



Region of Waterloo

INITIAL SCREENING



**ROUNDBOUT
FEASIBILITY WORKSHOP
MAY 7, 2009**



Planning Process Overview

- Phase 1: Initial Screening
 - Quick assessment of feasibility of a roundabout vs other forms of traffic control based on order-of-magnitude life-cycle cost
 - Review of Screening Tool by Roundabout Coordination Committee (RCC) (Optional)



Initial Screening Tool Overview

- 5 page questionnaire designed to be completed in 3-5 hours
- Includes background information
 - Intersection location
 - Existing configuration/traffic control
 - Collision history
 - Forecasted traffic volumes



Initial Screening Tool Overview

- Includes proposed configurations for both roundabout and conventional improvements
 - Signals - #lanes, storage lengths, etc.
 - Roundabout – size, # of entry lanes, etc.
- Concept sketches of each config.
- 20-Year Life Cycle Cost Estimate

Initial Screening Tool Overview

WHAT A SCREENING TOOL IS NOT USED FOR:

- To compare safety performance
- To compare operational performance
- To determine property requirements of a roundabout

Screening Tool Guide

- Located in handout
- Information tips/sources are provided to assist proponent in filling out questionnaire



Screening Tool Question #9

Is the intersection located within a corridor that is scheduled for improvements in the 10 Year Transportation Capital Program? What is the ultimate cross-section of the approach roads?

ARE ANY OF THE APPROACH ROADS SCHEDULED FOR WIDENING IN REGION'S 10 YEAR TRANSPORTATION CAPITAL PROGRAM?

CHECK WITH TRANSPORTATION PLANNING REPRESENTATIVE OR ACCESS CAPITAL PROGRAM ON REGION WEBSITE.



Screening Tool Question #10

What is the collision history of the intersection over the past five years? Is there a collision problem that needs to be addressed?

**COLLISION PROBLEM TO BE
DETERMINED BY
TRANSPORTATION
ENGINEERING.**



Screening Tool Question #13

If traffic control signals are being considered, are the traffic signal warrants met for the horizon year?

BASED ON OTM WARRANTS.

WARRANT TO BE VERIFIED BY
TRANSPORTATION
ENGINEERING



Screening Tool Question #14

What size of roundabout is being considered for this intersection? (eg. Single-lane, two-lane entry or three-lane entry?) Please attach a Traffic Flow Worksheet and lane configuration diagram. Please attach a sketch showing how a roundabout would "fit" into the right-of-way.

USE TRAFFIC FLOW WORKSHEET AND RODEL (OPTIONAL) TO DETERMINE NUMBER OF ENTRY LANES.

Screening Tool Question #14

Typical Sizes:

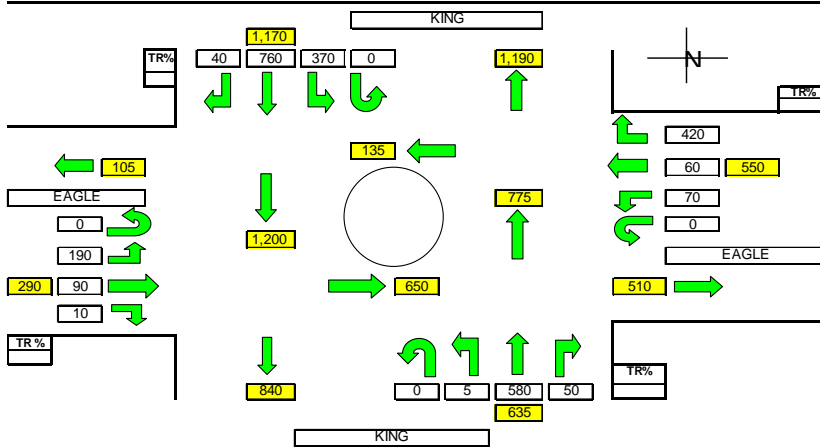
- *SINGLE – 40M INSCRIBED CIRCLE DIAMETER (ICD)*
- *2-LANE – 55M INSCRIBED CIRCLE DIAMETER (ICD)*
- *3-LANE – 70M INSCRIBED CIRCLE DIAMETER (ICD)*

**REGION OF WATERLOO
ROUNDBOUT
TRAFFIC
FLOW SHEET**

VERSION 1.0 AUG 22, 2008

Project: KING/SHANTZ
Project No.: 5337
Intersection: KING/EAGLE
Time Period: 2016 PM

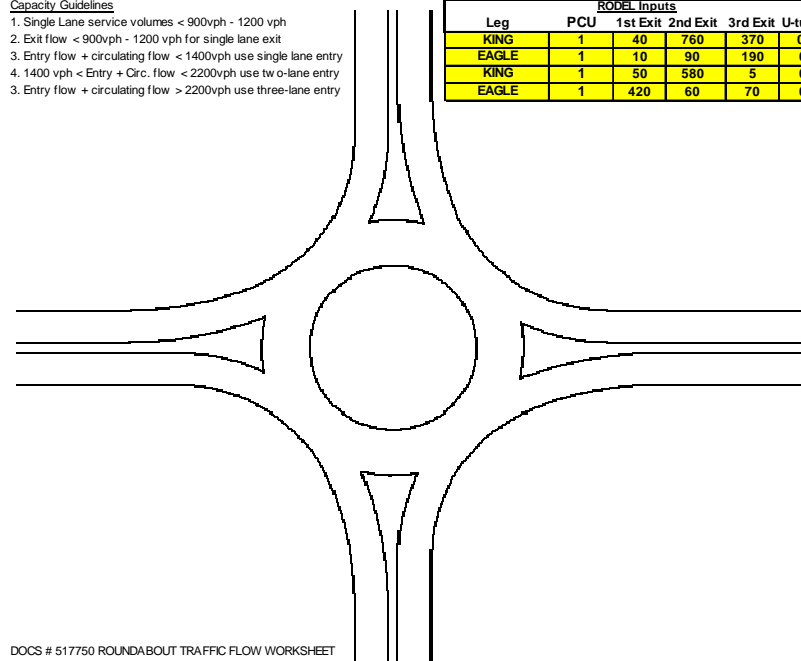
Drawn By: SVDK
Sheet of



Capacity Guidelines

1. Single Lane service volumes < 900vph - 1200 vph
2. Exit flow < 900vph - 1200 vph for single lane exit
3. Entry flow + circulating flow < 1400vph use single lane entry
4. 1400 vph < Entry + Circ. flow < 2200vph use two-lane entry
5. Entry flow + circulating flow > 2200vph use three-lane entry

