

# Appendix Four

## Shuttle Bus Calculations

**Alerus Center Traffic Management Plan**

SRF # 5370

4-Aug-05 *Revised 18-Aug-05*

by: mkk

**Shuttle Bus Calculations - Calculation Method 1 (assumes average speed of 10 mph)**

Assumptions

- All people parking off-site travel between the Alerus Center and their car within 75 minutes.
- Off-site parking is located on the University of North Dakota (UND) campus and/or the Altru Hospital campus in Grand Forks, ND.
- UND is 2.6 miles from the Alerus Center (average distance to all lots)
- Altru Hospital is 1.1 miles from the Alerus Center and has a maximum capacity of 425 vehicles.
- 2,160 vehicles park off-site for a UND football game (vehicle occupancy of 2.0)
- The capacity of one bus is 60 people (42 sitting, 18 standing)
- A bus travels an average of 10 mph (includes loading time, traffic control delay, etc.)
- No train interruptions for shuttles to/from UND.

		Cycle Time # Round Trips
UND	31.2	2.403846
Altru	13.2	5.681818

Number of **vehicles** parking off-site                    2,160  
 Number of **people** parking off-site                    4,320

Scenario	Percent of Off-site Parking		Number of Vehicles		Number of Buses (Calculated)			Number of Buses (Rounded)		
	UND	Altru Hospital	UND	Altru	UND	Altru	Total	UND	Altru	Total
A	100	0	2,160	0	30.0	0.0	30.0	30.0	0.0	30.0
B	80	20	1,728	432	24.0	2.5	26.5	24.0	3.0	27.0

**Number of Shuttle Buses =**

***(Total # of people being bussed) \* (% of total going to location) / (75 min / ((2 \* One-way Distance to Site/Assumed Speed Limit) \* 60 min per hour) \* 60 people per bus trip)***

**Alerus Center Traffic Management Plan**

SRF # 5370

9-Aug-05

by: mkk

**Shuttle Bus Calculations - Method 2 (assumes 30 mph plus load/unload and congestion/control delay)**

Assumptions

- All people parking off-site travel between the Alerus Center and their car within 75 minutes.
- Off-site parking is located on the University of North Dakota (UND) campus and/or the Altru Hospital campus in Grand Forks, ND.
- UND is 2.6 miles from the Alerus Center (average distance to all lots)
- Altru Hospital is 1.1 miles from the Alerus Center and has a maximum capacity of 425 vehicles.
- 2,160 vehicles park off-site for a UND football game (vehicle occupancy of 2.0)
- The capacity of one bus is 60 people (42 sitting, 18 standing)
- It takes each person three seconds to load/unload from the bus (three minutes for 60 people).
- A bus travels an average of 30 mph (DOES NOT include loading time)
- No train interruptions for shuttles to/from UND.

	Cycle Time # Round Trips
UND	16.4 4.573171
Altru	10.4 7.211538

Number of **vehicles** parking off-site                    2,160  
 Number of **people** parking off-site                    4,320

Distance to UND (mi)                                        2.6 average to all lots  
 Distance to Altru (mi)                                      1.1

Scenario	Percent of Off-site Parking		Number of Vehicles		Number of Buses (Calculated)			Number of Buses (Rounded)		
	UND	Altru Hospital	UND	Altru	UND	Altru	Total	UND	Altru	Total
A	100	0	2,160	0	20.5	0.0	20.5	21.0	0.0	21.0
B	80	20	1,728	432	16.4	3.0	19.4	17.0	3.0	20.0

**Number of Shuttle Buses =**

**$(Total \# \text{ of people being bussed}) * (\% \text{ of total going to location}) / (75 \text{ min} / ((Load \text{ and Unload Time} + Traffic \text{ congestion/control delay} + A*B)*60 \text{ people per bus trip}))$**

Load and Unload Time = 2 \* (3 sec/person \* 60 people \* 1 min/60 sec) = 6 min

Traffic congestion/control delay = 5 minutes (estimated)

A = Distance of round trip as a multiple of 2.2 miles (round trip from Altru Hospital).

B = Duration of Altru Hospital round trip = 2.2 mi / 30 mph \* 60 min = 4.4 min