# How much technical analysis do we need in planning for large freeway and interchange projects?

Paul Chan, P.Eng, M.Sc.

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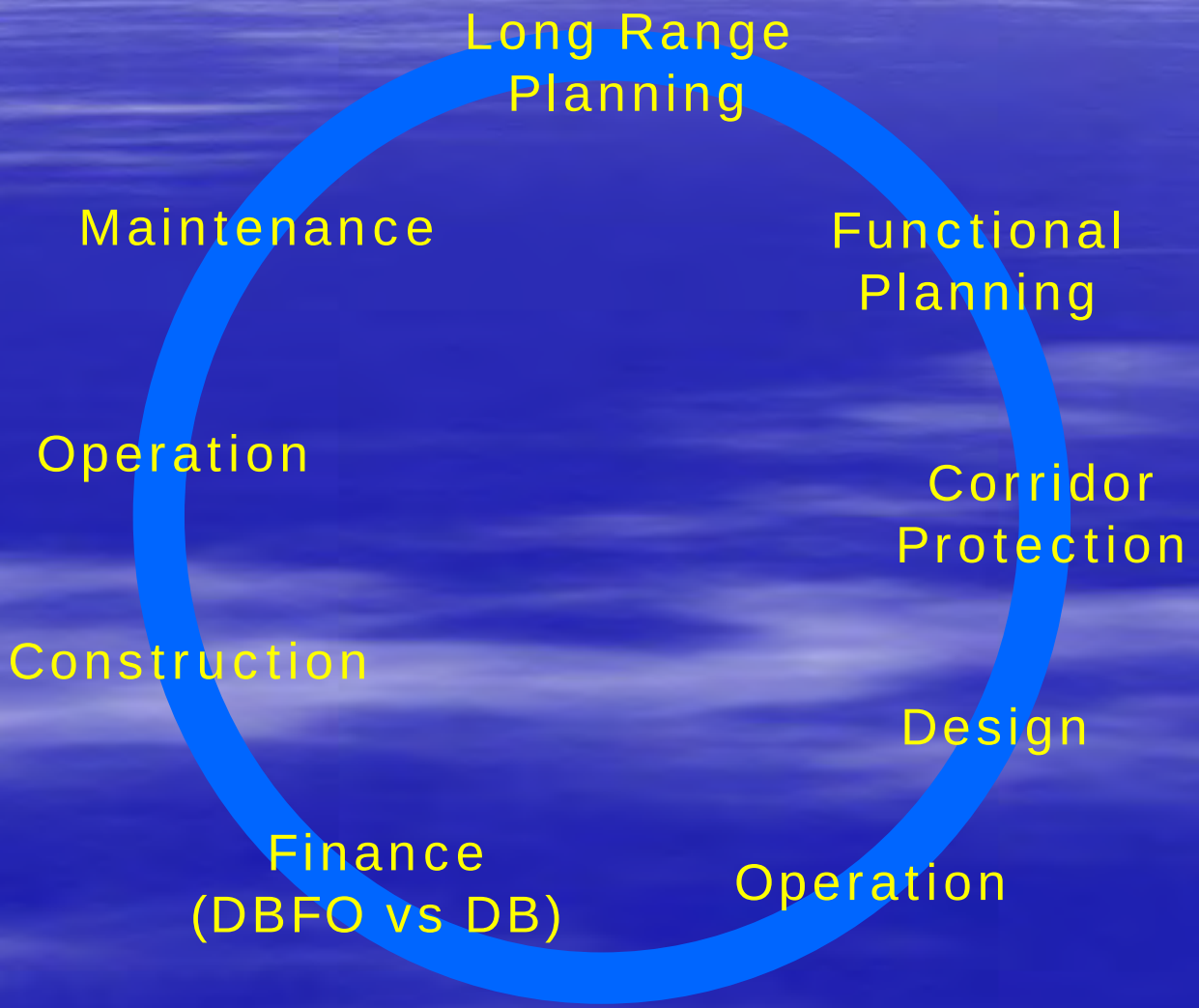

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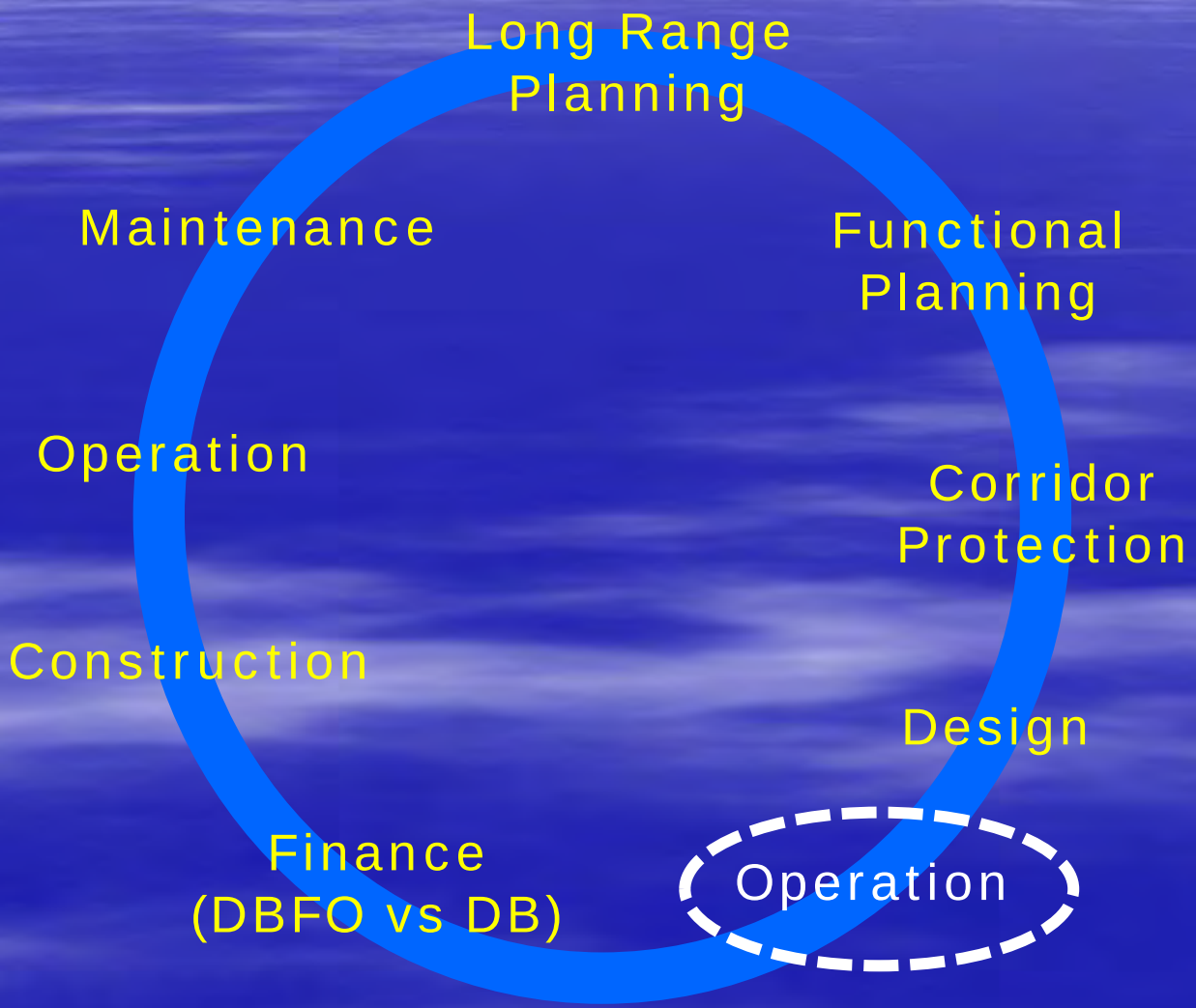

**How much technical analysis do we need in planning for large freeway and interchange projects?**

# Operation:

## Freeway Analysis

## Interchange Operations

# How much technical analysis do we need in planning for large freeway and interchange projects?

# Operation:

## Freeway Analysis

## Interchange Operations

## Comprehensive Interchange Operation Analysis Program

By

Paul Chan, P.Eng. M.Sc.

Investec Consulting Ltd.

