534,978.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & 36TH	$	624,134.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & 33RD	$	584,135.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & BENSON	$	548,798.00
TRAFFIC SIGNAL SYSTEM COMPLETE, DENALI & N.LIGHTS	$	511,060.00
TRAFFIC SIGNAL SYSTEM COMPLETE, 36TH & A ST	$	546,749.00
TRAFFIC SIGNAL SYSTEM COMPLETE, 36TH & OLD SEWARD HWY	$	634,651.00
LIGHTING SYSTEM COMPLETE, DENALI ST	$	790,800.00
LIGHTING SYSTEM COMPLETE, 36TH AVE	$	849,750.00
PEDESTRIAN LIGHTING SYSTEM COMPLETE, DENALI ST	$	364,638.00
LOAD CENTER TYPE I	$	112,000.00
FIBER OPTIC INTERCONNECT	$	820,000.00

Denali & Tudor Signal					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	450	LF	$ 7	$ 3,150	
Remove Junction Box	6	EA	$ 656	$ 3,936	
Remove Control Cabinet	1	EA	$ 2,362	$ 2,362	
Remove Luminaire Pole	0	EA	$ 2,100	$ -	
Remove Signal Pole	3	EA	$ 3,281	$ 9,843	
Remove Pedestrian Pole	1	EA	$ 1,181	$ 1,181	
INSTALLATIONS					
Trench and Backfill (2' x 3')	450	LF	$ 16	$ 7,200	
Combination Signal/Luminaire Pole	3	EA	$ 26,247	$ 78,741	
Signal Mast Arm Pole Foundation	3	EA	$ 9,843	$ 29,529	
Signal Pedistal Pole	1	EA	$ 4,856	$ 4,856	
Signal Pedistal Pole Foundation	1	EA	$ 2,887	$ 2,887	
Signal Mast Arm, 25' Length	0	EA	$ 6,562	$ -	
Signal Mast Arm, 30' Length	0	EA	$ 7,874	$ -	
Signal Mast Arm, 35' Length	0	EA	$ 9,187	$ -	
Signal Mast Arm, 40' Length	1	EA	$ 11,155	$ 11,155	
Signal Mast Arm, 45' Length	0	EA	$ 12,599	$ -	
Signal Mast Arm, 50' Length	0	EA	$ 14,042	$ -	
Signal Mast Arm, 60' Length	2	EA	$ 17,061	$ 34,122	
Pedestrian Pole	8	EA	$ 4,331	$ 34,648	
Pedestrian Pole foundation	8	EA	$ 3,543	$ 28,344	
12" 3-Face LED Signal Head	8	EA	$ 5,774	$ 46,192	
12" 4-Face LED Signal Head	0	EA	$ 6,562	$ -	
12" 5-Face LED Signal Head	2	EA	$ 8,399	$ 16,798	
Radar Detector	0	EA	$ 3,281	$ -	
Pedestrian LED Signal Head W/ Countdown	8	EA	$ 2,231	$ 17,848	
Pedestrian Pushbutton Assembly	8	EA	$ 1,706	$ 13,648	
Luminaire, 106W LED	3	EA	$ 1,969	$ 5,907	
Luminaire Arm, 15' Length	3	EA	$ 1,575	$ 4,725	
Luminaire Pole, (40' Mount Ht)	0	EA	$ 15,748	$ -	
Driven Pile Luminaire Pole Foundations	0	EA	$ 3,543	$ -	
Conductor, 3C #8 AWG XHHW-2 Cable	2500	LF	$ 7	$ 17,500	
2" Steel Conduit	900	LF	$ 39	$ 35,100	
3" Steel Conduit	1600	LF	$ 59	$ 94,400	
Junction Box (Type IA)	3	EA	$ 1,640	$ 4,920	
Junction Box (Type II)	2	EA	$ 3,281	$ 6,562	
Junction Box (Type III)	4	EA	$ 4,856	$ 19,424	
			Total:	$ 534,978	

Denali & 36th Signal					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	400	LF	$ 7	$ 2,800	
Remove Junction Box	10	EA	$ 656	$ 6,560	
Remove Control Cabinet	1	EA	$ 2,362	$ 2,362	