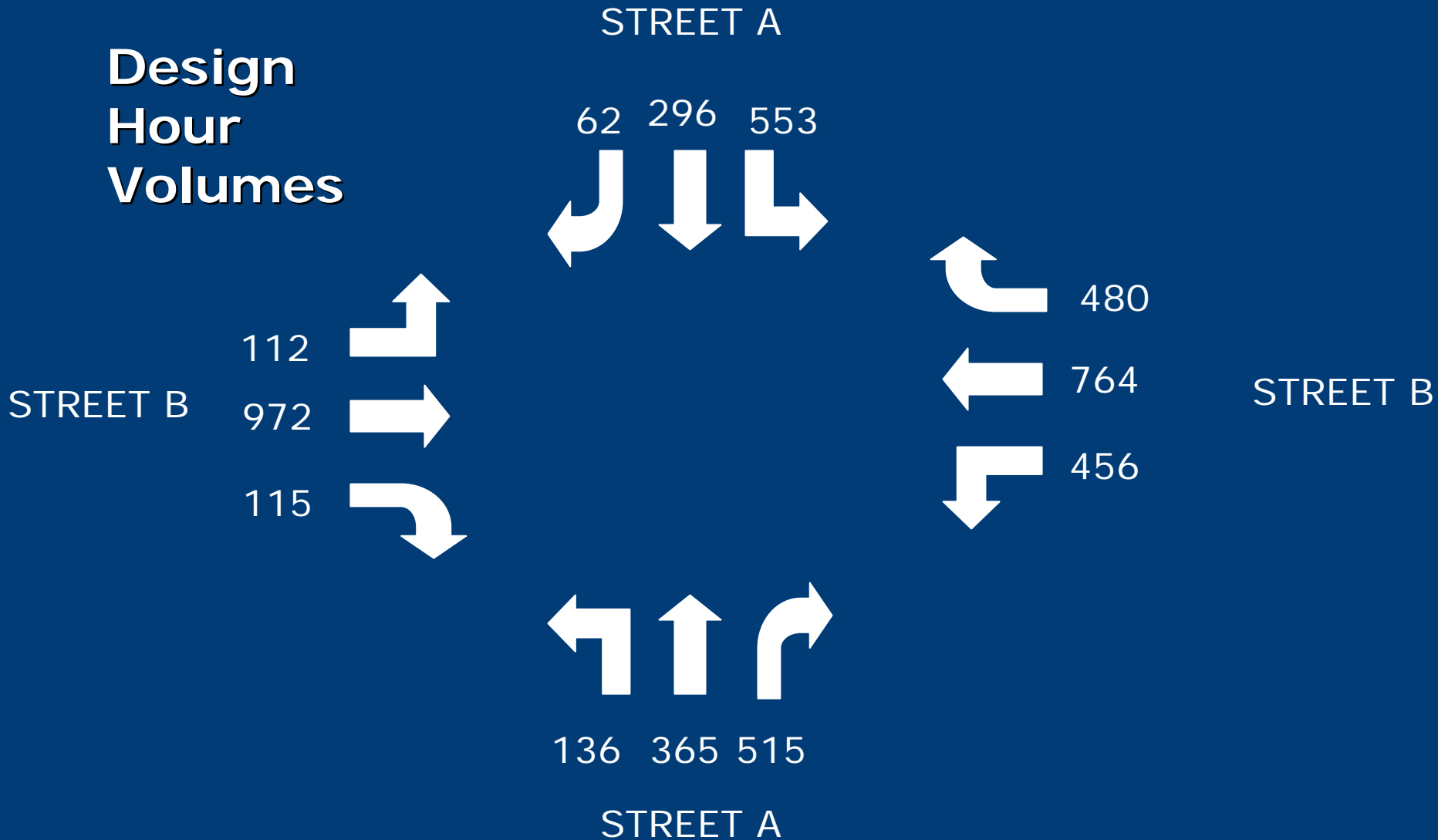
Leg	PCU	RODEL Inputs			
		1st Exit	2nd Exit	3rd Exit	U-turn
KING	1	40	760	370	0
EAGLE	1	10	90	190	0
KING	1	50	580	5	0
EAGLE	1	420	60	70	0