**March 12, 2024**

This presentation will provide a glimpse on the amount of operational analyses carried out to provide a comprehensive assessment on service interchanges

# Originally developed

- **15 years or so ago**
- **Alberta Transportation - Major Capital Planning, Major Capital Projects Branch**
  - **SE AHD, NE AHD, NW AHD, SEST, NEST, Deerfoot Tr Projects**
    - Jarret Berezanski, P.Eng., (retired)
    - Stan Turner, P.Eng., (retired)
    - Julian MacDonald, P.Eng., (Highway Planning Specialists)
    - Richard Reid – Senior Traffic Consultant, Traffic Solutions / Invistec
      - **Owner's Engineer**
      - ISL Engineering
      - CH2M Hill
      - UMA / AECOM
      - Traffic Solutions
  - **2006 ITE Banff Conference Presentation**

# Program Limitations

- **What needs to be upgraded?**
- **Who will upgrade it?**
- **WIP**
  - Paul Chan, Richard Reid
  - Julie Saunders, Emma Poon - UoA Co-Op Students
  - Darren Mackie, Darren Wong – Invistec Consultng
  - UoA Transportation Engineering Capstone Project (Graduating students)

# Introduction

- Freeways and interchanges are expensive to build and upgrade
  - A simple diamond interchange can easily cost over $20-$30 Million
  - More complex interchanges can cost well over $100 Million
- Therefore, when planning for freeways and interchange facilities, considerable efforts should be expended to ensure that the investments will be spent in the most cost-effective manner
- Optimal Design - not over-built, not under-built

# Service Interchanges

- Freeway - Arterial
- Cost: Bridge Cost $3,500/m$^2$ - $5,000/m$^2$
- Interchange analysis is complex
- High turn volumes, turn bay storage, proximity of ramp intersections, impact of signal coordination or lack thereof, trucks
- Analysis: Deterministic vs Stochastic Models
- Needs traffic simulation for interchange with signalized ramp interesections
- Many interchange types, many lane combinations
- Time Consuming
- Quite tedious

# Service Interchanges Types

- Diamond – tight diamond, single-point diamond, split diamond
- Partial Cloverleaf - Parclo A2, A4, B2, B4, AB, BA
- How many simulation scenarios can you model?
- Pre-screening

# Interchange Analysis Scenarios

- Horizon 1 - AM, PM
- Horizon 2 – AM, PM
- Horizon 3 – AM, PM
- All these for just 1 interchange type and 1 laning combination
- There are multiple interchange types and multiple laning combinations that should be compared

- What if the traffic forecasts are not quite precise? Or not accurate? (land use)

- What if future traffic volumes are actually 20% higher? Or lower?

- What if we have to replace / upgrade / modify the lowest cost interchange after 10, 15 years - are we better off to build a more adequate interchange in the beginning ?

Many questions that need to be answered before an interchange is planned, designed and build

We have developed, through past projects, an exhaustive and highly powerful service interchange planning level analysis program

It can analyze multiple interchange types at the same time

It can analyze multiple lane configuration combinations

It can analysis the % Capacity Utilization or LOS of over 1,000 scenarios of multiple interchange configurations and lane combinations instantly

# Example of interchange types that can be analyzed

## - Parclo A

# Example of interchange types that can be analyzed

## - Parclo B

# Example of interchange types that can be analyzed

- **Diamond**

- **Hybrid**

# Other Interchange Types

## Systems Interchange

# Other Interchange Types

## Diverging Diamond

# Other Interchange Types

## - Other places

# - Then there are these...

# Assessed / planned 71 Interchanges

## of which

- Systems : 14 (20%)
- Diamond : 9 (13%)
- Split Diamond: 2 (3%)
- Parclo A: 21 (30%)
- Parclo B: 6 (8%)
- Parclo AB: 5 (7%)
- Hybrid: 7 (10%)
- Trumpet: 4 (6%)
- Cloverleaf: 2 (3%)
- Diverging Diamond: 1 (1%)

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- Directly Applicable: 48 (67%)
- Partially Applicable: 18 (34%)

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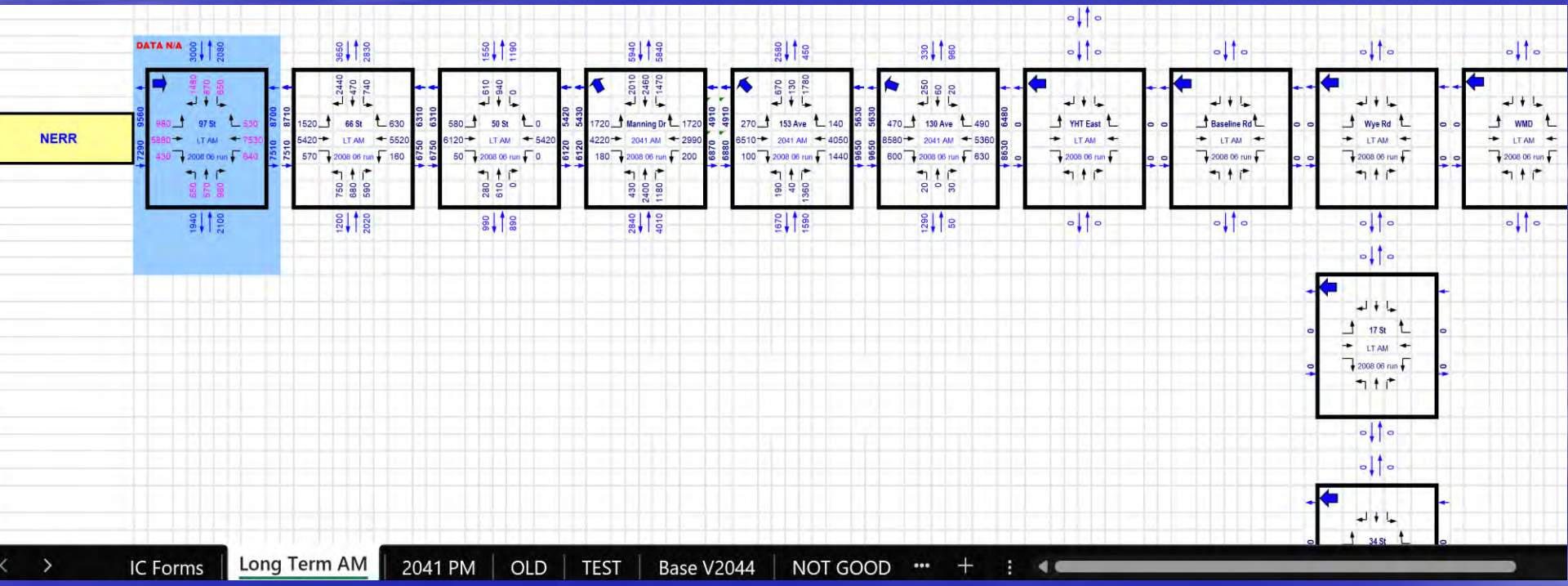
- TOTAL: 66 / 71 (93%)