Remove Luminaire Pole	0	EA	$ 2,100	$ -	
Remove Signal Pole	4	EA	$ 3,281	$ 13,124	
Remove Pedestrian Pole	0	EA	$ 1,181	$ -	
INSTALLATIONS					
Trench and Backfill (2' x 3')	420	LF	$ 16	$ 6,720	
Combination Signal/Luminaire Pole	4	EA	$ 26,247	$ 104,988	
Signal Mast Arm Pole Foundation	4	EA	$ 9,843	$ 39,372	
Signal Pedistal Pole	0	EA	$ 4,856	$ -	
Signal Pedistal Pole Foundation	0	EA	$ 2,887	$ -	
Signal Mast Arm, 25' Length	0	EA	$ 6,562	$ -	
Signal Mast Arm, 30' Length	0	EA	$ 7,874	$ -	
Signal Mast Arm, 35' Length	1	EA	$ 9,187	$ 9,187	
Signal Mast Arm, 40' Length	2	EA	$ 11,155	$ 22,310	
Signal Mast Arm, 45' Length	1	EA	$ 12,599	$ 12,599	
Signal Mast Arm, 50' Length	0	EA	$ 14,042	$ -	
Signal Mast Arm, 60' Length	0	EA	$ 17,061	$ -	
Pedestrian Pole	8	EA	$ 4,331	$ 34,648	
Pedestrian Pole foundation	8	EA	$ 3,543	$ 28,344	
12" 3-Face LED Signal Head	8	EA	$ 5,774	$ 46,192	
12" 4-Face LED Signal Head	0	EA	$ 6,562	$ -	
12" 5-Face LED Signal Head	8	EA	$ 8,399	$ 67,192	
Radar Detector	2	EA	$ 3,281	$ 6,562	
Pedestrian LED Signal Head W/ Countdown	8	EA	$ 2,231	$ 17,848	
Pedestrian Pushbutton Assembly	8	EA	$ 1,706	$ 13,648	
Luminaire, 106W LED	4	EA	$ 1,969	$ 7,876	
Luminaire Arm, 15' Length	4	EA	$ 1,575	$ 6,300	
Luminaire Pole, (40' Mount Ht)	0	EA	$ 15,748	$ -	
Driven Pile Luminaire Pole Foundations	0	EA	$ 3,543	$ -	
Conductor, 3C #8 AWG XHHW-2 Cable	2350	LF	$ 7	$ 16,450	
2" Steel Conduit	850	LF	$ 39	$ 33,150	
3" Steel Conduit	1500	LF	$ 59	$ 88,500	
Junction Box (Type IA)	4	EA	$ 1,640	$ 6,560	
Junction Box (Type II)	2	EA	$ 3,281	$ 6,562	
Junction Box (Type III)	5	EA	$ 4,856	$ 24,280	
			Total:	$ 624,134	

Denali & 33rd Signal					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	390	LF	$ 7	$ 2,730	
Remove Junction Box	10	EA	$ 656	$ 6,560	
Remove Control Cabinet	1	EA	$ 2,362	$ 2,362	
Remove Luminaire Pole	0	EA	$ 2,100	$ -	
Remove Signal Pole	4	EA	$ 3,281	$ 13,124	
Remove Pedestrian Pole	0	EA	$ 1,181	$ -	
INSTALLATIONS					
Trench and Backfill (2' x 3')	400	LF	$ 16	$ 6,400	
Combination Signal/Luminaire Pole	4	EA	$ 26,247	$ 104,988	
Signal Mast Arm Pole Foundation	4	EA	$ 9,843	$ 39,372	
Signal Pedistal Pole	0	EA	$ 4,856	$ -	
Signal Pedistal Pole Foundation	0	EA	$ 2,887	$ -	
Signal Mast Arm, 25' Length	0	EA	$ 6,562	$ -	
Signal Mast Arm, 30' Length	0	EA	$ 7,874	$ -	
Signal Mast Arm, 35' Length	1	EA	$ 9,187	$ 9,187	
Signal Mast Arm, 40' Length	1	EA	$ 11,155	$ 11,155	
Signal Mast Arm, 45' Length	1	EA	$ 12,599	$ 12,599	
Signal Mast Arm, 50' Length	1	EA	$ 14,042	$ 14,042	
Signal Mast Arm, 60' Length	0	EA	$ 17,061	$ -	
Pedestrian Pole	8	EA	$ 4,331	$ 34,648	
Pedestrian Pole foundation	8	EA	$ 3,543	$ 28,344	