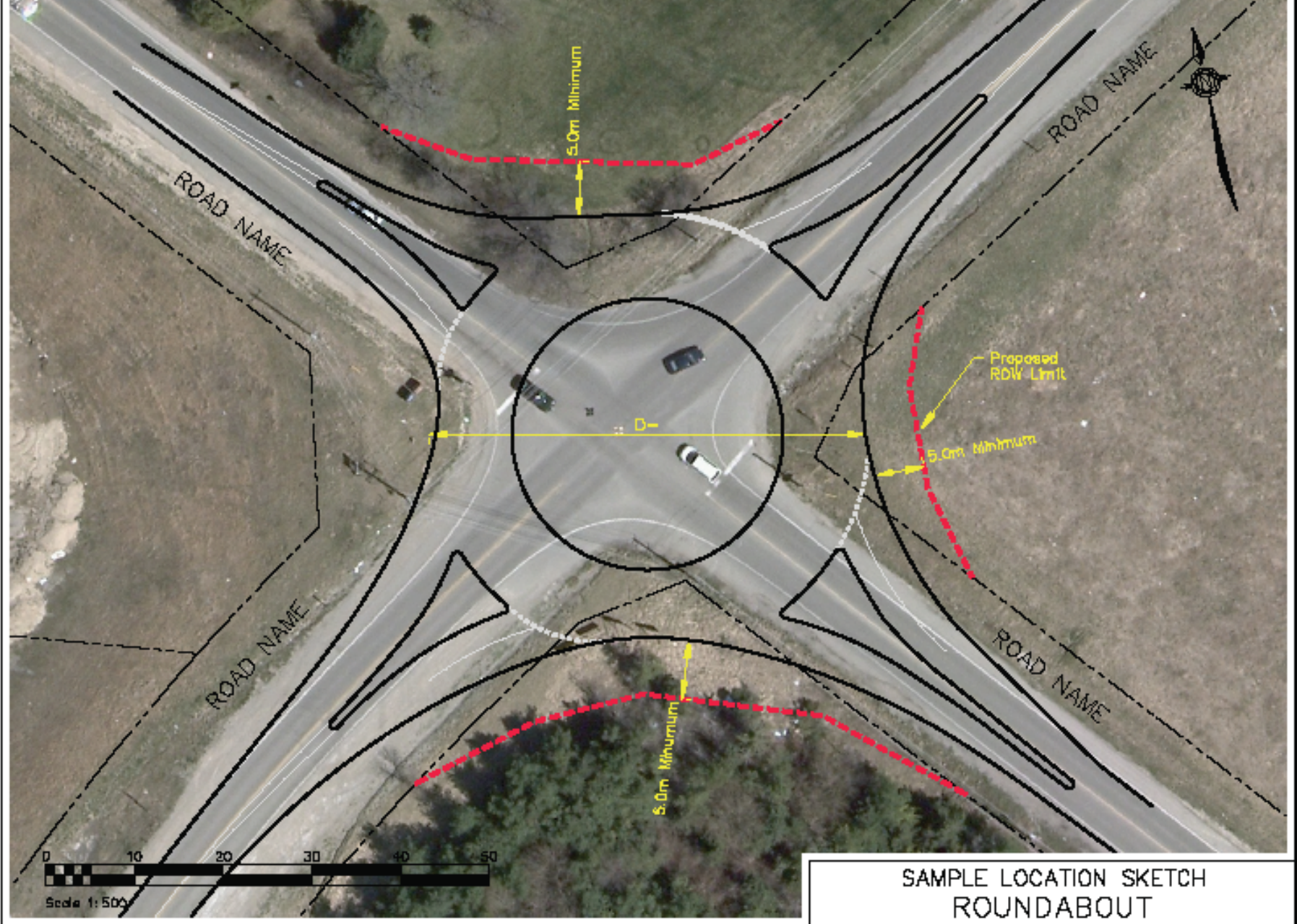


Traffic Flow Worksheet

- Excel spreadsheet
- enter turning movements
- calcs circulating flows
- basic lane configuration