**Interchanges Assessed / Planned :**

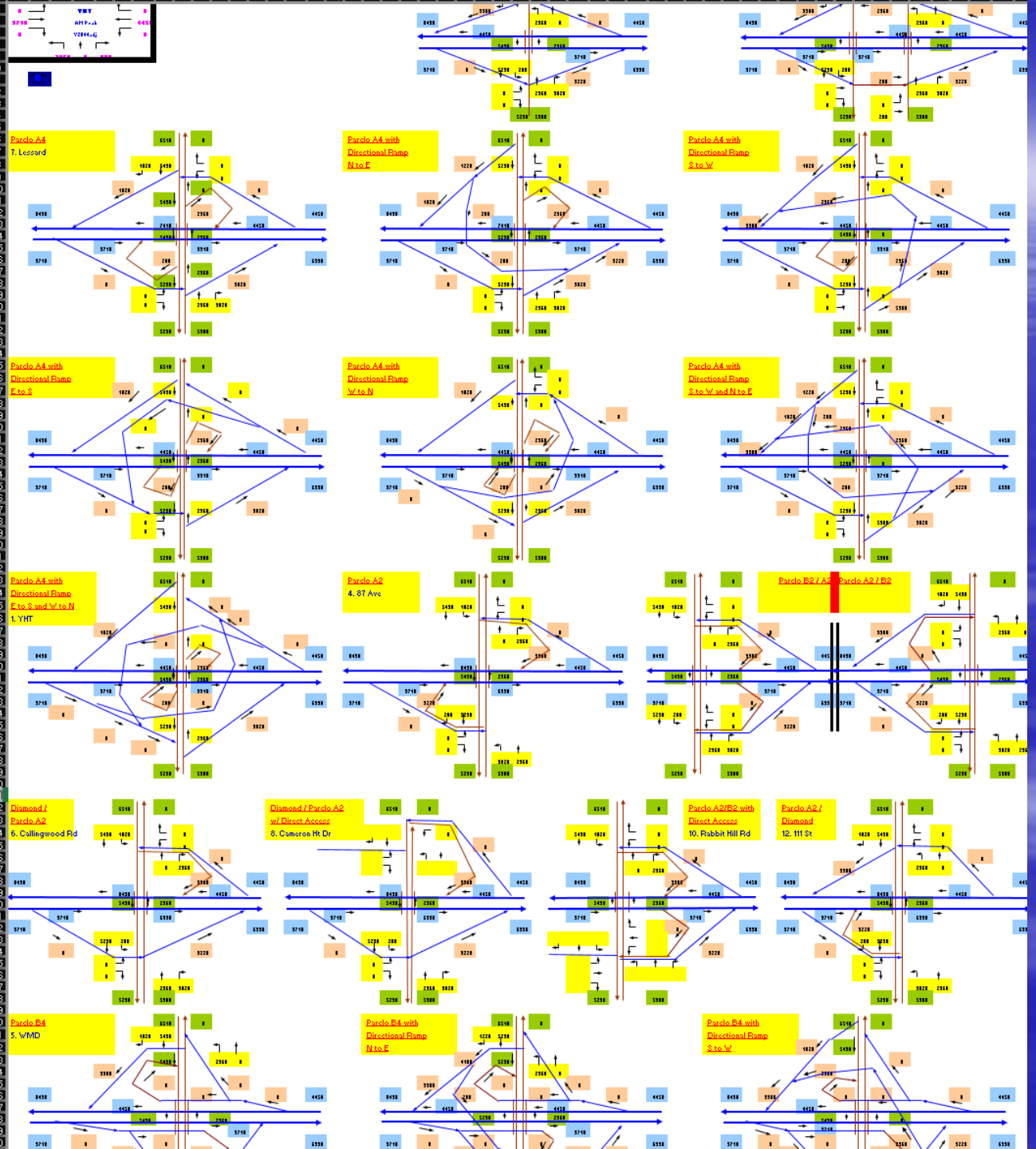
| Corridor | Interchange Location | Systems | Diamond | Split Dia | Parclo A | Parclo B | Parclo AB | Hybrid | Trumpet | Cloverleaf | Div.Dia |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Anthony Henday Dr | Yellowhead Trail (West) | Systems | | | | | | | | | |
| Anthony Henday Dr | Stony Plain Rd / 100 Ave | Systems | | | | | | | | | |
| Anthony Henday Dr | 87 Ave | | | | A2 | | | | | | |
| Anthony Henday Dr | Whitmud Dr (West) | | | | | B4 | | | | | |
| Anthony Henday Dr | 62 Ave / Callingwood Rd | | | | | | | Dia/A2 | | | |
| Anthony Henday Dr | Lessard | | | | A4 | | | | | | |
| Anthony Henday Dr | Maskekoshiko / Cameron Heights Dr | | | | | | | Dia-A2 | | | |
| Anthony Henday Dr | Terwillegar Dr | | Diamond | | | | | | | | |
| Anthony Henday Dr | Rabbit Hill Rd | | | | | | A2-B2-Art | | | | |
| Anthony Henday Dr | 111 St | | | | | | Dia/A2 | | | | |
| Anthony Henday Dr | QE2 | Systems | | | | | | | | | |
| Anthony Henday Dr | 91 St | | | | | | A2/B4 | | | | |
| Anthony Henday Dr | 50 St | | | | | | A4/B2 | | | | |
| Anthony Henday Dr | 17 St | | | | | B2 | | | | | |
| Anthony Henday Dr | Bretona Interchange | Systems | | | | | | | | | |
| Anthony Henday Dr | Whitemud Dr (East) | Systems | | | | | | | | | |
| Anthony Henday Dr | Sherwood Park Fwy / Wye Rd | Systems | | | | | | | | | |
| Anthony Henday Dr | 101 Ave / Baseline Rd | | | | A4 | | | | | | |
| Anthony Henday Dr | Yellowhead Trail (East) | Systems | | | | | | | | | |
| Anthony Henday Dr | 130 Ave / Aurum Rd | | | | | | | Dia/B2 | | | |
| Anthony Henday Dr | 153 Ave | | | | A4 | | | | | | |
| Anthony Henday Dr | Manning Dr | Systems | | | | | | | | | |
| Anthony Henday Dr | 66 St | | | | | B4 | | | | | |
| Anthony Henday Dr | 97 St / Hwy 28 | | | | A4 | | | | | | |
| Anthony Henday Dr | 127 St | | Diamond | | | | | | | | |
| Anthony Henday Dr | Campbell Rd | | | | A4 | | | | | | |
| Anthony Henday Dr | St Albert Tr | | | | A4 | | | | | | |
| Anthony Henday Dr | Ray Gibbon Dr | | | | A4 | | | | | | |
| QE2 | 23 Ave (Edmonton) | | | Split Dia | | | | | | | |
| QE2 | Ellerslie Rd (Edmonton) | | Diamond | | | | | | | | |
| QE2 | 41 Ave (Edmonton) | | | | A4 | | | | | | |
| QE2 | Hwy 19 / Hwy 625 (Leduc County) | | | | A4 | | | | | | |
| QE2 | Airport Rd (Leduc County/Leduc) | | | | A4 | | | | | | |
| QE2 | Hwy 39 / 50 Ave (Leduc) | | Diamond | | | | | | | | |
| QE2 | Hwy 567 (Airdrie) | | | | | | A2/B4-Art | | | | |
| QE2 | Yankee Valley Blvd (Airdrie) | | | | A4 | | | | | | |
| Stoney Tr | QE2 | Systems | | | | | | | | | |
| Stoney Tr | Metis Tr | | | | A2 | | | | | | |
| Stoney Tr | Country Hills Blvd | | | | A4 | | | | | | |
| Stoney Tr | Airport Rd | | | | | | | | Trumpet | | |
| Stoney Tr | McKnight Blvd | | Diamond | | | | | | | | |
| Stoney Tr | Hwy 1 | Systems | | | | | | | | | |
| Stoney Tr | 17 Ave SE | | | | A4 | | | | | | |
| Stoney Tr | Peigan Tr SE | | | | A4 | | | | | | |
| Stoney Tr | Glenmore Tr SE | | | | | B4 | | | | | |
| Stoney Tr | 114 Ave SE | | | | A4 | | | | | | |
| Stoney Tr | Hwy 22X | Systems | | | | | | | | | |
| Hwy 22X / Stoney Tr | 57 St SE | | | | | | | Dia/A2 | | | |
| Hwy 22X / Stoney Tr | Deerfoot Tr | Systems | | | | | | | | | |
| Hwy 22X / Stoney Tr | Chaparral Rd / Sun Valley Blvd | | Diamond | | | | | | | | |
| Hwy 22X / Stoney Tr | McLeod Tr | Systems | | | | | | | | | |
| Deerfoot Tr | 64 Ave NE | | | | | | | Dia/A4 | | | |
| Deerfoot Tr | McKnight Blvd | | | | | B4 | | | | Cloverleaf | |
| Deerfoot Tr | 32 Ave NE | | Diamond | | | | | | | | |
| Deerfoot Tr | 16 Ave NE | | | Split Dia | | | | | | | |
| Deerfoot Tr | Memorial Dr | | | | | | | SplDia/A2 | | | |
| Deerfoot Tr | 17 Ave SE | | | | | B4 | | | | | |
| Deerfoot Tr | PeiganTr SE | | | | | | | | Trumpet | | |
| Deerfoot Tr | Glenmore Tr SE | | | | | | | | | Cloverleaf | |
| Deerfoot Tr | Southland Dr | | | | | | | Dia/A4 | | | |
| Deerfoot Tr | Anderson Rd | Systems | | | | | | | | | |
| Deerfoot Tr | Douglasdale Blvd | | | | A4 | | | | | | |
| Deerfoot Tr | Barlow Tr | | | | | | | | Trumpet | | |
| Deerfoot Tr | 130 Ave SE | | | | A4 | | | | | | |
| Deerfoot Tr | Cranston Dr / Seton Rd | | | | A4 | | | | | | |
| Whitemud Dr | 122 St (Edmonton) | | Diamond | | | | | | | | |
| Hwy 63 | Parsons Creek Dr (Ft McM) | | | | A2 | | | | Trumpet | | |
| Hwy 63 | Abasand Dr / Hospital St (Ft McM) | | Diamond | | | | | | | | |
| Hwy 1 | Pilot Butt Dr (Regina) | | | | | | | | | | DDI |
| | *Total No of Interchanges* | *14* | *9* | *2* | *21* | *6* | *5* | *7* | *4* | *2* | ***1*** |
| | *71 interchanges* | *20%* | *13%* | *3%* | *30%* | *8%* | *7%* | *10%* | *6%* | *3%* | *1%* |