12" 3-Face LED Signal Head	8	EA	$ 5,774	$ 46,192	
12" 4-Face LED Signal Head	0	EA	$ 6,562	$ -	
12" 5-Face LED Signal Head	4	EA	$ 8,399	$ 33,596	
Radar Detector	2	EA	$ 3,281	$ 6,562	
Pedestrian LED Signal Head W/ Countdown	8	EA	$ 2,231	$ 17,848	
Pedestrian Pushbutton Assembly	8	EA	$ 1,706	$ 13,648	
Luminaire, 106W LED	4	EA	$ 1,969	$ 7,876	
Luminaire Arm, 15' Length	4	EA	$ 1,575	$ 6,300	
Luminaire Pole, (40' Mount Ht)	0	EA	$ 15,748	$ -	
Driven Pile Luminaire Pole Foundations	0	EA	$ 3,543	$ -	
Conductor, 3C #8 AWG XHHW-2 Cable	2200	LF	$ 7	$ 15,400	
2" Steel Conduit	800	LF	$ 39	$ 31,200	
3" Steel Conduit	1400	LF	$ 59	$ 82,600	
Junction Box (Type IA)	4	EA	$ 1,640	$ 6,560	
Junction Box (Type II)	2	EA	$ 3,281	$ 6,562	
Junction Box (Type III)	5	EA	$ 4,856	$ 24,280	
			Total:	$ 584,135	

Denali & Benson Signal					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	410	LF	$ 7	$ 2,870	
Remove Junction Box	7	EA	$ 656	$ 4,592	
Remove Control Cabinet	1	EA	$ 2,362	$ 2,362	
Remove Luminaire Pole	1	EA	$ 2,100	$ 2,100	
Remove Signal Pole	3	EA	$ 3,281	$ 9,843	
Remove Pedestrian Pole	0	EA	$ 1,181	$ -	
INSTALLATIONS					
Trench and Backfill (2' x 3')	400	LF	$ 16	$ 6,400	
Combination Signal/Luminaire Pole	3	EA	$ 26,247	$ 78,741	
Signal Mast Arm Pole Foundation	3	EA	$ 9,843	$ 29,529	
Signal Pedistal Pole	0	EA	$ 4,856	$ -	
Signal Pedistal Pole Foundation	0	EA	$ 2,887	$ -	
Signal Mast Arm, 25' Length	0	EA	$ 6,562	$ -	
Signal Mast Arm, 30' Length	0	EA	$ 7,874	$ -	
Signal Mast Arm, 35' Length	2	EA	$ 9,187	$ 18,374	
Signal Mast Arm, 40' Length	1	EA	$ 11,155	$ 11,155	
Signal Mast Arm, 45' Length	0	EA	$ 12,599	$ -	
Signal Mast Arm, 50' Length	1	EA	$ 14,042	$ 14,042	
Signal Mast Arm, 60' Length	0	EA	$ 17,061	$ -	
Pedestrian Pole	8	EA	$ 4,331	$ 34,648	
Pedestrian Pole foundation	8	EA	$ 3,543	$ 28,344	
12" 3-Face LED Signal Head	9	EA	$ 5,774	$ 51,966	
12" 4-Face LED Signal Head	1	EA	$ 6,562	$ 6,562	
12" 5-Face LED Signal Head	1	EA	$ 8,399	$ 8,399	
Radar Detector	2	EA	$ 3,281	$ 6,562	
Pedestrian LED Signal Head W/ Countdown	8	EA	$ 2,231	$ 17,848	
Pedestrian Pushbutton Assembly	8	EA	$ 1,706	$ 13,648	
Luminaire, 106W LED	4	EA	$ 1,969	$ 7,876	
Luminaire Arm, 15' Length	4	EA	$ 1,575	$ 6,300	
Luminaire Pole, (40' Mount Ht)	1	EA	$ 15,748	$ 15,748	
Driven Pile Luminaire Pole Foundations	1	EA	$ 3,543	$ 3,543	
Conductor, 3C #8 AWG XHHW-2 Cable	2300	LF	$ 7	$ 16,100	
2" Steel Conduit	850	LF	$ 39	$ 33,150	
3" Steel Conduit	1450	LF	$ 59	$ 85,550	
Junction Box (Type IA)	4	EA	$ 1,640	$ 6,560	
Junction Box (Type II)	2	EA	$ 3,281	$ 6,562	
Junction Box (Type III)	4	EA	$ 4,856	$ 19,424	
