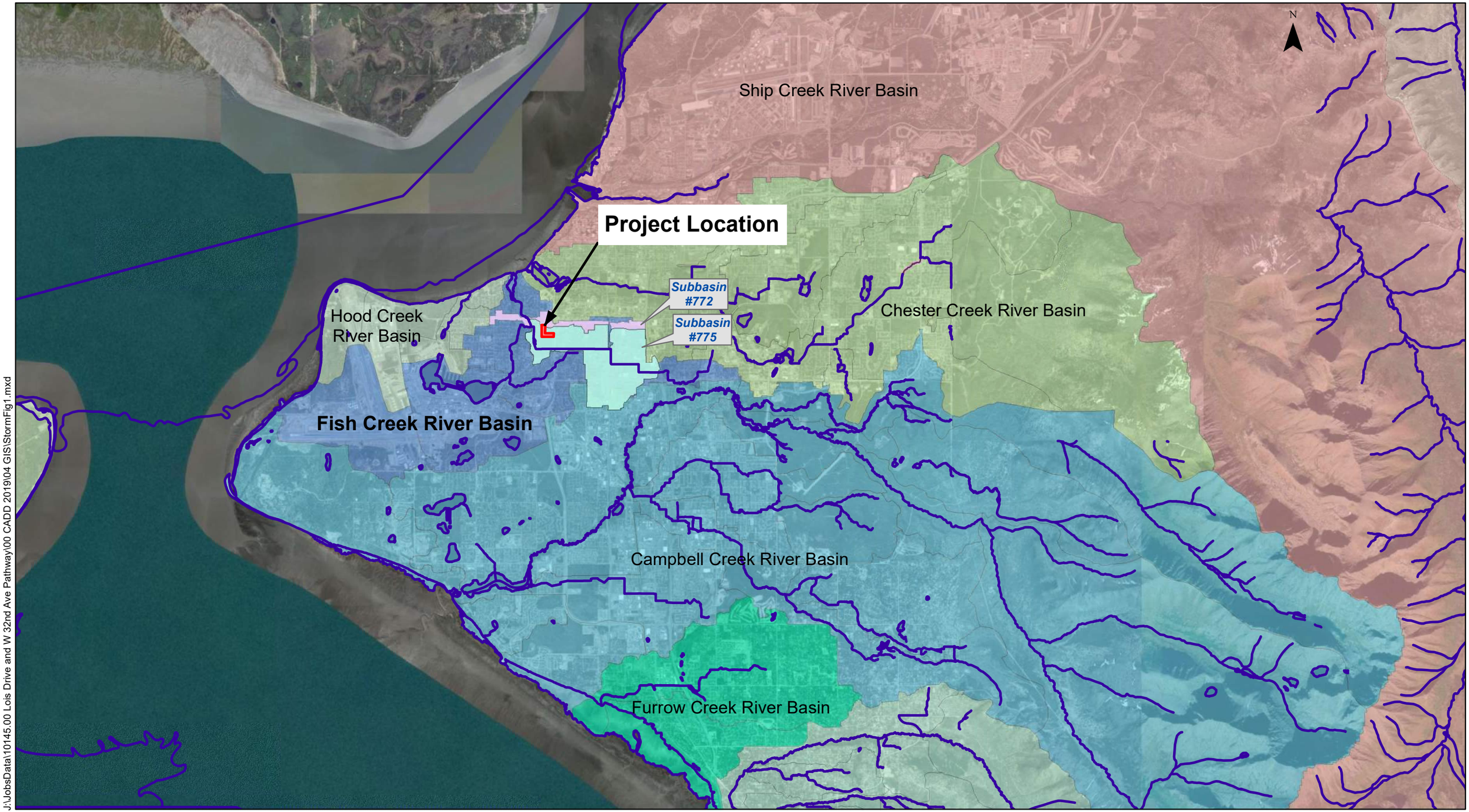
# Storm Drain Modeling Data & CCTV Storm Drain Condition Assessment Memorandum

# Appendix D




J:\JobsData\10145.00 Lois Drive and W 32nd Ave Pathway\00 CADD 2019\04 GIS\StormFig1.mxd

| | |
|---|---|
| **Project Location and Subbasin**<br>**Lois Drive & W. 32nd Avenue Pathway Design Study Report** | **Date: AUG 2020**<br>**Figure: 1** |