## Existing and Future Interchange Configurations

| I/C # | Location | Current Interchange Configuration | Potential Interim Interchange Forms | Long Term Interchange Configuration |
|---|---|---|---|---|
| 1 | Yellowhead Tr | Systems | | |
| 2 | 109 Ave / 111 Ave | RIRO | | |
| 3 | Stony Plain Rd / 100 Ave | Systems | | |
| 4 | 87 Ave | Parclo A2 | Parclo A4 / Braided Ramps | |
| 5 | Whitemud Dr | Parclo B4 | Modified Parclo B4 / Braided Ramps | Systems |
| 6 | Callingwood Rd / 62 Ave | Diamond / Parclo A2 | Parclo A4 / Braided Ramps | |
| 7 | Lessard Rd | Parclo A4 | | |
| 8 | Cameron Heights Dr | Diamond / Parclo A2 (Direct Access) | | |
| 9 | Terwillegar Dr | Simple Diamond | Parclo A4 | Split Diamond |
| 10 | Rabbit Hill Rd | Parclo B2 (Direct Access) / Parclo A2 | ? | |
| 11 | 119 St / 127 St | RIRO | | |
| 12 | 111 St | Parclo A2 / Diamond | Parclo A4 / Braided Ramps | |
| 13 | QE2 | Systems | | |

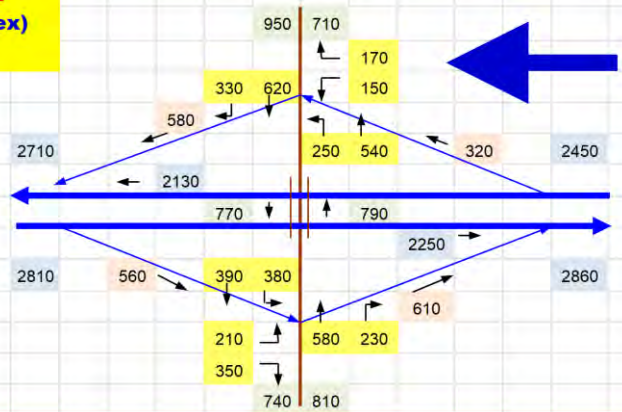



IC Forms | Long Term AM | 2041 PM | OLD | TEST | Base V2044 | NOT GOOD


Parclo A4
7. Lessard
Parclo A4 with
Directional Ramp
N to E
Parclo A4 with
Directional Ramp
S to W
Parclo A4 with
Directional Ramp
E to S
Parclo A4 with
Directional Ramp
W to N
Parclo A4 with
Directional Ramp
S to W and N to E
Parclo A4 with
Directional Ramp
E to S and W to N
1. YHT
Parclo A2
4. 87 Ave
Parclo B2 / A2
Parclo A2 / B2
Diamond /
Parclo A2
6. Callingwood Rd
Diamond / Parclo A2
w/ Direct Access
8. Cameron Ht Dr
Parclo A2/B2 with
Direct Access
10. Rabbit Hill Rd
Parclo A2 /
Diamond
12. 111 St
Parclo B4
5. WMD
Parclo B4 with
Directional Ramp
N to E
Parclo B4 with
Directional Ramp
S to W