			Total:	$ 548,798	

Denali & N.Lights Signal					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	350	LF	$ 7	$ 2,450	
Remove Junction Box	6	EA	$ 656	$ 3,936	
Remove Control Cabinet	1	EA	$ 2,362	$ 2,362	
Remove Luminaire Pole	1	EA	$ 2,100	$ 2,100	
Remove Signal Pole	3	EA	$ 3,281	$ 9,843	
Remove Pedestrian Pole	0	EA	$ 1,181	$ -	
INSTALLATIONS					
Trench and Backfill (2' x 3')	375	LF	$ 16	$ 6,000	
Combination Signal/Luminaire Pole	3	EA	$ 26,247	$ 78,741	
Signal Mast Arm Pole Foundation	3	EA	$ 9,843	$ 29,529	
Signal Pedistal Pole	0	EA	$ 4,856	$ -	
Signal Pedistal Pole Foundation	0	EA	$ 2,887	$ -	
Signal Mast Arm, 25' Length	1	EA	$ 6,562	$ 6,562	
Signal Mast Arm, 30' Length	1	EA	$ 7,874	$ 7,874	
Signal Mast Arm, 35' Length	1	EA	$ 9,187	$ 9,187	
Signal Mast Arm, 40' Length	0	EA	$ 11,155	$ -	
Signal Mast Arm, 45' Length	0	EA	$ 12,599	$ -	
Signal Mast Arm, 50' Length	1	EA	$ 14,042	$ 14,042	
Signal Mast Arm, 60' Length	0	EA	$ 17,061	$ -	
Pedestrian Pole	8	EA	$ 4,331	$ 34,648	
Pedestrian Pole foundation	8	EA	$ 3,543	$ 28,344	
12" 3-Face LED Signal Head	11	EA	$ 5,774	$ 63,514	
12" 4-Face LED Signal Head	0	EA	$ 6,562	$ -	
12" 5-Face LED Signal Head	0	EA	$ 8,399	$ -	
Radar Detector	2	EA	$ 3,281	$ 6,562	
Pedestrian LED Signal Head W/ Countdown	8	EA	$ 2,231	$ 17,848	
Pedestrian Pushbutton Assembly	8	EA	$ 1,706	$ 13,648	
Luminaire, 106W LED	3	EA	$ 1,969	$ 5,907	
Luminaire Arm, 15' Length	3	EA	$ 1,575	$ 4,725	
Luminaire Pole, (40' Mount Ht)	1	EA	$ 15,748	$ 15,748	
Driven Pile Luminaire Pole Foundations	1	EA	$ 3,543	$ 3,543	
Conductor, 3C #8 AWG XHHW-2 Cable	1900	LF	$ 7	$ 13,300	
2" Steel Conduit	700	LF	$ 39	$ 27,300	
3" Steel Conduit	1200	LF	$ 59	$ 70,800	
Junction Box (Type IA)	2	EA	$ 1,640	$ 3,280	
Junction Box (Type II)	3	EA	$ 3,281	$ 9,843	
Junction Box (Type III)	4	EA	$ 4,856	$ 19,424	
			Total:	$ 511,060	

36th & A St Signal					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	500	LF	$ 7	$ 3,500	
Remove Junction Box	7	EA	$ 656	$ 4,592	
Remove Control Cabinet	1	EA	$ 2,362	$ 2,362	
Remove Luminaire Pole	1	EA	$ 2,100	$ 2,100	
Remove Signal Pole	3	EA	$ 3,281	$ 9,843	
Remove Pedestrian Pole	0	EA	$ 1,181	$ -	
INSTALLATIONS					
Trench and Backfill (2' x 3')	450	LF	$ 16	$ 7,200	
Combination Signal/Luminaire Pole	3	EA	$ 26,247	$ 78,741	
Signal Mast Arm Pole Foundation	3	EA	$ 9,843	$ 29,529	
Signal Pedistal Pole	0	EA	$ 4,856	$ -	
Signal Pedistal Pole Foundation	0	EA	$ 2,887	$ -	
Signal Mast Arm, 25' Length	1	EA	$ 6,562	$ 6,562	
Signal Mast Arm, 30' Length	0	EA	$ 7,874	$ -	
Signal Mast Arm, 35' Length	1	EA	$ 9,187	$ 9,187	
Signal Mast Arm, 40' Length	1	EA	$ 11,155	$ 11,155	