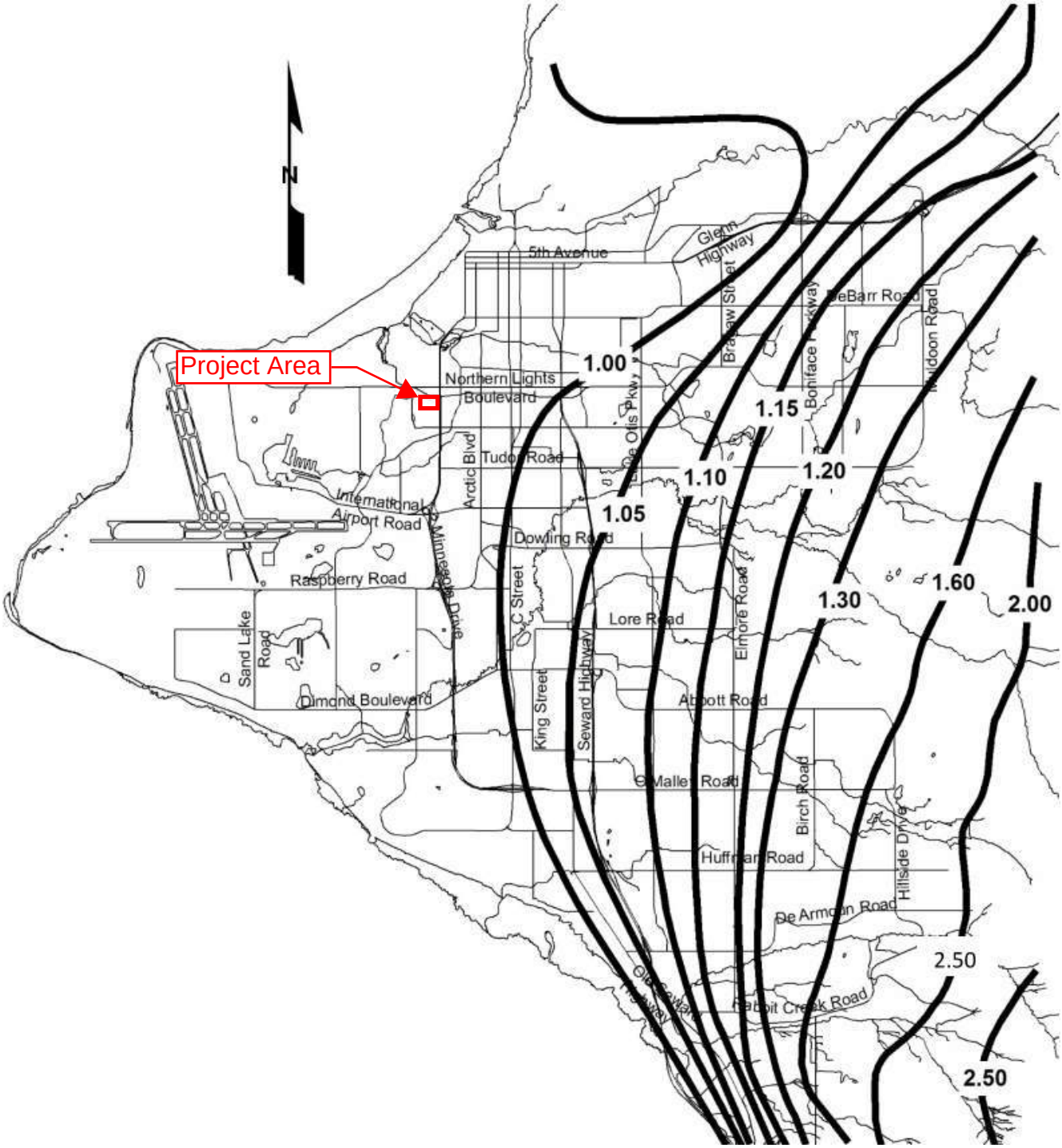



***Figure 2: Orographic Factor Map (Anchorage)***

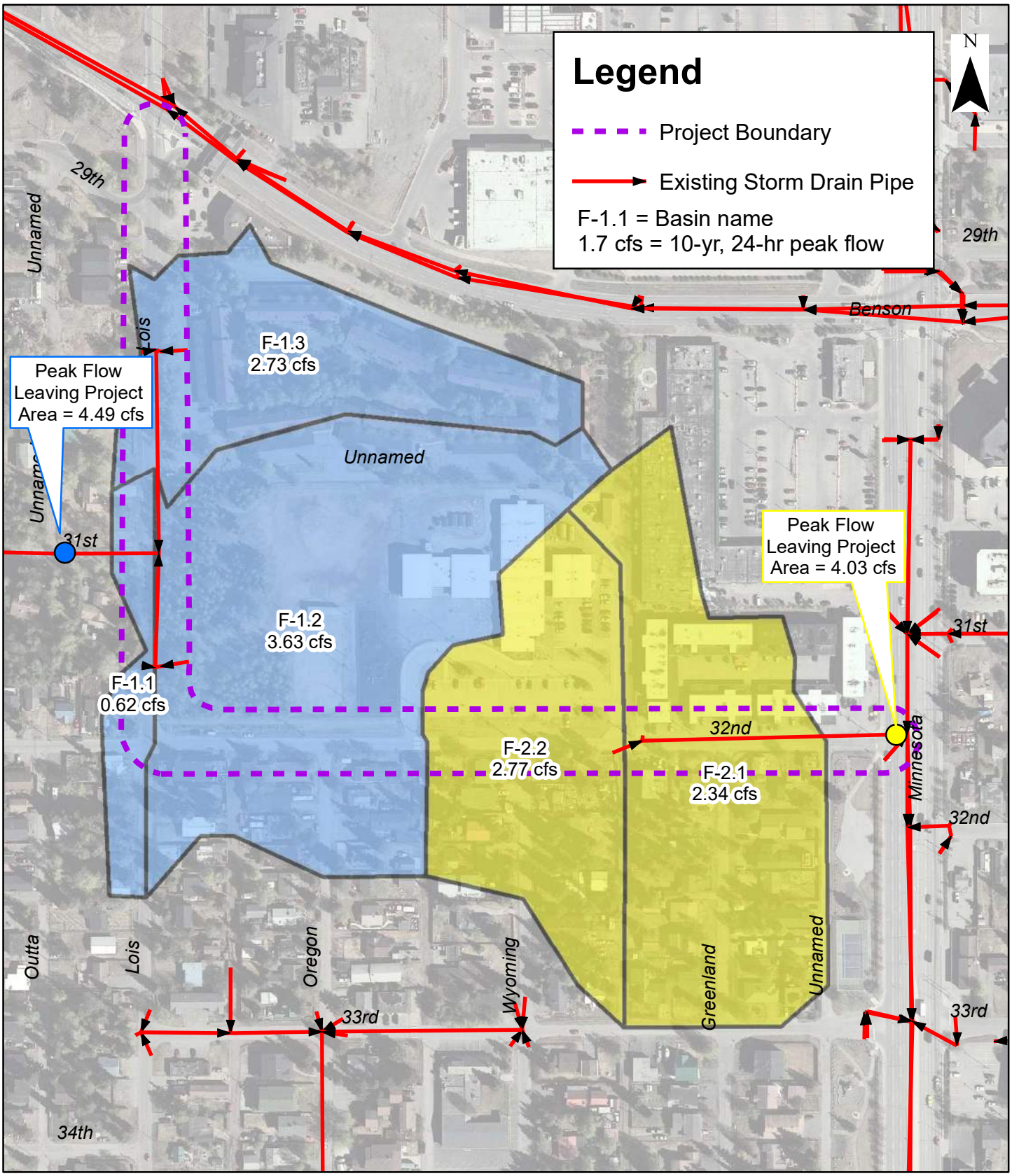



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**Figure 3**
**Existing Stormwater System**

**Lois Drive & 32nd Avenue Pathway**
**Design Study Report**

**Date: AUG 2020**

CRW ENGINEERING GROUP, LLC

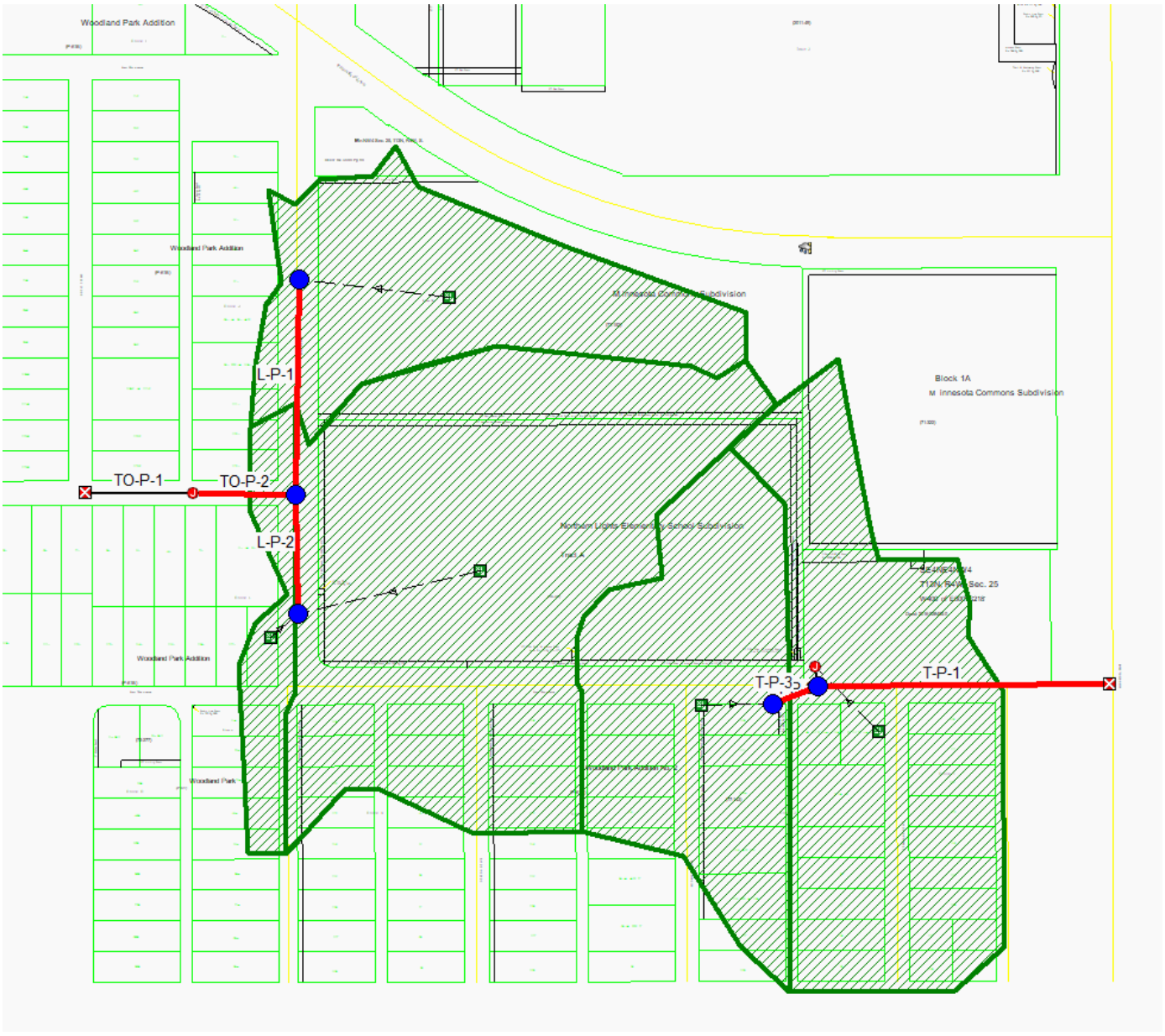



***Figure 4: Existing Model Pipe Layout***

## Project Description

| | |
|---|---|
| File Name | 10145.00 Lois32ndStormExisting.SPF |

## Project Options

| | |
|---|---|
| Flow Units | CFS |
| Elevation Type | Elevation |
| Hydrology Method | SCS TR-55 |
| Time of Concentration (TOC) Method | SCS TR-55 |
| Link Routing Method | Kinematic Wave |
| Enable Overflow Ponding at Nodes | YES |
| Skip Steady State Analysis Time Periods | NO |

## Analysis Options

| | | |
|---|---|---|
| Start Analysis On | Apr 30, 2020 | 00:00:00 |
| End Analysis On | May 01, 2020 | 00:00:00 |
| Start Reporting On | Apr 30, 2020 | 00:00:00 |
| Antecedent Dry Days | 0 | days |
| Runoff (Dry Weather) Time Step | 0 01:00:00 | days hh:mm:ss |
| Runoff (Wet Weather) Time Step | 0 00:05:00 | days hh:mm:ss |
| Reporting Time Step | 0 00:05:00 | days hh:mm:ss |
| Routing Time Step | 30 | seconds |

## Number of Elements

| | Qty |
|---|---|
| Rain Gages | 1 |
| Subbasins | 5 |
| Nodes | 9 |
| *Junctions* | 7 |
| *Outfalls* | 2 |
| *Flow Diversions* | 0 |
| *Inlets* | 0 |
| *Storage Nodes* | 0 |
| Links | 7 |
| *Channels* | 0 |
| *Pipes* | 7 |
| *Pumps* | 0 |
| *Orifices* | 0 |
| *Weirs* | 0 |
| *Outlets* | 0 |
| Pollutants | 0 |
| Land Uses | 0 |

## Rainfall Details

| SN | Rain Gage ID | Data Source | Data Source ID | Rainfall Type | Rain Units | State | County | Return Period (years) | Rainfall Depth (inches) | Rainfall Distribution |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Rain Gage-01 | Time Series | 10-year, 24-hour, Anchorage | Cumulative | inches | | | | 0.00 | |

## Subbasin Summary

| SN | Subbasin ID | Area (ac) | Weighted Curve Number | Total Rainfall (in) | Total Runoff (in) | Total Runoff Volume (ac-in) | Peak Runoff (cfs) | Time of Concentration (days hh:mm:ss) |
|---|---|---|---|---|---|---|---|---|
| 1 | F-1.1 | 1.07 | 89.59 | 2.28 | 1.31 | 1.40 | 0.62 | 0 00:24:35 |
| 2 | F-1.2 | 9.41 | 85.82 | 2.28 | 1.06 | 9.93 | 3.63 | 0 00:34:51 |
| 3 | F-1.3 | 4.13 | 90.00 | 2.28 | 1.34 | 5.52 | 2.73 | 0 00:19:34 |
| 4 | F-2.1 | 6.24 | 87.83 | 2.28 | 1.18 | 7.39 | 2.34 | 0 00:45:38 |
| 5 | F-2.2 | 4.61 | 92.00 | 2.28 | 1.49 | 6.87 | 2.77 | 0 00:29:07 |

# Subbasin Hydrology

## Subbasin : F-1.1

### Input Data

Area (ac) ..... 1.07
Weighted Curve Number ..... 89.59
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| Paved roads with curbs & sewers | 0.47 | C | 98.00 |
| 1/4 acre lots, 38% impervious | 0.60 | C | 83.00 |
| Composite Area & Weighted CN | 1.07 | | 89.59 |

### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .4 | 0.00 | 0.00 |
| Flow Length (ft) : | 38 | 0.00 | 0.00 |
| Slope (%) : | 2.63 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.05 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 12.96 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | 0.019 | 0.00 | 0.00 |
| Flow Length (ft) : | 365 | 0.00 | 0.00 |
| Channel Slope (%) : | .82 | 0.00 | 0.00 |
| Cross Section Area ($ft^2$) : | 0.08 | 0.00 | 0.00 |
| Wetted Perimeter (ft) : | 4 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.52 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 11.63 | 0.00 | 0.00 |

