WELLS + ASSOCIATES

THE RIVER SCHOOL COMMUNITY MEETING

Queuing Analysis Discussion

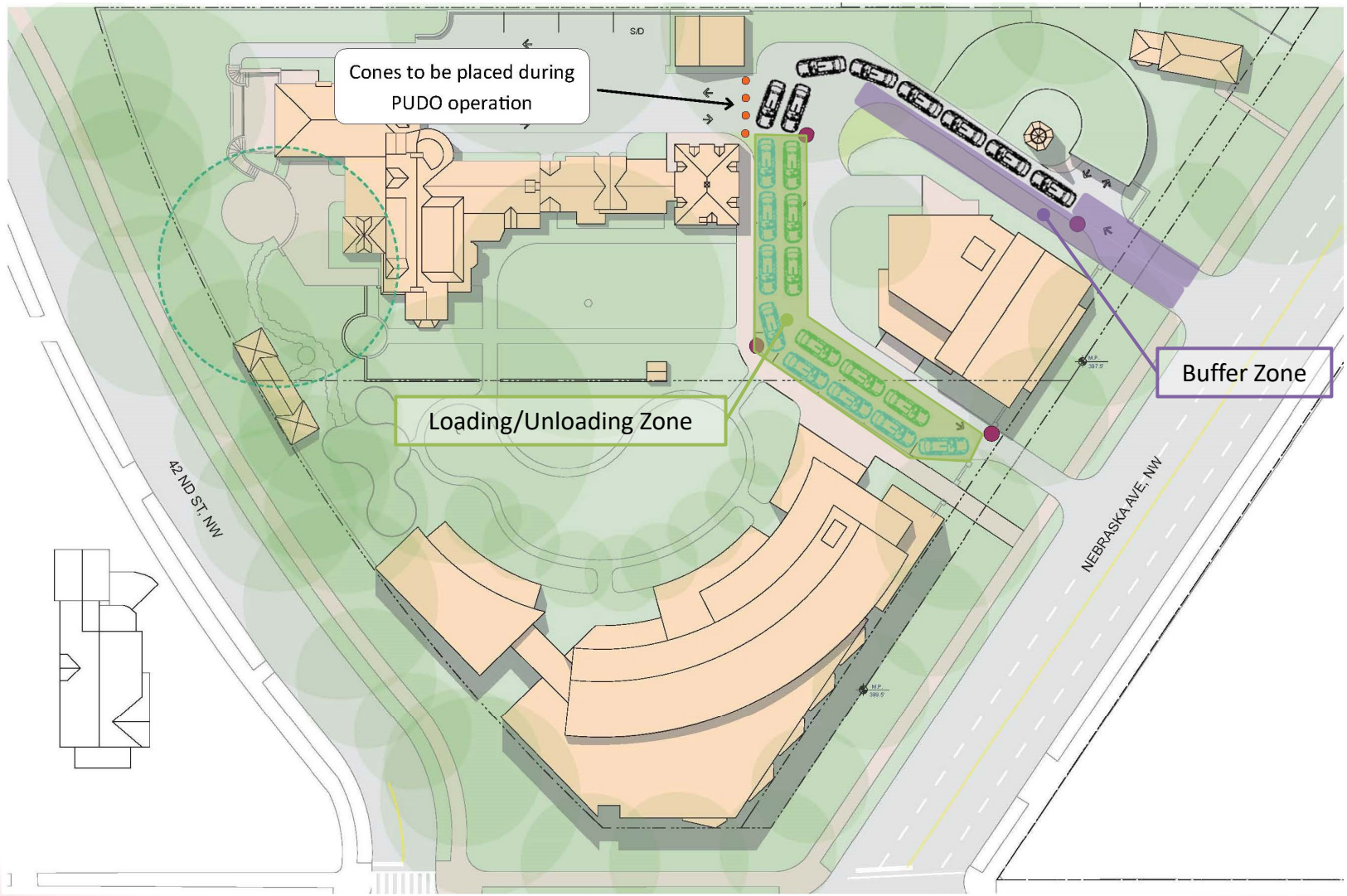
August 31, 2021

Agenda

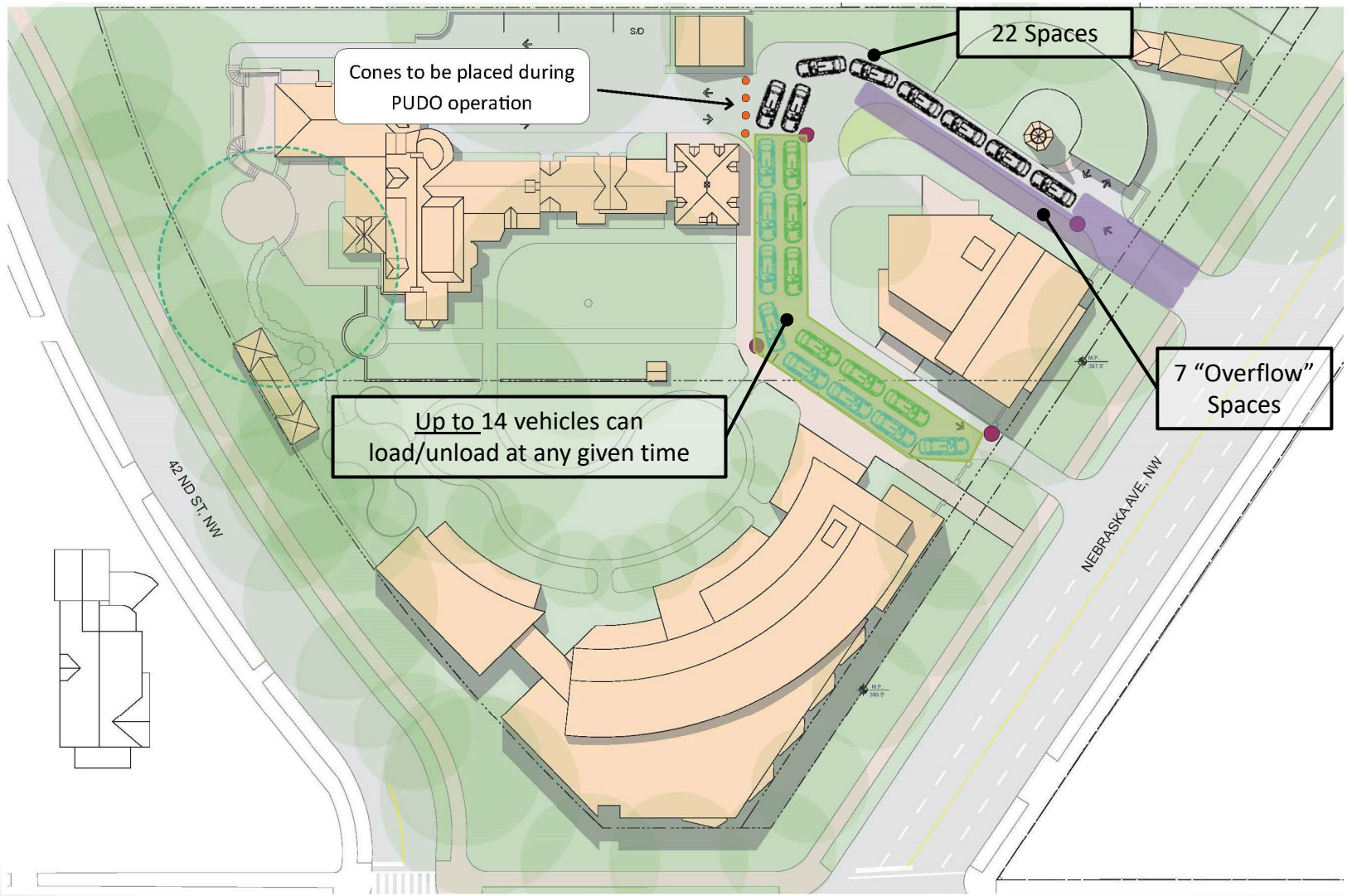
- Review Pick-up/Drop-off Circulation Plan
- Update on Trip Generation
- Projected Queues based on M/M/1 Queuing Model
- Projected Queues based on Extrapolation
- Questions