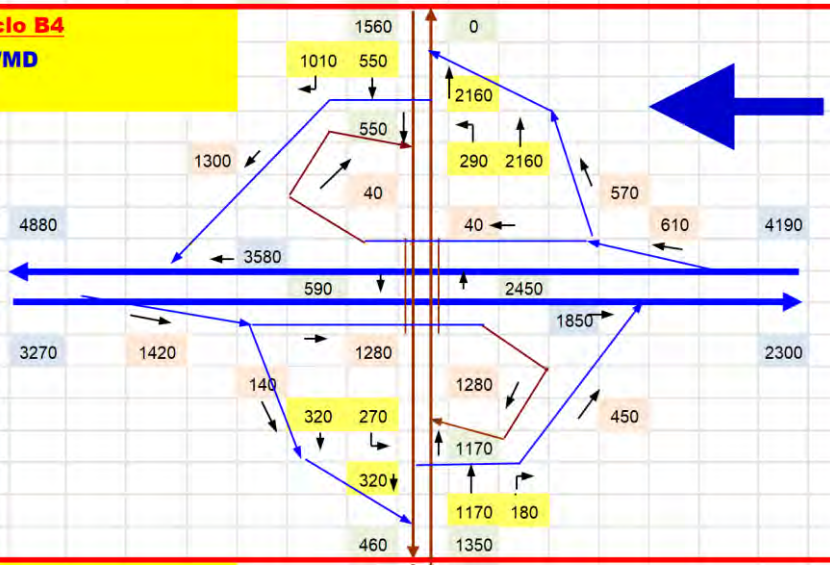
**Simple Diamond**

**9. Terwillegar (ex)**

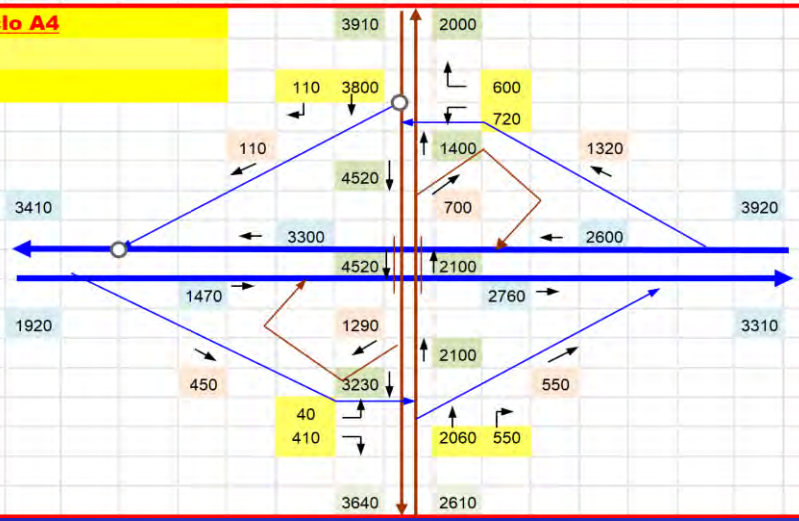



**Parclo B4**

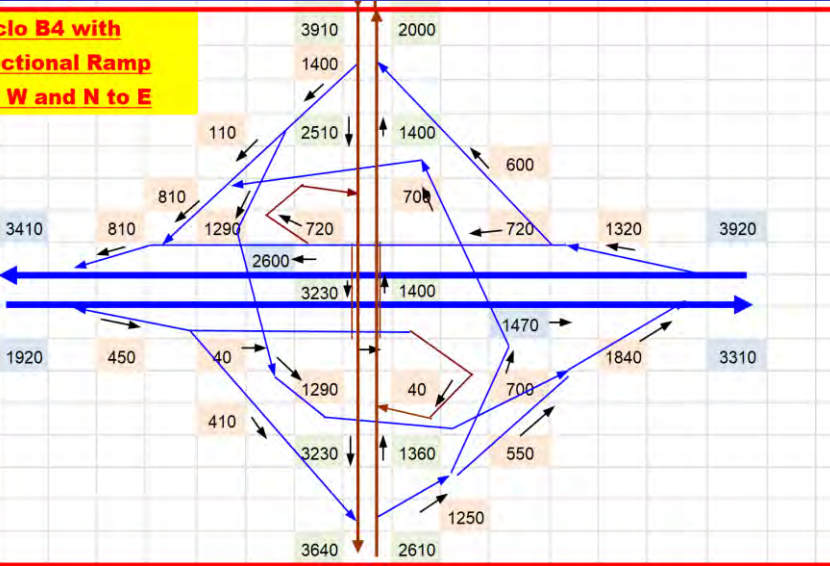
**5. WMD**

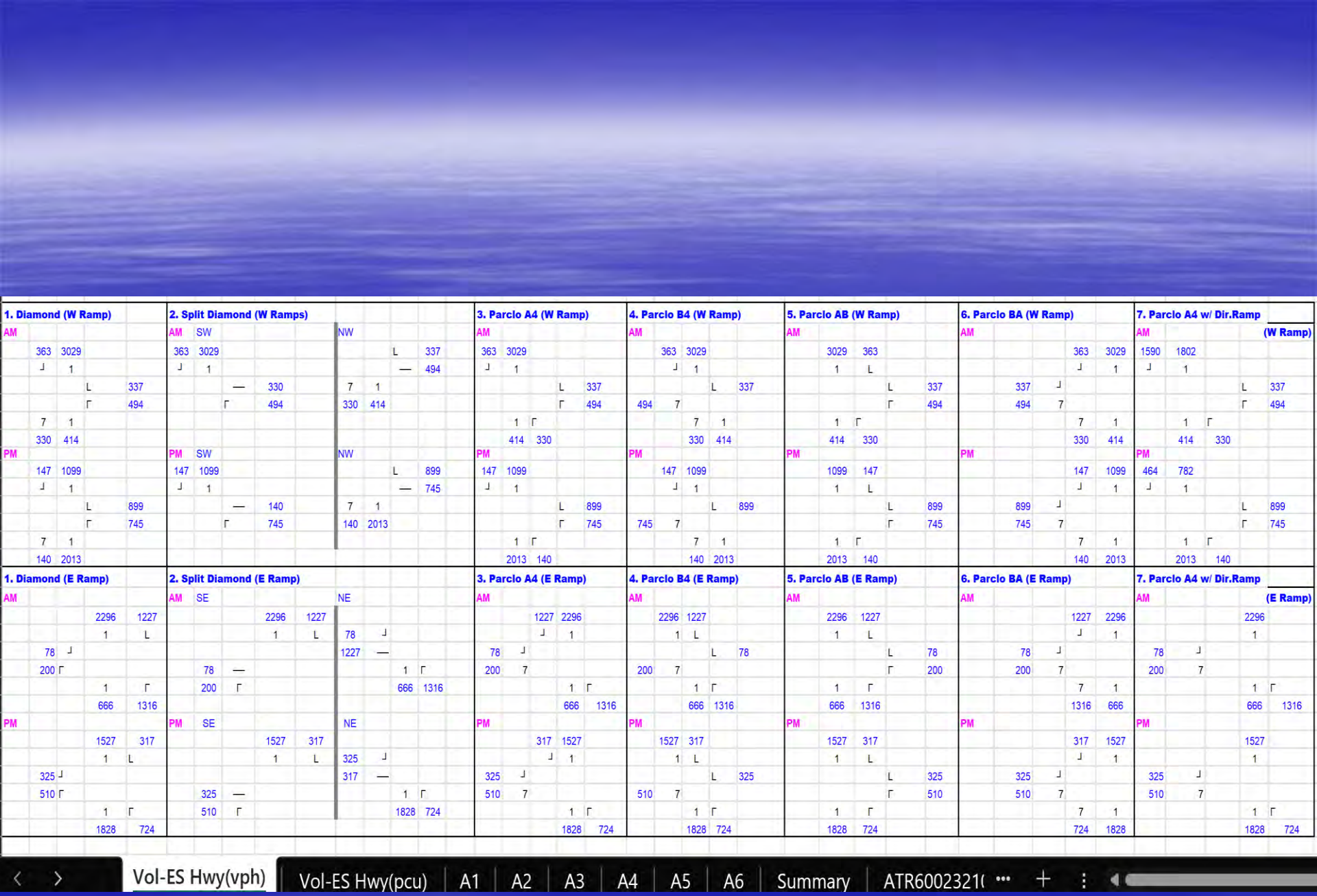



**Parclo A4**




**Parclo B4 with Directional Ramp S to W and N to E**






Vol-ES Hwy(vph) | Vol-ES Hwy(pcu) | A1 | A2 | A3 | A4 | A5 | A6 | Summary | ATR6002321( ••• + ⋮

# 3. Parclo A4 Interchange

## Critical Lane Volume Intersection Capacity Analysis:

| | |
|---|---|
| Cycle Length: | 120 |
| Critical Lane Volume Capacity: | 1665 |
| No. of signal phaseses: | 2 |

| | ↓↑ 1 | ↓ 3 | Sum | g/c |
|---|---|---|---|---|
| Lost Time: | 6.0 | 6.0 | 12.0 | 0.90 |
| CLV for min Green | 238 | 158 | | |

## E Ramp

**AM**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 363 | 3029 | | | | | 424 | 3534 | | | $CLV_1$ |
| | | | | | | | | | | | $CLV_2$ |
| | | | | | 337 | | | | 393 | | $CLV_3$ |
| | vph | | | | 494 | | pcu | | 576 | | |
| | | | | | | | | | | | Max of CLV1 & CLV2 & Min G1 |
| | | 414 | 330 | | | | | 483 | 385 | | Max of CLV3 & Min G3 |
| | | | | | | | | | | | Sum CLV |
| PM | | | | | | | | | | | v/c |
| | | | | | | | | | | | LOS |
| | 147 | 1099 | | | | | 172 | 1282 | | | |
| | | | | | 899 | | | | 1049 | | $CLV_1$ |
| | vph | | | | 745 | | pcu | | 869 | | $CLV_2$ |

**Project:** TE032 SW AHD Operational Analysis | **I/C No:** | **Scenario:** | **Date:** | **Adj. Factor:** | **I/C Location:**

**Location:** AHD & 111 St Interchange | I/C No. 12 | 2029 | 22/2/13 | ## | **AHD & 111 St Inter**

## 3. Parclo A4 Interchange

### Critical Lane Volume Intersection Capacity Analysis:

Cycle Length: 120

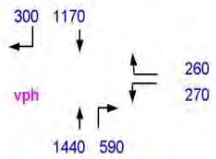
Critical Lane Volume Capacity: 1657

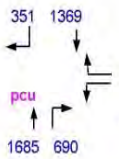
No. of signal phaseses: 2

| | 1 | 3 | Sum | g/c |
|---|---|---|---|---|
| Lost Time: | 6.5 | 6.0 | 12.5 | 0.90 |
| CLV for min Green | 238 | 158 | | |

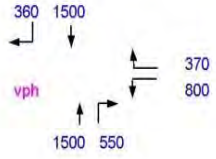
**N Ramp**

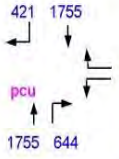
AM




PM




| | 2A4-1 | 2A4-2 | 2/3A4 | 3A4 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 / 1 | 11 / 11 | 111 / 11 | 11 1 / 111 | 11 11 / 111 | 11 11 / 1111 | 1 11 11 / 1111 1 | | | | |
| | 1 / 1 | 11 / 11 | 11 / 11 | 111 / 11 | 111 / 11 1 | 1111 / 11 1 | 1111 / 11 1 | 1111 / 11 11 | 1111 / 11 11 | 1111 / 11 11 | 1111 1 / 11 11 |
| CLV1 | 1685 / 1 | 1685 / 2 | 1685 / 2 | 1685 / 2 | 1685 / 3 | 1685 / 3 | 1685 / 3 | 1685 / 3 | 1685 / 4 | 1685 / 4 | 1685 / 4 |
| CLV2 | 1369 / 1 | 1369 / 2 | 1369 / 2 | 1369 / 3 | 1369 / 3 | 1369 / 4 | 1369 / 4 | 1369 / 4 | 1369 / 4 | 1369 / 4 | 1369 / 5 |
| CLV3 | 332 / 1 | 332 / 1 | 348 / 2 | 348 / 2 | 363 / 3 | 348 / 2 | 363 / 3 | 348 / 2 | 363 / 3 | 348 / 2 | 348 / 2 |
| Max of CLV1 & CLV2 & Min G1 | 1685 / 1 | 1685 / 2 | 1685 / 2 | 1685 / 2 | 1685 / 3 | 1685 / 3 | 1685 / 3 | 1685 / 3 | 1685 / 4 | 1685 / 4 | 1685 / 4 |
| Max of CLV3 & Min G3 | 332 / 1 | 332 / 1 | 348 / 2 | 348 / 2 | 363 / 3 | 348 / 2 | 363 / 3 | 348 / 2 | 363 / 3 | 348 / 2 | 348 / 2 |
| Sum CLV | 2017 | 1174 | 1016 | 1016 | 735 | 683 | 735 | 683 | 595 | 542 | 595 |
| v/c | 1.22 | 0.71 | 0.61 | 0.61 | 0.44 | 0.41 | 0.44 | 0.41 | 0.36 | 0.33 | 0.36 |
| LOS | F | C | B | B | A | A | A | A | A | A | A |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CLV1 | 1755 / 1 | 1755 / 2 | 1755 / 2 | 1755 / 2 | 1755 / 3 | 1755 / 3 | 1755 / 3 | 1755 / 3 | 1755 / 4 | 1755 / 4 | 1755 / 4 |
| CLV2 | 1755 / 1 | 1755 / 2 | 1755 / 2 | 1755 / 3 | 1755 / 3 | 1755 / 4 | 1755 / 4 | 1755 / 4 | 1755 / 4 | 1755 / 4 | 1755 / 5 |
| CLV3 | 983 / 1 | 983 / 1 | 1030 / 2 | 1030 / 2 | 1030 / 2 | 1077 / 3 | 1030 / 2 | 1077 / 3 | 1030 / 2 | 1077 / 3 | 1030 / 2 |
| Max of CLV1 & CLV2 & Min G1 | 1755 / 1 | 1755 / 2 | 1755 / 2 | 1755 / 2 | 1755 / 3 | 1755 / 3 | 1755 / 3 | 1755 / 3 | 1755 / 4 | 1755 / 4 | 1755 / 4 |
| Max of CLV3 & Min G3 | 983 / 1 | 983 / 1 | 1030 / 2 | 1030 / 2 | 1030 / 2 | 1077 / 3 | 1030 / 2 | 1077 / 3 | 1030 / 2 | 1077 / 3 | 1030 / 2 |
| Sum CLV | 2738 | 1861 | 1393 | 1393 | 1100 | 944 | 1100 | 944 | 954 | 798 | 954 |
| v/c | 1.65 | 1.12 | 0.84 | 0.84 | 0.66 | 0.57 | 0.66 | 0.57 | 0.58 | 0.48 | 0.58 |
| LOS | F | F | mD | mD | B | A | B | A | A | A | A |