Total TOC (min) .....24.59

**Subbasin Runoff Results**

| | |
|---|---|
| Total Rainfall (in) | 2.28 |
| Total Runoff (in) | 1.31 |
| Peak Runoff (cfs) | 0.62 |
| Weighted Curve Number | 89.59 |
| Time of Concentration (days hh:mm:ss) | 0 00:24:35 |

## Subbasin : F-1.2

### Input Data

Area (ac) ..... 9.41
Weighted Curve Number ..... 85.82
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| Woods, Poor | 1.74 | C | 77.00 |
| > 75% grass cover, Good | 1.68 | C | 74.00 |
| 1/8 acre lots, 65% impervious | 3.44 | C | 90.00 |
| Urban commercial, 85% imp | 2.55 | C | 94.00 |
| Composite Area & Weighted CN | 9.41 | | 85.82 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .15 | 0.00 | 0.00 |
| Flow Length (ft) : | 106 | 0.00 | 0.00 |
| Slope (%) : | .94 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.09 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 20.28 | 0.00 | 0.00 |

| Shallow Concentrated Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Flow Length (ft) : | 258 | 484 | 0.00 |
| Slope (%) : | 1.16 | .83 | 0.00 |
| Surface Type : | Paved | rass pastu | Unpaved |
| Velocity (ft/sec) : | 2.19 | 0.64 | 0.00 |
| Computed Flow Time (min) : | 1.96 | 12.60 | 0.00 |

Total TOC (min) .....34.85

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.06
Peak Runoff (cfs) ..... 3.63
Weighted Curve Number ..... 85.82
Time of Concentration (days hh:mm:ss) ..... 0 00:34:51

## Subbasin : F-1.3

### Input Data

Area (ac) ..... 4.13
Weighted Curve Number ..... 90.00
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| 1/8 acre lots, 65% impervious | 4.55 | C | 90.00 |
| Composite Area & Weighted CN | 4.55 | | 90.00 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .15 | 0.00 | 0.00 |
| Flow Length (ft) : | 44 | 0.00 | 0.00 |
| Slope (%) : | 2.27 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.10 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 7.05 | 0.00 | 0.00 |

| Shallow Concentrated Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Flow Length (ft) : | 276 | 0.00 | 0.00 |
| Slope (%) : | .36 | 0.00 | 0.00 |
| Surface Type : | Paved | Unpaved | Unpaved |
| Velocity (ft/sec) : | 1.22 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 3.77 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .013 | .03 | 0.00 |
| Flow Length (ft) : | 410 | 147 | 0.00 |
| Channel Slope (%) : | .49 | .68 | 0.00 |
| Cross Section Area ($ft^2$) : | .33 | .5 | 0.00 |
| Wetted Perimeter (ft) : | 8 | 2.24 | 0.00 |
| Velocity (ft/sec) : | 0.96 | 1.51 | 0.00 |
| Computed Flow Time (min) : | 7.13 | 1.63 | 0.00 |

Total TOC (min) .....19.58

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.34
Peak Runoff (cfs) ..... 2.73
Weighted Curve Number ..... 90.00
Time of Concentration (days hh:mm:ss) ..... 0 00:19:35

## Subbasin : F-2.1

### Input Data

Area (ac) ..... 6.24
Weighted Curve Number ..... 87.83
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| Urban commercial, 85% imp | 2.74 | C | 94.00 |
| 1/4 acre lots, 38% impervious | 3.50 | C | 83.00 |
| Composite Area & Weighted CN | 6.24 | | 87.83 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .4 | 0.00 | 0.00 |
| Flow Length (ft) : | 48 | 0.00 | 0.00 |
| Slope (%) : | 2.08 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.05 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 17.16 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .023 | 0.00 | 0.00 |
| Flow Length (ft) : | 692 | 0.00 | 0.00 |
| Channel Slope (%) : | .72 | 0.00 | 0.00 |
| Cross Section Area (ft²) : | .08 | 0.00 | 0.00 |
| Wetted Perimeter (ft) : | 4 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.41 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 28.48 | 0.00 | 0.00 |

Total TOC (min) .....45.64

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.18
Peak Runoff (cfs) ..... 2.34
Weighted Curve Number ..... 87.83
Time of Concentration (days hh:mm:ss) ..... 0 00:45:38

## Subbasin : F-2.2

### Input Data

Area (ac) ..... 4.61
Weighted Curve Number ..... 92.00
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| 1/8 acre lots, 65% impervious | 2.30 | C | 90.00 |
| Urban commercial, 85% imp | 2.31 | C | 94.00 |
| Composite Area & Weighted CN | 4.61 | | 92.00 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .35 | 0.00 | 0.00 |
| Flow Length (ft) : | 60 | 0.00 | 0.00 |
| Slope (%) : | 1.67 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.05 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 20.13 | 0.00 | 0.00 |

| Shallow Concentrated Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Flow Length (ft) : | 31 | 0.00 | 0.00 |
| Slope (%) : | 3.22 | 0.00 | 0.00 |
| Surface Type : | Unpaved | Unpaved | Unpaved |
| Velocity (ft/sec) : | 2.90 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 0.18 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .033 | 0.00 | 0.00 |
| Flow Length (ft) : | 349 | 0.00 | 0.00 |
| Channel Slope (%) : | .29 | 0.00 | 0.00 |
| Cross Section Area ($ft^2$) : | .167 | 0.00 | 0.00 |
| Wetted Perimeter (ft) : | 1.18 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.66 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 8.81 | 0.00 | 0.00 |

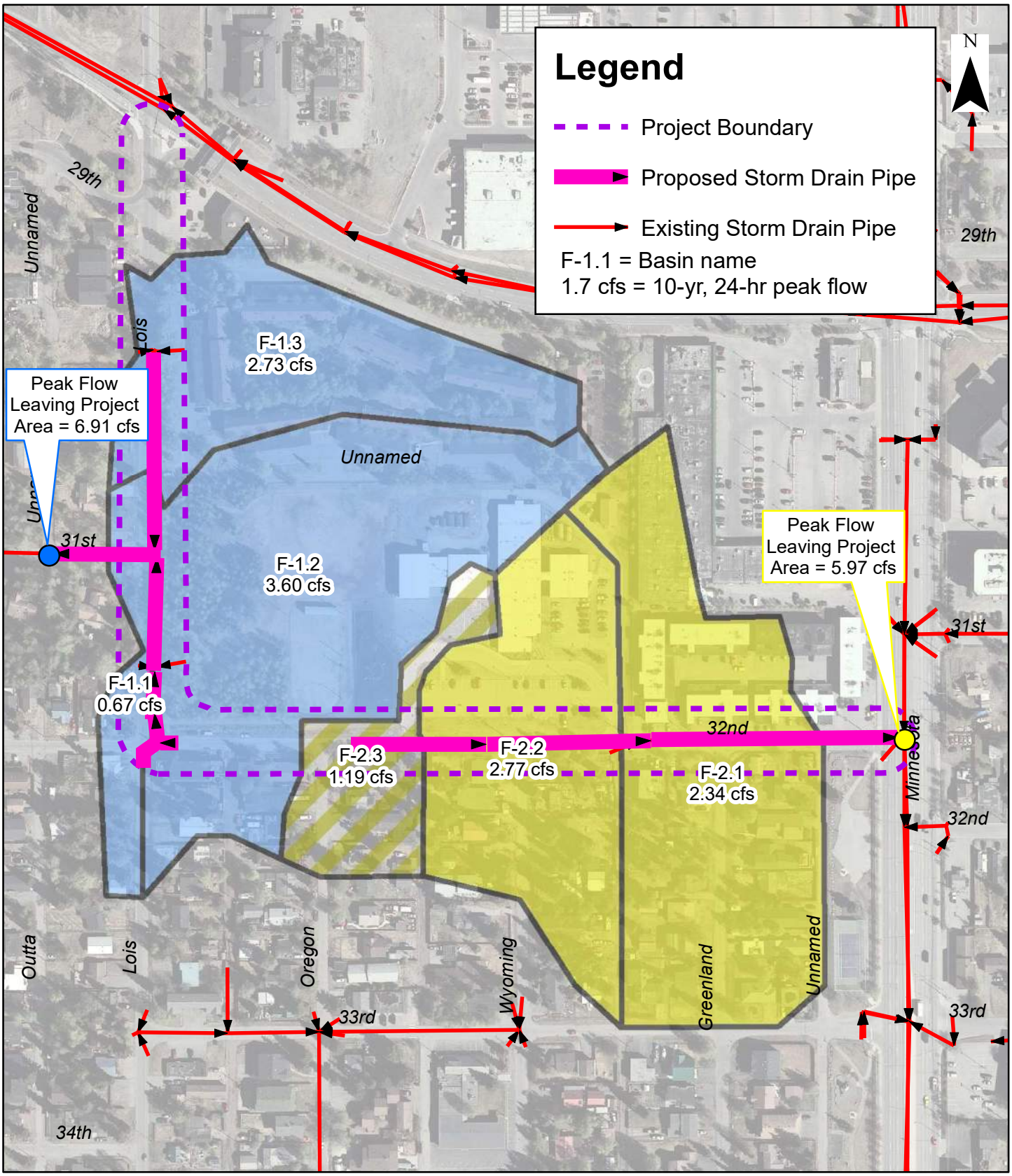
Total TOC (min) .....29.12

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.49
Peak Runoff (cfs) ..... 2.77
Weighted Curve Number ..... 92.00
Time of Concentration (days hh:mm:ss) ..... 0 00:29:07