Pick-up/Drop Off Circulation Review

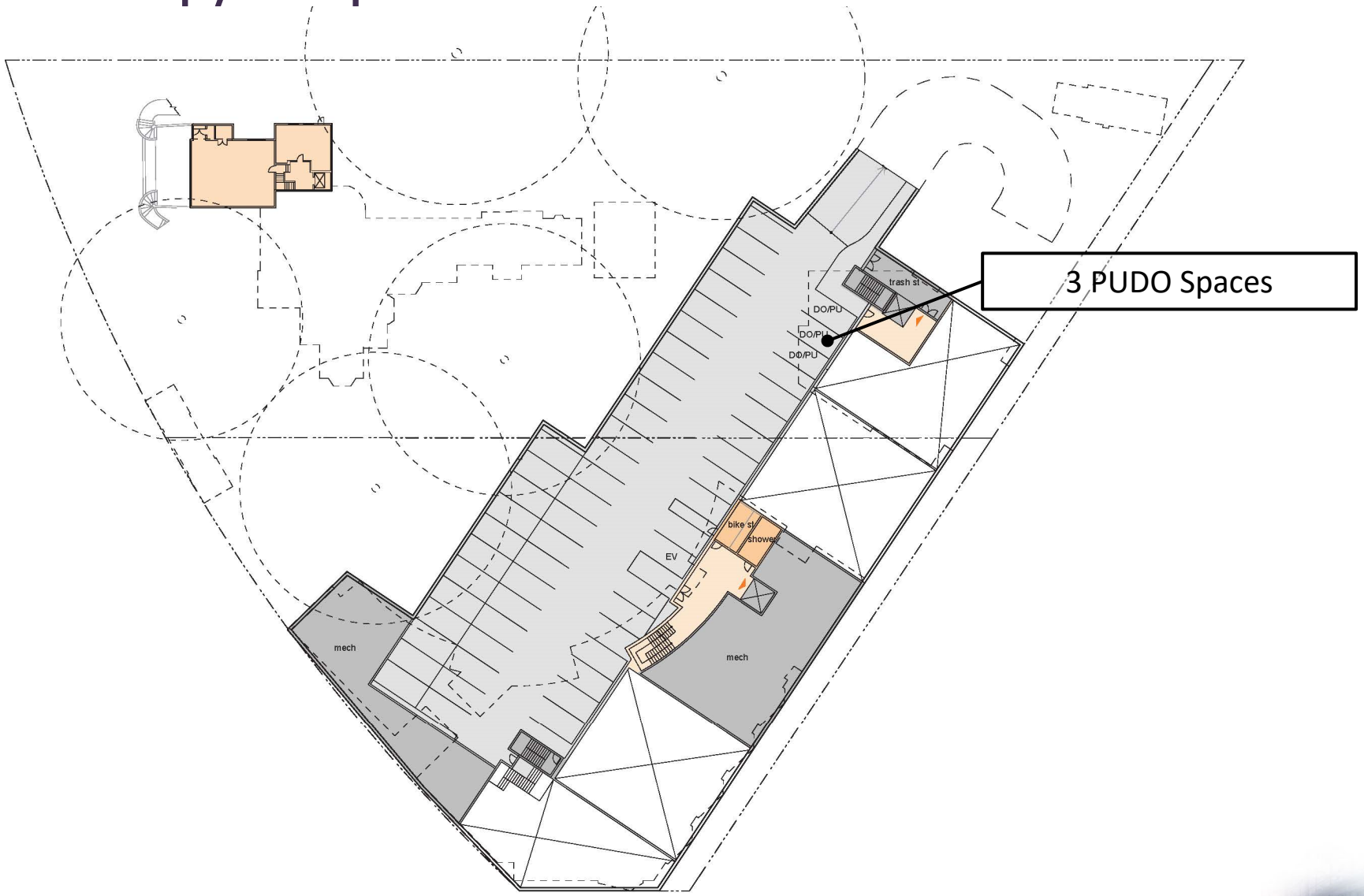
Pick-up/Drop-off Plan



Pick-up/Drop-off Plan



Pick-up/Drop-off Plan



Trip Generation Update

Vehicle Trip Generation – Original TDM Plan

	AM Peak Hour (8:00-9:00 AM)		PM School Peak Hour (2:45 – 3:45 PM)		PM Cmmtr Peak Hour (5:00-6:00 PM)	
	In	Out	In	Out	In	Out
Students	173	173	74	74	28	28
Faculty/Staff	0	0	0	0	0	32
Clinic	0	0	0	0	2	2
Total	173	173	74	74	30	62

Vehicle Trip Generation – Original TDM Plan

	AM Peak Hour (8:00-9:00 AM)		PM School Peak Hour (2:45 – 3:45 PM)		PM Cmmtr Peak Hour (5:00-6:00 PM)	
	In	Out	In	Out	In	Out
Students	173	173	74	74	28	28
Faculty/Staff	0	0	0	0	0	32
Clinic	0	0	0	0	2	2
Total	173	173	74	74	30	62

Vehicle Trip Generation – Current TDM Plan

	AM Peak Hour (8:00-9:00 AM)		PM School Peak Hour (2:45 – 3:45 PM)		PM Cmmtr Peak Hour (5:00-6:00 PM)	
	In	Out	In	Out	In	Out
Students	112	112	74	74	28	28
Faculty/Staff	0	0	0	0	0	32
Clinic	0	0	0	0	2	2
Total	112	112	74	74	30	62

Represents a **35% Reduction** in AM Peak Hour Vehicular Trips compared to our last proposal

Represents a **45% Reduction** in AM Peak Hour Vehicle Trips compared to No TDM Plan

How Will River School Achieve Reduction?

