CE351 Transportation Systems: Planning and Design

TOPIC:

Level of Service in Highways

Outline

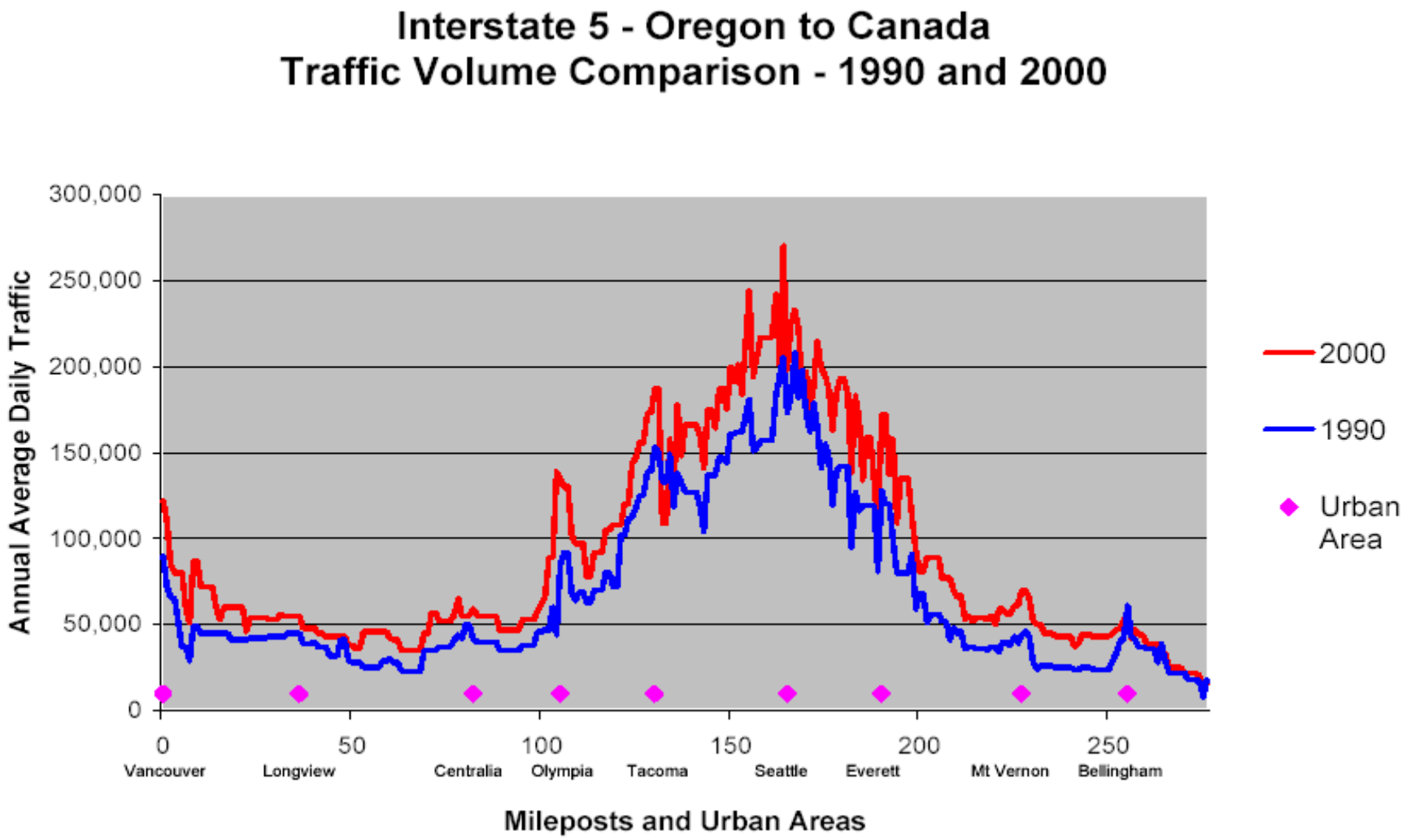
1. Definitions
2. Level of Service (LOS)
   - Traditional concept
   - New concepts (under research)

LEVEL OF SERVICE CONCEPT

- **Highway Capacity and Level of Service Analysis**

- Seek to measure Highway Performance (Congestion). Needed for:
  - Highway construction
  - Congestion relief