## Pipe Results

| SN | Element ID | Peak Flow (cfs) | Time of Peak Flow Occurrence (days hh:mm) | Design Flow Capacity (cfs) | Peak Flow/ Design Flow Ratio | Peak Flow Velocity (ft/sec) | Travel Time (min) | Peak Flow Depth (ft) | Peak Flow Depth/ Total Depth Ratio | Total Time Surcharged (min) | Froude Number | Reported Condition |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | TO-P-1 | 2.21 | 0 12:16 | 2.04 | 1.08 | 3.16 | 1.82 | 1.00 | 1.00 | 11.00 | | SURCHARGED |
| 2 | L-P-1 | 2.64 | 0 12:16 | 2.45 | 1.08 | 3.69 | 0.87 | 1.00 | 1.00 | 32.00 | | SURCHARGED |
| 3 | L-P-2 | 4.49 | 0 12:30 | 4.21 | 1.07 | 4.00 | 0.65 | 1.25 | 1.00 | 14.00 | | SURCHARGED |
| 4 | TO-P-2 | 4.03 | 0 12:35 | 3.72 | 1.08 | 3.63 | 2.16 | 1.25 | 1.00 | 6.00 | | SURCHARGED |
| 5 | T-P-1 | 2.34 | 0 12:35 | 4.25 | 0.55 | 5.54 | 0.04 | 0.53 | 0.53 | 0.00 | | Calculated |
| 6 | T-P-2 | 2.08 | 0 12:36 | 1.93 | 1.08 | 2.84 | 0.16 | 1.00 | 1.00 | 21.00 | | SURCHARGED |
| 7 | T-P-3 | | | | | | | | | | | |




J:\JobsData\10145.00 Lois Drive and W 32nd Ave Pathway\00 CADD 2019\04 GIS\Lois & 32nd StormProposed.mxd

0 62.5 125 250 375 500 Feet

**Figure 5**
**Proposed Stormwater System**

**Lois Drive & 32nd Avenue Pathway**
**Design Study Report**

**Date: AUG 2020**

CRW ENGINEERING GROUP, LLC

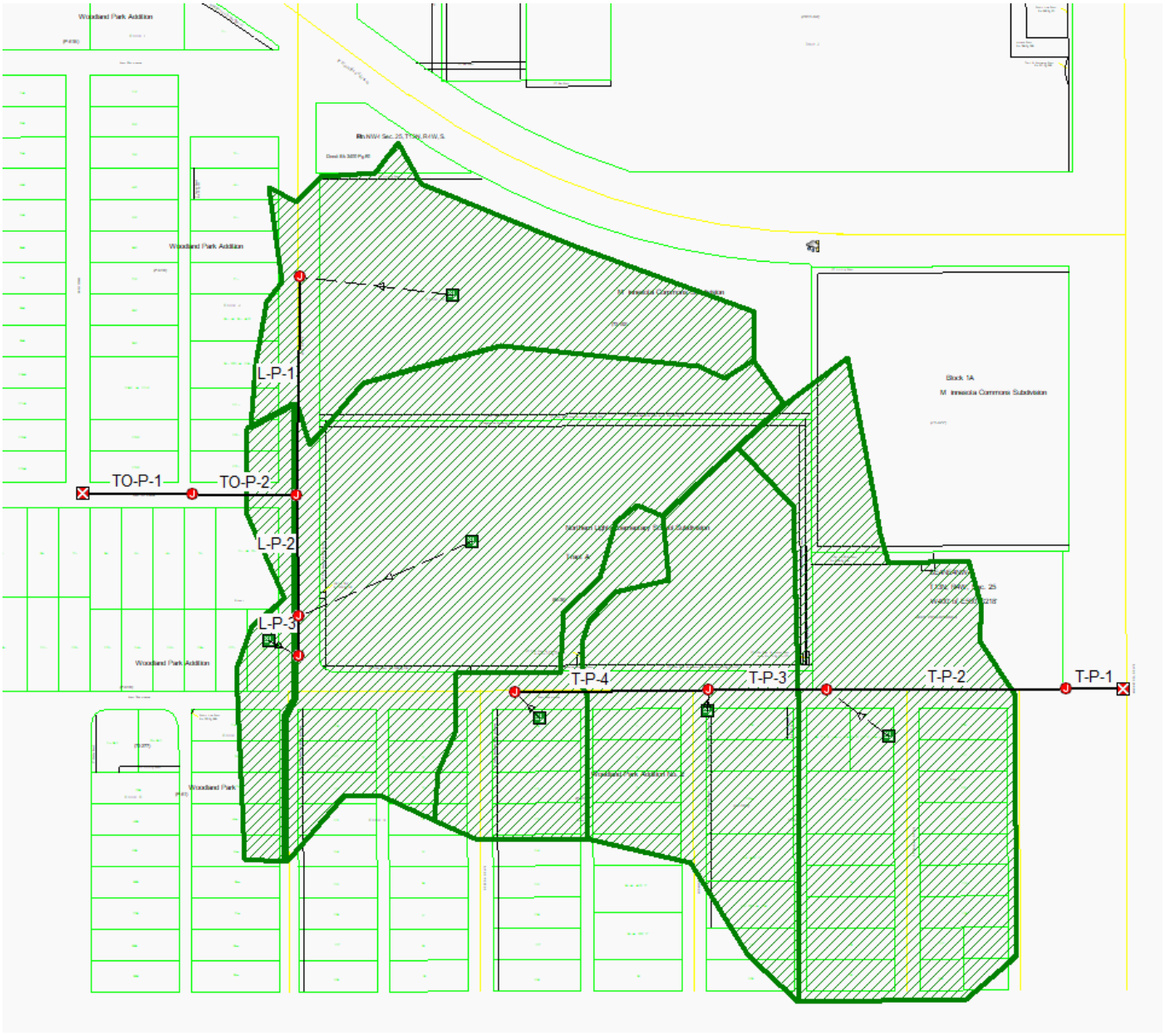



***Figure 6: Proposed Model Pipe Layout***

## Project Description

| | |
|---|---|
| File Name | 10145.00 Lois32ndStormProposed.SPF |

## Project Options

| | |
|---|---|
| Flow Units | CFS |
| Elevation Type | Elevation |
| Hydrology Method | SCS TR-55 |
| Time of Concentration (TOC) Method | SCS TR-55 |
| Link Routing Method | Kinematic Wave |
| Enable Overflow Ponding at Nodes | YES |
| Skip Steady State Analysis Time Periods | NO |

## Analysis Options

| | | |
|---|---|---|
| Start Analysis On | Apr 30, 2020 | 00:00:00 |
| End Analysis On | May 01, 2020 | 00:00:00 |
| Start Reporting On | Apr 30, 2020 | 00:00:00 |
| Antecedent Dry Days | 0 | days |
| Runoff (Dry Weather) Time Step | 0 01:00:00 | days hh:mm:ss |
| Runoff (Wet Weather) Time Step | 0 00:05:00 | days hh:mm:ss |
| Reporting Time Step | 0 00:05:00 | days hh:mm:ss |
| Routing Time Step | 30 | seconds |

## Number of Elements

| | Qty |
|---|---|
| Rain Gages | 1 |
| Subbasins | 6 |
| Nodes | 11 |
| *Junctions* | 9 |
| *Outfalls* | 2 |
| *Flow Diversions* | 0 |
| *Inlets* | 0 |
| *Storage Nodes* | 0 |
| Links | 9 |
| *Channels* | 0 |
| *Pipes* | 9 |
| *Pumps* | 0 |
| *Orifices* | 0 |
| *Weirs* | 0 |
| *Outlets* | 0 |
| Pollutants | 0 |
| Land Uses | 0 |

## Rainfall Details

| SN | Rain Gage ID | Data Source | Data Source ID | Rainfall Type | Rain Units | State | County | Return Period (years) | Rainfall Depth (inches) | Rainfall Distribution |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Rain Gage-01 | Time Series | 10-year, 24-hour, Anchorage | Cumulative | inches | | | | 0.00 | |

## Subbasin Summary

| SN | Subbasin ID | Area (ac) | Weighted Curve Number | Total Rainfall (in) | Total Runoff (in) | Total Runoff Volume (ac-in) | Peak Runoff (cfs) | Time of Concentration (days hh:mm:ss) |
|---|---|---|---|---|---|---|---|---|
| 1 | F-1.1 | 1.07 | 89.59 | 2.28 | 1.31 | 1.40 | 0.67 | 0 00:20:38 |
| 2 | F-1.2 | 7.69 | 84.44 | 2.28 | 0.97 | 7.48 | 3.60 | 0 00:20:16 |
| 3 | F-1.3 | 4.13 | 90.00 | 2.28 | 1.34 | 5.52 | 2.73 | 0 00:19:34 |
| 4 | F-2.1 | 6.24 | 87.83 | 2.28 | 1.18 | 7.39 | 2.34 | 0 00:45:38 |
| 5 | F-2.2 | 4.61 | 92.00 | 2.28 | 1.49 | 6.87 | 2.77 | 0 00:29:07 |
| 6 | F-2.3 | 1.72 | 94.00 | 2.28 | 1.66 | 2.86 | 1.19 | 0 00:26:39 |

# Subbasin Hydrology

## Subbasin : F-1.1

### Input Data

Area (ac) ..... 1.07
Weighted Curve Number ..... 89.59
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| Paved roads with curbs & sewers | 0.47 | C | 98.00 |
| 1/4 acre lots, 38% impervious | 0.60 | C | 83.00 |
| Composite Area & Weighted CN | 1.07 | | 89.59 |

### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .4 | 0.00 | 0.00 |
| Flow Length (ft) : | 38 | 0.00 | 0.00 |
| Slope (%) : | 2.63 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.05 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 12.96 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | 0.019 | 0.00 | 0.00 |
| Flow Length (ft) : | 192 | 0.00 | 0.00 |
| Channel Slope (%) : | .52 | 0.00 | 0.00 |
| Cross Section Area ($ft^2$) : | 0.08 | 0.00 | 0.00 |
| Wetted Perimeter (ft) : | 4 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.42 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 7.68 | 0.00 | 0.00 |

Total TOC (min) .....20.64

**Subbasin Runoff Results**

| | |
|---|---|
| Total Rainfall (in) | 2.28 |
| Total Runoff (in) | 1.31 |
| Peak Runoff (cfs) | 0.67 |
| Weighted Curve Number | 89.59 |
| Time of Concentration (days hh:mm:ss) | 0 00:20:38 |

## Subbasin : F-1.2

### Input Data

Area (ac) ..... 7.69
Weighted Curve Number ..... 84.44
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| Woods, Poor | 1.74 | C | 77.00 |
| > 75% grass cover, Good | 1.68 | C | 74.00 |
| 1/8 acre lots, 65% impervious | 2.58 | C | 90.00 |
| Urban commercial, 85% imp | 1.69 | C | 94.00 |
| Composite Area & Weighted CN | 7.69 | | 84.44 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .15 | 0.00 | 0.00 |
| Flow Length (ft) : | 106 | 0.00 | 0.00 |
| Slope (%) : | .94 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.09 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 20.28 | 0.00 | 0.00 |