Signal Mast Arm, 45' Length	1	EA	$ 12,599	$ 12,599	
Signal Mast Arm, 50' Length	0	EA	$ 14,042	$ -	
Signal Mast Arm, 60' Length	0	EA	$ 17,061	$ -	
Pedestrian Pole	8	EA	$ 4,331	$ 34,648	
Pedestrian Pole foundation	8	EA	$ 3,543	$ 28,344	
12" 3-Face LED Signal Head	9	EA	$ 5,774	$ 51,966	
12" 4-Face LED Signal Head	2	EA	$ 6,562	$ 13,124	
12" 5-Face LED Signal Head	0	EA	$ 8,399	$ -	
Radar Detector	0	EA	$ 3,281	$ -	
Pedestrian LED Signal Head W/ Countdown	8	EA	$ 2,231	$ 17,848	
Pedestrian Pushbutton Assembly	8	EA	$ 1,706	$ 13,648	
Luminaire, 106W LED	2	EA	$ 1,969	$ 3,938	
Luminaire Arm, 15' Length	3	EA	$ 1,575	$ 4,725	
Luminaire Pole, (40' Mount Ht)	1	EA	$ 15,748	$ 15,748	
Driven Pile Luminaire Pole Foundations	1	EA	$ 3,543	$ 3,543	
Conductor, 3C #8 AWG XHHW-2 Cable	2550	LF	$ 7	$ 17,850	
2" Steel Conduit	950	LF	$ 39	$ 37,050	
3" Steel Conduit	1600	LF	$ 59	$ 94,400	
Junction Box (Type IA)	2	EA	$ 1,640	$ 3,280	
Junction Box (Type II)	3	EA	$ 3,281	$ 9,843	
Junction Box (Type III)	4	EA	$ 4,856	$ 19,424	
			Total:	$ 546,749	

36th & Old Seward Hwy Signal					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	450	LF	$ 7	$ 3,150	
Remove Junction Box	11	EA	$ 656	$ 7,216	
Remove Control Cabinet	1	EA	$ 2,362	$ 2,362	
Remove Luminaire Pole	0	EA	$ 2,100	$ -	
Remove Signal Pole	4	EA	$ 3,281	$ 13,124	
Remove Pedestrian Pole	0	EA	$ 1,181	$ -	
INSTALLATIONS					
Trench and Backfill (2' x 3')	450	LF	$ 16	$ 7,200	
Combination Signal/Luminaire Pole	4	EA	$ 26,247	$ 104,988	
Signal Mast Arm Pole Foundation	4	EA	$ 9,843	$ 39,372	
Signal Pedistal Pole	0	EA	$ 4,856	$ -	
Signal Pedistal Pole Foundation	0	EA	$ 2,887	$ -	
Signal Mast Arm, 25' Length	0	EA	$ 6,562	$ -	
Signal Mast Arm, 30' Length	0	EA	$ 7,874	$ -	
Signal Mast Arm, 35' Length	0	EA	$ 9,187	$ -	
Signal Mast Arm, 40' Length	2	EA	$ 11,155	$ 22,310	
Signal Mast Arm, 45' Length	2	EA	$ 12,599	$ 25,198	
Signal Mast Arm, 50' Length	0	EA	$ 14,042	$ -	
Signal Mast Arm, 60' Length	0	EA	$ 17,061	$ -	
Pedestrian Pole	8	EA	$ 4,331	$ 34,648	
Pedestrian Pole foundation	8	EA	$ 3,543	$ 28,344	
12" 3-Face LED Signal Head	8	EA	$ 5,774	$ 46,192	
12" 4-Face LED Signal Head	0	EA	$ 6,562	$ -	
12" 5-Face LED Signal Head	8	EA	$ 8,399	$ 67,192	
Radar Detector	0	EA	$ 3,281	$ -	
Pedestrian LED Signal Head W/ Countdown	8	EA	$ 2,231	$ 17,848	
Pedestrian Pushbutton Assembly	8	EA	$ 1,706	$ 13,648	
Luminaire, 106W LED	4	EA	$ 1,969	$ 7,876	
Luminaire Arm, 15' Length	4	EA	$ 1,575	$ 6,300	
Luminaire Pole, (40' Mount Ht)	0	EA	$ 15,748	$ -	
Driven Pile Luminaire Pole Foundations	0	EA	$ 3,543	$ -	
Conductor, 3C #8 AWG XHHW-2 Cable	2500	LF	$ 7	$ 17,500	
2" Steel Conduit	900	LF	$ 39	$ 35,100	