I-5 Average Daily Traffic



from the WSDOT 2001 *Annual Traffic Report*

LEVEL OF SERVICE CONCEPT

COMPLEX ISSUE

- Wide variation of highway conditions:

- Different roadway types (Freeway, multilane, etc.)
- Number of lanes and width of lanes
- Vehicle mix (cars vs. trucks)
- Shoulder widths
- Temporal variation in traffic flow over the day and over the peak hour

LEVEL OF SERVICE CONCEPT

- The level of service provides a qualitative ranking of the traffic operational conditions experienced by users of a facility

- Highway Capacity Manual defines the LOS categories for freeways and multilane highways as using the letters A, B, C, D, E, and F

Definitions – Level of Service (LOS)

- Chief measure of “quality of service”
  - Describes operational conditions within a traffic stream.
  - Does not include safety
  - Different measures for different facilities
- Freeway & Multilane Highway LOS
  - Based on traffic density
- Two lane-two way highway
  - Based on % passing distance

Levels of Service

- LOS A
  - Free-flow operation
  - Individual users are virtually unaffected by the presence of others in the traffic stream.

- LOS B
  - Reasonably free flow
  - Ability to maneuver is only slightly restricted
  - Effects of minor incidents still easily absorbed

From *Highway Capacity Manual*, 2000

Levels of Service

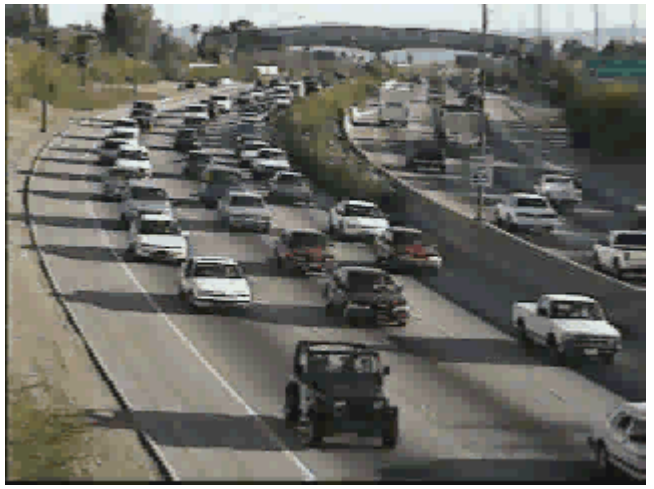
- LOS C
  - Speeds at or near FFS
  - Freedom to maneuver is noticeably restricted
  - Queues may form behind any significant blockage.

- LOS D
  - Speeds decline slightly with increasing flows
  - Density increases more quickly
  - Freedom to maneuver is more noticeably limited
  - Minor incidents create queuing

From *Highway Capacity Manual*, 2000

Levels of Service

- LOS E
  - Operation near or at capacity
  - No usable gaps in the traffic stream
  - Operations extremely volatile
  - Any disruption causes queuing



- LOS F
  - Breakdown in flow
  - Queues form behind breakdown points
  - Demand > capacity

From *Highway Capacity Manual*, 2000

Is this the best way to measure LOS?

- Why do people use highways?
- How can we measure LOS in a more meaningful way for travelers?
- Car drivers?
- Trucks? Distribution and Delivery?
- ACTIVE RESEARCH TOPICS