Total TOC (min) .....20.28

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 0.97
Peak Runoff (cfs) ..... 3.60
Weighted Curve Number ..... 84.44
Time of Concentration (days hh:mm:ss) ..... 0 00:20:17

## Subbasin : F-1.3

### Input Data

Area (ac) ..... 4.13
Weighted Curve Number ..... 90.00
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| 1/8 acre lots, 65% impervious | 4.55 | C | 90.00 |
| Composite Area & Weighted CN | 4.55 | | 90.00 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .15 | 0.00 | 0.00 |
| Flow Length (ft) : | 44 | 0.00 | 0.00 |
| Slope (%) : | 2.27 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.10 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 7.05 | 0.00 | 0.00 |

| Shallow Concentrated Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Flow Length (ft) : | 276 | 0.00 | 0.00 |
| Slope (%) : | .36 | 0.00 | 0.00 |
| Surface Type : | Paved | Unpaved | Unpaved |
| Velocity (ft/sec) : | 1.22 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 3.77 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .013 | .03 | 0.00 |
| Flow Length (ft) : | 410 | 147 | 0.00 |
| Channel Slope (%) : | .49 | .68 | 0.00 |
| Cross Section Area ($ft^2$) : | .33 | .5 | 0.00 |
| Wetted Perimeter (ft) : | 8 | 2.24 | 0.00 |
| Velocity (ft/sec) : | 0.96 | 1.51 | 0.00 |
| Computed Flow Time (min) : | 7.13 | 1.63 | 0.00 |

Total TOC (min) .....19.58

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.34
Peak Runoff (cfs) ..... 2.73
Weighted Curve Number ..... 90.00
Time of Concentration (days hh:mm:ss) ..... 0 00:19:35

## Subbasin : F-2.1

### Input Data

Area (ac) ..... 6.24
Weighted Curve Number ..... 87.83
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| Urban commercial, 85% imp | 2.74 | C | 94.00 |
| 1/4 acre lots, 38% impervious | 3.50 | C | 83.00 |
| Composite Area & Weighted CN | 6.24 | | 87.83 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .4 | 0.00 | 0.00 |
| Flow Length (ft) : | 48 | 0.00 | 0.00 |
| Slope (%) : | 2.08 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.05 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 17.16 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .023 | 0.00 | 0.00 |
| Flow Length (ft) : | 692 | 0.00 | 0.00 |
| Channel Slope (%) : | .72 | 0.00 | 0.00 |
| Cross Section Area (ft²) : | .08 | 0.00 | 0.00 |
| Wetted Perimeter (ft) : | 4 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.41 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 28.48 | 0.00 | 0.00 |

Total TOC (min) .....45.64

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.18
Peak Runoff (cfs) ..... 2.34
Weighted Curve Number ..... 87.83
Time of Concentration (days hh:mm:ss) ..... 0 00:45:38

## Subbasin : F-2.2

### Input Data

Area (ac) ..... 4.61
Weighted Curve Number ..... 92.00
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| 1/8 acre lots, 65% impervious | 2.30 | C | 90.00 |
| Urban commercial, 85% imp | 2.31 | C | 94.00 |
| Composite Area & Weighted CN | 4.61 | | 92.00 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .35 | 0.00 | 0.00 |
| Flow Length (ft) : | 60 | 0.00 | 0.00 |
| Slope (%) : | 1.67 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.05 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 20.13 | 0.00 | 0.00 |

| Shallow Concentrated Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Flow Length (ft) : | 31 | 0.00 | 0.00 |
| Slope (%) : | 3.22 | 0.00 | 0.00 |
| Surface Type : | Unpaved | Unpaved | Unpaved |
| Velocity (ft/sec) : | 2.90 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 0.18 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .033 | 0.00 | 0.00 |
| Flow Length (ft) : | 349 | 0.00 | 0.00 |
| Channel Slope (%) : | .29 | 0.00 | 0.00 |
| Cross Section Area ($ft^2$) : | .167 | 0.00 | 0.00 |
| Wetted Perimeter (ft) : | 1.18 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.66 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 8.81 | 0.00 | 0.00 |

Total TOC (min) .....29.12

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.49
Peak Runoff (cfs) ..... 2.77
Weighted Curve Number ..... 92.00
Time of Concentration (days hh:mm:ss) ..... 0 00:29:07

## Subbasin : F-2.3

### Input Data

Area (ac) ..... 1.72
Weighted Curve Number ..... 94.00
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

| Soil/Surface Description | Area (acres) | Soil Group | Curve Number |
|---|---|---|---|
| 1/8 acre lots, 65% impervious | 0.86 | C | 90.00 |
| Paved parking & roofs | 0.86 | C | 98.00 |
| Composite Area & Weighted CN | 1.72 | | 94.00 |

### Time of Concentration

| Sheet Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .2 | 0.00 | 0.00 |
| Flow Length (ft) : | 98 | 0.00 | 0.00 |
| Slope (%) : | 1.02 | 0.00 | 0.00 |
| 2 yr, 24 hr Rainfall (in) : | 1.50 | 0.00 | 0.00 |
| Velocity (ft/sec) : | 0.07 | 0.00 | 0.00 |
| Computed Flow Time (min) : | 23.20 | 0.00 | 0.00 |

| Channel Flow Computations | Subarea A | Subarea B | Subarea C |
|---|---|---|---|
| Manning's Roughness : | .019 | .013 | 0.00 |
| Flow Length (ft) : | 106 | 48 | 0.00 |
| Channel Slope (%) : | .94 | 2.08 | 0.00 |
| Cross Section Area ($ft^2$) : | .08 | .08 | 0.00 |
| Wetted Perimeter (ft) : | 4 | 1.18 | 0.00 |
| Velocity (ft/sec) : | 0.56 | 2.75 | 0.00 |
| Computed Flow Time (min) : | 3.15 | 0.29 | 0.00 |

Total TOC (min) .....26.65

### Subbasin Runoff Results

Total Rainfall (in) ..... 2.28
Total Runoff (in) ..... 1.66
Peak Runoff (cfs) ..... 1.19
Weighted Curve Number ..... 94.00
Time of Concentration (days hh:mm:ss) ..... 0 00:26:39

## Pipe Results

| SN | Element ID | Peak Flow (cfs) | Time of Peak Flow Occurrence (days hh:mm) | Design Flow Capacity (cfs) | Peak Flow/ Design Flow Ratio | Peak Flow Velocity (ft/sec) | Travel Time (min) | Peak Flow Depth (ft) | Peak Flow Depth/ Total Depth Ratio | Total Time Surcharged (min) | Froude Number | Reported Condition |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | L-P-1 | 2.69 | 0 12:21 | 7.42 | 0.36 | 3.88 | 1.39 | 0.62 | 0.42 | 0.00 | | Calculated |
| 2 | L-P-2 | 4.24 | 0 12:20 | 7.43 | 0.57 | 4.35 | 0.66 | 0.81 | 0.54 | 0.00 | | Calculated |
| 3 | L-P-3 | 0.67 | 0 12:20 | 10.48 | 0.06 | 3.32 | 0.42 | 0.26 | 0.17 | 0.00 | | Calculated |
| 4 | TO-P-1 | 6.89 | 0 12:21 | 12.05 | 0.57 | 10.16 | 0.29 | 0.67 | 0.54 | 0.00 | | Calculated |
| 5 | TO-P-2 | 6.91 | 0 12:21 | 18.19 | 0.38 | 9.59 | 0.30 | 0.64 | 0.43 | 0.00 | | Calculated |
| 6 | T-P-1 | 5.97 | 0 12:29 | 12.45 | 0.48 | 3.92 | 0.28 | 0.98 | 0.49 | 0.00 | | Calculated |
| 7 | T-P-2 | 5.97 | 0 12:29 | 12.38 | 0.48 | 3.91 | 1.57 | 0.98 | 0.49 | 0.00 | | Calculated |
| 8 | T-P-3 | 3.92 | 0 12:25 | 5.78 | 0.68 | 3.52 | 0.77 | 0.91 | 0.60 | 0.00 | | Calculated |
| 9 | T-P-4 | 1.17 | 0 12:25 | 5.77 | 0.20 | 2.58 | 2.12 | 0.46 | 0.31 | 0.00 | | Calculated |

# Memorandum

| | |
|---|---|
| **Date:** | July 7, 2020 |
| **From:** | Joey Hegna, P.E. – CRW Engineering Group, LLC |
| **Project:** | Lois Drive and 32nd Avenue Pathway – Benson Boulevard to Minnesota Drive |
| **Project No:** | PM&E# 19-08 (CRW# 10145.00) |
| **Subject:** | Storm Drain Condition Assessment (DRAFT) |

This memorandum summarizes the findings of the storm drain pipe and structure inspections performed by Municipality of Anchorage (MOA) Street Maintenance and CRW Engineering Group, LLC (CRW) for the Lois Drive and 32nd Avenue Pathway – Benson Boulevard to Minnesota Drive project.

**Project Background**

The MOA Project Management & Engineering Department (PM&E) plans to upgrade Lois Drive and W. 32nd Avenue to improve non-motorized connectivity by constructing a new roadway. Improvements may include a new roadway section and surfacing, drainage improvements, pedestrian and/or bicycle facilities, traffic calming, signage, landscaping, lighting, and utility reconstruction. The existing storm drain infrastructure that could be impacted by these roadway upgrades was inspected to determine if replacement is necessary. See *Appendix A* for *Grid Map SW1628* that shows the project limits.

**Purpose**

The purpose of this condition assessment memo is to describe the condition of the existing storm drain pipe and structures along the project corridor. The results of this assessment will serve as a tool to determine if the existing pipe and structures should remain or be replaced in conjunction with the planned roadway upgrades. Some of the pipe segments inspected extend outside of the roadway upgrade limits. The pipe segments that are identified as needing replacement and are located outside the project corridor will not be upgraded by this project, but may be upgraded by MOA in the future as funding becomes available.