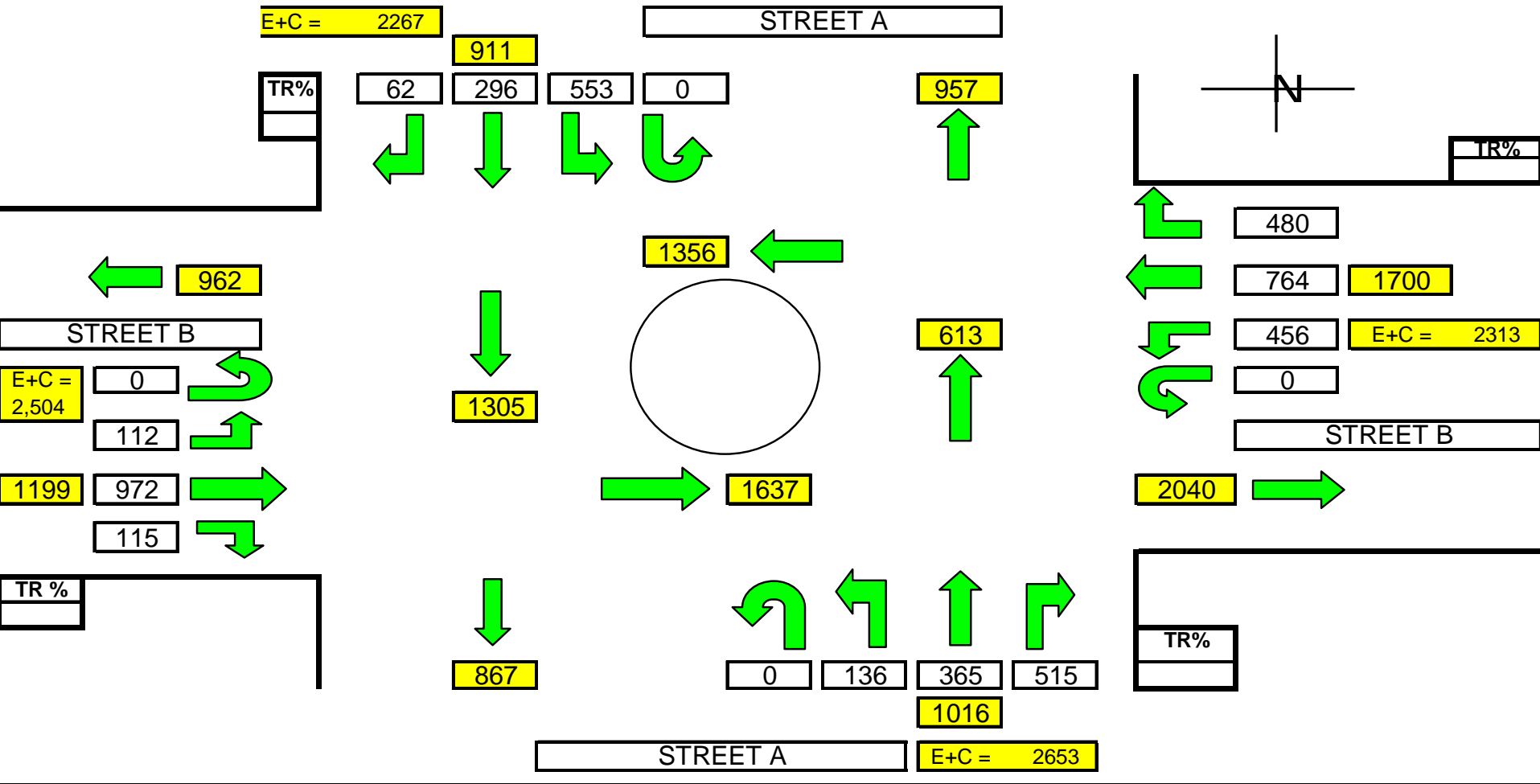
Traffic Flow Worksheet





SAMPLE LOCATION SKETCH
ROUNDBOUT

Traffic Flow Worksheet

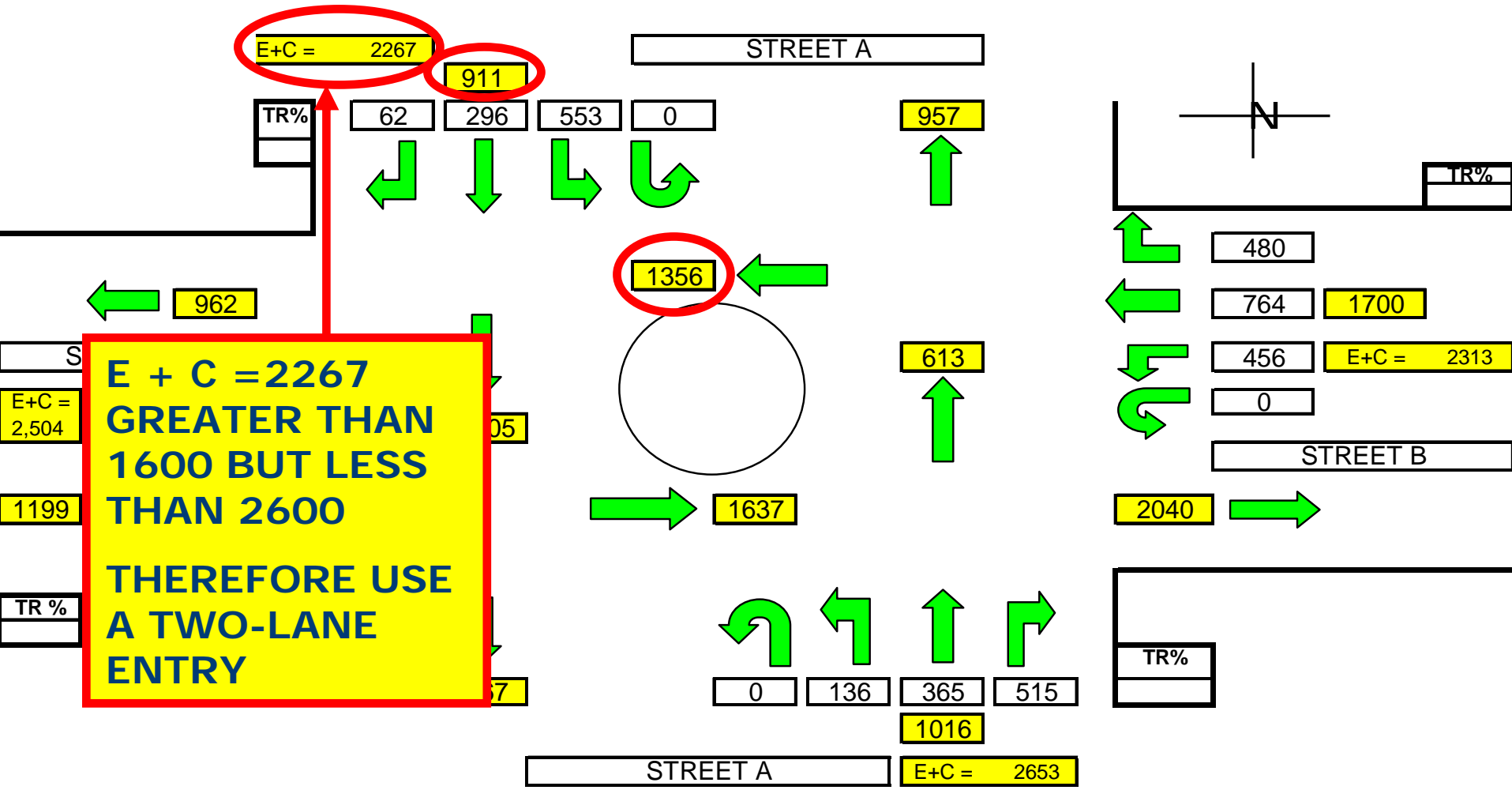


Traffic Flow Worksheet

Capacity Rules of Thumb:

- $\text{Entry} + \text{Circulating Flow} < 1600$ use single-lane entry
- $1600 < \text{Entry} + \text{Circulating Flow} < 2600$ use two-lane entry
- $\text{Entry} + \text{Circulating Flow} > 2600$ use three-lane entry

Traffic Flow Worksheet





Traffic Flow Worksheet

Determine Lane Configurations

- Each approach handled separately
- Add the turning movements on each approach
- Divide the total approach volume by the number of lanes
- Ensure balanced queuing and demand lane by lane by designating lanes as shared or exclusive

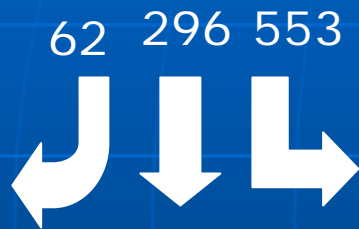
Traffic Flow Worksheet



Traffic Flow Worksheet

Lane Assignment Calculation

- Sum the volumes: $62 + 296 + 553 = 911$



- Divide the total by the number of lanes on the approach: $911 / 2 = 455$

- 455 vehicles per lane results in even lane distribution and even queuing

- Determine what lane assignments are needed to apportion the turning flows to achieve 455 per lane



- Look for high right turns : Possible right-turn by-pass

Traffic Flow Worksheet

Lane Configuration Options



• RODEL assumes even distribution of vehicles into approach lanes and calculates queues based on this