One alternative way of measuring LOS

Travel Time Reliability

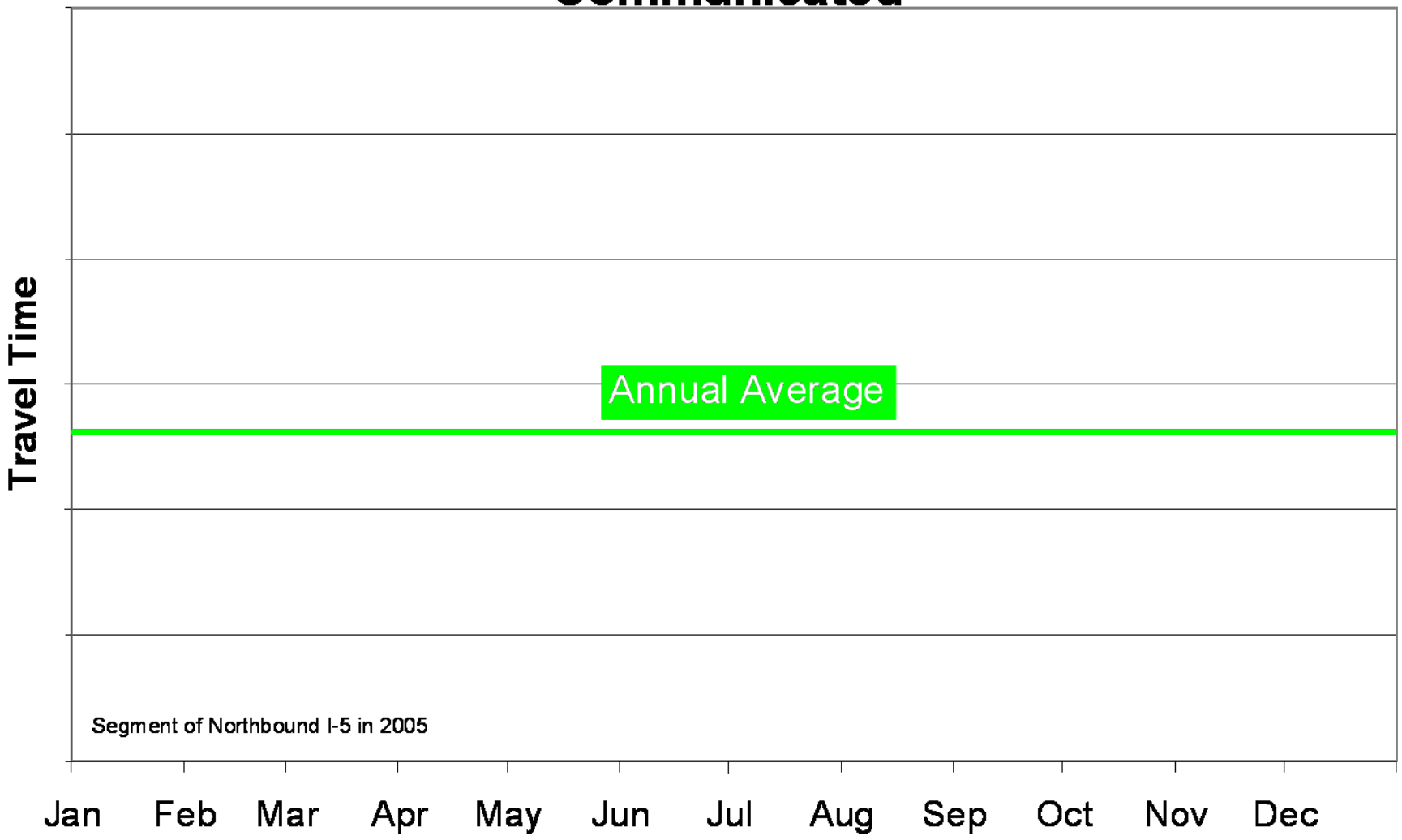
Traffic Congestion

- Large numbers of people trying to reach their destination
- Peak hours
- Expected congestion
  - Recurrent
  - Plan for it
- Unexpected congestion
  - Nonrecurrent
  - Late for work or childcare pickup
  - Late shipments, disrupt just-in-time delivery