New Commitments:

- Implement one of the following or some combination of the following:
  - Shuttle students in grades K – 6 from off site location in AM
    - Potential location – Wells Fargo or other commercial property on MacArthur Blvd
  - Increase mandatory carpooling for Kindergarten or older from 2 students per car to 3 students per car
  - Provide tuition discounts or subsidies for families who use Metro, walk, or bike to school

How Will River School Achieve Reduction?

Current Commitments:

- Bicycle amenities and incentives
  - Provide covered/secure bicycle parking
  - Provide bicycle repair station on campus
  - Provide bicycle subsidies or annual CaBi membership for faculty/staff Incorporate bicycle education into the phys ed curriculum
  - Host bike and walk to school events
  - Participate in Safe Routes to School Program
- Transit Incentives
  - Provide monthly transit subsidy for faculty/staff who take transit
  - Enroll in Guaranteed Ride Home
- Carpooling Initiatives
  - Provide carpool matching assistance for students and faculty/staff
  - Register with Commuter Connections School Pool Program
  - Implement mandatory carpooling program with at least 2 students per car for grades K - 6

M/M/1 Queuing Model

M/M/1 Queuing Model

- Markovian Arrivals and Departures
  - Arrivals follow a Poisson process or exponential inter-arrival times
  - The Poisson distribution estimates the probability of cars arriving following an exponential distribution
  - The Poisson process assumes a “memoryless” time between arrivals
    - e.g. the time between the arrivals of Vehicle 2 and Vehicle 3 is independent of the time between the arrivals of Vehicle 1 and 2
- Single Server Queue
  - First-In/First-Out service
  - Does not mean that only one car is loaded or unloaded at a time

M/M/1 Queuing Model

λ = arrival rate

μ = service rate

ρ = utilization = λ / μ

$Q_{99} = [\ln (1-0.99)/\ln (\rho)] - 1$

Existing vs. Proposed Traffic Data

	Existing	Proposed
AM Peak Hour Vehicles	88	112
PM Peak Hour Vehicles	95	74

M/M/1 Queuing Model

Existing Model Calibration – AM Peak

λ = 88 vph

λ_{adj} = 135 vph (accounts for uneven distribution of traffic over peak hour)

μ = 240 vph (assumes 4 vehs unload at once; 60 sec unloading time)

ρ = 0.564

Q_{99} = 8 vehs

Q_{obs} = 9 vehs

Existing Model Calibration – PM Peak

λ = 95 vph

λ_{adj} = 158 vph (accounts for uneven distribution of traffic over peak hour)

μ = 179 vph (assumes 6 vehs load at once; 121 sec loading time)

ρ = 0.887

Q_{99} = 38 vehs

Q_{obs} = 38 vehs

M/M/1 Queuing Model

Projected Queues – AM Peak

λ = 108 vph

λ_{adj} = 166 vph (accounts for uneven distribution of traffic over peak hour)

μ = 240 vph (assumes 4 vehs unload at once; 60 sec unloading time)

ρ = 0.692

Q_{99} = 12 vehs

Projected Queues – PM Peak

λ = 74 vph

λ_{adj} = 123 vph (accounts for uneven distribution of traffic over peak hour)

μ = 179 vph (assumes 6 vehs load at once; 121 sec loading time)