**Pipe Inspection – Procedure**

The closed circuit television (CCTV) data collection process works by operating a camera which is mounted on a self-propelled robotic crawler that is connected to a video monitor on the ground surface. The crawler is driven through the storm drain pipe to provide visual documentation of the condition of the interior walls of the pipe. The remotely controlled crawler and camera are typically inserted into the storm drain pipe from a manhole and are operated from the ground surface.

The purpose for collecting video images of the interior of the storm drain pipe is to identify obstructions, structural deficiencies, damaged areas, sags, and confirm the pipe size and material type. For the most comprehensive pipe assessment, it is preferred to collect CCTV data when no water is present in the piped system. This typically requires bypassing stormwater flows or the work is performed during dry conditions and has no base flow. In most cases, however, some stormwater is present during CCTV recording, preventing the observer from assessing the condition of the pipe invert.

The storm drain pipe within the project area and several downstream segments of pipe was inspected using a CCTV camera operated by MOA Street Maintenance from December 2019 to May 2020. MOA provided the CCTV data files to CRW for evaluation in late May 2020. A total of 9 pipes were inspected. See *Figures 1 & 2*, *Appendix A* showing the location of the pipes inspected for this project.

CRW evaluated the CCTV data provided by MOA using GraniteNet software. This software is an interface that allows the observer to view the CCTV video images in detail and assess the condition of the interior of the pipe. The observer can input pertinent information into the CCTV data file while performing the assessment, such as pipe size, pipe material, installation date, location and type of defects, date of inspection and any other notes relevant to the inspection. The findings and notes generated during the CCTV review process are then used to develop a comprehensive summary of the condition of each pipe segment.

The CCTV data provided by MOA Street Maintenance included video of approximately 1,660 linear feet (LF) of main line storm drain pipe. Only one catch basin lead (Pipe 28932) was inspected with CCTV, the remaining leads within the project limits were not. The assumption is that catch basin leads will likely need to be replaced regardless of condition, since new catch basins will be located to align with the proposed curb and gutter. The videoed pipe consisted of 1,636 LF of corrugated metal pipe (CMP) and 24 LF of reinforced concrete pipe (RCP). Approximately 375 LF of pipe was not videoed due to blockages in the pipe. The majority of pipe evaluated was installed in the late 1970's and early 1980's. The installation date of the 48 inch CMP located upstream of the Fish Creek outfall and west of Lois Drive is unknown as record drawings were not obtained for this pipe.

**Pipe Inspection – Condition Summary**

The condition of the storm drain pipe throughout the project corridor ranged widely from fair to poor. Some of the issues identified included blockages due to debris, joint offsets, metal loss, pipe damage, and mineralization/infiltration at pipe joints.

Refer to the *Storm Drain CCTV Inspection Summary Table, Appendix B* and the individual *CCTV Inspection Forms, Appendix C* for a detailed assessment for each pipe segment that was inspected. Corresponding *Storm Drain Infrastructure Inspection Maps* (*Figure 1 & 2, Appendix A*) provide an overview of the project area and the existing storm drain systems along Lois Drive and W. 32nd Avenue, as well as downstream systems. Note that the pipe identification numbers used throughout this memo and the appendices are based on the naming convention provided in MOA's GIS Stormwater Asset Map.

*Photo 1 - Mineralization/Infiltration at Joint*

The majority of the inspected pipes have significant debris (rocks, soil, mineralization, etc.) deposited within the pipe. These blockages reduce the overall capacity of the piping system and can further deteriorate the condition of the pipe. The *Storm Drain CCTV Inspection Summary Table, Appendix B* recommends several pipes to be cleaned to improve flow efficiency and extend the life of the piped system. While cleaning these pipes is recommended and good practice, it won't necessarily resolve the source of the debris entering into the pipe (joint offsets & holes). This is where lining, also known as cured in place pipe (CIPP), may be an option to repair these pipes and reduce the amount of debris entering the system. CIPP is a trenchless method (no excavation required) for rehabilitating existing pipe. CIPP consists of a liner that is constructed of a soft fabric tube that is impregnated with resin. After the tube is inserted into the

existing (host) pipe, it is inflated with water or air and cured until hard. A CIPP liner provides a long-term fully structural repair to the host pipe. Further investigation would be required to determine if CIPP is a suitable repair option the identified pipes. The alternative is to remove and replace these pipes by conventional open cut excavation methods.

Several storm drain pipes (12828, 13603, 25204, 27764, 27885, 30570, & 33747) are identified as requiring complete replacement or CIPP lining. These pipes or certain segments of the pipe have significant enough defects where cleaning alone is not a suitable long-term fix.

Below is a list of some of the notable pipe defects identified during review of the CCTV data:

- Pipe 28932 & 12828: CCTV investigation not completed due excessive debris in pipe. These type of blockages significantly reduce the capacity of these pipe. Additionally, Pipe 12828 exceeds 300 foot maximum spacing per the *Anchorage Stormwater Manual (ASM).* MOA Street Maintenance are unable to clean pipes adequately in this type of situation.
- Pipe 27764: Mineralization/infiltration and root intrusion at several locations along this pipe segment, as well as a significant gouge in the pipe.
- Pipe 30570: Significant pipe joint separation.
- Pipe 13603: Moderate to significant mineralization and metal loss/corrosion near outlet end of pipe.
- Pipe 27885: Two blind connections deposit moderate to significant mineralization into interior of pipe. Per the CCTV operator, this pipe was previously lined and the liner is showing damage at several locations
- Pipe 33747: Crown of pipe deformed several inches. Several holes and metal loss/corrosion identified at multiple locations along pipe segment.

*Photo 2 - Pipe Gouge*

The MOA is dealing with increasing CMP failures throughout the City due to corrosion. With that in mind, it should be noted that the majority of the inspected pipe in the project area is CMP and approximately 40 years old, which is nearing the design life of this pipe material. While these pipes may appear to be in fair to good condition, it's possible the invert is failing. Most of the pipes inspected had a significant amount of debris and/or flow within the invert. This prevents the observer from assessing the condition of the pipe invert.

**Structure Inspection – Procedure**

An inspection was performed on all the accessible storm drain structures within the project area. The inspection is conducted by removing the manhole cover or catch basin inlet grate to view the interior of the structure. Each structure is assessed from the ground surface; no structures were entered for this effort. Any notable characteristics, irregularities, and/or defects are documented and photographed and are presented on the *Storm Drain Structure Inspection Forms, Appendix D*. The overall condition of the

components of each structure (e.g. lid, grade rings, barrel, ladder rungs, etc.) are scored between 1 and 4 (poor to good, respectively).

A total of 9 storm drain structures within the project corridor were inspected in June 2020 by CRW. The structures inspected included catch basins, catch basin manholes and standard manholes. These structures were installed as part of two separate projects in the late 1970's and early 1980's. The structure identification numbers used throughout this memo and the appendices are based on the naming convention provided in MOA's GIS Stormwater Asset Map. Note that all structures are located on MOA Storm Drain Grid SW1628, so structure names referenced were abbreviated (e.g. Structure 31628097 = 97). See *Figures 1 & 2, Appendix A* showing the location of the structures inspected for this project.

*Photo 3 - Grout Loss at Pipe Penetration*

Two catch basins (142 & 143) within the project corridor are located on private property and were not inspected. The manhole (45) located towards the north end of Lois Drive was also not inspected due to the cover being located under pavement preventing access.

**Structure Inspection – Condition Summary**

The condition of the storm drain structures throughout the project limits ranged from fair to poor, similar to the condition of the storm drain pipe. Some of the issues identified during the inspection process included missing components (grade rings, ladder rungs & frames), spalling at pipe penetrations, concrete cracking, and significant sediment build-up in sumps. Refer to the *Storm Drain Structure Inspection Forms, Appendix D* for a detailed assessment of each structure.

Below is a list of some of the defects or irregularities observed in the inspected structures:

- Catch Basins 28 & 29: Non-standard inlet, no grade rings (frame placed on reducing slab), and grout spalling at pipe penetration.
- Catch Basin 55: Cracking in grade ring and significant debris in sump.
- Catch Basin 56: Curb inlet and frame installed in skewed position in relation to curb and gutter and cracking present in grout above pipe penetration.
- Catch Basin 81: Catch basin set in location that is ineffective at intercepting runoff.

*Photo 4 - Non-standard Manhole Lid*

- Catch Basin Manhole 82: Non-standard frame, offset between barrel and reducing slab, and sump and outlet pipe (east) full of debris/sediment.
- Manhole 44: Angle iron welded to non-standard lid that rests directly on reducing cone.
- Manhole 45: Manhole lid partially located under pavement, preventing access to structure for maintenance.
- Manhole 97: Spalling at grade ring constructed of brick, non-standard ladder rungs exceeding maximum spacing, non-standard frame & lid, and grout cracking at pipe penetration (west).
- Manhole 120: Manhole lid buried in gravel (difficult to locate), vertical cracking in grade ring, and grade ring offset from reducing cone & frame.