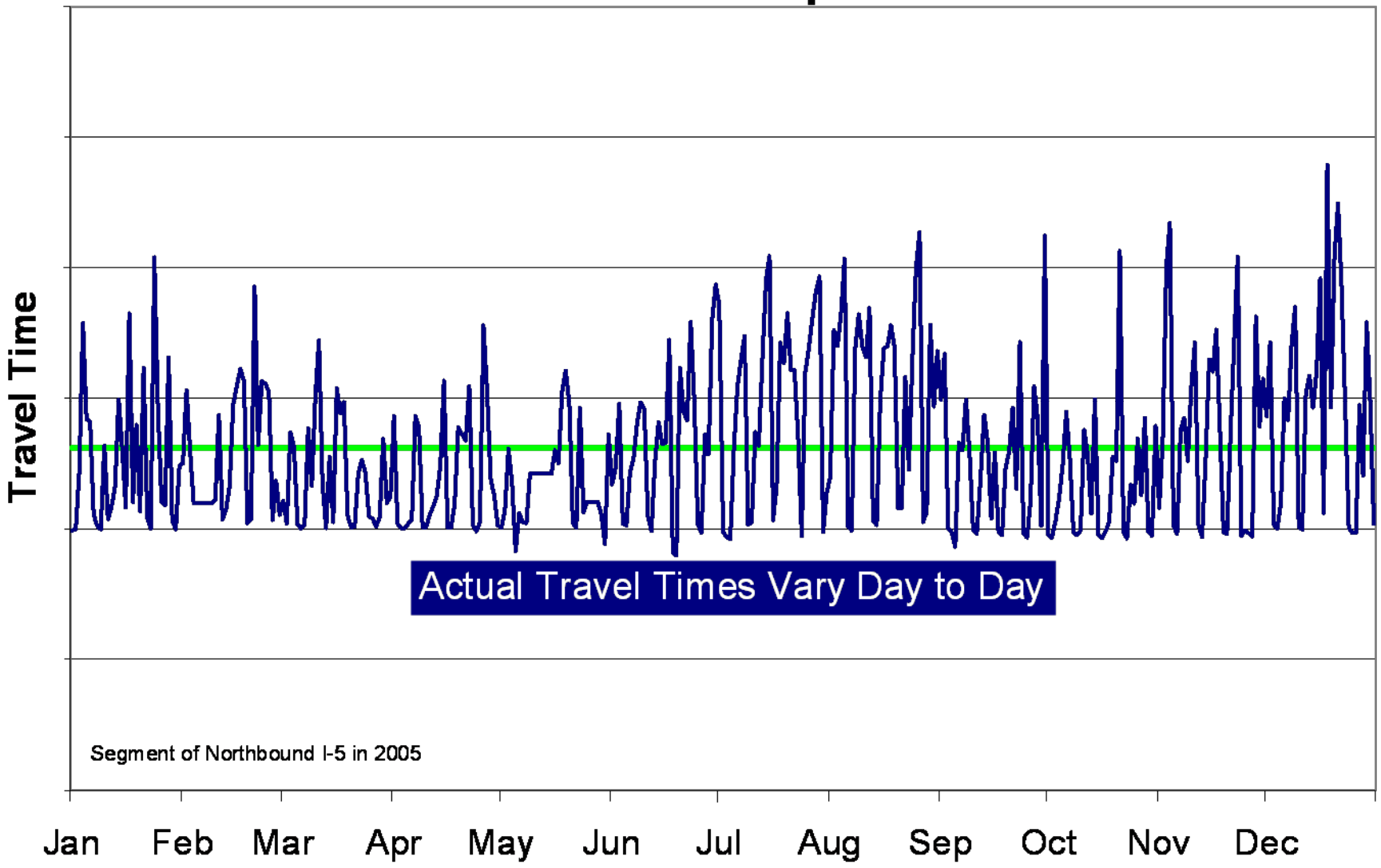
Reliability Defined

- Consistency or dependability in travel times
- Measured from day to day or across different times of day
- Tend to remember the few bad days