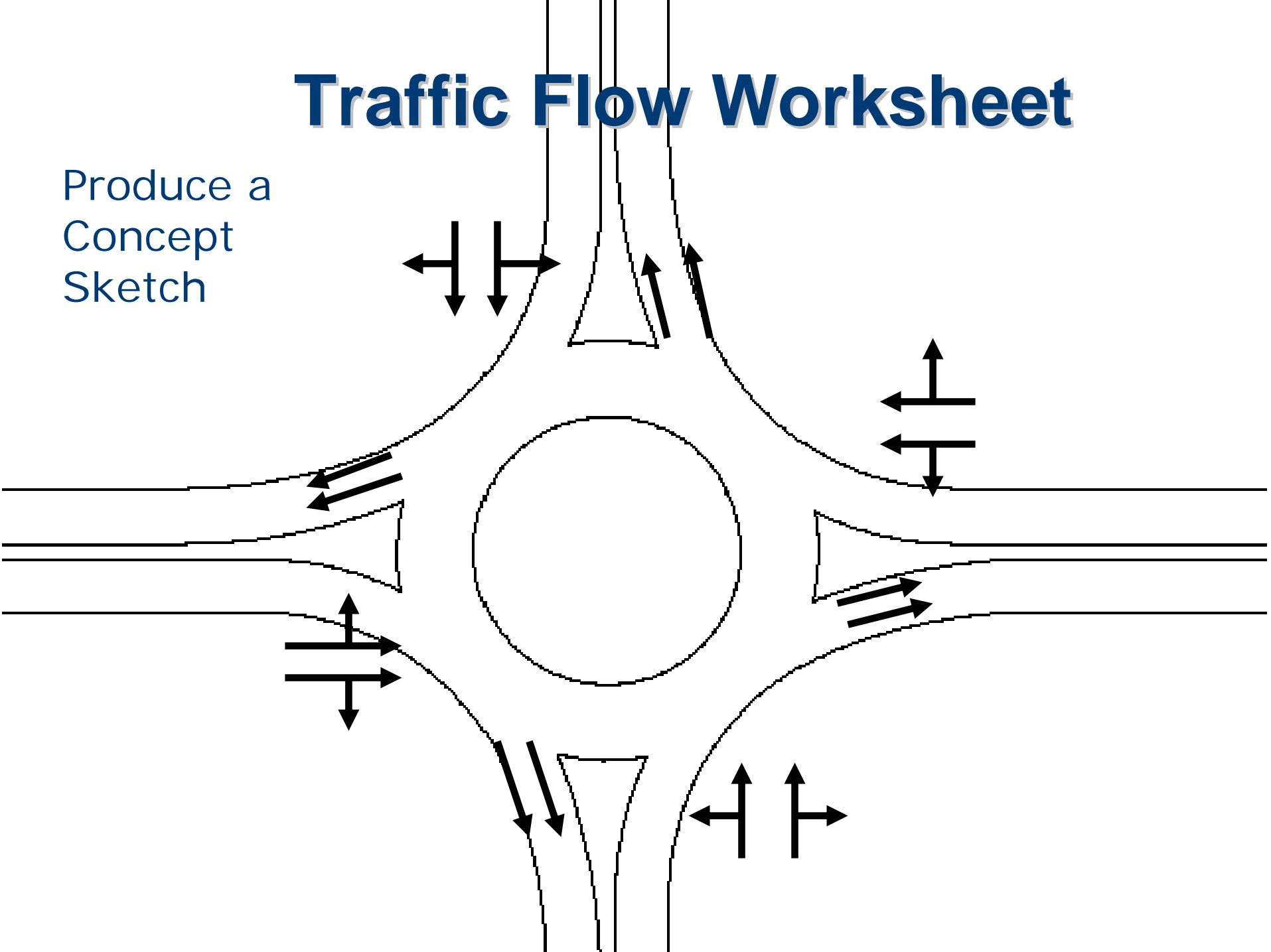
HOW ABOUT THIS?

OR THIS?