**-End of Memorandum-**

# Appendix A

## Project Location &
## Storm Drain Infrastructure Inspection Maps

# Legend

- Confined Space
- Manhole
- Catchbasin Manhole
- Clean-Out
- Catch Basin
- OGS
- Lift Station
- Diverter
- Drywell
- Weir
- Blind Connect
- Top Intake Manhole
- Roof Drain
- Bypass Outlet
- Curb Inlet
- End of Pipe
- Pipe Inlet
- Pipe Cap
- Inlet
- Pipe Outlet
- Control Inlet
- Control Outlet
- Other
- Outfall
- Outfall Major
- Outfall Minor
- Sink -(Closed Drainage Basin)
- Divide
- Feature Start
- Other

## Storm Pipes

- ADOT
- ADOT-Airport
- Abandoned
- Fed_Military
- MOA-ASD
- MOA-Facility Maintenance
- MOA-Merrill Field
- MOA-Other
- MOA-Parks and Recreation
- MOA-Port of Anchorage
- MOA-M&O/CBERRRSA/LRSA/SA
- Private
- SOA-Alaska Railroad
- Unknown
- Bridge

## Constructed Channels

- ADOT
- MOA-Other
- MOA-Port of Anchorage
- MOA-M&O/CBERRRSA/LRSA/SA
- Private
- SOA-Alaska Railroad
- Unknown