## 3. Parclo A4 Interchange

**S Ramp**

| | 2A4 | 2/3A4 | 3A4 | | | | |
|---|---|---|---|---|---|---|---|
| | 1 / 1 | 11 / 11 | 11 1 / 111 | 11 11 / 111 | 11 11 / 1111 | 11 11 / 1111 1 | |

| | 2A4 | | 2/3A4 | 3A4 | | | |
|---|---|---|---|---|---|---|---|
| 1<br>1 | 11<br>11 | | 111<br>11 | 11 1<br>111 | | 11 11<br>111 | |
| 1<br>1 | 11<br>11 | 11<br>11 | 111<br>11 | 111<br>11 1 | 111<br>11 1 | 1111<br>11 1 | 1111<br>11 1 |
| 483 / 1<br>3534 / 1<br>605 / 1 | 483 / 2<br>3534 / 2<br>605 / 1 | 483 / 2<br>3534 / 2<br>634 / 2 | 483 / 2<br>3534 / 3<br>634 / 2 | 483 / 3<br>3534 / 3<br>634 / 2 | 483 / 3<br>3534 / 3<br>663 / 3 | 483 / 3<br>3534 / 4<br>634 / 2 | 483 / 3<br>3534 / 4<br>663 / 3 |
| 3534 / 1<br>605 / 1<br>4139<br>2.49<br>F | 3534 / 2<br>605 / 1<br>2372<br>1.42<br>F | 3534 / 2<br>634 / 2<br>2084<br>1.25<br>F | 3534 / 3<br>634 / 2<br>1495<br>0.90<br>D | 3534 / 3<br>634 / 2<br>1495<br>0.90<br>D | 3534 / 3<br>663 / 3<br>1399<br>0.84<br>mD | 3534 / 4<br>634 / 2<br>1200<br>0.72<br>C | 3534 / 4<br>663 / 3<br>1104<br>0.66<br>B |
| 2349 / 1<br>1282 / 1<br>913 / 1 | 2349 / 2<br>1282 / 2<br>913 / 1 | 2349 / 2<br>1282 / 2<br>956 / 2 | 2349 / 2<br>1282 / 3<br>956 / 2 | 2349 / 3<br>1282 / 3<br>956 / 2 | 2349 / 3<br>1282 / 3<br>1000 / 3 | 2349 / 3<br>1282 / 4<br>956 / 2 | 2349 / 3<br>1282 / 4<br>1000 / 3 |
| 2349 / 1<br>913 / 1<br>3261<br>1.96<br>F | 2349 / 2<br>913 / 1<br>2087<br>1.25<br>F | 2349 / 2<br>956 / 2<br>1652<br>0.99<br>E | 2349 / 2<br>956 / 2<br>1652<br>0.99<br>E | 2349 / 3<br>956 / 2<br>1261<br>0.76<br>C | 2349 / 3<br>1000 / 3<br>1116<br>0.67<br>B | 2349 / 3<br>956 / 2<br>1261<br>0.76<br>C | 2349 / 3<br>1000 / 3<br>1116<br>0.67<br>B |

| Adj. Factor | Ramp Location | Diamond | | | | Parclo A4 | | | | Parclo B4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2-SLT-2 | 2-DLT-2 | 2-SLT-1 | 3-SLT-2 | 2A4-1 | 2A4-2 | 2/3A4 | 3A4 | 2B4-SLT | 2B4-DLT | 3B4-SLT | 3B4-DLT |
| 1.0 | N Ramp | 1.27 | 1.07 | 1.56 | 1.09 | 1.12 | 0.84 | 0.84 | 0.66 | 0.90 | 0.72 | 0.73 | 0.55 |
| | S Ramp | 1.22 | 0.99 | 1.33 | 1.01 | 1.11 | 0.90 | 0.90 | 0.68 | 1.03 | 0.82 | 0.84 | 0.62 |
| 0.8 | N Ramp | 1.02 | 0.86 | 1.25 | 0.87 | 0.90 | 0.67 | 0.67 | 0.53 | 0.72 | 0.57 | 0.59 | 0.44 |
| | S Ramp | 0.97 | 0.79 | 1.07 | 0.81 | 0.89 | 0.72 | 0.72 | 0.54 | 0.83 | 0.65 | 0.67 | 0.50 |
| 0.9 | N Ramp | 1.14 | 0.97 | 1.40 | 0.98 | 1.01 | 0.76 | 0.76 | 0.60 | 0.81 | 0.64 | 0.66 | 0.49 |
| | S Ramp | 1.10 | 0.89 | 1.20 | 0.91 | 1.00 | 0.81 | 0.81 | 0.61 | 0.93 | 0.74 | 0.75 | 0.56 |
| 1.0 | N Ramp | 1.27 | 1.07 | 1.56 | 1.09 | 1.12 | 0.84 | 0.84 | 0.66 | 0.90 | 0.72 | 0.73 | 0.55 |
| | S Ramp | 1.22 | 0.99 | 1.33 | 1.01 | 1.11 | 0.90 | 0.90 | 0.68 | 1.03 | 0.82 | 0.84 | 0.62 |
| 1.1 | N Ramp | 1.40 | 1.18 | 1.72 | 1.20 | 1.23 | 0.92 | 0.92 | 0.73 | 0.99 | 0.79 | 0.81 | 0.60 |
| | S Ramp | 1.34 | 1.09 | 1.47 | 1.11 | 1.22 | 0.99 | 0.99 | 0.75 | 1.14 | 0.90 | 0.92 | 0.69 |
| 1.2 | N Ramp | 1.53 | 1.29 | 1.87 | 1.31 | 1.35 | 1.01 | 1.01 | 0.80 | 1.08 | 0.86 | 0.88 | 0.66 |
| | S Ramp | 1.46 | 1.19 | 1.60 | 1.22 | 1.33 | 1.08 | 1.08 | 0.81 | 1.24 | 0.98 | 1.01 | 0.75 |