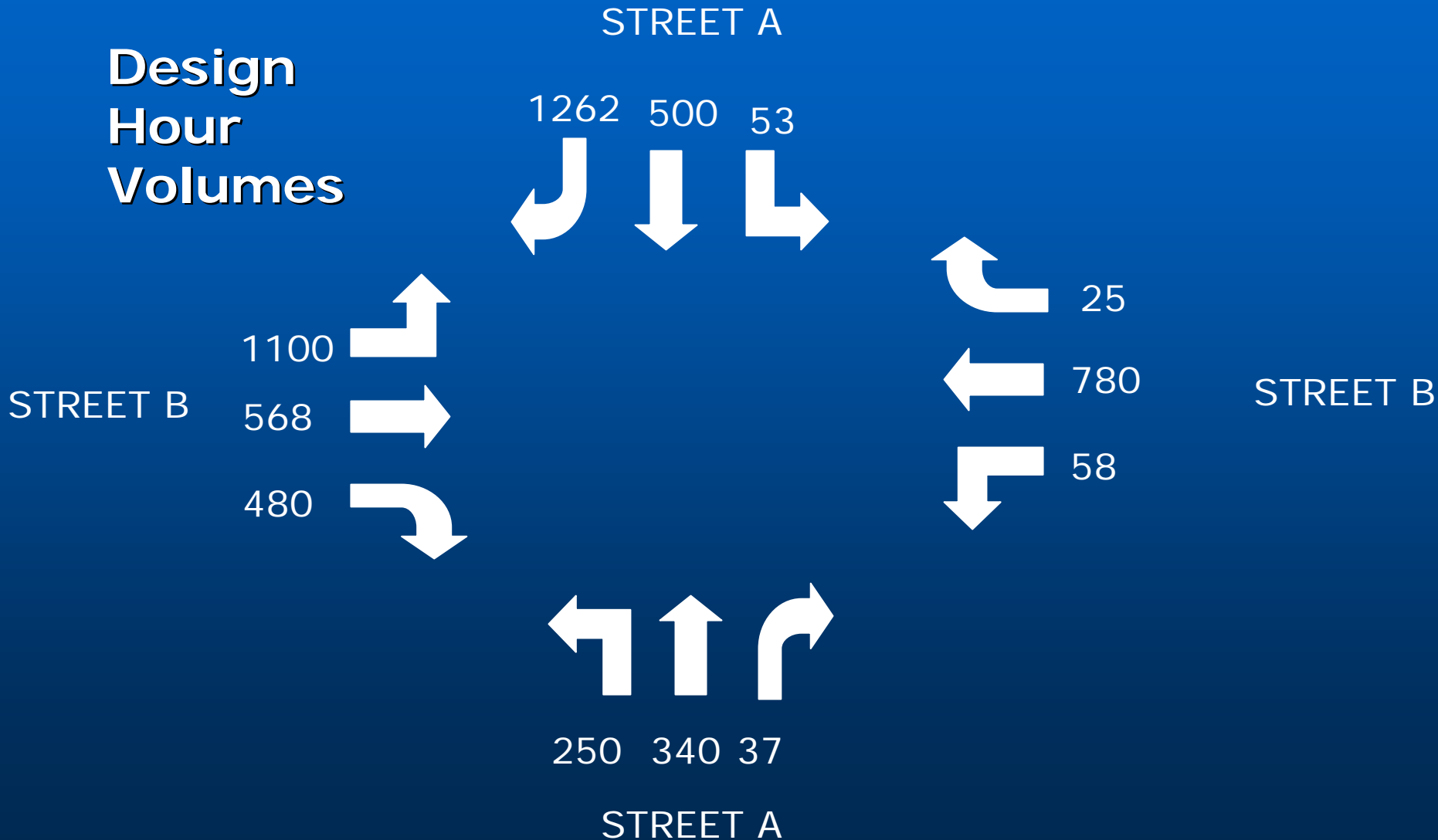
Traffic Flow Worksheet

Produce a
Concept
Sketch



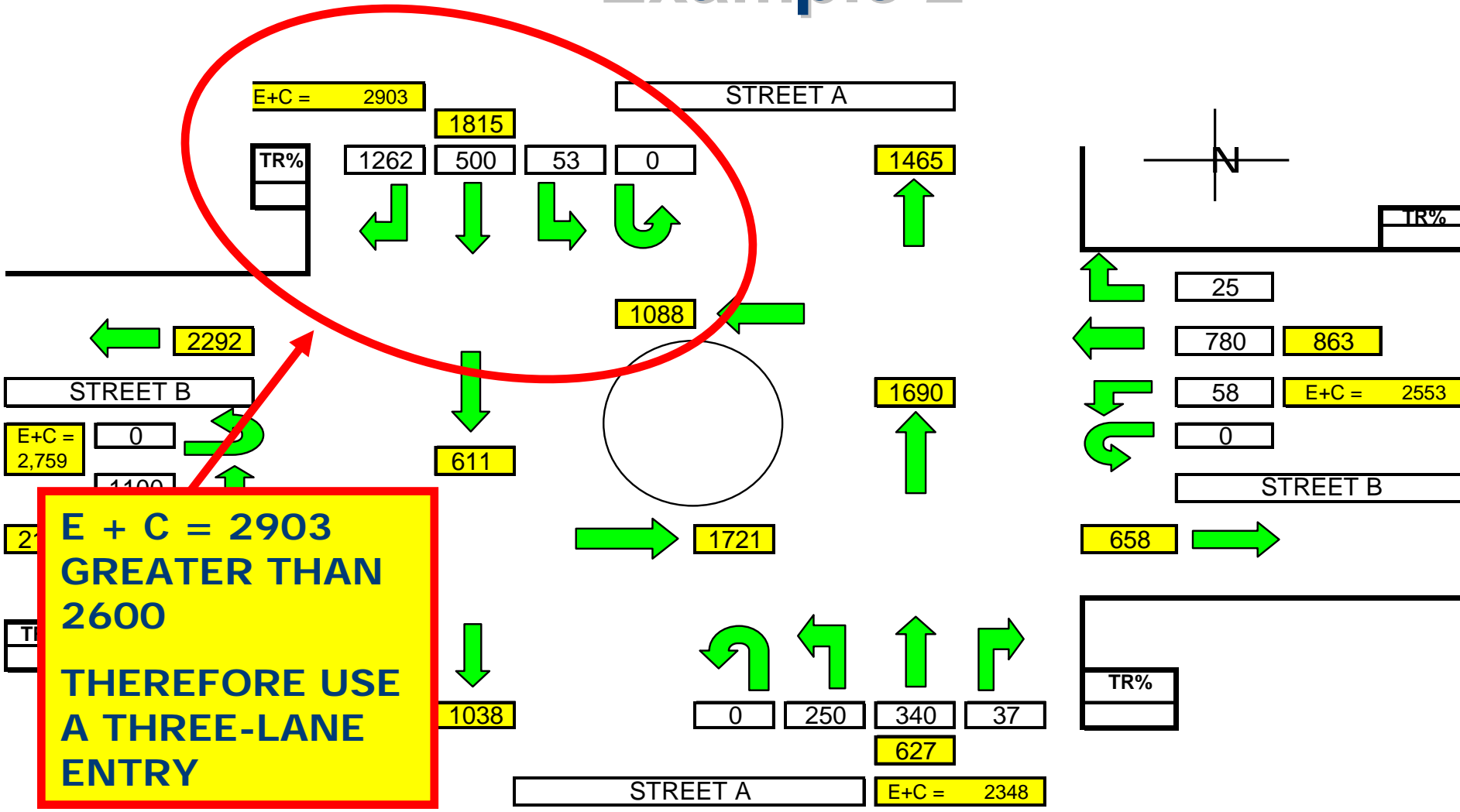
Traffic Flow Worksheet

Example 2



Traffic Flow Worksheet

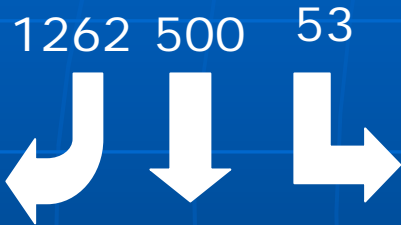
Example 2



Traffic Flow Worksheet

Lane Assignment Calc. Example 2

- Sum the volumes: $1262 + 500 + 53 = 1815$



- Divide the total by the number of lanes on the approach: $1815 / 3 = 605$

- 605 vehicles per lane results in even lane distribution and even queuing

- Determine what lane assignments are needed to apportion the turning flows to achieve 605 per lane