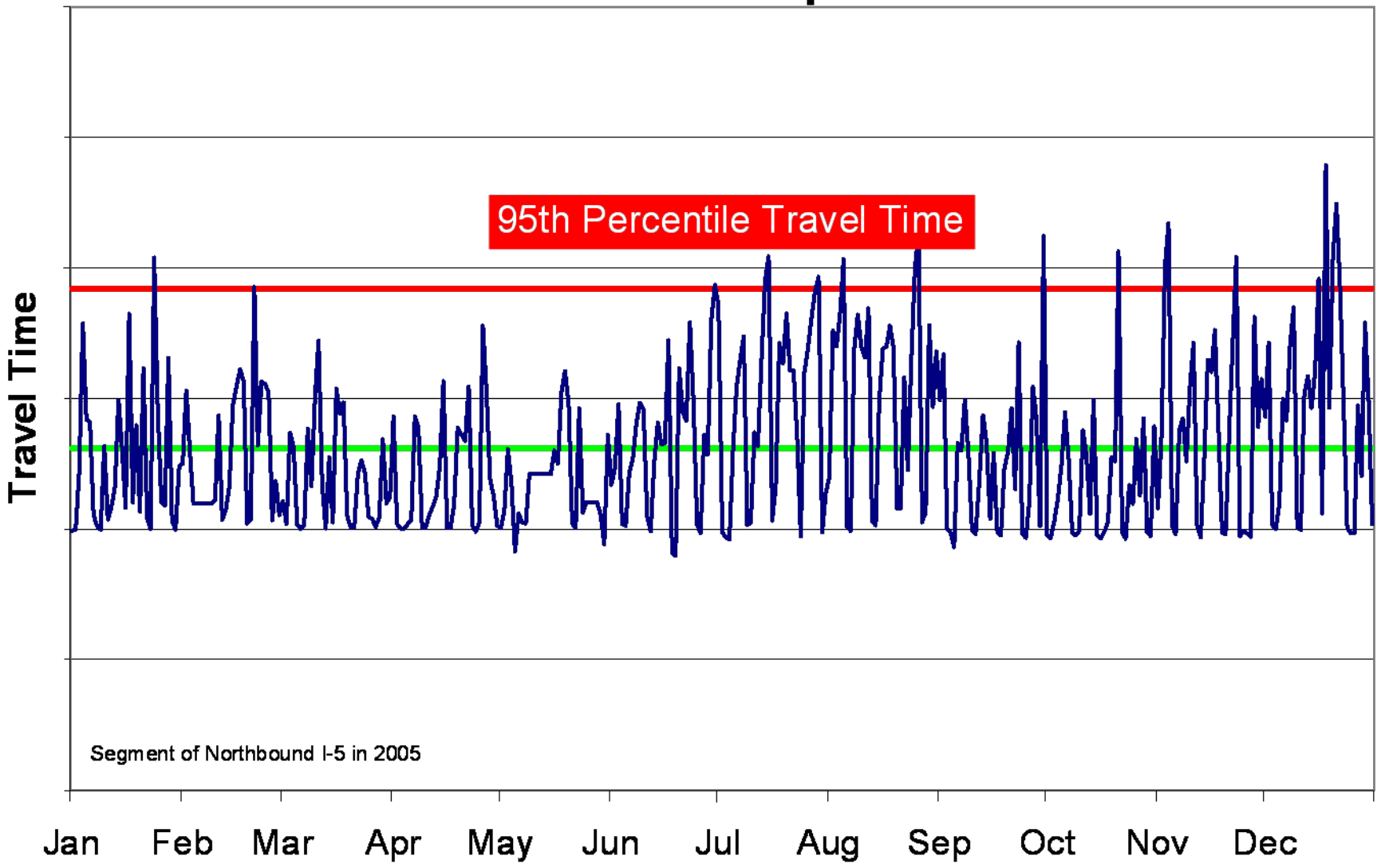
How Traffic Conditions Have Been Communicated