3" Steel Conduit	1600	LF	$ 59	$ 94,400	
Junction Box (Type IA)	4	EA	$ 1,640	$ 6,560	
Junction Box (Type II)	3	EA	$ 3,281	$ 9,843	
Junction Box (Type III)	5	EA	$ 4,856	$ 24,280	
			Total:	$ 634,651	

Lighting System Complete, Denali St					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	6000	LF	$ 6	$ 36,000	
Remove Junction Box	30	EA	$ 585	$ 17,550	
Remove Luminaire Pole	30	EA	$ 1,872	$ 56,160	
INSTALLATIONS			$ -		
Trench and Backfill (2' x 3')	6000	LF	$ 14	$ 84,000	
Luminaire, 106W LED	17	EA	$ 1,755	$ 29,835	
Luminaire Arm, 15' Length	17	EA	$ 1,404	$ 23,868	
Luminaire Pole, (40' Mount Ht)	17	EA	$ 14,040	$ 238,680	
Driven Pile Luminaire Pole Foundations	17	EA	$ 3,159	$ 53,703	
Conductor, 3C #8 AWG XHHW-2 Cable	6250	LF	$ 6	$ 37,500	
2" Steel Conduit	250	LF	$ 35	$ 8,750	
3" Steel Conduit	6000	LF	$ 53	$ 318,000	
Junction Box (Type IA)	17	EA	$ 1,463	$ 24,871	
Pedestrian Luminaire Pole (12')	0	EA	$ 3,861	$ -	
Pedestrian Luminaire, LED	0	EA	$ 1,170	$ -	
			Total:	$ 928,917	

Lighting System Complete, 36th Ave					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	3000	LF	$ 6	$ 18,000	
Remove Junction Box	14	EA	$ 585	$ 8,190	
Remove Luminaire Pole	14	EA	$ 1,872	$ 26,208	
INSTALLATIONS			$ -		
Trench and Backfill (2' x 3')	2900	LF	$ 14	$ 40,600	
Luminaire, 106W LED	16	EA	$ 1,755	$ 28,080	
Luminaire Arm, 15' Length	16	EA	$ 1,404	$ 22,464	
Luminaire Pole, (40' Mount Ht)	16	EA	$ 14,040	$ 224,640	
Driven Pile Luminaire Pole Foundations	16	EA	$ 3,159	$ 50,544	
Conductor, 3C #8 AWG XHHW-2 Cable	3800	LF	$ 6	$ 22,800	
2" Steel Conduit	800	LF	$ 35	$ 28,000	
3" Steel Conduit	3000	LF	$ 53	$ 159,000	
Junction Box (Type IA)	69	EA	$ 1,463	$ 100,947	
Pedestrian Luminaire Pole (12')	53	EA	$ 3,861	$ 204,633	
Pedestrian Luminaire, LED	53	EA	$ 1,170	$ 62,010	
			Total:	$ 996,116	

Denali St: Pedestrian Lighting					
Work Description	**Estimated Quantity**	**Units**	**Unit Price**	**Total Item Price**	**Remarks**
REMOVALS					
Remove Steel Conduit	0	LF	$ 6	$ -	
Remove Junction Box	0	EA	$ 585	$ -	
Remove Luminaire Pole	0	EA	$ 1,872	$ -	
INSTALLATIONS			$ -		
Trench and Backfill (2' x 3')	550	LF	$ 14	$ 7,700	
Luminaire, 106W LED	0	EA	$ 1,755	$ -	
Luminaire Arm, 15' Length	0	EA	$ 1,404	$ -	
Luminaire Pole, (40' Mount Ht)	0	EA	$ 14,040	$ -	
Driven Pile Luminaire Pole Foundations	0	EA	$ 3,159	$ -	
Conductor, 3C #8 AWG XHHW-2 Cable	0	LF	$ 6	$ -	
2" Steel Conduit	550	LF	$ 35	$ 19,250	
3" Steel Conduit	0	LF	$ 53	$ -	
Junction Box (Type IA)	52	EA	$ 1,463	$ 76,076	
Pedestrian Luminaire Pole (12')	52	EA	$ 3,861	$ 200,772	
Pedestrian Luminaire, LED	52	EA	$ 1,170	$ 60,840	
			Total:	$ 364,638	