# Program Weakness

Pron

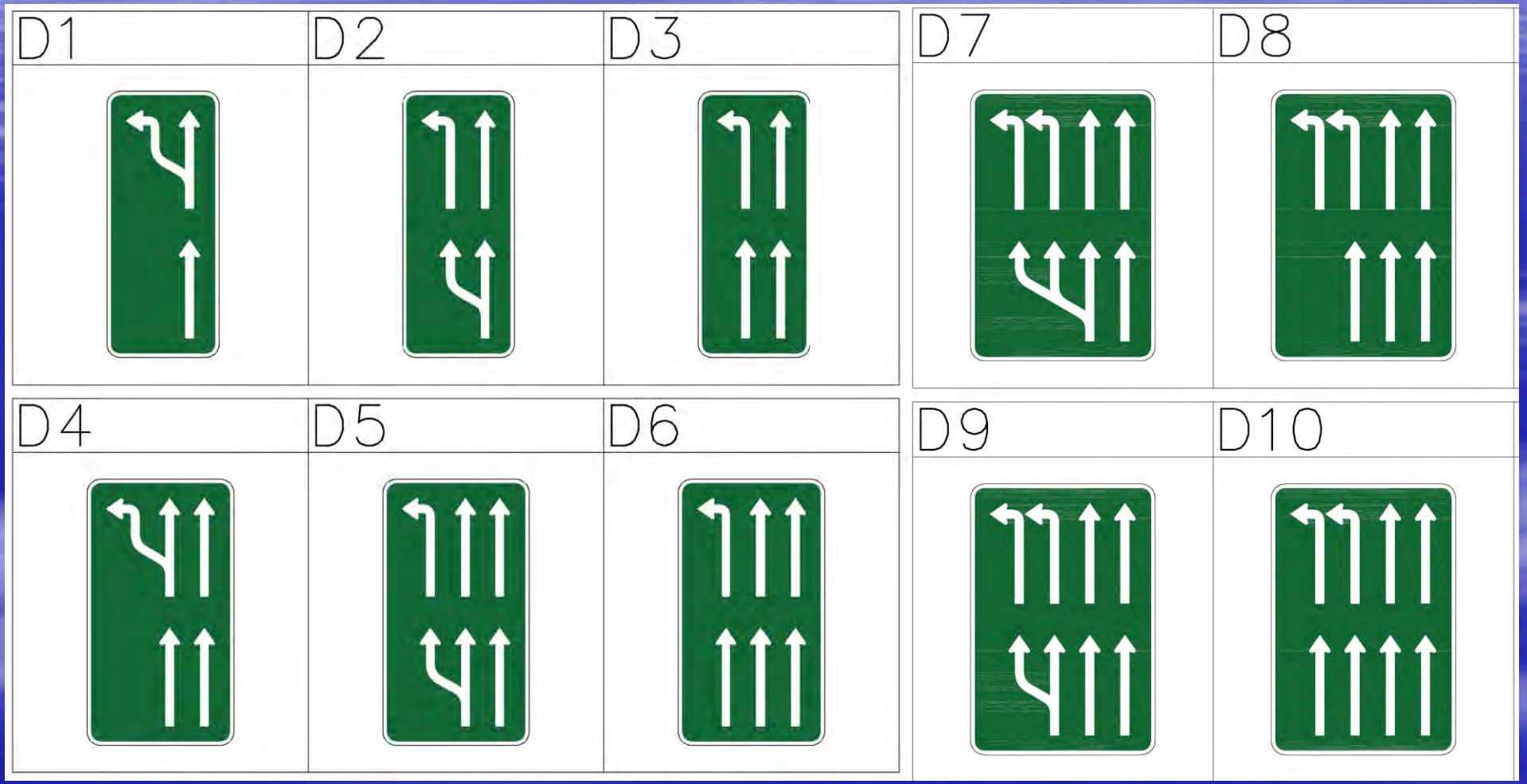
# Program Weakness

## Lane Utilization Factor, Inaccurate Land Use

# We are at this stage…

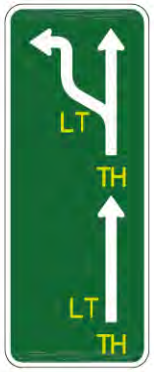
(WIP)

Pron



Pron

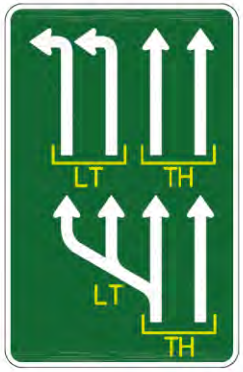
D1




D2

D3

D7

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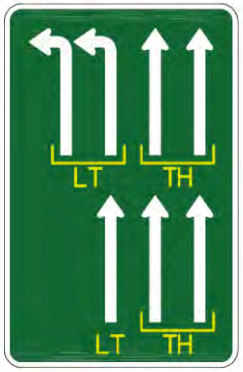
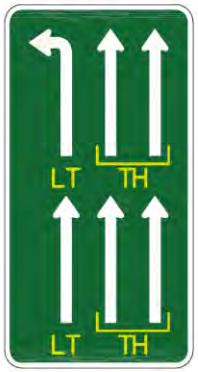



D4

D5

D6

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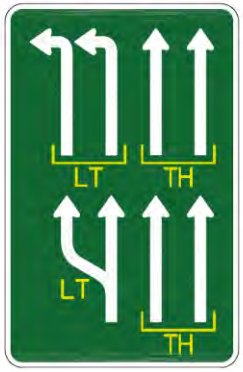


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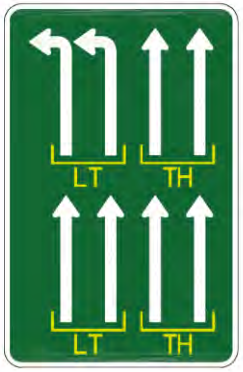

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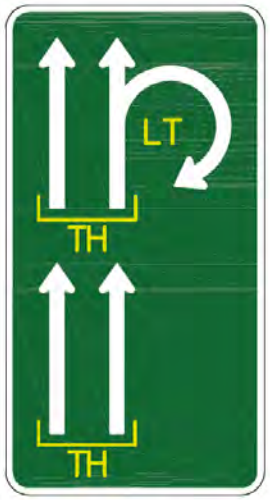


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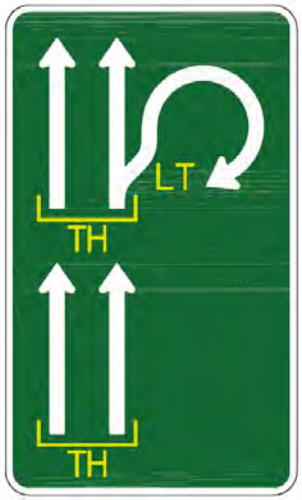


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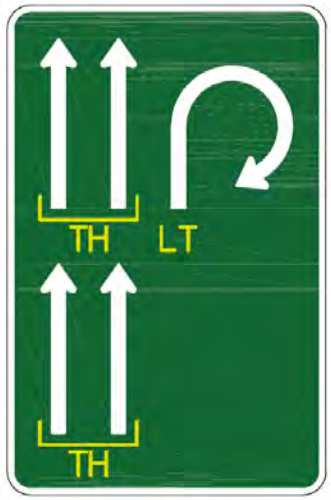


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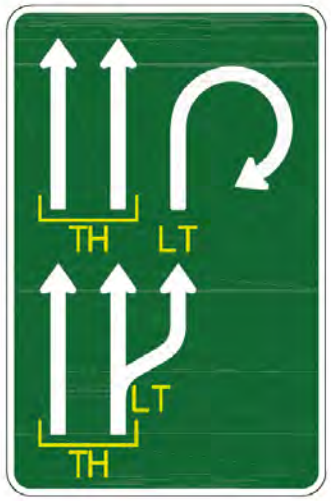


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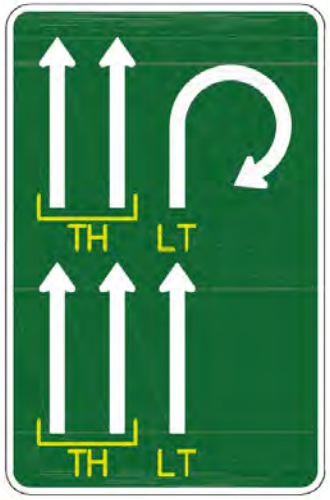


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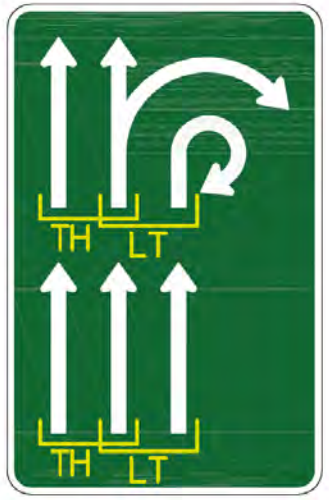
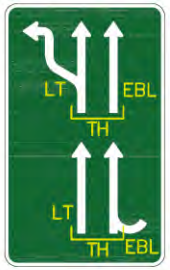


B1

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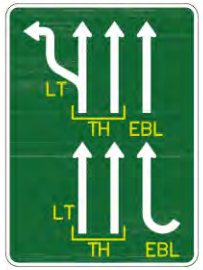


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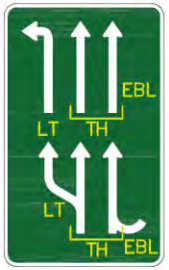


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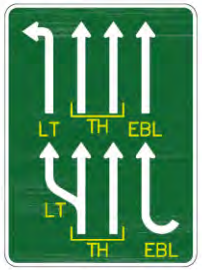


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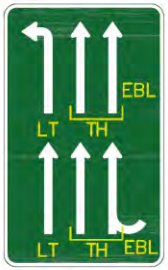


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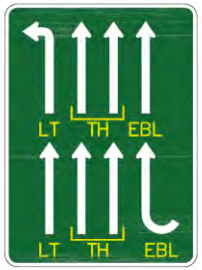


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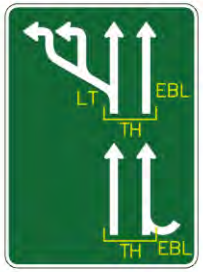


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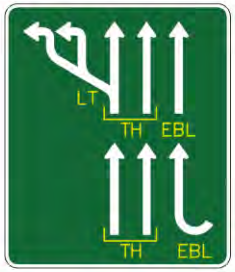


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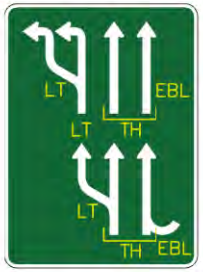