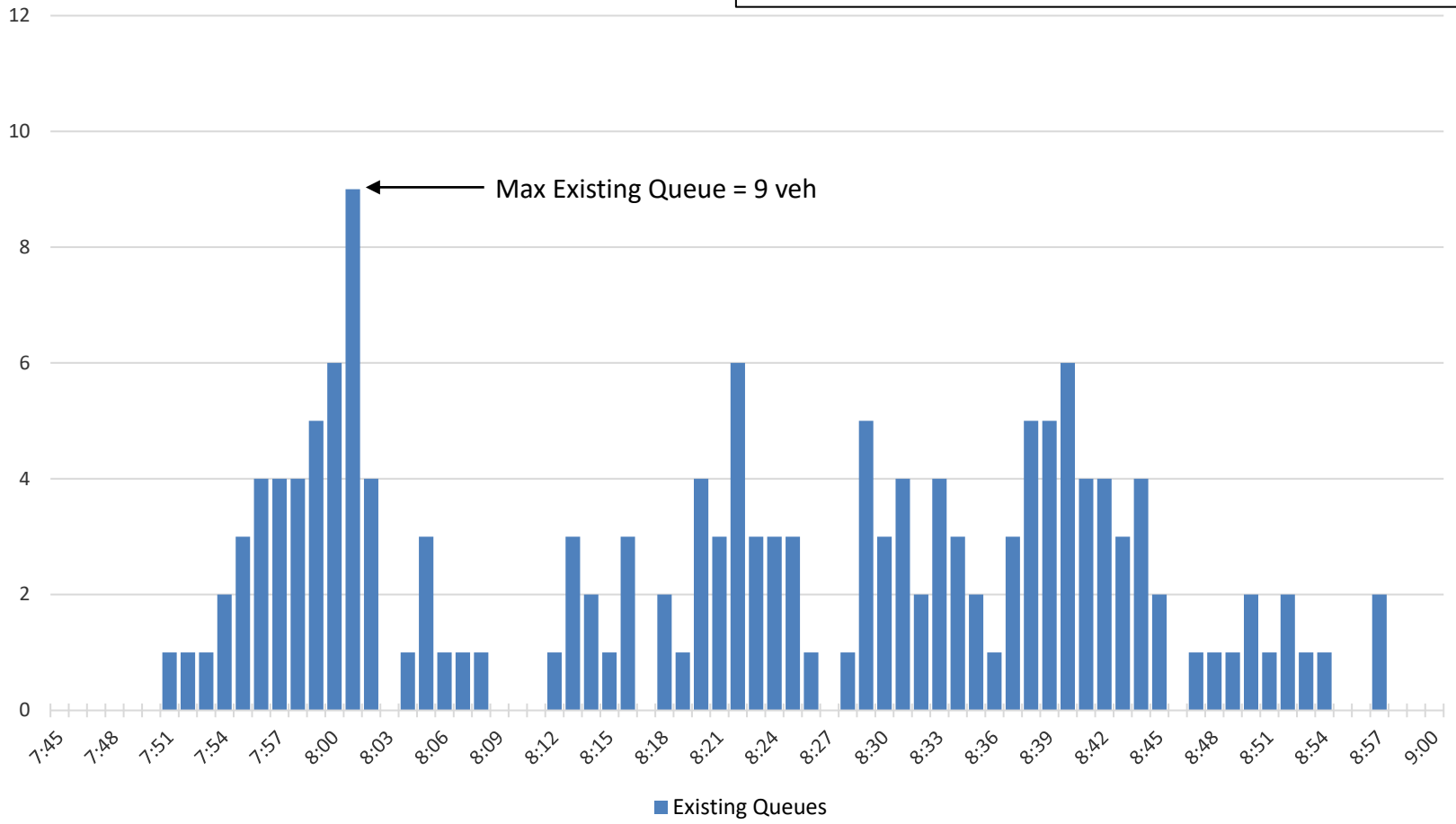
ρ = 0.691

Q_{99} = 17 vehs

Extrapolated Queues

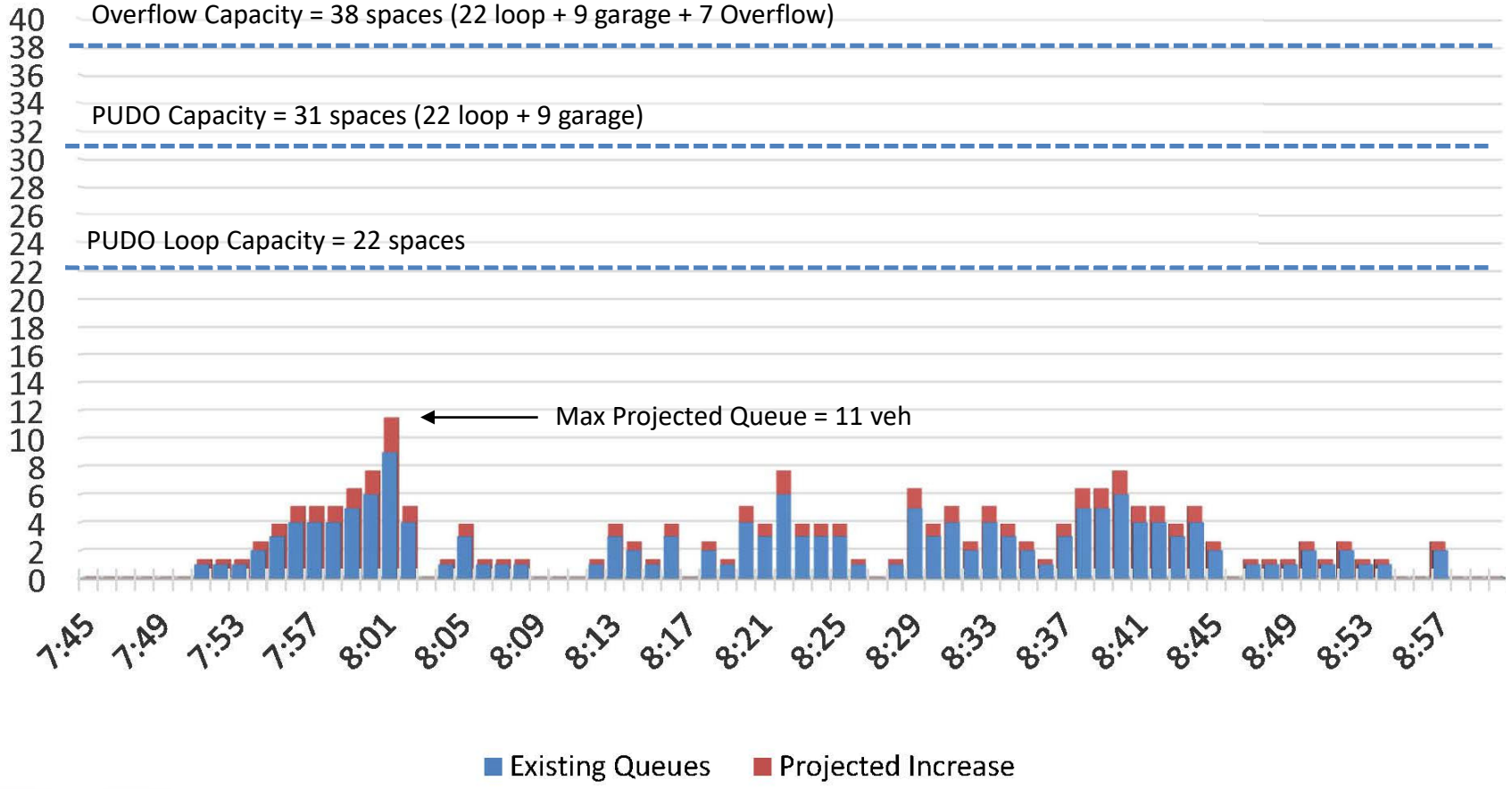
Existing AM Peak Hour

Total number of vehicles dropping off = 88