Traffic Flow Worksheet

Example 2

Lane Configuration Options

1262 500 53



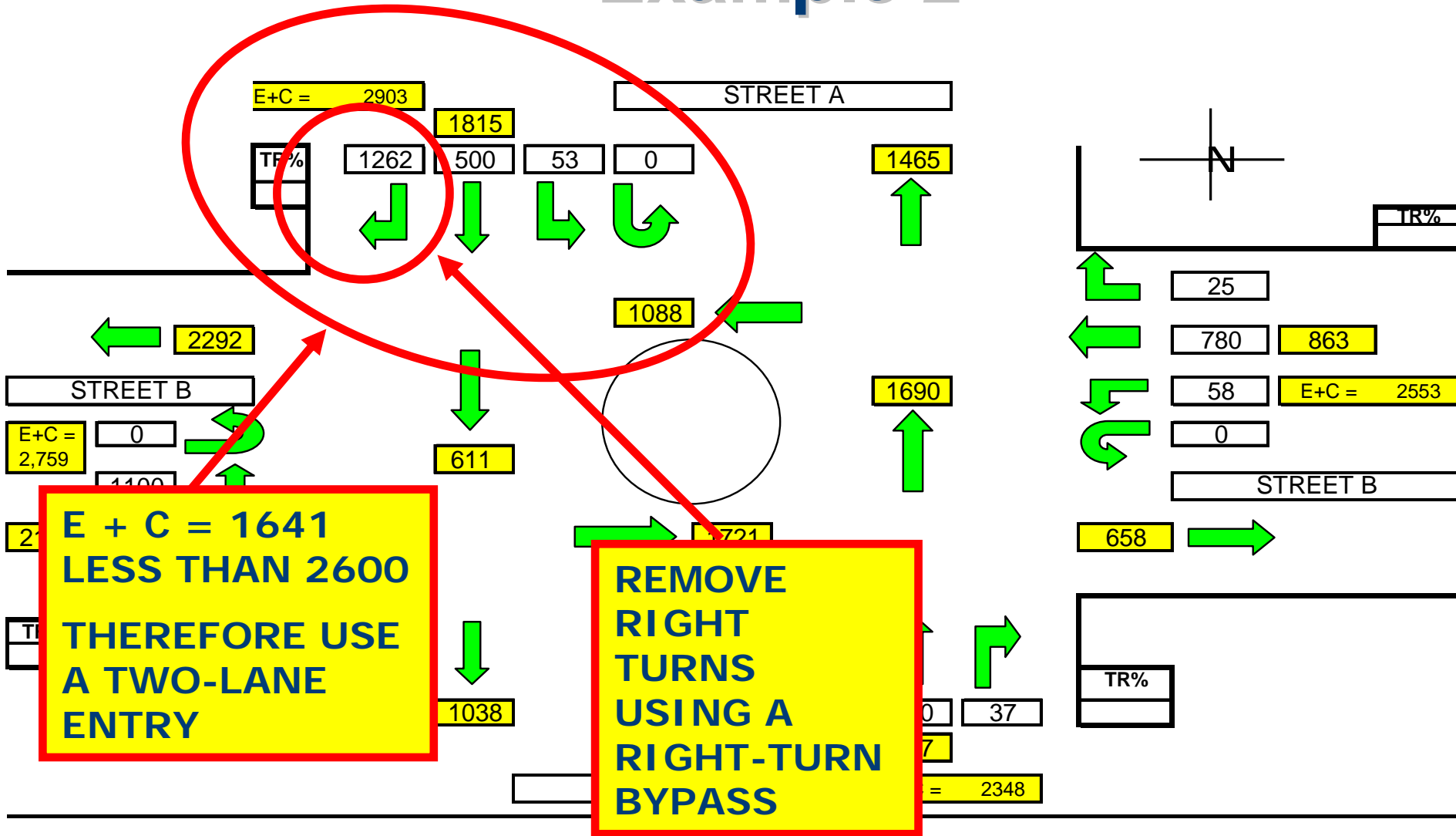
605 605 605



- RODEL assumes even distribution of vehicles into approach lanes and calculates queues based on this
- IS THIS WHAT YOU WANT?

Traffic Flow Worksheet

Example 2



Traffic Flow Worksheet

Lane Assignment Calc. Example 2

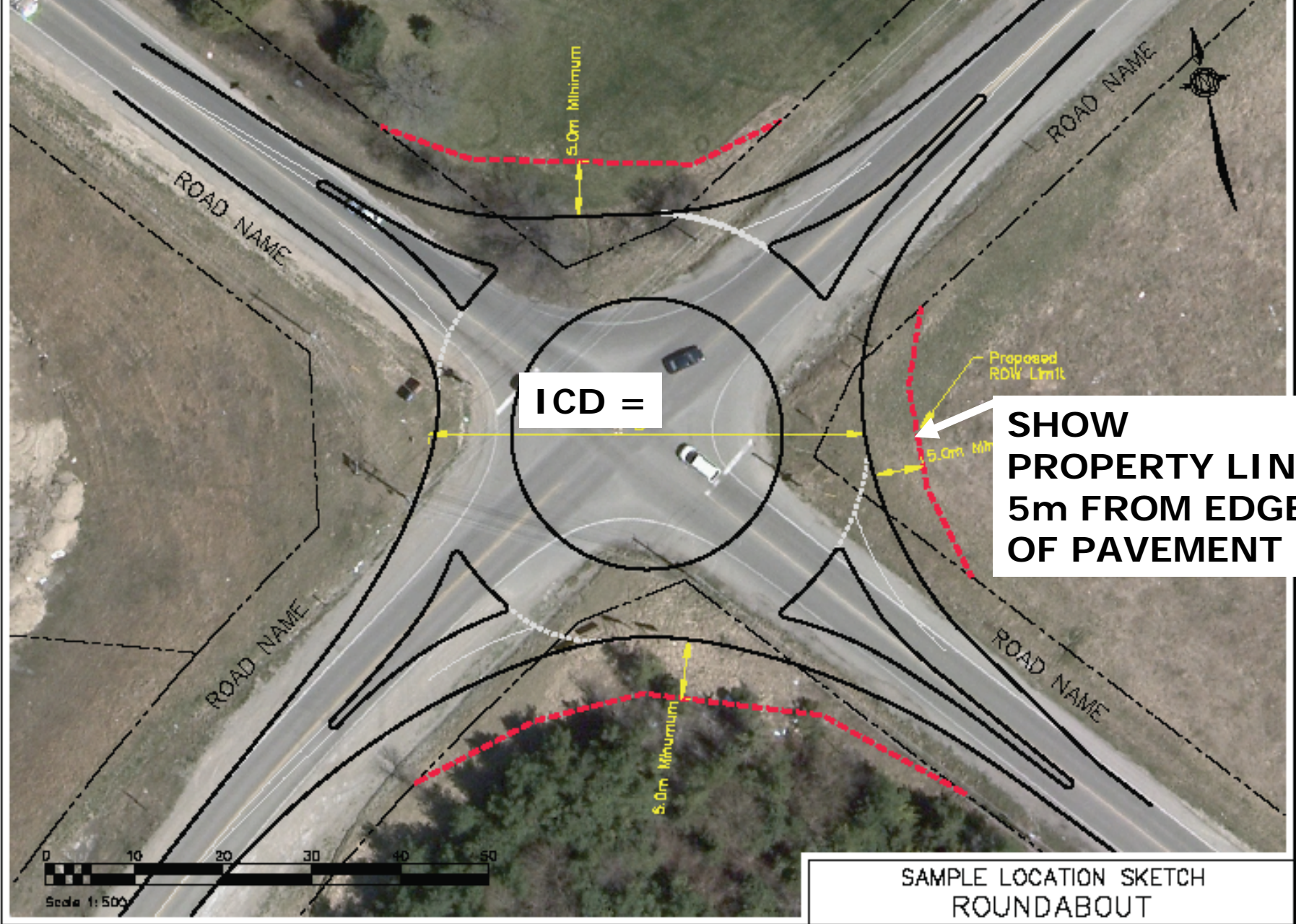


- Sum the volumes: $500 + 53 = 553$
- Divide the total by the number lanes on the approach: $553 / 2 = 276$

• 276 vehicles per lane results in even lane distribution and even queuing



- Determine what lane assignments are needed to apportion the turning flows to achieve 276 per lane