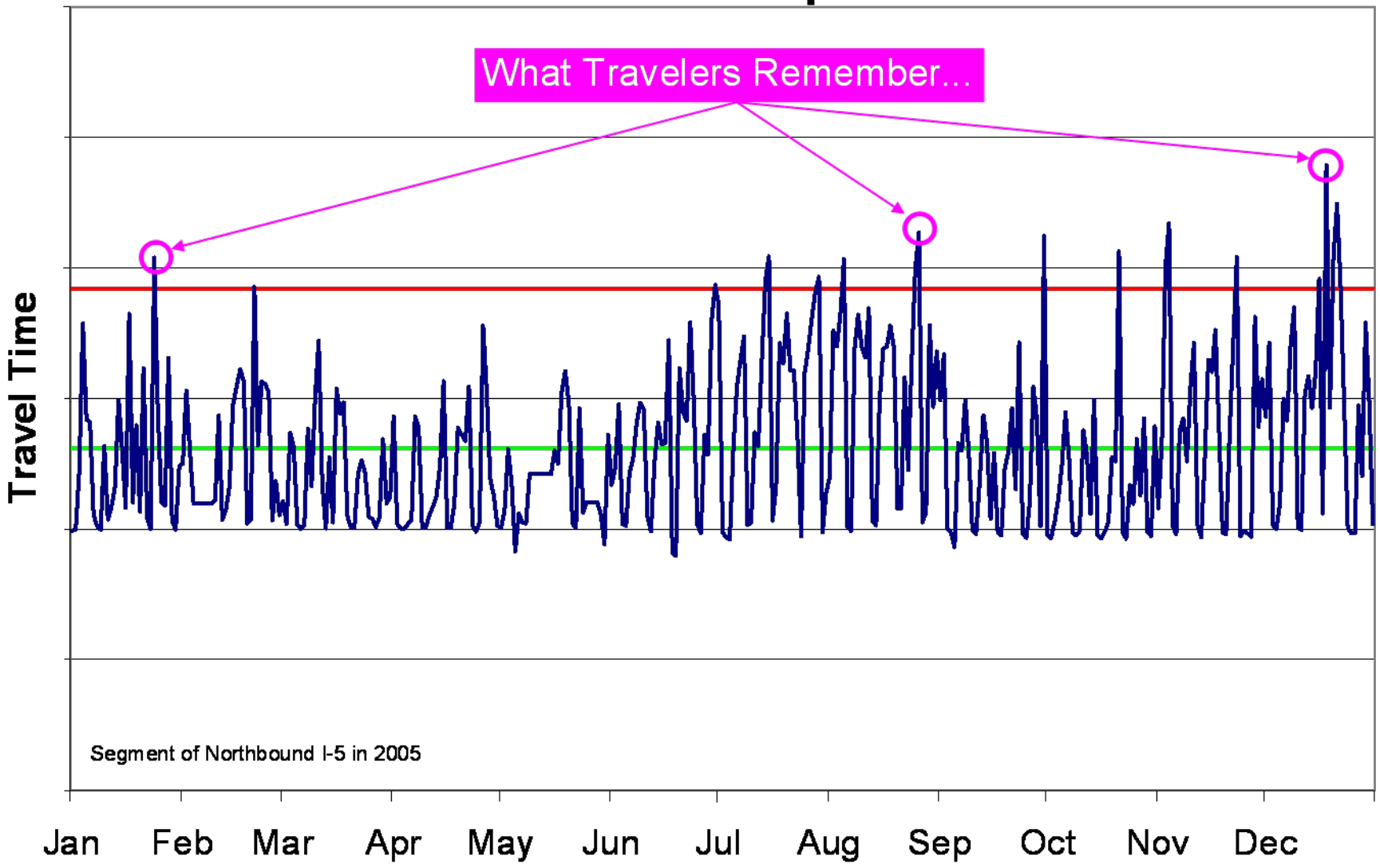
What Travelers Experience...



What Travelers Experience...



What Travelers Experience...



Measurements

- 95th Percentile Travel Times
  - Late one day per month
- Buffer Index
  - Extra time (cushion) to ensure on-time arrival 95% of the time

Average travel time = 20 min
Buffer index = 40%
Buffer time = 20 min × 0.40 = 8 minutes

- Planning Time Index
  - Total time to ensure on-time arrival

Free flow travel time = 15 min
Planning time index = 1.60
Planning time = 15 min × 1.60 = 24 min