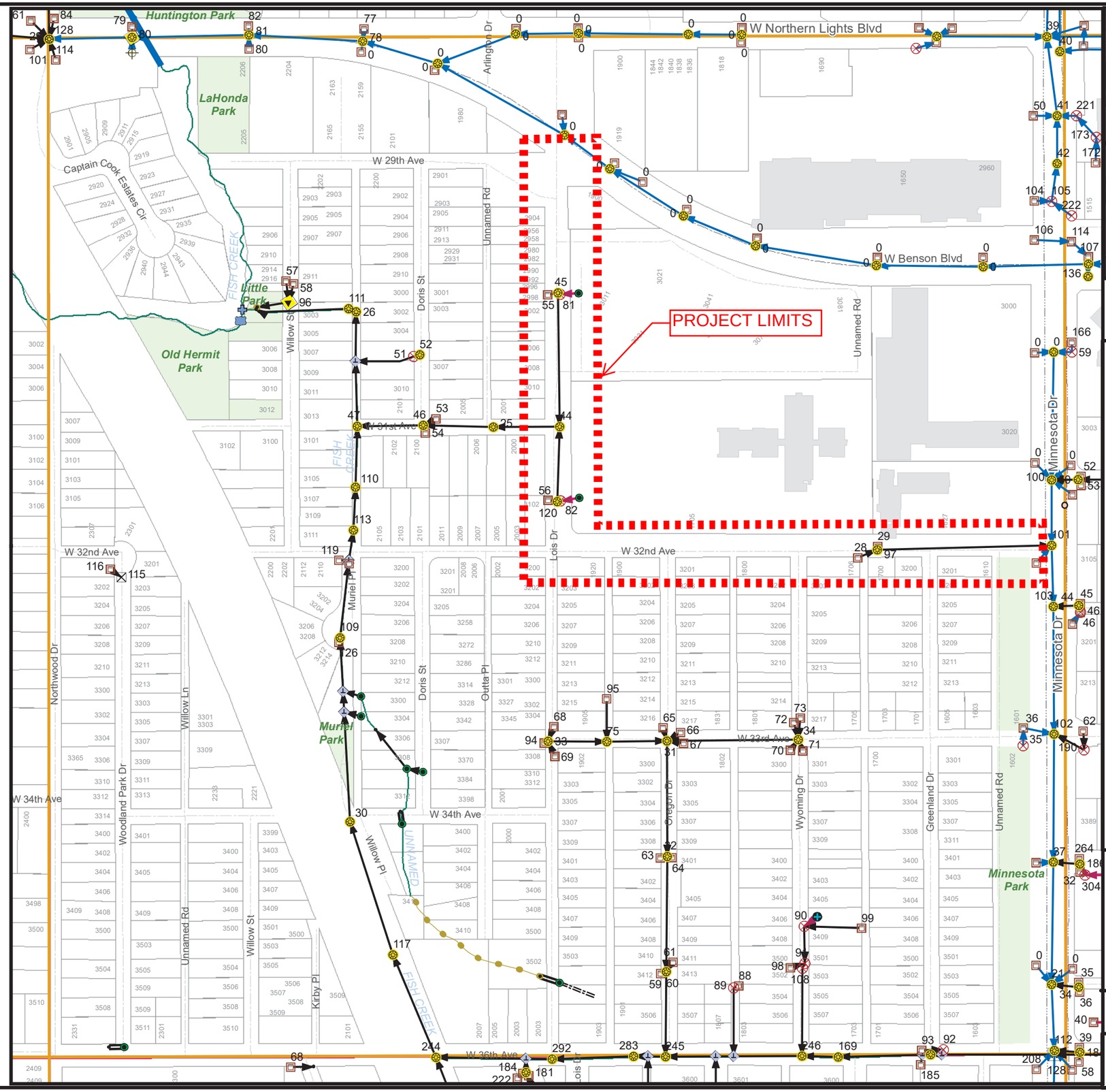
## Other Drainageways

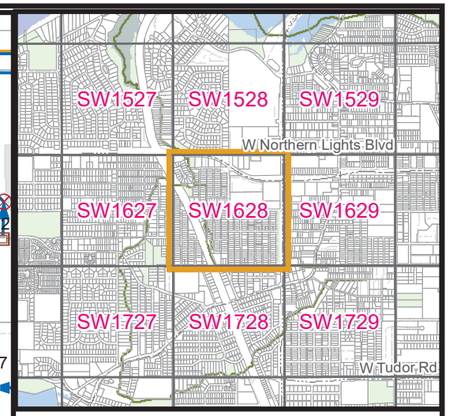
- Other Drainageways

N W E S

0 150 300 600

Feet




Anchorage Bowl
Legal: NW 1/4 Sec25 T13N R4W

## Notes:

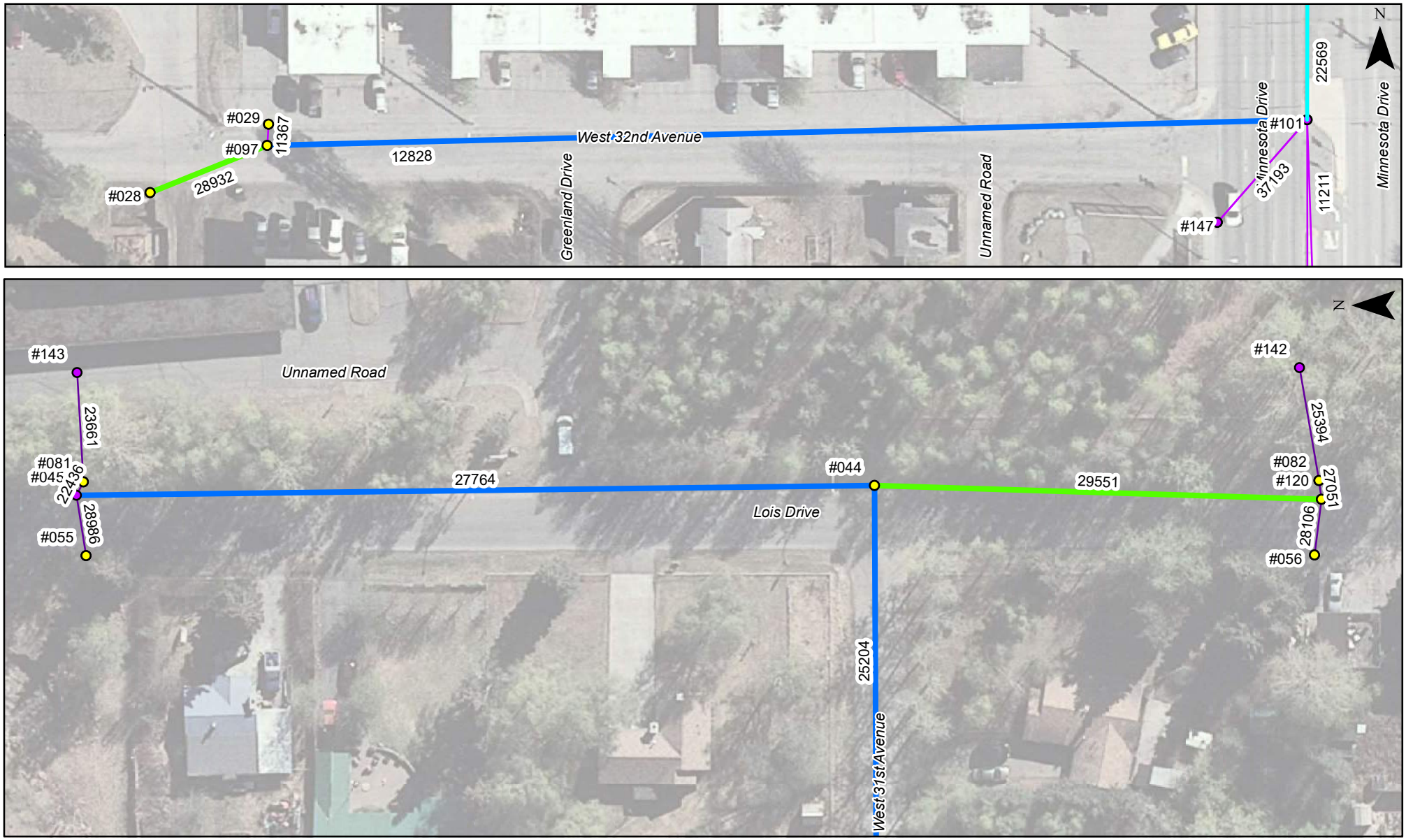


# MOA Storm Drain and Drainage Atlas

Map Created: 3/23/2019

Grid Number

**SW1628**




**Legend**

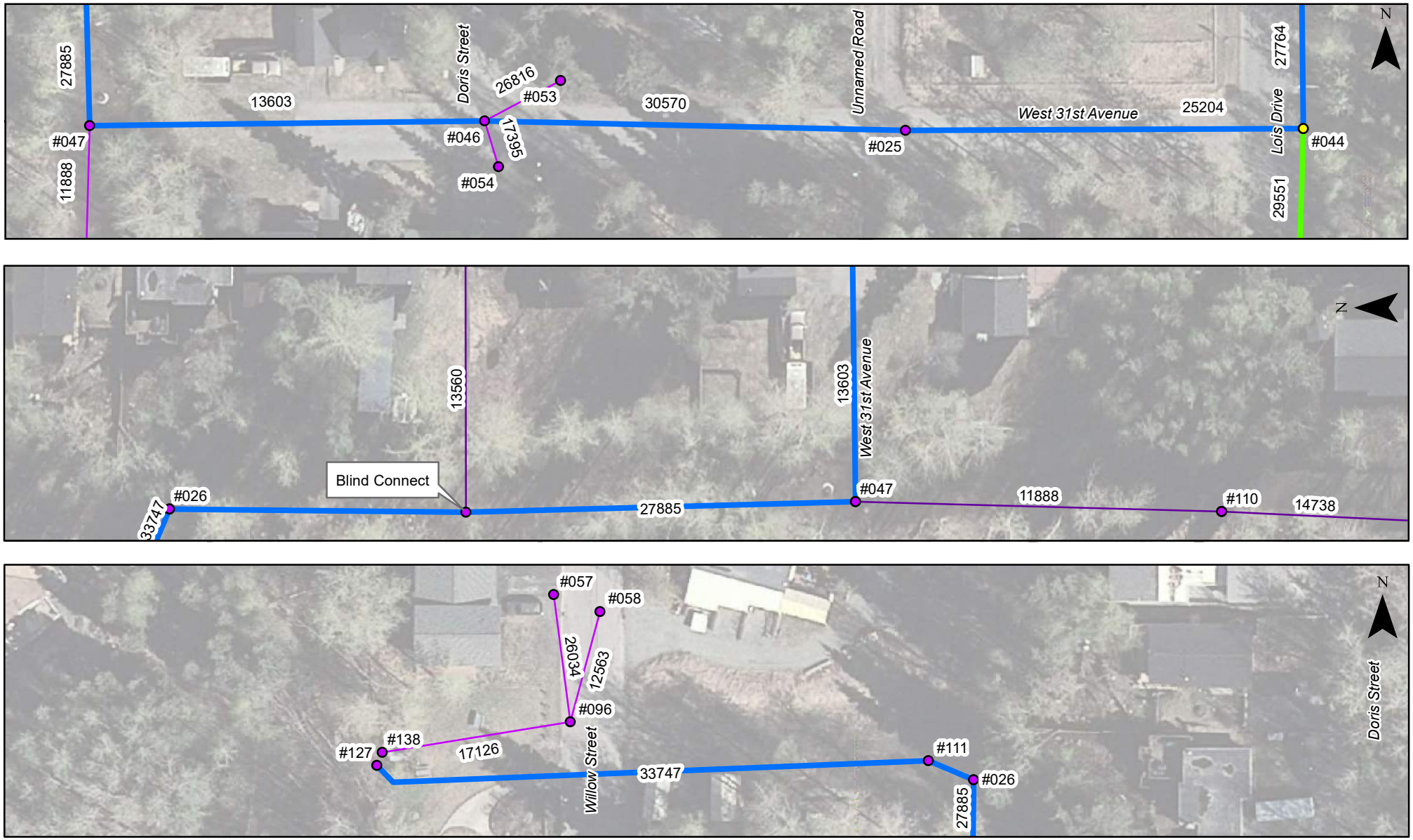
- Existing Storm Drain Structures (Inspected)
- Existing Storm Drain Structures (Not Inspected)
- Existing Storm System Drain Pipe (Not Inspected)

**Pipe Recommendation**

- Cleaning Recommended
- Replace or CIPP Pipe Recommended

100 50 0 100 Feet

| | | |
|---|---|---|
| **Storm Drain Infrastructure Inspection Map**<br>**Lois Drive and 32nd Avenue Pathway**<br>**Benson Blvd to Minnesota Drive** | CRW ENGINEERING GROUP, LLC | **Date: JUL 2020** |
| | **Grid Number**<br>**SW1628** | **Figure 1** |




## Legend

- Existing Storm Drain Structures (Inspected)
- Existing Storm Drain Structures (Not Inspected)
- Existing Storm System Drain Pipe (Not Inspected)

**Pipe Recommendation**

- Cleaning Recommended
- Replace or CIPP Pipe Recommended

100 50 0 100 Feet

# Storm Drain Infrastructure Inspection Map

**Lois Drive and 32nd Avenue Pathway**
**Benson Blvd to Minnesota Drive**

CRW ENGINEERING GROUP, LLC

**Date: JUL 2020**

**Grid Number**
**SW1628**

**Figure 2**

# Appendix B

## Storm Drain CCTV Inspection Summary Table

## Lois Drive and 32nd Avenue Pathway - Benson Boulevard to Minnesota Drive (PM&E No. 19-08)
## Storm Drain CCTV Inspection Summary Table

| MOA Pipe Identification No. | Upstream Structure No. | Downstream Structure No. | Diameter (in) | Material | Install Date - Asbuilt No. | CCTV Date | CCTV Direction | CCTV Length (ft) | Asbuilt Length (ft) | Pipe Condition Comments | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***West 32nd Avenue*** | | | | | | | | | | | |
| 28932 | 31628028 | 31628097 | 12 | CMP | 1978-777 | 4/30/2020 | Upstream | 24.1 | 28 | CCTV abandoned at 24.1 feet due to significant debris in invert, minor to moderate debris from 6.3 feet to 19.7 feet. | Clean pipe |
| 11367 | 31628029 | 31628097 | 12 | CMP | 1978-777 | No CCTV | - | - | 13 | No CCTV completed for this catch basin lead. | |
| 12828 | 31628097 | 31628101 | 15 | RCP | 1978-777 | 4/30/2020 | Downstream | 23.6 | 395 | CCTV abandoned at 23.6 feet due to significant debris in invert, offset joints at 15.5 feet & 21.8 feet. Pipe exceeds 300 foot max. manhole spacing per MASS. | Replace or CIPP pipe |
| ***Lois Drive*** | | | | | | | | | | | |
| 28986 | 31628055 | 31628045 | 10 | CMP | 1982-347 | No CCTV | - | - | 17 | No CCTV completed for this catch basin lead. | |
| 22436 | 31628081 | 31628045 | 10 | CMP | 1982-347 | No CCTV | - | - | 17 | No CCTV completed for this catch basin lead. | |
| 23661 | 31628143 | 31628081 | - | - | - | No CCTV | - | - | - | No CCTV completed for this catch basin lead. No asbuilts of private pipe. | |
| 27764 | 31628045 | 31628044 | 12 | CMP | 1982-347 | 12/19/2019 | Upstream | 341.7 | 345 | Minor to moderate debris present throughout length of pipe. Mineralization/infiltration at pipe joints at 132.1 feet, 197.3 feet & 216.6 feet. Root intrusion at pipe joints at 216.6 feet & 317.0 feet. 1"x4" gouge through pipe at 12 o'clock position, soil visible. | Replace or CIPP pipe |
| 28106 | 31628056 | 31628120 | 10 | CMP | 1982-347 | No CCTV | - | - | 17 | No CCTV completed for this catch basin lead. | |
| 27051 | 31628082 | 31628120 | 10 | CMP | 1982-347 | No CCTV | - | - | 17 | No CCTV completed for this catch basin lead. | |
| 25394 | 31628142 | 31628082 | - | - | - | No CCTV | - | - | - | No CCTV completed for this catch basin lead. No asbuilts of private pipe. | |
| 29551 | 31628120 | 31628044 | 12 | CMP | 1982-347 | 4/30/2020 | Upstream | 188.0 | 193 | Minor debris present throughout remainder of pipe inspected. Mineralization/Infiltration at pipe joint at 45.3 feet and 65.4 feet. | Clean pipe |
| ***West 31st Avenue*** | | | | | | | | | | | |
| 25204 | 31628044 | 31628025 | 15 | CMP | 1982-347 | 12/19/2019 | Upstream | 166.3 | 159 | Minor to moderate debris present throughout length of pipe. Mineralization/infiltration at pipe joints at 39.6 feet, 59.9 feet, 120.6 feet & 161.0 feet. Significant joint separation at 140.7 feet. | Replace or CIPP pipe |
| 30570 | 31628025 | 31628046 | 15 | CMP | 1982-347 | 12/19/2019 | Downstream | 180.4 | 182 | Minor debris and metal loss/corrosion present throughout length of pipe. Offset joint at 152.1 feet. Mineralization/Infiltration at pipe joint at 6.4 feet, 21.5 feet, 72.3 feet and 121.8 feet. Joint separation at 41.7 feet. | Replace or CIPP pipe |
| 26816 | 31628053 | 31628046 | 10 | CMP | 1982-347 | No CCTV | - | - | 64 | No CCTV completed for this catch basin lead. | |
| 17395 | 31628054 | 31628046 | 10 | CMP | 1982-347 | No CCTV | - | - | 19 | No CCTV completed for this catch basin lead. | |
| 13603 | 31628046 | 31628047 | 15 | CMP | 1982-347 | 12/19/2019 | Downstream | 176.0 | 178 | Minor debris and metal loss/corrosion present from 0 feet to 143.1 feet. Moderate to significant mineralization and metal loss/corrosion present from 143.1 feet to end of pipe. Mineralization/infiltration near flow line at 4 o'clock position at 131.1 feet. Mineralization/infiltration near along CMP seam at 9 o'clock position at 132.6 feet. Significant mineralization/infiltration at pipe joints at 114.2 feet, 134.3 feet & 154.9 feet. Surface damage/corrosion at 10 o'clock & 2 o'clock at 55.0 feet. | Replace or CIPP pipe |
| ***Fish Creek Alignment*** | | | | | | | | | | | |
| 27885 | 31628047 | 31628026 | 48 | CMP/ Lined | Unknown | 5/15/2020 | Upstream | 296.0 | ? | Moderate mineralization present throughout length of pipe. Significant debris/blockage at 260.5 feet. According to CCTV operator, this pipe was previously lined with CIPP. Operator noted lining failures at 32.9 feet, 60.3 feet, 131.6 feet & 182.1 feet. CPEP lateral at 9 o'clock position at 21.3 feet with significant mineralization at discharge point. CMP lateral at 11 o'clock position at 133.2 feet with moderate mineralization at discharge point. | Replace or re-line pipe |
| 33747 | 31628026 | 31628127 | 48 | CMP | Unknown | 5/15/2020 | Downstream | 264 | ? | Moderate mineralization present throughout length of pipe. Multiple holes in pipe from 7 to 9 o'clock position at 7.1 to 11.3 feet. Tee connection at 12 o'clock position at 12.9 feet. Hole in pipe at 4'oclock position at 45.9 feet. Crown of pipe deformed several inches at 112.4 feet. CCTV camera submerged at 129.5 feet. Joint separations at 148.0 feet, 168.6 feet & 189.0 feet. Angle point in pipe at 263.7 feet. | Replace or CIPP pipe |