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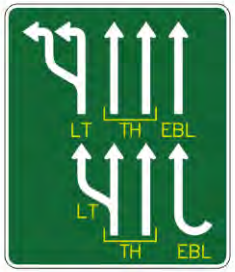


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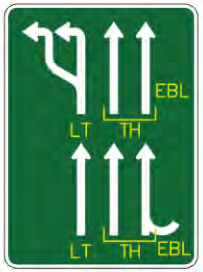


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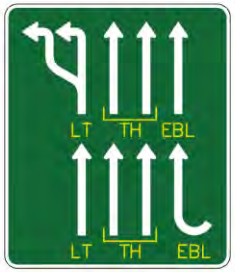


# WIP

## ( Work In Progress )

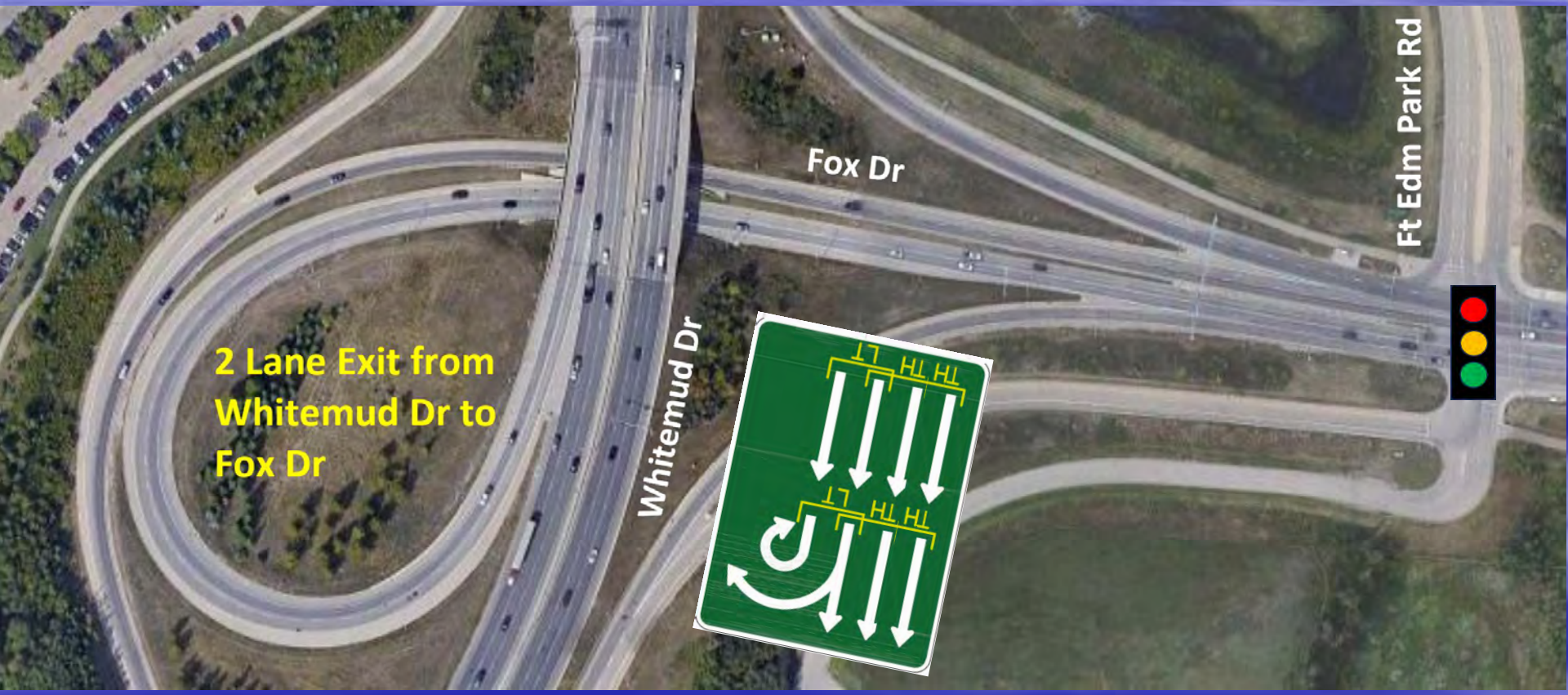
Capacity Assessment Logic

Programming

Additional Interchange Styles ?

2 Lane Exit ???

# 2 Lane Exit ???


2 Lane Exit from Whitemud Dr to Fox Dr
Whitemud Dr
Fox Dr
Ft Edm Park Rd

# Next up

IMSA®

Internation Municipal Signal Association

Canadian Prairie Section Conference & Trade Show

April 14 - 17, Calgary

***Operation Optimization***

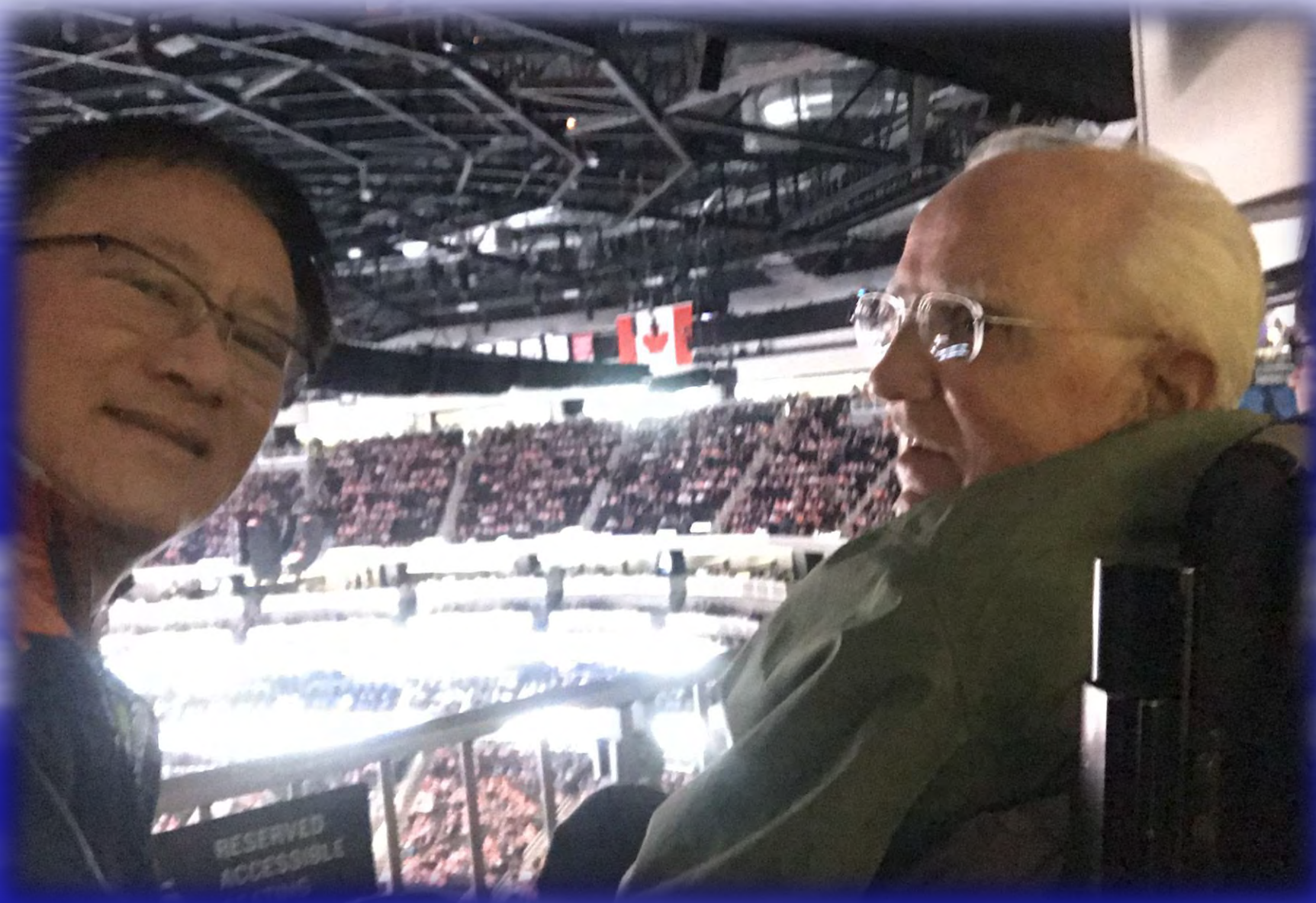
***at Service Interchanges***

# End of Presentation

*p.s.*

*Presentation prepared in memory of*

# *Roman Wozniak, P.Eng.*



*miss you Roman…*