Measurements

- Reliability Indices

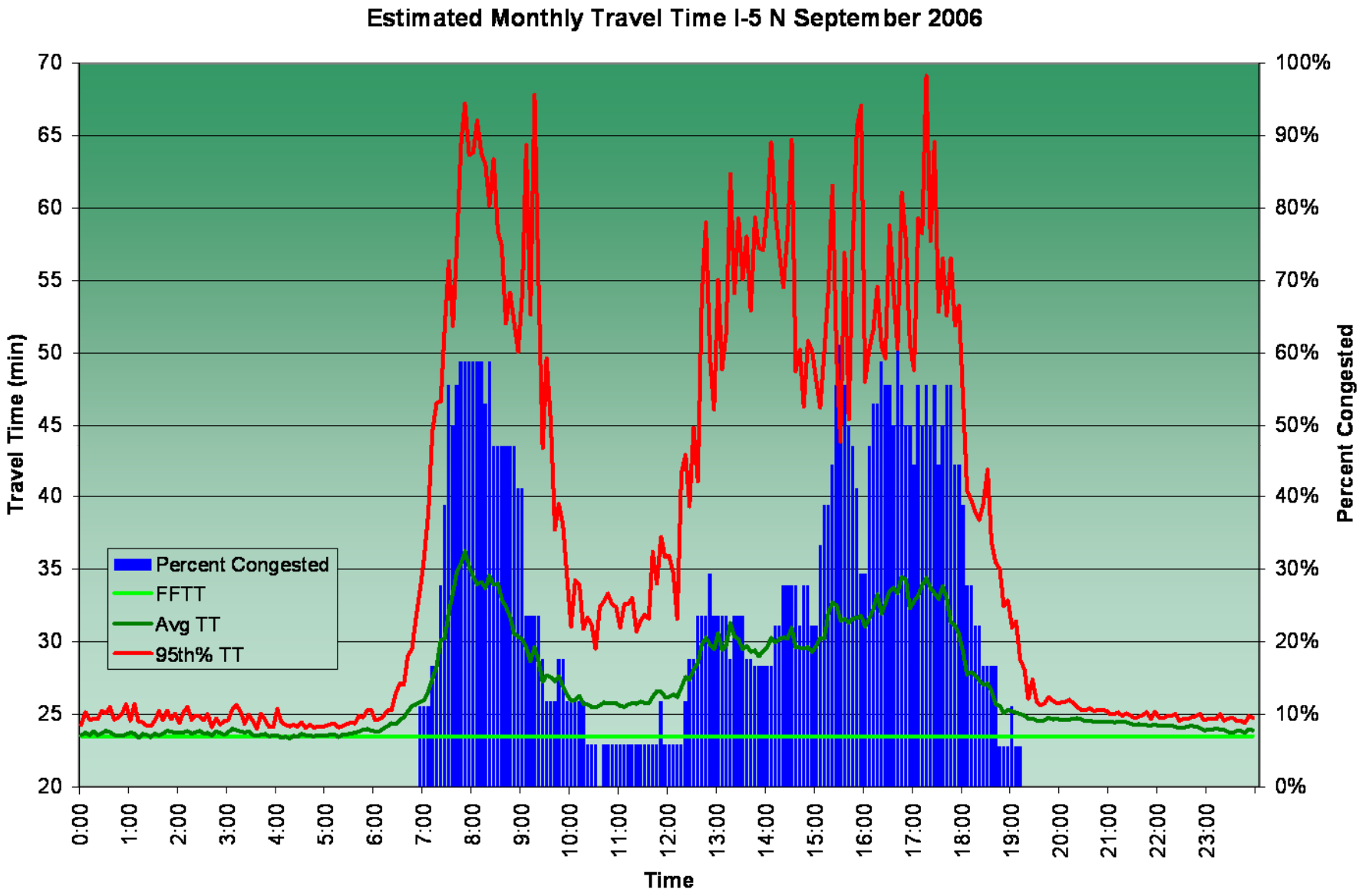
Link Reliability (travel time) $$r_t = \frac{\bar{t}}{z\sqrt{\text{var}(t)}}$$

Link Reliability (speed) $$r_v = \frac{\bar{v}}{z\sqrt{\text{var}(v)}}$$

Path Reliability $$r_p = \frac{\sum \bar{t}_i}{z\sqrt{\sum \text{var}\, t_i + 2\sum \text{cov}\, t_i t_j}}$$

$$\text{cov}_{ij} = E(t_i t_j) - t_i t_j$$

Reliable Time of Arrival $$RTA = ETA \pm z\sqrt{\text{var}(T_p)}$$


Estimated Monthly Travel Time I-5 N September 2006
Travel Time (min)
Percent Congested
Time
Percent Congested
FFTT
Avg TT
95th% TT
70
65
60
55
50
45
40
35
30
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100%
90%
80%
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23:00

Reliability

- This is a topic currently studied at PSU
- Passenger side:

ITS LAB

http://portal.its.pdx.edu

Also reliability affecting freight

- Intercity-long haul
- Urban distribution

research projects underway