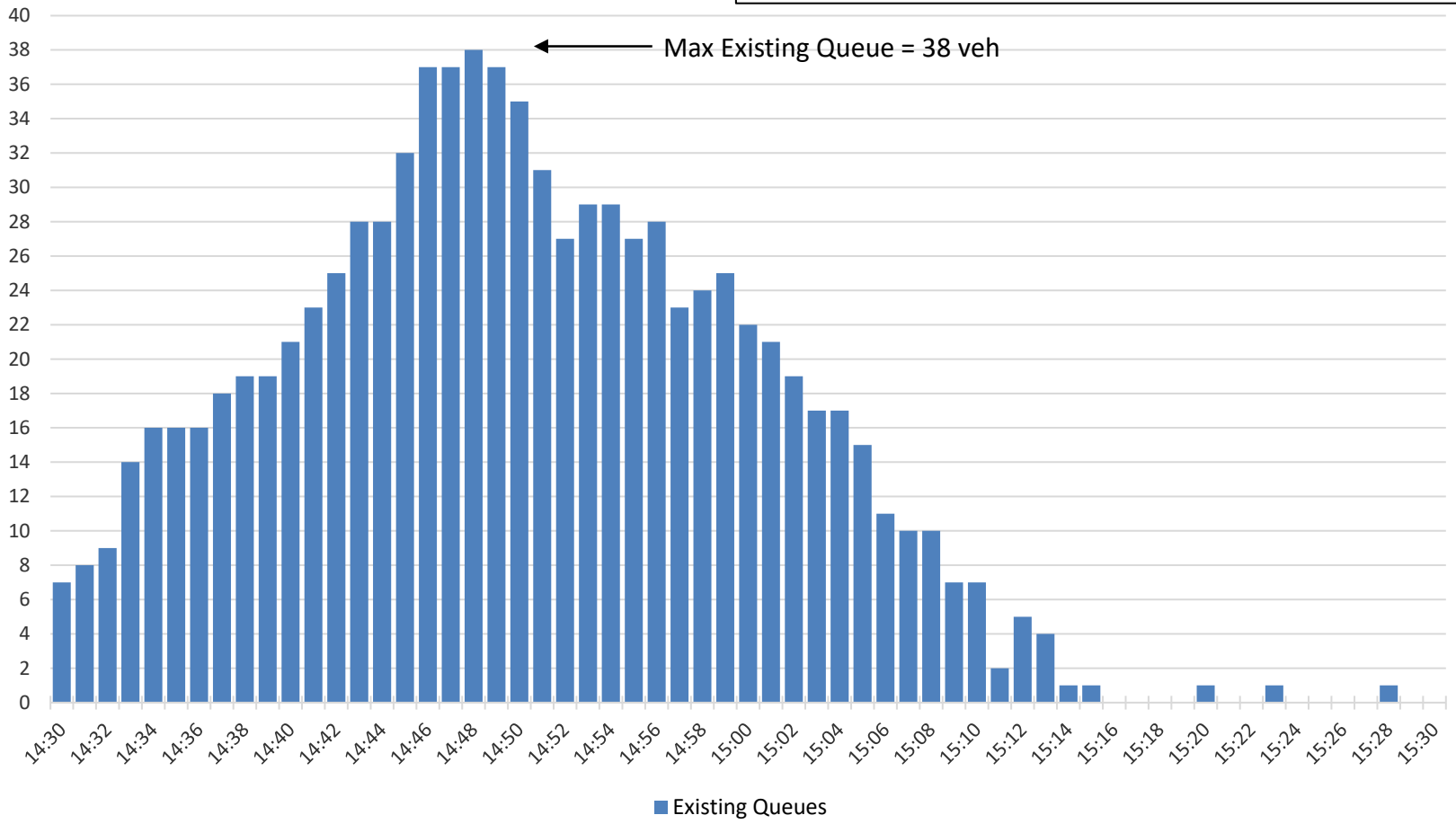
Projected AM Peak Hour

Total number of vehicles dropping off = 112



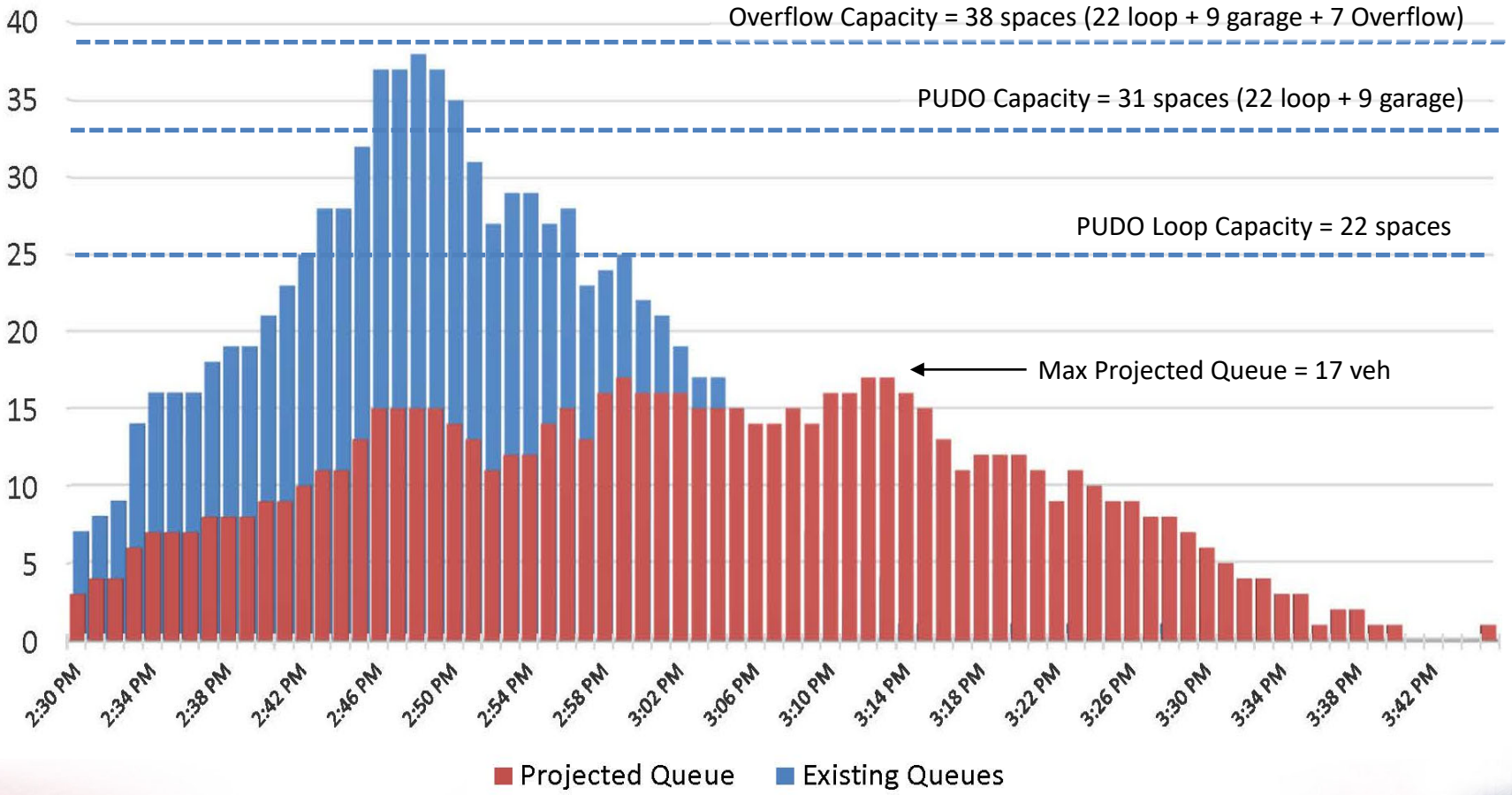
Existing PM Peak Hour

Total number of vehicles picking up = 95