**SHOW
PROPERTY LINE
5m FROM EDGE
OF PAVEMENT**

Screening Tool Question #15

20-Year Life Cycle Cost Estimate

- Initial implementation cost
 - Construction
 - Property
 - Utilities
 - engineering
- Injury collision cost
- All costs are expressed in Present Value



Screening Tool Question #15

Initial Implementation Cost

Traditional forms of Traffic Control

4-WAY STOP INCL. FLASHERS	\$25,000
TRAFFIC SIGNALS	\$100,000
ADD LEFT-TURN LANE	\$250,000
ADD RIGHT-TURN LANE	\$150,000
MAJOR IMPROVEMENTS INCL. DUAL LTL'S, RTL'S, ADD'L THRU LANES, SIGNAL MOD., ETC.	\$500,000- \$1,000,000



Screening Tool Question #15

Initial Implementation Cost Roundabouts

SINGLE	\$750,000
TWO-LANE	\$1.2 MILLION
THREE-LANE	\$1.8 MILLION

Injury Collision Cost

- Injury Collision Cost = expected #of injury collisions per year X 20 years X \$30,000 (TAC)
- Existing intersection: expected collisions based on 5-year history
- New intersection: expected collisions based on collisions at similar Regional intersections
- Assumption: roundabout collision frequency is 50% of signals

20-Year Present Value Injury Collision Costs

Existing Unsignalized Intersections
and
Future Intersections

Step 1 – Determine applicable injury collision rate

- Obtain 10-year horizon AADT, # legs
- Determine average injury collision rate from table

average injury collision rate at signalized intersections
(injury collisions per million vehicles entering (Coll/MVE))

AADT Entering	3-legs	4-legs
0 to 5,000	n/a	n/a
5,001 to 10,000	0.09	0.15
10,001 to 15,000	0.07	0.12
15,001 to 20,000	0.12	0.16
20,001 to 25,000	0.11	0.16
Greater than 25,000	0.14	0.22

Step 2 – Determine expected annual injury collision frequency (AICF) for a proposed signal

$$\text{AICF} = 365 \times \text{injury collision rate} \times \text{AADT} / 1000000$$

Step 3 – Calculate 20-year present value (PV) injury collision cost for a proposed signal

$$PV_{\text{signal}} = \text{AICF} \times \text{ICC} \left(\frac{(1+i)^{20} - 1}{i(1+i)^{20}} \right)$$

$$PV_{\text{roundabout}} = PV_{\text{signal}} * 0.50$$

Where:

AICF = annual injury collision frequency

ICC = injury collision cost (\$30,000)

i = discount rate (6% or 0.06)

20-Year Present Value Injury Collision Costs

Existing Signalized
Intersections

Step 1 – Calculate existing injury collision rate for the intersection

- Determine total 5-year historical injury collisions
- Obtain existing AADT
- Calculate specific injury collision rate
- $ICR = \frac{5 \text{ yr. injury collisions} \times 1000000}{365 \times 5 \times AADT}$

$$365 \times 5 \times AADT$$

Step 2 – Compare injury collision rates

- Compare intersection specific rate to average rate
- Determine factor higher or lower than avg. rate

average injury collision rate at signalized intersections
(injury collisions per million vehicles entering (Coll/MVE))

AADT Entering	3-legs	4-legs
0 to 5,000	n/a	n/a
5,001 to 10,000	0.09	0.15
10,001 to 15,000	0.07	0.12
15,001 to 20,000	0.12	0.16
20,001 to 25,000	0.11	0.16
Greater than 25,000	0.14	0.22

Step 3 – Determine expected injury collision rate (future)

- Obtain 10-year horizon AADT
- Reference 10-year horizon ICR from table
- adjust ICR by factor higher or lower than avg.

average injury collision rate at signalized intersections
(injury collisions per million vehicles entering (Coll/MVE))

AADT Entering	3-legs	4-legs
0 to 5,000	n/a	n/a
5,001 to 10,000	0.09	0.15
10,001 to 15,000	0.07	0.12
15,001 to 20,000	0.12	0.16
20,001 to 25,000	0.11	0.16
Greater than 25,000	0.14	0.22

Step 4 – Determine expected annual injury collision frequency (AICF) for a signal (future)

$$\text{AICF} = 365 \times \text{factored injury collision rate} \times \text{AADT} / 1000000$$

average injury collision rate at signalized intersections
(injury collisions per million vehicles entering (Coll/MVE))

AADT Entering	3-legs	4-legs
0 to 5,000	n/a	n/a
5,001 to 10,000	0.09	0.15
10,001 to 15,000	0.07	0.12
15,001 to 20,000	0.12	0.16
20,001 to 25,000	0.11	0.16
Greater than 25,000	0.14	0.22

Step 5 – Calculate 20-year present value injury collision cost

$$PV_{\text{signal}} = \text{AICF} \times \text{ICC} \left(\frac{(1+i)^{20} - 1}{i(1+i)^{20}} \right)$$

$$PV_{\text{roundabout}} = PV_{\text{signal}} * 0.50$$

Where:

AICF = annual injury collision frequency

ICC = injury collision cost (\$30,000)

i = discount rate (6% or 0.06)

Working Example:

- Existing 4-leg signalized intersection
- Current AADT = 12,000 vehicles/day
- 10-year horizon AADT = 17,000 vehicles/day
- 4 injury collisions over past 5 years

Therefore:

AICF (current) = 0.8 injury coll/year

injury collision rate (current)

= 0.18 compared to 0.12 injury coll/MVE (average)

injury collision rate factor = 1.5

injury collision rate (future)

= 0.16 (from table) x 1.5 factor

= 0.24 injury coll/MVE

20-Year present value injury collision cost

$$\begin{aligned} \text{AICF} &= 365 \times 0.24 \times 17000 / 1000000 \\ &= 1.49 \text{ injury coll/year} \end{aligned}$$

and therefore

$$\begin{aligned} \text{PV}_{\text{signal}} &= \text{AICF} \times \text{ICC} \left((1+i)^{20} - 1 \right) / i(1+i)^{20} \\ &= 1.49 \times 30000 \left((1.06)^{20} - 1 \right) / 0.06(1.06)^{20} \\ &= \quad \quad \quad \$ 512,700 \end{aligned}$$

$$\text{PV}_{\text{roundabout}} = \quad \quad \quad \$ 256,350$$



Recommendations and Conclusions

- Provide a recommendation to proceed to an Intersection Control Study (ICS) or not
- Briefly explain your rationale



Questions?