Projected PM Peak Hour

Total number of vehicles picking up = 74



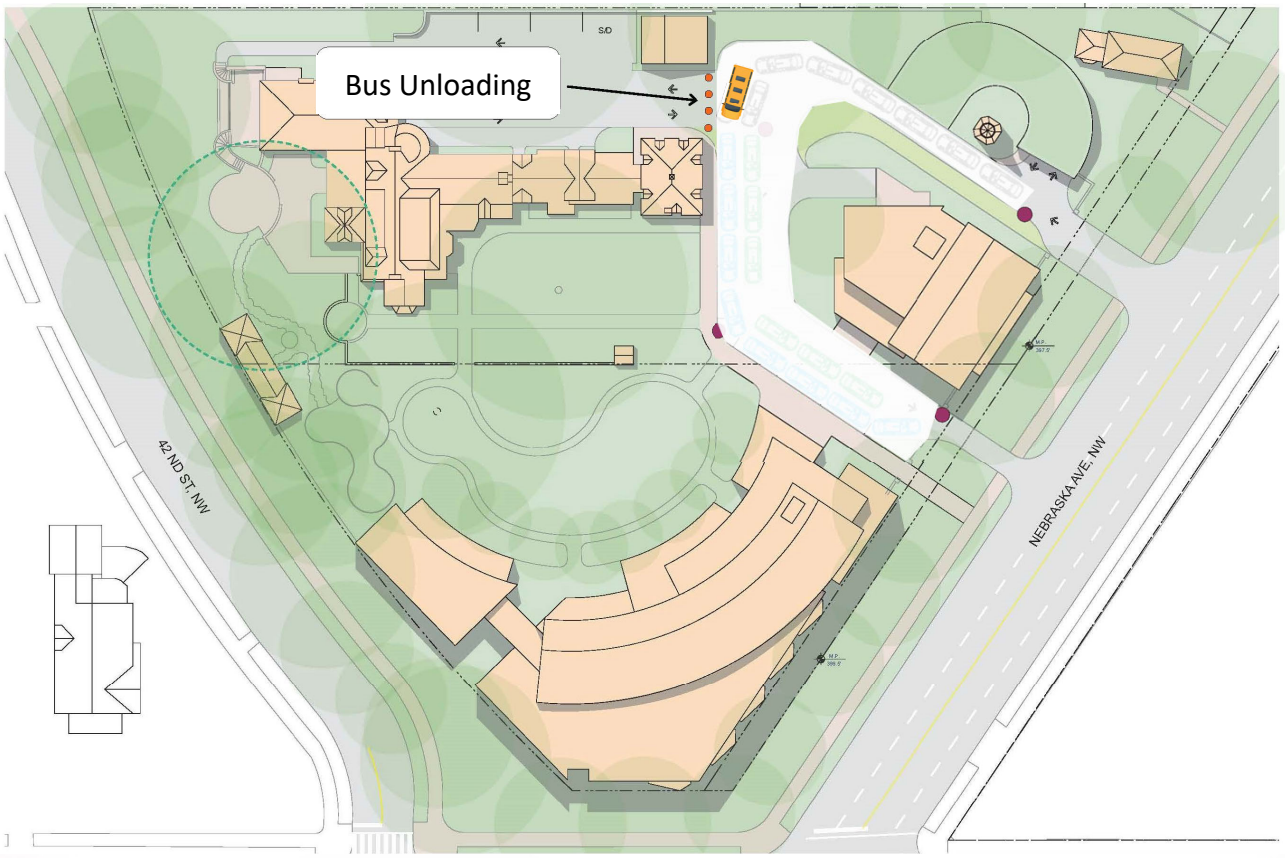
Summary

	M/M/1 Model	Extrapolation	Capacity*
AM Peak Hour	12	11	31
PM Peak Hour	11	17	31

* Capacity includes loop capacity plus three spaces in garage. It does not include overflow capacity of 7 vehs

Buses

- 2 shuttle buses will make 2 trips each
- Total of 4 buses, at most 2 buses at one time



QUESTIONS?